ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT, PUERTO BOLÍVAR PROJECT

– PHASE 1

– COMPLEMENTARY STUDIES –

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

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GREENHOUSE GAS (GHG) EMISSIONS INVENTORY

1. Introduction

The greenhouse effect is a natural phenomenon that makes life on Earth possible. It is caused by a number of gases present in the atmosphere, resulting in some of the sun's heat reflected by the planet getting trapped, maintaining the mean global temperature. However, more than one decade ago scientists around the world started to warn that the earth was warming at an unprecedented rate (WWF, 2010).

This acceleration can be explained by the direct relationship between global warming and greenhouse gas (GHG) emissions. These gases have increased significantly since the industrial revolution, where the burning of fossil fuels released large amounts of CO2 into the atmosphere, causing the atmosphere to trap even more heat, resulting in the global warming: increased temperature in the atmosphere and the oceans.

The Intergovernmental Panel on Climate Change (IPCC) suggested in its latest report (2018) that global warming is likely to reach 1.5°C between 2030 and 2052, with the resulting increase in the frequency and intensity of rainfalls, forest fires, floods and droughts (Miller & Croft, 2018) (IPCC, 2018).

In order to help combat climate change, YILPORTECU has decided to measure and manage its carbon footprint. The purpose is to prevent or minimize the impacts on human health and the environment as well as contamination. With this in mind, it promotes a more sustainable use of resources such as energy and water, and seeks to reduce the emissions of Greenhouse Gas related to the project.

2. General Purpose

Determine the gas emissions generated during port operation in the years 2019 and 2020 and during the construction of the Puerto Bolívar Port – Phase 1; and identify alternatives to minimize its ecological footprint.

3. Requirements

This document seeks to comply with the requirements established by the International Finance Corporation (IFC) that are based on the Environmental and Social Performance Standards and the Equator Principles, taking into account the Guidance Notes to the Performance Standards.

Specifically, Performance Standard 3 on Resource Efficiency and Pollution Prevention will be taken into account, along with its respective Guidance Note 3 and the recommendations on greenhouse gas inventories.

Technical documents such as the General Environmental, Health and Safety Guidelines and the specific Environmental, Health and Safety Guidelines for Ports, Harbors and Terminals will be also taken into account.

In this manner, it is recognized that increased economic activity, in this case commercial activities related to the fluvial transportation of products in a maritime terminal, generate increased levels of pollution to air, water and land, consuming resources and increasing the risks for people and the environment at the local, regional and global levels. Therefore, it is necessary to measure GHG emissions and promote reduction strategies.

3.1. Resource Efficiency and Pollution Prevention

The Guidance Note (GN) related to this performance standard considers that the potential environmental impacts associated with the emission of greenhouse gases (GHG) are among the most complex to predict and mitigate due to their global nature.

It further establishes that key environmental impacts can occur at any phase of a project and depend on a great number of factors, including the nature of the industry and site location.

Specifically, with regard to greenhouse gases, GN3 urges to apply alternatives, implement solutions to reduce GHG emissions, and quantify direct and indirect emissions on a yearly basis, particularly for projects producing more than 25,000 annual tons of CO2.

It is recognized that anything that needs to be managed must be measured first; therefore, the quantification of GHG emissions is the first step in managing them. Such quantification must consider all significant sources of GHG emissions, including non-energy related sources such as methane and nitrous oxide, among others, and the appropriate methodologies are those recommended by the IPCC.

In the General Environmental, Health and Safety Guidelines, the quantification of emissions is framed within the preventive approach of the risks and potential impacts of the project during any of its phases (construction, operation or decommissioning).

The specific Environmental, Health and Safety for Ports, Harbors and Terminals states that it is important to consider the air emissions generated by the terrestrial and maritime activities of terminals or ports. During the construction phase, emissions are generated by the use of vehicles, equipment and engines of machinery such as tractors, excavators or tugs, to undertake dredging, excavating, paving, material transport and construction activities.

During operations of ports and terminals, emissions result mainly from the combustion of diesel engines used for the propulsion of ships or vessels, engines and boilers for power generation. Emissions are also generated from land-based activities involving the use of vehicles, cargo handling equipment, and other engines and boilers.

In addition to the above-mentioned Guidelines and Performance Standards, the Equator Principles Financial Institutions have established Principles to ensure that projects are developed in a manner that is socially and environmentally responsible.

These principles promote sustainable management in all aspects, respecting human rights. For this reason, for the purposes of this study, Principle 2 on environmental and social assessment considers an analysis of alternatives in the case of projects generating scope 1 and scope 2 emissions in excess of 100,000 tons of CO2 equivalent annually. In this case, lower GHG intensive alternatives must be evaluated.

4. General Description of the Company

YILPORT HOLDING is a business group that operates port terminals around the world and that started operations in Ecuador in 2016 upon being awarded the Delegated Management Contract for the Design, Financing, Equipping, Execution of Additional Works, Operation and Maintenance of the Puerto Bolívar Port Terminal in the city of Machala, province of El Oro.

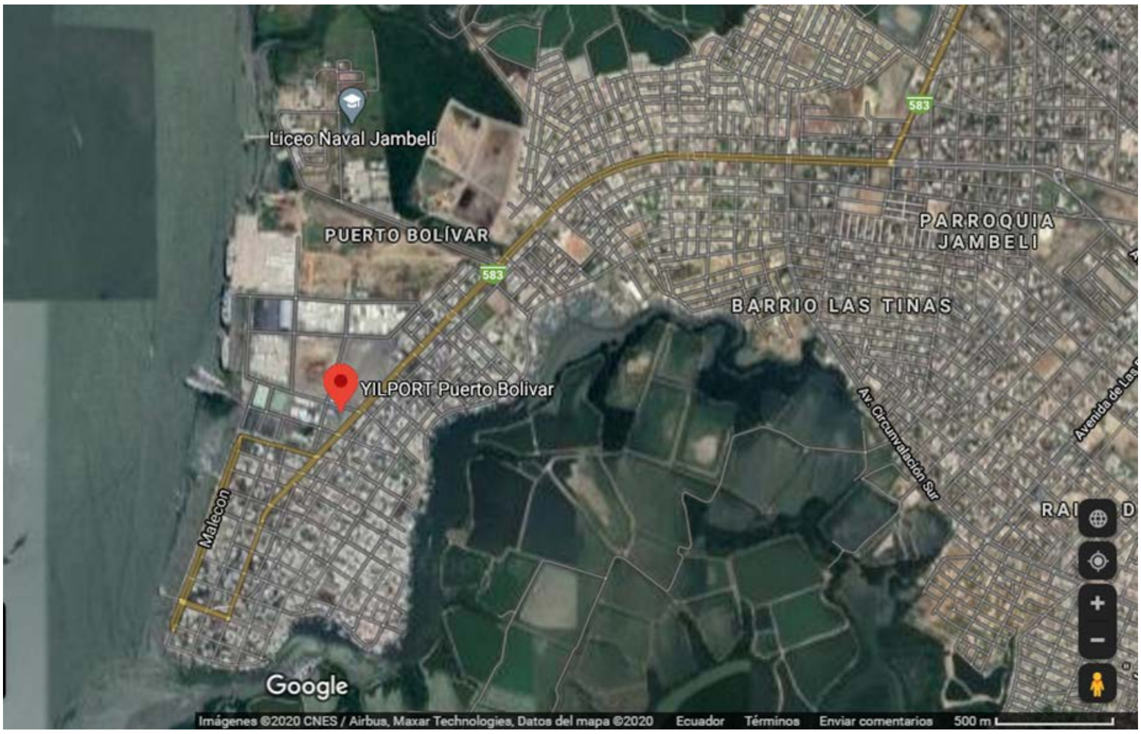
The operations and infrastructure that will be evaluated as part of the Puerto Bolívar Port – Phase 1, are those described in the Project Presentation and Description document.

5. Quantification of GHG Emissions from Port Operations

5.1. Definition of Organizational Limits

The greenhouse gas emissions generated within the physical and operational boundaries of the Puerto Bolívar Port Terminal are considered.

Figure 1. Location of the Puerto Bolívar Port Terminal

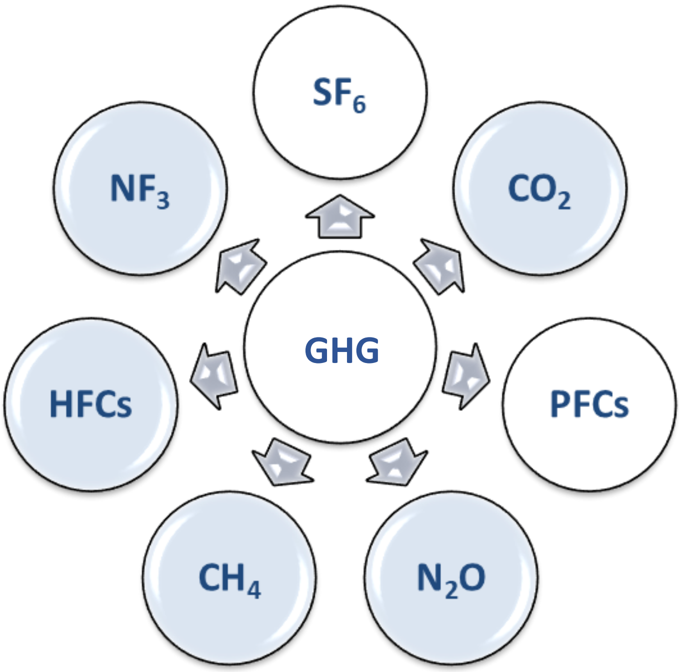


Province	Company	Terminal	Geo-referenced Points (Coordinates)	Address
El Oro	Yilport Terminal Operations	Puerto Bolívar	3°15’55’’ South Latitude and 80°00’01’’ West Longitude	Av. Bolívar Madero Vargas S/N, Puerto Bolívar - El Oro - Ecuador

5.2. Definition of Operational Limits

The greenhouse gases established in the Kyoto Protocol were considered: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF_6). No nitrogen trifluoride (NF_3) or perfluorocarbons (PFCs) were identified at the facilities (See Figure 2).

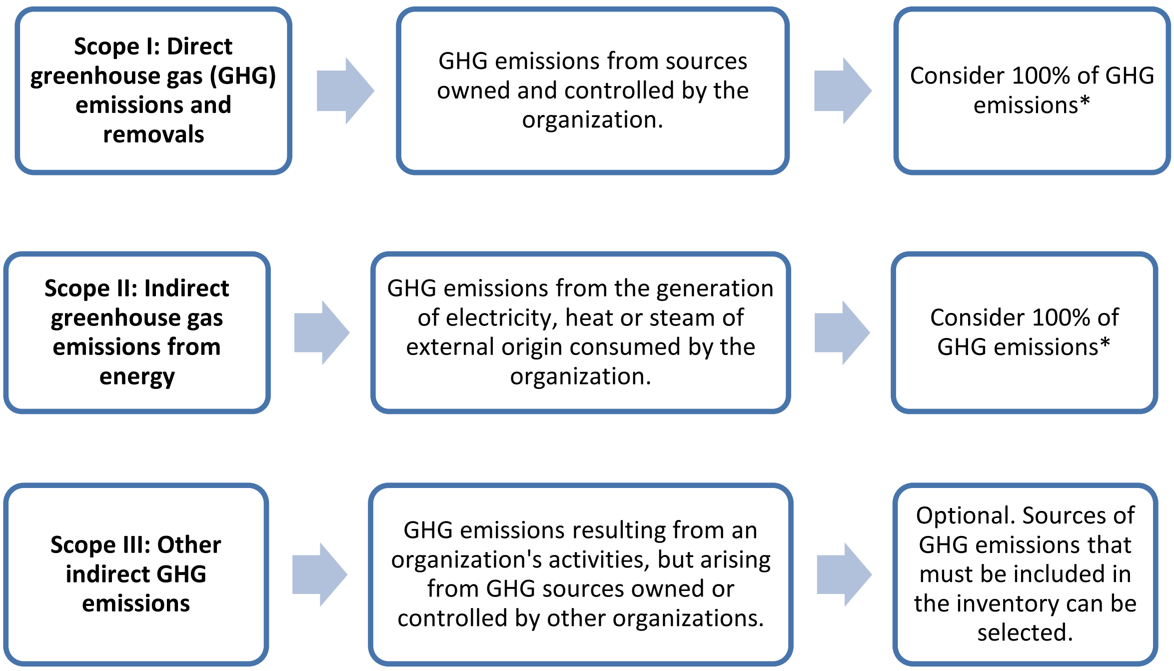
Figure 2. Greenhouse Gases



In accordance with the reference standards (GHG Protocol and ISO 14064-1), emissions may be classified into three categories (Scope 1, 2 and 3).

The considerations for this classification are detailed below:

Figure 3. Definitions and Requirements according to ISO 14064-1.



As can be seen in Figures 2 and 3, it is a mandatory requirement to consider all the “direct emissions and removals” (scope 1) and the “indirect emissions from energy” (scope 2). However, the inclusion of sources of emissions in the “other indirect GHG emissions” category (scope 3) is optional and this is the primary focus in defining operational limits.

In order to delimit the established scope, a tour of the Terminal’s facilities was carried out. During such tour, the organization’s activities representing sources of gas emission were determined, as detailed below:

- ✓ Consumption of fuels and lubricants by mobile machinery and equipment: container ships, light trucks, forklifts, spreaders, cranes, headers.
- ✓ Fuel for boats.
- ✓ Consumption of fuels and lubricants by stationary machinery and equipment: generators, power packs.
- ✓ Consumption of liquefied petroleum gas (LPG): forklifts.
- ✓ Consumption of power from the grid.
- ✓ Refrigerant gas recharge: air conditioners.
- ✓ CO2 fire extinguisher gas recharge.
- ✓ Biological waste (wastewater).
- ✓ Non-recyclable waste.
- ✓ Welds.
- ✓ Sulfur hexafluoride.

6. Base Year Selected

2019 is taken as the base year in view that YILPORTECU has developed a solid database since that year and has reliable supports and records that support the primary information required to determine the Carbon Footprint.

The base year will be recalculated when some of the following conditions are met:

- Significant changes in the quantification methodologies and/or emission factors.
- Significant structural changes in the facilities, including mergers, acquisitions and expansions.
- Changes in the operating and operational limits.
- New sources of data concerning other scope 3 indirect emissions.
- Discovery of significant errors or accumulation of a considerable number of minor errors progressively and significantly altering the total number of GHG emissions quantified.

YILPORTECU has identified and established that the significance levels that will be considered for the recalculation of the base year will be those above 10% of the values established in the base year.

7. Calculation of Greenhouse Gas Emissions

7.1. Calculation Methodologies Used

For purposes of the calculation, the methodology and emission factors contained in the IPCC 2006 (2019 update) were implemented, as it is the highest authority in greenhouse gas emission inventory matters; the GHG Protocol 2000 was also implemented. The only national factor used is the electricity factor issued by Ecuador's National Center for Energy Control (CENACE in Spanish) according to the country's energy matrix.

The calculation of emissions of each GHG (CO_2, CH_4, N_2O, etc.) is expressed in tons of CO_2-eq/year.

In order to make the greenhouse gas inventory, the following methodology was used:

Table 1. Methodology Used for GHG Calculation.

EMISSION SOURCE	METHODOLOGY
Electricity	Based on data from CENACE (National Center for Energy Control).
Refrigerant gases and sulfur hexafluoride	(AR5), Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forc-ing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
Biological waste	2006 IPCC Guidelines (2019 update) for National Greenhouse Gas Inventories. Volume 5. Chapter 6: Wastewater Treatment and Discharge.
Non-recyclable waste	IPCC - "V5_2_Ch2_Waste_Data.pdf" - Vol. 5 "Waste"- Chapter 2 - page 2.15.
Fuels (diesel, gasoline, LPG)	2006 IPCC Guidelines (2019 update) for National Greenhouse Gas Inventories. Volume 2: Energy, Chapter 2: Stationary Combustion, and Chapter 3: Mobile Combustion.
Lubricants	2006 IPCC Guidelines (2019 update) for National Greenhouse Gas Inventories.

For the calculation of CO_2 emissions, the process described below was followed:

a) *Emission source: Electricity*

In order to estimate GHG emissions from electricity, the following formula was used:

Emissions in tCO_2e = (Activity data × Emission factor).

The emission factors used are described below:

Table 2. GHG Emission Factors for Electricity

Emission Category	Methodology Used	Emission Source	Measurement Unit	Emission Factor
Indirect	CENACE	Electricity	Mwh	2018: 0.5371 t CO_2/Mwh 2019: 0.4509 t CO_2/Mwh

b) *Emission source: Refrigerant gases and sulfur hexafluoride*

For the refrigerant gas emission source, the emissions were calculated in tons CO_2e as detailed below:

Emissions of each type of refrigerant gas in tCO_2e = *(Activity data × PCG).*

The global warming potentials used are detailed below:

Table 3. GHG Emission Factors for Refrigerant Gases and Sulfur Hexafluoride.

Emission Category	Methodology Used	Emission Source	Measurement Unit	Emission Factor
Direct	IPCC 2006 (2019 update) AR5, 2013	Refrigerant gas and SF6	Pounds	Global warming potential R-22: 1.760 R-410 A: 1.924 SF_6: 23.500

c) *Emission source: Biological waste*

The estimation of biological waste was based on the number of persons, BOD and the factors listed below. The calculation is not detailed in the table due to the complexity, but the details can be viewed in SIM CO_2.

Table 4. GHG Emission Factors for Biological Waste

Emission Category	Methodology Used	Emission Source	Measurement Unit	Emission Factor
Direct	IPCC, 2007	Biological waste	Number of persons	BOD: 0.40 g/person/day 65 kg protein/person/day 0.16 kg N/kg protein 1.10 adjustment factor for non-consumed proteins 1.25 industrial and commercial proteins co-discharged 0.005 kg N_2O/kg N (N removed with sludge)

d) *Emission source: Non-recyclable waste*

In order to estimate the emissions from non-recyclable waste, the following formula was used:

Emissions in tCO_2e = (Activity data x MS fraction x C fraction x 3.67).

The emission factors used are detailed below:

Table 5. GHG Emission Factors for Miscellaneous Waste

Emission Category	Methodology Used	Emission Source	Measurement Unit	Emission Factor
Other indirect	IPCC 2006 (2019 update)	Non-recyclable waste	Kg	% non-recyclable matter: 90 Organic carbon content: 60% CO_2 conversion factor: 3.67

e) *Emission source: Fuels (gasoline, diesel, LPG).*

In order to estimate emissions from fuels, the following formulae were used:

CO_2 emissions in tCO_2e = (Activity data × CO_2 emission factor × GWP of CO_2) ÷ 1000

CH_4 emissions in tCO_2e = (Activity data × CH_4 emission factor × GWP of CH_4) ÷ 1000

N_2O emissions in tCO_2e = (Activity data × N_2O emission factor × GWP of N_2O) ÷ 1000

$tCO_2e = \sum tCO_2e\ (CO_2, CH_4, N_2O)$

Note: GWP = Global Warming Potential.

The emission factors used are detailed below:

Table 6. GHG Emission Factors for Fossil Fuels

Emission Category	Methodology Used	Emission Source	Measurement Unit	Emission Factor
Direct	IPCC 2006 (2019 update)	Diesel for vehicles	Gallons	Fuel density: 0.83 NCV: 43 TJ/Gg E.F CO_2: 74,100 E.F. CH_4: 3.9 Global warming potential of methane: 28 E.F. N_2O: 3.9 Global warming potential of N_2O: 265
Direct	IPCC 2006	Diesel for heavy machinery	Gallons	Fuel density: 0.832 NCV: 43 TJ/Gg E.F. CO_2: 74,100 E.F. CH_4: 4.15 Global warming potential of methane: 28 E.F. N_2O: 28.6 Global warming potential of N_2O: 265
Direct	IPCC 2007	Diesel for stationary combustion (generators)	Gallons	Fuel density: 0.83 NCV: 43 TJ/Gg E.F. CO_2: 74,100 E.F. CH_4: 10.00 Global warming potential of methane: 28 E.F. N_2O: 0.60 Global warming potential of N_2O: 265
Direct	IPCC 2006 (2019 update)	LPG for forklifts	Kilograms	NCV: 47.30 TJ/Gg E.F. CO_2: 63,100 E.F. CH_4: 62 Global warming potential of methane: 28 E.F. N_2O: 0.20 Global warming potential of N_2O: 265

Emission Category	Methodology Used	Emission Source	Measurement Unit	Emission Factor
Other indirect	IPCC 2007	Gasoline for boats	Gallons	Gasoline density: 0.73 NCV: 44.30 TJ/Gg E.F. CO_2: 69,300 E.F. CH_4: 5 Global warming potential of methane: 28 E.F. N_2O: 0.60 Global warming potential of N_2O: 265

f) Emission source: Lubricants

In order to estimate the emissions of lubricants, the following formula was used:

Emissions in tCO_2e = (Activity data x NCV x C contents x oxidation fraction x 3.67).

Note: NCV=net calorific value.

The emission factors used are detailed below:

Table 7. GHG Emission Factors for Lubricants

Emission Category	Methodology Used	Emission Source	Measurement Unit	Emission Factor
Direct	IPCC 2006 (2019 Update)	Lubricants - oxidation	Gallons	Fuel density: 0.864 NCV: 40.20 TJ/Gg Carbon content: 20 Oxidation during use: 0.20 C to CO_2 conversion factor: 3.67

8. GHG Emissions in YILPORTECU's Operations

8.1. Results of GHG Inventory 2019-2020

8.1.1. Analysis of GHG Emissions - 2019

During the base year (2019), the Port Terminal facilities emitted a total of 9,664.42 Ton CO_2e. In that year, the main emission source was energy consumption (6,315.19 Ton CO_2e/year), which accounted for 65.34% of the total emissions.

The second most important emission source was the consumption of fuels and lubricants for heavy machinery, which totaled 2,856.42 Ton CO_2e/year, i.e. 29.56% of total emissions in 2019. The third most important emission source was the consumption of fuels and lubricants by stationary combustion machinery, which totaled 205.71 Ton CO_2e/year, i.e. 2.13% of total emissions. In the fourth place, the emissions from miscellaneous waste totaled 107.89 Ton CO_2e/year, which accounted for 1.12% of the total TonCO_2e/year.

The remaining emissions accounted for 1.85% of total annual emissions and consists of the emissions coming from the following sources: LPG for forklifts, consumption of gasoline for vehicles, gases such as sulfur hexafluoride, biological waste, consumption of gasoline for boats, consumption of lubricants and refrigerant gases (see Table 8).

Table 8. Greenhouse Gas Emissions – Year 2019.

No.	Emission Source	Classification	Total CO2 Emissions (ton CO2/year) 2019	Percentage (%)
1	Energy	Indirect	6,315.19	65.34
2	Fuels for heavy machinery	Direct	2,856.42	29.56
3	Stationary combustion fuels	Direct	205.71	2.13
4	Miscellaneous waste	Other indirect	107.89	1.12
5	LPG for forklifts	Direct	69.46	0.72
6	Diesel for vehicles	Direct	34.81	0.36
7	Biological waste	Direct	28.33	0.29
8	Sulfur hexafluoride	Direct	21.15	0.22
9	Gasoline for boats	Direct	16.89	0.17
10	Lubricants	Direct	4.58	0.05
11	Refrigerant gases	Direct	4.00	0.04
TOTAL			9,664.42	100.00

Based on the classification of emissions according to their scope, it can be determined that in 2019 the main GHG emission source corresponded to scope 2, that is, indirect emissions, represented by consumption of energy (6,315.19 Ton CO_2e/year), followed by scope 1 emissions with 3,241.35 Ton CO_2e/year, and finally scope 3 emissions with 107.89 Tn CO_2eq (see Table 9).

Table 9. Emissions classified according to Scope – Year 2019.

Emissions classified according to scope, as per NTE INEN-ISO 14064-1	GHG emissions by month (Ton CO2eq)
Scope 1: Direct GHG emissions	3,241.35
Consumption of fuels for heavy machinery	2,856.42
Consumption of fuels for stationary equipment	205.71
LPG for forklifts	69.46

Diesel for vehicles	34.81
Biological waste	28.33
Sulfur hexafluoride	21.15
Gasoline for boats	16.89
Lubricants	4.58
Refrigerant gases	4.0
Scope 2: Indirect GHG emissions	6,315.19
Energy	6,315.19
Scope 3: Other indirect GHG emissions	107.89
Miscellaneous waste	107.89
Emissions (Ton CO_2eq)	**9,664.42**

8.1.2. Analysis of GHG Emissions - 2020

During 2020 (January to November), Yilportecu emitted a total of 10,239.99 Ton CO_2e/ year. The main emission source was energy consumption (5,881.85 Ton CO2e/year), which accounted for 57.44% of the total emissions in 2020.

The second most representative emission source was the combustion of heavy machinery, which totaled 2,898.40 Ton CO_2e/year, i.e. 28.30% of annual emissions. The third most important emission source was the consumption of fuels for stationary equipment, which totaled 1,098.91 Ton CO_2e/year, i.e. 10.73% of the emissions of this year.

The fourth emission source in 2020 was miscellaneous waste, which totaled 192.46 Ton CO_2e/year, i.e. 1.88% of the total emissions.

The remaining emissions accounted for 1.64% of emissions and consists of the emissions coming from the following sources: LPG for forklifts, consumption of diesel for vehicles, biological waste, sulfur hexafluoride, consumption of gasoline for boats, consumption of lubricants and refrigerant gases.

Table 10. Greenhouse Gas Emissions – Year 2020.

No.	Emission Source	Classification	Total CO2 Emissions (ton CO2/year)	Percentage (%)
1	Energy	Indirect	5,881.85	57.44
2	Fuels for heavy machinery	Direct	2,898.40	28.30
3	Stationary combustion fuels	Direct	1,098.91	10.73
4	Miscellaneous waste	Other indirect	192.46	1.88
5	LPG for forklifts	Direct	51.22	0.50
6	Diesel for vehicles	Direct	31.91	0.31
7	Biological waste	Direct	29.90	0.29
8	Sulfur hexafluoride	Direct	21.15	0.21
9	Gasoline for boats	Direct	15.48	0.15
10	Lubricants	Direct	6.72	0.07

11	Refrigerant	Direct	12.00	0.12
	TOTAL		**10,239.99**	**100.00**

Based on the classification of GHG emissions according to their scope, it can be determined that most of them come from scope 2 indirect sources, that is, energy consumption, with 5,881.85 Ton CO_2eq, followed by scope 1 sources, that is, direct GHG emissions, with 4,165.69 Ton CO_2eq, and finally scope 3 sources, that is, other indirect emissions, with 192.46 Tn CO_2eq of the total emissions in 2020.

Table 11. Emissions Classified according to Scope - Year 2020

Emissions classified according to scope, as per NTE INEN-ISO 14064-1	GHG emissions by month (Ton CO2eq)
Scope 1: Direct GHG emissions	4,165.69
Consumption of fuels for heavy machinery	2,898.40
Consumption of fuel and lubricants for stationary equipment	1,098.91
LPG for forklifts	51.22
Diesel for vehicles	31.91
Biological waste	29.90
Sulfur hexafluoride	21.15
Gasoline for boats	15.48
Lubricants	6.72
Refrigerant gases	12.00
Scope 2: Indirect GHG emissions	5,881.85
Energy	5,881.85
Scope 3: Other indirect GHG emissions	192.46
Miscellaneous waste	192.46
Emissions Ton CO_2eq	**10,239.99**

8.2. Comparison of 2019 and 2020 Emissions

When comparing the GHG emissions generated during the base year (2019) with the 2020 carbon footprint, it can be seen that they have increased, given that 9,664.42 Ton CO_2e were emitted from January to December 2019, whereas 10,239.99 Ton CO_2e were emitted from January to November 2020.

This is due to the increase in the consumption of fuels for stationary and mobile machinery, the increase in miscellaneous waste and biological waste, and the consumption of lubricants and refrigerant gases, in view that the Port is increasing its operations.

Table 12. Analysis of CO2 Emissions.

No.	Emission Source	Classification	Total CO2 Emissions (ton CO2/year) 2019	Total CO2 Emissions (ton CO2/year) 2020
1	Energy	Indirect	6.315,19	5.881,85

No.	Emission Source	Classification	Total CO2 Emissions (ton CO2/year) 2019	Total CO2 Emissions (ton CO2/year) 2020
2	Fuels for heavy machinery	Direct	2,856.42	2,898.40
3	Stationary combustion fuels and lubricants	Direct	205.71	1,098.91
4	Miscellaneous waste	Other indirect	107.89	192.46
5	LPG for forklifts	Direct	69.46	51.22
6	Diesel for vehicles	Direct	34.81	31.91
7	Sulfur hexafluoride	Direct	21.15	21.15
8	Biological waste	Direct	28.33	29.90
9	Gasoline for boats	Direct	16.89	15.48
10	Lubricants	Direct	4.58	6.72
11	Refrigerant	Direct	4.00	12.00
TOTAL			**9,664.42**	**10,239.99**
Increase in CO_2 emissions			**575.57 Ton CO_2e**	

8.3. Efficiency Indicators

In order to determine the efficiency of the operation in relation to its carbon footprint, the GHG index per TEU (twenty-foot equivalent unit) was estimated. In 2019, it was 63.79 Kg CO_2e/TEU, whereas in 2020 it was 57.75 Kg CO_2e/TEU. This means that the operation improved the productivity of its processes, as it is making more dispatches with lower emissions per TEU (see Table 13).

Table 13. Emissions Index per TEU

Year	Total Emissions (Ton CO_2eq)	TEU	Ton CO_2eq/TEU	Kg CO_2eq/TEU
2019	9,664.42	151,498	0.063	63.79
2020	10,239.99	177,316	0.058	57.75

When comparing the indicator obtained (57.75 Kg CO_2e/TEU) with other ports of the country and the region, it can be seen that it is very high. For example, other Ecuadorian ports have recorded values of 39.58 Kg CO_2e/TEU and the Arica Port in Chile has recorded values of 32.50 Kg CO_2/TEU. This difference is mainly due to the fact that such other ports have implemented actions to reduce their environmental impact, such as the electrification of reefer towers, preventive maintenance programs for machinery, etc. Another factor that favors the Arica Port is Chile's energy matrix, since it is based, to a greater extent, on renewable energies. In contrast, Ecuador still heavily relies on thermoelectric power stations.

9. Quantification Exclusions in the Terminal Operations

The following is excluded from the calculation of the emissions from the Port Terminal operations:

- The consumption of fuel by the trailers and trucks carrying the containers and cargo, because they arrive on time to leave the cargo only and belong to different carriers, thus falling under scope 3.
- The transportation of tank trucks with the fuel and the transportation of personnel.
- The emissions from welding, as they account for 0.05% of the inventory emissions, for which reason they are not considered a significant source.
- Acetylene emissions, as they account for 0.001% of the inventory emissions and, hence, are not a significant source.
- Fire extinguishers, as they account for 0.01% of the inventory emissions and, hence, are not a significant source.

10. Quantification of GHG Emissions and GHG Precursors in Vessels

10.1. Considerations for the Calculation of Emissions

According to Prieto Montañez (2019), it is widely recognized by the scientific community that ships are a major source of contamination in port cities and river regions, have a negative impact on air quality, and contribute to global warming.

As per this author, currently 90% of the world trade is carried out by ships, for which reason it is necessary to estimate the gas emissions they generate. These emissions are produced by ship propulsion engines (main engine), auxiliary engines and boilers.

Upon preparing the inventory of maritime traffic emissions, a distinction is made between the three following operations or phases of a ship, which are detailed below:

- Cruising. This phase covers the vessel's journey to the open sea, which is counted between breakwaters, i.e. the distance it travels to get from one port to another until reaching the breakwater. During this phase, the vessel travels at a service speed of about 94% of its maximum speed and maintains a main engine load of 83% (ICF, 2006, p.17).

- Maneuvering. In this operation, the vessel travels the distance between the port's breakwater and the docking wharf. Here both the vessel speed and the engine load are reduced.

- Hotelling. This phase refers to the stay of the vessel at the dock. During this phase, operations such as loading/unloading of goods are carried out. Although the vessel remains moored and does not need energy for propulsion, during this operation it is necessary to generate such energy to feed the electrical, heating and ventilation systems, pumps, etc.

The Cruising operation is not taken into account in the calculation of gas emissions, given that such emissions do not directly affect the port infrastructure and its surroundings.

While most of the emissions into the atmosphere occur during the Cruising operation, the Maneuvering and Hotelling operations are very important, as the pollutants emitted during such phases directly affect the air quality of the population centers located near the ports and of the ports themselves.

This inventory considers combustion gas emissions generated during the Maneuvering and Hotelling phases, thus focusing on the emissions produced at ports.

The primary pollutants considered in the emissions inventory are: NOx, CO, SO2, PM, HC, CO2 y N2O.

For this study of YILPORTECU, the phase of maneuvering and docking of cargo vessels and container ships will be considered, as they are the main types of ships arriving at the Port. Small boats and tourist or recreational cruises with people are excluded because they arrive sporadically.

The calculation of emissions for such boats and cruises was based on information provided by the Port on the most representative types of ships arriving at the port and on data obtained from the "Marine Traffic" system, which collects data from the various Automatic Identification System (AIS) stations. Data such as the year of construction, gross tonnage, average and maximum speed were obtained from the above-mentioned database.

This study also used the methodology and emission factors described in "Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions. EPA EPA-420-B-20-046. September 2020".

The installed power capacity (kW) of the main engines was estimated based on the gross tonnage and type of vessel, through a non-linear regression developed by the Italian physicist Trozzi, 2010. It corresponds to equations (1) and (2):

$ME = a \times GT^b$ Eq. (1)

$AE = r \times ME$ Eq. (2)

Where:

ME= main engine used for ship propulsion

AE= auxiliary engine

GT= gross tonnage

r= ratio of the installed power capacity of the auxiliary engine and main engine (AE/ME);

a and b= the regression coefficients.

The table below shows the indicated variables by type of vessel.

Table 14. Linear Regression Coefficient for Estimation of Installed Power Capacities.

Type	a	b	r
General	6	0.7425	0.191
Bulk	35.9120	0.5276	0.222
Container	2.9165	0.8719	0.22

Source: Nunes et al., 2017a; Port et al., 2017; Sanabria et al., 2014; Trozzi, 2010; quoted by Prieto Montañez, 2019.

No information was obtained on the boiler systems of the vessels that arrived at the Puerto Bolívar. Therefore, for purposes of the calculation, such values were assumed according to the type of vessel, based on secondary sources. Table 15 shows the installed power capacities of the auxiliary boilers. Just as in Nunes et al., 2017a, their operation was only considered in the maneuvering and docking phases.

Furthermore, the load factors of the auxiliary engines were obtained from secondary sources according to the operating phase (Table 16).

Table 15. Installed Power Capacity of Auxiliary Boilers.

Type	Maneuvering (Kw)	Hotelling (Kw)
Bulk	132	132
Container	506	506
General	137	137

Source: Nunes et al, 2017a.

Table 16. Load Factors by Operating Phase.

Operating Phase	ME LF (%)	AE LF (%)
Cruising	80	30
Maneuvering	20	50
Hotelling	20	40

Source: Nunes et al, 2017a.

It is considered that the vessels traveling to Puerto Bolívar have a Slow Speed Diesel (SSD) engine and that the type of fuel they use belongs to the Bunker Fuel Oil (BFO) category.

Table 17. Specifications by Type of Vessel.

Type of Vessel	Type of Engine	Rpm	Type of Fuel	Engine	Type of Fuel
General cargo	Ssd	Rpm≤300	Bfo	Msd/hsd	Bfo
Container ship	Ssd	Rpm≤300	Bfo	Msd/hsd	Bfo

On the other hand, YILPORTECU supplied the data on the number of vessels that arrived in 2019 and 2020 (cut-off until November). The data of 2019 was used because full-year information was available.

The following gas emission factors were used:

Table 18. Emission Factors used to calculate Vessel Emissions.

	Type of Engine	Type of Fuel	PM	HC	CO	NOx	N2O	CO2	SO2
			g/kwh						
Main engine	SSD	HFO	1.40	0.6	1.4	18.1	0.031	607.23	10.29
Auxiliary engine	MSD	HFO	1.54	0.4	1.1	14.7	0.031	706.878	11.98
Boiler	Boiler	HFO	1.87	0.1	0.2	2.1	0.08	949.77	16.10

Source: EPA 2020.

10.2. Results

In 2019, a total of 558 vessels arrived at Puerto Bolívar, of which 314 are container ships and 244 are general cargo vessels.

Table 19. Details of Arrival of Vessels at Yilportecu

Month	Vessels with Containers	Vessels with General Cargo
Jan-19	30	15
Feb-19	27	19
Mar-19	29	22
Apr-19	26	21
May-19	27	26
Jun-19	22	16
Jul-19	25	17
Aug-19	24	23
Sept-19	23	20
Oct-19	24	20
Nov-19	27	26

Month	Vessels with Containers	Vessels with General Cargo
Dec-19	30	19
Total	**314**	**244**

Vessels' maneuvering time is 2.16 hours approximately. Maneuvering is the distance they travel from the breakwater to the port and, during such journey, vessels move at a slower speed.

In the Hotelling phase, container ships stay in the port 10 hours in average (0.42 days) and general cargo vessels stay in the port from 5 to 7 days while the unloading and loading operations are carried out. Vessels' dwell time in port depends on several factors, such as ease of loading and unloading of goods, the technologies used at the port, among others. Therefore, a longer dwell time may cause more emissions. Furthermore, cargo vessels must wait longer in the port until the cargo is complete to be able to depart again.

In the case of cargo vessels, most of the emissions occur during the Hotelling phase (it is assumed that the main engine does not operate during this phase) because this is the phase during which vessels stay the longest at the Port. This is due to the fact that the auxiliary engine is in charge of supplying the energy to carry out the different operations in the port, thus being the main source of pollutant emission. In contrast, the maneuvering phase takes less time and, hence, emissions are lower (Table 20).

In the case of container ships, the situation is different because the greatest emissions occur during the maneuvering phase due to the fact that these vessels have a larger gross tonnage (GT). A larger GT implies a higher installed power capacity, which is logical taking into account that a larger volume of goods must be transported and the installed power capacity translates into greater atmospheric emissions (Table 21).

Table 20. Gas Emissions from Cargo Vessels in 2019

Emissions from cargo vessels during maneuvering	Ton gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Total emissions from vessels in 2019	3.09	1.14	2.76	34.88	0.06	1,364.44	23.71

Emissions from cargo vessels during hotelling	Ton gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Total emissions from vessels in 2019	49.36	11.27	30.69	407.86	1.16	23,017.68	390.18

Total emissions from cargo vessels during maneuvering and hotelling	Ton gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Total emissions from vessels in 2019	52.45	12.41	33.45	442.75	1.23	24,382.12	413.89

Table 21. Gas Emissions from Container Ships in 2019.

Emissions from container ships during maneuvering	Ton gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Total emissions from vessels in 2019	10.05	3.58	8.70	110.25	0.227	4,457.15	77.31

Emissions during hotelling	Ton gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Total emissions from container ships in 2019	7.72	1.69	4.59	60.94	0.19	3,616.84	61.31

Total emissions from container ships during maneuvering and hoteling	Ton gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Total emissions from container ships in 2019	17.77	5.27	13.30	171.19	0.42	8,073.99	138.62

In 2019, container ships and cargo vessels emitted 32,456.11 Ton CO2, followed by NOx (613.93 Ton) and by SO2 (552.52 Ton) (Table 22).

Table 22. Total Emissions from Container Ships and Cargo Vessels during Maneuvering and Hotelling.

Source of Emissions	Ton Gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Gas emissions from container ships during maneuvering and hotelling in 2019	17.77	5.27	13.30	171.19	0.42	8,073.99	138.62
Gas emissions from cargo vessels during maneuvering and hotelling in 2019	52.45	12.41	33.45	442.75	1.23	24,382.12	413.89
Total emissions	70.22	17.68	46.74	613.93	1.65	32,456.11	552.52

According to the growth YILPORTECU expects to achieve in the coming years, the emissions that could be generated each year were estimated, obtaining the following results: 91,244.04 Ton CO2, 1,694.59 Ton NOx, 1,551.64 Ton SO2, 196.93 Ton PM, 128.68 Ton CO, 48.35 Ton HC and 4.64 Ton N2O (Table 23).

Table 23. Projected Emissions from Container Ships and Cargo Vessels during the Maneuvering and Hotelling Phases.

Source of Emissions	Ton Gas						
	PM	HC	CO	NOx	N2O	CO2	SO2
Gas emissions from container ships during maneuvering and hotelling in 2019	44.98	12.29	31.56	409.54	1.07	20,626.49	352.75
Gas emissions from cargo vessels during maneuvering and hotelling in 2019	151.95	36.06	97.12	1,285.05	3.57	70,617.56	1,198.89
Total emissions	196.93	48.35	128.68	1,694.59	4.64	91,244.04	1,551.64

11. Alternatives to Reduce GHG Emissions from the Project during the Operation Phase

YILPORTECU is committed to sustainability in all its actions. For this reason, after measuring its carbon footprint, it will promote processes to reduce its greenhouse gas emissions.

The alternatives proposed to reduce GHG emissions include the following:

Table 24. Alternatives Proposed to Reduce GHG Emissions during the Operation.

Alternatives Proposed	
1-Action to reduce GHG emissions: Implementation of photovoltaic energy	
Description of the reduction action to be implemented	The implementation of solar panels allowing for the use of photovoltaic energy provides energy to the system during the day, which reduces consumption from the conventional network, the invoice amount, and GHG emissions. It also lowers operating costs, contributes to the achievement of the Sustainable Development Goals (SDG) proposed by the United Nations Organization (UNO), and reduces the carbon footprint.
2-Maintenance of cold systems and use of refrigerant gases of low environmental impact	
Description of the reduction action to be implemented	Refrigerant gases have a high global warming potential, which implies that any leakage in the equipment will emit significant amounts of this type of gases. When equipment is changed, it is necessary to prioritize the purchase of efficient equipment with refrigerant gases of low global warming potential. For example, the following gases have a low global warming potential:

Alternatives Proposed

Refrigerant	GWP
R-449a	1,400
R-449b	1,412
R-448a	1,387
HFC-32	675
R-513a	630
R-450a	601
R-447a	583
R-446a	461
R-451b	164
R-451a	149
HFO-1234ze(E)	6
R-441a	<5
HFO-1234yf	4
R-600a (isobutane)	3
R-290 (CO2)	3
R-744 (CO2)	1
R-717 (ammonia)	0

Source: Adapted from (Environmental Protection Agency [EPA], 2016)

The Terminal is provided with R22 refrigerant gas equipment, so it is possible for it to shift to more efficient and sustainable equipment. On the other hand, it is important to be attentive to their maintenance to prevent any possible leakage and thus reduce GHG emissions and their consequences on the ozone layer and climate change.

3-Diesel purification and filtration systems

Description of the reduction action to be implemented	This action seeks to improve diesel quality to reduce diesel consumption and thus reduce GHG emissions. The diesel sold in Ecuador is of poor quality, since it contains a large amount of impurities, resulting in an inefficient combustion process. In this regard, there are several diesel purification and filtration systems that turn diesel into an ultra-clean fuel that meets the highest international standards. This will translate into significant savings for the company by reducing fuel consumption. The available technologies include: - FMS: It is an Ultra-Efficient technology capable of retaining particles as small as 0.1 micron, and its certified Beta Factor 4 >4000 (ISO 16889:99 multi-pass test) proves that the particle filter is more efficient than others available in the market. - Fueltron: It enhances fuel burning efficiency by reducing its viscosity, resulting in better atomization. Fuel passing through the Fueltron receives an electrical charge that clusters the largest molecules and spreads out the smallest ones. This treatment enhances combustion and reduces fuel emissions, with a 2.5% to 14% saving. By purifying the diesel, a more efficient combustion is achieved, which contributes to reducing fuel consumption and

Alternatives Proposed	
	helps lower GHG emissions. It also brings economic benefits for the company because it lowers production costs by consuming less fuel.
4-Preventive maintenance of equipment	
Description of the reduction action to be implemented	The preventive maintenance of equipment and machinery enables their optimal operation and helps the combustion process to be complete, which avoids an incomplete combustion and thus the waste of fuel, resulting in lower GHG emissions. Some of its advantages are that it enhances the efficiency of equipment, prolongs their useful life and saves time on repairs that slow down processes.
5-Crane electrification	
Description of the reduction action to be implemented	The installation of E-RTG conductor rail system for the electrification of diesel rubber-tyred gantry cranes enables to significantly reduce fuel consumption and the use of lubricants, since diesel rail-mounted gantry cranes consume a significant amount of energy and, hence, are responsible for a considerable amount of CO2 emissions. Thus, cranes can quickly switch to cost-saving and electrical operation and reduce environmental impact.
6-System to connect vessels to the port grid	
Description of the reduction action to be implemented	The connection of vessels to the port grid allows docked vessels to switch off their diesel engines and connect to the power grid to reduce noise and environmental pollution. This is one of the problems that cities with busy ports face, since, for example, today a cruise ship emits in eight hours the same amount of nitrogen oxides as 10,000 diesel cars while docked at a port. The Onshore Power Supply (OPS), equipped with a medium to low voltage transformation station, enables to reduce noise, vibrations and pollutants from vessels while they are docked at ports.
7-Waste separation and plastic reduction	
Description of the reduction action to be implemented	Waste sorting at source makes it possible to start recycling processes and insert such waste into a circular economy chain, which brings not only environmental benefits but also economic and social benefits by activating productive chains from the recycling base. YILPORTECU produces large amounts of plastics in the dining hall that can be managed so that they do not end up in the landfill and can be recycled.

12. GHG Emissions in the Project Construction Stage

The project is an EPC contract, that is, a design, construction and equipping contract for building Dock 6 at Puerto Bolívar Port Terminal. This contract was awarded to Consorcio PBO and is currently in the design stage, for which reason the final details as to the quantity of materials and equipment that will be used are not still available and, hence, it is not possible to estimate GHG emissions at this stage. However, it was possible to identify on a preliminary basis the emission sources in the different stages of the project, including strategies to minimize the impacts in each stage. It was also possible to generate forms for the periodical collection of the information required to measure and calculate its carbon footprint.

The Dock 6 construction project is divided into several phases. The first design phase is estimated to take about 6 months out of a total construction time of 25 months. The construction works are expected to start between October and November 2021.

Below is an estimated table showing the planned stages, the possible emission sources, and the actions to be taken to reduce environmental impacts.

Table 25. Estimation of Emission Sources during the Construction Stage

Project Stage	Possible Emission Sources	Actions to reduce Environmental Impacts
Camp construction and operation	Fuel for tractors and container lifts, fuel for vehicles, waste, welding, wastewater and energy	
Subsea research and geotechnics	Fuel and lubricants for barges, drilling rigs and drilling trucks	
Platform improvement	Fuel for backhoe loader, motor graders and front-end loaders	
Pipe stacking for piles	Carriage of pipes by sea, welding, energy consumption	
Construction of the new station	Fuel for machinery	Equipment that does not contain sulfur hexafluoride are evaluated
Demolition of the pre-existing structure	Fuel for barges, crane hoists, crushers and diamond wire cutting equipment	Concrete will be recycled on site
Ground-level demolition	Consumption of fuel and lubricant by cranes and heavy machinery	
Implementation	Consumption of fuel by heavy machinery and welding	
Dock 6 construction	Consumption of fuel by machinery, land transportation of inputs, carriage of steel by sea, and consumption of fuel by barges	
Conditioning of strategic areas	Consumption of fuel and lubricants by machinery and energy consumption	
Construction of the refrigeration area	Consumption of fuel by machinery and consumption of refrigerant gases	Use or refrigerant gases of low global warming potential and high-efficiency equipment

12.1. Alternatives to reduce GHG Emissions during the Design and Construction Stage

Consorcio PBO has embedded in its organizational culture a strong environmental awareness by applying several guidelines to reduce its carbon footprint, such as the following ones:

- the ongoing in-house training in sustainability.
- the application of environmental criteria and best practices in the designs.
- the decreased use of fuel in the organization's and third-parties' motorized equipment.
- the use of energy-efficient resources.
- the optimization of water use at the project site.
- the recycling of materials and the reduction of waste at the project site.
- the conservation of natural environments.

13. Air Quality and the Environment

The EHS Guidelines establish that the permissible parameters and limits for environmental conditions measurements will be those set forth in the legislation in force and in IFC Environmental, Health and Safety Guidelines for Ports, Harbors and Terminals and that, should there be any discrepancy between them, the most stringent ones will be used.

According to the standard on ambient air quality and immission level, and as set forth in Ministerial Resolution 097-A, dated July 30, 2015, *Annex No. 4 Standard on Ambient Air Quality or Immission Level*, Point No. 4 Requirements, 4.1.1.1, the following are established as ambient air criteria pollutants: sedimentable particles, particulate matter with aerodynamic diameter less than 10 (ten) microns (PM10), particulate matter with aerodynamic diameter less than 2.5 (two and five-tenths) microns (PM 2.5), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO) and ozone (O_3).

13.1. Measurement Points

Air quality monitoring was conducted at several points of Dock 6 of the Puerto Bolívar Terminal between 2017 (baseline) and 2020. The dock is located on the shores of the Pacific Ocean at a height of 4 meters above sea level (masl).

Table 26. Characteristics of the Air Quality Measurement Station

Type of Area	Sector's Infrastructure	Potential Receptors
Port	Sea port	Pacific Ocean

Table 27. Points Designated for Air Quality Measurement

Measurement Date	Monitoring No.	Location	Coordinates	
*April 2017	1	Dock 5 SW corner		
May 2018	2	Dock 5 SW corner		
June 2018	3	Dock 5 SW corner		
Sept 2018	4	Dock 5 SW corner		
2018/12/21	5	Dock 5 SW corner	611146	9639828
2019/03/25	6	Dock 5 SW corner	610994	9639822
2019/06/17	7	Dock 5 SW corner	610981	9639822
2019/09/02	8	Dock 5 SW corner	610981	9639822
Dec 2019	9	Dock 5 SW corner		
2020/03/16	10	Dock 5 SW corner	610981	9639822
2020/06/08	11	Dock 5 SW corner	610951	9639819
2020/09/22	12	Dock 5 SW corner	610988	9639818
2020/12/20	13	Dock 5 SW corner	610985	9639824

*Baseline; prior to the start of Dock 6 construction activities.

Figure 4. Air Quality Monitoring Stations

13.2. Methodology

The methodology used to monitor ambient air quality was that indicated by the laboratory. Laboratories GRUENTEC and AFH SERVICES CIA. LTDA. participated in this monitoring.

13.3. Results

The results are evaluated according to Point 4.1.2 of the General Rules for Concentrations of Criteria Pollutants in Ambient Air. For the purposes of this analysis, the results will also be evaluated considering the limits set in Table 1.1.1: WHO Ambient Air Quality Guidelines of the World Bank Group's Environmental, Health and Safety General Guidelines (Table 29).

It is worth noting that the ambient air quality standards refer to the quality levels set and published from national legislative and regulatory processes, whereas the ambient air quality guidelines refer to the air quality levels mainly obtained from clinical, toxicological and epidemiological data (such as those published by WHO) [1].

Table 28. Evaluation of the Monitoring Results based on Annex No.4 to A.M. 097-A.

Parameters	Measure ment Unit	Year 2017	Year 2018				Year 2019				Year 2020				Maximum Permissible Limit (µg/m³)	Evaluation
		1	2	3	4	5	6	7	8	9	10	11	12	13		
Carbon monoxide (CO) b)	µg/m³	2086.62	1412.8	2505.62	3.50	524	<114	556	365	432	4291	541	751	432	10000	All measurements COMPLY with the MPL.
Carbon monoxide (CO) c)	µg/m³	-	-	-	-	1497	<114	1247	802	-	4745	4793	1860	-	30000	All measurements COMPLY with the MPL.
Nitrogen oxides (NO) c)	µg/m³	-	-	-	-	<94	133	<94	<94	-	<94	<94	<94	-	N/A	All measurements COMPLY with the MPL.
Nitrogen dioxide (NO_2) c)	µg/m³	11.29	12.30	11.93	5.47	<94	<94	<94	<94	19	<94	<94	<94	19	200	All measurements COMPLY with the MPL.
Sulfur dioxide (SO_2) a)	µg/m³	8.9	11.75	10.76	10.78	<125	<125	<125	<125	26	<125	<125	<125	26	125	All measurements COMPLY with the MPL.
Sulfur dioxide (SO_2) d)	µg/m³	-	-	-	-	<125	<125	<125	<125	-	<125	<125	<125	-	500	All measurements COMPLY with the MPL.
Ozone (O_3) b)	µg/m³	23.56	25.69	24.94	4.18	<98	<98	<98	<98	37	<98	<98	<98	37	100	All measurements COMPLY with the MPL.
Particulate Matter PM 10	µg/m³	-	-	-	-	29	22	29	17	54	45	<42	33	54	100	All measurements COMPLY with the MPL.
Particulate Matter PM 2.5	µg/m³	-	-	-	-	19	8	15	10	20	9	<42	18	20	50	All measurements COMPLY with the MPL.

a) Average value of hourly measurements taken over a 24-hour period.
b) Average value of hourly measurements taken over an 8-hour period.
c) Maximum concentration of measurements taken every ten minutes over a 1-hour period.
d) Average value of measurements taken every minute over a 10-minute period.

Table 29. Evaluation of Monitoring Results based on Table 1.1.1 - WHO Ambient Air Quality Guidelines

Parameters	Measurement Unit	Year 2017	Year 2018				Year 2019				Year 2020				Maximum Permissible Limit (µg/m^3)	Evaluation
		1	2	3	4	5	6	7	8	9	10	11	12	13		
Carbon monoxide (CO) b)	µg/m^3	2086.62	1412.8	2505.62	3.50	524	<114	556	365	432	4291	541	751	432		
Carbon monoxide (CO) c)	µg/m^3	-	-	-	-	1497	<114	1247	802	-	4745	4793	1860	-		
Nitrogen oxides (NO) c)	µg/m^3	-	-	-	-	<94	133	<94	<94	-	<94	<94	<94	-		
Nitrogen dioxide (NO_2) c)	µg/m^3	11.29	12.30	11.93	5.47	<94	<94	<94	<94	19	<94	<94	<94	19	200	All measurements COMPLY with the MPL.
Sulfur dioxide (SO_2) a)	µg/m^3	8.9	11.75	10.76	10.78	<125	<125	<125	<125	26	<125	<125	<125	26	125	All measurements COMPLY with the MPL.
Sulfur dioxide (SO_2) d)	µg/m^3	-	-	-	-	<125	<125	<125	<125	-	<125	<125	<125	-		
Ozone (O_3) b)	µg/m^3	23.56	25.69	24.94	4.18	<98	<98	<98	<98	37	<98	<98	<98	37	160	All measurements COMPLY with the MPL.
Particulate matter PM 10	µg/m^3	-	-	-	-	29	22	29	17	54	45	<42	33	54	150	All measurements COMPLY with the MPL.
Particulate matter PM 2.5	µg/m^3	-	-	-	-	19	8	15	10	20	9	<42	18	20	50	All measurements COMPLY with the MPL.

a) Average value of hourly measurements taken over a 24-hour period.
b) Average value of hourly measurements taken over an 8-hour period.
c) Maximum concentration of measurements taken every ten minutes over a 1-hour period.
d) Average value of measurements taken every minute over a 10-minute period.

13.4. Conclusions

NO_2, SO_2, CO and O_3 levels **are below the maximum permissible limits** established in the Ambient Air Quality Standard, Annex 4, Book VI of the Unified Text on Secondary Environmental Legislation (TULSMA in Spanish), as well as in Table 1.1.1 of the World Bank Group's Environmental, Health and Safety General Guidelines.

Similarly, Particulate Matter (PM10 and PM2.5) levels **are below the maximum permissible limits** established in the Ambient Air Quality Standard, Annex 4, Book VI of the TULSMA, as well as in Table 1.1.1 of the World Bank Group's Environmental, Health and Safety General Guidelines.

Emissions do not produce pollutant concentrations equivalent to or higher than those permitted by the national environmental regulations and the World Bank's Ambient Air Quality Guidelines.

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ENVIRONMENTAL AND SOCIAL ASSESSMENT, PUERTO BOLÍVAR PROJECT – PHASE 1

– CLIMATE CHANGE RISKS ASSESSMENT –

Prepared for:

YILPORT PUERTO BOLIVAR

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

SAMBITO Soluciones Ambientales Totales

ECOSAMBITO C.LTDA.

December 2020

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ABBREVIATIONS/ACCRONYMS

APG	Autoridad Portuaria de Guayaquil
APPB	Puerto Bolívar Port Authority
EP	EquatorPrinciples
MTOP	Ministryof Transport and Public Works
NDC	Nationally Determined Contributions
TCFD	*Task Force on Climate-Related Financial Disclosures*
TPH	Authorized Port Terminals (within the Port National System)

EXECUTIVE SUMMARY

This document constitutes the Climate Change Risks Assessment (CCRA) of the Phase 1 Puerto Bolivar Project, located on Av. Bolivar Madero Vargas/n, Bolívar Port Terminal, in the Machala canton, El Oro province, sponsored by Yilport Terminal Operations – YILPORTECU S.A. and carried out in compliance with the *Equator Principles* (EP), September 2020 version, adapted to the specificities of the Project. According to what is stated in EP Principle 2: Environmental and Social Assessment, Climate Change Risks Assessment should be carried out on all Category A Projects, and will include taking into account the relevant physical risks defined by the TCFD (*Task Force on Climate-Related Financial Disclosures*). Similarly, it should be aligned with Climatic Physical Risk Categories and Climatic Transition Risk from the TCFD.

The Project establishes the design, financing, equipment, execution of additional construction, operation and maintenance of the Port Terminal, property of Puerto Bolivar Port Authority (APPB in Spanish), and it is located on Bolivar Madero Vargas Avenue, no number, Puerto Bolivar Port Terminal, in the Machala canton, El Oro province. The emplacement area consists of a parcel of land with an irregular inverted trapezoid shape with an area of 72 hectares; a 3.1-hectare rectangular parcel where Dock 6 will be built; and an area corresponding to the Access Channel and Maneuvering Area of Puerto Bolivar, as well as the sediment deposit basin in open sea, although they are not the property of APPB or YILPORTECU.

Climate related physical risks were identified for this study (as much for acute impacts or impacts propelled by events, as chronic events or events due to long term changes in climate patterns). Tools provided by the World Bank, such as “Climate & Disaster Risk Screening Tools”, and studies and/or country profiles carried out by other agencies such as “*German Watch”*and its“*Global Climate Risk Index 2020”, Think Hazard*!, and the *UNDP* have been used for this projection.

Other sources of information were consulted, such as the time series available in the World Bank databases (“*Climate Change Knowledge Portal”)*; and a literature search for publications related to climate change risks for port operations at national and global levels.

Finally, to reduce greenhouse gas emissions and to achieve greater resilience to the expected effects of it, recommendations from the pre-design stage (life cycle analysis, carbon footprint measurement, inclusion of ecologic engineering criteria), design (use of sustainable energy, implementation of green areas, urban agriculture, fostering biodiversity), construction (circular life cycle, alternative fuel transport, inclusion of social fabric), and operation and maintenance (restoration actions and mangrove conservation, buffer zones and urban protection borders, monitoring and surveillance) were established.

CLIMATE CHANGE RISK ASSESSMENT

1. Introduction

Port facilities are nodular components throughout the supply, transport and logistics chain, and as such, they are greatly exposed and vulnerable to direct and indirect impacts from climate change. Apart from possible sea level changes, the risk of floods resulting from coastal process alterations and the coastal geomorphology caused by the development of port infrastructure, in the future, the operation may be exposed to more damaging storms or a higher than historical sea level or to other impacts that result in losing connectivity between inland and coastal components, but also to the deceleration and/or the standstill of the cargo management activities. That is, the impacts from climate change may affect the viability of port operations.

Critical activities related to ports and ships (particularly, movement and mooring of ships, loading and unloading and dredging activities) and the infrastructure of the port's supply chain (in our case, freight movement by road), can be seen as vulnerable to the risks related to climate variability, such as the increase of the intensity of rains, flash floods, heatwaves, storms and strong winds.

With this in mind, the projected future impacts related to climate change and the development of adaptation measures should be considered in the design phase of new port projects and/or significant port expansions in order to allow the vulnerabilities and risks from climate change to be identified, analyzed and evaluated as part of the consideration of alternatives, design and location of the project.

Also, weather conditions should be evaluated periodically during the operational phase of the port.

Operational and design aspects for consideration as part of planning of the adaptation to climate change include:

- Design port infrastructure to increase its climatic resilience in the context of sea level changes and more extreme meteorological phenomena;
- Choose and replace handling, storing and cargo transport equipment (for example, taking into consideration crane stability, shutting material storage bays, location of electrical equipment, protection against corrosion) and review freight transport routes (e.g., avoid areas prone to flooding, improve drainage at the systems and maintenance site) to increase their climate resilience in the context of climate changing events.
- Evaluate the contribution of port construction and operation to the incremental impacts from climate change on high biodiversity habitats and on rare species, threatened species or critically endangered species which are found in the port vicinity.

2. Methodology

This document constitutes the Climate Change Risks Assessment (CCRA) for the area of the Puerto Bolívar Port Project – Phase 1, carried out in accordance with the GUIDANCE NOTE ON CLIMAGE CHANGE RISK EVALUATION from the Equator Principles (EP), September 2020[1] version, adapted to the specificities of the Project. Pursuant to what is established in EP Principle 2: Environmental and Social Assessment[2], the Evaluation of Climate Change Risks should be carried out on all Category A Projects[3], and will take into consideration the relevant physical risks defined by the TCFD (*Task Force on Climate-Related Financial Disclosures*). In the same way, it should be aligned with the Climate Physical Risk Categories and Climate Transition Risk of the TCFD[4].

In addition, the TCFD requires that physical risks related to the climate be identified as one of the main types of risk that the Projects should disclose, including acute cases (propelled by events) and chronic cases (due to long-term changes in weather patterns). In this regard, projection tools will be provided by the World Bank, such as Climate & Disaster Risk Screening Tools (see Annex I. *Climate and Disaster Risk Screening Tools* - Puerto Bolivar) and studies and/or country profiles carried out by other agencies such as *German Watch* and its *Global Climate Risk Index 2020, Think Hazard*!, and the *UNDP*.

Also, the information available (series of time) in the database of the World Bank[5] is analyzed.

A literature search of publications related to climate change risks for national and global port operations is carried out.

This document includes the identification, analysis and evaluation of the vulnerabilities and climate change risks associated with project activities of the port development of the Puerto Bolivar project.

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[1] Available at https://equator-principles.com/wp-content/uploads/2020/09/CCRA_Guidance_Note_Ext_Sept_2020.pdf, consulted on November 18 2020.

[2] Available at https://equator-principles.com/wp-content/uploads/2020/09/CCRA_Guidance_Note_Ext_Sept_2020.pdf, consulted on November 18 2020.

[3] Available at https://equator-principles.com/wp-content/uploads/2020/09/CCRA_Guidance_Note_Ext_Sept_2020.pdf, consulted on November 18 2020.

[4] Available at https://equator-principles.com/wp-content/uploads/2020/09/CCRA_Guidance_Note_Ext_Sept_2020.pdf, consulted on November 18 2020.

[5] Available at https://climateknowledgeportal.worldbank.org/country/ecuador , consulted on November 18 2020.

3. Ecuador in the Climate Change Context

The Ecuadorian Constitution, through Environmental Organic Code, governs the obligations, actions and responsibilities of Ecuador on climate change topics. Additionally, Ecuador has regulations, ministerial resolutions and municipal and provincial regulatory bodies which also govern climate change actions.

In 2017, Ecuador participated in the CMNUCC and ratified its participation in the Paris Agreement through Executive Decree #98.

The strategy determined in Ecuador in order to mitigate climate change has three parts:

1) The plan for implementing the internationally agreed actions (includes preparation of Nationally Determined Contributions NDC)

2) The launch of the National Strategy of Climate Finance

3) The fourth communication of climate change that allows national and local projects to be carried out.

In 2012, the document "National Strategy of Climate Change of Ecuador/ NSCCE 2012-2025" (Ministry of the Environment, 2012) was published. This document guides and governs in a coordinated way the actions and measures that Ecuador needs to stimulate to prepare the nation to face extreme climatic events of greater intensity and frequency. Likewise, it dictates the actions that Ecuador will proactively implement in order to reduce the level of greenhouse gas emissions in strategic productive and social sectors.

3.1 Priority Sectors

The priority sectors were defined based on information related to climate change generated by the Government of Ecuador and other stakeholders at the national level and international cooperation; and the information produced by different scientific studies internationally consolidated by the IPCC (Intergovernmental Panel on Climate Change). The priority sectors are those which the strategy should focus on since they are the most vulnerable in the face of climate change, and its impact could cause the greatest economic, social and environmental losses in the country. These are:

Energy

- Fuel burning activities
- Fuel emissions leak
- Carbon dioxide transport and storage

Industrial Processes and use of products

- Mining industry
- Metallurgic industry
- Non-energy products from fuels and solvent use
- Electronic industry
- Use of substitutes for ozone-depleting

- Manufacture and use of other products
- Other

Agriculture, Forestry and other Land Use

- Livestock
- Soil
- Accumulated sources and emission sources not related to CO2 in the soil
- Other

Waste

- Solid waste management
- Biological treatment of solid waste
- Incineration and open field burningof waste
- Wastewater treatment and discharge
- Other

Other

- Indirect N_2O emissions due to atmospheric nitrogen deposition in NOx and NH3
- Other

3.1.1 Priority Sectors to Adapt to Climate Change in Ecuador

In Ecuador, two criteria have been considered to define priority sectors (or priority "work areas"). The first criterion responds to the priority sectors in the National Plan for Good Living and in the country's Public Policies. The second criterion considers the defined sectors as most vulnerable in the Fourth Report from the IPCC (IPCC, 2007).

Priority sectors to adapt to climate change in Ecuador are as follows:

- Food sovereignty, agriculture, livestock, aquaculture and fishing
- Productive and strategic sectors
- Health
- Hydric heritage
- Natural heritage
- Priority attention groups
- Human settlements
- Risk management

3.1.2 Priority Sectors for Reduction of GHG Emissions in Ecuador

In order to define priority sectors for the reduction of GHG emissions in Ecuador, three criteria were considered: the ones considered priority are those sectors that generate the most emissions in the country (according to the GHG national inventory in the Second National

Communication) and which showing a tendency to increase; the relative importance of the sector in the country's economy; and the future commitments that the nation may have for the GHG emissions report in relation to the UNFCCC. These are:

- Agriculture
- Land use, Change in land use and Forestry
- Energy
- Solid and liquid waste management
- Industrial processes

3.2 Strategic Plan: Adaptation to Climate Change

The general objective is to create and strengthen the capacity of social, economic and environmental systems in order to address the impacts caused by climate change.

Specific objectives are:

- Implement measures that guarantee food sovereignty in the presence of the impacts from climate change.
- Start actions so that the levels of productive and strategic sector performance as well as the infrastructure of the country are not affected by the effects of climate change.
- Implement prevention measures to protect human health before the impacts of climate change.
- Manage the hydric heritage with a comprehensive and integrated approach per hydrographic unit to ensure water resource availability, sustainable use and quality for the different human and natural uses in the presence of climate change.
- Conserve and sustainably manage natural heritage and marine and terrestrial ecosystems in order to contribute to their capacity to respond in the presence of impacts from climate change.
- Take measures to guarantee access of priority groups and priority attention to resources that contribute to strengthen its response capacity in the face of climate change impacts.
- Include comprehensive management of risks in the face of extreme events attributed to climate change in public and private scope and activities.
- Implement measures to increase the response capability of human settlements in order to deal with the impacts from climate change.

3.3 Strategic Line: Climate Change Mitigation

Its general objective is to create favorable conditions for adopting measures that lower GHG emissions and increase carbon sinks in strategic sectors.

The specific objectives are as follows:

- Identify and incorporate appropriate practices to mitigate climate change in the agriculture and livestock sectors that may also strengthen and improve their productive efficiency and competitiveness.
- Implement measures that help the integration and connectivity of relevant ecosystems for capturing and storing and sustainably managing manipulated ecosystems with the capacity to store carbon.
- Strengthen the implementation of measures to foster energy efficiency and autonomy, as well as the gradual change of the energy mix, increasing the proportion of generating renewable energy sources, thus contributing to climate change mitigation.
- Foster the application of practices that allow lower GHG emissions in the processes related to supply services and the generation of goods, from its manufacturing, distribution, consumption through final disposal.
- Foster the transformation of the productive matrix, incorporating measures that help lower GHG emissions and carbon footprint, the sustainable use of renewable natural resources and the responsible use of non-renewable natural resources.

3.4 Priority Measures

According to the National Communication, priority measures for the sector include:

- Establishing a climate change biophysical and monitoring program
- Reconfiguring the sewage systems and safe water systems of the city of Guayaquil
- Mangrove conservation and reforestation
- Reorganizing shrimping activities
- Establishing disengagement lines, buffer zones and urban protection boundaries
- Reconfiguring road drainage systems;
- Adopting adaptation programs and policies that include research on productive capacity
- Ecological needs, climate change assessments, monitoring and surveillance procedures
- Financing and economic incentive policies for marine conservation

4. Puerto Bolivar Port Terminal Expansion Project – Phase 1

The Puerto Bolivar Port Terminal Expansion Project takes into consideration the modernization, operation and maintenance of Puerto Bolivar Port Terminal. Phase I sets up modernization of infrastructure and equipment for a more efficient operation, with the objective to be able to manage a 600,000-TEU volume of containerization at the end of the phase. As part of this modernization, it contemplates the dredging works to increase draft depth of the access channel to -14.5 m, a new dock called #6 that is 450 meters long with a draft depth of -16.5 m, the container yard expansion, new blocks for piling up containers through RTG cranes, refrigerated warehouse, a new terminal access system, other smaller buildings and the purchase of new cargo handling equipment.

It is estimated that the approximated cost of the project is 350 million USD.

4.1 Project Carbon Footprint

Measuring the carbon emissions of the Project means calculating the total quantity of greenhouse gas (GHG) that the Project emits as part of its operations. This involves identifying emission sources and collecting data from each of them in order to calculate the total. Yilportecu has a rigorous GHG inventory and has established its internal reduction goals, as well as a system to measure and report progresses (SimCO_2).

The Project GHG inventory determines a carbon footprint of 9,664.3 tons of CO2e (taking 2019 as a base year), 65.35% of which comes from the consumption of electric energy, 29.56% is due to the consumption of fuel and lubricants by mobile machinery and 2.13% comes from stationary combustion sources.

In 2020, GHG emissions totaled 10,239.99 tons of CO2e, 57.44% of which come from electric energy consumption, 28.3% from the combustion of mobile equipment and 10.73% from the combustion of stationary equipment.

When comparing GHG emissions with the base year (2019) and the carbon footprint of 2020, it can be seen that it has increased as much from the increase in fuel used by fixed and mobile machinery, the increase in the generation of various wasteand biological waste (associated with the COVID-19 pandemic), the consumption of lubricants and refrigerant gases, and some hidden emissions due to the participation of contractors with different types of work.

However, when analyzing it in terms of the global operation relating the GHG emission with deployed cargo units (kg CO2e/ TEU), it results that in 2020 the GHG emissions were reduced by 9% with respect to 2019.

Table1. Project Greenhouse Gas Inventory

Year	Emissions Total (TonCO2eq)	TEU	Tons of CO2eq/TEU	Kgs of CO2eq/TEU
2019	9,608.90	151,498	0.063	63.43
2020	10,229.90	177,316	0.058	57.69

Prepared by: Ecosambito, 2020

While there is an improvement in efficiency in relation to its carbon footprint between the years of the study, it is still very far from the indexes from similar ports in the country and in the region, where values registered 39.58 Kg CO_2e/ TEU or as in Arica Port (Chile) where it reports 32.50 Kg CO_2e/TEU. This difference occurs mainly because the energy matrix of Chile has a greater proportion of renewable energy and, since it is mainly a banana port, the electric energy consumption for refrigerating banana containers in Puerto Bolivar is constant.

5. Risk Identification and Assessment

For the development of this analysis, a tool for the detection of climate risks and disasters from the World Bank[6] was used, which allows physical risks associated with climate change to be identified and assessed in the short and long term, by analyzing historical information of the parameters associated with such risks.

This tool generates a characteriziation of the risks based on historical data and the understanding of the topic and the context of the country in order to help inform the dialog, consultation and planning processes at a project and program level.

5.1 Identification of Physical Climate Risks

The physical risks related to climate refer to the possible negative impacts in an organization caused by climate change. The physical risks that derive from climate change may be driven by (acute) events such as: major severity in extreme climate events (for example, cyclones, droughts, floods and fires) or related to (chronic) long-term changes, such as an increase in precipitation and temperature, and an increase in the variability of weather patterns (for example, an increase in sea level).

To identify these and their influence and tendencies in Ecuador, we have also used other sources of information such as *Reporte de País de Gestión de Cambio Climático,* de la UNDP (Climate Risk Management - Technical Assistance Support Project - CRM-TASP, 2013); 2013); *Riesgo Climático y Adaptación, Perfil de País - Ecuador* (World Bank Group, 2011) (see Annex II); the report *Think Hazard! - Ecuador* (GFDRR, 2020) (see Annex III) and the guideline *GLOBAL CLIMATE RISK INDEX 2020* (Eckstein, Künzel, Schäfer, & Winges, 2019).

[6] Available athttps://climatescreeningtools.worldbank.org/

5.1.1 Historical Data and Trends

Ecuador has two main seasons that differ in the distribution of rains (a rainy season and a dry season). The coast has a tropical climate and a rainy season that extends from the end of December to May. The temperature regime is marked by having a variation of 2 to 3 °C between the hottest and the coldest months.

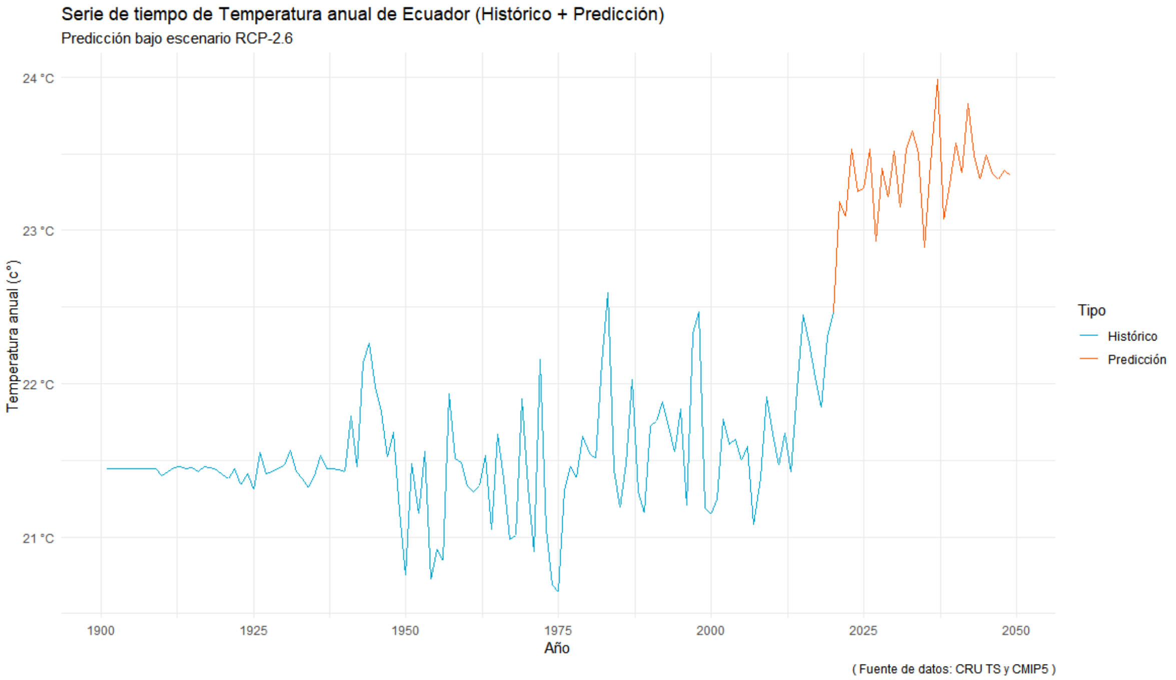
Melting of glaciers, increase in temperatures and increase in extreme precipitations are the trends that have been observed in various regions of Ecuador. The following list is based on information from the National Communication of the Republic on:

- Increase of temperatures, according the data from 14 stations located in different geographical regions of Ecuador (for example, change in the average temperature of 1.5°C at the Cotopaxi station during the 1901-2002 period). The rural coastal area does not show a clear positive trend in terms of temperature; however, the urban coastal area shows a growing trend in terms of average and extreme temperatures (between 0.5 and 1°C in the case of the average temperature).It has also been observed that there is a growing trend in the increase of temperature in hydrographic basins.
- There is no clear trend in the changes in precipitation at a national level, but a major inclination towards a reduction of precipitation has been observed, especially on the coast. Also, a positive trend of extreme rains on the western coast of Peru and Ecuador has been observed (1961-1990).
- The length of glacier 15 on Mount Antisana has decreased gradually from 1956 to 1998. More than 4,555 meters above sea level the glacier cover has decreased from 70% to 54% during that period of time. The El Niño – Southern Oscillation (ENSO) events of high intensity tend to decrease the value of the balance of the glacier mass on Mount Antisana; however, during the La Niña events, the value of the balance of the glaciers mass tends to stabilize and even become positive.
- There are increasing tendencies of cold nights in northern Peru and Ecuador, possibly related to the increase in the maximum length of dry period in this region (1961-1990).

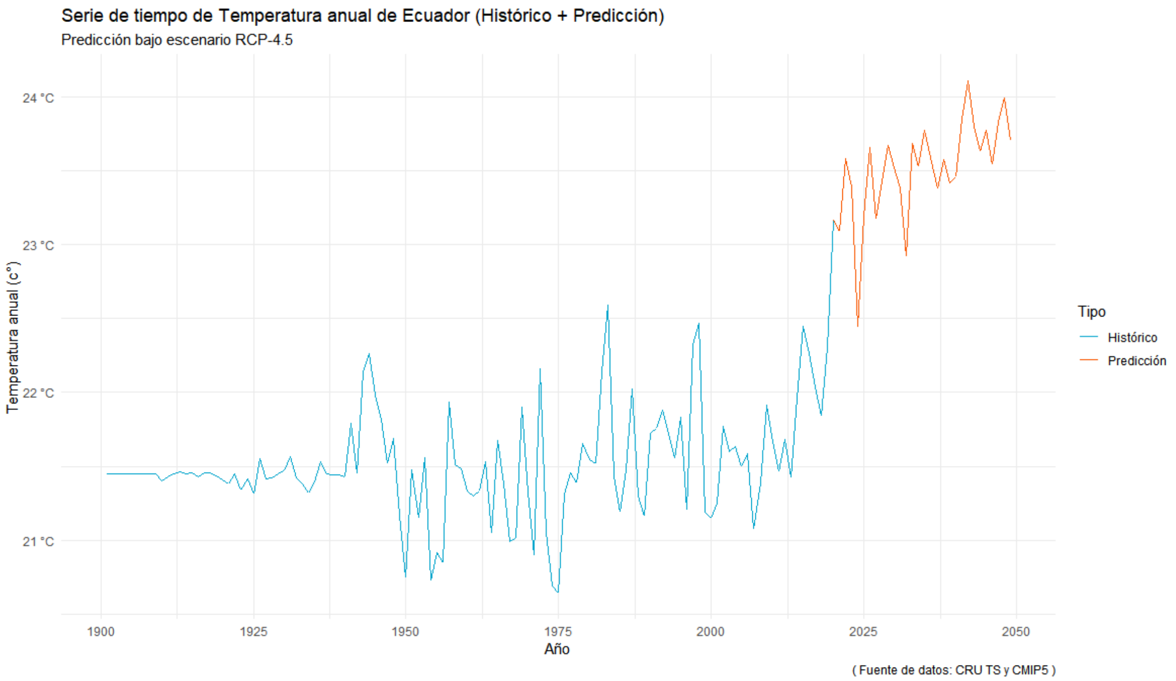
5.1.1.1 Temperature

For this analysis, the historic temperature (in degrees C) from the Climate Research Unit (CRU) and East Anglia University have been used, where the data is generated from thousands of meteorological stations around the world and collects temperature and precipitation observations in a recording period of 1901 – 2019.

The projected temperature data (in °K) used for the analysis come from the CMIP5 (Coupled Model Intercomparison Project Phase 5). The scenarios taken into consideration here are RCP-2.6, RCP-4.5, RCP-6.0 and RCP-8.5. The numbers attached to the RCP represent the global average radiative forcing in watts per square meter reached in each of the scenarios by 2100. The models that were taken into account were the models generated by NASA's Goddard Institute for Space Studies (GISS) for each scenario considered. The projections were carried out for the period 2020 – 2050.Figure1.Annual Temperature Time Series of Ecuador (Historical Plus Prediction), under RCP-2.6, RCP--4.5, RCP-6.0 and RCP-8.5 Scenarios

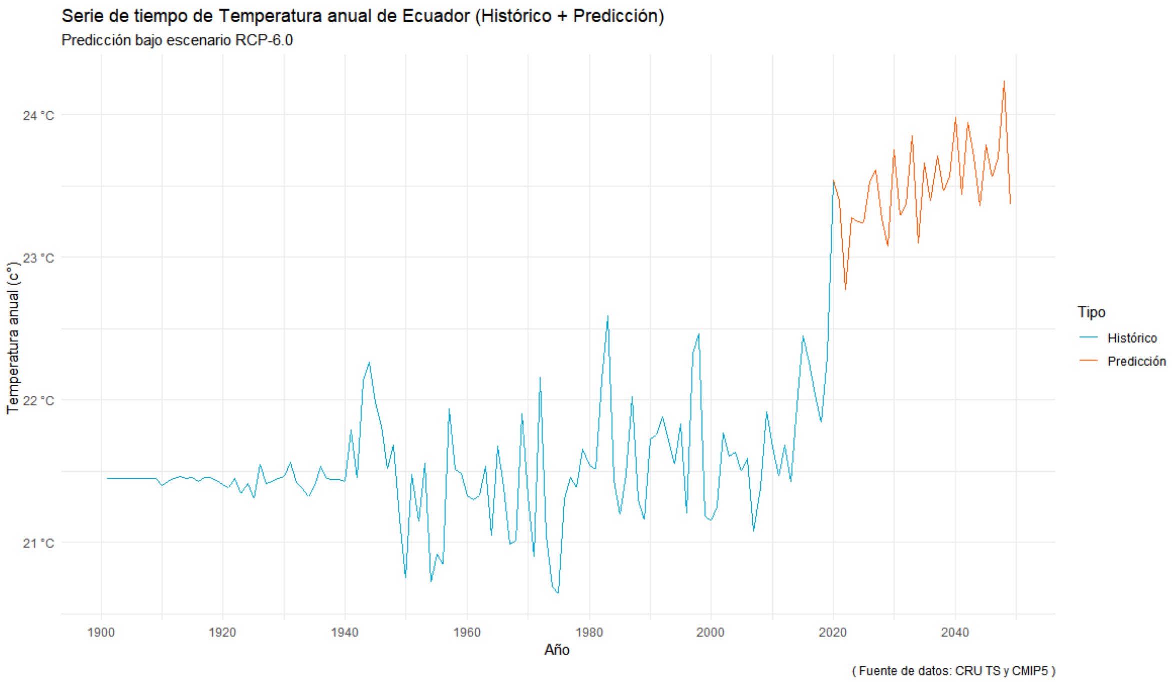


Annual Temperature Time Series of Ecuador (Historical plus Prediction)Prediction under scenario RCP -2.6Type, Historical, Prediction(Data Source: CRU TS and CAMP5)



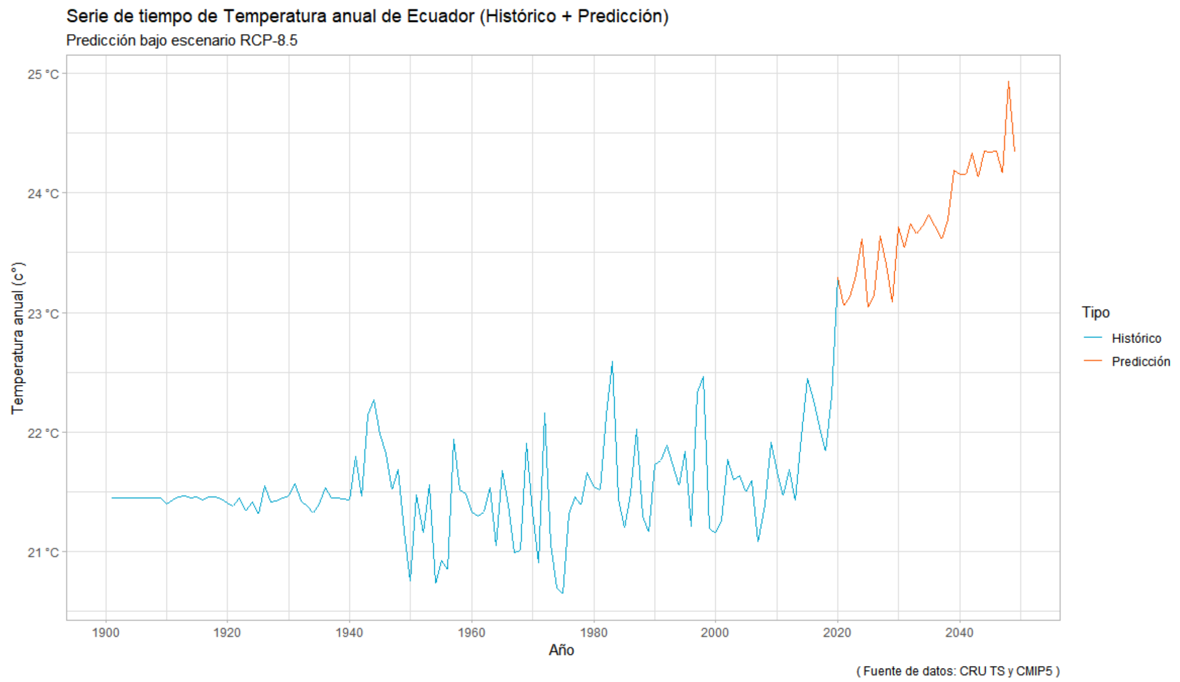
Annual Temperature Time Series of Ecuador (Historical plus Prediction)
Prediction under scenario RCP -4.5
Type, Historical, Prediction

(Data Source: CRU TS and CAMP5)



Annual Temperature Time Series of Ecuador (Historical plus Prediction)
Prediction under scenario RCP -6.0
Type, Historical, Prediction

(Data Source: CRU TS and CAMP5)



Prepared by: Ecosambito, 2020

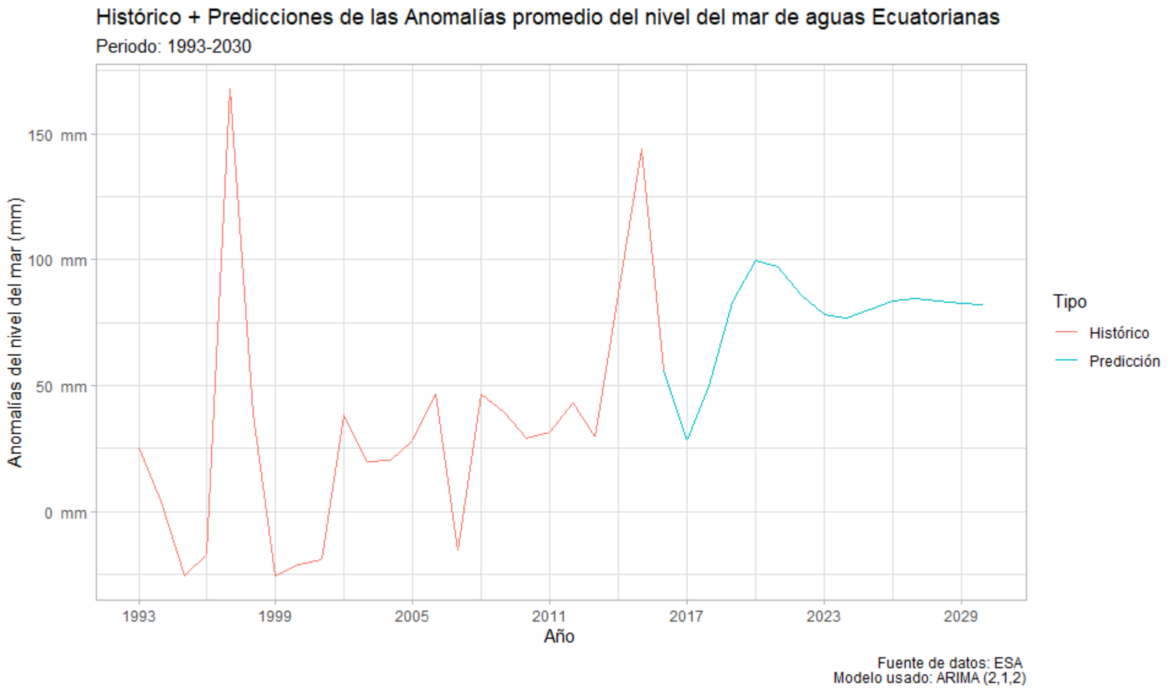
Annual Temperature Time Series of Ecuador (Historical plus Prediction)
Prediction under scenario RCP -8.5
Type, Historical, Prediction

(Data Source: CRU TS and CAMP5

Sea level anomalies

The sea level anomaly data (in millimeters) was produced by the *National Centre for Space Studies (CNES)* as part of the *Climate Change Initiative* on sea level from the *European Space Agency (ESA).* It contains a combined time series of monthly seal level anomalies that has been produced starting in satellite altimetry measurements. For the Ecuadorian coastal waters there are records of the anomalies from 1993 to 2015. The anomalies are comparisons carried out among satellite observation and a calculated historical average starting from the years 1900 – 1990.

Figure2. Time Series of Sea Level Anomalies IN Ecuadorian Waters



Historical + Predictions of Average Anomalies in Ecuadorian Waters Sea Level
Period: 1993-2030
Type: Historical and Prediction
(Data Source: ESA) Model used: ARIMA (2,1,2)
Sea level Anomalies (mm)

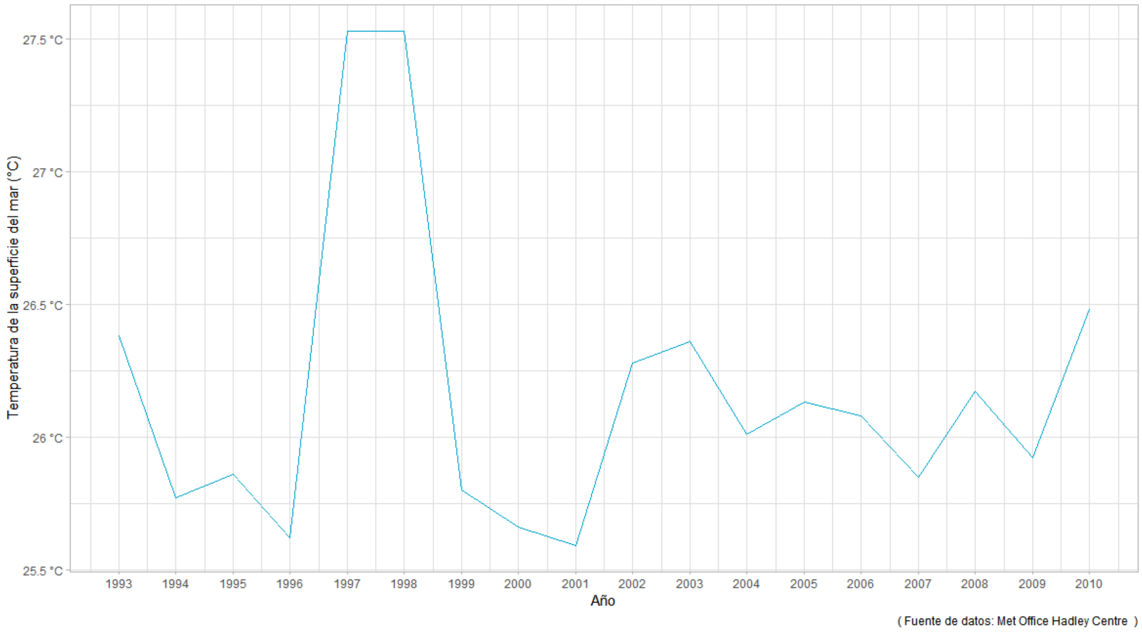
Prepared by: Ecosambito, 2020

In this case, a tendency can be observed in the increase of anomalies between 50 and 100 m.a.s.l. for the 2020 -2030 decade.

5.1.1.2 Sea temperature

The data on sea surface temperature (in °C) come from the *Met Office Hadley Centre* which gathers world sea surface temperatures. There are records for Ecuador from 1993 until 2010.

Figure3. Time Series of Sea Surface Temperature in Ecuadorian Waters



Temperature at Sea Level Surface
(Data Source: Met Office Hadley Centre)

Prepared by: Ecosambito, 2020

5.1.1.3 Impacts on Agriculture

The set of data for this section comes from *Global Agro-Ecological Zones 3.0 (GAEZ 3.0)* published by the *International Institute for Applied Systems Analysis (IIASA)* and *Food and Agriculture Organization (FAO)*. The data are represented as changes in the percentage of average potential performance (tons/hectare) from 1961-1990 in comparison with the projected potential performance (tons/hectare) for 2050. The data are separated according to performance based on high input agriculture or irrigation from rain or surface irrigation. For this analysis, the potential performance does not refer to the real performance or historical performance of the sector, but to the potential performance that there may be per hectare if applied to high input agriculture along with stream irrigation. The potential performance is calculated from various geographic variables pertaining to the study site. The model used for the projections to 2050 is from the *Canadian Centre for Climate Modelling and Analysis (CCCma) Coupled Global Climate Model (CGCM2) or its acronyms CCCMA CGCM2 A2*.

The projection of impacts is analyzed in this section, which is defined as the percentage of change in 2050 maize crop yields with regard to the historical average for the surface irrigation scenario and high input agriculture in planning zone 7 (El Oro, Azuay and Loja provinces) and Zone 4, Guayas. This, as a general impact indicator, that allows us to establish potential impacts on banana production, the main exportable product through Puerto Bolivar, and that, in the assessed areas, represent on average: Zone 7, <34% of the total national production and Zone 4, Guayas, with 22% of the national total (INEC, 2013).

Table2. 2009-2012 Annual Production (Thousands of Metric Tons)

Year/ Province	Los Ríos	El Oro	Guayas	Rest of the Country	National
2009	3,744.6	1,861.7	1,554.7	476.3	7,637.3
2010	3,887.1	1,892.6	1,719.4	432.0	7,931.1
2011	2,670.1	2,443.7	1,692.7	621.3	7,427.8
2012	2,753.7	2,269.9	1,585.1	403.5	7,012.2
Average (2009-2012)	3,263.9	2,117.0	1,638.0	483.3	7,502.1
Total National %	44%	28%	22%	6%	100%

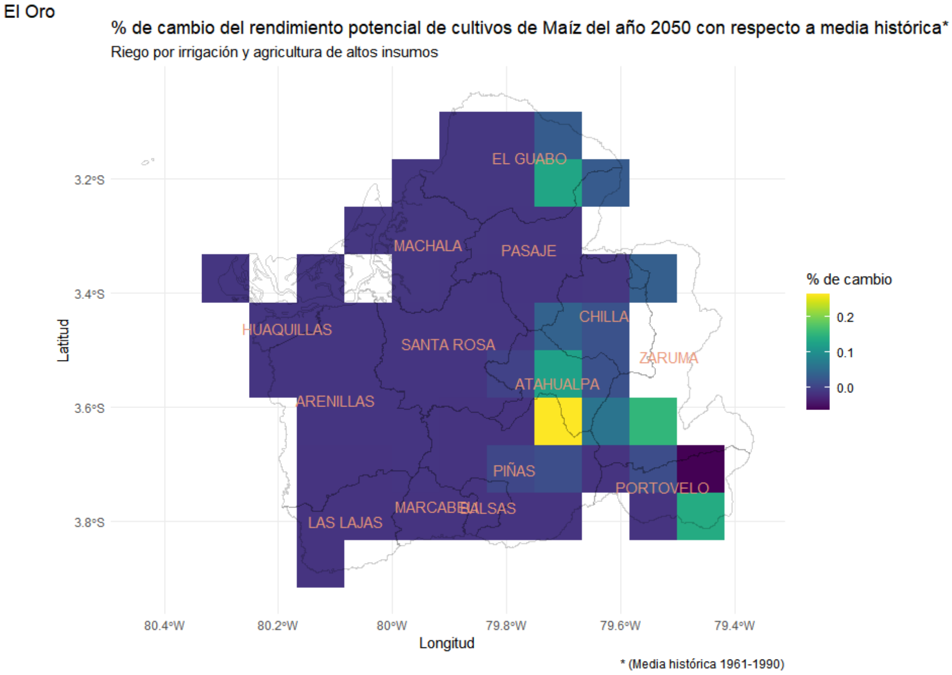
Prepared by: Ecosambito, 2020

The terms used are defined in the following:

Single Irrigation: It is a type of agriculture where controlled quantities of water are used on crops at the necessary intervals.

High input agriculture: Uses heavy equipment and large amounts of financial capital, fossil fuel, water, commercial fertilizers and pesticides to produce single crops, or monocrops.

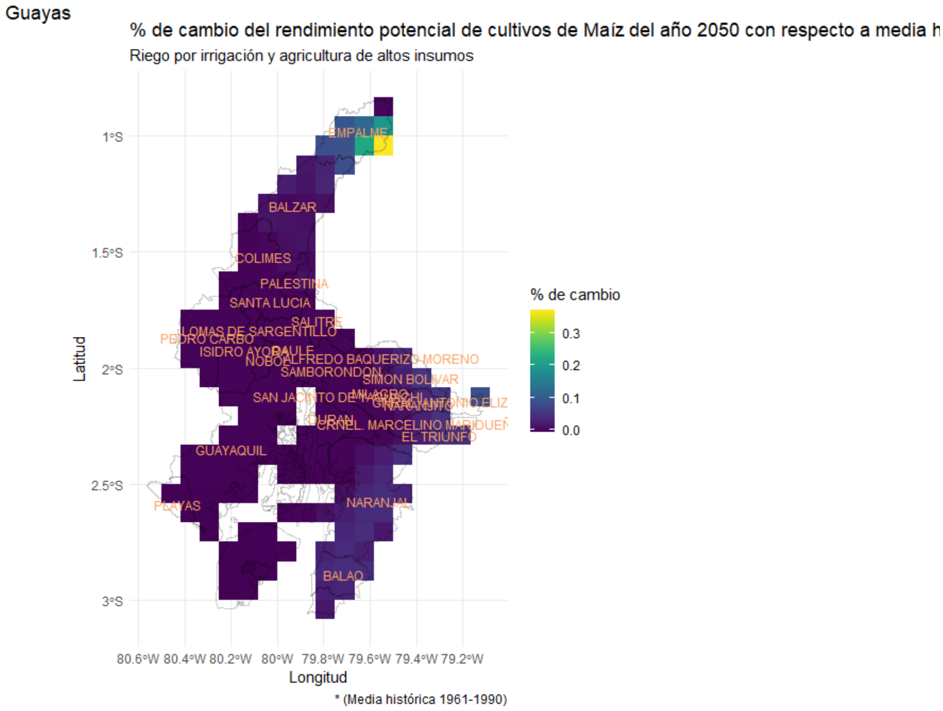
Figure4. Percentage of the Change in Corn Crop Output for 2050 with Regard to the Historical Average for High Input Agriculture in El Oro Province.



Percentage of Potential Corn Crop Output for 2050 Regarding the Historic Average.
Single Irrigation and High Input Agriculture Change % Latitude

Prepared by: Ecosambito, 2020

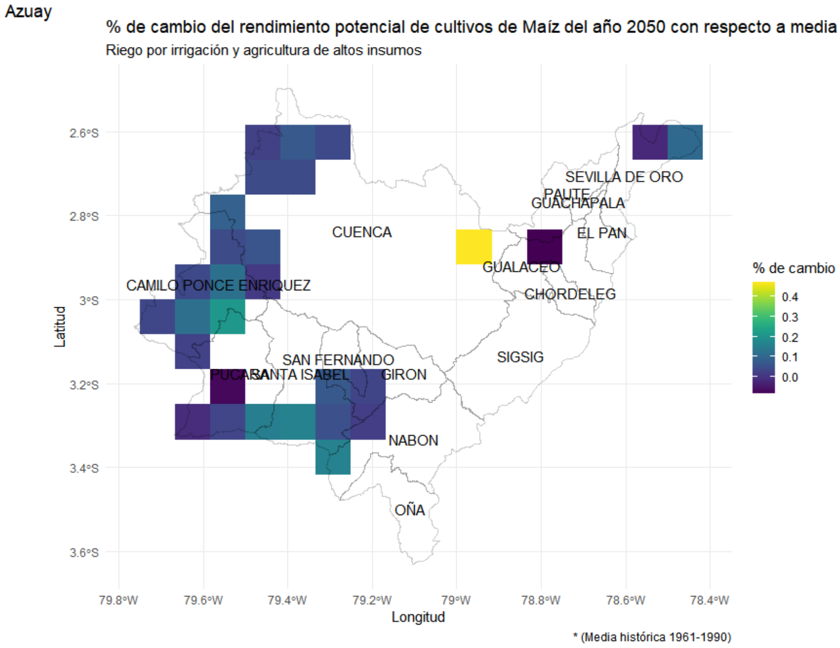
Figure5. Percentage of the Change in Corn Crop Output for 2050 with Regard to the Historical Average for High Input Agriculture in Guayas Province



Percentage of Potential Corn Crop Output for 2050 in Regard to Historic Media.
Single Irrigation and High Input Agriculture Change % Longitude

Prepared by: Ecosambito, 2020

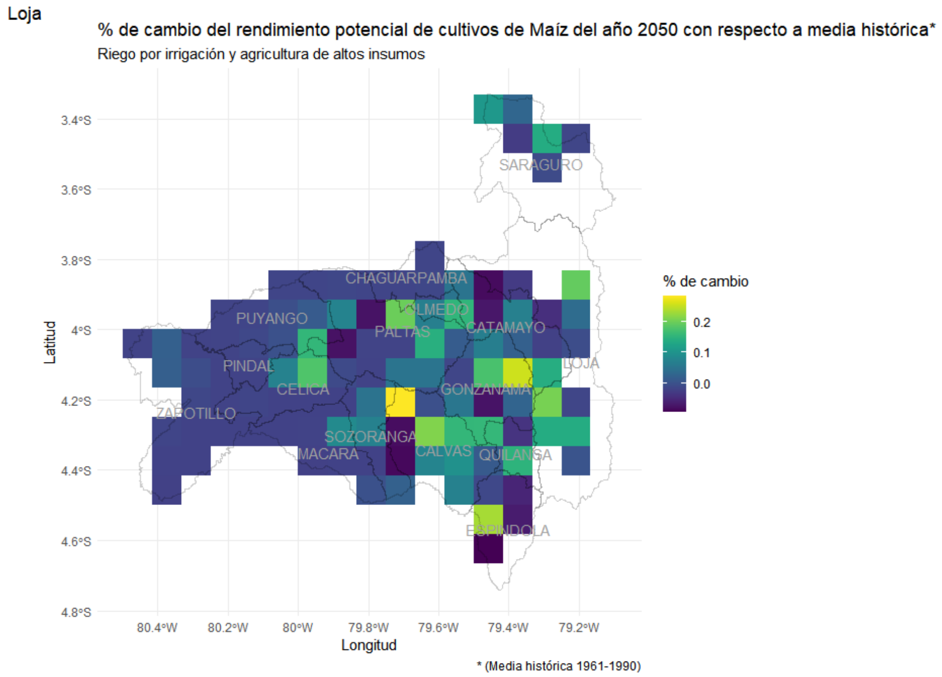
Figure6. Percentage of the Change in Corn Crop Output for 2050 with Regard to the Historical Average for High Input Agriculture in Azuay Province.



Percentage of Potential Corn Crop Output for 2050 Regarding the Historic Media.
Single Irrigation and High Input Agriculture Latitude Change % Latitude

Prepared by: Ecosambito, 2020

Figure7. Percentage of the Change in Corn Crop Output for 2050 with Regard to the Historical Average for High Input Agriculture in Loja Province.



Percentage of PotentialCorn Crop Output for 2050 Regarding the Historic Media.
Single Irrigation and High Input Agriculture
Latitude Change % Longitude
* (Historical Media 1951-1990)

Prepared by: Ecosambito, 2020

From this analysis, null impacts (0.0%) to positive (+0.1%) can be seen in a general way, which allows us to conclude that no impacts are expected on regional agriculture due to climate change.

5.1.1.3.1 Impacts on National Banana Production of

The sectoral study of climate change and sustainability of the banana in Ecuador (Elbehri, Calberto, Staver, Hospido, & Skully, 2015) concludes that it is unlikely that climate change may represent a significant problem for banana production capacity in Ecuador from now until halfway through the century, even though climate conditions will be continuously less favorable for banana production. However, in the second half of the century, the increase in average temperatures will start to harm banana plants, and this means important changes in production will have to be made. Greater precipitation and the decrease of glacier buffer zones may result in an increase in the risk of floods and create problems for current water management systems. In this scenario, two adaptations are proposed:

i. Move banana production to higher altitudes, around 500 meters, to fully compensate the average increase of 3.3 °C as foreseen by the IPCC.

ii. Develop and adopt varieties adapted to high temperatures.

On the other hand, the change of precaution relative to the frequency and intensity of tropical storms has as a net impact in the long- term risk that tropical cyclones may cause damage in a lot of important banana production areas, specifically in Central America, the Caribbean, Philippines and part of southeastern continental Asia. The increase in risk may reduce or modify banana production investment in these areas. It may also likely cause an increase in the attraction of banana production in areas where the risk that tropical cyclones occur may be little of none, such as on the Pacific coast of Ecuador, Peru and Colombia.

At a local level, it is considered that the Ecuadorian coast has an ideal climate for banana production and the magnitude of the rise in temperature expected for 2030 and 2050 will not seriously affect its suitability. This scenario turns out to be favorable for banana production on the Ecuadorian coast. However, from a historic analysis of drops in banana production, four out of six cases of a decline in banana exports of Ecuador analyzed (between 1961 and 2011) are related to climate events that affected banana production and exports, mainly due to floods or low temperatures linked to El Niño and Niña events. After the climate events, commercial restrictions, specially from the European Union, and international price fluctuations are the direct cause of the variations in banana exports.

5.1.2 Climate Risk Index

Considering that the signs of an increase in climate change can no longer be ignored globally when addressing climate change related risks, Ecuador is not among the countries that are predicted to have had and/or will have the greatest impacts. According to *Global Climate Risk Index 2020,* a Climate Risk Indicator (CRI) was calculated for Ecuador for the period between 1999 and 2018 giving a score of 92.83 (putting Ecuador in the 100th place), while in 2018, the CRI for Ecuador is 97.00 (in position 112). This analysis is carried out taking into consideration the total amount of losses caused by meteorological phenomena: storms, floods and extreme temperatures, the number of deaths, total insured damages and economic damages (these two indicated in millions of inflation-adjusted USD) and movements of masses (due to heat waves, cold waves, and others) (Eckstein, Künzel, Schäfer, & Winges, 2019).

Table3. Climatic Risk Index (CRI) - Ecuador

			Ranking per Parameter			
Period Evaluated	**CRI Ranking**	**CRI score**	**Fatalities**	**Fatalities per 100,000 Inhabitants**	**Losses in Millions of Dollars**	**Losses per unit of GDP (%)**
1999-2018	100	92.83	69	84	86	117
2018	112	97	62	73	122	126

Source: Global Climate Risk Index 2020
Prepared by: Ecosambito, 2020

5.1.3 Acute Physical Risks

The acute physical risks identified for the projects are shown below:

5.1.3.1 River Flooding

The danger of river flooding is classified as high (according to the available information on modeled floods). This means that it is expected that potentially damaging and fatal river floods happen at least once in the next 10 years. This is connected to increase of daily precipitation and the number of intense precipitation days. The level of danger may remain similar in the long term when only climate change is taken into account.

5.1.3.2 Urban Flooding

There is a danger of urban flooding classified as high (according to the information available on modeled floods). This means that it is expected that potentially damaging and fatal river floods happen at least once in the next 10 years. This is connected to increase in daily precipitation and the number of intense precipitation days. In this scenario, a standstill of the land transport access roads and towards the port terminal due to floods may put the continuance of operations at risk.

5.1.3.3 Coastal Flood

There is a danger of coastal flood classified as high (according to information currently available). This means that it is expected that waves may occur that will be potentially damaging at least once in the next 10 years,.

5.1.3.4 Heatwaves

A danger of extreme heatwaves classified as high exists according to the information available. This means that it is expected that a prolonged exposure to extreme heat occurs at least once, causing thermal stress, in the next 5 years.

5.1.4 Chronic Physical Risks

5.1.4.1 Change in Precipitation Patterns Resulting in Drought or Hydric Stress

From a high-resolution model (20 km) a decrease of annual average precipitation for the end of the twenty-first century is projected with it also probable that the levels of precipitation from December to February (DJF) and March to May (MAM) increase by 3% to 5%, while it is probable that the temperatures in December to February (DJF) increase by 1°C in the 2030 -2049 period. For the June to August (JJA) period, it is probable that the levels of precipitation decrease by 3% and that temperatures suffer an increase of 1°C in the same period.

Increases for the frequency and intensity of extreme rain events on the north coast of Peru and Ecuador in the 2071 - 2100 period are projected (PRECIS, IPCC SRES A2 y B2).

5.1.4.2 Growing Average Temperature

According to the majority of scenarios from IPCC's *Global Climate Models*, annual average precipitation and temperature is expected to increase by 3% and between 2 and 3°C, respectively, in the 2030 – 2049 period. This is in comparison with the annual averages from the period 1980 - 1999. This represents increases in temperature substantially higher than the global average.

5.1.4.3 Sea Level Rise

The coastal area of Ecuador, and in particular the El Oro province, is highly vulnerable to natural hazards and to climate change due to the high population and infrastructure density, and its exposure to El Niño effects, sea level rise and river floods in general. This corresponds to what is established in the CLIMATE RISK MANAGEMENT IN ECUADOR (ArjunapermalSubbiah, 2013) document, where a sea level rise of around 10 to 20 cm is projected in the following 20 years along the continental area, with similar impacts as in the years 1982-83 and 1997-98 resulting from El Niño event.

5.2 Transition Climate Risks Identification

The risks related to climate can also be linked to the transition to a global economy with low carbon emissions. The most common are related to policies and legal actions, technological changes, market response and reputation concerns.

5.2.1 Risks Due to Policies Adopted by the Ecuadorian Republic

In its article 413, the Constitution of the Republic of Ecuador states that the State will foster energy efficiency, the development and use of environmentally clean and healthy practices and technologies, as well as renewable, diversified, low-cost energies that do not pose a risk to food sovereignty, ecological balance of ecosystems nor the right to water. In its article 414, it establishes that the State will adopt adequate transverse measures for climate change mitigation through the **limitation of emissions** of greenhouse gas, deforestation and atmospheric contamination. Measures will be taken to preserve forests and vegetation, and the population that is at risk will be protected. In article 415, the Constitution states that the Central State and decentralized autonomous governments shall adopt comprehensive and participatory territorial urban planning and land use policies that allow regulation of urban growth, urban fauna management and encourage establishing green areas.

Thus, there is a legal constitutional basis that makes the Ecuadorian State regulate and take actions on key issues related to sustainability and climate change, as well as mitigation and adaptation in the urban context.

The Environment Organic Code, CHAPTER II INSTRUMENTS FOR MANAGING CLIMATE CHANGE, in articles 250 – On the instruments and 251- Coordination and articulation mechanisms, states that managing climate change will be carried out according to policy and the National Climate Change Strategy, and its instruments that will be enacted and updated by the National Environmental Authority. This will be the entity that will coordinate with the prioritized intersectoral public entities for that purpose, and all the different levels of government, the formulation and implementation of policies and objectives addressing the effect of climate change. Also, it will safeguard its trasnverse incorporation in the programs and projects of such sectors through mechanisms created for such purpose.

The following Principles are established (Article 671) in the FOURTH BOOK. CLIMATE CHANGE, TITLE I. MANAGING CLIMATE CHANGE of the Regulation on the Environment Organic Code:

a) Self-management: Natural people or legal persons, either public or private, will develop their own actions to contribute to managing climate change aligned in compliance with national policies and commitments ratified by the State.

b) Co-responsibility: All natural or legal persons, public or private, have the responsibility of participating in climate change management according to what is established by the Constitution, Environment Organic Code and current regulation.

c) Benefit- effectiveness: Implementation of actions for managing climate change that bring greater social, environmental and climate change co-benefits will be a priority.

The selection of priority sectors for both adapting and mitigating climate change were already reviewed in section 3.1 of this document, and the general measures to adopt are described in sections 3.2, 3.3 and 3.4. While none of these lines of action directly implicate port activity, it does implicate it with respect to the repair and conservation of coastal-marine ecosystems, territorial planning and the farming sector.

There are also a series of international commitments and treaties aimed at conserving natural heritage and biological wealth of the ecosystems, as set up in the “National Biodiversity Strategy 2015-2030” (MAE, 2016) document, where commitments are present which have been acquired since 1975 (CONVENTION ON THE INTERNATIONAL TRADE OF ENDANGERED SPECIES, CITES) up-to-date.

However, since there is no secondary legislation yet and/or specific regulations for defining the objectives in the medium and long term, nor on the implementation and control mechanisms, the potential impact of these actions on the operation and performance of the Port Terminal is still uncertain.

5.2.2 Risk Due to Market and Technology

The changes in client demand (mainly from markets in developed or emerging countries) as an increase of product demand, and the associated logistics chain, with a lower carbon footprint, could affect operations or income of the Project, given that port activity decarbonization initiatives already exist in Ecuador. By mid-December, a milestone in the banana market was reached with the first container of Ecuadorian banana for exportation with a neutral carbon certificate of land and port logistics, achieved by Contecon[7], first terminal in America to comply with the ISO 14064 standard, and thus attracting Ecuadorian banana exporters, since it is recognized as a competitive advantage to enter the global market. The companies that took part in this milestone were SIIM / *Groupe Omer-Decugis* (banana distributor for the European market); *MSC Cargo*, leading company in transport of containerized cargo; and *Tropical Fruit Export*, important banana export group from Ecuador.

In this regard, the risk of not adopting measures for carbon neutrality or of adapting to climate change can result in a situation where the port will lose competitiveness, being less attractive than other existing logistics chain options. This is especially relevant when designing operations and defining the technology to adopt for a 5- to 20-year time horizon, since all new machinery acquisition and construction infrastructure should contribute to Port Terminal operations carbon footprint reduction and global sustainability.

5.2.3 Legal Risks

No current legal type of risk has been identified for the Project, considering that the physical climatic and transition risks of the Project have been evaluated, and a plan for its mitigation is proposed.

5.2.4 Reputation Impact Risk

From the beginning, the public-private partnership contract between APPB and YILPORTECU has had, on one side, a strong resistance from stakeholders and exporters from the banana sector and carriers that make comparisons between the previous management of APPB and the current one, due to the service and rate changes as well as control standards and terminal access procedures. Additionally, at the start of YILPORTECU operation, there was a negative perception, mainly from some social actors, part of the shrimping community and artisan fishermen. This negative perception was not based on any technical basis with regard to the dredging operations. After YILPORTECU carried out various monitoring and sediment dispersion studies, contributing to verifiable technical information, the negative perception of these actors diminished considerably.

Avoiding possible impacts on the reputation of the Project implies the need for adopting measures that minimize the risks perceived by different stakeholders through public consultation and socialization, pursuant to provisions in the Environmental Management Plan.

6. Physical Climate Opportunities

The TCFD defines “climate related opportunity” as “possible positive impacts related to climate change within an organization” and highlights that the opportunities “vary according to the region, the market and the industry in which an organization operates". Three major types of opportunities related to physical climate are identified.

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[7]Contecon Guayaquil S.A. is the operator of Containers and Multipurpose Terminals of Guayaquil Seaport “Libertador Simón Bolívar”.

For the case of the Puerto Bolivar Port Terminal, taking into consideration that its main competitor for port services is located in the city of Guayaquil (MTOP, 2018), which in 2018 covered 84.2% of the total cargo exported (adding APG and TPH[8]), while APPB reached 13.9%; and that, precisely the city of Guayaquil has been identified as one of the 20 main coastal cities with major loss in 2050, assuming the SLR-1 scenario, sinking and optimistic increase of sea level (Stephane Hallegatte, 2013), an opportunity for receiving additional exportation cargo (mainly banana) and a new import destination is set up if current conditions foreseen for Guayaquil persist.

In this scenario (SLR-1), the port services offered by Puerto Bolivar, considering that it is not affected – or at least not in the same magnitude as Guayaquil and its ports – has the opportunity to contribute with a vertical type solution (that adapts to specific commercial sectors) in the medium and long term. The adaptation that the banana sector adopts to ensure sustainability under the same scenario will play a major role.

The design and/or planning of this solution should lie in the conversion of the logistic chain to a sustainable source wherein the Port Terminal serves as an anchor for transforming the regional logistic sector.

7. Adopted Measures

In this section, the measure and/or actions adopted by YILPORTECU are described that aim at preventing the risks already identified.

7.1 Processes and Systems

The processes and systems are implemented to ensure that this happens.

• How realistic are these plans/process/systems?

• How effective are these plans/ processes/systems expected to be?

- In the design of new berthing facilities and cargo storage yards, drainage and sewage systems, it takes into account a flood stage 0.5 m above existing facilities.
- Acquisition of port power sourcing equipment that enables energy transition to a clean source for port operation.

8. Recommendations

it is recommended that the following measures be adopted to reduce greenhouse gas emissions that generate climate change, achieving more resilience to it expected effects, and in general, to be capable of adapting to the challenges in the short and medium term.

8.1 Pre-design Stage

- Measure and estimate carbon footprint on projects and include this valuation in the analysis of alternatives, considering at least *Scope 1* + *Scope* 2.

[8] Autoridad Portuaria de Guayaquil and Authorized Port Terminals

- Analysis and selection of materials and supplies with a lower carbon footprint, through life cycle assessment (LCA) considering a "*cradle to cradle*" life cycle.
- Include an ecologic engineering team and/or criteria, whose role consists of preserving and developing biodiversity through adapted measures (assessments, publications, management) on the ecosystems potentially affected by its interventions.

8.2 Design Stage

- Design infrastructure with renewable energy sources, and collection and recycling of rain water and grey water.
- Design infrastructure that allows its environmental impact to be reduced throughout its life cycle by using photovoltaic and/or thermal technology integrated in buildings and dynamic glazing solutions, ventilated concrete floors (radiant floor) to generate a positive energy balance and work as energy hubs, that contribute with the power autonomy of insulated sectors, blue infrastructure, or other public use buildings.
- Include the implementation of ecological areas and maintenance of ecologic continuance within the conceptual design of the projects.
- Include alternatives for integrating biodiversity and urban agriculture in the projects with a certain impact on urban planning of the place (measurement of biodiversity potential of an urban project).The ecologic transparency works should be designed with the help of local naturalists, who will also be associated with supervision of biodiversity preservation measures.
- Include, whenever possible, elimination of waterproof surfaces, or the establishment of flood defenses at the project location.
- Adopt a strategy of gradual replacement of machinery for moving fossil fuel loads (cranes, container ships, loading platforms, cargo freight elevators and others) with machinery and equipment having power source technology.
- Implement facilities for electric energy provision by inclusing loading points for machinery and vehicles inside and/or outside the terminal.

8.3 Construction and Assembly Stage

- Foster circular economy through recovering and recycling waste from the operations (oils, filters, packaging, other), as well as recycling debris from demolition resulting from the project.
- Protect natural surroundings.
- Protect and include social fabric into Project considerations.
- Evaluate the use of hydrocarbon-based alternatives for transporting and evacuating construction materials and/or debris.

8.4 Operation and MaintenanceStage

- Support mangrove cleaning campaigns;

- Establish lines of withdrawal, buffer zones and urban protection borders;
- Reconfigure rain water drainage systems in the road network within port facilities;
- Adopt adjustment programs and policies that include studies on productive capacity.
- Ecological needs, assessment of climate change, monitoring and surveillance mechanisms.

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10. Annexes

ANNEX 1. Climate and Disaster Risk Screening Tools - Pto Bolivar

ANNEX 2. Climate Risk and Adaptation Country Profile - Ecuador

ANNEX 3. Think Hazard! Country Profile – Ecuador

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PUERTO BOLÍVAR PROJECT PHASE 1

– HUMAN RIGHTS RISK ASSESSMENT –

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

December 2020

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EXECUTIVE SUMMARY

This document establishes a risk assessment on human rights related to the activities of Yilport Terminal Operations. A human rights risk identification methodology has been used based on the United Nations Guiding Principles on Business and Human Rights, and in accordance with EP2: Environmental and Social Assessment.

After carrying out an initial identification of the threats to the human rights of the interested parties, identifying the related human rights, an assessment of the risks to human rights is carried out, considering the impact produced by the threat and its probability of occurrence. A qualitative assessment of the identified vulnerability is also presented. Then the risks are ranked from highest to lowest.

The results of the assessment show that there are present and potential risks, of medium and low magnitude, that can be managed with improvements in the activities, procedures, and protocols that Yilportecu has been developing. For this, corrective measures established as an Action Plan are included.

Finally, it is recommended to carry out a review of this human rights risk assessment every two years, or when a project generating substantial changes that require a review of this assessment is carried out.

HUMAN RIGHTS ASSESSMENT

Human rights are basic standards that have been established with the purpose of ensuring dignity and equality among people. Every human being is the holder of these rights by the simple fact of being, without any distinction of nationality, place of residence, sex, ethnicity, religion, language, or any other condition.

States are primarily responsible for guaranteeing human rights to all people. However, more and more private actors are taking initiatives to guarantee that human rights are fulfilled and promoted, within their organizations. This is because respect for Human Rights is not a passive responsibility, on the contrary, it requires establishing policies and processes that help identify, prevent, mitigate, and remedy the effects that may result from their violation. This responsibility applies to activities, operations, products, or services, and also to relationships with suppliers, customers, States. It is important to note that this responsibility applies to the broad spectrum of Human Rights.

In June 2011, the United Nations Human Rights Council approved the Guiding Principles on Business and Human Rights, which established a framework to “Protect, respect and remedy” that involves three aspects, i.e., the obligation of the State to offer protection against human rights violations committed by third parties, including companies; the obligation of companies to respect human rights; and better access for victims to effective remedies, both judicial and extrajudicial. These principles were enshrined as the global standard of conduct expected of all companies and all States in relation to human rights.

On the other hand, the Equator Principles, EP2: Environmental and Social Assessment, establish the need to evaluate the possible adverse impacts on human rights.

1. Methodology

In this document, the methodology established by CEADS & Deloitte (2016) has been adapted, which establishes, among other things, a matrix of Human Rights Risks, which has served as a basis for the identification of possible human rights risks, which then are evaluated based on Probability and Impact. Finally, the Vulnerability to the identified risks is also assessed, to propose improvements through an Action Plan.

1.1. Identification of risks.

The starting point for a risk assessment is identification, in which a list of applicable and relevant risks is obtained. In this instance, the analysis is made on the broad spectrum of risks that make up the universe and the risk profile of the organization. In this stage, the Human Rights Risks Matrix prepared by CEADS & Deloitte (2016) (ANNEX I) has been used.

1.2. Assessment Criteria.

The first activity within the risk assessment process is the development of a common set of assessment criteria. Risks and their associated opportunities are often evaluated by organizations in terms of degree, impact, and probability. The scales defined shall allow a significant differentiation to classify and prioritize risks.

1.2.1. Impact.

This refers to the degree to which a risk event could affect the organization. The impact assessment criteria can be financial, reputational, regulatory, health, safety, environmental, considering their influence on employees, customers, and suppliers. Companies typically analyze the impact of a given risk using a combination of the above considerations, as some risks may affect the company financially while others may impact reputation or health and safety.

Table 1. Value ranges for impact assessment

Impact (I)		
Description	**Definition**	**Value**
Extreme	• Economic loss above US$ 500,000 • Negative media coverage at the regional/international level • Loss of market share above 25% • Significant lawsuits and fines, imprisonment of executives • Severe injuries (including death) to employees or third parties • Loss of multiple experienced leaders	5
Major	• Economic loss from US$ 100,000 to US$ 500,000 • Negative media coverage at the national level with long-term impact • Loss of market share of up to 10% • Regulatory demands that require a significant corrective project • Inpatient clinical treatment for employees or third parties • Loss of certain executive levels, high turnover of experienced personnel. Lack of perception as a differential employer	4
Moderate	• Economic loss from US$ 25,000 to US$ 100,000 • Negative media coverage at the national level, medium-term impact • Regulatory demands that require immediate corrections • Outpatient clinical treatment for employees or third parties • High staff turnover, adverse work environment	3
Minor	• Economic loss from US$ 5,000 to US$ 25,000 • Damage to reputation at the local level • Regulatory fine • Minor damage caused to employees or third parties • Unfavorable working climate, increased turnover	2
Low	• Economic loss below US$ 5,000	1

Impact (I)		
Description	**Definition**	**Value**
	• Impact on local media easily remediable • No relevant impact on the health of employees or third parties • Lack of satisfaction in staff not generalized.	

Source: CEADS & Deloitte (2016)

1.2.2. Probability.

This presents the possibility for a certain event to happen. It can be expressed using qualitative terms (frequent, probable, possible, infrequent), as a percentage of possible occurrence, or as a frequency.

Table 2. Value ranges for probability rating

Probability (Po)				
Annual frequency		**Probability**		**Value**
Frequent	Once a year	Almost certain	90% or more	5
Probable	Once in 2 years	Probable	65% - 90%	4
Possible	Once in 5 years	Possible	35% - 64%	3
Unlikely	Once in 10 years	Unlikely	10% - 34%	2
Rare	More than 10 years	Rarely	Below 10%	1

Source: CEADS & Deloitte (2016)

1.2.3. Vulnerability.

This refers to the susceptibility of the company to a risk event in terms of its preparation to face it. The vulnerability assessment allows organizations to measure how well they are managing their most relevant risks. Vulnerability assessment may include the company's ability to anticipate events through, for example, scenario analysis, ability to prevent negative events, ability to respond and adapt quickly as events unfold.

Table 3. Value ranges for vulnerability rating.

Vulnerability		
Description	**Definition**	**Value**
Very high	• There are no planned scenarios • Lack of capacity at the company or process level to address risks • Undeveloped risk responses • Lack of contingency or crisis management plan	5
High	• There are only planned scenarios for strategic risks	4

Vulnerability		
Description	**Definition**	**Value**
	• Low capacity at the company or process level to address risks • Responses to risk are partially developed • Existence of contingency or crisis management plans with partial or limited coverage	
Medium	• There are scenarios developed that include sensitivity analysis and stress tests. • Medium capacity at the company or process level to address risks • Responses to risk are implemented and oriented to cover the control objectives for the majority of the occasions. • Existence of contingency or crisis management plans implemented with some level of tests conducted.	3
Low	• Strategic options have been defined • Medium/high capacity at company or process level to address risks • Responses to risk implemented and aimed at meeting control objectives, except for extreme situations. • Existence of comprehensive contingency or crisis management plans implemented with some level of tests conducted.	2
Very low	• High capacity at the company or process level to address risks • Existence of redundant risk response mechanisms implemented and periodically assessed in relation to the most critical risks • Existence of contingency or crisis management plans implemented and periodically assessed	1

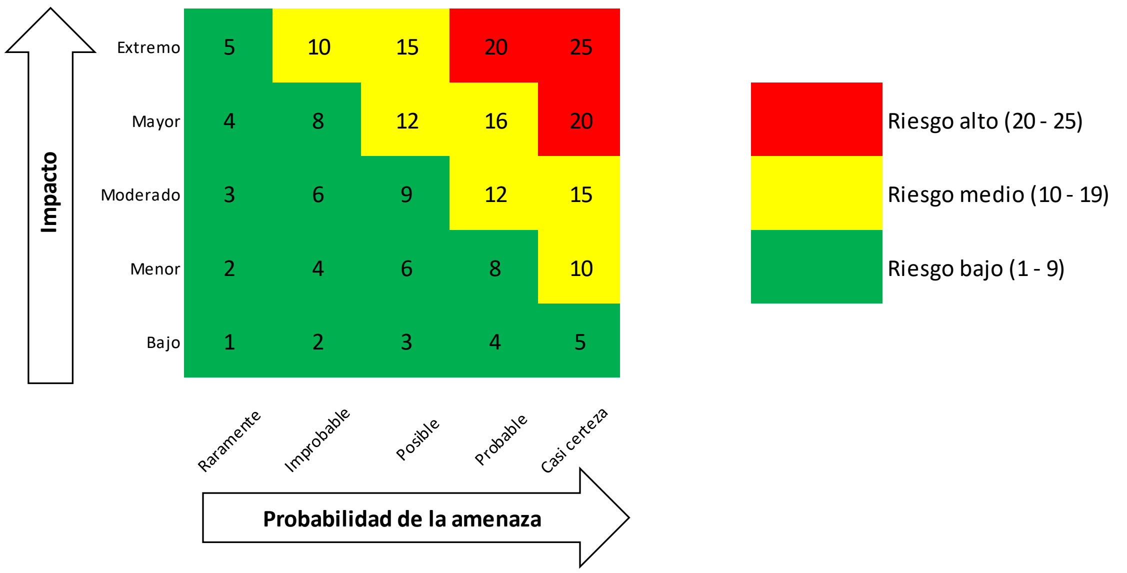
Source: CEADS & Deloitte (2016)

1.3. Risk assessment

This consists of assigning a value to each risk, taking as a reference the criteria defined above. The assessment can be carried out in two stages where initially a selection of the risks is made using qualitative criteria, followed by a more quantitative analysis of the most important ones.

Risk = Impact x Probability

Figure 1. Value ranges for impact assessment.



Legend:

Riesgo *= Risk;* ***Alto*** *= High;* ***Medio*** *= Medium;* ***Bajo*** *= Low,* ***Extremo*** *= Extreme,* ***Mayor*** *= Major;* ***Moderado*** *= Moderate;* ***Menor*** *= Minor;* ***Bajo*** *= Low;* ***Raramente*** *= Rarely;* ***Improbable*** *= Unlikely;* ***Posible*** *= Possible;* ***Casi Certeza*** *= Almost certain;* ***Probabilidad de amenaza*** *= Threat Probability*

Prepared by: Ecosambito, 2020.

Once the risk is obtained, a qualitative rating of the level of vulnerability is made, so that risk management priorities can be established.

1.4. Risk prioritization.

With the results of the assessment and based on the tolerance threshold defined by the management and taking into account the organizational objectives, the risks that need to be managed as a priority are defined. To do this, a prioritization list is presented that shows the threats to human rights, ordered from highest to lowest.

2. Human Rights Risk Assessment

The results of the risk assessment are shown in ANNEX 1.

3. Conclusions and recommendations

- 45 threats to human rights have been identified in the project activities. However, the assessment shows risks of low and medium level, mostly.
- A vulnerability assessment has also been established in which the existence or lack of response processes, procedures and protocols is analyzed, in order to be able to propose the corresponding activity that allows the improvement of this indicator.
- It is recommended to carry out this assessment every two years, or when carrying out major projects that cause changes in relationships with stakeholders and the community.

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5. Appendixes

Appendix 1. Human Rights Risk Assessment Matrix.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
PUERTO BOLÍVAR PROJECT
- PHASE 1

– PORT TRAFFIC ASSESSMENT –

Prepared for:

YILPORT TERMINAL OPERATIONS, YILPORTECU S.A.

Prepared by:

ECOSAMBITO C.LTDA.

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Traffic is one of the main components of port activity and mobilizes a diversity of both sea and land cargo. This assessment of port traffic makes a quantitative and qualitative analysis of this activity.

For this analysis, 3-year historical data have been taken as a basis, from 2017 to 2020 and provided by YILPORTECU, to describe the current traffic characteristics, trend to change, and forecast. For this forecast, two scenarios have been taken as a basis, one of which considers the expansion of the port capacity planned by YILPORTECU in 2030. In this analysis, the impact of activities during the construction of Dock 6 has also been considered.

PORT TRAFFIC ANALYSIS

Among port activities, both land and sea cargo transport must be evaluated in order to have accurate information that allows analyzing environmental impacts. These impacts will be influenced by the volume of cargo, the type of transport, the power used, the emissions generated, and the infrastructure on which operations are conducted. In general, both sea and land transport are linked to large consumption of fossil fuels, which causes an environmental impact, both globally (emission of greenhouse gases, particularly carbon dioxide), and locally (nitrogen oxides, sulfur oxides, noise, etc.). However, in recent decades, several shipping companies have been investing in reducing fossil fuel consumption and reducing carbon dioxide emissions.

Other expected impacts are those coming from the interaction of transport with the environment, such as traffic accidents. In the case of sea transport, we also have the discharge of bilge water, hydrocarbons, and a rise in sound pressure.

In this regard, it is very important to quantify the traffic generated by the Puerto Bolívar operation, characterize it, and be able to estimate its variation with future expansion.

1. Legal and institutional framework

The Constitution of the Republic of Ecuador (2008), in the transportation section, article 394 establishes that the state shall regulate land, air and water transportation and airport and port activities.

The Port System of Ecuador is regulated by national laws, regulations and municipal norms. The President of Ecuador acts as the highest body advising the National Council of Merchant Marine and Ports (CNMMP) which standardizes all public and private maritime and port activities. The General Directorate of the Merchant Marine (DIGIMER), an entity under the General Command of the Navy, oversees compliance with the regulations determined by the CNMMP and related laws, regulations and international conventions.

The legal framework is composed of laws that regulate all port activities and maritime and river terminals, such as the General Ports Law, the National Port Administrative Regime Law, and the General Regulations for Port Authorities in Ecuador. Other laws in force that regulate marine traffic, port captaincy and other activities related to water transportation are the Maritime Police Code and the General Law of Maritime and River Transportation.

Ecuador exercises its sovereignty and jurisdiction over the extension of maritime space established by the United Nations Convention on the Law of the Sea (UNCLOS). Ecuador's maritime space is classified into: Inland Waters, Territorial Sea, Contiguous Zone, Exclusive Economic Zone, Continental Shelf, High Seas and The Area.

The Ecuadorian Navy is in charge of developing maritime capabilities and providing integral security of aquatic spaces, supporting national maritime development and public and State security. The geographical coverage of the Ecuadorian Navy includes the maritime space of the territorial sea, the contiguous zone and the exclusive economic zone, in addition to the fluvial coastal space of inland waters.

Of the Port Captaincies established in the Maritime Police Code, 3 are established in the Coast of the Republic: Port of Guayaquil, Manta and Puerto Bolivar. The purpose of the Port

Captaincies is to oversee the correct and safe navigation of all national or foreign vessels, to demand order, comfort and safety of passengers and crew members on board, to maintain order, morality and safety on beaches, docks and other maritime establishments and to collaborate with the National Defense within the limits of their respective jurisdictions.

The Capitanía Mayor de Puerto Bolívar has as its northern limit the mouth of the Tenguel River and to the south, Peru. With respect to the military naval nature, the captaincies depend on the Command of the Naval Zone to which they belong. The Maritime Police has jurisdiction over internal waters, territorial sea and platform. Ports, rivers and lakes are part of inland waters.

2. Sea traffic

The area of influence of Puerto Bolívar is very active in sea traffic. Thus, we can list 3 entry and exit points for vessels to and from Puerto Bolívar, through the Santa Rosa Channel.

Port Terminal of Puerto Bolívar (YILPORTECU).

- The Port Terminal has 5 docks totaling 920 meters of berthing line, which allows up to 5 merchant vessels to dock simultaneously.

Cabotage Pier (0.2 km South of YILPORTECU):

- Berth and operation of tourist sea transport cooperatives, towards the Jambelí beach resort.
- Berth and operation of Navy vessels.
- Berth and operation for Tugboats serving at the Port Terminal.

Huaylá estuary (1 km South-East of YILPORTECU).

- Private docks where more than 1200 boats dock and provide transportation and supply services to shrimp farms and carry out artisanal fishing.

The Ecuadorian Navy registers 540 active vessels (less than 10 GRT) in Puerto Bolívar, of which 43% is registered for fishing, while 54% is registered for cargo and passengers, and 3% is related to sport, recreation, and passenger vessels.

This port traffic analysis includes indicators that collect the movements of cargo and supply vessels, concerning vessels in port and on land (loading, unloading, transit and transshipments), stopovers of merchant vessels (docking and undocking), passengers (docking and undocking), fishing (fresh fish catch) or number of active vessels.

2.1. Port Terminal of Puerto Bolívar (YILPORTECU).

In the sea traffic statistics of the Port Terminal, there are several important data with which it is expected to describe the characteristics of port traffic.

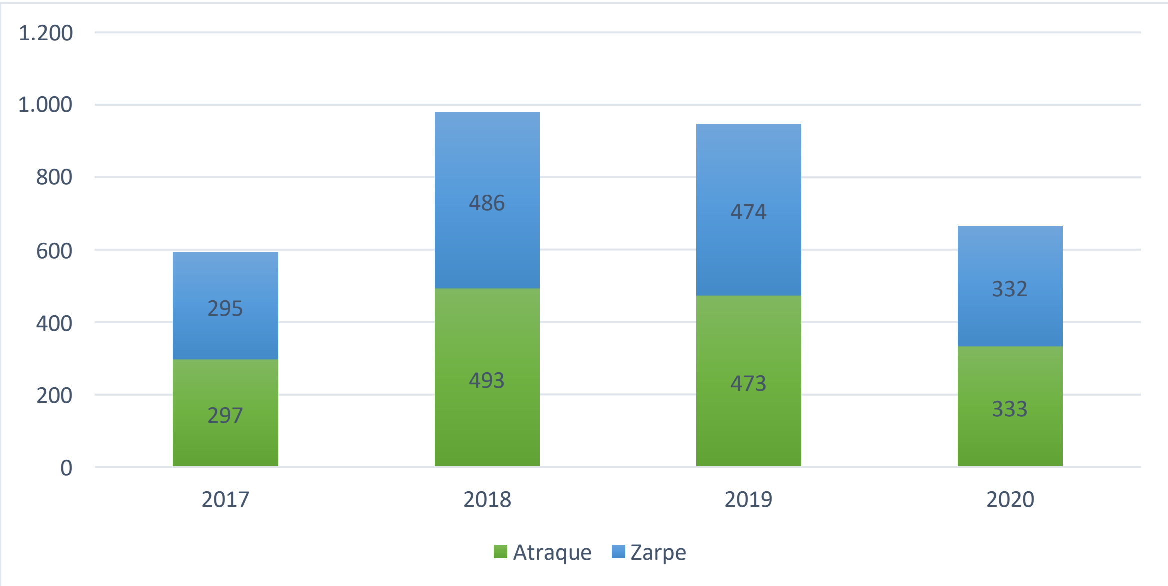
Time spent in port.

The first quantification is carried out through the berthing and departure data.

Berthing is the operation of mooring a vessel at an allotted place. Departure is the departure of a vessel from the port to the sea or another port. Both data represent the direct sea traffic produced by Yilportecu, on its sea environment.

The following graph shows the annual berthing and departure values for the period analyzed. The data in 2017 are shown as of March, while the data in 2020 are up to September.

Figure 1. Accumulated Annual Port Sea Traffic



Berthing Departure

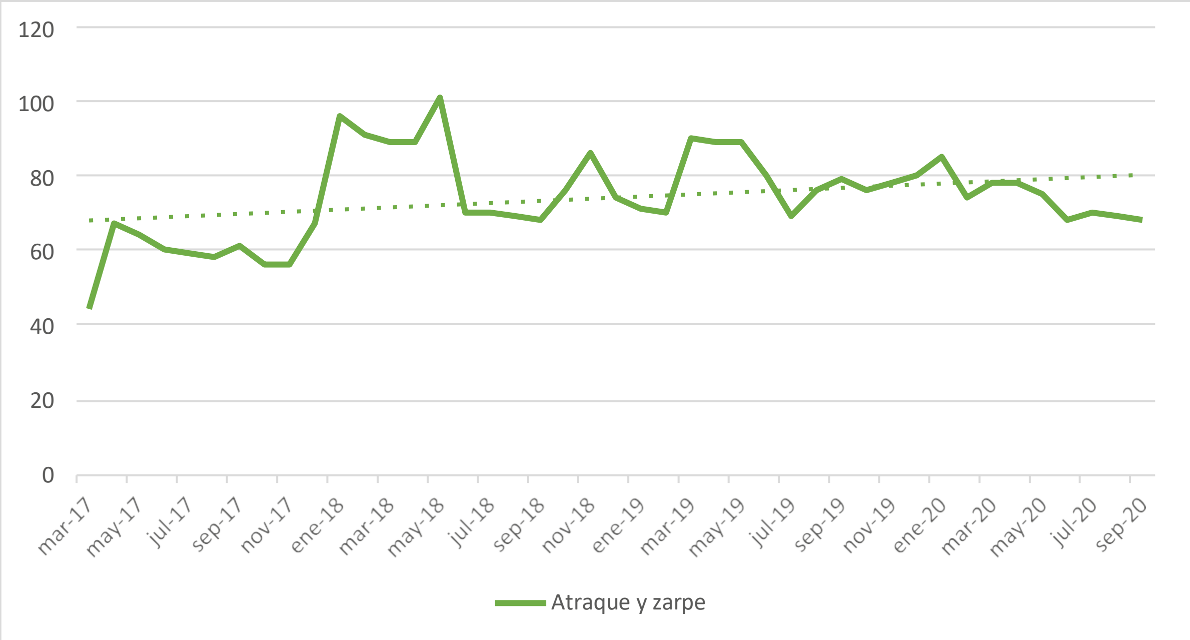
Source: Yilportecu S.A.
Compiled by author

Due to the fact that the annual data available are not complete in 2017 and 2018, it is more useful to carry out an analysis of the monthly movements during the period analyzed.

The graph below shows the entrances and exits of vessels to and from the Yilportecu docks in the analyzed period. The dotted line shows a trend of slight increases in these monthly movements.

Please note that each movement of a cargo vessel is accompanied by the movement of at least two tugboats. The port terminal is serviced by four tugboats.

Figure 2. *Monthly Sea Port Traffic, total entries and exits of vessels.*



Berthing & Departure

Source: Yilportecu S.A.
Compiled by author

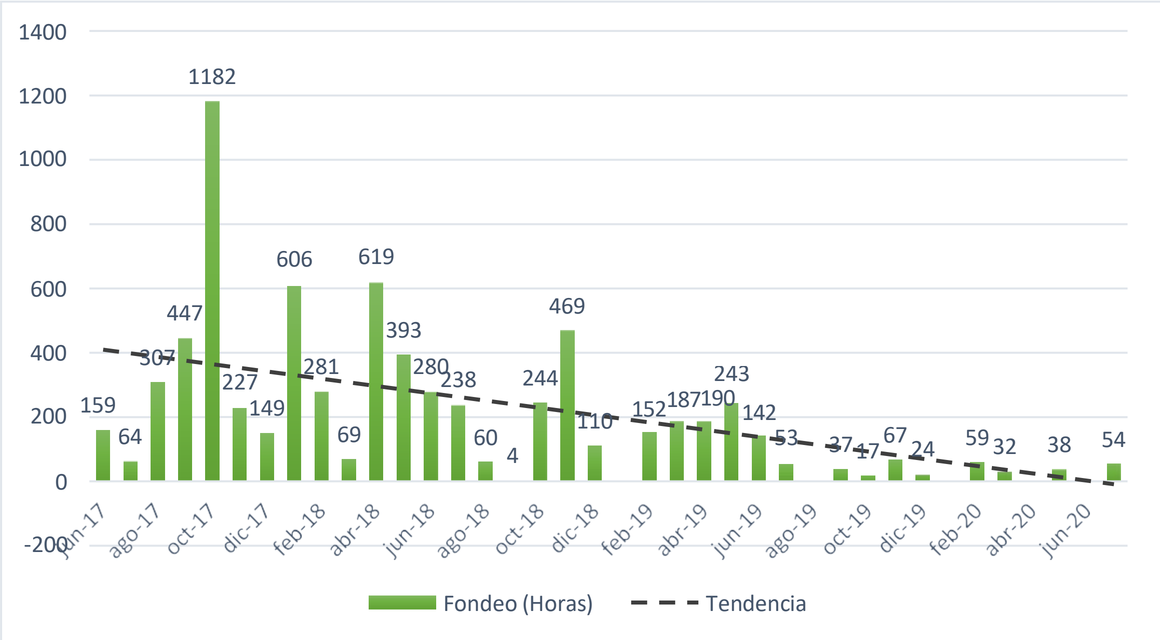
It is expected that an expansion of the capacity of Yilportecu's operations will emphasize the trend of increasing port sea traffic. However, the trend of world sea traffic is oriented towards the use of a smaller number of vessels, but each one of them with a greater loading and transport capacity. Thus, even if sea traffic increases, the number of vessels entering Puerto Bolívar will tend to decrease.

Stay Time and Anchoring Time.

The anchoring time is an indicator of the time a vessel is anchored in waters close to the port. The stay time refers to the permanence of a vessel, berthed at the dock.

While a vessel is in port, either anchored or berthed, it keeps its support systems operational, which results in an increase in emissions, noise and the probability of spills, accidents, etc. For this reason, these indicators should be at acceptable levels.

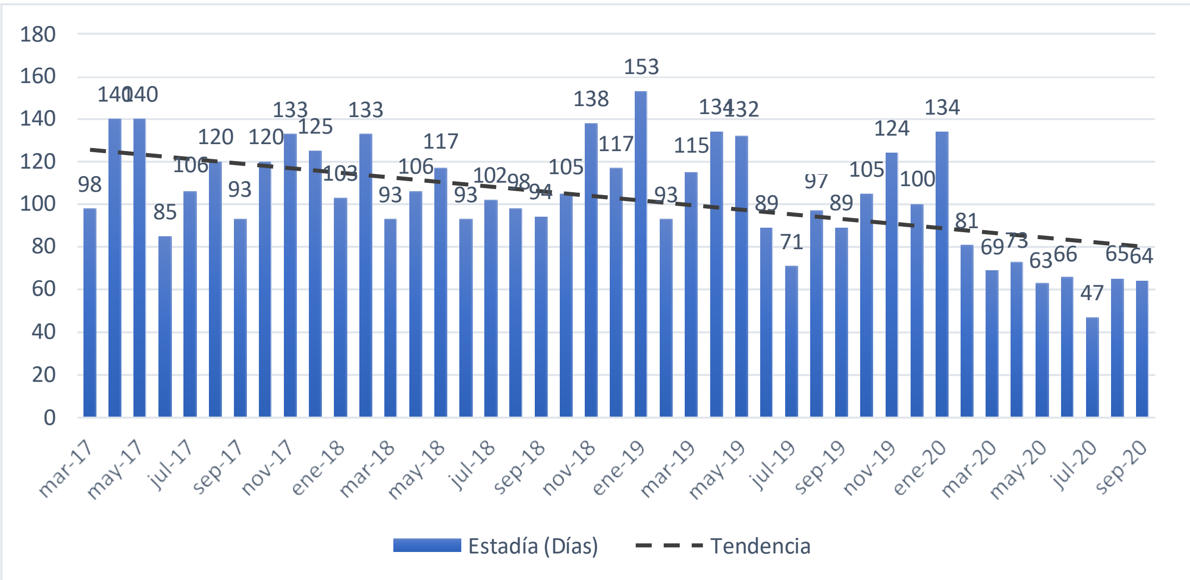
Figure 3. *Total anchoring time of vessels, monthly*



Anchoring time (Hours) **Trend**

Source: Yilportecu S.A.
Compiled by author

Figure 4. *Total stay time of vessels, monthly*

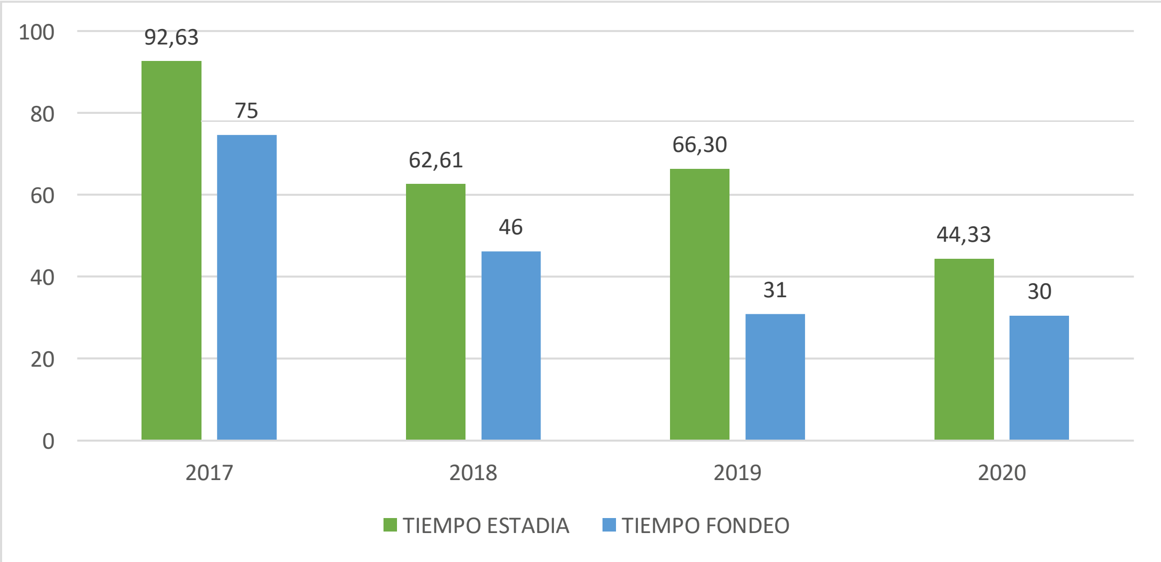


Stay Time (Days) **Trend**

Source: Yilportecu S.A.
Compiled by author

The data show a clear trend towards a decrease in the stay and anchoring times of the vessels, which indicates a greater efficiency in the logistics management of the port.

Figure 5. *Stay and anchoring times of vessels, annual average (hours)*



STAY TIME **ANCHORING TIME**

Source: Yilportecu S.A.
Compiled by author

This significant improvement in the stay and anchoring times can be an advantage in terms of environmental impacts of the port operation, since a decrease in the hours-year of stays of vessels in the vicinity of the port are manifested in fewer environmental impacts, particularly in the air quality of the area of influence.

2.2. Tourist traffic: Puerto Bolívar cabotage pier.

There are two tourist transport cooperatives that operate from the Cabotage Pier: Cooperativa “31 de Julio” and Cooperativa "Rafael Morán Valverde", each one has 15 registered vessels.

These 30 vessels, with capacity for 43 passengers each, carry out the passenger transport to Jambelí Island, taking approximately 40 minutes.

The tours take place throughout the morning, from the Puerto Bolívar cabotage pier to Jambelí Island. In the afternoon, from 3 PM, the tours get back to Puerto Bolívar.

The data on the frequency of trips, provided by Betty Sánchez, Manager of the Rafael Morán Valverde Cooperative, in an interview on November 2, 2020, are shown in Table 1. These data are estimates of the activity of the tourist vessels of two cooperatives in 2019, since, in 2020, due to the health emergency, transport restrictions and capacity limits were imposed and significantly decreased tourist mobilization towards Jambelí Island.

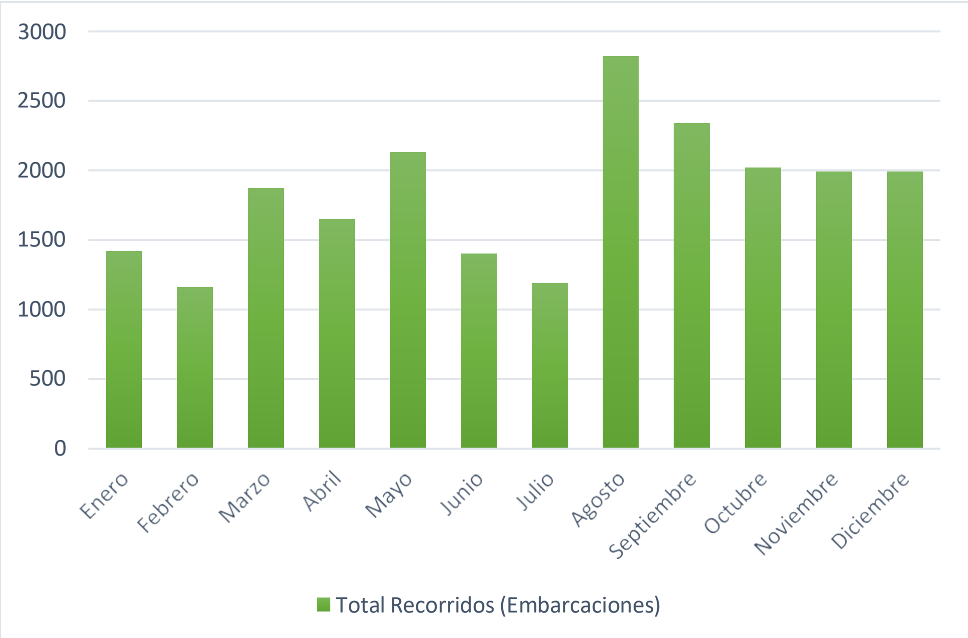
Table 1. Trip Schedule of Tourist Transport Routes, Annual Estimate 2019

	January – March	**August – September**	**April – July October – December**
Monday to Friday	10	60	10
Saturday and Sunday	120	120	120
Holidays		240	

Source: Cooperativa Rafael Morán Valverde
Compiled by author

According to the information provided by the tourist transport cooperatives, the annual behavior of this traffic is represented in Figure 6.

Figure 6. *Puerto Bolívar Tourist Traffic, monthly estimate 2019*



Total Number of Trips (Vessels)

Source: Cooperativa Rafael Morán Valverde
Compiled by author

2.3. Fishing traffic: Huaylá estuary and Puerto Bolívar Cabotage Pier.

According to data from the Port Authority of Puerto Bolívar, there are a total of 291 vessels registered in Puerto Bolívar for fishing operations. The vast majority are concentrated in commercial and private docks located in the Huaylá estuary, south of Puerto Bolívar.

However, a vessel count carried out on Sunday, November 1, 2020 from 6:00 AM shows the following data:

Table 2. *Census of vessels in the Huaylá estuary and the Cabotage Pier.*

Type of vessel	Number
Bongo boats	21
Wooden boat	30
Fiberglass boat	943
Industrial vessels	84
Shrimp 'Faluchos' (cargo boats)	109
Barges	20
Logistic vessels	13
TOTAL	**1.220**

Source: Ecosambito C. Ltda.
Compiled by author

2.4. Interactions between different types of vessels

Although there is high maritime traffic in the areas surrounding the areas occupied by vessels entering, maneuvering and leaving the Port Terminal, there are no reports of negative interactions between these vessels and vessels engaged in fishing, tourism or other types of transportation.

In the event that private vessels are located in a place that hinders the maneuvering of merchant vessels, the established procedure is as follows:

- In case of irruption or blockage of the access channel or maneuvering area, it will be assisted with the own vessel to communicate to the vessel that it is in a vessel transit zone and request the withdrawal.
- If necessary, the event will be reported to ECU 911, from where the Captaincy of Port Bolivar will be informed for intervention.

3. Land Traffic

It consists of the internal land transport of cargo, in the case of export, from the origin of the cargo to the port, and in the case of import, from the port to its destination. As it is a mainly banana trading port, the cargo comes from different parts of the province, both from banana farms and from collection sites. In addition, there is an important commercial interaction with neighboring provinces in the southern part of the country: Azuay, Loja, and Zamora. Growing mining production further increases cargo movements from neighboring provinces.

Below, the provincial and cantonal road network is described, through which cargo transport is carried out, to and from the Port Terminal.

3.1. Provincial and cantonal road network.

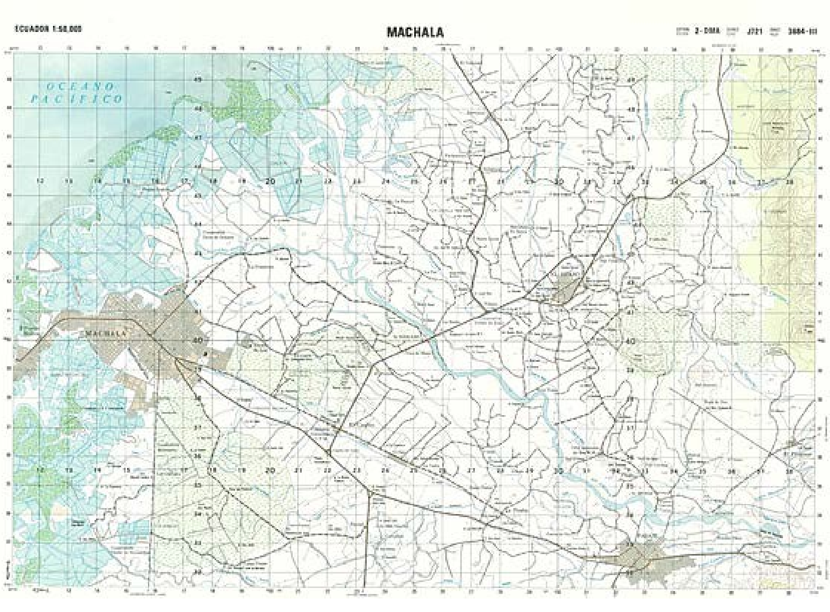
The road network in the province of El Oro is made up of a total of 3,036.70 kilometers, of which 389.88 kilometers correspond to the state road network and 2,646.82 kilometers to local roads. The state road network is, in turn, made up of 212.09 kilometers of arterial corridors and 177.79 kilometers of collector roads (Plan Vial Participativo de El Oro [Participatory Road Plan of El Oro], 2003).

In the arterial corridor axis, 99.43 kilometers correspond to the Troncal de la Costa road that crosses the province from north to southwest, connecting the province to the north with the canton Ponce Enríquez of the Province of Azuay and to the Southwest with Peru.

The Troncal de la Costa road crosses the cantons of El Guabo, Machala, Santa Rosa, Arenillas and Huaquillas; from which there are two secondary axes that link other cantons of the province. The first secondary axis crosses the cantons of Arenillas and Las Lajas, connecting the province with Loja. The second axis crosses the cantons of Santa Rosa (La Avanzada), goes to the Zaracay parish of the canton of Piñas, dividing into two branches, one of which crosses the canton of Balsas and connects with the province of Loja and the other passes through the cantons of Portovelo and Zaruma.

The main cantonal road network (1st order: more than 2 lanes), directly connects the cantons of Pasaje, Santa Rosa and El Guabo with paved roads and average distances of 12 km. The minimum distance is 8 km to Pasaje, followed by 9 km to Guabo and the longest distance corresponds to 22 km to Santa Rosa. The main roads amount to 70 km with asphalt roads. The 2nd order roads amount to an average of 30 km with paved and ballast roads. Depending on the connectivity, the population of the city of Machala shows a gradual growth in road traffic to Pasaje and high potential of traffic growth to Guabo. Furthermore, due to the existing settlements, provincial-level equipment and progressive growth of the city, potential traffic growth is expected to Santa Rosa.

Figure 7*. Machala Topographic Chart.*



Source: IGM

3.2. Access roads to Puerto Bolívar.

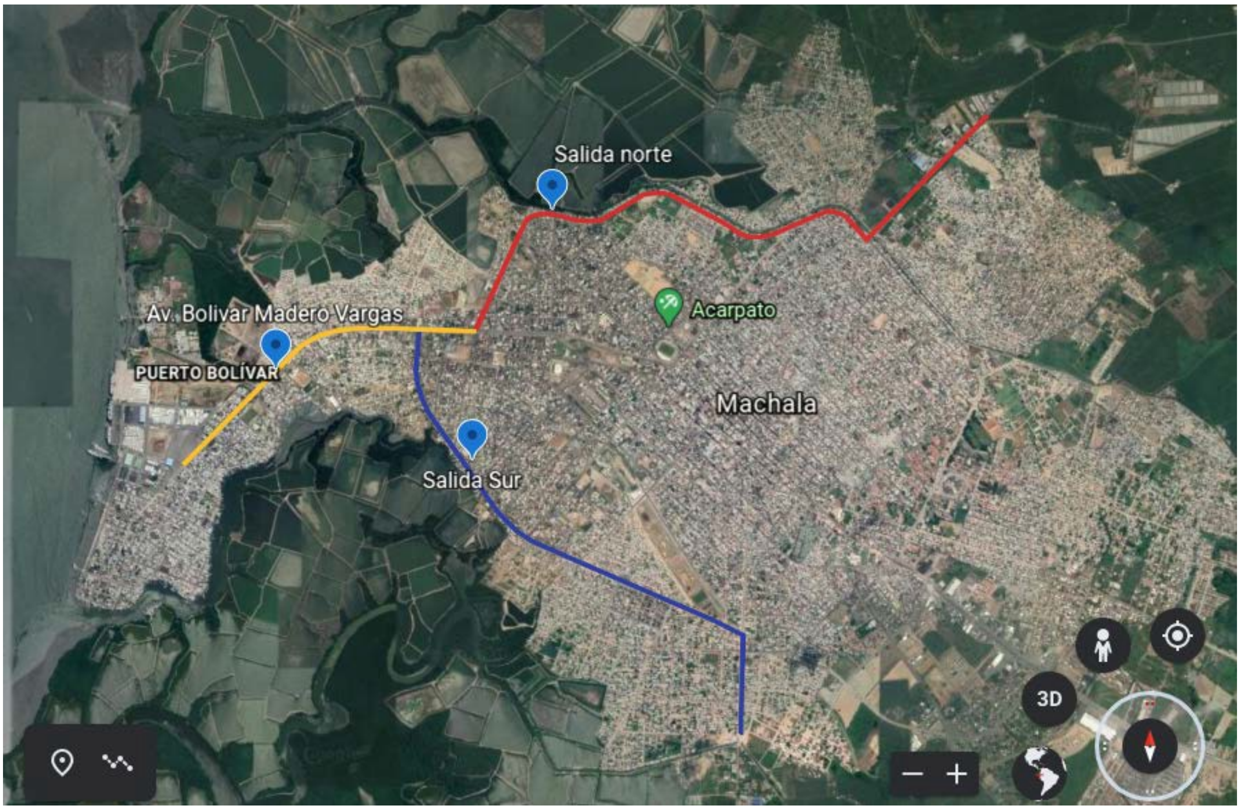
Bolívar Madero Vargas Avenue is the main access road to the urban parish of Puerto Bolívar and the Port Terminal. In addition, urban buses and private vehicles travel through it.

To access this avenue, cargo trucks must take the perimeter access roads to the urban area: 1) The Circunvalación Sur avenue is the most widely used since it connects directly with the eastern access road of the city (Machala – Pasaje road). The Circunvalación Sur connects with the southern part of the province (Balosa – Santa Rosa road).

2) The Circunvalación Norte avenue (2.7 km from the entrance to the port) is the most widely used since it connects directly with the eastern access of the city (Machala – Pasaje road). The Circunvalación Sur (2.3 km from the entrance to the port) connects with the southern part of the province (Balosa – Santa Rosa road).

Please note that both side crossings have two lanes in each direction. However, the urban area is widely consolidated, so that in some sections they can be considered as urban roads. (see Figure 8).

Figure 8. *Access roads to Puerto Bolívar.*

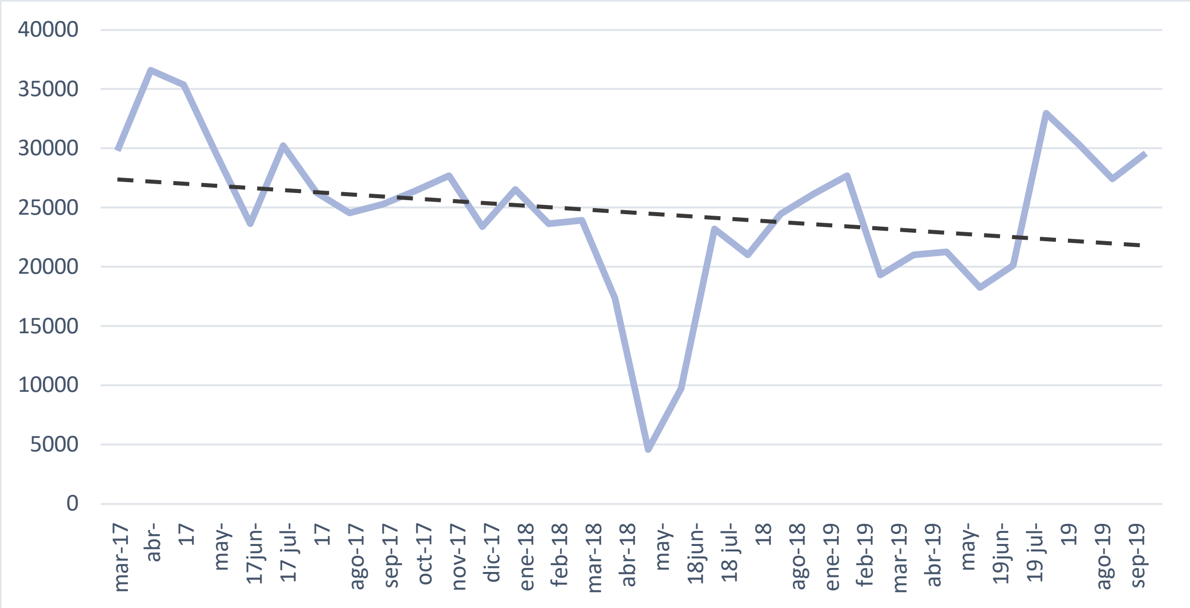


Source: Google Earth, 2020

3.3. Vehicle traffic to the Port Terminal.

The graph below shows the number of cargo vehicles entering the Port Terminal per month, in years 2017 – 2020.

Figure 9. *Port Land Traffic, total entries and exits of cargo vehicles, monthly*



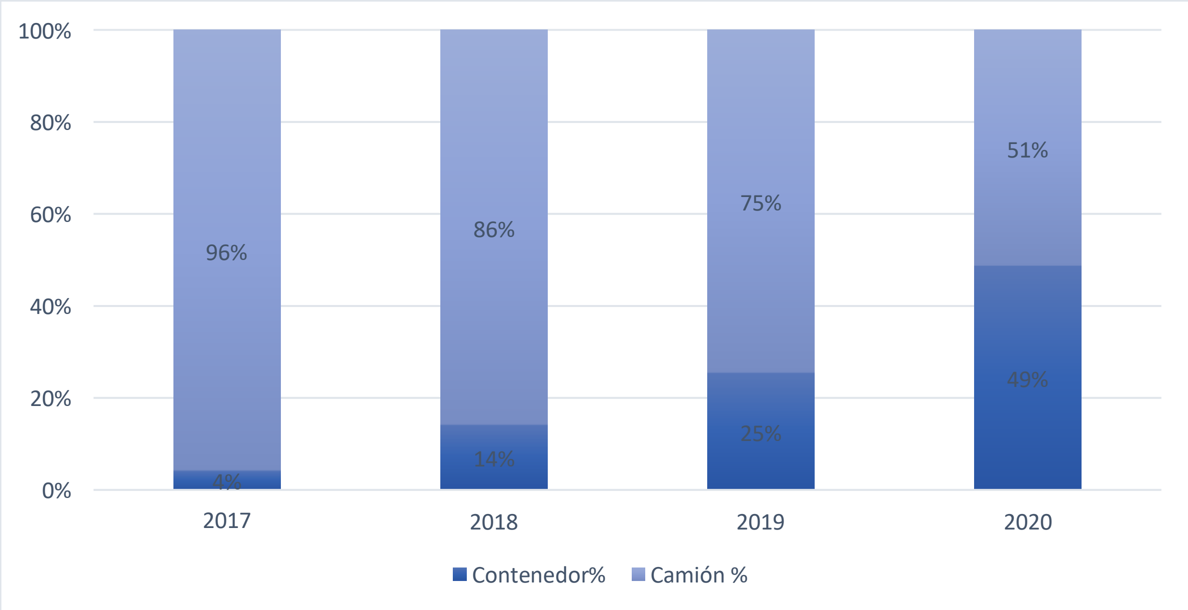
Source: Yilportecu S.A.
Compiled by author

Figure 9 shows a downward trend in port traffic at the Port Terminal (Yilportecu). Although the data show greater movement of cargo vessels, this effect is due to the increase in containerized cargo.

From 2017 to 2020, the entry of containerized cargo has increased from 4% to 49%.

This means that the number of trucks of all sizes, which in the past transported boxes of bananas to the port, is rapidly decreasing, and trucks are being replaced by larger capacity containers pulled only by one head. Thus, the consumption of fossil fuels, oils, etc. has decreased considerably, and the downward trend will continue as there is a transfer to containerization.

Figure 10. *Port Land Traffic, by type of vehicle, annual*

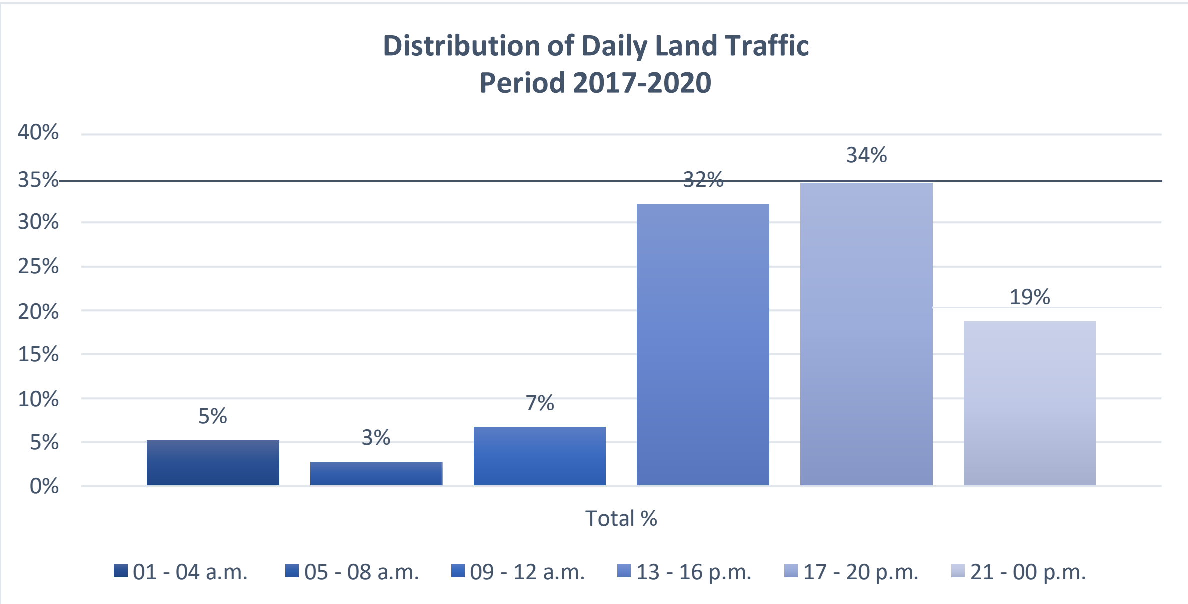


Container % **Truck %**

Source: Yilportecu S.A.
Compiled by author

The behavior of land traffic throughout the day is peculiar, slight in the morning, and increasing from 1:00 p.m. to 8:00 p.m. From 21:00 to 00:00, the traffic is considerable, if we relate it to the background traffic on the city roads.

Figure 11. *Distribution of Daily Land Traffic, Period 2017-2020*



Source: Yilportecu S.A.
Compiled by author

4. Traffic forecasts as of 2030

Forecasts of sea and land traffic caused by port operations will be made for two scenarios:

- Scenario 1: No increase in the port's operational capacity. Forecasts as of 2030 based on sea and land traffic data from 2017 to 2020.
- Scenario 2: With an increase in the operational capacity of the port. Forecasts as of 2024 based on monthly data of the volume of containers in TEUs from 2018 to 2020. The data on the construction of Dock 6 are considered here, i.e., estimates of sea travel (piles, fenders, bitts, ladders) and land travel (mobilization of construction material), during the construction period.

4.1. Scenario 1: No capacity increase

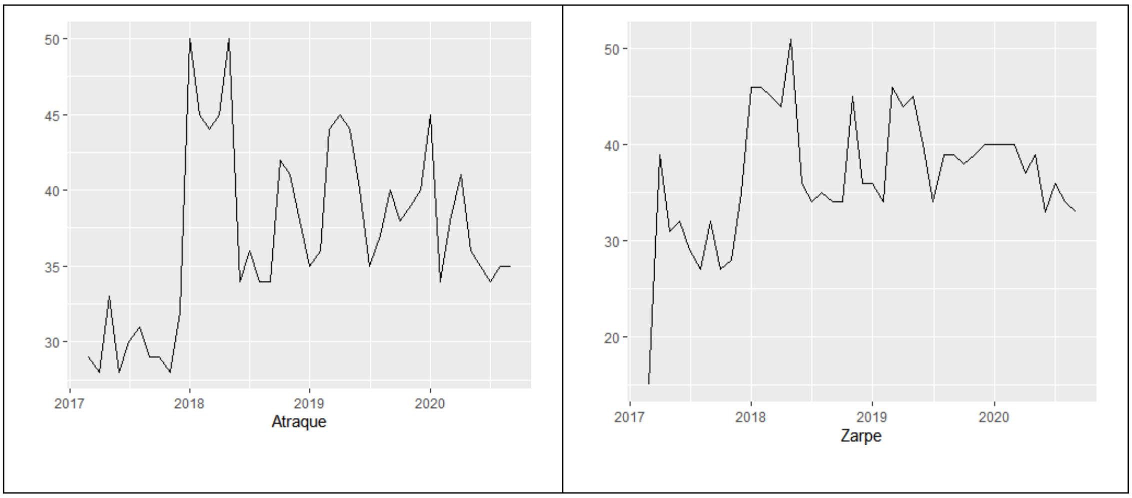
4.1.1. Methodology

To perform a time series analysis using ARIMA (Autoregressive Integrated Moving Average Model) and SARIMA (Seasonal Autoregressive Integrated Moving Average Model) models, the data must comply with seasonality and assumptions of seasonality. Therefore, the necessary transformations were made in the series to meet these assumptions.

4.1.2. Sea traffic

We begin by converting the data set to time series for both the berthing and departure variables. Then, we observe Figure 12 and Figure 13 that contain the series of the historical data of the variables berthing and departure.

Figure 12. *Historical data series of berthing and departure, Puerto Bolívar*

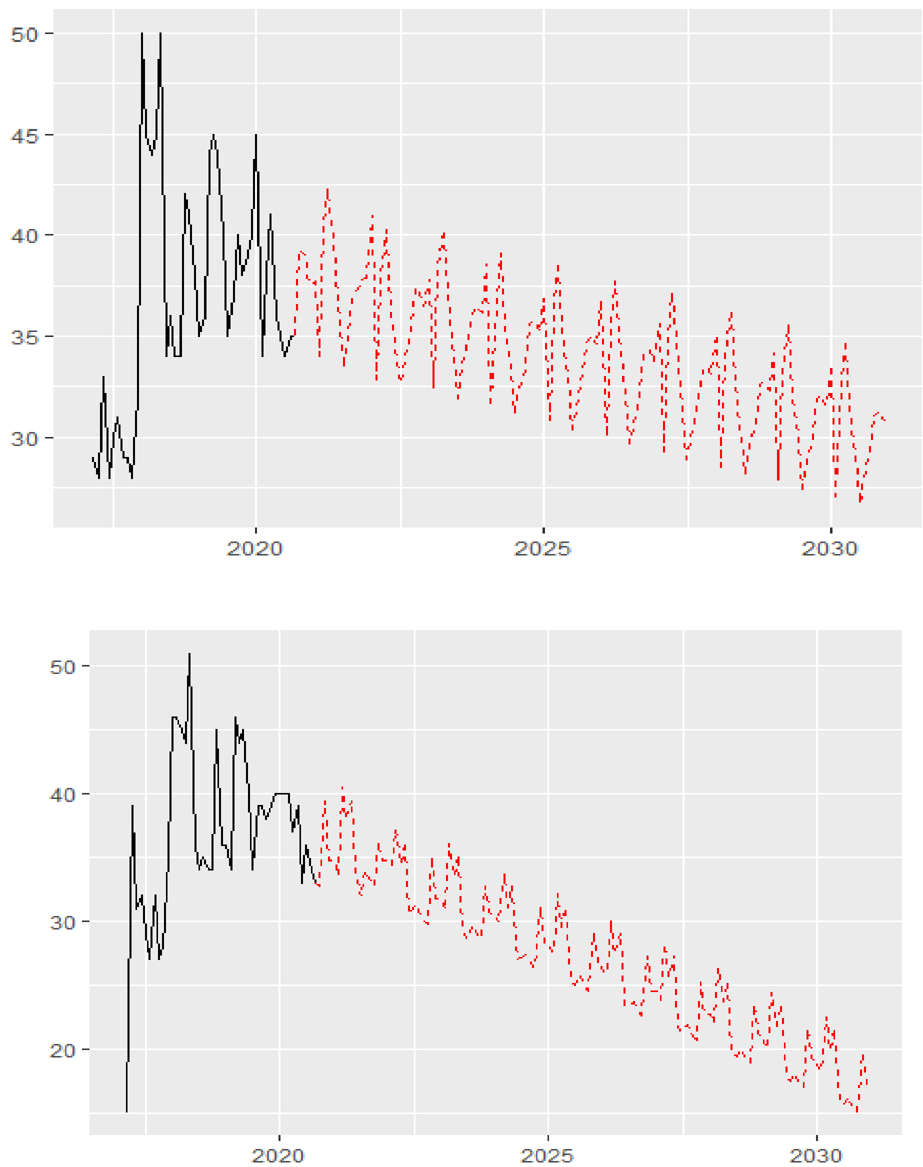


Berthing *Departure*

Source: Yilportecu S.A.
Compiled by author

Various models were adjusted for both series, concluding that the best adjustment was the ARIMA (1,1,0)(1,1,0) model. The model complies with the assumptions of independent and normal residuals.

Figure 13. *Forecast of departure and berthing variables*



Compiled by author

Figure 13 shows the current series in black and forecast in red. In both forecasts, a decreasing trend is observed. This is due to the presence of a trend in the historical data. This trend can also be influenced by the economic crisis derived from the 2020 health emergency.

It is important to emphasize that there is not enough historical data, so caution must be applied in these forecasts.

Table 3.. *Forecast of seaport traffic as of 2030.*

Year	**Total, Sea Traffic Forecast**	**Percentage change as compared to 2020**
2020	888	
2021	872	-1.80%
2022	831	-6.42%
2023	805	-9.35%
2024	770	-13.29%
2025	740	-16.67%
2026	707	-20.38%
2027	676	-23.87%
2028	644	-27.48%
2029	613	-30.97%
2030	581	-34.57%

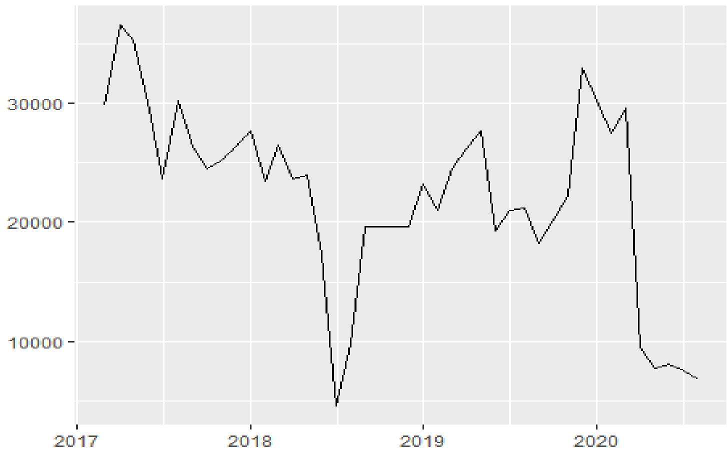
Compiled by author

4.1.3. Land Traffic

For land transport, the same methodology that was used for sea traffic was carried out. However, only one variable containing the total monthly entry and exit of trucks and containers was forecasted.

Figure 14 shows the series of historical data from 2017 to 2020.

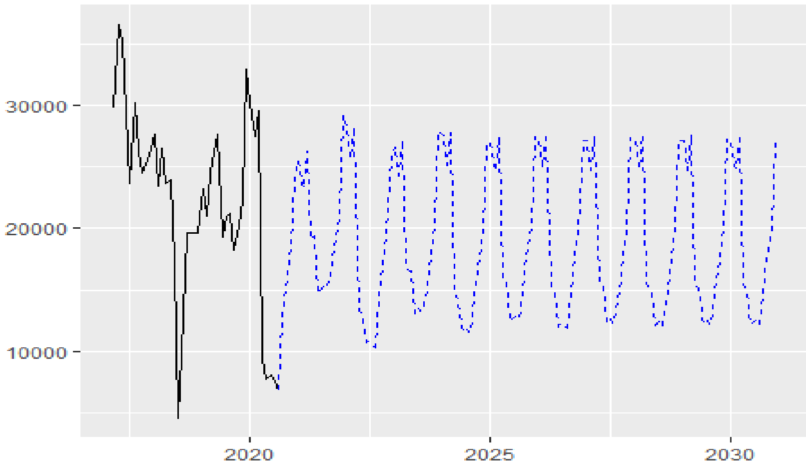
Figure 14. *Historical Data Series of Port Land Traffic in Puerto Bolívar*



Source: Yilportecu S.A.
Compiled by author

ARIMA (1,0,1)(1,1,0) was the most proper model. The forecast was carried out with a Confidence Level of 95%. Figure 15 shows the forecast as of 2030 in blue. It shows that the data will remain constant due to the seasonal characteristic presented by the historical data.

Figure 15. *Forecast of Port Land Traffic in Puerto Bolívar*



Source: Yilportecu S.A.
Compiled by author

Table 4 shows the annual forecasts of land traffic in Puerto Bolívar as of 2030.

Table 4. *Port Land Traffic Forecast.*

Year	Land Traffic (trips)	Percentage change as compared to 2020
2020	231,225	
2021	243,116	5.14%
2022	216,804	-6.24%
2023	232,235	0.44%
2024	223,186	-3.48%
2025	228,492	-1.18%
2026	225,380	-2.53%
2027	227,205	-1.74%
2028	226,135	-2.20%
2029	226,763	-1.93%
2030	226,395	-2.09%

Compiled by author

4.2. Scenario 2: Increased capacity

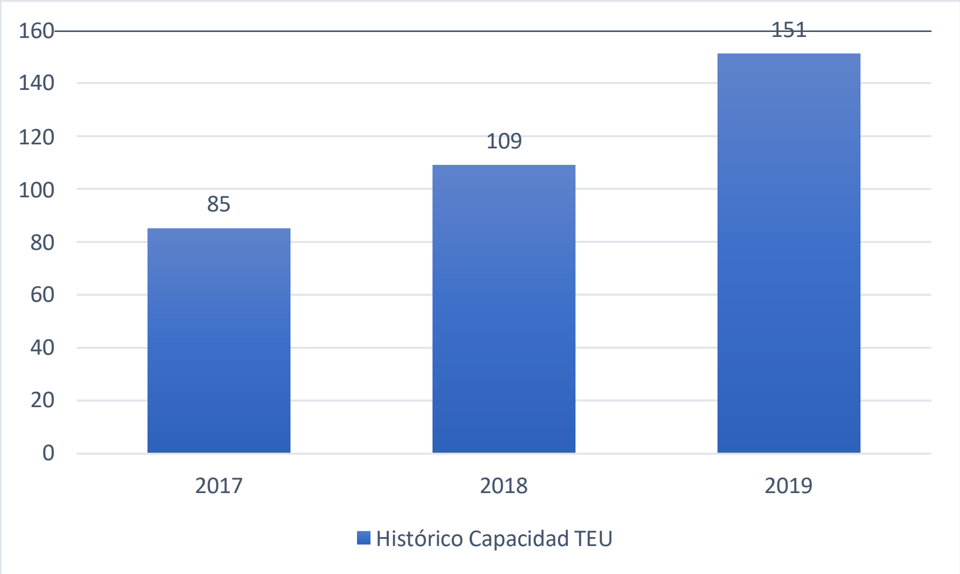
4.2.1. Methodology

A model previously established by the commercial department was used, in which the compound annual growth rate or CAGR of 4.9% from 2019 to 2065 is used.

4.2.2. Forecast of cargo mobilization.

Firstly, an analysis of historical data was carried out, in which a possible seasonality and increasing trend were observed, as can be seen in the figure below.

Figure 16. *Historical Data Container Capacity (TEU)*



Source: Yilportecu S.A.
Compiled by author

Table 5 shows annual forecast data as of 2030, the percentage change compared to 2020 and the annual growth percentage. We observe that the series has an annual growth trend. However, as time passes, the growth percentage will be lower than the previous year.

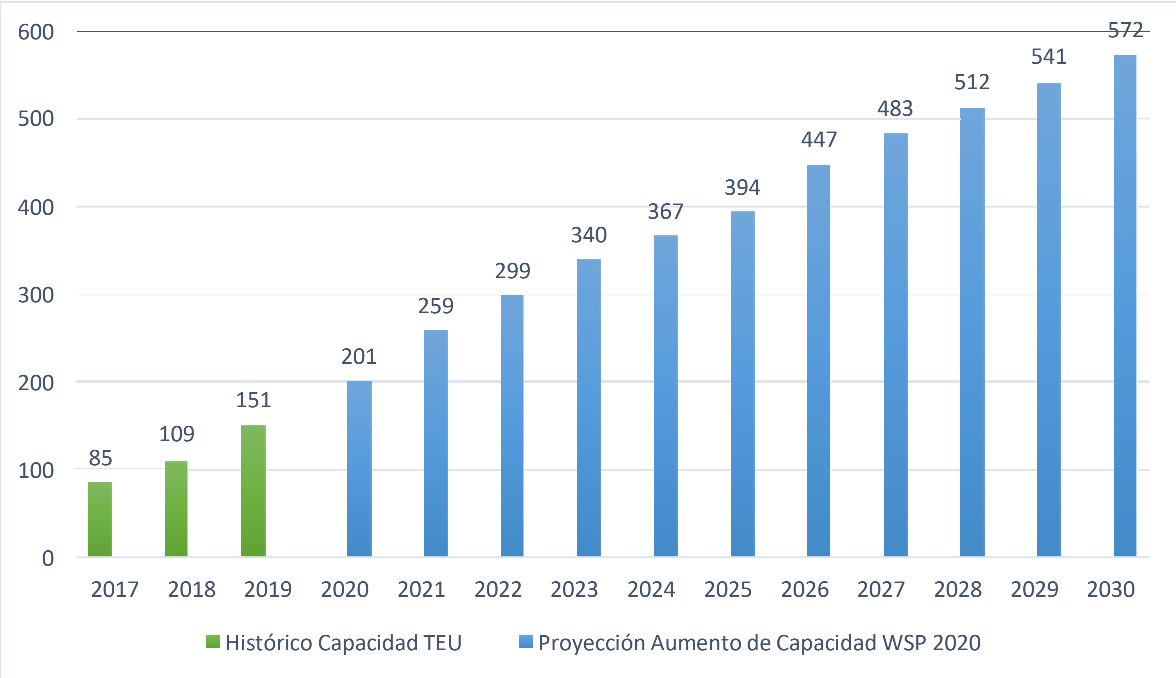
Table 5. *Cargo volume variation forecast.*

Year	Load Capacity Forecast (TEU)	Absolute variation	Percentage
2020	201		
2021	259	28.86	29
2022	299	48.76	15
2023	340	69.15	14
2024	367	82.59	8
2025	394	96.02	7
2026	447	122.39	13
2027	483	140.30	8
2028	512	154.73	6
2029	541	169.15	6
2030	572	184.58	6

Source: Yilportecu S.A.
Compiled by author

Finally, it is concluded that the forecasted volume as of 2030 will have an increasing trend, that is, the load capacity will progressively increase as can be seen in Figure 17, which shows the historical data and the forecasted data.

Figure 17. *Historical and Forecasted Data Container Capacity*



TEU Historical Data **Forecasted Capacity Increase WSP 2020**

Source: Yilportecu S.A.
Compiled by author

4.2.3. Increase during the construction of Dock 6 and Dredging

During the construction phase of Dock # 6 in Puerto Bolívar, it is expected that there will be an increase in land traffic as a result of the mobilization of construction materials and sea traffic due to dredging activities.

Dredging

From March to May 2021 and from November 2021 to January 2022, it is expected to dredge 1.5 million mm^3 to estimate the change that dredging will generate in sea traffic. Data on the number of trips and estimated dredging volume in mm^3 were used from the daily dredging reports in April and May of 2019. With the data collected, the variable amount of dredging per trip was obtained, resulting from the division of the total amount dredged in the day by the number of trips as described by Table 6.

Table 6. *Dredged Volume in 2019.*

Date	Trip	Dredged Volume (m^3)	m^3 per trip (volume/trip)
2019-APR-10	2	10734	5367.000
2019-APR-11	6	34709	5784.833
2019-APR-12	5	48075	9615.000
2019-APR-13	4	29573	7393.250
2019-APR-14	6	52249	8708.167
2019-APR-15	6	48558	8093.000
2019-APR-16	5	37842	7568.400
2019-APR-17	6	45254	7542.333
2019-APR-18	5	37581	7516.200
2019-APR-19	6	38415	6402.500
2019-APR-20	4	15648	3912.000
2019-APR-21	6	33448	5574.667
2019-APR-22	5	27852	5570.400
2019-APR-23	6	60485	10080.833
2019-APR-24	6	62692	10448.667
2019-APR-25	6	53586	8931.000
2019-APR-26	6	53253	8875.500
2019-APR-27	5	36687	7337.400
2019-APR-28	6	64218	10703.000
2019-APR-29	6	68232	11372.000
2019-APR-30	6	70913	11818.833
2019-MAY-01	6	79214	13202.333
2019-MAY-02	6	73082	12180.333
2019-MAY-03	5	63456	12691.200
2019-MAY-04	2	26024	13012.000
2019-MAY-05	4	48261	12065.250
2019-MAY-06	6	52184	8697.333
2019-MAY-07	6	47001	7833.500
2019-MAY-08	6	46151	7691.833
2019-MAY-09	6	44760	7460.000
2019-MAY-10	6	44392	7398.667
2019-MAY-11	6	44100	7350.000
2019-MAY-12	7	50661	7237.286
2019-MAY-13	5	35253	7050.600
2019-MAY-14	6	37518	6253.000
2019-MAY-15	6	44397	7399.500

Date	Trip	Dredged Volume (m^3)	m^3 per trip (volume/trip)
2019-MAY-16	6	61918	10319.667
2019-MAY-17	6	59640	9940.000
2019-MAY-18	5	44339	8867.800
2019-MAY-19	7	80193	11456.143
2019-MAY-20	6	62691	10448.500
2019-MAY-21	6	62566	10427.667
2019-MAY-22	6	63426	10571.000
2019-MAY-23	7	72815	10402.143
2019-MAY-24	6	73698	12283.000
2019-MAY-25	5	47022	9404.400
2019-MAY-26	6	66838	11139.667
2019-MAY-27	6	68690	11448.333
2019-MAY-28	7	79089	11298.429
2019-MAY-29	6	62878	10479.667
2019-MAY-30	7	67949	9707.000
2019-MAY-31	6	59061	9843.500

Source: Yilportecu S.A.
Compiled by author

Then, we obtain the mean of the aforementioned variable, which was 8828.018 $mm^3/ttttttt$. With this data we proceed to estimate the number of trips to carry out the dredging. $\frac{1.5MM}{8828{,}018} = 170\ tttttttttt$. 170 days are distributed in similar proportions for the 6 dredging months as shown in the table.

Table 7*. Forecast of traffic caused by dredging.*

Month	Number of trips, forecast
March 2021	28
April 2021	28
May 2021	28
November 2021	28
December 2021	28
January 2022	30

Source: Yilportecu S.A.
Compiled by author

Therefore, it can be concluded that the increase in sea traffic due to dredging activities, during the construction of Dock #6, is not significant, when compared to the existing sea traffic in Puerto Bolívar.

Transport of Materials

The construction of the dock will also generate the transfer of construction materials. For this reason, land and sea travel that will influence the traffic forecasts was estimated. The methodology used was to divide the volume of construction materials by the average capacity (11 mm^3 or 31 tons) of a dump truck or (10000 tons) of an export vessel, to obtain the estimate of trips necessary to move the construction materials.

The following table shows an estimate of certain construction materials with their respective quantities, type of transportation and estimated dates of mobilization.

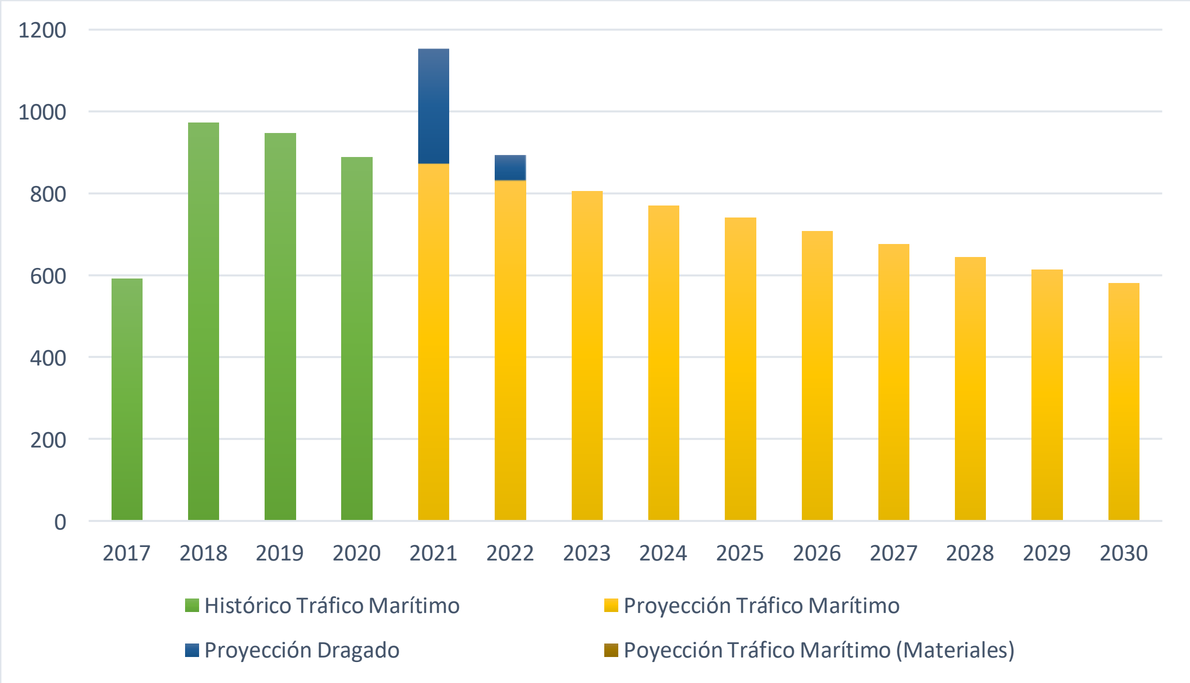
Table 8. *Requirement of construction materials forecasted for Dock 6.*

Dock Construction	Number	Transport Type	Date	Total Trips
Concrete (m^3)	41000	Land	Aug 21 - Aug 22	3727
Steel (tons)	10000	Land		323
Piles (tons)	30000	Sea	Feb 21 - Jun 21	3
Fenders (Parts)	25			
Bitts (Parts)	25	Sea	Aug 22	
Ladders (Parts)	13			1
Pavement				
Concrete (m^3)	30000	Land		2727
Cobblestones (m^2)	120000	Land	Mar 21 - Aug 22	
Subbase material (m^3)	16000	Land		1455

Source: Yilportecu S.A.
Compiled by author

Figure 18 and Figure 19 show the change in forecasted sea and land transport.

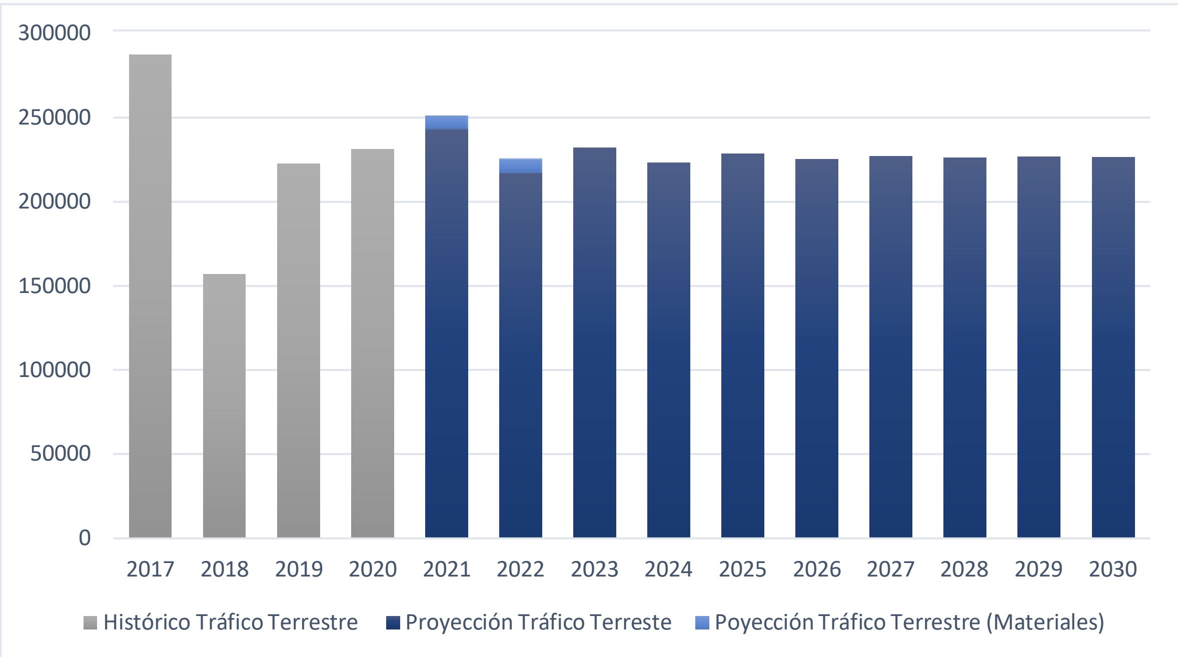
Figure 18. *Historical data and forecasted sea traffic, including mobilization of materials in the construction stage of Dock 6 and dredging.*



Sea Traffic Historical Data **Forecasted Sea Traffic**
Forecasted Dredging **Forecasted Sea Traffic (Materials)**

Source: Yilportecu S.A.
Compiled by author

Figure 19. *Forecasted land traffic, including mobilization of materials in the construction stage of Dock6.*



Historical Land Traffic Data Forecasted Land Traffic Forecasted Land Traffic (Materials)

Source: Yilportecu S.A.

Compiled by author

In conclusion, the sea traffic projected in this scenario will be influenced by dredging and not by the transfer of construction materials. And in relation to land traffic, it is expected that there will be a slight increase concerning the forecast. This is caused by the trips that will be made to move construction materials.

5. Conclusions

The data of the last 3 years of seaport traffic, related to the activity of YILPORTECU, has a slight growing trend. Although in 2020, due to the global economic crisis derived from the Covid 19 pandemic, it begins to show a decrease, which affects the forecasts as of 2030, in the "no increase in capacity" scenario. However, the "increased capacity" scenario shows a growth in cargo movement, which undoubtedly increases the volume of sea and land traffic.

The characteristics of land traffic have undergone an important change. In 2017, the largest value of land traffic corresponded to trucks with bulk cargo, while, at present, the largest value of traffic is related to containers. This has decreased the net land traffic by implementing a more efficient form of transport and the transport of more cargo units per transport unit. Forecasts show that this trend would continue until 2030.

Sea traffic also shows changes in the analyzed period, and less waiting and anchoring time of vessels is observed, showing greater efficiency in port operations.

The construction period of Dock # 6 will have a direct impact on the increase in land traffic, while sea traffic will be slightly influenced by dredging activity in specific months as planned for this activity.

6. Recommendations

It is recommended that road safety and traffic accident prevention measures be established on Bolívar Madero Vargas Avenue at the entrances and exits of the Port Terminal.

Establish a procedure to manage possible interactions of vessels with fishermen or other vessels moving in the maneuvering area and access channel.

ENVIRONMENTAL AND SOCIAL IMPACT STUDY, PUERTO BOLÍVAR PROJECT – PHASE 1

– HEALTH AND SAFETY IN THE COMMUNITY –

Prepared for:

[YILPORT PUERTO BOLIVAR LOGO]

YILPORTECU TERMINAL OPERATIONS, YILPORTECU S.A.

Produced by:

[SAMBITO TOTAL ENVIROMENTAL SOLUTIONS LOGO]

ECOSAMBITO C.LTDA.

December 2020

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ACRONYMS

APPB	Port Authority of Puerto Bolívar
EHA	Environmental Heath Areas
ESIA	Environmental and Social Impact Assessment *(EIAS)*
INEC	National Institute of Statistics and Census
GN	Guidance Note
ND	Performance Standard
HIA	Health Impact Assessment
HSE	Health, Security, and Environment
IFC	International Finance Corporation
MSP	Ministry of Public Health
MASS	Guidelines of the World Bank Group on Environment, Health, and Safety
PAC	Potential Affected Communities

EXECUTIVE SUMMARY

Based on the environmental and social risk and impact assessment developed in compliance with ND1, and to properly identifying aspects that could affect the health and safety of the community. This document has been structured to develop an assessment of the potential impacts on community health related to Yilportecu's activities.

Performance Standard 4 recognizes that the activities, equipment, and infrastructure of a project can increase the potential for the community to be exposed to risks and impacts. While recognizing the role of public authorities in promoting public health and safety, Performance Standard 4 focuses on the Promoter's responsibility to avoid or minimize risks and impacts to community health and safety that may arise from project-related activities, with particular attention to vulnerable groups.

This document identifies, analyzes, evaluates, and prioritizes risks and impacts on community health and safety using internationally recognized methodologies.

Measures have been structured with the results of this analysis that focus on the prevention of risks and impacts on the community, following recommendations set forth in international guidelines.

HEALTH AND SAFETY IN THE COMMUNITY

Performance Standard 4 provides that the activity, equipment, and infrastructure of a project may involve environmental and social risks and impacts that expose the project's area of influence to the community.

The process of identifying environmental and social risks and impacts provides an opportunity to detect, assess, and address the potential impacts and risks of the project to affected communities and to reduce the incidence of accidents, injuries, illnesses, and deaths as a result of project-related activities. Communities are not homogeneous, and therefore, there may be differentiated impacts among various groups such as women, men, youth, elderly people, people with disabilities, and vulnerable groups, which must be taken into account. The scope, depth, and type of analysis should be proportional to the nature and scale of the potential impacts of the proposed project, and the potential impacts on the health and safety of the local community.

The result of this analysis is to implement prevention strategies and mitigation of these impacts through measures that will be determined in the Environmental and Social Management Plan of this study

1. Introduction

Project activities may have a direct or indirect impact on community exposure to environmental-related health risks, such as communicable diseases, changes in food and nutrition, accidents with dangerous equipment and materials, among others. Factors that can contribute to these effects are a sudden influx of job seekers or family members who cause overcrowding in households and increased demand for food, health services, and sanitation, with respective consequences on community health; introduction of infectious diseases, changes in people's mobility, among others.

This type of impact, if not properly managed, can lead to damage to relationships with government communities or institutions, delay project implementation, lead to legal liability, and other additional costs. However, when properly managed, impacts on community health can reduce unnecessary costs (downtime, compensation) and help create positive perceptions. Many health problems can be solved by applying simple and economic methods, such as immunizations, information, education and communication programs, management of surface water drainage, etc.

1.1. Objectives

- Foresee and avoid adverse impacts on the health and safety of Affected Communities during the project, resulting from both routine and unusual circumstances.
- Ensure that the safeguarding of personnel and property is carried out in accordance with the relevant human rights principles and in a manner to avoid or minimize risks to social actors in the project's area of influence.

1.2. Scope

The applicability of this Performance Standard was determined during the process of identifying environmental and social risks and impacts and covers the possible risks and impacts of project activities on Affected Communities during the different stages of the project: Construction, operation, and dredging of the Port Terminal of Puerto Bolívar.

The geographical boundaries of this study cover the urban area of the Machala canton, as the IAS considers a large part of the urban area of this city in determining its area of direct and indirect influence.

The timeline for this study covers 50 years, from granting of the port operation to Yilportecu, starting in 2017.

The proposed prevention and control measures to avoid and counteract the identified risks and impacts will be based on good international industry-recommended practices, such as the World Bank Group on Environment, Health, and Safety (MASS) guidelines or other internationally recognized sources. The implementation of the actions necessary to comply with the requirements of this plan is included in the proposed Environmental and Social Management Plan. The implementation of this Plan will be in charge of the Department responsible for the HSE Department of Yilportecu, in charge of Community Relations.

2. Requirements and regulations

2.1. Requirements

The following are the requirements of IFC Performance Standard 4: Community Health and Safety.

Community health and safety requirements. The risks and impacts to the health and safety of the affected Communities will be assessed throughout the project cycle and prevention and control measures will be determined in accordance with good international industry best practices.

Infrastructure and equipment design and security. The structural elements or components of the project shall be designed, constructed, operated, and deactivated, in accordance with good international best practices for the industry, taking into account the safety risks to third parties or the Affected Communities.

Hazardous Materials Management and Safety. The potential for the community to be exposed to hazardous materials and substances that the project could generate will be avoided or minimized.

Services provided by ecosystems. The project can affect priority services provided by ecosystems, generating risks and adverse impacts on health and safety in affected communities. Where appropriate and feasible, these potential risks and impacts will be identified. Adverse effects should be prevented, but if not, mitigated.

Community exposure to disease. Possible community exposure to water-related, vector-borne diseases as well as communicable diseases that project activities may influence will be avoided or minimized, taking into account the differentiated exposure of vulnerable groups and their increased sensitivity.

Transmission of communicable diseases that may be associated with temporary or permanent migration of the project workforce will be avoided or minimized.

Emergency preparedness and response. Assistance and collaboration will be provided with Affected Communities, local government agencies, and other relevant parties in the preparations for effective emergency response.

Security personnel. In the event that employees or contractors are hired directly to provide security to protect their personnel and property, assess the risks that safety arrangements may entail for those on or off the project site.

2.2. National and international regulations

There are no regulatory requirements in the Ecuadorian territory related to the need for health and safety assessments of this kind. This report is developed as a requirement of international financial institutions.

The activities of the Puerto Bolívar Phase 1 project will fall within the requirements of Ecuadorian health and safety legislation, as well as international treaties to which the country is attached.

- Constitution of the Republic of Ecuador
- Health Code
- Environmental Organic Code
- National Sexual Health and Reproductive Health Plan
- Social Security Law
- Ecuador Transit Law
- Organic Human Mobility Law

International treaties to which Ecuador is attached, in the field of health and sanitation

- Universal Declaration of Human Rights
- American Convention on Human Rights
- Ottawa Charter for Health Promotion

3. Description of the project

This section presents a summary description of the project, reported more extensively in Book I. Presentation and description of the Environmental and Social Impact Study project.

3.1. Location

Phase 1 Puerto Bolivar expansion project, carried out by Yilportecu, is located in the parish of Puerto Bolívar, city of Machala, capital of El Oro province, on the south coast of Ecuador, and covers the Port Terminal of Puerto Bolívar, pier dredging, maneuvering area, and the access channel to the terminal.

The project's area is a consolidated urban area, which has grown and developed based on three main activities: Port activity, fishing, and tourism.

3.2. Key operational aspects

Puerto Bolívar contributed 5% of the total cargo mobilized at the national level, totaling 1,849,655.02 TM (Ministry of Transport and Public Works, 2019).

The vast majority of cargo handled by Puerto Bolívar is banana exports. In order to expand its service offering for the importing and exporting sector, Yilport is therefore developing new services:

- Export of mineral concentrates: Service for the mining sector. Currently, big bags of material are handled which are received, stored, and exported as piece goods on special boats for this type of cargo. In a second phase, it is planned to implement rotainers technology that will allow bulk loading on bulk vessels.
- Solid bulk handling. For storage and distribution of grains, Yilport considers the building of silos, horizontal transport from the ship to silo can be carried out with dump trucks and hoppers, and later, switch to conveyor systems.
  Storage of coal, cement, pet coke, or similar bulk will be open at first, with tarpaulins to cover if necessary. This will evolve into closed, probably dome-like silos when demand requests it.
- Ro-Ro. Reception and storage of vehicles for the southern region of Ecuador.

3.2.1. Existing infrastructure

The concession area is 72 hectares, completely enclosed and delimited, occupied by warehouses, industrial buildings, administrative offices, storage yards, internal circulation routes, parking and maneuvering yards, docks, and other infrastructure.

- 920 meters in berthing line divided into five berths
- 9 patios, totaling 192,186 m^2
- 13 warehouses among open and closed together occupy 26,054$^{m\ 2}$

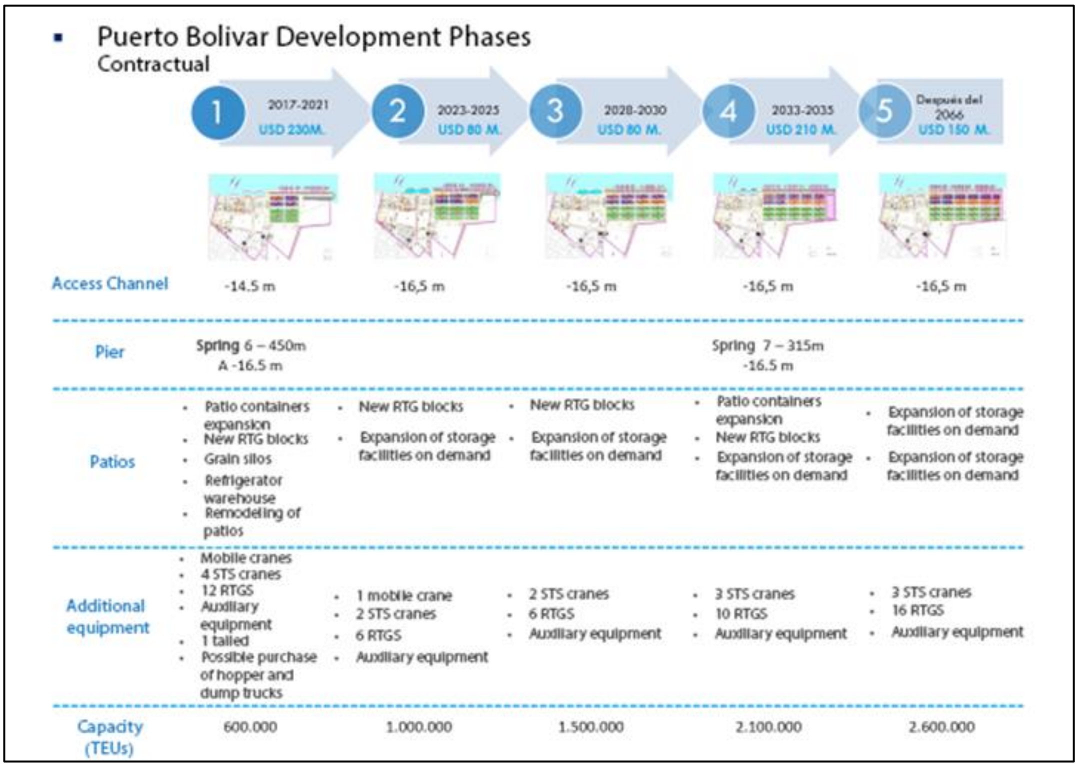
3.2.2. Expansion project

The concession of the port operation from Puerto Bolivar to Yilportecu is 50 years. During this period, the Port Terminal is being expanded in phases. Figure 1 shows the main works and capabilities that they expect to achieve (projections of the growth of cargo movement in TEU), and that will be the “triggers” of the following stages. An operational capacity of 2,600,000 TEUs is expected to be achieved by 2066.

The phase that is immediately planned is Phase 1, which will be developed between 2021 and 2022 and will be operational in March 2023. It includes the construction of a pier 450 meters long, 62 meters wide, and a depth of -16.5 meters below the level of average low tides of syzygy (MLWS), for the berthing of porta-container vessels up to 200,000 tons of deadweight (TPM), a 12 hectares container patio for storage. In addition, 4 STS (“ship-to-shore”) and 12 RTG (“rubber tire gantry”) dock cranes will be equipped to stack containers in the yards. It will have all the basic services, an electrical power system of all the load management equipment, and an emergency electric power generation system. In addition, other cargo segments will be developed, with the construction of infrastructure for cereals or other solid bulk such as cement, clinker, copper, etc.

This phase will increase the reception and handling capacity of Puerto Bolívar containers to 600,000 equivalent 20-foot containers ("TEUs: twenty equivalent units").

Figure 1. Main activities and temporary projections of Puerto Bolívar project



Source: Yilportecu S.A.

3.3. Project access routes

At the local level, Puerto Bolivar is located 10 minutes by road from the city center of Machala. The current system linking the city of Machala and its port with neighboring areas, production centers, neighboring provinces, and the rest of the country is a well-functioning network.

The main access road to the port is Avenida Bolívar Madero Vargas, which, in addition to Circunvalacion Norte and Circunvalacion Sur roads, form a circulation network connecting the Port Terminal with Av. 25 de Junio, and through this with the national road network:

- Guayaquil Axis Road – Machala (Route E40 and Route E25, distance 197 km, 3h17)
- Tumbes Axis Road – Machala (Route E25 and Route E50, distance 185 km, 3h)
- Cuenca Axis Road – Machala (Route E59 and E50, distance 168 km, time 3h17)
- Loja Axis Road – Machala (Route E35, E50, and E25, distance 233 km, time 4h20)

- Quito Axis Road – Machala (Route E25 and E87), distance 521 km, time 9h)
- Puerto Bolívar – Machala – Pasaje – Girón – Cuenca – Paute – Amaluza – Mendez – Puerto Morona Road.
- Puerto Bolívar – Machala – Santa Rosa - Balsas - Chaguarpamba – Loja – Zamora – Yantzatza – El Pangui – Gral. Leonidas Plaza y Méndez Road

The zone of terrestrial influence of the Port Terminal, or its *hinterland*, covers the southern Ecuadorian sector, efficiently serving the provinces of El Oro, Azuay, Loja, Cañar, Zamora, The nearest sector of the provinces of Guayas and Morona Santiago, and the north of Peru.

3.3.1. Vehicular traffic

Regarding traffic generated by cargo transport from and to the port, this is mainly caused by banana transport. The traffic analysis developed as part of the complementary studies of the IAS (Book V.D. Port Traffic Assessment), shows a trend toward the decline of land traffic in the Port Terminal, although the data expose greater movement of cargo vessels. This trend to the decrease in traffic is due to the effect of cargo containerization.

Between 2017 and 2020, the container cargo influx has increased from 4% to 49%. This means that the number of trucks of all sizes, which transported banana boxes to the port in the past, is decreasing rapidly and are being replaced by larger capacity containers pulled by only one header. In this regard, road use, implementation of appropriate signage, disclosure of schedules, training to staff, and other considerations are essential for them to avoid traffic accident risks and/or involving pedestrians or private property in the project's area of influence.

3.3.1. Maritime traffic

In the document Book V.D. Port Traffic Assessment, maritime traffic data between 2017 and 2020 are analyzed, showing a slight increase. It is to be hoped that an increase in the capacity of Yilportecu's operations will accentuate the trend of increasing port maritime traffic. However, the trend in global maritime traffic is oriented toward the use of fewer vessels, but each of them with greater cargo and transport capacity. Thus, even if maritime traffic increases, the number of vessels that will be recalculated in Puerto Bolívar will tend to decrease.

3.4. Operational support

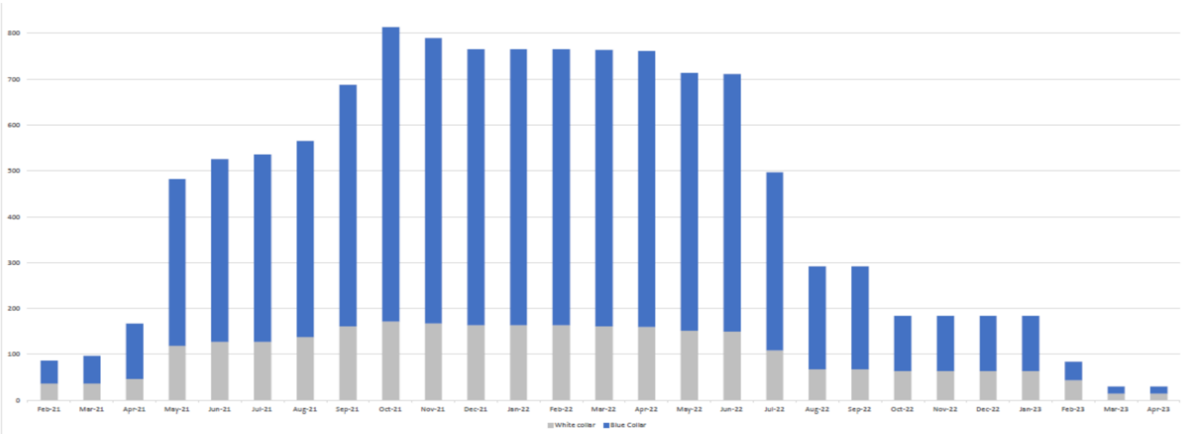
Operation. By granting this international Port Terminal to a multinational company, the presence of foreign personnel has become more pronounced. However, they are operational staff in positions that require high skills and specific experience.

Construction. The Phase 1 expansion will be carried out by an international contractor in partnership with nationals. Details of the methods of work can be found in Book I. Project Presentation and Description, Annex 7.

Some of the necessary services are expected to be provided by local subcontractors, except those who are highly specialized and require hiring personnel from other cities, such as Guayaquil or Quito.

Below is the labor demand expected for this phase. Stacked bars show the number of blue-collar workers (workers), and white-collar workers (technical heads and administrative workers). The peak demand for labor is estimated between May 2021 and July 2022, with between 500 and 800 workers, among extension employees, contractors, and subcontractors

Figure 2. Estimated labor at the Pier 6 construction stage



A camp will be built where there will be offices, cafeterias, and all hygiene services for the construction personnel, in accordance with Ecuadorian legislation. There will be no housing or camps for staff at the workplace.

Local staff will be recruited for labor; however, the foreign staff is expected to be in strategic positions. The foreign staff will be accommodated in the city of Machala, near the project area, where there is sufficient accommodation infrastructure.

3.5. Project timeline

The building of Puerto Bolívar Pier 6 is planned to be completed in 27 months, between 2021 and 2022, in which works will be carried out continuously.

4. Methodology

4.1. HIA within the framework of the project

This report is presented as a supplementary study of the Environmental and Social Impact Study (EIAS) of the Puerto Bolívar Expansion Project Phase 1.

Prevention and mitigation measures that have been carried out based on the risk and impact assessment results are presented at the end of this report and are also part of the EIAS Environmental and Social Management Plan.

4.2. Potentially affected communities

Potentially Affected Communities (PACs) will be a subgroup of the stakeholders and social actors identified in Book IV.C. Social Baseline, developed in the EIAS (chapter 16) and classified by the interest-power and attitude-activity matrix.

4.3. Nature of impacts assessed

This report specifically detects and evaluates the direct and local impacts of project activities on the affected population. They are not considered cumulative impacts on the population.

4.4. Health impacts and risks

The Environmental Health Areas (EHA) methodology will be used to identify health risks and impacts to the community. Within this methodology, the Limited in-country approach will be applied, which does not provide for new data collection within the communities of interest but is based on the review of existing data from various sources. As national statistics established at the National Institute of Statistics and Census (INEC), and other official sources. Methodological steps are:

- Preliminary Assessment: Identification of key aspects to determine the need for an HIA.
- Determination of Scope: Establishment of geographical, spatial, and temporal boundaries, determination of the type of approach for analysis.
- Baseline: Relevant information from Environmental Health Areas (EHA).
- Risk Assessment: Description of potential risks, identification, evaluation, and ranking.
- Action Plan: Prevention and mitigation measures based on identified risks.
- Monitoring and evaluation: Define indicators for data collection.

4.4.1. Risk and impact ranking

The Fundacion Natura matrix (1996) has been used for risk and impact ranking. The probability of occurrence of risk is rated on a scale of 1 to 4, according to the percentage

scale given. Consequences are rated on a scale from A to D, where A corresponds to non-important consequences and D to very serious consequences according to the following definitions:

- Not important: No danger, damage, or subsequent complications

- Limited: Consequences with a punctual, planned, and delimited extension

- Serious: Significant consequences

- Very serious: Severe consequences

Table 1. Risk Rating based on probability and consequences

		Consequences			
		Not important	Limited	Serious	Very serious
Probability		**A**	**B**	**C**	**D**
4	Greater than 25%				
3	Between 5 and 25%				
2	Between 1 and 5%				
1	Less than 1%				

Low	**Moderate**	**High**	**Very High**

Source: Modified from Fundacion Natura, 1996.

Once qualitatively rated, each risk in terms of probability and consequences, the risk category in which it is grouped according to both scores is determined, with categories: Low, Moderate, High, and Very High.

At this point, the range of risks to be managed is decided, in this case, the risks will be Moderate, High, and Very High.

4.4.2. Sectoral impact approach

This section provides a mini-identification of possible aspects that will impact the health of the community. For this purpose, the criteria for accommodation, water supply, sanitation and food, transport, and communication are analyzed for the project.

4.4.2.1. Accommodation

As indicated in 3.4. Operational support, no camps, or any temporary or definitive accommodation, will be built for the project staffing requirement. Labor will be settled close by, and foreign staff will be accommodated in rental housing in the city of Machala.

4.4.2.2. Water, sanitation, and food supply

Water provided through tankers will be used during the construction phase to supply hygienic services and operations. This water is obtained from wells that are part of the city's public supply network.

Water for human consumption of workers will be provided in bottles (20 liters) by distributors of private treating plants in Machala.

Regarding sanitation, the black and gray waters during the construction phase will be sent in tankers to the oxidation lagoons of the city. The city of Machala has little treatment of domestic wastewater.

During operation, the demand for personnel will be significantly lower, so the local drinking water supply will not be impacted. Wastewater during this stage will be connected to the Port Terminal's treatment plant.

In terms of food, Yilportecu has a dining room for its workers; however, when the presence of new construction workers is greater, it will be necessary to implement cafeterias on the work fronts and to hire an express food service.

4.4.2.3. Transportation

Routes will not be expanded or changed during the construction and operation of the Port Terminal. No other means of land, sea, or air transport shall be affected. The reason for the project is the improvement of port services and an efficiency gain that will be reflected in lower flows of land and sea traffic, despite the expected increase in the exported cargo.

4.4.2.4. Communication and distribution of information

Yilportecu, through its Department of Safety, Health, and Environment, and the Department of Projects, makes the publication in the written press, about the starting of construction and dredging works. It also communicates to the competent institutions by written communications.

In addition, regarding environmental permits, Yilportecu has carried out a social participation process prior to the dredging license, while it is in the execution of other socialization processes, through which it is making known the expansion projects.

4.4.3. Environmental health areas

The health areas to be included in the project analysis are then evaluated, with the help of a checklist established in IFC, 2009.

Those HAs that do not meet at least one verification criteria will be left out of the analysis.

Table 2. HIA detection process checklist

	Environmental Health Areas (EHA)	Things to consider	Verification
1	**Vector-related** *malaria, dengue, yellow fever*	○ Are there any of them in the project area?	√
		○ Will the existing road and water distribution patterns change due to the project?	
		○ Will there be an influx of workers from other areas?	√
2	**Respiratory and housing problems:** *acute respiratory infections, pneumonia, tuberculosis; respiratory effects of housing, overcrowding, housing inflation*	○ If there is a construction phase: ○ Will there be an influx of workers?	√
		○ Will there be work fields?	
3	**Veterinary medicine/ zoonotic problems:**	○ Will there be an interaction between the project and local livestock?	

	Environmental Health Areas (EHA)	Things to consider	Verification
	brucellosis, rabies, bovine tuberculosis, avian influenza, etc.		
4	**Sexually Transmitted Infections:** HIV/AIDS, syphilis, gonorrhea, chlamydia, hepatitis B	○ Will the project trigger an influx?	√
		○ Will the project trigger long-distance truck trips?	√
5	**Diseases transmitted by soil and water** *Giardiasis, worms, water access and quality, excrement management*	○ Will the project cause an influx?	√
		○ Will the project change the quality or distribution of water or soil in nearby communities?	
6	**Food and nutrition issues:** *Malnutrition, anemia, micronutrient-related diseases, changes in agricultural and hunting/fishing/harvesting practices, gastroenteritis; food inflation.*	○ Will the project cause an influx?	√
		○ Will the project change agricultural practices or food distribution?	
7	**Accidents/injuries** *road traffic, spills and spills, construction (related to home and project), and drowning*	○ Will the project cause an influx?	√
		○ Will the project trigger changes to existing road/rail/boat/air transport patterns?	√
		○ Will there be a temporary or permanent increase in road transport?	√
8	**Exposure to potentially hazardous materials** *Pesticides, fertilizers, road dust, air pollution (indoor and outdoor, vehicle-related), landfill waste or incineration ash, any other solvent, paint, oil, or cleaning agent related to the project, by-products, or release events*	○ For an existing installation: ▪ Is there a history of air/water/soil spillage? ▪ Have there been any complaints or concerns from the community regarding previous emissions?	√
		○ Will hazardous materials waste be transported to/from the site?	√
		○ Will hazardous material be used at the site?	√
		○ Are emissions expected to air, water, or soil?	√
		○ Are community exposure problems foreseen concerning the construction and operation phases of the facility?	
9	**Psychosocial (social, including key determinants of health):** *resettlement/relocation, violence, safety issues, substance abuse (drugs, alcohol, tobacco), depression, and changes in social cohesion*	○ Will the project cause an influx?	√
		○ Will there be work fields?	
		○ Is resettlement/relocation necessary?	
		○ Will the project change existing subsistence practices, i.e. access to hunting/fishing/agriculture?	
		○ Will temporary or permanent jobs be created for the local population?	√

	Environmental Health Areas (EHA)	Things to consider	Verification
		○ Will the project have any effect on equity or equality?	
10	**Cultural health practices** *role of traditional medical providers, indigenous medicines, and unique cultural health practices*	○ Will the project change the access or conventional health status service providers?	
11	**Infrastructure and capacity of health services** *Physical infrastructure, staffing levels, and competencies, technical capacities of health centers at the district level; program management delivery systems: Project coordination and alignment with existing health programs at the national and provincial levels (e.g., TB, HIV/AIDS), and future development plans.*	○ Will the project cause an influx?	√
		○ Will the project provide all health services to its workers?	
12	**Non-communicable diseases (NCDs):** *hypertension, diabetes, stroke, and cardiovascular disorders, and cancer*	○ Will the project cause an influx?	√
		○ Will there be work fields?	
		○ Will temporary or permanent jobs be created for the local population?	√

Source: Modified from IFC, 2009.

4.5. Impacts on community security

Identification of these impacts has been made based on requirements of Performance Standard 4 and determining which of those aspects are not directly evaluated in the criteria included in the EHA. These requirements are:

- Infrastructure and equipment design and security
- Emergency preparedness and response.
- Security personnel.

These impacts are evaluated in the General Matrix of Environmental Impact Assessment in EIAS (VI.A. Environmental and social impact assessment), through the Modified Leopold Matrix methodology. The segment of this assessment is also presented later in this document.

5. Baseline analysis

This chapter describes the aspects of the Health Areas established in the HIA methodology, based on Performance Standard 4, for the project implementation area. According to Table 2 and Table 3, 10 health areas will be considered in this analysis, excluding Zoonotic Problems and Cultural Health Practices, as they are considered not relevant in the area where the project is developed.

Data from official agencies such as the Ministry of Public Health of Ecuador, the National Transit Agency, and the National Institute of Statistics and Census are included. The data presented are the most current that have been published by these institutions, and are presented for the province of El Oro, given that few health data are disaggregated in more detail.

5.1. Vector-related diseases

In terms of vector diseases, the epidemiological situation of Ecuador is influenced by the distribution and density of the different vector species, especially the arboviruses transmitted by the mosquitoes Aedes aegypti and Ae. Albopictus (Dengue, Zika, Chikungunya, Mayaro), and parasitosis transmitted by mosquitoes Anopheles. (Malaria), phlebotomies (leishmaniasis) and triatomine bed bugs (Chagas disease). The population conditions of the vectors being linked to socio-economic, environmental, and ecological variables, as well as to the provision of basic services and access to timely health care, Condition the occurrence of epidemic rallies, and the maintenance of endemic vector disease transmission (Ministry of Public Health, 2021)

Table 3. Cases of vector-borne diseases in Ecuador.

Event	2015	2016	2017	2018	2019	2020*
Dengue fever	42.459	14.159	11.387	3.094	8.416	16.570
Chikungunya	33.619	1.860	196	8	2	1
Zika	1	2.947	2.413	10	0	0
Yellow fever	0	0	3	0	0	0
Malaria	686	1.191	1.380	1.806	2.081	1.946
Leishmaniasis	1.382	1.397	1.654	1.336	1.108	924
Chagas disease	45	44	61	79	167	113
Mayaro	-	-	-	-	5	-

Source: Monitoring System (SIVE-ALERTA)
Produced by: National Department of Epidemiological Monitoring
*Data 2020 for epidemiological weeks 01-53

As shown in Table 3, Chikungunya, Zika, Yellow Fever, and Mayaro, are diseases that have been decreasing their incidence in recent years.

Leishmaniasis is a disease caused by the bite of some Diptera species of the subfamily Phlebotomine (white manta), infected with parasites of the genus Leishmania. In the province of El Oro, 9 cases were reported in 2020.

Dengue is a disease caused by the bite of female Aedes Aegypti and Aedes Albopictus mosquitoes infected with the DENV virus. It can be fatal if no proper clinical care is provided. In El Oro province, 958 cases were reported in 2020. While in the canton of Machala the incidence rate of dengue of 42.3 per 100,000 inhabitants.

Malaria is a disease caused by the bite of some species of female Anopheles mosquitoes, infected with the parasites P.vivax, P.falciparum, P.malariae, and P.ovale. In Ecuador, infections are caused by P.vivax and P.falciparum, the latter being the one that produces the most complications or deaths. In El Oro province, 43 cases were reported in the year 2020

5.2. Respiratory and housing problems

Tuberculosis is a chronic infectious disease caused by the Mycobacterium tuberculosis complex, the most common form being pulmonary; however, it can also affect any other organ or tissue. It spreads through the air, the main source of infection are people with pulmonary tuberculosis who cough, sneeze, or expectorate, and who spread infecting droplets in the air that contain bacilli. Populations with certain health conditions such as people with HIV, in addition to those in custody and under the age of 15, have intrinsic and extrinsic factors that increase the risk of developing the disease.

Ecuador had an occurrence of 43 cases per 100,000 inhabitants (2017), with 6,094 total cases, of which 444 were in El Oro province (7.3 % of the national total).

Influenza is an ENDEMIC disease with a high transmission capacity caused by seasonal influenza viruses. The subtypes circulating in the country are A(H1N1)pdm09, A(H3N2), and type B.

Out of the total number of infections, 10% are considered to have a Severe Acute Respiratory Infection (SARS). The most recent data at the national level are 2018-2019, where 365 cases occurred, with a mortality rate of 2.7% (2018 November 13 - 2019 April 4). Of these, only 1 case was presented in El Oro province in the period described.

Pneumonia is the leading individual cause of infant mortality worldwide. Pneumonia is estimated to account for 15 percent of all deaths of children under the age of 5 worldwide. However, the most affected age group is 65 years and older. In 2020, 89,338 cases of pneumonia were reported in Ecuador, of which 173 occurred in El Oro province.

5.3. Sexually transmitted infections

Estimates by the MSP with UNAIDS technical support indicate that by the end of 2019, 47,206 people are living with HIV in Ecuador, of whom 4,320 were diagnosed in 2019, 257 in El Oro province (5.95%).

5.4. Diseases transmitted by soil and water

Food-borne diseases (ETAS) are generally infectious, toxic, and are caused by bacteria, viruses, or parasites that enter the body through contaminated food or water. The most common clinical manifestation is the appearance of gastrointestinal symptoms, although they can also lead to neurological, gynecological, immunological, and other symptoms.

Table 4. Cases of ETAS reported in Ecuador.

Event	2017	2018	2019	2020*
Other bacterial food poisoning	11861	15439	12203	5890
Hepatitis A	3499	4126	4314	1057
Salmonella infections	2063	2680	1614	1099
Typhoid and parathiphoid fever	1659	1476	1106	766
Shigellosis	560	386	248	112
Cholera**	1**	0	2**	0

Source: Monitoring System (SIVA-ALERTA)
Produced by: National Department of Epidemiological Monitoring
2020* Information obtained up to SE 01 *Data subject to change
**Non-toxigenic strain

Bacterial food poisoning: Bacteria can contaminate food at any time during production or processing. Symptoms include nausea, vomiting, diarrhea, abdominal pain and cramps, and fever. In Ecuador during 2020, 5,890 cases of bacterial food poisoning were reported, of which 70 cases were reported in El Oro province (1.18% of the national total).

Salmonella: Infection with this bacteria can be caused by the ingestion of contaminated animal foods such as eggs and raw derivatives, and meats not fully cooked, as well as by vegetables contaminated with feces or excrement. In Ecuador in 2020, 1,099 cases of Salmonella infections were reported, 49 in El Oro province (4.45% of the national total).

Typhoid fever: Typhoid is an acute disease caused by Salmonella enteric Typhi serovar, and paratyphoid is caused by Salmonella enteric Paratyphi A and B serovar. Transmission is fecal-oral through water and food contaminated with feces or urine from patients or carriers, vectors (flies and cockroaches) posing on foods in which they can multiply, and from person to person. The national total recorded in 2020 was 766 cases, of which 43 were in El Oro province (5.61% of the national total).

Hepatitis A: This is a liver disease caused by the hepatitis A virus (HAV). It is mainly transmitted when an uninfected person ingests something contaminated by feces from a person infected with this virus. This disease is linked to a lack of safe water, poor sanitation, and poor personal hygiene. In 2020, 1,057 cases were reported at the national level; 11 occurred in El Oro province (1.04% of the national total).

Shigellosis: This is an acute invasive enteric infection caused by bacteria belonging to the genus Shigella. It is endemic in most developing countries and is the most important cause of bloody diarrhea worldwide. In 2020, Ecuador recorded only 112 cases of Shigellosis, 4 of them in El Oro province (3.57% of the national total).

Table 5. Diseases at the national level and in El Oro province

Diseases	Total cases			
	Ecuador	**El Oro**	**% of national total**	**Machala**
Vectors				
Leishmaniasis	924	9	0.97%	
Dengue Fever	16570	958	5.78%	42.3/100,000 inh.
Malaria	1946	43	2.21%	
Respiratory and housing problems				
Tuberculosis	43 /100,000 inh.	444	7.30%	
* Influenza	365	1		
Pneumonia	89338	137		
Sexually transmitted infections				
** HIV	4320	257	5.95%	
Diseases transmitted by soil and water				
Bacterial food poisoning	5890	70	1.18%	
Salmonella	1099	49	4.45%	
Typhoid fever	766	43	5.61%	
Hepatitis A	1057	11	1.04%	
Shigellosis	112	4	3.57%	

* Between November 4, 2018 and April 13, 2019
** Data from 2019

Produced by: ECOSAMBITO

5.5. Food and nutrition issues

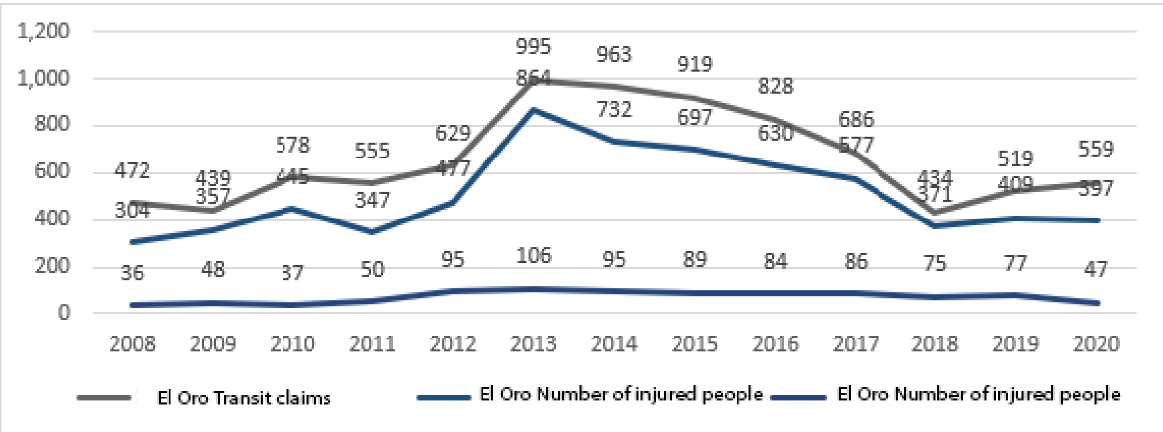
Acute malnutrition: A child with acute malnutrition is characterized by very low weight for height, may be accompanied by a degree of wasting or thinness, this type of malnutrition should be detected, be reported, and managed promptly because in a short time the child can go to a severe degree of acute malnutrition and be complicated by infectious diseases, being the leading cause of deaths among children in malnutrition. ***Moderate acute malnutrition***: Any patient younger than five years whose Z-score of the P/T indicator according to the WHO infant growth patterns may be accompanied by moderate weight loss or thinness.

Severe acute malnutrition: Any patient under 5 years of age whose Z-score of the P/T indicator according to the WHO infant growth patterns is below–3DE may also be accompanied by bilateral edema, severe wasting, and other clinical signs such as lack of appetite.

In 2018, Ecuador reported 3,549 cases of acute childhood malnutrition, of which 161 occurred in El Oro province. Full data are not available for subsequent years.

5.6. Accidents and injuries

Figure 3. Traffic accidents and injuries statistics



Source: National Transit Agency – Directorate of Studies and Projects

Data from the National Transit Agency - Directorate of Studies and Projects, regarding traffic incidents in El Oro province, show that these had a significant increase between 2012 and 2015, from when they begin to decrease. This situation is probably due to the improvement in the quality of road infrastructure, signaling, and improvement of the motor park. A slight increase has been observed since 2018. In 2020, in the province of El Oro, 559 incidents were recorded, with 47 persons killed.

5.7. Exposure to potentially hazardous materials

Toxics are substances capable of producing structural or functional injuries in an organ or system, and even causing death if they are present in the body in sufficient quantities.

Table 6. Cases of toxic and chemical effects, per year

Cases of toxic and chemical effects per type. Ecuador, years 2017, 2018, 2019, 2020, and 2021 (SE 12)					
EVENT	2017	2018	2019	2020	2021*
Pesticide poisoning	689	425	410	216	74
Snake bite	1450	1431	1489	1438	340
Scorpion sting	328	342	433	221	95
Methyl alcohol poisoning	75	5	7	1	0

ECUADOR SIVE-ALERTA TOXIC AND CHEMICAL MONITORING SUB-SYSTEM
Source: Monitoring System (SIVE ALERTA)
Prepared by: National Department of Epidemiological Monitoring
Information obtained up to the week 14 year 2021.
*data subject to changes.

As it can be seen in the statistics, pesticide poisonings are the most common events of exposure to hazardous substances. Out of the 216 national incidents in 2020, 32 occurred in El Oro province.

There are no records that there has been exposed to potentially hazardous materials in Puerto Bolivar or Machala. Industrial development is still recent, and when we talk about hazardous substances, we can identify the storage and marketing of fuels as the main risk in this regard, in addition to the handling of mineral concentrate for export, which includes: Transport, storage, handling, and shipping. This activity could be a new risk to which it is primarily exposed to workers who handle it, as the health risk is caused by prolonged exposure and inhalation.

The internal instructions in force at the Port Terminal and which are a priority part of the operation are: YECU-EHS-113- Instruction Mineral Spill Rotainer and YECU-EHS-SI-04-22-V5- BIG BAG Handling Instruction.

5.8. Psychosocial: Social determinants

For the description of this area of health, information was collected that addresses social aspects: Human Development Index, Poverty, Gini Coefficient and Education; Physical: Violence, Security and Mobility; and Economic: Population Demographics, VAB/PBI, Economic Active Population (EAP), Employment, Underemployment, Unemployment, and Degree of openness).

Table 7. Social indicators of Machala canton

Aspects	Social Determinants	Machala canton
Social	Human Development Index	0.755
	Poverty	8.6%
	Extreme poverty	2.0%
	Gini coefficient	0.411
	Education (illiteracy)	3.6%
Economic	Population demography	286,120.0
	VAB/PBI	3.32%
	Active Economic Population (EAP)	1.96%
	Employment Underemployment Unemployment	1.80% 0.38% 0.08%
Physical	Degree of openness	32.63%
	Security and mobility	73
	Violence (intrafamily, ill-treatment)	25.00%

5.9. Infrastructure and capacity of health services

In El Oro province, according to data from 2019, there are 38 health facilities, between public and private, totaling 1,089 hospital beds, with an occupancy rate of 54.07% (INEC, 2019).

Out of the health facilities in the province, 5 are general hospitals and 23 are basic hospitals.

The table below shows the health infrastructures of Puerto Bolívar parish and Machala canton.

Table 8. Health infrastructure in Machala and Puerto Bolívar.

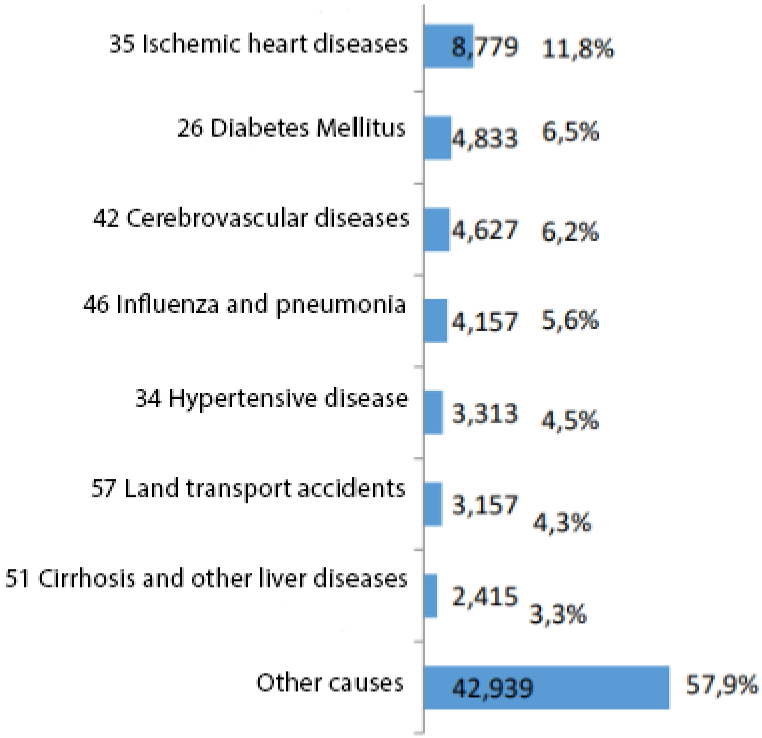
Health Infrastructure	
Puerto Bolivar Parish	**Machala Canton**
▪ Subcentro Amazonas ▪ Subcentro Puerto Bolívar ▪ Epidemiological Monitoring Post	▪ Hospital General Teófilo Dávila ▪ Hospital General Machala (IESS) ▪ Subcentro Patria Nueva ▪ Subcentro Brisas del Mar ▪ Subcentro 18 de Octubre ▪ Subcentro Buenos Aires ▪ Subcentro Venezuela ▪ Subcentro San Martín de Porres ▪ Subcentro Velasco Ibarra ▪ Subcentro Rayito de Luz ▪ Subcentro El cambio La Iberia ▪ Subcentro El Paraíso ▪ Subcentro El Aguador ▪ Subcentro El Retiro ▪ Subcentro El Bosque ▪ Subcentro Dra. Mabel Estupiñán

Source: Ministry of Health, 2017

5.10. Non-communicable diseases

Diabetes, high blood pressure, stroke, cancer, and chronic respiratory diseases cause up to 70% of deaths worldwide. Risk factors include poor nutrition (a diet low in fruits and vegetables, and high in processed products), tobacco and alcohol consumption, and a sedentary lifestyle.

Figure 4. Main causes of general death in Ecuador, 2019



Source: Statistical Registry of Deaths

2016 data from the Ministry of Public Health show morbidity and mortality for Machala and Puerto Bolívar, of the main diseases or non-communicable conditions.

Table 9. Major non-communicable diseases

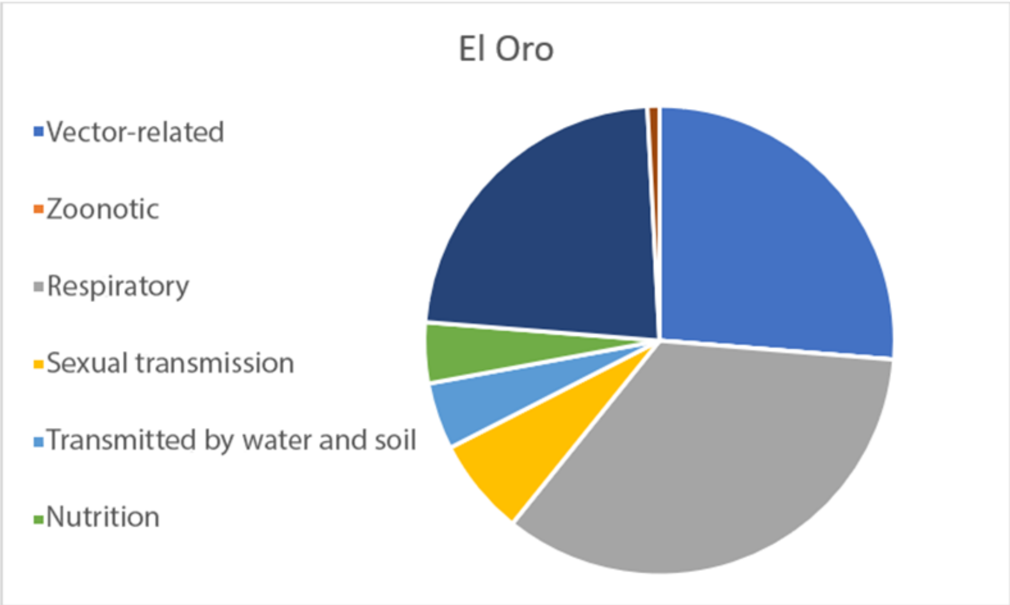
Non-communicable diseases	Machala		Puerto Bolívar	
	Morbidity	Mortality	Morbidity	Mortality
Hypertension	2,668	43	255	5
Diabetes	1,105	103	54	21

Source: Ministry of Health, 2016

5.11. Summary of results

The results for El Oro province, in terms of the main health areas analyzed, are shown in the following figure. In this case, water-borne diseases, vector-borne diseases, and respiratory diseases are the most common.

Figure 5. Representation of cases by health area in El Oro province, 2020



Source: Ministry of Public Health

6. Social actors and stakeholders

The detailed identification of social actors and stakeholders of the Puerto Bolívar project is developed in Book IV.C. Social Baseline, developed in the EIAS (Chapter 16).

Individuals, organizations, institutions, and any other group that may be or may feel affected, or in turn, directly or indirectly affect the development of the project, have been obtained from three sources: 1) Previous social participation processes of the project, 2) Surveys, information workshop, and interviews conducted with part of the primary information survey, 3) Secondary information.

Identified social actors include both potentially affected communities (PACs) for health and safety issues and institutions that play a key role in community health (stakeholders).

Table 10. Stakeholders of Puerto Bolívar project

Category	Name	PAC	Interested parties
Control institutions	Ministry of the Environment and Water		
	El Oro Provincial Government		
	GAD Machala		

Category	Name	PAC	Interested parties
	Government of El Oro Province		
	Fire Corps of Machala Canton		
	National Police - Emergencies		X
	Community Police Unit Puerto Bolívar		
	Attorney's Office in Puerto Bolivar		
	Puerto Bolívar Captaincy		
	Coast Guard Sub Command		
	Port Authority of Puerto Bolívar		
Formal organizations	Shrimp Associations		
	El Oro Fishing associations		
	Tourist transport associations		
	Women's organizations	X	
Educational institutions	Schools, universities		
Neighborhood organizations	Neighborhoods of Puerto Bolivar	X	
Health institutions	Municipal health centers and the Ministry of Public Health		X
Sub-contractors	Contractors and subcontractors	X	
Suppliers	Suppliers		
Financial institutions	Financial institutions		
Employees	Employees	X	
Customers	Customers		

7. Risk analysis

7.1. Health impacts

7.1.1. Aspects that impact health

Typical health impacts are described below.

An influx of people. This impact is linked to a significant migration, caused by project activities, which may include workers, their families, service providers, among others, temporarily or permanently settled in the communities around the project. Interaction between local and imported workers can facilitate the spread of respiratory diseases, which can also affect the community. Another risk is the spread of food-borne diseases that can go between the workplace and the community, and vice versa, via food suppliers and small businesses in the area.

Resettlement and relocation. The health effects of such events can be varied and complex. The Puerto Bolívar project will not cause resettlement or relocation of people.

Water management. During the construction period, the project may lead to the creation of new vector focuses, such as mosquitoes. The accumulation of tires, tanks, and other containers, the formation of temporary puddles, and stagnation of water, can become important mosquito breeding sites, with the consequent increase in the risk of outbreaks of dengue, malaria, and other endemic diseases. This concern is greatest in the rainy season from January to June.

Linear characteristics. Any physical structure (roads, bridges, transmission lines, pipes, river systems, etc.) that crosses and/or connects various ecological or human populations can be considered a linear characteristic. Linear characteristics have the potential to have both positive and negative health consequences, as they facilitate the movement and interaction of various human groups.

Control and disposal of hazardous materials. Inadequate internal management of these materials can cause them to be reused by the population, with unusual consequences (e.g., increased small-scale breeding grounds for dengue mosquito vectors). In addition, waste storage drums that have industrial waste can adversely impact domestic food and water supplies because these containers are often appreciated as cost-effective storage devices.

Changes in revenue and consumer spending. A potential significant impact of projects is that they can positively alter income levels in the community and households, which could lead to an improvement in a community's health performance indicators. On the contrary, projects can trigger significant food or housing inflation, which can adversely affect existing vulnerable groups, with negative consequences on individual and community health performance indicators. Significant and sudden changes in income can have a marked effect on alcohol consumption and consequent gender-based violence. Labor force education and training are key mitigation activities possible.

Infrastructure and facilities. Large projects demand a significant amount of physical structures that can affect the overall human environment (wastewater treatment plants, maintenance yards, administrative office buildings, among others). All of these structures can have a potential positive or negative impact on local communities. It is important to analyze different facilities so that primary design changes can be made to mitigate negative impacts efficiently and cost-effectively.

7.1.2. Identification and assessment of impacts on health areas

The identification of the health impacts to be evaluated is done through a matrix by health areas and considering each of the typical aspects described above.

The assessment, based on the risk analysis described in the methodology, is shown below:

Table 11. Risk analysis of identified impacts.

Health Areas	Impacts	Probability	Consequence	Risk
Vector-related	Increased human parasitic burden (malaria)	1	B	Low
	Creation and displacement of vector breeding areas	2	B	Low
	Creation of domestic breeding sites by reuse/recycling of	1	B	Low
	Creation of breeding grounds due to inadequate drainage and creation of temporary ponds	1	B	Moderate
Respiratory and housing	Overcrowding in community housing	3	C	High
	Housing inflation with overcrowding as a result	1	B	Low
Sexually transmitted infections; HIV/AIDS	A mixture of high and low prevalence groups	1	C	Low
	A mix of men with money and vulnerable women	1	C	Low
Soil, water, and sanitation	Explosive epidemics of food origin	1	C	Low
	Changes in surface water quality	2	C	Low
	Long-term impacts on groundwater	1	C	Low
	Potential reduction of groundwater	1	C	Low
Food and nutrition	The extended family influx and pressure on the family economy	2	B	Low
	Changes in access to local markets	1	B	Low
	Long-term impacts on groundwater	1	B	Low
	Potential reduction of groundwater	2	B	Low
Accidents and injuries	Overcrowding, falls, burns, road traffic	2	B	Low
	Road traffic, increased pedestrian activity	4	C	High
	Unplanned discharges/emissions	3	D	High
Exposure to hazardous materials	Adjacent populations with unplanned discharges	1	D	High
	Truck travel of hazardous materials through the communities to project areas	3	D	High
	Use of project containers for water storage and food	1	B	Low
	Release of contaminants in water bodies used by the community	2	C	Moderate
Social determinants of health	Cultural shock due to rapid social change	1	B	Low
	A mixture of different social/ethnic groups	1	TO	Low
Infrastructure and capacity of health services	Increased outpatient and inpatient service requests	3	TO	Low
	Changes in access	1	B	Low
	Attracting more private providers/increasing insurance membership	1	B	Low
Not Communicable	Changes in diet	1	B	Low
	Change to a sedentary lifestyle	1	B	Low

As stated in the methodology, the risks to be managed by the project are those whose risk rating was Moderate, High, or Very High. For impacts that pass this filter, manageability will also be analyzed qualitatively.

Manageability is the ability to influence risk through risk responses (proactive or reactive) and is given by the following scale.

HIGH: Under the control of the Project Management team. It is possible to control the probability and/or consequence.

MEDIUM: Within the influence of the Project Management team. It is possible to influence probability and/or consequence.

LOW: Outside the influence of the Project Management team. It is only possible to influence the consequence.

Table 12. Health impacts to be managed

Impacts		Risk	Manageability
1	Creation of breeding grounds due to inadequate drainage and temporary ponds	Moderate	High
2	Road traffic, increased pedestrian activity	High	Medium
4	Unplanned discharges/emissions	High	High
4	Adjacent populations with unplanned discharges	High	Low
5	Truck travel of hazardous materials through the communities to project areas	High	Low
5	Release of contaminants in water bodies used by the community	Moderate	Medium

The impacts that will be directly managed by Yilportecu are those of high and medium manageability. For those impacts of low manageability, measures are proposed to minimize their consequences through actions with project partners, such as health care and training.

7.2. Safety impacts

As mentioned in the methodology, the following aspects will be integrated into the analysis, in compliance with ND4, to cover the impacts that project activities can generate on community security:

- Infrastructure and equipment design and security
- Emergency preparedness and response.
- Security personnel.

Impacts are evaluated very similarly in the 3 project phases considered in this study: Construction, Operation, and Dredging.

Table 13. Safety risk assessment.

OPERATION/CONSTRUCTION AND DREDGING					Address	Probability	Magnitude	Extension	Duration	Frequency	Reversibility	QUALIFI-CATION	HIERARCHY
Medium	Compo-nent	Environmental aspect	Impact Environmental	Description									
Medium	Health community safety	Infrastructure and equipment design and security	Risks to the safety and health of the population due to infrastructure failures.	Includes all risks to which an external person is exposed when entering the infrastructure: physical trauma due to building failure, burns and smoke inhalation in the event of fire, injuries as a result of falls or contact with heavy machinery, alterations of the respiratory system caused by dust, fumes or harmful odors,exposure to hazardous materials.	-1	0,3	3	3	2	0	2	-3	Mild negative
		Health community safety	Health community safety	Some incidents or accidents, depending on magnitude, may affect to varying degrees the community that is related to the project. These emergencies may include explosions, fires, accidental discharge leaks, etc.	-1	0,1	3	2	3	0	2	-1	Mild negative
		Health community safety	Health community safety	The use of security personnel runs the risk of abuse of force, and is contrary to the human rights of the population.	-1	0,1	2	1	1	0	2	-0,6	Mild negative

8. Community Health and Safety Overview.

8.1. Objectives

- Have measures to avoid the risks to the health and safety of the potentially affected Communities, arising from both routine and unusual circumstances.
- Ensure that the safeguarding of personnel and property is carried out in accordance with the relevant human rights principles, avoiding or minimizing risks to the Communities concerned.

8.2. Scope

This Plan contains the measures and actions necessary to prevent and counteract the risks and impacts on the health and safety of communities that may be affected throughout the life cycle of the project.

The guidelines of the World Bank Group on Environment, Health, and Safety (MASS) or other internationally recognized sources have been used to identify appropriate measures to take action on these risks and impacts.

8.3. Responsibilities

The implementation of this Plan will be the responsibility of the HSE Department, and will also be extended to the Expansion Project Contractors, through its General Management and HSE Department.

8.4. Disclosure

This plan should be disclosed to the Communities potentially affected by the project. Where complex health and safety aspects are presented in the different phases of the project, it will be advisable to hire external experts to carry out an independent evaluation. Complementing the process of identifying risks and impacts required by Performance Standard 1 that can be fed and strengthened during the project cycle.

8.5. Proposed measures

8.5.1. Disease control

Vector cleaning and control

Both Yilportecu staff and project contractors, through their departments of Maintenance and Safety, Health and Environment (SSA, HSE, or other designation) will continue to do the following:

i. Routine maintenance of all project areas and work fronts, order control, and cleaning. The accumulation of standing water and trash deposits in the open air should be avoided. Check for clean and clear drains.

ii. Periodic maintenance (at least monthly) of the rainwater drains. During the rainy season, it should be weekly.
iii. Continue periodic inspections of bathrooms, dining room, and restrooms. Cafeterias should receive special attention on disinfection and general hygiene.
iv. Maintain periodic fumigation plan for vector control, at work fronts, warehouses, yards, offices. The frequency will depend on the season of the year and the type of vector to be controlled.
v. Perform a monthly cleaning and disinfection of the areas outside the Port Terminal. To promote their cleansing and ornate through campaigns to sensitize workers not to carry out biological needs abroad, nor as a dump.
vi. Timely management of tanks, drums, and other containers of hazardous and non-hazardous substances through MAAE-authorized managers. Maintain optimal conditions at the Hazardous Waste Collection Center according to NTE INEN 2266, until delivery to the manager. Tanks, drums, and other containers should be drilled in their base, with the aim of preventing them from being collected by villagers in the sector for domestic or commercial use.

Prevention and control of diseases in staff

Both Yilportecu staff and project contractors, through their Departments of Safety, Health, and Environment (SSA, HSE, or other designation) will continue to do the following:

i. Training of staff in preventive measures and good health practices. The following topics should be addressed, with the schedule established by each medical department:
    - Ergonomic care training
    - Cardiovascular health and EKG
    - First Aid Workshop
    - Prevention HIV - AIDS
    - Sexual and reproductive health
    - Prevention of alcohol and drug use
    - Raising awareness to prevent gender-based violence
ii. Continue with the following preventive campaigns:
    - Deworming campaign
    - Vaccination campaign
    - Active break campaign
    - Diabetes prevention campaign
iii. Medical care on-site
iv. Medical follow-up through Pre- and Post-Occupational Health Forms, preventive and special examinations.

Protocols regarding COVID 19

Both Yilportecu staff and project contractors, through their Departments of Safety, Health, and Environment (SSA, HSE, or other designation) will continue to do the following:

i. Adopt the Good Health, Safety, and Hygiene Practices for the Prevention of the Spread of Covid-19 and Other Infectious Diseases (ANNEX 1), in development projects funded by the IDB. The purpose of this Technical Note is to provide safety, health, and hygiene recommendations for the prevention of infectious disease infections and indicate recommendations for preventing infection and managing the situations of personnel infected in these, including possible cases of COVID-19 responsibly.
ii. To continue with the requirement for the submission of COVID-19 tests to contractor and subcontractor personnel and the implementation of the current Biosecurity Plan (YECU-EHS-01-07-V9_BIOSECURITY Plan), and recommendations for best practices from local health authorities and competent multilateral agencies (PAHO/WHO).

8.5.2. Mobility and traffic impact control

Ground traffic impact control

Both Yilportecu staff and project contractors, through their departments of Physical Safety and Health and Environment (SSA, HSE, or other designation) will continue to do the following:

i. Assess existing risks where members of the public will have access to new constructions or structures, including their possible exposure to operational accidents or natural hazards, and will be consistent with the principles of universal access.
ii. The implementation of structural elements that allow universal accessibility (ramps, railings, emergency accesses, others) shall be designed and constructed by qualified professionals and shall be certified or approved by competent authorities or professionals. In the case of mobile equipment on public roads and other forms of infrastructure, measures should be taken to prevent the public from being affected by incidents and injuries related to the operation of such equipment.
iii. Implement with transit authority:
    - Safe pedestrian steps in the areas surrounding the Port Terminal's revenue.
    - Signs on the port access road, indicating the permitted speed limit for cargo vehicles.
    - Use of traffic lights and organization, in the revenue and departure of vehicles in the Port Terminal.
iv. If more than 10 vehicles are expected to be in or out of the Terminal, designate a traffic controller to monitor vehicle progress in groups of 5 units. All other units must remain on standby with the engine off.

v. Implement clean points (waste sorting sites) in the Waiting Area inside the Terminal, so that carriers can dispose of the waste generated on their route properly.

vi. Implement a formal commitment with carriers and their associations to:

- Comply with and follow the guidelines given by the traffic controller in case waiting queues are expected to enter and exit the Terminal.
- Prioritize the use of visible signals such as flashing lights, rather than audible signals. If required, audible signals must not exceed permissible noise limits.
- Correct final disposal of solid waste generated in transport.

vii. Maintain and update feature indicators as:

- Times of permanence and anchorage of vessels in port.
- Waiting time for transport units to enter and exit.

And analyze their developments at least quarterly, to take additional measures if necessary.

viii. When subcontractors carry out transportation-related activities, Yilportecu must use commercially reasonable efforts to influence the safety of these service providers, contractually requiring the analysis of traffic safety risk and the adoption and implementation of driver safety programs. For this, it is important to comply with emergency preparedness and response to road emergencies that address emergency driver and third-party assistance contingencies equally, especially in remote locations or situations with little capacity to cope with emergencies involving traumatic and other serious injuries.

ix. Where new buildings have public access, the design must be consistent with the principles of universal access. The issue of accessibility is one of the key principles of the Convention that should be included in the design and operation of buildings intended for public use. The concept of "universal design" is defined in Article 2 of the United Nations Convention as follows: "the design of products, environments, programs, and services that can be used by all people, to the greatest extent possible, without the need for adaptation or specialized design. The "universal design" will not exclude technical support for particular groups of people with disabilities, when needed." The concept of "Reasonable adjustments" can be used in situations where Universal Design alone is insufficient to remove obstacles to accessibility. As defined in the United Nations Convention, "Reasonable adjustments" means "necessary and appropriate modifications and adaptations that do not impose a disproportionate or undue burden, when required in a particular case, to ensure enjoyment or exercise by persons with disabilities, on an equal footing with others, all human rights and fundamental freedoms".

Impact control by maritime traffic

Both Yilportecu staff and project contractors performing water body operations, through their departments of Physical Safety and Health and Environment (SSA, HSE, or other denomination), in the event of impasses with fishing, commercial or tourist vessels, in the maneuvering areas or access channel, you must:

i. In the event of an inrush or blocking of the access channel or maneuver zone, the vessel will be assisted in communicating to the vessel in a ship transit zone and requesting the withdrawal. If necessary, the fact will be reported to ECU 911, from where the Captaincy of Puerto Bolívar is informed for its intervention. If there are any complaints from the occupants of the vessel, proceed in accordance with Measure 7.3. Attention to suggestions, queries, and complaints.

ii. To disseminate this plan to fishermen and their associations, being the main actors in the project's area of influence.

iii. Establish discussion tables with the mediation of representatives of public institutions and/or social facilitators, in case of disputes or claims.

8.5.3. Project infrastructure safety

Infrastructure

During the design stage, to ensure the reduction of possible safety risks, the following measures must be taken into account:

i. Inclusion of a seat belt or other methods of physical separation around the project site to protect the public from the main risks associated with hazardous material incidents or process failures, as well as noise, odor, and other emission-related inconvenience.
ii. Incorporating technical safety criteria and site selection to prevent accidents caused by natural hazards such as earthquakes, tidal waves, wind, floods, landslides, and fires. All buildings must be designed according to technical and design criteria based on site-specific hazards, in particular, but not exclusively, seismic activity, soil stability, wind intensity, and other dynamic loads.
iii. Application of local or internationally recognized building codes and regulations ensures buildings are designed and built under good architectural and engineering practices, including fire prevention aspects and fire emergency plans.

iv. Technicians responsible for the design and construction of facilities, buildings, plants, and other structures must demonstrate proven experience in the design and construction of projects of similar complexity. Qualifications can be demonstrated through the combination of formal technical training and practical experience, or membership in a more formal professional association, national, and international certifications.

v. For complex structures, the need for prior certification and approval of structural elements and engineering safety skills, including geotechnical, structural, electrical, mechanical, and fire specialties, must be established by professionals from national or international professional organizations authorized to perform these tasks, and/or local regulatory agencies that control these matters. Buildings accessible to the public must be designed, built, and operated in full compliance with the local building code(s), fire department standards, local legal/insurance requirements, and in accordance with an internationally accepted life and fire safety standard (L&FS[1]).

vi. While major design modifications are not feasible for ongoing projects, risk analysis can be performed to identify opportunities to reduce the consequences of a failure or accident. For example, reduce the likelihood and consequences of accidental leaks, spills, or leaks of hazardous materials by:
   - Improvements in inventory and process management;
   - improvements in operations and control systems;
   - maintenance and inspection activities; and
   - improvements to existing equipment and infrastructure.

Port maritime operation

Both Yilportecu staff and port operators (OPC, OPSC) operating inside the terminal, through their departments of Physical Safety and Health and Environment (SSA, HSE, or other designation) will continue to implement and continuously improve their respective security management systems (SMS) that are capable of effectively identifying and correcting unsafe conditions, including:

i. Procedures for regulating the safe movement of vessels within the port (pilotage, port control, and ship traffic services, navigation aids, and studies of hydrography, among others), actions to protect the general public and surrounding communities from hazards arising from offshore and port activities, and to prevent events that could result in injury to workers and the public, including fishermen and recreational users.

[1] Available at https://www.ifc.org/wps/wcm/connect/3590ce6b-b3ab-42b8-b061-416719168937/Life%26FireSafety.pdf?MOD=AJPERES&CVID=jqeIe4L

ii. Comprehensive emergency preparedness and response plans, which provide a coordinated response based on government, port authority, port users, and community resources needed to manage the nature and severity of the emergency event, Included or complementary to Document YEC-EHS-01-010-V3_Oil Spill Contingency Plan and the National Plan.

Port security

Both Yilportecu staff and project contractors, through their departments of Physical Safety and Health and Environment (SSA, HSE, or other designation) will continue to do the following:

i. Periodic training of port operators on their responsibilities, including international legal and technical obligations, to provide security to passengers, crews, and personnel at the port, in accordance with the provisions of the current PBIP Compliance Statement of the Port Terminal.

8.5.4. Emergency and contingency

Both Yilportecu staff and project contractors, through their departments of Physical Safety and Health and the Environment (SSA, HSE, or other designation) must:

i. Plan and execute, together with the competent authorities, an annual drill involving the community: Public institutions, educational institutions, guilds, and other actors within the area of potential involvement, for fire and explosion events, floods and tsunamis, evacuation.
ii. Develop posters, diptychs, or other information mechanisms to disseminate the emergency and contingency plans of the project to natural and anthropic events that may generate community affectations. This information should contain the main actions to be taken in the event of an emergency.
iii. Provide relevant local authorities, emergency services, and affected communities and other social actors with information on the nature and scope of environmental and human effects that may result from routine operations and unplanned emergencies at the project site.

Information campaigns should describe appropriate behavior and security measures in the event of an incident and actively seek the affected community's views or other social actors concerning risk management and preparedness. Consideration should also be given to the inclusion of the affected Community and other social actors in regular training exercises (e.g. simulations, exercise evaluations, and actual events) in order to familiarize them with appropriate procedures in case of emergency. Emergency plans should address the following aspects of preparedness and response:

- Specific emergency response procedures

- Trained emergency response teams
- Contacts and communication systems/protocols in case of emergency, including notification to authorities, emergency services, and neighboring communities affected or susceptible to compromise.
- Procedures for interaction with local and regional authorities emergency and health
- Permanent emergency equipment and facilities (first aid stations, fire extinguishers and hoses, sprinkler systems)
- Protocols for emergency vehicle services such as auto pumps, ambulances, and others
- Evacuation routes and meeting points
- Drills (yearly or more frequently as needed)

8.5.5. Community Impact Prevention Plan by the Physical Security Services

Both Yilportecu staff and project contractors, through their Physical Security and Human Resources departments, must implement physical security service contracting protocols that include:

i. Conduct reasonable investigations to ensure that security officers have not been involved in past abuses.
ii. Continue with the demand for ongoing training in the proper and proportional use of force (and, where appropriate, firearms), appropriate behavior toward the workers and communities concerned, and respect for applicable law, and good international practices (E.g. the United Nations Code of Conduct for Law Enforcement Officials and the UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials).
iii. In no case shall the use of force be approved, except for preventive and defensive purposes proportional to the nature and extent of the threat.
iv. The complaint handling mechanism of affected employees and communities should also consider the concerns of these groups regarding security arrangements and the actions of security personnel.
v. Consider and, where appropriate, investigate any reports of illegal or abusive acts of security personnel, take measures (or urge the relevant parties to take them) to prevent such acts from recurring, and report such acts to the public authorities.

9. Monitoring and evaluation

The measures established in the Community Health and Safety Plan should be monitored and evaluated to know their status of implementation, adapt existing measures, or design and implement new measures if required.

To do this, the Departments involved in both Yilportecu and the project contractors must report and keep their records and indicators of:

- Diseases and health conditions are found through their periodic monitoring and control reports.
- Statistics of safety incidents with sector dwellers and other actors, whether by road, pedestrian, maritime, or another form of interaction.
- Reports of security incidents, investigations carried out, and corrective actions taken for each reported incident.
- Technical report for building construction that includes the key elements adopted for improving security and accessibility to the general public, certifications achieved, others considered necessary for the design of the respective operational, maintenance, and emergency and contingency plans.

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11. Annexes

Annex 1. Technical Note on Good Health, Safety, and Hygiene Practices for the Prevention of Transmission of Covid-19 and Other Infectious Diseases, in IDB-funded development projects.

I, Miguel Angel Pantoja Shimanskii, certify that the present document consisting of 47 pages in english was translated from its original version in spanish, it's accurate to the best of my capacities as a Sworn Court Certified Translator of the Judicial Council of Ecuador.

Yo, Miguel Angel Pantoja Shimanskii certifico que el presente documento que consta de 47 páginas en ingles fueron traducidas de su versión original en español, son precisas en mis capacidades como traductor calificado y jurado del Consejo de la Judicatura.

Nombre/ Name: Miguel Angel Pantoja Shimanskii
CC/National ID #:1717206534

Fecha/Date: 1 de Junio 2021 / June 1, 2021
Número de calificación/ Qualification number: 1840315
Correo electrónico/email: m.pantoja@translatorsecuador.com
Tel: +593. 999946572

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