Environmental Impact Assessment and Environmental Management Plan

Dredging of Piers 1,2,3,4,5 and 6 Maneuvering Area and Access Channel of Puerto Bolivar

[Logo of YILPORT – PUERTO BOLIVAR]

[Logo of ECOSFERA – ENVIRONMENTAL CONSULTING]

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EXECUTIVE SUMMARY

YILPORTECU S.A., within its Modernization project of the Port Terminal of Puerto Bolívar, has planned the fulfillment of the Environmental Impact Study for the Dredging of the Docks, Maneuvering Zone, and Access Channel of Puerto Bolivar.

The EsIA comprises the description of several components Physical, Biotic, and Socioeconomic Environment, Project Description, Influence Area Determination, Alternative Analysis, Impact Identification and Valuation, Risk Analysis, and the Design of an Environmental Management Plan.

The area is located in the Santa Rosa area and corresponds to the navigation axis line to access the Maritime Terminal of Puerto Bolivar.
For the Dredging material deposit (Sediments) of Piers #1, #2, #3, #4, #5, and #6, the site located on ISSFA former premises has been considered, the volume to be dredged is 575,384.84 m3. While a delimited overseas area is available for the sediment depot of the Maneuvering Zone and Access Channel dredging, the volume to be dredged in these areas is 7'000,000 m3.

1.- DATA SHEET

List 1: Project Data Sheet

SUBJECT CONTROL INFORMATION			
Name of the Company (control subject):	YILPORT TERMINAL OPERATION S (YILPORT ECU) S.A.		
Legal representative:	Ing. Carlos Cruz Hernandez		
Main Economic activity	**Province:** El Oro **Canton**: Machala **Parish**: Puerto Bolívar **Address**: **Av. Bolívar M. Vargas s/n. Port Authority Building of Puerto Bolivar**		
Telephone (Landline/mobile):	0989576178	E-Mail	carlos.cruz@yilport.com.tr
Business type:	Private	Public	Joint
	X		
ENVIRONMENTAL CONSULTANT			
ECOSFERA CIA. LTDA. MAE - SUIA - 0010 - CC			
PROJECT INFORMATION			
Name of the project:	Dredging of Docks 1, 2, 3, 4 and 5, 6, Maneuver Zone and Access Channel of Puerto Bolívar		
Geographical Location:	**Province**:El Oro **Canton**: Machala **Parish**:Puerto Bolívar		
Project Phase:	**Construction**	**Operation**	**Closure/Abandonment**
		X	
CCAN code:	**CONSTRUCTION AND/OR OPERATION OF DREDGING WORKS OF RIVER AND/OR SEA SOURCES**		
Intersects with a Protected Area	**Yes:**	**No: X**	
WGS84 COORDINATES			
DREDGING COORDINATES OF PIERS 1, 2, ,3, 4, 5, 6 AND MANOEUVRING AREA			
East (X): 610956	**North (Y): 9639311**	**Altitude (masl): 0 m**	
East (X): 610478	**North (Y): 9639203**	**Altitude (masl): 0 m**	
East (X): 609957	**North (Y): 9639327**	**Altitude (masl): 0 m**	
East (X): 610347	**North (Y): 9639927**	**Altitude (masl): 0 m**	

East (X): 610216	**North (Y): 9640713**	**Altitude (masl): 0 m**
East (X): 611014	**North (Y): 9640712**	**Altitude (masl): 0 m**
ACCESS CHANNEL COORDINATES		
East (X): 610141	**North (Y): 9640786**	**Altitude (masl): 0 m**
East (X): 609917	**North (Y): 9642098**	**Altitude (masl): 0 m**
East (X): 609498	**North (Y): 9644527**	**Altitude (masl): 0 m**
East (X): 608686	**North (Y): 9646508**	**Altitude (masl): 0 m**
East (X): 608189	**North (Y): 9647676**	**Altitude (masl): 0 m**
East (X): 605878	**North (Y): 9648244**	**Altitude (masl): 0 m**
East (X): 605974	**North (Y): 9648726**	**Altitude (masl): 0 m**
East (X): 608511	**North (Y): 9648113**	**Altitude (masl): 0 m**
East (X): 609175	**North (Y): 9646587**	**Altitude (masl): 0 m**
East (X): 609970	**North (Y): 9644652**	**Altitude (masl): 0 m**
East (X): 610433	**North (Y): 9642109**	**Altitude (masl): 0 m**
East (X): 610654	**North (Y): 9640792**	**Altitude (masl): 0 m**
ACCESS CHANNEL AND MANEUVERING ZONE OFFSHORE SEDIMENT DEPOSIT AREA		
East (X): 583880	**North (Y): 9651278**	**Altitude (masl): 0 m**
East (X): 585837	**North (Y): 9651184**	**Altitude (masl): 0 m**
East (X): 585560	**North (Y): 9649187**	**Altitude (masl): 0 m**
East (X): 583544	**North (Y): 9649248**	**Altitude (masl): 0 m**
PIPELINE COORDINATE TRAJECTORY PATH FROM PIERS TO SEDIMENT POOL		
East (X): 610931	**North (Y): 9639816**	**Altitude (masl): 0 m**
East (X): 611233	**North (Y): 9639806**	**Altitude (masl): 0 m**
East (X): 611697	**North (Y): 9640103**	**Altitude (masl): 0 m**
East (X): 611804	**North (Y): 9640152**	**Altitude (masl): 0 m**
East (X): 611925	**North (Y): 9640110**	**Altitude (masl): 0 m**
SEDIMENT POOL COORDINATES		
East (X): 611860	**North (Y): 9640136**	**Altitude (masl): 3 m**
East (X): 612034	**North (Y): 9640067**	**Altitude (masl): 3 m**
East (X): 612130	**North (Y): 9640308**	**Altitude (masl): 2 m**
East (X): 612169	**North (Y): 9640505**	**Altitude (masl): 4 m**
East (X): 612027	**North (Y): 9640551**	**Altitude (masl): 6 m**
East (X): 611950	**North (Y): 9640585**	**Altitude (masl): 7 m**
East (X): 611875	**North (Y): 9640626**	**Altitude (masl): 8 m**
East (X): 611766	**North (Y): 9640402**	**Altitude (masl): 5 m**
East (X): 611927	**North (Y): 9640295**	**Altitude (masl): 1 m**

Source: Prepared by the authors
Created by: Ecosfera Cía. Ltda.
Location: Puerto Bolívar, Machala, Santa Rosa - El Oro
Date: May 11, 2017

MEMBERS OF THE ADVISORY TEAM			
Name	**Professional Training**	**Participation Component in the Research**	**Responsibility Signature**
Harry Veintimilla Pro	Engineer Agronomist	▪ Project Manager ▪ Legal and Institutional Framework	[Signature]
Claudia Cordero	Environmental Engineer	▪ Environmental Baseline Survey ▪ Project Description ▪ Impact Identification and Valuation ▪ Risk Analysis ▪ Development of EMP	[Signature]
Alex Arias	Engineer in Environmental Management	▪ Impact Identification and Valuation ▪ EMP	[Signature]
Edwin Pacheco	Forestry Engineer	▪ Biotic Component ▪ Forestry inventory ▪ Valuation of Assets and Environmental Services	[Signature]
Jorge Intriago	Biologist	▪ Biotic Component	[Signature]
Vladimir Ordoñez	Environmental Engineer	▪ Area Study Definition ▪ Area of Influence Assessment	[Signature]
María Fernanda Gonzalez	Geography Engineer	▪ Cartography, Thematic Maps	[Signature]
-César Valarezo Macias	Fish Farmer Engineer	▪ Bioassays of Lethal Clustering of Shrimp	[Signature]
Katy Perez	Sociologist	▪ Social Component ▪ Social Participation Process	[Signature]

Source: Prepared by the authors
Prepared by: Ecosfera Cía. Ltda., Machala - El Oro
Date: May 11, 2017

2.- ACRONYMS AND ABBREVIATIONS

- **AAN**: (National Environmental Authority)
- **AAAr**: (Responsible Enforcement Environmental Authority)
- **AAAc**: (Cooperating Environmental Enforcement Authority)
- **AAC**: (Environmental Compliance Audit)
- **AISD**: (Area of Direct Social Influence)
- **AISI**: Area of Indirect Social Influence
- **APPB**:(Puerto Bolívar Port Authority)
- **BVP**: Forestry and Protective Vegetation
- **CCAN**: (National Environmental Categorization] Catalogue)
- **CI**: Certificate of Intersection
- **COIP**: (Comprehensive Organic Penal Code)
- **CPAS**: (Pacific Coast of South America)
- **CIP**: (Public Information Centers)
- **dB**: (Decibel)
- **DIA**: (Environmental Impact Statement)
- **EsIA**: (Environmental Impact Assessment)
- **FA**: (Environmental Information Sheet)
- **FMI**: (International Monetary Fund)
- **GADPEO**: (El Oro Provincial Autonomous Government)
- **GEY**: (Yildirim Group of Companies)
- **GQM**: (Marcos Chemical Group Laboratory)
- **INEC**: (National Census Institute)
- **INOCAR**: (Navy Oceanographic Institute)
- **IP**: Private Initiative
- **ISO**: (International Organization for Standardization.)
- **KM**: (Kilometer)
- **M**:(Meter)
- **MAE**: (Ecuador's Ministry of Environment)
- **MAGAP**: (Ministry of Agriculture, Livestock, Aquaculture and Fisheries) MHC: (Mobile Harbor Cranes)
- **MLWS**: Mean Low Water Spring
- **MN**: (Nautical Miles)
- **NC**: (No Conformity)
- **PA**: (Abandonment Plan)

- **PB**: (Puerto Bolívar)
- **PCC**: (Communication and Training Plan)
- **PDC**: (Contingency Plan)
- **PEA**: (Economically Active Population)
- **PIB**: (Gross Domestic Product)
- **PF**: (State Forest Heritage)
- **PMA**: (Environmental Management Plan)
- **LDC**: (Waste Management Plan)
- **PMS**: (Monitoring and Follow-up Plan)
- **PRC**: (Community Relations Plan)
- **PPP**: (Private -Public Participation)
- **PPM**: (Prevention and Mitigation Plan)
- **PPS**: (Social Participation Process)
- **PSS**: (Health and Safety Plan)
- **LA**: (Environmental License)
- **RI**: (Information Meetings)
- **RGDP**: (Hazardous Waste Generator Registry)
- **CSR**: (Corporate Social Responsibility)
- **SNAP**: (National System of Protected Areas)
- **SUIA**: (Sole Environmental Information System)
- **SUMA**: (Sole Environmental Managing System)
- **TdR:** (Reference Terms)
- **TM:** (Metric Tons)
- **TSHD**: (Trailing Suction Hopper dredger)
- **TULAS**: Unified Environmental Sub-legislation Text
- **US EPA**: United States of America Environmental Protection Agency. YILPORTECU: YILPORT TERMINAL OPERATIONS S.A.
- **YPH**: Yilport Holding Inc.

3.- INTRODUCTION

YILDIRIM Company Group is currently active in more than 10 countries, covering four continents, with Turkey being its base. In Ecuador, the company YILPORTECU SA was established to complete the Project: "Design, Financing, Execution of additional works, Equipment, Operation, and Maintenance of Puerto Bolívar Terminal Port" once the contract was signed in May 2015 in force for an ordinary term of 50 years.

According to the Forty-Ninth clause, the Private Manager must prepare and supply all the studies and documents necessary to obtain the Environmental License and other legal qualifications of the projects to be carried out in the concession, for which the company YILPORTECU S.A. has planned to perform the Environmental Impact Assessment of Pier Dredging 1, 2, 3, 4, 5 and 6, Motion Zone and Access Channel of Puerto Bolívar to obtain the corresponding Environmental License, for which the services of the Environmental Consultant ECOSFERA CIA. LTDA has been contracted, with rating record MAE-SUIA-0010-CC.

The project area is in the Santa Rosa estuary and corresponds to the navigation axis line to access the Puerto Bolívar Maritime Terminal. It includes two stages: Port Dredging 1, 2, 3, 4, 5, and 6; corresponding to 9 hectares and the dredging of the Motion Area and Access Channel to the port; corresponding to 473.57 hectares. The volume to be drained of the first stage will be 575,384.84 m^3, while for the second stage will be 7’000,000 m^3.

Environmental Assessments consist of a predictive estimate or a current identification of environmental damage or alterations. The methodology for this study's preparation was based on diagnoses that allow reliable, qualitative, and quantitative information to be obtained in short periods. In the first instance, a bibliographic review was carried out through research work that began with the search and analysis of bibliography and existing information.
Regarding field research, primary data were obtained to outline the area where its characteristics could also be evaluated in situ and to define the environmental and significant impacts that can affect the physical, biotic, and socioeconomic environment.
The fieldwork provided an overview of the project's structure, functions, and operational processes. Sufficient, competent, and relevant objective evidence of the project was collected, such as photographs, process flows, forms, procedures, laboratory analysis, among others.
A multidisciplinary team of technicians carried out the research and fieldwork. The environmental study has been carried out technically according to the project's scope and depth according to the requirements laid down in the applicable environmental regulations.

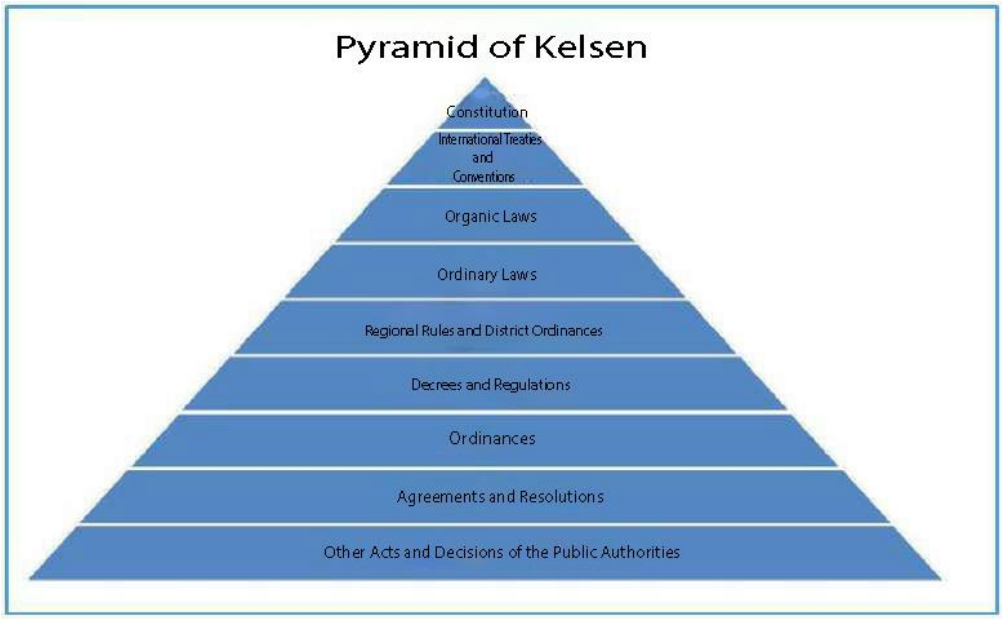
As a fundamental part of the study, an Environmental Management Plan has been designed, which is a document that establishes in detail and chronological order, the actions that are required to be carried out to prevent, mitigate, control, correct, and compensate for possible negative environmental impacts or accentuate the positive impacts caused in the development of a proposed action. Generally, the Environmental Management Plan consists of several sub-plans, depending on the project features.

4.- LEGAL AND INSTITUTIONAL FRAMEWORK

The applicable legal–environmental framework is a series of laws, rules, regulations, and ordinances that are in force at national, regional, and local levels; For the Environmental Impact Assessment, the hierarchical superiority order of the Law must be considered and thus be able to establish the legal order of environmental protection, as established by the Constitution of Ecuador, in Art. 424.- The Constitution is the supreme rule and prevails over any other of the legal system. The rules and acts of the public power shall be in conformity with the constitutional provisions; otherwise, they shall not have legal effect. The Constitution and international human rights treaties ratified by the State that recognize rights more favorable to those in the Constitution shall prevail over any other legal rule or act of public power.

In Art. 425, it is established that the hierarchical order of application of the rules shall be the following: The Constitution; international treaties and conventions; organic laws; ordinary laws; regional rules, and district ordinances; decrees and regulations; ordinances; agreements and resolutions; and other acts and decisions of the public authorities. In the event of a conflict between rules of different hierarchies, the Constitutional Court, judges, administrative authorities, and public officers shall resolve this by applying the higher hierarchical rule. The regulatory hierarchy shall, where appropriate, consider the principle of competition, in particular the ownervessel of the exclusive competencies of decentralized autonomous governments.

Figure 1: Pyramid of Kelsen



Source: *Hans Kelsen, lawyer, politician, and professor of philosophy at the University of Vienna*
Produced by: *Ecosfera Co. Ltda., Machala – El Oro*
Date: *May 11, 2017*

Table 2: Applicable Legal Framework

APPLICABLE LEGAL FRAMEWORK
Constitution of the Republic of Ecuador
Basel Convention
Stockholm Convention
Rotterdam Convention
Comprehensive Criminal Organic Code
Comprehensive Code of Territorial Organization, Autonomy, and Decentralization
Environmental Management Law
Environmental Pollution Prevention and Control Act
Ministerial Agreement 061 of April 7, 2015
Ministerial Agreement 134 of September 25, 2012 (Forest Inventory)
Ministerial Agreement 026
Ministerial Agreement 142
INEN Standard 2266 – 2013

Source: *Own elaboration*
Produced by: *Ecosfera Co. Ltda., Machala – Gold*
Date: *May 11, 2017*

The nature of the signed contract involves a Delegation to the private sector of the management of the port public service of the Port Authority of Puerto Bolívar (APPB), under the modality of a Private Public Association following the Political Constitution of the Republic of Ecuador, Organic Code of Production, Trade, and Investment, Organic Law on Incentives for Private Public Associations and Foreign Investment, the Law on Modernization of the State, Privatization and Provision of Public Services by Private Initiative, the Regulation on the Application of the Exceptional Regime for Delegation of Public Transport Services, The General Regulations of Port Activity in Ecuador, the Regulations of the Private-Public Collaboration Regime, the Rules Governing Port Services in Ecuador, and the other applicable laws and regulations on the matter.

4.1.- POLITICAL CONSTITUTION OF THE REPUBLIC OF ECUADOR

Approved by the National Constituent Assembly and the approved referendum, which is published in the Official Register No. 449 on Monday, October 20, 2008.

Title II: RIGHTS
CHAPTER II: RIGHTS OF GOOD LIVING

- **Art. 13.-** Individuals and communities have the right to secure and permanent access to healthy, sufficient, and nutritious food, preferably produced at the local level and in correspondence with their diverse cultural identities and traditions. The Ecuadorian State will promote food sovereignty.

- **Art. 14.The population's right** to live in a healthy environment is recognized and ecologically balanced, which guarantees sustainability and good living, sumak kawsay. The preservation of the environment, the conservation of ecosystems, biodiversity, and the integrity of the country's genetic heritage, the prevention of environmental damage, and the recovery of degraded natural spaces are declared to be of public interest.
- **Art. 15.-** The State will promote, in the public and private sectors, the use of environmentally clean technologies and low-impact, non-polluting alternative energy.
- **Art. 32.-** Health is a right guaranteed by the State, whose realization is linked to the exercise of other rights, including the right to water, food, education, physical culture, work, social security, healthy environments, and others that support good living.

CHAPTER VII: NATURE RIGHTS

- **Art 71.-** Nature or Pacha Mama, where life is created and reproduced, has the right to its existence to be respected and to the maintenance and regeneration of its life cycles, structure, functions, and evolutionary processes. Any person, community, people, or nationality may require the public authority to fulfill nature's rights.
- **Art. 2**.- Nature has the right to restoration. This restoration will be independent of the State's obligation and natural or legal persons to compensate individuals and collectives who depend on the affected natural systems.
- **Art. 73.-** The State shall apply precautionary and restrictive measures for activities that may lead to the extinction of species, destruction of ecosystems, or permanent alteration of natural cycles.
- **Art. 74.-** Individuals, communities, peoples, and nationalities shall be entitled to benefit from the environment and the natural riches that allow them to live well. Environmental services will be subject to appropriation; the State will regulate their production, delivery, use, and exploitation.

CHAPTER IX: RESPONSIBILITIES

- **Art. 83.-** These are duties and responsibilities of Ecuadorians, without prejudice to others provided for in the Constitution and the Law:
  - Defend the territorial integrity of Ecuador and its Natural Resources.
  - Respect the rights of nature, preserve a healthy environment, and use natural resources in a rational, sustainable, and sustainable manner.

Title VI: THE GOOD LIVING REGIME

CHAPTER I. INCLUSION AND EQUITY

- **Art. 389.-** The State shall protect individuals, communities, and nature from the negative effects of natural or anthropic disasters through risk prevention, disaster mitigation, recovery, and improvement of social, economic, and environmental conditions, to minimize the vulnerability condition.

The decentralized national risk management system consists of all public and private institutions' risk management units at the local, regional, and national levels. The State shall exercise the rectory through the technical body established by law. It will have as its main functions, among others:

1. Identify existing and potential risks, internal and external, that affect the Ecuadorian territory.
2. Generate, democratize access, and disseminate sufficient and timely information to manage risk adequately.
3. Ensure that all public and private institutions must incorporate risk management in their planning and management transversally.
4. Strengthen citizens' and public and private entities' powers to identify the risks inherent in their respective fields of action, report on them, and incorporate actions aimed at reducing them.
5. Articulate the institutions to coordinate actions to prevent and mitigate risks and confront them, recover and improve conditions before the occurrence of an emergency or disaster.
6. Perform and coordinate the actions needed to reduce vulnerabilities and to prevent, mitigate, address, and recover possible negative effects from disasters or emergencies on the national territory.
7. Ensure adequate and timely financing for the functioning of the system and coordinate international cooperation aimed at risk management.

- **Art. 390.** The risks will be managed under the principle of subsidiary decentralization, which will involve the institutions' direct responsibility within their geographical scope. Where their risk management capabilities are insufficient, the bodies with a greater territorial scope and greater technical and financial capacity will provide the necessary support concerning their authority in the territory and without relieving them of their responsibility.

CHAPTER I. BIODIVERSITY AND NATURAL RESOURCES

SECTION ONE: NATURE AND ENVIRONMENT

- **Art. 395.-** The Constitution recognizes the following environmental principles:
  1. The State shall ensure a sustainable model of development, environmentally balanced and respectful of cultural diversity, that preserves biodiversity and the capacity for natural regeneration of ecosystems and ensures the satisfaction of present and future generations' needs.
  2. Environmental management policies shall be implemented transversally and shall be enforced by the State at all levels and by natural or legal persons in the national territory.
  3. The State shall ensure the active and permanent participation of affected individuals, communities, peoples, and nationalities in the planning, executing, and controlling any activity that generates environmental impacts.
  4. In the event of doubt as to the scope of the environmental legal provisions, they shall apply in the most favorable sense to the protection of nature.
- **Art. 396.-** The State shall adopt appropriate policies and measures to avoid negative environmental impacts, where there is a certainty of damage. In case of doubt about the

Environmental impact of any action or omission, although there is no scientific evidence of the damage, the State shall take effective and timely protective measures. Liability for environmental damage is objective. Any damage to the environment, in addition to the corresponding sanctions, will also entail an obligation to restore ecosystems comprehensively and to compensate affected individuals and communities. Each of the actors involved in the processes of production, distribution, marketing, and use of goods or services will assume direct responsibility to prevent any environmental impact, mitigate and repair the damage it has caused, and maintain a system of permanent environmental control. Legal actions to prosecute and punish for environmental damage will be imprescriptible.

- **Art. 397.** In case of environmental damage, the State shall act immediately and, in a subsidiary, to guarantee ecosystems' health and restoration. In addition to the corresponding sanction, the State shall repeat against the operator of the activity that produced damage the obligations that lead to integral reparation, under the conditions and procedures established by law. The responsibility will also lie with the servers or servers responsible for environmental control. To guarantee the individual and collective right to live in a healthy and ecologically balanced environment, the State undertakes to:
  1. To allow any natural or legal person, community, or human group, to exercise the legal actions and to turn to the judicial and administrative institutions, without prejudice to their direct interest, to obtain from them effective protection in environmental matters, including the possibility of requesting precautionary measures that allow the threat of environmental damage to the matter of litigation to cease. The burden of proof on the absence of potential or actual harm shall be on the activity manager or the respondent.
  2. Establish effective mechanisms for preventing and controlling environmental pollution, the recovery of degraded natural spaces, and the sustainable management of natural resources.
  3. Regulate the production, import, distribution, use, and final disposal of toxic and hazardous materials for people or the environment.
  4. Ensure the intangible nature of protected areas in such a way as to ensure the conservation of biodiversity and the maintenance of ecological functions of ecosystems. The management and administration of protected natural areas will be the responsibility of the State.
  5. Establish a national system of prevention, risk management, and natural disasters based on the principles of immediacy, efficiency, precaution, responsibility, and solidarity.
- **Art. 398.**- Any state decision or authorization that may affect the environment shall be consulted with the community, to which it shall be informed widely and in due course. The subject of consultation shall be the State. The law shall regulate prior consultation, citizen participation, deadlines, the subject consulted, and the criteria of assessment and objection to the activity submitted for consultation. The State shall assess the community's opinion according to the criteria established in international human rights law and instruments. If the above consultation process results in a majority opposition from the corresponding community, the decision to execute the project will not be taken by duly motivated resolution of the corresponding superior administrative body following the law.

- **Art. 399.-** The integral exercise of the State guardianvessel over the environment and the citizenry's responsibility in its preservation will be articulated through a decentralized national system of environmental management, which will be responsible for the defense of the environment and nature.

SECTION TWO BIODIVERSITY

- **Art. 400.-** The State will exercise sovereignty over biodiversity, whose administration and management will be carried out with inter-generational responsibility. The conservation of biodiversity and all its components, agricultural and wild biodiversity, and its genetic heritage are declared to be of public interest.
- **Art. 402.-** The granting of rights, including intellectual property rights, on derived or synthesized products obtained from collective knowledge associated with national biodiversity is prohibited.
- **Art. 403.-** The State shall not commit itself to cooperation agreements or agreements that include clauses that undermine the conservation and sustainable management of biodiversity, human health, and collective and nature rights.

SECTION THREE: CULTURAL HERITAGE AND ECOSYSTEMS

- **Art. 404.-** The natural heritage of the unique and invaluable equator includes, among others, physical, biological, and geological formations whose environmental, scientific, cultural, or landscape value requires their protection, conservation, recovery, and promotion. Its management shall be subject to the principles and guarantees provided for in the Constitution and shall be carried out following the territorial order and ecological zoning, following the law.
- **Art. 405.-** The national system of protected areas shall ensure biodiversity conservation and the maintenance of ecological functions. The system will be integrated into the other state, autonomous decentralized, community, and private systems, and the State will exercise its stewardvessel and regulation. The state will allocate the economic resources necessary for the system's financial sustainability and encourage the participation of the communities, peoples, and nationalities that have ancestrally inhabited the protected airlines in their administration and management.
- **Art. 406.-** The state will regulate conservation, management, and sustainable use recovery, and limitations of the domain of fragile and threatened ecosystems; among others, moors, wetlands, cloud forests, dry and humid tropical forests and mangroves, marine and coastal ecosystems.

SECTION SIX: WATER

- **Art. 411.-** The State shall guarantee the conservation, recovery, and integral management of water resources, water basins, and ecological flows associated with the hydrological cycle. Any activity that may affect the quality and quantity of water, and the balance of ecosystems, especially in water sources and recharge areas, shall be regulated. The sustainability of ecosystems and human consumption will be a priority in the use and use of water.
- **Art. 412.-** The water management authority shall be responsible for its planning, regulation, and control. This authority will cooperate and coordinate with the one responsible for environmental management to ensure water management with a systemic eco-approach.

4.2.- INTERNATIONAL TREATIES AND CONVENTIONS

Art. 425 of the Constitution of the Republic of Ecuador adopted in October 2008 establishes the following hierarchical order of application of the rules: Constitution; international treaties and conventions; organic laws; ordinary laws; regional norms and district ordinances; decrees and regulations; ordinances; agreements and resolutions; and other acts and decisions of public authorities.

According to the Constitution in force, International Treaties, once adopted and ratified, take precedence over organic laws and ordinary laws.

4.2.1.- INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM VESSELS, 1973- MARPOL

- **Art. 3-** Scope of application:
  1) This Convention shall apply to:
     a) Vessels entitled to fly the flag of a Party to the Convention; and
     b) Vessels without the right to fly the flag of a Party operate under a State Party's authority.
  2) Nothing in this Article shall be construed as repealing or extending the Parties' sovereign rights under international law to the seabed and its subsoil adjacent to its coasts to explore or exploit their natural resources.
  3) This Convention shall not apply to vessels of war or auxiliary naval units or to those which are owned by a State or while at your service, only provide non-commercial government services for the time being. However, each Party shall take care to take appropriate measures to ensure that, within the reasonable and practicable, such vessels owned or operated by the State shall act following the purpose and purpose of this Convention, without prejudice to the operations or operational capabilities of such vessels.
- **Art. 4.- Violations**
  1) Any violation of this Convention's provisions, wherever it occurs, shall be prohibited and shall be sanctioned by the legislation of the Administration of the vessel concerned. If the Administration, after being informed of a violation, considers there is sufficient evidence to initiate proceedings regarding the alleged violation, it will cause such proceedings to be initiated as soon as possible following its legislation.
  2) Any violation of the provisions of this Convention within the jurisdiction of any Party to the Convention shall be prohibited and shall be sanctioned by that Party's laws. Whenever such transgression occurs, that Party shall take one of the following two measures:
     a) Have a proceeding initiated, following its legislation, or.
     b) Provide the vessel's administration with all information and evidence that comes to its power that a transgression has occurred.

3) Where information or evidence concerning any breach of this Convention by that vessel is provided to the Administration, it shall immediately inform the Party which has provided the information or evidence to it, as well as the Organization, of the measures it takes.
4) The sanctions provided for in the legislation of a Party under this Article shall be sufficiently severe to deter any breach of this Convention. The severity of the sanction will be the same wherever the transgression occurs.

- **Art. 5.-** Certificates and special rules on vessel inspection

1) Subject to paragraph 2 of this Article, any certificate issued under the authority of a Party to the Convention following the rules shall be accepted by the other Parties and deemed valid for all purposes provided for in this Convention, such as certificates issued by themselves.
2) Any vessel obliged to hold a certificate following the rules shall, while in piers or terminals offshore under the jurisdiction of a Party, be subject to the inspection of officials duly authorized by said Party. Such inspection shall be limited to checking that a valid certificate is on board unless there are clear grounds for thinking that the condition of the vessel or its equipment does not correspond substantially to the details of the certificate. In such a case, or if it turns out that the vessel does not have a valid certificate, the Party which carried out the inspection shall take the necessary measures so that the vessel does not go to sea until it can do so without unreasonable threat of damage to the marine environment. However, that Party may give the vessel permission to leave the port or terminal offshore to go to the nearest appropriate repair yard.
3) When a Party denies a foreign vessel entry into piers or terminals offshore under its jurisdiction, or in any way acts against such vessel on the grounds that it does not comply with the provisions of this Convention, that Party shall immediately inform the consul or diplomatic representative of the Party whose flag the vessel is entitled to fly or, if this is not possible, the Administration of the vessel concerned. Before refusing entry or acting in any way, the Party may request a consultation with the vessel's Administration. The Administration shall also be informed when it turns out that a vessel does not carry a valid certificate following the rules.
4) Concerning vessels of States not a party to the Convention, the Parties shall apply to the extent necessary for this Convention's provisions to ensure that such vessels are not treated more favorably.

- **Art. 6.-** Detection of violations of the Convention compliance thereof.

1) The Parties to the Convention shall cooperate in any management leading to the detection of violations and compliance with the provisions of this Convention by making use of any appropriate and practicable measures for environmental detection, monitoring, and control, as well as appropriate methods of information transmission and accumulation of evidence.
2) Any vessel to which this Convention applies may be subject to inspection, at any port or terminal offshore from a Party, by officials who name or authorize that Party to verify whether the vessel made any discharge of harmful substances in violation of the rules. If the inspection indicates that there was a violation of the

This Convention shall be sent to the Administration for appropriate action.

3) Any Party shall provide the Administration with evidence, if any, that a vessel has discharged harmful substances, or effluents containing such substances in violation of the rules. Where possible, the competent authority of that Party shall notify the vessel's captain of the transgression charged to him.
4) Upon receipt of the evidence referred to in this article, the Administration shall investigate the matter and may request the other Party to provide it with further information or better evidence of the alleged transgression. If the Administration considers that there is sufficient evidence to initiate proceedings regarding this, the alleged violation will lead to the initiation of such proceedings as soon as possible in accordance with its legislation. The Administration shall immediately transmit to the Party which has reported the alleged violation and the Organization's news of the action taken.
5) Any Party may also conduct an inspection of a vessel to which this Convention applies when the vessel enters piers or terminals offshore under its jurisdiction If you have received from any other Party an investigation request together with sufficient evidence that that vessel has discharged from any location of harmful substances, or effluents containing such substances. The investigation report shall be transmitted both to the requesting Party and to the Administration so that appropriate measures may be taken under this Convention.

- **Art. 7.-** Unnecessary delays to vessels
  1) Every effort shall be made to prevent the vessel from being subjected to unnecessary immobilization or delay through measures taken following Articles 4, 5, and 6 of this Convention.
  2) When a vessel has gone through unnecessary immobilization or delay due to the measures taken following Articles 4, 5, and 6 of this Convention, it has the right to be compensated for any damage or injury suffered.
- **Art. 8.-** Repiers on events related to harmful substances.
  1) The event shall be reported and without delay applying as far as possible the provisions of Protocol I to this Convention.
  2) Any Party to the Convention shall:
     a. Take the necessary steps for an official or competent body to receive and process all repiers relating to events.
     b. Notify the Organization, giving it full details of such arrangements, so that it may bring them to the attention of the other Parties and the Member States of the Organization.
  3) Whenever a Party receives a report under this Article, it shall transmit it without delay to:
     a. The Administration of the vessel concerned.
     b. Any other State that may be affected.
  4) Any Party to the Convention undertakes to instruct its maritime inspection vessels and aircraft and other competent services to communicate to its authorities any events referred to in Protocol I to this Convention. If it deems it appropriate, such Party shall transmit a report to the Organization and any other interested party.
- **Art. 9.-** Other treaties and their interpretation

1) From its entry into force, this Convention shall replace the amended International Convention for the Prevention of Pollution of Sea Waters by Hydrocarbons, 1954, between the Parties to that Convention.
2) Nothing in this Convention shall prejudice the codification and development of maritime law at the United Nations Conference on the Law of the Sea, convened under resolution 2750 C (XXV) of The General Assembly of the United Nations, nor the present or future legal claims and theses of any State about maritime law and the nature and extent of its jurisdiction over its coastal zone or its flag vessels.
3) This Convention shall interpret the term jurisdiction in the light of international law in force when this Convention is to be applied or interpreted.

- **Art.10.-** Settlement of disputes: Any dispute between two or more parties to the Convention relating to its interpretation or application, which could not be resolved by negotiation between the Parties concerned, shall be subject, at the request of either Party, to the arbitration procedure established in Protocol II to this Convention, unless those Parties agree on another procedure.
- **Art.11.-** Communication of information
  1) The Parties to the Convention undertake to communicate to the Organization:
     a. The text of laws, ordinances, decrees, regulations, and other instruments promulgated concerning the various matters within this Convention's scope.
     b. A list of non-governmental bodies authorized to act on their behalf concerning the project, construction, and equipment of vessels intended to transport harmful substances, following the rules.
     c. Samples, in sufficient numbers, of certificates issued following the rules.
     d. A list of reception facilities, including their location, capacity, available equipment, and other characteristics.
     e. Official repiers or summaries of official repiers as soon as they reveal the results of the implementation of this Convention; and
     f. As standardized by the Organization, an annual statistical report on sanctions imposed for violations of this Convention.
  2) The Organization shall notify the Parties of any communication it receives under this Article and shall circulate among the Parties any information communicated to it under paragraphs (b) to (f) of paragraph 1) of this Article.
- **Art. 12.-** Accidents suffered by vessels.
  1) The Administrations undertake to investigate any incident involving any of their vessels which is subject to the provisions of the rules if such incident has caused significant deleterious effects on the marine environment.
  2) The Parties to the Convention undertake to inform the Organization of the results of such investigations if they consider that this information will contribute to determining which amendments to this Convention are to be made.
- **Art.13.-** Signature, ratification, acceptance, approval, and adhesive.

1) This Convention shall be open for signature at the offices of the Organization from 15 January 1974 until 31 December 1974 and shall remain open for adhesive after that period. States may participate in this Convention by: (A) unreserved signature as to ratification, acceptance, or approval; or (b) signature subject to ratification, acceptance, or approval, followed by ratification, acceptance, or approval; or (c) adhesive.
2) Ratification, acceptance, approval, or adhesive shall be affected by an instrument to that effect with the Organization's Secretary-General.
3) The Secretary-General of the Organization shall inform all States that have signed or acceded to this Convention of any signature or deposit of any new instrument of ratification, acceptance, approval, or adhesive and the date of such deposit.

- **Art. 14.-** Optional Annexes

1) Any State, at the time of signing, ratifying, accepting, approving, or acceding to this Convention, may declare that it does not accept any or all of Annexes III, IV, and V (hereinafter referred to as optional annexes) to this Convention. Subject to the above, the Parties to the Convention shall be bound by any of the annexes in their entirety.
2) Any State which has declared itself not bound by an optional annex may at any time accept that annex by depositing with the Organization an instrument of the type prescribed in article 13, paragraph 2.
3) A State which makes a declaration under paragraph 1(2) of this article in respect of any optional annex, and which has not subsequently accepted that annex following paragraph 2(2) of this article shall not assume any obligation, nor shall it have the right to claim any privilege under this Convention, in respect of matters relating to the Annex in question, and references to Parties to this Convention shall not include that State in respect of matters relating to that Annex.
4) The Organization shall inform all States which have signed or acceded to this Convention of any declaration made under this Article, as well as of any instrument received and deposited following paragraph 2(2) of this Article.

- **Art. 16.-** Amendments

1) This Convention may be amended by any of the procedures specified below:
2) Amendment after consideration by the Organization:
    a. Any amendment proposed by a Party to the Convention shall be submitted to the Organization and circulated by the Secretary-General of the Organization to all Members of the Organization and all Parties at least six months before its consideration.
    b. Any amendment proposed and circulated following subparagraph (a) of this paragraph shall be submitted by the Organization to a competent body for its consideration.
    c. The Parties to the Convention, whether they are Members of the Organization, shall have the right to participate in the deliberations of the competent body.
    d. Amendments shall be adopted by a two-thirds majority of those present and voting by the Parties to the Convention only intervening in the vote.

e. If adopted following subparagraph (d) of this paragraph, the amendment shall be communicated by the Secretary-General of the Organization to all Parties to the Convention for acceptance.

f. an amendment shall be deemed to be accepted in the following circumstances:
   - An amendment to an article of the Convention shall be deemed to be accepted from the date on which it has been accepted by two-thirds of the Parties whose combined merchant fleets represent not less than 50 percent of the gross tonnage of the world merchant fleet.
   - An amendment to an Annex to the Convention shall be deemed to be accepted following the procedure specified in subparagraph (f) of this paragraph unless the competent body, at the time of its adoption, determines that the amendment shall be considered accepted from the date on which it has been accepted by two-thirds of the Parties whose combined merchant fleets represent not less than 50 percent of the gross tonnage of the world merchant fleet. However, at any time before the entry into force of an amendment to an annex to the Convention, a Party may notify the Secretary-General of the Organization that the amendment for it to enter into force concerning that Party must give its express approval. The Secretary-General shall make such notification and the date of its receipt known to the Parties.
   - An amendment to an appendix of an annex to the Convention shall be considered accepted at the end of a period, not less than ten months, to be determined by the competent body at the time of its adoption, unless, within that time, at least one-third of the Parties, or those Parties whose combined merchant fleets represent at least 50 percent of the gross tonnage of the world merchant fleet, depending on which of these two conditions is met earlier, notify the Organization that they reject the amendment;
   - Any amendment to Protocol I to the Convention shall be subject to the same procedures as provided for in subparagraphs (f) (ii) or (iii) of this paragraph to amend the Annexes to the Convention.
   - Any amendment to Protocol II to the Convention shall be subject to the same procedures as provided for in subparagraph (i)
     (f) of this paragraph to amend the articles of the Convention.

g. the amendment shall enter into force under the following conditions:
   - In the case of an amendment to an article or Protocol II to the Convention, or to Protocol I or an annex to the Convention which shall not be made following the procedure specified in subparagraph (f) (iii) of this paragraph, the amendment accepted following the provisions above shall enter into force six months after the date of its acceptance concerning Parties which have declared their acceptance.
   - In the case of an amendment to Protocol I, to an appendix of an annex or to an annex to the Convention to be made following to the procedure specified in subparagraph (f) (iii) of this paragraph, an amendment deemed to be accepted following the above conditions shall enter into force six months after its acceptance concerning all

Parties except for those who, before that date, have stated that they do not accept or notify it, under subparagraph (f) (ii) of this paragraph, that their express approval is necessary.

3) Amendment by Conference:
   a. At the request of any Party, provided that at least one-third of the Parties agree, the Organization shall convene a conference of Parties to the Convention to consider amendments to this Convention.
   b. Any amendment adopted at such a conference by a two-thirds majority of the Parties present and voting shall be communicated by the Secretary-General of the Organization to all Parties for acceptance.
   c. Unless the Conference decides otherwise, the amendment shall be deemed to have been accepted and entered into force following the procedures specified for this purpose in paragraphs 2 (f) and (g).
4)
   a. In the case of an amendment to an optional annex, any reference made in this article to a Party to the Convention shall be understood as also a reference to a Party bound by that annex.
   b. Any Party which has refused to accept an amendment to an Annex shall be considered as a non-Party with regard solely to the application of that amendment.
5) The adoption and entry into force of a new annex shall be subject to the same procedures as the adoption and entry into force of an amendment to an article of the Convention.
6) Unless otherwise expressly indicated, any amendment to this Convention, made following the provisions of this Article, which relates to the structure of a vessel, shall apply only to vessels whose construction contract has been formalized or, in the absence of a construction contract, the keel of which has been placed on or after the date of entry into force of the amendment.
7) Any amendment to a Protocol or an annex shall refer to the substance of that Protocol or annex and be compatible with the provisions of the articles of this Convention.
8) The Secretary-General of the Organization shall inform all Parties of any amendments which enter into force following the provisions of this Article, as well as of the date of entry into force of each Party.
9) Any statement that an amendment is accepted or rejected under this article shall be notified in writing to the Secretary-General of the Organization, who shall inform the Parties to the Convention of the receipt of the notification and of the date on which it was received.

❖ **Art. 17.-** Promotion of technical cooperation

The Parties to the Convention, in consultation with the Organization and other international bodies and with the assistance and coordination of the Executive Director of the United Nations Environment Program, shall encourage the provision of assistance to those Parties seeking technical assistance to:

   a. training scientific and technical personnel.
   b. provide the necessary reception and monitoring and control equipment and facilities.
   c. facilitate the adoption of other measures and provisions aimed at preventing or mitigating pollution of the marine environment by vessels; and

d. promote research, preferably in the countries concerned, thereby promoting the achievement of the purposes and purposes of this Convention.

- **Art. 18.-** Denunciation
  1) This Convention, or any of its optional annexes, may be denounced by a Party to the Convention at any time after the expiry of a period of five years from the date on which the Convention or the Annex has entered into force for that Party.
  2) The denunciation shall be affected by written notification to the Secretary-General of the Organization, who shall inform the other Parties of its receipt of such notification, of the date on which it was received, and of the date on which such denunciation takes effect.
  3) Denunciation shall take effect twelve months after the notification of denunciation has been received by the Secretary-General of the Organization or upon the expiration of any longer period as may be provided for in such notification.
- **Art. 19.** Delivery and registration
  1) This Convention shall be delivered to the Secretary-General of the Organization, who shall transmit authentic copies thereof, duly certified, to all States which sign or accede to this Convention.
  2) As soon as this Convention enters into force, the Secretary-General of the Organization shall send it in written to the Secretary-General of the United Nations for registration and publication following Article 102 of the Charter of the United Nations.

1978 PROTOCOL TO THE INTERNATIONAL CONVENTION ON THE PREVENTION OF POLLUTION FROM VESSELS, 1973 MARPOL

- **Art. 3.-** Communication of information

  The text of Article 11 1(b) of the Convention shall be replaced by the following:

  ‘‘a list of appointed inspectors or recognized organizations authorized to act on their behalf in the management of project, construction, equipment, and operation issues relating to vessels intended to transport harmful substances, following the rules to distribute such list to the Parties for the information of their officials. The Administration shall notify the Organization of the specific powers assigned to the appointed inspectors or recognized organizations, and of the conditions under which authority has been delegated to them.’’
- **Art.- 6.-** Amendments

  The procedures set out in Article 16 of the Convention concerning amendments to the Articles, to an Annex, and to an Appendix of an Annex to the Convention shall apply respectively to amendments to the Articles, to the Annex, and to an Appendix of an Annex to this Protocol.
- **Art. 7.-** Denunciation
  1. This Protocol may be denounced by a Party to this Protocol at any time after the expiration of a period of five years from the date on which the Protocol entered into force for that Party.
  2. The denunciation shall be affected by depositing an instrument of denunciation with the Secretary-General of the Organization.

3. Denunciation shall take effect twelve months after receipt by the Secretary-General of the Organization of the notification or after the expiration of any longer period set out in the notification.

- **Art. 8.-** Depositary

1. This Protocol shall be deposited with the Organization's Secretary-General (hereinafter referred to as the depositary).
2. The DEPOSITARY:
    a. Shall inform all States which have signed or acceded to this Protocol of:
        - each new signature and each new deposit of the instrument of ratification, acceptance, approval, or adhesive are being produced and the date on which they occur.
        - The date of entry into force of this Protocol.
        - Any deposit of an instrument of denunciation of this Protocol and of the date on which the instrument was received and of the date on which the denunciation takes effect.
        - any decision taken following Article II.
          1) of this Protocol.
    b. Shall transmit authentic certified copies of this Protocol to all States which have signed or acceded to it.
3. As soon as this Protocol enters into force, the depositary shall send a certified authentic copy thereof to the United Nations' Secretariat for registration and publication under Article 102 of the Charter of the United Nations.

AMENDMENTS TO THE ANNEX TO THE 1978 PROTOCOL TO THE INTERNATIONAL CONVENTION ON THE PREVENTION OF POLLUTION FROM VESSELS, 1973

- Small island developing States may meet the requirements of paragraphs 1 to 3 of this rule through regional arrangements when, due to the unique circumstances of these States, such agreements are the only practical means of meeting such requirements. Parties participating in a regional agreement shall develop a regional plan for reception facilities considering the guidelines developed by the Organization.
- The Governments of the Parties participating in the Agreement shall consult with the Organization for distribution to the Parties to this Convention:
    1. How the guidelines are considered in the regional plan of reception facilities.
    2. The details of the regional waste reception centers of the vessels identified; and
    3. The details of piers with only limited facilities.
    4. Small island developing States may meet the requirements of paragraph 4 of this rule through regional arrangements when, due to the unique circumstances of these States, such agreements are the only practical means of meeting such requirements. Parties participating in a regional agreement shall develop a regional plan for reception facilities considering the Organization's guidelines.
- The Governments of the Parties participating in the Agreement shall consult with the Organization for distribution to the Parties to this Convention:

1. How guidelines are considered in the regional plan of reception facilities.
2. The details of the regional waste reception centers of the vessels identified; and
3. Details of piers with limited facilities only."

- Small island developing States may meet the requirements of paragraphs 1, 2, and 4 of these rules through regional arrangements when, due to the unique circumstances of these States, such agreements are the only practical means of meeting such requirements. Parties participating in a regional agreement shall develop a regional plan for reception facilities considering the guidelines developed by the Organization.
- The Governments of the Parties participating in the Agreement shall consult with the Organization for distribution to the Parties to this Convention:
    1. How guidelines are considered in the regional plan of reception facilities.
    2. The details of the regional waste reception centers of the vessels identified; and
    3. The details of piers with only limited facilities.
- Small island developing States may meet the requirements of paragraph 1 of this rule through regional arrangements when, due to the unique circumstances of these States, such agreements are the only practical means of meeting such requirements. Parties participating in a regional agreement shall develop a regional plan for reception facilities considering the guidelines developed by the Organization.
- The Governments of the Parties participating in the Agreement shall consult with the Organization for distribution to the Parties to this Convention:
    1. How the guidelines are considered in the regional plan of reception facilities.
    2. The details of the regional waste reception centers of the vessels identified; and
    3. Details of piers with limited facilities only."
    4. The following new paragraph 2bis is added to rule 8 of Annex V:1
        - Small island developing States may meet the requirements of paragraphs 1 and 2.1 of these rules through Regional agreements where, due to the unique circumstances of these States, such agreements are the only practical means of meeting such requirements. Parties participating in a regional agreement shall develop a regional plan for reception facilities considering the guidelines developed by the Organization.
- The Governments of the Parties participating in the Agreement shall consult with the Organization for distribution to the Parties to this Convention:
    1. How the guidelines are considered in the regional plan of reception facilities.
    2. The details of the regional waste reception centers of the vessels identified; and
    3. Details of piers with limited facilities only."

AMENDMENTS TO THE ANNEX TO THE 1978 PROTOCOL TO THE INTERNATIONAL CONVENTION ON THE PREVENTION OF POLLUTION FROM VESSELS, 1973. RESOLUTION MEPC 238 (65) adopted on May 17.

- **Rule 6**

  The current text of the last sentence of paragraph 3.1 is replaced by the following: "Such organizations, including classification societies, shall be authorized by the Administration following the provisions of this Convention and with the Code for Recognized Organizations (OR Code), which consists of Part 1 and Part 2 (the provisions of which shall be deemed mandatory) and Part 3 (The provisions of which will be considered as recommendations), adopted by the Organization by Resolution MEPC,237(65), as may be amended by the Organization, provided that:

  1. Amendments to Part 1 and Part 2 of the OR Code shall be adopted, entered into force, and take effect following the provisions of Article 16 of this Convention concerning the amendment procedures applicable to this Annex.
  2. The Committee adopts amendments to Part 3 of the OR Code on the Protection of Marine Environment under its Rules of Procedure; and
  3. Any amendments mentioned in .1 and .2, adopted by the Maritime Safety Committee and the Marine Environment Protection Committee, are identical and enter into force or become effective simultaneously, as appropriate."

Amendments to Annex II of the MARPOL Convention

- **Rule 8**

  The current text of paragraph 2.2 is replaced by the following:

  "Such organizations, including classification societies, shall be authorized by the Administration following the provisions of this Convention and with the Code for Recognized Organizations (OR Code), which consists of Part 1 and Part 2 (the provisions of which shall be deemed mandatory) and Part 3 (the provisions of which shall be considered as recommendations), adopted by the Organization by Resolution MEPC.237(65), as may be amended by the Organization, provided that:

  1. Amendments to Part 1 and Part 2 of the OR Code shall be adopted, entered into force, and take effect following the provisions of Article 16 of this Convention concerning the amendment procedures applicable to this Annex.
  2. Amendments to Part 3 of the OR Code are adopted by the Committee Protection of the marine environment under its Rules of Procedure; and
  3. Any amendments mentioned in .1 and .2 adopted by the Maritime Safety Committee and the Marine Environment Protection Committee are identical and enter into force or become effective simultaneously, as appropriate."

AMENDMENTS TO THE ANNEX TO THE 1978 PROTOCOL TO THE INTERNATIONAL CONVENTION ON THE PREVENTION OF POLLUTION FROM VESSELS, 1973. RESOLUTION MEPC,246 (66) adopted on 4 April 2014 Rule 1

- 35 Audit is the systematic, independent, and documented process for obtaining audit evidence and objectively evaluating it to determine the extent to which the audit criteria are met.

- 36 Audit Plan means the Plan Audits of the IMO Member States established by The Organization considering its guidelines.*
- 37 Implementation Code means the Code for the Implementation of IMO Instruments (Code III), adopted by the Organization in Resolution A.1070(28).
- 38 Auditing standard means the Code for Implementation."

Rule 44: Scope of application

- The Parties shall use the Code's provisions for implementation in the exercise of the obligations and responsibilities set out in this Annex.

Rule 45: Compliance verification

- Each Party shall be subject to periodic audits by the Organization following the audit standard to verify compliance with this Annex implementation.
- The Secretary-General of the Organization shall be responsible for administering the Audit Plan, based on the Organization's guidelines.*
- Each Party shall be responsible for facilitating the conduct of audits and implementing a program of measures to address the findings, based on the guidelines developed by the Organization.
- The audit of all Parties shall: Be based on a general timetable established by the Secretary-General of the Organization, considering the Organization's guidelines.

The following text is added at the end of **Rule 1**:

- 18 Audit is the systematic, independent, and documented process for obtaining audit evidence and objectively evaluating it to determine the extent to which the audit criteria are met.
- 19 Audit Plan means the Plan Audits of the IMO Member States established by The Organization considering the Organization's guidelines.*
- 20 Implementation Code means the Code for the Implementation of IMO Instruments (Code III), adopted by the Organization by Resolution A. 1070 (28).
- 21 Auditing standard means the Code for Implementation.

Rule 19: Scope of application

- The Parties shall use the provisions of the Code for implementation in the exercise of the obligations and responsibilities set out in this Annex.

Rule 20: Verification of compliance

- Each Party shall be subject to periodic audits by the Organization following the audit standard to verify compliance with this Annex implementation.
- The Secretary-General of the Organization shall be responsible for administering the Audit Plan, based on the Organization's guidelines.
- Each Party shall be responsible for facilitating the conduct of audits and implementing a program of measures to address the findings, based on the guidelines developed by the Organization.

- Audit of all Parties:
    1. It shall be based on a general timetable established by the Secretary-General of the Organization, considering the guidelines developed by the Organization; and
    2. It shall be carried out at regular intervals, considering the guidelines developed by the Organization.

Rule 10: Scope of application

- The Parties shall use the Code's provisions for implementation in the exercise of the obligations and responsibilities set out in this Annex.

Rule 11: Verification of compliance

- Each Party shall be subject to periodic audits by the Organization following the audit standard to verify compliance with this Annex implementation.
- The Secretary-General of the Organization shall be responsible for administering the Audit Plan, based on the Organization's guidelines.
- Each Party shall be responsible for facilitating the conduct of audits and implementing a program of measures to address the findings, based on the guidelines developed by the Organization.*
- Audit of all Parties:
    1. It shall be based on a general timetable established by the Secretary-General of the Organization, considering the guidelines developed by the Organization;* and
    2. It shall be carried out at regular intervals, considering the guidelines developed by the Organization.

Rule 15: Scope of application

- The Parties shall use the Code's provisions for implementation in the exercise of the obligations and responsibilities set out in this Annex.

Rule 16: Verification of compliance

- Each Party shall be subject to periodic audits by the Organization following the audit standard to verify compliance with this Annex implementation.
- The Secretary-General of the Organization shall be responsible for administering the Audit Plan, based on the Organization's guidelines.*
- Each Party shall be responsible for facilitating the conduct of audits and implementing a program of measures to address the findings, based on the guidelines developed by the Organization.
- Audit of all Parties:
    1. It shall be based on a general timetable established by the Secretary-General of the Organization, considering the guidelines developed by the Organization; and
    2. It shall be carried out at regular intervals, considering the guidelines developed by the Organization.

4.2.2.- UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

To adopt the United Nations Convention on the Law of the Sea (CONVEMAR) with the Declaration of Ecuador at the time of accession to the United Nations Convention on the Sea's Law. Given and signed at the National Assembly offices, located in the Metropolitan District of Quito, province of Pichincha, two thousand twelve on the twenty-two days of May. Published in Official Register Supplement 715 of 1 June 2012.

- **Art. 1.- Ratify accession** to the United Nations Convention on The Law of the Sea (CONVEMAR), signed on 10 December 1982, with the Declaration of the National Assembly

PART II TERRITORIAL SEA AND THE CONTIGUOUS ZONE SECTION 1. GENERAL PROVISIONS

- **Art. 2.-** Legal regime of the territorial sea, of the airspace above the territorial sea, and its bed and subsoil 1. The sovereignty of the coastal State extends beyond the territory of its internal waters and, in the case of the archipelagic State, from its archipelagic waters to the adjacent strip of sea designated by the name of the territorial sea. 2. This sovereignty extends to airspace over the territorial sea, as well as to the bed and subsoil of that sea. 3. Sovereignty over the territorial sea is exercised according to this Convention and other international law rules.

SECTION 2. LIMITS OF THE TERRITORIAL SEA

- **Art. 3.-** Width of the territorial sea. Every state has the right to establish its territorial sea's width up to a limit not to exceed 12 nautical miles measured from baselines determined following this Convention.
- **Art. 10.- Bays**
  1. This article refers only to bays whose coasts belong to a single State.
  2. For this Convention, a bay is any well-determined recess whose inland penetration, concerning the width of its mouth, is such that it contains waters enclosed by the coast and constitutes more than a mere inflection of it. However, the recess shall not be considered a bay if its surface is not equal to or greater than that of a semicircle with the diameter of the mouth of that recess.
  3. For its measurement, the surface of a recess is between the low line following the coast of the recess and a line linking the low lines of its natural entry points. When, due to islands' existence, a recess has more than one entry, the semicircle will be drawn by taking as diameter the sum of the lengths of the lines that close all entries. The surface of the islands within a recess shall be within the total surface of the recess.
  4. If the distance between the low-seas lines of a bay's natural entry points does not exceed 24 nautical miles, a demarcation line may be drawn between the two low-water lines, and the waters thus enclosed shall be considered inland waters.

- **Art. 11.- Ports.** For the territorial sea's delimitation, the permanent port constructions furthest from the coast that forms an integral part of the port system are considered part of it. Offshore facilities and artificial islands will not be considered permanent port buildings.
- **Art. 12.- Anchorages.** The ranges normally used for loading, unloading, and anchoring vessels, which would otherwise be in whole or in part outside the general outline of the outer boundary of the territorial sea, are covered by the territorial sea.

4.2.3.- LONDON CONVENTION: CONVENTION ON THE PREVENTION OF MARINE POLLUTION BY DUMPING OF WASTES AND OTHER MATTERS, 1972

- **Art.1.-** Contracting parties shall promote individually and collectively the effective control of all sources of pollution of the marine environment and undertake to take all possible measures to prevent pollution of the sea by the dumping of wastes and other substances that may constitute a danger to human health, damage biological resources and marine life, reduce the possibilities of recreation or hinder other legitimate uses of the sea.
- **Art. 2.-** The Contracting Parties shall, under the provisions of the following Articles, take effective measures individually, according to their scientific, technical, and economic capacity, and collectively, to prevent pollution of the sea caused by dumping, and harmonize their policies in this regard.
- **Art. 3.-** For this Convention:
  1.
     a) Dumping means:
     - Any deliberate disposal in the sea of waste or other material from vessels, aircraft, platforms, or other constructions at sea.
     - Any deliberate sinking of vessels, aircraft, platforms, or other constructions at sea.

     b) Dumping does not include :
     - The disposal at sea of wastes and other materials that are incidental to or derived from the normal operations of vessels, aircraft platforms, or other constructions at sea and their equipment, except wastes and other materials transported by vessels, aircraft platforms, or other constructions at sea operating to eliminate such materials or result from the treatment of such wastes or other materials on such vessels, aircraft, platforms, or constructions.
     - The placement of materials for a purpose other than that of their mere evacuation. Provided that such placement is not contrary to the objectives of this Convention.

     c) The disposal of wastes or other materials directly derived from the exploration, exploitation, and related treatments, off the coast, of the

The provisions of this Convention shall not cover seabed mineral resources or related mineral resources.

2. Vessels and aircraft are vehicles that move through water or air of any kind. This expression includes vehicles moving on an air mattress and floating vehicles, either or not self-propelled.
3. By sea, all sea waters are understood to be not Be the inland waters of the states.
4. Wastes or other materials mean materials and materials of any kind, form, or nature.
5. Special permit means permit granting specifically upon request and following Annex II and Annex III.
6. A general permit is a permit previously granted and following Annex III.
7. The Organization shall mean the organization designated by the Contracting Parties following Article XIV(2).

❖ **Art. 4.**

1. Following the provisions of this Convention, the Contracting Parties shall prohibit the dumping of any wastes or other matters in any form or condition, except as specified below:
   a) Dumping of wastes or other materials listed in Annex I is prohibited.
   b) Special prior permission is required for the dumping of wastes or other materials listed in Annex II.
   c) A prior general permit is required for the dumping of all other wastes or materials.
2. Permits shall be granted only after careful consideration of all factors listed in Annex III, including prior studies of the dumping site's characteristics, as provided for in Sections B and C of that Annex.
3. Nothing in this Convention may be construed to prevent a Contracting Party from prohibiting, as far as that Party is concerned, the dumping of wastes or other materials not mentioned in Annex I. The Party concerned shall notify such measures to the Organization.

The London Convention is intended to promote the effective control of all sources of pollution of the marine environment and the adoption of all possible measures to prevent pollution of the sea by dumping of wastes and other materials. There are currently 87 States members of the Convention, including Spain, and the Secretariat of the Convention is hosted by the International Maritime Organization, based in London.

Unlike the OSPAR and Barcelona Conventions, the London Convention deals only with discharges from vessels and not those arriving at sea from land.

The “Protocol on the London Convention” was adopted in 1996 to modernize the Convention, which entered into force in March 2006. The 72 Convention establishes a list of substances and products that cannot be dumped into the sea, but, following the new Protocol, the procedure referred to as the “reverse list” is established, i.e., Dumping into the sea of all wastes is prohibited with the only exception of those included in the list in Annex I to the Protocol.

Therefore, only the following materials are susceptible to spillage:

1. Dredging material
2. Sewage sludge
3. Dumping of fish discards or materials resulting from the fish handling operations
4. Vessels and platforms, or other constructions at sea
5. Inert inorganic geological materials
6. Organic matter of natural origin
7. Harmless bulky objects generated in isolated facilities (such as small islands) no other delete options possible.

Subsequently, in 2007, amendments were approved to include a new category of material susceptible to dumping to the sea, the CO2 flows for sequestration in underwater geological structures.
This amendment protocol also incorporates the advances and requirements that originate from the Rio de Janeiro Conference (1992) and the precautionary and polluter-pays principles and banning incineration at sea and the export of waste. Within the Protocol's scope, “General Guidelines” and “Specific Guidelines” have been drafted for some of the wastes that can be discharged. Detail of the procedures for waste assessment, landfill site selection, monitoring, characterization procedures, etc.

4.2.4.- BASEL CONVENTION

Subparagraph (a) of Article 4, paragraph 2, of the Basel Convention on the Control of Transboundary movements of hazardous wastes and disposal provides that each Party shall take appropriate measures to minimize the generation of hazardous wastes and other wastes therein, considering social, technological, and economic aspects.

Subparagraph (b) of Article 4, paragraph 2, of the Basel Convention, provides that each Party shall take appropriate measures to establish adequate disposal facilities for the environmentally sound management of hazardous wastes and other wastes, regardless of where their disposal takes place, where possible, it shall be located within it.
Subparagraph (c) of Article 4, paragraph 2, of the Basel Convention, states that each Party shall ensure that persons involved in the management of hazardous wastes and other wastes within it take the necessary measures to prevent such management from resulting in and, in the event of pollution, to minimize its impact on human health and the environment.

4.2.5.- STOCKHOLM CONVENTION

- **Art. 1** Each Party:

a) Shall prohibit and/or take the necessary legal and administrative measures to eliminate: (i) their production and use of chemicals listed in Annex A subject to the provisions contained in that Annex; and (ii) their impiers and expiers of chemicals listed in Annex A following the provisions of paragraph 2.
b) Shall restrict the production and use of chemicals listed in Annex B following the provisions of that Annex.

- **Art. 2.-** literal a. Protect human health and the environment by taking the necessary measures to minimize or prevent releases.

4.2.6.- ROTTERDAM CONVENTION

- **Art. 1.-** The objective of this Convention is to promote the shared responsibility and joint efforts of the Parties in the field of international trade in certain hazardous chemicals to protect human health and the environment from possible harm and to contribute to their environmentally sound use, facilitating the exchange of information on its characteristics, establishing a national decision-making process on its import and export, and disseminating those decisions to the Parties.

4.2.7.- AGENDA 21

The United Nations Conference on Environment and Development, held in Rio de Janeiro in June 1992, adopted Agenda 21, which consists of a comprehensive set of action plans on sustainable development to be implemented by countries in the 21st Century. The Rio Declaration, the Declaration on Forest Principles, and the United Nations Framework Conventions on Biological Diversity, Climate Change, and Desertification were also adopted at the Conference.

4.2.8.- CONVENTION ON BIOLOGICAL BIODIVERSITY

The Convention is the first comprehensive global agreement to address all aspects of biological diversity: genetic resources, species, and ecosystems. It recognizes, for the first time that the conservation of biological diversity is "a common concern of humanity" and an integral part of the development process.
The Convention on Biological Diversity's objectives is "the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of the benefits resulting from the utilization of genetic resources".

4.2.9.- KYOTO PROTOCOL

The Kyoto Protocol on climate change is an international agreement aimed at reducing emissions of six global warming-provoking gases: Carbon dioxide (CO_2), methane gas (CH_4), and nitrous oxide (N_2O), plus three fluorinated industrial gases: Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6), in a percentage of about 5 percent, over the period 2008 to 2012, compared to emissions by 1990.

4.2.10.- FRAMEWORK CONVENTION ON CLIMATE CHANGE

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in New York on 9 May 1992 and entered into force on 21 March 1994. It allows, among other things, to strengthen public awareness, on a global scale, of the problems related to climate change.
In 1997, governments agreed to incorporate an addendum to the treaty, known as the Kyoto Protocol, which has stronger (and legally binding) measures. In 2006, this Protocol to the United Nations Framework Convention on Climate Change was amended in Nairobi and a new protocol was planned for adoption in 2009 in Copenhagen, which had to be delayed and moved to Mexico in 2010.
The objective of the Convention is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference in the climate system and within a sufficient time to allow ecosystems to adapt naturally to climate change, ensuring that food production is not threatened and allowing economic development to continue sustainably.

In defining this objective, it is important to highlight two aspects:

1) The concentration levels of GHGs that are considered dangerous anthropogenic interference in the climate system are not determined, thus recognizing that there was no scientific certainty at the time as to what should be understood by non-hazardous levels.
2) The fact that climate change is already inevitable is suggested, and therefore, preventive actions (to curb climate change) and adaptation to new climate conditions should be addressed.

4.3.- LAWS

4.3.1.- ENVIRONMENTAL MANAGEMENT LAW

Published in RO, Supplement No. 418 of September 10, 2004. Before its current codified status, the Environmental Management Law issuance (D.L. No. 99-37: 22-07-99 R.O. No. 245: 30-O7-99) for the first time, the environmental management of the State and gives a new institutional structure. Also, the principles and guidelines of an environmental policy are

established, determining the obligations of the public and private sectors in environmental management, and indicating permissible limits, controls, and sanctions in this area.

TITLE I: SCOPE AND PRINCIPLES OF ENVIRONMENTAL MANAGEMENT

- **Art. 1.-** This Law establishes the principles and guidelines for environmental policy; it determines the obligations, responsibilities, levels of participation of the public and private sectors in environmental management and indicates permissible limits, controls, and sanctions in this area.
- **Art. 2.-** Environmental management is subject to the principles of solidarity, co-responsibility, cooperation, coordination, recycling, and reuse of waste, use of environmentally sustainable alternative technologies, and respect for traditional cultures and practices.

TITLE II. THE INSTITUTIONAL SYSTEM OF ENVIRONMENTAL MANAGEMENT
CHAPTER I. SUSTAINABLE DEVELOPMENT

- **Art. 7 and 8.-** Sustainable development for the conservation of the Natural Heritage and the sustainable use of natural resources is established as a principle. The Ministry of the Environment, acting as the governing, coordinating, and regulating body of the "Decentralized System of Environmental Management," is provided as the national environmental authority. This regulatory institution must, among other things, determine works, projects, and investments that require approved environmental impact studies.

CHAPTER IV. PARTICIPATION OF STATE INSTITUTIONS

Various State agencies and sectoral entities are actively involved in the decentralization of Environmental Management, evidence of which is that the Ministry of the Environment assigns responsibility for executing the plans to all State institutions that have to do with environmental issues. At present, the municipalities are acting in this field with the expedition of Environmental Ordinances. With this measure, the State hopes to expand its scope of action and improve its effectiveness.

TITLE III: ENVIRONMENTAL MANAGEMENT INSTRUMENTS
CHAPTER II. ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL CONTROL

- **Art. 19.-** Private or mixed public works, and public or private investment projects that may cause environmental impacts, shall be qualified before their execution by decentralized control bodies, following the Sole Environmental Management System, the guiding principle of which will be the precautionary principle.
- **Art. 21.**- Environmental management systems will include baseline studies; environmental impact assessment; risk assessment; management plans; risk management plans; monitoring systems; contingency and mitigation plans; environmental audits; and abandonment plans. Once these requirements have been met and following their qualification, the corresponding Ministry may grant or deny the corresponding license.
- **Article 22.**- Environmental management systems in contracts requiring environmental impact studies and in activities for which environmental licenses have been granted may be evaluated at any time, at the request of the Ministry of

the affected persons' sector.

- **Art. 23.-** The environmental impact assessment shall include:
  a) Estimation of the effects on the human population, biodiversity, soil, air, water, landscape, and the structure and function of ecosystems present in the area expected to be affected.
  b) Quietness of public conditions such as noise, vibrations, odors, light emissions, thermal changes, and any other environmental damage resulting from their execution; and,
  c) The impact that the project, work, or activity will have on the elements that make up the historical, scenic, and cultural heritage.
- **Article 28.**- It is established that citizens have the right to participate in environmental management through consultations, public hearings, initiatives, proposals, or any form of partner vessel between the public and private sectors. Article 29 also states that citizens shall have the right to be informed promptly and enough about any activity that can produce environmental impacts. The RO appeared at the same time. 1040.

CHAPTER V: INSTRUMENTS FOR THE APPLICATION OF ENVIRONMENTAL STANDARDS

- **Art. 33.-** Set up as instruments for the application of environmental standards the following: Environmental quality parameters, effluent and emission standards, technical product quality standards, licensing and administrative licensing regime, environmental impact assessments, lists of products that are polluting and harmful to human health and the environment, certifications of environmental quality of products and services and others that will be regulated in the respective regulations.
- **Art. 34.-** They will also serve as instruments for the application of environmental standards, contributions, and fines for environmental protection and sustainable use of natural resources, as well as risk insurance and deposit systems, which can be used to encourage actions favorable to environmental protection.

TITLE V: INFORMATION AND ENVIRONMENTAL MONITORING

- **Art. 40.-** Any natural or legal person who, during their business or industrial activities, establishes that they may or are producing environmental damage to ecosystems is obliged to inform the Ministry of the Branch or the institutions of the autonomous sectional regime.

TITLE VI: PROTECTION OF ENVIRONMENTAL RIGHTS

- **Art. 41.** To protect the individual or collective environmental rights, public action must be granted to natural persons, legal persons, or human groups to denounce the violation of environmental standards, without prejudice to the constitutional complaint action provided for in the Constitution of the Republic."

CHAPTER I. CIVIL ACTIONS

- **Art. 43.** Natural persons, legal persons, or human groups linked by a common interest and directly affected by the harmful action or omission may bring before the competent

judge, actions for damages and deterioration caused to health or the environment including biodiversity with its constituent elements.

CHAPTER II. ADMINISTRATIVE ACTIONS AND ADMINISTRATIVE LITIGATION

- **Art. 46.-** In case of individuals, by action or omission, failing to comply with environmental protection standards, the competent authority shall adopt the sanctions provided for in this Law and the following administrative measures:
  It will require the regularization of authorizations, study permits, and assessments and verification of compliance with measures taken to mitigate and compensate for environmental damage within thirty days.

4.3.2.- LAW ON PREVENTION AND CONTROL OF ENVIRONMENTAL POLLUTION

CHAPTER I: PREVENTION AND CONTROL OF AIR POLLUTION

- **Art. 1.-** It is prohibited to expel or discharge into the atmosphere, without subject to the corresponding technical standards and regulations, pollutants which, in the opinion of the Ministries of Health and the Environment, in their respective areas of competence, may harm human health and life, flora, fauna, and resources or property of the state or individuals or constitute a nuisance.
- **Art. 2.-** For this Law, they will be considered as potential sources of air pollution:
  A) artificial ones, originating from technological development and human action, such as factories, boilers, steam generators, workshops, thermoelectric plants, oil refineries, chemical plants, aircraft, automotive and similar, incineration, open burning of wastes and wastes, exploitation of construction materials and other activities that produce or may produce pollution; and,
- **Art. 5.-** Public or private institutions interested in installing industrial projects, or others that may cause alterations in ecological systems and that produce or may produce air pollution, shall submit to the Ministries of Health and the Environment, as appropriate, for prior approval, studies on the environmental impact and the control measures to be applied.

CHAPTER II: PREVENTION AND CONTROL OF WATER POLLUTION

- **Art. 6.-** It is prohibited to discharge, without subject to the corresponding technical rules and regulations, to sewage networks, or in the ravines, ditches, rivers, natural or artificial lakes, or in the maritime waters, as well as to infiltrate into the land, wastewater containing contaminants that are harmful to human health, wildlife, flora, and property.

CHAPTER III: PREVENTION AND CONTROL OF WATER POLLUTION

- **Art. 10.-** It is prohibited to discharge, without subject to the corresponding technical standards and regulations, any kind of contaminants that may alter the quality

of the soil and affect human health, flora, fauna, natural resources, and other goods.

4.3.3.- ORGANIC LAW OF WATER RESOURCES. WATER USES AND EXPLOITATION

- **Article 1.- Nature.** Water resources are part of the State's natural heritage and will be within its exclusive competence, which will be exercised concurrently between the Central Government and the decentralized autonomous governments, following the Law.
  Water is a strategic national heritage of public use, inalienable, imprescriptible, non-seizable, and essential to life, a vital element of nature and fundamental to ensuring food sovereignty.
- **Article 2.- Scope of application.** This Organic Law shall govern throughout the national territory, subject to its rule's persons, nationals, or foreigners who are in it.
- **Article 3.- Object of the Law.** The purpose of this Law is to guarantee the human right to water as well as to regulate and control authorization, management, preservation, conservation, restoration, of water resources, water use and exploitation, integral management, and its recovery, in its different phases, forms, and physical states, to guarantee the sumak kawsay or good living and the rights of nature established in the Constitution.
- **Article 4.- Principles of the Law.** This Law is based on the following principles:
  a) The integration of all water, whether surface, underground or atmospheric, into the hydrological cycle with ecosystems.
  b) Water, as a natural resource, must be preserved and protected through sustainable and sustainable management, which guarantees its permanence and quality.
  c) Water, as a public good, is inalienable, imprescriptible, and non-seizable.
  d) Water is a national and strategic heritage serving citizens' needs and an essential element of food sovereignty; consequently, any private owner vessel of water is prohibited.
  e) Access to water is a human right.
  f) The State guarantees equitable access to water.
  g) The State guarantees the integrated, participatory, and integrated management of water; and,
  h) Water management is public or community.
- **Article 5.- Strategic Sector.** Water is a national heritage, strategic sector of decision-making, and its exclusive control is on the hands of the State through the Sole Water Authority. Its management will be oriented toward the full exercise of rights and the public interest, given its decisive social, community, cultural, political, environmental, and economic influence.
- **Article 6.- Prohibition of privatization.** All forms of water privatization are prohibited, because of their importance to life, the economy, and the environment; as such, it cannot be the subject of any trade agreement with government, multilateral entity, or private domestic or foreign enterprise. Its management shall be exclusively public or Community. No form of individual or collective owner vessel of water, whatever its state, shall be recognized. Consequently, the following are prohibited:

a) Any delegation to the private sector of water management or any of the powers assigned constitutional or legally to the State through the Sole Water Authority or decentralized autonomous governments.
b) The indirect management, delegation, or outsourcing of the provision of public services related to the integral water cycle by the private initiative.
c) Any trade agreement imposing a profit-based economic regime for water management.
d) Any form of commodification of environmental services over water for profit.
e) Any form of a cooperation agreement or agreement that includes clauses that undermine conservation, sustainable water management, biodiversity, human health, the human right to water, food sovereignty, human and natural rights; and,
f) The granting of perpetual or indefinite authorizations for the use or use of water.

- **Article 7.- Activities in the strategic water sector.** The provision of the public water service is exclusively public or community. Exceptionally, the private initiative and the popular and solidarity economy may participate, in the following cases:
  a) Emergency declaration adopted by the competent authority, following the legal order; or,
  b) Development of public service administration threads where the competent authority does not have the technical or financial conditions to do so. The maximum period shall be ten years after an audit.
- **Article 8.- Integrated water resources management.** The Sole Water Authority is responsible for integrated and integrated water resources management with a systemic and basin-based eco-approach or water basin systems, which will be coordinated with the different levels of government according to their fields of competence.
  The water basin is defined as the territorial unit delimited by the dividing line of its waters that drain superficially toward a common channel, including in this space population, infrastructure, conservation areas, protection, and productive zones.
  Where the groundwater limits do not coincide with the surface water boundary line, this delimitation shall include the projection of the groundwater recharge flowing into the surface-delimited basin.
  The Sole Water Authority shall approve the specific delineation of water basins and their possible grouping for planning and management purposes and groundwater allocation to the relevant watershed.
  Integrated water resources management will be the transversal axis of the decentralized national system of participatory development planning.
- **Part. 9.- Guarantee of public rights and policies.** The State shall allocate in an equitable and united manner the public budget for implementing policies and the provision of public services following the Law.
- **Article 57.-Definition.** The human right to water is the right of all people to have clean, sufficient, safe, acceptable, and accessible water and affordable for personal and home use in quantity, quality, continuity, and coverage. Access to environmental sanitation is

part of this right, ensuring human dignity, health, avoiding contamination, and ensuring water reserves' quality for human consumption.

The human right to water is fundamental and indispensable. No person may be private and excluded or deprived of this right.

The exercise of the human right to water will be sustainable so that future generations can exercise it. The Sole Water Authority shall define quality water reserves for the human consumption of present and future generations and shall be responsible for implementing policies related to the effectiveness of the human right to water.

- **Article 58.- The requirement of the human right to water.** Individuals, communities, peoples, nationalities, and communities may require the authorities concerned to comply with the human right to water, the same ones that will attend to their requests in a priority and progressive manner. Authorities that fail to exercise this right shall be subject to sanction following the law.
- **Article 59.- Vital quantity and minimum rate.** Under national and international standards and guidelines, the Sole Water Authority shall establish the vital amount of water per person to meet its basic and domestic needs, whose access forms the essential content of the human right to water. The vital amount of raw water intended for human consumption processing is free to guarantee the human right to water. When you exceed the set minimum life amount, the applicable fee will apply. The vital amount of the processed water per person will have guaranteed fee sustainability of service provision.
- **Article 60.- Free access and use of water.** The human right to water implies the free access and use of surface or groundwater for human consumption provided that no diversion is made from its channel, no discharge is made, no alteration in its quality or a significant decrease in its quantity, no effect is made on the rights of third parties and following the limits and parameters established by the National Environmental Authority and the Sole Water Authority. The Sole Water Authority shall maintain a record of the human use of groundwater.

CHAPTER III.
NATURE RIGHTS

- **Article 64.- Water conservation.** Nature or Pacha Mama has the right to the conservation of waters with their properties as essential support for all life forms. In water conservation, nature has the right to:
  a) The protection of its sources, catchment areas, regulation, recharge, outcropping, and natural water channels, in particular snow, glaciers, moors, wetlands, and mangroves.
  b) The maintenance of ecological flow as a guarantee of the preservation of ecosystems and biodiversity.
  c) Preservation of the natural dynamics of the integral water cycle or hydrological cycle.
  d) The protection of watersheds and ecosystems from pollution; and
  e) Restoration and recovery of ecosystems by the effects of imbalances caused by water pollution and soil erosion.

- **Art. 65.- Integrated water management.** Water resources will be managed in an integrated and integral way, with a systemic eco-approach that guarantees biodiversity, sustainability, and preservation following this Law's regulations.

CHAPTER V
COLLECTIVE RIGHTS OF COMMUNITIES, PEOPLES, AND NATIONALITIES

- **Article 71.- Collective rights on water.** Indigenous communities, peoples, and nationalities, Afro-Ecuadorian and Montubian people from their worldview, enjoy the following collective rights over water:
  - **a)** Conserve and protect the water flowing through their lands and territories in which they live and develop their community life.
  - **b)** Participate in the use, exploitation, and community management of water flowing through their lands and territories that are necessary for the development of their collective life.
  - **c)** Preserve and protect their water management and management practices directly related to the right to health and food.
  - **d)** Maintain and strengthen their spiritual relationship with water.
  - **e)** Safeguard and disseminate their collective knowledge, sciences, technologies, and ancestral knowledge about water.
  - **f)** To be consulted in a mandatory manner, free, informed, and within a reasonable time, about any relevant regulatory decision or State authorization that may affect the management of the water flowing through their lands and territories.
  - **g)** Participate in the formulation of environmental impact studies on activities affecting ancestral uses and water management forms in their lands and territories.
  - **h)** Have access to accurate, complete, and reasonable-time water information; and,
  - **i)** Participation in the social control of any public or private activity likely to generate impact or affections on the ancestral uses and forms of water management in its properties and territories. Communities, peoples, and nationalities shall exercise these rights through their representatives in the terms provided for in the Constitution and the law.
- **Article 72.- Participation in water conservation.** Communities, peoples, and nationalities have the right to have the State, through its institutions, articulate policies and programs for conservation, protection, and preservation of the water flowing through their lands and territories. The exercise of this right shall not prevail or impair any of the State's powers over water.
- **Article 73.- Community water use, exploitation, and management.** Communities, peoples, and nationalities have the right to participate in the use, exploitation, and community management of water flowing through their lands and territories as a means of strengthening their identity, culture, traditions, and rights, following the legal system. For this purpose, through the representatives of their organizations and under this Law, they will participate in the integrated planning and community management of water flowing in their lands and territories and be part of the organizations forming in the basins in which their lands and territories are located.
- **Article 74.- Conservation of water management practices.** The application of traditional forms of management and management of the hydrological cycle is guaranteed.

practiced by indigenous, afro-Ecuadorian, and Montauban communities, peoples, and nationalities and their forms, uses, and customs for the internal distribution and distribution of authorized water flows are respected.

CHAPTER VI.
PREVENTIVE GUARANTEES
Section One
Ecological Flow and Water Protection Areas

- **Article 76.- Ecological Flow.** For this Law, ecological flow is the amount of water, expressed in terms of magnitude, duration, time, and frequency of the specific flow rate and the water quality expressed in terms of range, frequency, and duration of concentration of parameters required to maintain an adequate level of health in the ecosystem.
  In coordination with the National Environmental Authority, the Sole Water Authority shall establish the criteria, parameters, and methodologies for the determination of ecological flow according to the conditions and characteristics of the water bodies, which will be considered within the national water planning.
- **Article 73.- Community water use, exploitation, and management.** Communities, peoples, and nationalities have the right to participate in the use, exploitation, and community management of water flowing through their lands and territories as a means of strengthening their identity, culture, traditions, and rights, following the legal system.
  For this purpose, through the representatives of their organizations and under this Law, they will participate in the integrated planning and community management of water flowing in their lands and territories as well as be part of the organizations that are formed in the basins in which their lands and territories are located.
- **Article 74.- Conservation of water management practices.** The application of the traditional forms of management and management of the hydrological cycle, practiced by indigenous, Afro-Ecuadorian, and Montubian communities, peoples, and nationalities, is guaranteed and their forms, uses, and customs are respected for the internal distribution and distribution of authorized water flows.

CHAPTER VI.
PREVENTIVE GUARANTEES
Section One: Ecological Flow and Water Protection Areas

- **Article 78.- Water protection areas.** Water protection areas are territories where water sources are declared to be of public interest for their maintenance, conservation, and protection, that supply human consumption or guarantee food sovereignty, and they will form part of the National System of Protected Areas.
  Following a technical report issued by the National Environmental Authority and in coordination with the decentralized autonomous governments in the scope of its powers, the Sole Water Authority shall establish and define the areas of water protection that are necessary for the maintenance and conservation of the public water domain.
  The State will regulate the use of water protection areas to ensure proper management. The protection regime established for water protection areas shall respect the spiritual uses of peoples and nationalities. The Regulation of this

Law shall determine the procedure for establishing these water protection areas, if they are not protected wetlands, forests, and vegetation.

Where land use affects the protection and conservation of water resources, the Sole Water Authority, in coordination with decentralized autonomous governments and territorial constituencies, shall establish and define water protection areas, to prevent and control water pollution on riverbanks, riverbeds, lakes, lagoons, reservoirs, estuaries, and table mats.

SECOND SECTION

Objectives of Prevention and Control of Water Pollution

- **Article 79. Objectives for water prevention and conservation.-** The Sole Water Authority, the National Environmental Authority, and the decentralized autonomous governments will work in coordination to meet the following objectives:
  - **a)** Guarantee the human right to water for good living or sumak kawsay, the recognized rights to nature, and the preservation of all life forms in a healthy, ecologically balanced, and pollution-free environment.
  - **b)** Preserve the amount of water and improve its quality.
  - **c)** Control and prevent soil accumulation and subsoil of toxic substances, wastes, discharges, and other elements capable of contaminating surface or groundwater.
  - **d)** Control activities that may cause water degradation and related aquatic and terrestrial ecosystems and, when degraded, arrange for restoration.
  - **e)** Prohibit, prevent, control, and punish water pollution by dumping or depositing solid, liquid, and gaseous wastes, organic, inorganic compounds, or any other toxic substance that alter water quality or affects human health, fauna, flora, and the balance of life.
  - **f)** Ensure the integral conservation and care of defined water sources and the balance of the hydrological cycle; and,
  - **g)** Avoid degradation of ecosystems related to the hydrological cycle.
- **Article 80.- Dumping: Prohibitions and control.** Discharges of wastewater directly or indirectly into the public water domain are considered runoffs. Direct or indirect dumping of water or waste products, wastewater, untreated, and leachate susceptible to water contamination in the public water domain is prohibited.

  The National Environmental Authority shall exercise discharge control in coordination with the Sole Water Authority and the decentralized autonomous governments accredited to the Sole Environmental Management System.

  It is the responsibility of autonomous municipal governments to treat wastewater and solid waste to prevent water pollution following the law.
- **Article 81.- Administrative runoff authorization.** The authorization for runoffs shall be included in the environmental permits issued for the purpose. The parameters of the water quality to be discharged and the procedure for granting, suspending, and revising the authorization shall be regulated by the National or accredited

Environmental Authority, in coordination with the Sole Water Authority.
The decentralized autonomous governments within the scope of their competence and their jurisdiction shall issue the administrative discharge authorization provided for in this Law subject to the National Environmental Authority's public policies.

- **Article 82.- Citizen participation and oversight.** Peoples, communities and nationalities, and social groups may carry out oversight processes, observatories, and other social control mechanisms over water quality and of plans and programs for the prevention and control of pollution, following the Law.

CHAPTER VII: STATE OBLIGATIONS FOR THE HUMAN RIGHT TO WATER

SECTION ONE: OBLIGATIONS AND PROGRESSIVITY

- **Responsibility obligations.-** The State at its different levels of government is responsible to users, consumers, communities, peoples, and nationalities for the fulfillment of the following obligations:
  a) Reduce unsustainable extraction, diversion, or dams of flows.
  b) Prevent, reduce, and reverse water pollution.
  c) Monitor and protect declared reserves of optimal water quality.
  d) Contribute to the analysis and study of water quality and availability.
  e) Identify and promote technologies to improve water efficiency.
  f) Reduce waste of water during collection, handling, and distribution.
  g) Take measures for the restoration of degraded ecosystems.
  h) Support projects for the collection, storage, management, and rational, efficient, and sustainable use of water resources; and,
  i) Develop and promote training, scientific, and technological research in the water field.

SECOND SECTION

Uses of Water.

- **Article 86.- Water and its priority.** Under the constitutional provision, the order of priority between the different destinations or functions of water is:
  a) Human consumption.
  b) Irrigation that guarantees food sovereignty.
  c) Ecological flow; and,
  d) Productive activities.

  Irrigation water that guarantees food sovereignty includes the watering hole for animals, aquaculture, and other domestic food agricultural production activities, following the Regulations of this Law.
- **Article 87.- Types and time limits of authorizations.** The granting, suspension, or cancellation of authorizations is the responsibility of the Sole Water Authority. Authorizations according to the nature of their destination are classified in:
  1. Authorizations for water use. It is the administrative act issued by the Sole Water Authority through which it favorably responds to a request submitted by natural or legal persons for the use of a water flow, intended for human consumption or irrigation that guarantees food sovereignty, also including the watering hole of animals and Aquaculture production activities

in the form and conditions provided for in this Law.

2. Authorizations for the productive use of water. It is the administrative act issued by the Sole Water Authority, through which it responds favorably to a request submitted by natural or legal persons for the productive use of a flow of water intended for any of the economic exploitation in the form and conditions provided for in this Law.

- **Article 88.- Use.** Water use is understood to be used in basic life-critical activities, such as human consumption, irrigation, aquaculture, and animal watering to ensure food sovereignty under the terms of the Law.
- **Article 89.- Authorization of use.** According to the definition in the previous article, the use of water shall have the corresponding authorization granted following this Law, its Regulations, and water planning. The authorization for water uses for human consumption and irrigation for food sovereignty, animal watering, and aquaculture grants the user of this, in an exclusive way, the capacity for the collection, treatment, conduction, and utilization of the flow to which the authorization relates.
- **Article 90.- Conditions for the granting of water use authorizations.** Before the granting of water use authorizations, the Sole Water Authority shall verify compliance with the following conditions:
  a) Respect for the order of priority laid down in the Constitution and this Law.
  b) That has been certified, the availability of water of sufficient quality and quantity. Regarding water quality, the Sole Water Authority will progressively implement the certification processes.
  c) That the studies and projects of hydraulic infrastructure required for their use have been approved previously by the Sole Water Authority.
  d) That the beneficiary is responsible for the prevention and mitigation of the environmental damage that it causes, and is obliged to contribute to the good management of authorized water; and,
  e) That the use of the water be immediate or within a certain time limit for the destination to which it was authorized under the respective technical report.
- **Article 91.- Recreational and spiers use.** Recreational events and aquatic competitions involving a non-consumptive use of water shall not require prior authorization from the Sole Water Authority.
- **Article 92.- Cultural and sacred practices.** The Sole Water Authority shall ensure the integrity and permanence of the places where communities, peoples, and nationalities traditionally practice rites, cultural and sacred water values.

  The Sole Water Authority, along with communities, towns, and nationalities, will carry out and maintain a fully up-to-date and participatory National Inventory of Sacred and Ritual Water Places.

  The administration and conservation of sacred sites concerning water shall be carried out by entities or organizations of peoples and nationalities on whose lands or territories they are located, with the support of national programs and projects of the decentralized government agencies and autonomous governments, following the Constitution and its rights.

4.3.4.- ORGANIC HEALTH LAW

Published in Official Register No. 423 of 22 December 2006.

CHAPTER III: RIGHTS AND DUTIES OF INDIVIDUALS AND THE STATE IN RELATIONSHIP TO HEALTH

- **Art. 7** literal (c) refers to people's right to live in a healthy, ecologically balanced environment free from pollution.

BOOK II: ENVIRONMENTAL HEALTH AND SAFETY. COMMON PROVISION

- **Art. 95.** The national health authority coordinates with the MAE the basic standards for preserving the environment in human health issues.

SINGLE TITLE: CHAPTER I. WATER FOR HUMAN CONSUMPTION

- **Art. 96.-** it indicates the obligation of any natural or legal person to protect any aquifer, source, or basin that serves as a water supply for human consumption and prohibits any activity that may pollute such source of water collection.

CHAPTER II: COMMON, INFECTIOUS, SPECIAL WASTES, AND IONIZING AND NON-IONIZING RADIATION

- **Art. 103.-** Any person, natural or legal, is prohibited from discharging or depositing wastewater without appropriate treatment, as provided in the relevant regulations, in rivers, seas, canals, streams, lagoons, lakes, and other similar sites. Their use in animal husbandry or agricultural activities is also prohibited.
  Infectious wastes, unusual, toxic, and hazardous to health, must be treated technically before disposal and the final deposit will be carried out at the special sites established for the purpose by the country's municipalities.
  For the disposal of household waste, the provisions established for this purpose shall be complied with.
  The health authorities, in coordination with the municipalities, will be responsible for enforcing these provisions.
- **Art. 104.-** Any industrial, commercial, or service establishment must install systems to treat contaminated water and toxic waste produced by its activities. The health authorities, in coordination with the municipalities, will be responsible for enforcing this provision.

CHAPTER III: AIR QUALITY AND NOISE POLLUTION

- **Art. 111.-** refers to air quality and noise pollution and requires the national health authority to coordinate with the MAE all types of emanations affecting the respiratory, auditory, and visual systems, to prevent air and noise pollution that affects human health.
- **Art. 113.-** All work, productive, industrial, commercial, recreational, and fun activities, as well as housing and other facilities and means of transport, must comply with the provisions of the respective rules and regulations on prevention and control to avoid noise pollution, which affects human health.

CHAPTER V: HEALTH AND SAFETY AT WORK

- **Art. 117.-** It establishes that the national health authority, in coordination with the Ministry of Labor and Employment and the Ecuadorian Social Security Institute, shall establish occupational health and safety standards to protect the workers' health.
- **Art. 118**. Employers shall protect their workers' health by providing them with sufficient information, protective equipment, appropriate clothing, safe working environments, to prevent, reduce or eliminate risks, accidents, and the occurrence of occupational diseases.
- **Art. 119.-** Employers must notify the competent authorities of work accidents and occupational diseases, without prejudice to actions taken by both the Ministry of Labor and Employment and the Ecuadorian Social Security Institute.
- **Art. 120.** In coordination with the Ministry of Labor and Employment and the Ecuadorian Social Security Institute, the national health authority shall monitor and control working conditions so that they are not harmful or unhealthy during the periods of pregnancy and lactation of working women.
  Employers must comply with the rules and adjust the work activities of pregnant and nursing women.

BOOK III: HEALTH SURVEILLANCE AND MONITORING

- **Art. 129.-** Compliance with health surveillance and control standards is mandatory for all public and private institutions, agencies, and establishments engaged in the production, import, export, storage, transport, distribution, marketing, and distribution of products for human use and consumption.
- **Art. 130.** Establishments subject to health control for their operation shall have the national health authority's permission. The operating permit shall be valid for one calendar year.
- **Art. 132.-** Health monitoring and control activities include quality control, safety, and safety of processed products for human use and consumption, as well as verification of compliance with technical and health requirements in establishments engaged in production, storage, distribution, marketing, import, and export of the products indicated.

SINGLE TITLE: CHAPTER I: HEALTH RECORD

- **Art. 137.-** Processed foods, food additives, medicinal products in general, nutraceutical products, biological products are subject to health registration, naturally processed for medicinal use, homeopathic medicines and dental products; medical devices, biochemical and diagnostic reagents, hygienic products, pesticides for domestic and industrial use, manufactured in the national territory or abroad, for import, export, marketing, dispensing and dispensing, including those received in a donation.
- **Art. 138.-** The national health authority, through its competent body, National Institute of Hygiene and Tropical Medicine Dr. Leopoldo Izquieta Pérez, who will exercise its functions in a deconcentrated manner, will grant, suspend, cancel, or re-register the certificate of health registration before the fulfillment of the procedures, requirements

and deadlines set out in this Law and its regulations, under the guidelines and standards issued by the national health authority, which shall determine the payment of an amount for the registration and re-registration of such health registration certificate, the securities of which shall be destined for institutional development, this will include, as a priority, a national post-registration quality and safety control program.

- **Art. 139.-** The health register shall be valid for five years from the date of its grant. Any change in the condition in which the product was approved in the health register must be notified to the national health authority through the National Institute of Hygiene and Tropical Medicine Dr. Leopoldo Izquieta Pérez and will give rise to the procedure set out in the law and its regulations.
- **Art. 140.-** The import, export, marketing, and distribution of processed products for human use and consumption that do not comply with is prohibited the prior obtaining of the health register, except for the exceptions provided for in this Act.
- **Art. 141.-** The health register will be suspended or canceled by the national health authority through the National Institute of Hygiene and Tropical Medicine Dr. Leopoldo Izquieta Pérez, at any time if the product or its manufacturer is found not to comply with the requirements and conditions outlined in this Law and its regulations or where the product may cause harm to health, and the other penalties set out in this Law shall apply. In all cases, the holder of the register or the natural or legal person responsible shall fully compensate any damage to third parties, without prejudice to other legal actions to which it may have taken place.
- **Art. 142.** Through its competent bodies, the national health authority shall periodically carry out post-registration checks on all products subject to health registration by taking samples for quality control analysis and safety, whether in manufacturing, storage, transport, distribution, or distribution. It will also perform.

CHAPTER II: FOOD

- **Art. 145.-** It is the responsibility of producers, distributors, and other agents involved during the consumption production cycle to comply with the standards established in this Law and other provisions in force to ensure the quality and safety of food for human consumption.
- **Art. 146.-** In the area of food, it is prohibited to:
    a) The use of additives to disguise, attenuate, or correct technological deficiencies in production, handling, or conservation and to fraudulently highlight their characteristics.
    b) The use, import, and marketing of raw materials not suitable for human consumption.
    c) The inclusion of harmful substances that make them dangerous or potentially harmful to the health of consumers.
    d) The use of raw materials and products treated with ionizing radiation or that have been genetically modified to develop infant and infant food formulas.
    e) Processing and handling in non-hygienic conditions.

f) The use of containers that do not comply with the technical specifications approved for this purpose.
g) The supply of food is processed with names, brands, graphics, or labels that make false claims or omit data misleadingly or misleadingly to the consumer.
h) Storage of raw materials or processed foods in premises where harmful or dangerous substances are found.
i) Any form of counterfeiting, contamination, alteration or adulteration, or any procedure that produces the effect of making them harmful or dangerous to human health; and,
j) The display and sale of products whose lifetime has expired.

- **Art. 147.** In coordination with the municipalities, the national health authority will establish health education programs for food producers, food handlers, and consumers, promoting hygiene, individual and collective health, and environmental protection.
- **Art. 152.** In coordination with the competent agencies, the national health authority will establish and implement an integrated national system to ensure food safety.

In conclusion, the Organic Health Law provides for inter-institutional coordination between health and environmental authorities at the national level to prevent the pollution of resources and prevent any attacks on the inhabitants' human health.

4.3.5.- GENERAL LAW OF PORTS

- **Art. 1.**- All port facilities of Ecuador, maritime and river, as well as activities related to their operations carried out by organizations, entities, and natural or legal persons, shall be governed by the provisions of this Law.
- **Art. 2.**- The functions of planning, direction, coordination, orientation, and control of the national shipping and port policy shall be carried out through the following bodies: (A) National Council of the Merchant Navy and Ports. (b) The Directorate of the Merchant and Coastline Navy. (c) Port Institutions.
  Note: Art. 11 of D.E. 1111 (R.O. 358, 12-VI-2008) prescribes the replacement of any reference to the Directorate of the Merchant and Coastline Navy - DIGMER, with that of the “Secretariat of Ports and Maritime and River Transport”. However, since decree is not possible to introduce reforms to higher standards, we have retained the original text of this provision.
- **Art. 3.**- (**Reformed by Art. 28 of Law 12, R.O. 82-S, 9-VI-1997)** The National Council of the Merchant Navy and Ports shall be composed of the following members: The Minister of National Defense, who shall preside; the Commander General of the Navy; The Ministers or Under-Secretaries for Foreign Affairs, Public Works, Finance, Foreign Trade, Industrialization, and Fisheries; The President or Technical Director of the National Economic Planning and Coordination Board; the Chief of the First Naval Zone; and the Director of Maritime Development of the Navy. The Director of the Merchant and Coastline Navy will be on the Council as an Advisor with an informative voice but without a vote.

- **Art. 4.**- The National Council of the Merchant Navy and Ports is the highest advisory body of the Government in shipping and port matters and has the following powers:
    a. Approve the tariff regulations of the port entities and any changes or modifications to be considered.
    b. Decide on the desirability of establishing new piers, per national interests, considering the zones of influence, the National Transport Policy, and the Development Plan.
    c. Authorize the use of private or public natural or legal persons for commercial purposes, of piers or maritime or river installations.
    d. Know and approve the annual program of activities of the National Port System, which must be presented by the Directorate of the Merchant and Coastline Navy until December 31 of each year.
    e. Arrange for studies and projections on the influence of port facilities on the National Transport System.
    f. Approve the General Investment Plan of the National Port System and the port entities' annual budgets, which will be put to its consideration by the Directorate of the Merchant and Coastline Navy, no later than December 31 of each year.
    g. To know and to rule on the report of activities of the National Port System that will be presented by the Directorate of the Merchant and Coastline Navy in the first quarter of each year.
    h. Determine the jurisdiction of port entities.
    i. Present to the President of the Republic the proposal in a table, from among whose components the Member of the Board of Directors of each of the port entities shall be elected, by the President of the Republic.
    j. The others entrusted to him by the Law or Regulations.
- **Art. 6.** - The Directorate of the Merchant and Coastline Navy shall have in its Organization the National Department of Ports, which shall be responsible for the study and analysis of port activities in administrative, operational, construction, and improvement of Ecuadorian commercial piers, and the technical administrative bodies necessary for the performance of their mission. Note Art. 11 OD 1111 (R.O. 358, 12-VI-2008) prescribes the replacement of any reference to the Directorate General of the Merchant and Coastline Navy - DIGMER, with that of the “Secretariat of Ports and Maritime and River Transport”. However, since it is not possible by decree to introduce reforms to higher standards, we have retained the original text of this provision.

4.3.6.- HEALTH CODE: OFFICIAL REGISTRATION 158 OF FEBRUARY 8, 1971

This document “prohibits the discharge of solid, liquid or gaseous waste no treatment; harmful and undesirable substances that contaminate or affect water quality; stool, wastewater, industrial waste in any watercourse for domestic, agricultural use, industrial discharges in public sewage without the corresponding permit. Art. 12, 17, 25, and 28. Articles 03, 04, 06, 07, 08, 10, and 11 also apply.

- **Art. 6.-**The Health Code determines that environmental sanitation is the best set of activities devoted to conditioning and controlling the environment in which man lives to protect his health.
- **Art. 12.-** No person may remove solid, liquid, or gaseous waste into the air, soil, or water, without prior treatment that makes it harmless to health.
- **Art. 17.-** No one may discharge, directly or indirectly, harmful or undesirable substances in such a way that they may contaminate or affect the sanitary quality of the water and obstruct, in whole or in part, the supply routes.
- **Art. 25.-** Stool, wastewater, industrial waste may not be discharged, directly or indirectly, into streams, rivers, lakes, ditches, or in any course water for domestic, agricultural, industrial, or recreational use, unless previously treated by methods that make them harmless to health.
- **Art. 29.-** Tenure, production, import, distribution, transport, distribution, use, and disposal of toxic substances and products of a corrosive or irritating, flammable, or oxidizing character, explosive or radioactive, which constitute a health hazard, must be carried out under sanitary conditions that eliminate such risk and be subject to the control and requirements of the relevant regulation.
- **Art. 35.-** The removal or destruction of scrap, debris, garbage, or any pile of undesirable materials corresponds to the owner of a property or the person responsible for the occupation of a public road or site.
- **Art. 56.-** The workplaces must meet the hygiene and safety conditions for their personnel. The health authority shall also provide appropriate health measures for the benefit of workers employed during the construction of a work.
- **Art. 59.-** The owners or holders of open or closed places, to which the persons have regular access, shall keep them in conditions that avoid them the existence or reproduction of arthropods, rodents, snakes, and other species of animals acting as disease-transmitting agents, or which are harmful to man. The health authority shall issue the case instructions for the use of means and the opportunity to fulfill this obligation. Scientific experimentation centers and other establishments with the appropriate permit are excepted.

4.3.7.- COMPREHENSIVE CRIMINAL ORGANIC CODE

CHAPTER FOUR: CRIMES AGAINST THE ENVIRONMENT AND NATURE OR PACHA MAMA

Section One

Crimes against biodiversity

- **Article 245.-** Invasion of areas of ecological importance.- The person who invades the areas of the National System of Protected Areas or Fragile Ecosystems shall be punished with deprivation of liberty for one to three years.
  The maximum penalty provided shall be applied when:

1. As a result of the invasion, serious damage to biodiversity and natural resources is caused.
2. Promote, finance, or direct the invasion by taking advantage of people with deceit or false promises.

- **Article 247**

Crimes against wild flora and fauna.- The person who hunts, fish, captures, collects, extracts, have, transport, traffic, benefit, trade or market, specimens or parts thereof, their constituent elements, products, and derivatives, of terrestrial, marine or aquatic wildlife, of threatened, endangered and migratory species, listed at the national level by the National Environmental Authority as well as international instruments or treaties ratified by the State, it shall be punished with a custodial sentence of one to three years.

The maximum penalty provided shall apply if any of the following circumstances arise:

1. The event is committed in a period or area of seed production or reproduction or incubation, nesting, childbirth, breeding, or growth of the species.
2. This is done within the National System of Protected Areas.

Except for this provision, only hunting, fishing or subsistence capture, practices of traditional medicine, as well as the domestic use and consumption of timber made by communities in their territories, whose purposes are not commercial or for-profit, these should be coordinated with the National Environmental Authority.

SECOND SECTION
CRIMES AGAINST NATURAL RESOURCES

- **Article 251.- Crimes against water.-** The person who contravenes the existing regulations, contaminates, wishes, or alters the bodies of water, slopes, sources, ecological flows, natural waters that are outcrops or subterranean from water basins, and in general the hydrobiological resources or discharges into the sea causing serious damage, he shall be punished with a custodial sentence of three to five years.

  The maximum penalty shall be imposed if the offense is perpetrated in the space of the National System of Protected Areas or if the offense is perpetrated for profit or with methods, instruments, or means that result in extensive and permanent damage.
- **Article 252.- Crimes against the land.-** The person who contravenes the existing regulations concerning the plans of territorial and environmental management changes the use of forest land or soil intended for the maintenance and conservation of native ecosystems and their ecological functions, affects, or damages their fertile layer, cause erosion or desertification, causing serious damage, will be punished with deprivation of liberty for three to five years.

  The maximum penalty shall be imposed if the offense is perpetrated in the space of the National System of Protected Areas or if the offense is perpetrated for profit or with methods, instruments, or means that result in extensive and permanent damage.
- **Article 253.- Air pollution.-** The person who, contrary to the current regulations or by not taking the measures required by the standards, contaminates the air, the atmosphere, or other components of airspace at such levels as they result in

serious damage to natural resources, biodiversity, and human health, will be punished with imprisonment for one to three years.

- **Article 254.- Prohibited or unauthorized management of dangerous products, runoffs, wastes, or substances.-** The person who, contrary to the provisions of the regulations in force, develops, produces, possesses, burns, markets, enters, amounts, transpires, stores, deposits, or uses, products, wastes, runoffs, and chemical or hazardous substances, and with this causing serious damage to biodiversity and natural resources, will be punished with imprisonment for one to three years. The person shall be punished with imprisonment of three to five years in the case of:
    1. Chemical, biological, or nuclear weapons.
    2. Banned chemicals and agrochemicals, highly toxic persistent organic pollutants, and radioactive substances.
    3. The spread of diseases or pests.
    4. Technologies, experimental biological agents, or genetically modified organisms are harmful and harmful to human health or threaten biodiversity and natural resources.

  If death occurs because of these crimes, imprisonment of sixteen to nineteen years will be punishable.
- **Art. 255.- Misrepresentation or concealment of environmental information.-** The person who issues or provides false information or conceals information that is of support for the issuance and granting of environmental permits, environmental impact studies, environmental audits, and diagnoses, permits or licenses of forest use, that cause the making of an error by the environmental authority, they shall be punished with a penalty of deprivation of liberty of one to three years. The maximum penalty will be imposed if the public officer, for the sake of its functions or by taking advantage of its server status or responsibilities to carry out the control, processes, issues, or approves with false information environmental permits and others established in this article.

4.3.8.- ORGANIC CODE OF TERRITORIAL ORGANIZATION, AUTONOMY, AND DECENTRALIZATION

- **Article 136.- Second subparagraph.-** It is the responsibility of the decentralized provincial, autonomous governments to rule, direct, order, dispose of, or organize environmental management, the defense of the environment and nature, within the scope of their territory; these actions will be carried out within the framework of the decentralized national environmental management system and following the policies issued by the national environmental authority. To grant environmental licenses, they must be accredited as a responsible environmental enforcement authority in their constituency.

4.4.- CONSOLIDATED TEXT OF SECONDARY ENVIRONMENTAL LEGISLATION

PRELIMINARY TITLE

OF ECUADOR'S BASIC ENVIRONMENTAL POLICIES

- **Art. 1.-** Set up the following basic environmental policies of Ecuador:

Basic environmental policies of Ecuador

1. It recognizes that the fundamental principle that must transcend the policy package is society's commitment to promoting sustainable development. Ecuadorian society should continuously observe the concept of minimizing environmental risks and negative impacts while maintaining sustainable development's social and economic opportunities.
2. It recognizes that sustainable development can only be achieved when its three elements, social, economic, and environmental, are treated harmoniously and evenly at every moment and for every action. Every inhabitant of Ecuador and its public and private institutions and organizations must take every action, at every moment, in a way that simultaneously propends to be socially just, economically profitable, and environmentally sustainable.
3. Recognizing that environmental management corresponds to everyone at every moment of life and that no one can substitute the responsibility of everyone in this management in their field of action: Through coordination by the Ministry of the Environment, to ensure proper national coherence, public sector and private sector entities in Ecuador, without prejudice to each having to attend to its specific area, will contribute, Within the framework of these policies, to identify, for each case, the specific policies, and strategies, the guidelines and guidelines necessary to ensure that all of them have adequate environmental management permanently aimed at achieving sustainable development, They will also collaborate on the necessary aspects to ensure that each inhabitant of Ecuador adapts its behavior to this purpose.
4. Recognizing that the environment has everything to do with and is present in every human action: Environmental considerations must be explicitly present in all human activities and each field of action of public and private entities, particularly as an obligatory and indissoluble part of decision-making; therefore, the environment should not, in any case, be considered as an independent sector and separate from social, economic, political, cultural, and general considerations of any order. This is without prejudice to the fact that, for purely methodological reasons, analysis and training on so-called "environmental issues" should be carried out.
5. Recognizing that each environmental management issue has several important actors, linked to or with interests in them: Environmental management in Ecuador will be based primarily on solidarity, co-responsibility, cooperation, and coordination among all the inhabitants of Ecuador, aimed at ensuring sustainable development, based on the balance and harmony between social, economic, and environmental issues. Similar criteria will guide Ecuador in its relations with the other countries and peoples of the world so that activities carried out within or outside its jurisdiction and competence do not harm other States.

and areas without jurisdiction, nor is it adversely affected by the actions of others. Mention is made to promote the rational and sustainable co-management of shared resources with other countries.

6. Recognizing that, without prejudice to necessary and advisable legal and institutional complements and systematizations, there are sufficient laws and institutions in Ecuador to carry out and maintain adequate environmental management, but that laws and regulations are only partially complied with and that many institutions go through a crisis in several orders: their decision to promote the rational and sustainable co-management of shared resources with other countries.

BOOK IV.
OF BIODIVERSITY
CHAPTER VII: PROHIBITIONS

- **Art. 103.-** The hunting of the species, birds, or mammals, which make up the wild fauna and which are listed in Annex 1 to this Title, which are classified as threatened or endangered, is prohibited at any time of the year. Hunting in certain areas or areas and for the duration of the closures is not also permitted.
- **Art. 109.** It is prohibited to disturb and threaten the lives of wild animals throughout the country, with the exceptions provided for this regulation.
- **Art. 110.-** The collection of eggs, the capture or apprehension of neonates, and wild animal husbandry are prohibited without authorization.
- **Art. 114.-** All kinds of hunting in areas of the National Heritage are prohibited, such as National parks, ecological reserves, wildlife refuges, existing and future biological reserves.

4.5.- MINISTERIAL AGREEMENTS

4.5.1.- MINISTERIAL AGREEMENT 061

MODIFICATION OF BOOK VI OF THE CONSOLIDATED TEXT OF SECONDARY LEGISLATION MINISTRY OF THE ENVIRONMENT (TULSMA)

BOOK VI ENVIRONMENTAL QUALITY TITLE
I PRELIMINARY PROVISIONS

- **Art. 1 SCOPE.-** This book establishes procedures and regulates public and private activities and responsibilities in the field of environmental quality. Environmental quality is defined as the set of characteristics of the environment and nature that includes air, water, soil, and biodiversity, concerning the absence or presence of harmful agents that may affect the maintenance and regeneration of life cycles, structure, evolutionary functions and processes of nature.
- **Art. 2 PRINCIPLES.-** Without prejudice to those contained in the Constitution of the Republic of Ecuador and the laws and secondary rules of any hierarchy governing the matter, the principles contained in this Book apply are of mandatory.

application, and constitute the conceptual elements that originate, support, govern, and inspire all decision and public/private activities of natural and legal persons, populations, nationalities and communities regarding the management of environmental quality and responsibility for environmental damage.

For this Book, the administrative authorities and judges shall consider the principles of environmental legislation and, in particular, the following:

- **Preventive or of Prevention.** According to public powers assigned by law, it is the state's obligation through its institutions and entities to adopt the appropriate policies and measures to avoid negative environmental impacts when damage is certain.

- **Preventative or of Precaution.-** It is the obligation of the state, through its institutions and entities, and according to public powers assigned by law, to adopt protective, effective, and timely measures in case of risk of severe or irreversible damage to the environment, even if the environmental impact of any action or omission is uncertain, or if there is no scientific evidence of such damage. The precautionary principle is applied when it is necessary to decide between alternatives in a situation where technical and scientific information is insufficient, or there is a significant level of uncertainty in the conclusions of the technical-scientific analysis. In such cases, the precautionary principle requires implementing a solution with the minimum risk to directly or indirectly damage the ecosystem.

- **Polluter-Payer or Polluter Pays.**- It is the obligation of all operators of activities involving environmental risk of internalizing environmental costs, assuming the costs of prevention and pollution control, as well as those necessary to restore ecosystems in case of environmental damage, duly considering the public interest, the rights of nature and the right to live in a healthy and ecologically balanced environment. This principle is also applied in sanctioning procedures or in determining administrative or tax payment obligations.

- **Correction at Source.-** It is the obligation of Control Subjects to adopt all the relevant measures to avoid, minimize, mitigate, and correct environmental impacts from the production process's origin. This principle shall be applied in projects in addition to management plans or, of any nature, included in this Book.

- **Responsibility sharing in environmental matters.-** When compliance with the environmental obligations corresponds to several persons jointly, there shall be shared responsibility of the infractions they commit and the imposed penalties.

- **Cradle to the grave.-** The Controllers' responsibility includes all the phases of the integral management of hazardous chemical substances and the proper management of waste, hazardous and/or special waste from its generation to its final disposal, in an integral, shared, and differentiated manner.

- **Strict liability.-** Liability for environmental damage is objective. In addition to the corresponding penalties, any damage to the environment shall also imply the obligation to restore ecosystems and compensate the affected people and communities fully.

- **Extended Producer and/or Importer Responsibility.-** Producers and/or importers are responsible for the product throughout its entire life span, including impacts inherent to the selection of materials, of the production process thereof, as well as those related to the use and final disposal of these at the end of their life span.

- **Best available technology.-** Any activity that may produce an environmental impact or risk must be carried out efficiently and effectively, that is, using the most appropriate technical procedures available to prevent and minimize environmental impact or risk.

- **Primary Repair or In Natura.-** It is the obligation to fully restore ecosystems when there is any damage to the environment, without prejudice to the corresponding penalties, seeking to return to the initial condition before the damage.

TITLE III: ON THE UNIQUE ENVIRONMENTAL MANAGEMENT SYSTEM

CHAPTER I

INSTITUTIONAL REGIME

❖ **Art. 6 General Obligations.-** Any new work, activity, or project and any extension or modification of the same that may cause environmental impact must be submitted to the Unique Environmental Management System, in accordance with the provisions of the applicable legislation, this Book, and the administrative and technical regulations issued for that purpose.

Any action related to environmental management must be planned and executed on

the basis of the sustainability, equity, social involvement, validated representativeness, coordination, caution, prevention, mitigation, and remediation of negative impacts, shared responsibility, solidarity, cooperation, waste reduction, reuse, recycling and use of waste, conservation of general resources, use of clean technologies, alternative environmentally responsible technologies, good environmental practices, and respect for traditional cultures and practices and ancestral possessions.

Likewise, any product's environmental impacts, industrialized or not, must be considered during its life span.

❖ **Art. 7 Scope of the environmental impact assessment. The environmental impact assessment process** shall be carried out by the National Environmental Authority, which may be delegated to the Decentralized Autonomous Governments at the province, district and/or municipality level, through an accreditation process in accordance with the provisions of this Book.

The environmental impact assessment process is an environmental administrative authorization, and its scope and nature depend on the management tool used according to the case.

Both the environmental authorization and the environmental impact assessment tools are described in this Book.

CHAPTER II: UNIQUE ENVIRONMENTAL INFORMATION SYSTEM

Art. 12.- On the Unique System of Environmental Information (SUIA, in Spanish). - It is the computer tool of mandatory use for the bodies that make up the Decentralized National System of Environmental Management; the National Environmental Authority shall administer it, and it shall be the only online mean used to carry out the entire process of

environmental regularization, according to the principles of speed, simplification of procedures, and transparency.

- **Art. 14.-** On the regularization of the project, work or activity. - The projects, works or activities, included in the catalog issued by the National Environmental Authority must be regularized through the SUIA, which shall automatically determine the type of environmental permit being:

  Environmental Registry or Environmental License.

CHAPTER III
ON THE ENVIRONMENTAL REGULARIZATION

- **Art. 21 General objective.-** Authorize the execution of public, private and mixed projects, works or activities, based on their particular characteristics and the significance of environmental impacts and risks.
- **Art. 22 List of projects, works, or activities.-** It is the list of projects, works or activities to be regularized through the environmental permit based on the significance of the impact and risk generated to the environment.
- **Art. 25 Environmental License.** The Competent Environmental Authority issued the environmental permit through the SUIA, being mandatory for those projects, works or activities considered medium or high impact and environmental risk. The control Subject shall comply with the obligations arising from the environmental permit issued.

CHAPTER IV
ON THE ENVIRONMENTAL ASSESSMENTS

- **Art. 27 Objective.-** Environmental assessments serve to guarantee an adequate and well-founded prediction, identification, and interpretation of the environmental impacts of existing projects, works or activities and those to be developed in the country, as well as the technical suitability of the measure control for the management of its environmental impacts and risks; the Environmental Assessment must be carried out in a technical manner and depending on the scope and depth of the project, work or activity, according to the requirements outlined in the applicable environmental regulations.
- **Art. 28 On the evaluation of environmental impacts.-** The evaluation of environmental impacts enables the prediction, identification, description, and assessment of the potential environmental impacts that a project, work, or activity may cause to the environment; this analysis establishes the most effective measures to prevent, control, mitigate and compensate negative environmental impacts, framed in the provisions of the applicable environmental regulations. For the evaluation of environmental impacts, the relevant environmental variables of the media or matrices are observed, among these:
  a) Physical (water, air, soil, and climate).
  b) Biotic (flora, fauna, and their habitats).
  c) Social-cultural (archeology, social-economic organization, among others);

  Access to environmental information is guaranteed to civil society and public officials of undergoing projects, works, or activities or those with an environmental license.
- **Art.29 Responsible for environmental assessments.-** Environmental Assessments of projects, works, or activities shall be carried out under the responsibility of the regulated party, in accordance with the applicable environmental guidelines and regulations, who shall be responsible for the veracity and accuracy of their contents.

The Environmental Assessments of the environmental licenses shall be carried out by Consultants whom the corresponding authority authorizes, Which, at the same time, shall periodically evaluate the technical and ethical capacities of the consultants to carry out said studies, in cooperation with other competent bodies.

- **Art. 30 On the terms of reference.-** They are standardized or specialized preliminary documents that determine the content, scope, focus, methods, and techniques to be applied in the preparation of Environmental Assessments.

  The terms of reference for the conduction of an Environmental Assessment shall be available online through SUIA for the sponsor of the project, work or activity; the corresponding environmental authority shall focus the studies According to the activity under regularization.

- **Art. 31 On the description of the project and analysis of alternatives.-** The projects or activities that require environmental licenses must be described in detail to predict and evaluate their potential or real impacts.

  During the evaluation of the project or work, Environmental, social and economic components shall be equally valuated; this information shall complement the feasible alternatives for the analysis and selection of the most appropriate one.

  Failure to execute the project shall not be considered as an alternative within the analysis.

- **Art. 32 On the Environmental Management Plan.-** The Environmental Management Plan consists of several sub-plans, depending on the activity or project's characteristics.

  The Environmental Management Plan shall contain the following sub-plans, with their related programs, budgets, administrators, means of verification, and schedule.
  a) Impact Prevention and Mitigation Plan;
  b) Contingency Plan;
  c) Training Plan;
  d) Occupational Health and Safety Plan;
  e) Waste Management Plan;
  f) Community Relations Plan;
  g) Plan for the Restoration of Affected Areas;
  h) Area Abandonment and Delivery Plan;
  i) Monitoring and Follow-up Plan.

  If the Studies on the environmental impact for activities under operation (EslA Ex post) shall be included in addition to the plans as mentioned above, the action plan that allows correcting the Non-Conformities (NC), found during the process.

- **Art. 33 On the scope of environmental assessments.-** Environmental Assessments must cover all phases of a project's life span, work, or activity, except when established by the nature and characteristics of the activity and based on environmental regulations different phases and within these, different stages of their execution.

- **Art. 35 Ex Post Environmental assessments (EslA Ex Post).-** These are Environmental Assessments that have the same purpose as studies above and that allow regularizing in environmental terms to execute a work or activity in operation, according to this legal instrument's provisions.

- **Art. 36 On the observations to the environmental assessments.-** During the review and analysis of the Environmental Assessments, prior to the favorable pronouncement, the Competent Environmental Authority may request, among others:

  a) Modification of the proposed project, work, or activity, including the corresponding alternatives.

b) Incorporation of alternatives not initially foreseen in the Environmental Assessment, as long as these do not substantially change the nature and/or dimensioning of the project, work or activity.

c) Correction of the information presented in the Environmental Assessment;

d) Carrying out complementary or new analyzes.

The Corresponding Environmental Authority shall review the Environmental Assessment, issue observations one time only, notify the proposer to accept their observations, and regarding these responses, said authority may require additional information from the sponsor for final approval. If these observations are not cleared in the second review cycle, the process shall be archived.

- **Art.37 On the favorable pronouncement of the Environmental Assessments.-** If the corresponding Environmental Authority considers that the Environmental Assessment submitted Fulfills the demands and complies with the requirements outlined in the applicable environmental regulations and in the applicable technical standards, it shall issue a favorable pronouncement by means of an official letter.

- **Art. 38 On the provision of the policy or guarantee of faithful compliance with the Environmental Management Plan.-** Environmental regularization for projects, works or activities requiring environmental licenses Shall include, among other conditions, the provision of a policy or guarantee of faithful compliance with the Environmental Management Plan, equivalent to one hundred percent (100%) of the cost thereof, to face possible breaches, related to the execution of the licensed activity or project, whose endorsement must be in favor of the Corresponding Environmental Authority.

  This guarantee or policy shall not be required when the executors of the project, work or activity Are bodies of the public sector or companies whose subscribed capital belongs, at least to two thirds, to bodies of public law or private law with social or public purposes.

  However, the executing body shall respond administratively and civilly for the full and timely compliance with the Environmental Management Plan of the licensed project, work or activity and the contingencies that may cause environmental damage or third-party effects, in accordance with the provisions of the applicable regulation.

- **Art. 39 On the issuance of environmental permits.-** The projects, works, or activities that require environmental permits, in addition to the favorable pronouncement, must place the corresponding payments for administrative services in accordance with the requirements provided for each case.

  The projects, works or activities requiring an environmental license must deliver the guarantees and policies established in the applicable environmental regulations; once the Corresponding Environmental Authority verifies this information, it shall issue the corresponding environmental license.

- **Art. 40 On the Resolution.-** The Corresponding Environmental Authority shall notify the subjects of control of the projects, works or activities about the issuance of the Resolution of the environmental license, which shall clearly explain the governing condition the project, work or activity shall be subject during all its phases, as well as the legal and regulatory powers for the operation of the project, work or activity, including as follows:

  a) The legal considerations that served as the basis for the pronouncement and approval of the Environmental Assessment

  b) The technical considerations on which the Resolution is based;

c) The considerations on the Social Participation Process, in accordance with the applicable environmental regulations;

d) The approval of the corresponding Environmental Assessments, the issuance of the environmental license and that conditioning regarding the suspension and/or revocation of the environmental license, in case of non-compliance.

e) The obligations that must be fulfilled during all phases of the life span of the project, work or activity.

- **Art. 41 Environmental permits for activities and projects in operation (ex post studies).-** The projects, works, or activities in operation that must obtain an environmental permit in accordance with the provisions of this Book must start the regularization process from the date of publication of this regulation in the Official Registry.
- **Art. 42 On the Registry of environmental permits.-** The National Environmental Authority shall keep a record of the environmental permits issued at a national level through the SUIA.
- **Art. 43 On the closure of operations and abandonment of the area or project.-** Control Subjects that for any reason require the closure of operations and/or abandonment of the area, must execute the closure and abandonment plan, as approved in the Respective Environmental Management Plan; additionally, they must submit environmental reports, Environmental audits, or other documents According to the guidelines established by the Corresponding environmental Authority.

CHAPTER V
ON SOCIAL INVOLVEMENT

- **Art. 44 On social involvement.-** It is governed by the principles of legitimacy and representativeness and defined as an effort by State Bodies, citizens and the control subject interested in carrying out a project, work or activity. The corresponding environmental authority shall inform the population on the potential Performance of activities and/or projects and the potential social-environmental impacts expected, and the relevance of the actions to be taken. In order to collect their opinions and observations and incorporate in the Environmental Assessments those that are technically and economically feasible.

  The process of social involvement is mandatory as part of obtaining the environmental license.

- **Art. 45 On the involvement mechanisms.-** These are the procedures that the Corresponding Environmental Authority applies for an effective Social Involvement. For these mechanisms to be applied and the systematization of their results, an action shall be taken under the provisions of the Instructions or Instruments issued by the National Environmental Authority for this purpose.

  The mechanisms of social involvement shall be defined considering: the impact level generated by the project and the conflict level identified, and if this is the case, they will generate greater spaces for involvement.

- **Art. 46 Moments of involvement-** Social Involvement shall take place during the revision of the Environmental Assessment, according to the procedure established on the regulations issued for this purpose, and it must be carried out in a mandatory manner by the Corresponding Environmental Authority, in coordination with the sponsor of the activity or project, considering the details of each case.

CHAPTER VI: COMPREHENSIVE MANAGEMENT OF NON-HAZARDOUS SOLID WASTE, AND HAZARDOUS AND/OR SPECIAL WASTE

- **Art. 47 National Priority.-** The Ecuadorian State declares the integral management of non-hazardous solid waste and hazardous and / or special waste as a national priority and, as such, of public interest and subject to State protection. The public interest and state protection on the matter implies the assignment of leadership and protection in favor of the National Environmental Authority, for the issuance of policies on the integral management of non-hazardous solid waste, hazardous and/or special waste. It also implies the responsibility extended and shared by the whole society to contribute to sustainable development through a set of cross-sectional, national policies in all management areas, as defined and established in this Book and, in particular, in this Chapter. They complement the comprehensive regimen, the set of public policies, institutionality and specific regulations applicable at the national level. Under this declaration, both the policies and the regulations contained in the relevant legislation, as well as those included in this Book and in the technical standards deriving from it, are of priority implementation at a national level; non-compliance shall be penalized by the National Environmental Authority, according to the penalization procedure established in this Book.

SECTION I

COMPREHENSIVE MANAGEMENT OF NON-HAZARDOUS, SOLID WASTE AND/OR RESIDUES

- **Art. 55 On the comprehensive management of non-hazardous, solid waste and/or residues.-** The comprehensive management constitutes the set of regulatory, operational, economic, financial, administrative, educational, planning, monitoring and evaluation actions and provisions, which are designed to dispose of non-hazardous solid waste in the most suitable manner, from a technical, environmental and social-economic perspective, according to its characteristics, volume, origin, costs of treatment, recovery And use possibilities, commercialization or, In the end, its final disposal. It aims to implement the phases of managing solid waste, including the minimization of its generation, separation at the source, storage, collection, transport, accumulation and/or transfer, treatment, use, and final disposal. Appropriate waste management contributes to reducing the environmental impacts associated with each of the waste management stages.

- **Art. 56 Technical standards.-** The National Environmental Authority shall establish the technical standard for the comprehensive management of non-hazardous solid waste and/or residues in all the phases.

PARAGRAPH I

ON THE GENERATION

- **Art. 60 On the Generator.-** All non-hazardous, solid waste and/or residue generators shall:
  a) Be responsible for their handling until the moment they are delivered to the collection service and deposited in authorized sites determined by the corresponding authority.
  b) Implement measures in order to reduce, minimize and/or eliminate its generation at the source by optimizing waste-generating processes.

c) Perform separation and classification at the source in accordance with the provisions of the specific regulations.
d) Temporarily store waste under technical conditions established in the regulations issued by the National Environmental Authority.
e) Large generators such as industry, commerce, and services must have adequate and technically built facilities for the temporary storage of non-hazardous, solid waste, with easy access to carry them out.
f) Large generators such as industry, commerce and services, must keep a monthly record of the type and quantity or weight of the generated waste.
g) Large generators such as industry, commerce and services Shall deliver the non-hazardous, solid waste already classified to environmental managers authorized by the National Environmental Authority or that responsible for enforcement Duly authorized for its approval, in order to guarantee its use and/or proper final disposal, as needed.
h) The Autonomous Decentralized Municipal Governments must make an annual declaration of the generation and management of non-hazardous residues and/or wastes before the National Environmental Authority or the Environmental Authority responsible for its approval.
i) Place the containers in the collection area, according to the established schedule.

- **Art. 61 On the prohibitions.-** Do not deposit liquid, pasty or viscous substances, excreta, or hazardous or special handling waste, in the containers intended for the collection of non-hazardous, solid waste.

PARAGRAPH II
ON THE SEPARATION AT THE SOURCE

- **Art. 62 On the separation at the source.-** The generator of non-hazardous, solid waste is obliged to carry out the separation at the source, classifying it according to the Comprehensive Waste Management Plan, as established in the applicable environmental regulations.

PARAGRAPH III
ON THE TEMPORARY STORAGE

- **Art. 63 On urban temporary storage.-** The parameters for the temporary storage of non-hazardous, solid waste that is already classified are established, without prejudice to others established by the National Environmental Authority, in accordance with the following:

a) Non-hazardous solid waste must be temporarily disposed of in closed containers or bins (with a lid), identified and classified, organized and, if possible, with a plastic cover inside.
b) Containers for the temporary storage of non-hazardous, solid waste shall, At least: Be covered and properly placed, have proper capacity for the volume generated, be built with robust materials, and be identified in accordance with the type of waste.
c) The temporary storage of non-hazardous waste shall be carried out under the INEN technical standard conditions.

- **Art. 65 On the prohibitions.-** Bags and/or containers with solid waste should not remain on public roads and places on days and times other than those established by the collection service.

SECTION II

COMPREHENSIVE MANAGEMENT OF HAZARDOUS AND/OR SPECIAL WASTE

- **Art. 78 Scope.-** This Chapter regulates the management phases and the mechanisms for the prevention and control of contamination by hazardous and/or special wastes in the national territory, in accordance with the procedures and technical standards provided for in the applicable regulations and in the International Agreements related to this matter, signed and ratified by the Ecuadorian state. In this framework, the present normative body regulates in a differentiated manner the phases of the comprehensive management and administrative and technical regulations corresponding to each of them. Without prejudice to environmental state protection, all citizens, especially sponsors of hazardous and/or special waste management, are responsible for collaborating with said materials' security and control measures from their respective scope of action. When risks are managed under the principle of subsidiary decentralization, it will imply the institutions' direct responsibility within their geographic scope. When their capacities for risk management are insufficient, the authorities of greater territorial scope and greater Technical and financial capacity Shall provide the necessary support according to their authority within the territory and without relieving them from their responsibility.

- **Art. 79 Hazardous wastes.-** For the purposes of this Book, the following shall be considered hazardous waste:

  a) Solid, pasty, liquid or gaseous waste resulting from a process of production, extraction, transformation, recycling, use or consumption and those containing any substance with corrosive, reactive, toxic, flammable, biological-infectious, And/or radioactive characteristics that represent a risk to human health and the environment, in accordance with the applicable legal provisions; and,

  b) Those determined in the national lists of hazardous wastes, unless they do not have any of the characteristics described in the numeral above. These listings shall be established and updated through ministerial agreements.

  To determine whether or not a waste should be considered hazardous, the characterization of the said waste must Be performed According to the technical standards established by the National Environmental Authority and/or the National Standardization Authority or, otherwise, by internationally accepted technical standards, expressly accepted by the National Environmental Authority. The management of hazardous waste containing radioactive material, of natural or artificial origin, shall be regulated and controlled by the specific regulation issued by the National Authority of Electricity and Renewable Energy, or that replacing it, which does not exempt the generator from providing information on the environmentally adequate management of these wastes to the National Environmental Authority, nor from the need to have the corresponding environmental permit by virtue of the regularization process established in this Book.

- **Art. 80 Special waste.-** For the purposes of this Book, the following shall be considered as special waste:

  a) Those wastes that, without being dangerous, by their nature, can impact the environment or health, due to the generation volume and/or difficult.

degradation and to which a Recovery, reuse and/or recycling system Must be applied, in order to reduce the amount of waste generated, avoid its inappropriate handling and disposal, as well as the oversaturation of municipal sanitary landfills.

b) Those whose substance content has reactive, toxic, flammable, biological-infectious, And/or radioactive characteristics not exceeding the concentration limits established in national environmental regulations or, failing that, applicable international regulations.

c) Those included in the national list of Special wastes. These listings shall be established and updated through ministerial agreements. To determine whether or not a waste should be considered as special, the characterization of said waste shall Be performed According to The technical standards established by the corresponding National Environmental Authority and/or the National Standardization Authority, or, failing that, by internationally accepted technical standards.

- **Art. 81 Enforceability.-**They are subject to compliance and application of the provisions of this section, all natural or legal persons, public or private, national or foreign, that within the national territory participate in any of the phases and management activities for hazardous and/or special wastes, in terms of the preceding articles in this Chapter. It is mandatory for all natural or Legal persons, public or private, national or foreigner, who are dedicated to one, several or all phases of the integral management of hazardous and/or special wastes, ensure that the personnel in charge of handling these wastes have the necessary training and appropriate protection, in order to protect the health.

PARAGRAPH IV: NATIONAL MARITIME AND RIVER TRANSPORTATION

- **Art. 120 Enforceability.-** Those who transport hazardous and/or special wastes by sea or river in the national territory must obtain the environmental permit from the National Environmental Authority, under the procedures established for such effect. The personnel in charge of the maritime and river transport operation of hazardous and/or Special materials must be trained on the subject; the training must be performed through courses endorsed by the National Directorate of Aquatic Spaces, or that replacing it, and/or the International Maritime Organization. The Controllers must comply with the applicable provisions regulating the transport of dangerous goods by water, established in the International Maritime Code for Dangerous Goods (IMDG) to each substance, material or article possible to be transported, international agreements in which Ecuador is part, as well as the applicable national and international maritime regulations.
- **Art. 121 On the coordination.-** For the purposes of control and compliance with the requirements laid out for transportation of hazardous materials, The National Environmental Authority shall coordinate actions with the National Directorate of Aquatic Spaces or, the one replacing it, and other local and national authorities competent in matter of maritime and river transport, for which relevant mechanisms shall be established.

CHAPTER VIII: QUALITY OF BIOTIC AND ABIOTIC COMPONENTS

- **Art. 192 Obligation.-** All natural or legal persons, public or private, communal or mixed, national or foreign, are obliged to be subject to

the regulations contained in this Book, prior to the development of a work, activity or project that may negatively alter the biotic and abiotic components in order to prevent and minimize impacts, whether or not said work, activity, or project is its responsibility, or when a third party executes it.

- **Art. 194 On the evaluation, control, and monitoring.-** The National Environmental Authority, the responsible Environmental Enforcement Authorities or the entities of the Decentralized National System of Environmental Management, within the framework of their competencies, shall evaluate and control the quality of the biotic and abiotic components through the environmental control and monitoring mechanisms established in this Book, in accordance with the technical standards issued for that purpose.

- **Art. 195 Responsibility.-** Under no circumstance, the Corresponding Environmental Authority shall be Responsible for emissions, discharges, and dumping containing Different components or that fail to comply with the established limits reported by the Control Subject who is responsible for the administrative, civil, or criminal field. Apart from the imposition of administrative civil, or criminal penalties generated by non-compliance with applicable environmental regulations, non-compliance with contingency measures for cleaning, remediation and restoration of a contaminated area that in turn becomes a source of environmental contamination can lead to the generation of environmental liabilities, whose responsibility shall fall on those who generated the contamination, on the Control Subject failing to take immediate corrections, and on whoever prevents the application of the pertinent corrective measures, if applicable.

- **Art. 196 On the authorizations of emissions, discharges and dumpings.-** Control Subjects must comply with this Book and its technical regulations. Likewise, they must obtain the corresponding environmental administrative authorizations from the Corresponding Environmental Authority. Under no circumstance, the corresponding environmental authority shall issue Environmental administrative authorizations when emissions, discharges and dumpings exceed the allowable limits or the corresponding quality criteria established in this Book, the technical regulations or the application annexes. In case the activity exceeds the allowable limits, it shall be subject to the penalization procedure established in this Book. Sewage or industrial water discharges shall not be authorized on Water bodies, whose minimum Annual flow Fails to support the discharge, i.e., exceed the water body's carrying capacity. The Single Water Authority shall establish the determination of the water body's carrying capacity in coordination with the National Environmental Authority.

- **Art. 199 On contingency plans.-** Contingency plans must be implemented, maintained, and periodically evaluated through drills. Drills shall be documented, and their records shall be available for the corresponding environmental authority. The lack of records shall constitute proof of breach of this provision. The execution of contingency plans must be immediate. In case of delay, it shall be considered as aggravating when resolving the administrative procedure.

SECTION II: QUALITY OF BIOTIC COMPONENTS

- **Art.202 Biotic components.-** Meaning flora, fauna, and other living organisms at their various levels of an organization. According to the area and characteristics of the regulated activity, environmental quality shall be evaluated and additionally controlled by biotic studies through the tools

established in the current environmental regulation and control mechanisms, the scope and focus of the studies of the biotic component shall be determined in the corresponding Terms of Reference.

- **Art. 203 On the minimization of impacts.-** For those projects that directly or indirectly affect areas with primary plant cover, native forests, protected areas, sensitive ecosystems, All the existing technological alternatives at the national and international level Shall be analyzed to minimize impacts; for such analysis, the environmental aspect shall be primarily considered. When it is required to install oil pipelines, gas pipelines, mineraducts, flow lines, electrical transmission lines, heliports and/or carriage accesses in areas with virgin forests, protected forests, and by exception and with the limitations established in the Constitution in protected areas, the planning of the rights of way must embrace, among others, the following provisions:

  a) Avoid clearing large trees, sensitive and threatened species, and sensitive sites.

  b) Use a single right-of-way, including carriage access, electrical transmission lines, flow lines, oil pipelines, gas pipelines, mineraducts or pipes, and ducts to transport other materials.

  c) The maximum clearance allowed on average for the right-of-way is ten (10) meters wide, and construction technology must be applied to minimize clearance.

PARAGRAPH I: ON THE WATER

- **Art. 209 On water quality.-** These are the physical, chemical, and biological characteristics that establish the water composition and make it suitable to satisfy the population's health, well-being, and ecological balance. Water quality evaluation and control shall be carried out with analytical procedures, samples, and monitoring of discharges, dumping, and receiving bodies; said guidelines Are available in detail in Annex I. In any case, the Corresponding Environmental Authority may order the Controlling Subject responsible for discharges and dumpings to take samples of their discharges as well as the receiving body of water. All anthropic activity must carry out the necessary preventive actions so as not to alter and ensure the quality and quantity of water in the water basins; the alteration of the physical-chemical and biological composition of water sources due to discharges and liquid spills or disposal of waste in general, or other negative actions on its components, shall entail the penalties corresponding to each case.

PARAGRAPH II: ON THE SOIL

- **Art. 212 Soil Quality.-** To carry out an adequate characterization of this component in the Environmental Assessments and adequate control, sampling and monitoring must be carried out according to the methodologies established in Annex II and other corresponding regulations. The corresponding environmental authority and bodies of the decentralized national System of Environmental Management, within the framework of its powers, shall control the soil's quality in accordance with the technical standards issued for this purpose. They constitute soil quality standards, physical-chemical and biological characteristics establishing the composition of the soil and make it acceptable to guarantee the population's ecological balance, health, and well-being.

PARAGRAPH III: ON THE SEDIMENTS

- **Art. 215 Quality of Sediments.-** Sediments can be of natural origins, such as those existing in the sea, the beds of lakes and lagoons, rivers, streams, and other water bodies, whether they are of permanent or temporary flow; and those of industrial origin, such as those from treatment plants, storage tanks or other to evaluate environmental quality through sediment analysis, sampling and monitoring of the areas directly influenced by the regulated activity, following the protocols regulating the National Environmental Authority and, in the case of not existing, Following internationally accepted protocols.
- **Art. 216 Technical regulations.-** The National Environmental Authority or the National Decentralized System of environmental management bodies shall issue technical regulations for sediment quality through the corresponding legal figure within its competencies framework.
- **Art. 217 Evaluation, monitoring, and control.-** Without prejudice to the application of the control mechanisms established in this Book, the National Environmental Authority shall evaluate and control the environmental quality employing the analysis of sediments or order the Control Subjects to carry out the relevant studies.
- **Art. 218 Treatment of contaminated sediments.-** It is carried out utilizing procedures accepted by the Corresponding Environmental Authority and following the provisions of the technical sediment standard and the hazardous waste regulations, if applicable.

CHAPTER XV

ON THE ENVIRONMENTAL TECHNICAL REGULATIONS. GENERAL CONSIDERATIONS OF TECHNICAL REGULATIONS FOR ENVIRONMENTAL QUALITY, EMISSIONS, DISCHARGES AND DUMPINGS

- **Art. 319 On the elaboration of regulations.-** The technical regulations of environmental quality and emission and discharges shall be elaborated through collaborative processes of discussion and analysis in the Decentralized National System of Environmental Management. These regulations shall be dictated by administrative act by the Corresponding Environmental Authority.
- **Art. 320 On the stages for the elaboration of regulations.-** For the elaboration of regulations on environmental quality, emission, discharges, and dumping, the provisions of article 4 of the Environmental Management Law shall be observed, in accordance with the following stages:

a) Development of the necessary scientific, technical and economic studies.

b) Consultations at the level of the Decentralized National System of Environmental Management, as well as to competent public and private organizations and civil society;

c) Analysis of the comments received.

4.5.2.- MINISTERIAL AGREEMENT 103

INSTRUCTIONS TO THE REGULATION OF APPLICATION MECHANISMS OF SOCIAL INVOLVEMENT ESTABLISHED IN THE EXECUTIVE DECREE 1040

CHAPTER I: DEFINITION AND SCOPE OF THE PROCESS OF SOCIAL INVOLVEMENT (PPS)

- **Article 1.-** The Social Involvement Process refers to the actions by which the Corresponding Environmental Authority will inform the population about the potential implementation of projects, works, or activities, as well as the possible expected social-environmental impacts and the relevance of the actions to be taken, in order to collect their opinions and observations, and incorporate in the Environmental Assessments those that are technically and economically feasible.

- **Article 2.-** The Social Involvement Process (PPS) shall be performed in a mandatory manner in all projects, works, or activities that require an Environmental Assessment for their regularization. Through the Unique Environmental Information System, the National Environmental Authority shall determine the procedure of Social Involvement to be applied, which may also be developed with or without a Social-environmental facilitator, according to the project's activity level impact, work, or activity.

- **Article 3.-** The National Environmental Authority shall be in charge of the institutional control and administration of the Social Involvement Processes (PPS) in those projects or activities in which it acts as a competent authority. If there is Any responsible environmental Enforcement authority duly authorized, it shall be in charge of applying these instructions. In both cases, the Environmental Assessment shall be published in the Unique Environmental Information System, where public comments shall also be recorded.

- **Article 4.-** Without prejudice to other mechanisms established in the Constitution of the Republic of Ecuador and in the law, for the proper implementation of this instrument, the following mechanisms and definitions shall be considered:

    1) **Public Presentation Assembly (APP):** Central act of the Social Involvement Process that summons all the actors related to the project. The Impact Study and the Environmental Management Plan of the project, work, or activity are presented educationally and adapted to local social-cultural conditions. The assembly creates a space for dialogue, response to projects concerns, and reception of observations, criteria, and recommendations from the participants.

    2) **Informative Meetings (RI):** In the RI, the sponsor shall report the main characteristics of the project, its foreseeable environmental impacts and the respective mitigation measures in order to clarify questions and doubts about the project, and receive observations and criteria from the participants.

    3) **Public Information Centers (CIP):** The Impact Study and Environmental Management Plant, as well as educational to be displayed shall be made available to the public in an easily accessible location; personnel familiar with the project, work or activity must be present in order to explain its contents. The Information Centers may be of a fixed or itinerant nature.

4) **Website:** mechanism through which all interested parties can have online access to information on the project, work, or activity. The website address shall be widely publicized.

5) **Social Involvement Procedure:** The National Environmental Authority, through the Unique Environmental Information System (SUIA), shall determine the procedure to be applied according to the project's impact level, work, or activity may generate.

6) **Participatory workshops:** to complement and reinforce the effect of the informative meetings, workshops may be held for the sponsor to identify perceptions and local development plans to insert their proposal for mitigating and/or compensating measures in their Environmental Management Plan, according to the reality of the environment where the development of the activity, work, or project is proposed.

7) **Social-environmental Facilitator:** independent professional, without a dependency relationship with a public or private institution, recognized by the Ministry of the Environment as qualified and registered for the organization, coordination, and conduction of the Social Involvement Processes and management of discussion groups and the systematization, analysis and interpretation of social dialogue processes between diverse actors: companies, local governments, the state, and civil society.

8) **Area of Direct Social Influence:** space resulting from the direct interactions of one or more elements of the project, work or activity with one or more elements of the social context where it shall be implemented. The direct relationship between the project, work or activity and the social environment occurs in at least two levels of social integration: individual units (farms, households, properties, and their corresponding owners) and social organizations of first and second order (communes, premises, neighborhoods, associations of organizations and communities). In the event that the final location of the elements and/or activities of the project is subject to factors external to those considered in the assessment or other subsequent technical and/or environmental aspects, duly supported case justifications must be submitted for evaluation and validation of the Corresponding Environmental Authority; therefore, the determination of the area of direct influence shall be made at least at the level of social organizations of first and second order.

9) **Area of Indirect Social Influence:** Social-institutional space resulting from the relationship of the project with the Political-territorial units where the project, work, or activity occurs parish, district and/or province. The reason for the relationship is the role of the project, work, or activity in the local territory's planning. Although it is based on the political-administrative location of the project, work, or activity, other territorial units are considered relevant for the project's social-environmental management, such as indigenous territorial constituencies protected areas and associations.

Chapter III: SOCIAL INVOLVEMENT PROCESS WITHOUT SOCIAL-ENVIRONMENTAL FACILITATOR

❖ **Article 27.-** The process of social involvement without a social-environmental Facilitator shall be carried out by publishing the Environmental Assessment on the Website of the Unique Environmental Information System; if there is a web portal, it must also be published online on the bidder's page. Citizen observations, comments and

recommendations shall be collected on the SUIA page, which shall be incorporated into the Environmental Assessments when technically and economically feasible.

The sponsor shall upload on the SUIA page the Environmental Assessment of the project, work or activity with all its annexes, and the executive summary thereof, which shall describe the main characteristics of the project, work or activity, its impacts and Proposed Environmental Management Plan in a clear and simple language.

- **Article 28.-** Once the Environmental Assessment, its annexes, and the executive summary have been published online, the sponsor of the project, work or activity shall inform the population about its socialization through the following means:

  1) Publication in a mass media with coverage in the areas of influence of the project, work or activity (press, radio, or television).

  2) Notice boards located at the project, work or activity Implementation site, on the billboards of sectional governments and in places with the greatest public influx of the communities involved.

  3) Communications written directed to the subjects of social involvement indicated in the Regulations for the Application of the Social Involvement Mechanisms established in the Environmental Management Law, to which the executive summary of the Environmental Assessment shall be attached, applying the principles of legitimacy and representativeness. For the issuance of said communications, the following shall be considered:

     a) Authorities of the central government and sectional governments related to the project, work or activity.

     b) Members of legally existing and duly represented community, indigenous, Afro-Ecuadorian, gender organizations; and

     c) People who live in the area of direct influence, where the project, work or activity implying environmental impact shall occur.

  The communication shall include an extract of the project, work or activity, and the Website address where the Environmental Assessment and the executive summary shall be published. In the case of projects, works or activities taking place in areas with the presence of communities of the native Towns and nationalities, the

  Communication of the Social Involvement Process must be performed in Spanish and in the languages of those communities residing in the Area of Direct Influence of the project, work or activity. In the same way, an extract of the project, work or activity translated into the language of the nationalities must be attached to the written communications.

  The verification means of the call made shall be delivered by the sponsor for review to the corresponding Environmental authority, who will verify that it has been carried out in accordance with the provisions of this Instruction. The publication of the Environmental Assessment shall be 7 days from the date of communication to the social actors of the project, work or activity, during which time the observations, comments and recommendations of the public shall be received online.

- **Article 29.-** Considering the level of impact of the project, work or activity, the corresponding Environmental Authority may also order the sponsor through SUIA to carry out an Informative Meeting in the area of influence of the project, which shall be held under the supervision of the Corresponding Environmental Authority. The meeting shall be summoned by the social actors related to the

project, work or activity in accordance with the provisions of Art. 29 of this instrument. The information on the place and date of the Informative Meeting shall be included in the means of convocation established in said article. The sponsor of the project, work or activity must submit the corresponding Environmental authority the report of the Informative Meeting held, including the forum for questions and the systematization of the observations, comments and suggestions of the community, as well as all the supporting documentation that allows verifying the compliance with this mechanism of social involvement: meeting minutes, registration of attendees, photographic registration, at the very least.

- **Article 30.-** Within the Environmental Assessment review, the corresponding Environmental Authority shall verify that the criteria, observations, and recommendations received, which are technically and economically feasible, are considered by the sponsor of the project, work or activity and included in the Environmental Assessment with its corresponding technical support.

4.5.3.- MINISTERIAL AGREEMENT 097 A

Issues the Annexes to the Unified Text of Secondary Legislation of the Ministry of the Environment

- **Article 1.-** Annex 1 is issued, referring to the Environmental Quality Standard and Discharge of Effluents from the Water Resource
- **Article 2.-** Issue Annex 2, referring to the Environmental Quality Standard for Soil Resources and Remediation Criteria for Contaminated Soils
- **Article 3.-** Issue Annex 3, referring to the Standard for Air Emissions from Stationary Sources
- **Article 4.-** Issue Annex 4, referring to the Ambient Air Quality Standard or Immission level
- **Article 5.-** Issue Annex 5, referring to the Maximum Levels of Noise Emission and Methodology for Fixed Sources and Mobile Sources, and Maximum Levels of Vibration Emission and Measurement Methodology.

4.5.4.- MINISTERIAL AGREEMENT -026

Procedure for the Registration of Hazardous Waste Generators

R.O. 334, dated May 12, 2008, Issues procedures for the registration of hazardous waste generators, hazardous waste management prior to the environmental licensing, and the transportation of hazardous materials.

4.6.- REGULATIONS

4.6.1.- REGULATION OF HEALTH AND SAFETY IN THE WORKPLACE

Issued by Resolution No. 172 of the Superior Council of the Ecuadorian Institute for Social Security. It establishes specific provisions to minimize occupational risk and encourages the use of safety and protection equipment for workers, in addition to establishing adequate work environment specifications.

4.6.2.-REGULATION OF HEALTH AND SAFETY OF THE WORKERS AND IMPROVEMENT OF THE WORK ENVIRONMENT FROM THE MINISTRY OF LABOR AND EMPLOYMENT

Issued by Executive Decree No. 2393 and published in Official Gazette # 565 of November 17, 1986. The provisions of this regulation apply to all work activities and in all work centers to prevent, reduce or eliminate work risks and improve the work environment. This regulation shall be applied to all work activities since its objective is to prevent, reduce or eliminate work risks, and improve the work environment. It shall also apply to all public companies, as prescribed in its article 11. In general, issues regulated by this legal rule refer to:

- **TITLE I:** General provisions
- **TITLE II:** Regulations regarding the general conditions of the work centers, project safety, structural safety, permanent services, temporary facilities, constructions, environment, and occupational hazards.
- **TITLE III:** Regulations on machines, Tools, and facilities. For installations, protections, control bodies, use, and maintenance.
- **TITLE IV:** Handling and transport of materials, cargo vehicles, forklifts
- **TITLE V:** Collective protection, Fire Prevention, Exit signs, Fire Prevention, Premises Evacuation, Safety Signs.
- **TITLE VI:** Personal protection for head, face, eyes, ears, respiratory tract, and others.
- **TITLE VII:** Incentives, responsibilities, and penalties

4.6.3.- GENERAL REGULATIONS OF THE CULTURAL HERITAGE LAW

Published in Official Gazette No. 787 of July 16, 1984. Articles 37, 38 and 39 of these regulations refer to the Authority of the National Director of the Institute of Cultural Heritage to order the suspension or restoration of works affecting the cultural heritage of the Nation; Article 38 establishes solidarity between the owner of the property, those who have authorized or ordered the execution of the work, and the contractors or those in charge of executing it.

According to Article 39, the Municipalities, or public or private entities must order the suspension or overthrow of works threatening the cultural heritage of the Nation and, if they are part of an environmental setting, they must be restored."

4.7.- TECHNICAL REGULATIONS

The following technical regulation shall apply:

4.7.1.- INEN ISO 3864:2013 STANDARD

GRAPHIC SYMBOLS, SAFETY COLORS, AND SAFETY SIGNS

This standard replaces NTE INEN 439:1984 safety colors, signs, and symbols. ISO 3864 includes the following parts, under the general title Graphic symbols - Safety colors and safety signs:

- Part 1: Design Principles for Safety Signs and Safety Indications
- Part 2: Design Principles for Product Security Labels
- Part 3: Design principles for graphic symbols used in safety signs.
- Part 4: Colorimetric and photometric properties of safety signaling materials.

This part of ISO 3864 establishes the safety identification colors and design principles for safety signs and safety indications to be used in workplaces and public areas for accident prevention, fire protection, information on health risks, and emergency evacuation. Likewise, it establishes the basic principles to be applied when developing the standards containing safety signs.

4.7.2.- INEN STANDARD 2841 ENVIRONMENTAL MANAGEMENT, STANDARDIZATION OF COLORS FOR TANKS AND TEMPORARY STORAGE OF SOLID WASTE

- **OBJECT**

This standard establishes the colors for the temporary storage and deposit containers for solid waste in order to promote separation at the source of generation and selective collection.

- **APPLICATION SCOPE**

This standard applies to the identification of all reservoir containers and temporary storage of solid waste generated from different sources:

domestic, industrial, commercial, institutional and services. Hazardous and special solid waste is excluded.

- **REQUIREMENTS**

The generator is responsible for separating waste at the source, and he must use containers that allow its identification for later separation, collection, use (recycling, recovery or reuse), or proper final disposal. The separation guarantees the usable waste quality and facilitates its classification; therefore, the recipients containing them must be clearly differentiated.

The collection procedures must be carried out safely, avoiding as much as possible Waste spillage, and they should not cause that the previous separation is lost. For this reason, waste must be packed in a way that avoids contact with the environment and the people in charge of the collection.

Containers for collection at the source of generation can be returnable or disposable and must be placed in established collection sites.

The infrastructure in the collection and storage areas must be duly signposted and evacuation and internal transport systems shall be considered as established in the NTE INEN 2266.

Once the waste is separated in its proper container, it must be stored according to their real feasibility of use and their compatibility, which shall facilitate their collection and transport.

Containers

The colored containers must meet the requirements established in this standard, depending on their location and type of waste.

4.8.- OTHER LEGAL BODIES

- General Regulation for Work Hazard Insurance, issued by Resolution No. 741 of the Superior Council of the Ecuadorian Institute of Social Security of May 30, 1990.
- Fire Prevention Regulations. Official Registry No. 47, of March 21, 2007.
- Regulation of Health and Safety in the Workplace issued by Resolution No. 172 of the Higher Council of the Ecuadorian Institute of Social Security.
- Regulation of health and safety of the workers and improvement of the work environment. Ministry of Labor and Employment. Official Registry 137 of August 9, 2000.

4.9.- INSTITUTIONAL FRAMEWORK

4.9.1.- MINISTRY OF THE ENVIRONMENT OF ECUADOR

The Environmental Management Law in its Art. 8. indicates that the national environmental authority shall be exercised by the Ministry of the Environment, which shall act as the governing, coordinating and regulatory body of the Decentralized National System of Environmental Management, without prejudice to other competences of the other State institutions. It is responsible for dictating the policies, regulations, and instruments of promotion and control to achieve sustainable use and conservation of natural resources aimed at ensuring the right of the inhabitants to live in a healthy environment and support the country's development.

The Environmental Management Law establishes in Article 9, literal g) the Ministry of the Environment's attributions. Said attributions include settling conflicts of competencies between the organizations' members of the Decentralized National System of Environmental Management. In accordance with Article 20 of the Environmental Management Law, this Ministry must issue environmental licenses without prejudice to the powers of the bodies accredited as environmental authorities of responsible application.

4.9.2.- AUTONOMOUS DECENTRALIZED PROVINCIAL GOVERNMENT OF EL ORO

The Autonomous Decentralized Provincial Government of El Oro aims to develop local capacities to generate knowledge regarding reality and its resources at the provincial and administrative, business, and corporate cultures. It emphasizes the adequacy of the necessary legal framework, coordination, and responsibility in the management and preservation of natural resources, enhances human resources in their management at the local provincial, national, and international level, to achieve the harmonious development of the province from the perspective of providing well-being and quality of life to its inhabitants.

4.9.3.- UNDERSECRETARY FOR PIERS, MARITIME AND RIVER TRANSPORTATION

"Promote the development of maritime and river activity by optimizing pier services in Ecuador, to position it as one of the main actors in cargo handling within our region."

Promote the development of maritime and river activity, plan, regulate and control the shipping and pier system at national territory, ensuring the fulfillment of objectives and priorities defined in the current legal framework.

The Powers and responsibilities are to inform the Ministry of Transport and Public Works' highest authorities about the convenience of establishing new ports of national character or the use of piers or maritime or river facilities, commercial purposes, by natural, legal, private, or public persons.

5.- DEFINITION OF THE ASSESSMENT AREA

The project for Dredging Piers 1,2, 3, 4, 5 and 6, Maneuvering Zone and Access Channel, is located in the Pier Terminal, at Puerto Bolívar parish, Machala canton, El Oro province, at the following coordinates:

Table 3: Project Location Coordinates

WGS84 COORDINATES		
POINTS	**COORDINATES OF DREDGING PIERS 1, 2, 3, 4, 5 AND 6 AND MANEUVER ZONE**	
1	**East (X): 610956**	**North (Y): 9639311**
2	**East (X): 610478**	**North (Y): 9639203**
3	**East (X): 609957**	**North (Y): 9659327**
4	**East (X): 610347**	**North (Y): 9639927**
5	**East (X): 610216**	**North (Y): 9640713**
6	**East (X): 611014**	**North (Y): 9640712**
POINTS	**ACCESS CHANNEL COORDINATES**	
7	**East (X): 610141**	**North (Y): 9640786**
8	**East (X): 609917**	**North (Y): 9642098**
9	**East (X): 609498**	**North (Y): 9644527**
10	**East (X): 608686**	**North (Y): 9646508**
11	**East (X): 608189**	**North (Y): 9648244**
12	**East (X): 605878**	**North (Y): 9648244**
13	**East (X): 605974**	**North (Y): 9648726**
14	**East (X): 608511**	**North (Y): 9648113**
15	**East (X): 609175**	**North (Y): 9646587**
16	**East (X): 609970**	**North (Y): 9644652**
17	**East (X): 610433**	**North (Y): 9642109**
18	**East (X): 610654**	**North (Y): 9640792**
POINTS	**COORDINATES OF THE DEPOSIT AREA IN SEDIMENT HIGH SEA OF THE ACCESS CHANNEL AND MANEUVER ZONE**	
19	**East (X): 583544**	**North (Y): 9649248**
20	**East (X): 583880**	**North (Y): 9651278**
21	**East (X): 583837**	**North (Y): 9651184**
22	**East (X): 585560**	**North (Y): 9649187**
POINTS	**COORDINATES OF PIPELINE TRAJECTORY FROM PIERS TO SEDIMENT POND**	
23	**East (X): 610931**	**North (Y): 9639816**
24	**East (X): 611233**	**North (Y): 9639806**
25	**East (X): 611697**	**North (Y): 9640103**
26	**East (X): 611804**	**North (Y): 9640152**
27	**East (X): 611925**	**North (Y): 9640110**

WGS84 COORDINATES		
POINTS	**COORDINATES OF SEDIMENT POND**	
28	**East (X): 611860**	**North (Y): 9640136**
29	**East (X): 612034**	**North (Y): 9640067**
30	**East (X): 612130**	**North (Y): 9640308**
31	**East (X): 612169**	**North (Y): 9640505**
32	**East (X): 612027**	**North (Y): 9640551**
33	**East (X): 611950**	**North (Y): 9640585**
34	**East (X): 611875**	**North (Y): 9640626**
35	**East (X): 611766**	**North (Y): 9640402**
36	**East (X): 611927**	**North (Y): 9640295**

Source: *Own source*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar - Machala, Santa Rosa - El Oro*
Date: *May 11, 2017.*

The project shall be developed in the Terminal Pier of Puerto Bolívar, which is located in the province of El Oro, Machala canton, in the parish of Puerto Bolívar, specifically at the entrance of the Santa Rosa channel, with the natural protection of the Jambelí Island, which makes it a safe place to accommodate ships at the docks. It is strategically located 13 nautical miles from international traffic routes and 4.5 nautical miles from the sea buoy to its breakwater and marginal docks.

At a national level, Puerto Bolívar is the second most important in the country; the volume of cargo attributes this qualifier it moves, representing an elementary link in international trade for El Oro's province. The main cargo at said province is mainly banana since 60% of the loads it moves correspond to banana production.

In order to obtain the Certificate of Intersection of the project with the National System of Protected Areas (SNAP), State Forest Heritage (PFE), Forests and Protective Vegetation (BVP), the relevant documentation was submitted to obtain the Intersection Certificate through the platform of the Unique System of Environmental Information of the Ministry of the Environment for the project "DREDGING OF PIERS 1, 2, 3, 4, 5 Y 6, MANEUVER ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR" located at the province/s of (EL ORO), from which it was obtained that the project **DOES NOT INTERSECT** with the National System of Protected Areas (SNAP), State Forest Heritage (PFE), Protective Forests and Vegetation (BVP).

5.1.- PROVINCE OF EL ORO

The province of El Oro is the southernmost province of the Ecuadorian coast, and it has several areas: mountainous, humid forest, dry forest, coast and archipelago.

The province covers an area of 5,791.85 km, which represents 2.15% of the national surface. The provincial limits are: at the north, the provinces of Guayas and Azuay; at the south, the province of Loja and Peru; at the east, the provinces of Azuay and Loja; and, at the west, Peru and the Pacific Ocean.

Much of the province's coastal sector, especially at the outlet of the Santa Rosa River, has a landscape of estuaries, palm trees and mangroves; in front of it, there is a set of channels separating it from the Jambelí archipelago.
El Oro has great diversity and natural cultural, archaeological, ecological, Landscape and gastronomy diversity.

The province is divided into 14 cantons:

- Machala
- Arenillas
- Atahualpa
- Balsas
- Chilla
- El Guabo
- Huaquillas
- Las Lajas
- Marcabelí
- Pasaje
- Pinas
- Portovelo
- Santa Rosa
- Zaruma

5.2.- MACHALA CANTON

Machala, is the capital of the Province of El Oro and it is among the main cities of Ecuador, offering a significant contribution to the country's economy.

Machala is geographically located in lowlands near the Gulf of Guayaquil.

It is geographically located in the lowlands near the Gulf of Guayaquil in the Pacific Ocean (thanks to its Puerto Bolívar), specifically at the Jambelí Archipelago's western end. For this reason, the city is located between 0 and 10 meters in altitude.

Within the province of El Oro, Machala is located in the Central East. It limits are: at the North, the Pacific Ocean, and El Guabo canton; at the south, Santa Rosa canton; at the east, Pasaje canton; and, at the west, Santa Rosa canton and its Archipelago of Jambelí.
Machala has a territorial extension or surface of 349.9 km, Representing 6% of the province.

The canton of Machala has 8 parishes in total, 7 of which are Urban and 1 is Rural, and they are:

- Machala (canton main city)
- Puerto Bolívar
- La Providencia
- 9 de mayo
- Jambelí
- Jubones
- El Cambio
- El Retiro (rural)

PUERTO BOLÍVAR PARISH

It is located 5.5 km from the city of Machala and offers tourist, economic, and commercial alternatives.

Puerto Bolívar is located at the entrance to the Santa Rosa channel, located south of the Gulf of Guayaquil, and in the natural shelter of Jambelí Island.

It is strategically located 13 nautical miles from the international traffic routes connecting the West Coast of South America with the Atlantic Ocean through the Panama Canal. Its piers are 4.5 nautical miles from the sea buoy.

The privileged location of Puerto Bolívar in the Santa Rosa Channel, sheltered by the island of Jambelí, offers natural port protection and makes it a safe place for docking and operating ships. Likewise, the channel, 200 meters wide and marked with luminous buoys, serves as access to the port and as an anchoring area.
According to its location from north to south, the parish of Puerto Bolívar consists of 31 neighborhoods.

5.3.- SANTA ROSA CANTON

Santa Rosa canton is an Ecuadorian subnational territorial body of the Province of El Oro. Its main city is Santa Rosa, where a large part of its total population is grouped. It has an area of 889km.

Santa Rosa canton has the following limits: at the North, Machala and Pasaje cantons; at the South, Arenillas and Pinas cantons; at the East, Atahualpa and Pasaje cantons, and at the West, Arenillas canton. Like the other Ecuadorian localities, Santa Rosa city and canton are governed by a municipality, as stipulated in the National Political Constitution. The Municipal Government of Santa Rosa is a sectional government body that independently manages the canton.

The canton is divided into parishes that can be urban or rural and are represented by the Parish Governments before the Mayor's Office of Santa Rosa.

Urban Parishes

- Santa Rosa
- Nuevo Santa Rosa
- Puerto Jelí
- Balneario Jambelí (satellite)
- Jumón (satellite)

Rural Parishes

- Bella maría
- Bellavista
- Jambelí
- La Avanzada
- San Antonio
- Torata
- Victoria

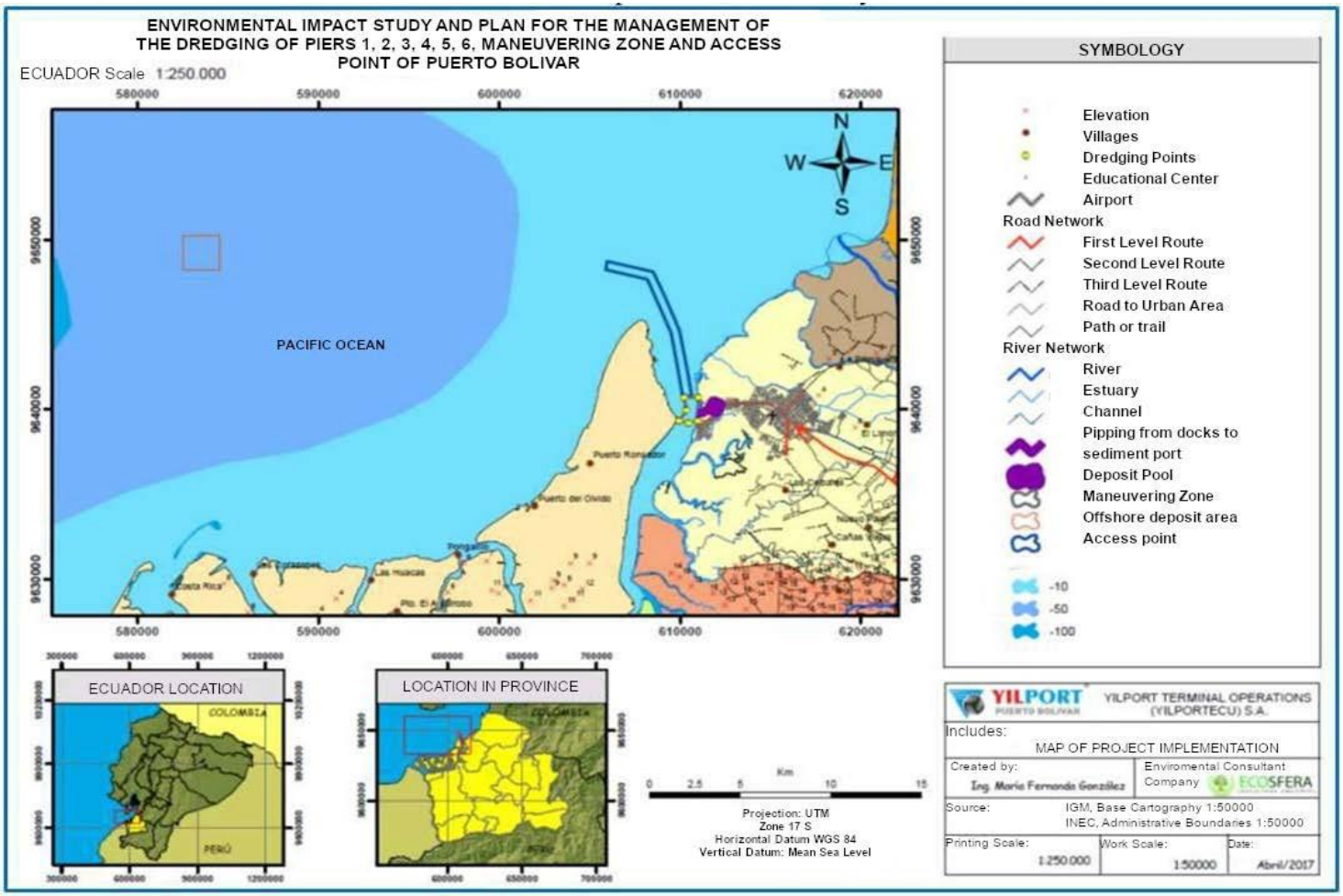
JAMBELÍ PARISH

The Jambelí Archipelago is located off the coast of the province of El Oro, south of the Gulf of Guayaquil, and is part of the Special Management Zone (ZEM) defined by the Coastal Resource Management Program. Around 600 hectares have been assigned to the Costa Rican community for its management.

The archipelago is full of mangroves and other species associated with brackish habitats (mud banks, estuaries). The sea between the islands of Jambelí and the continental portion of El Oro is shallow and strongly influenced by continental river waters. The island of Jambelí and the coast of Puerto Bolívar present open areas in which shrimp ponds have been established. These mangroves connect to those located in the Tumbes area in Peru. No specific research projects have been carried out in the Jambelí area. Ornithological information comes from occasional visits by bird watchers and ornithologists. There is an initiative of the provincial authorities to implement an efficient tourism program.

The Jambelí Parish owes takes its name from the Jambelí Archipelago, with its main parish formerly called Tembleque and currently called Costa Rica due to its ichthyological wealth.

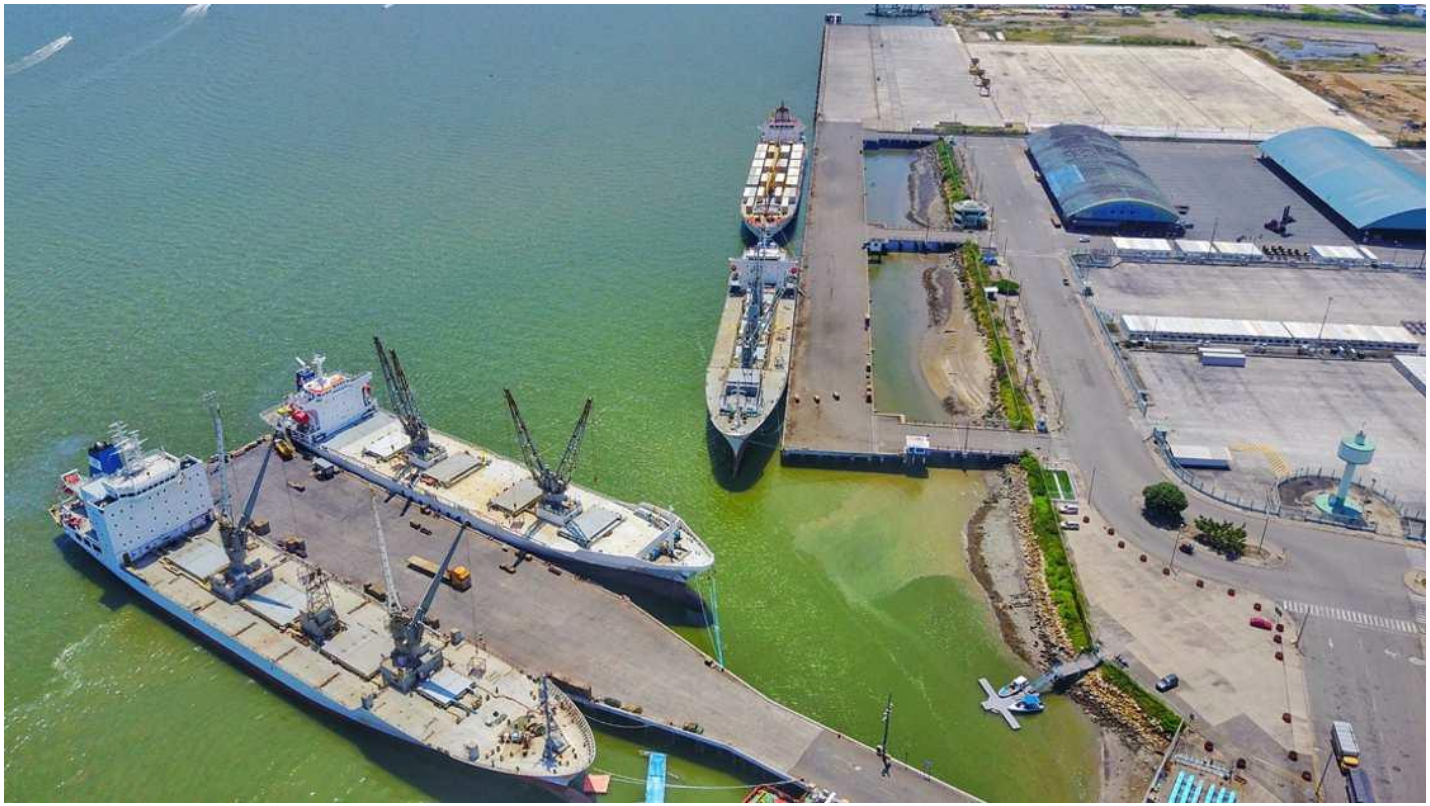
Image 2: Map of the Project Site



Fuente: *www.groportaligm.gob.ec, Instituto Geográfico Militar, INEC*
Elaborada por: *Ecosfera Cía. Ltda.*
Ubicación: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Fecha: *6 de Abril del 2017*

Photography 1: Piers 1, 2, 3, 4 and 5

PIERS 1, 2, 3, 4 y 5



Source: *Photography taken by Drone MAVIC (7 km transmission range, flight speed of 64km/h)*
Created by: *Ecosfera Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *28 of April, 2017*

Photography 2: Maneuvering Zone

MANEUVERING ZONE

***Source**: Photography taken by Drone MAVIC (7 km transmission range, flight speed of 64km/h)*
***Created by**: Ecosfera Cia. Ltda.*
***Location**: Puerto Bolívar – Machala, El Oro*
***Date**: 28 of April, 2017*

Photography 3: Access Channel

ACCESS CHANNEL

***Source**: Photography taken by Drone MAVIC (7 km transmission range, flight speed of 64km/h)*
***Created by**: Ecosfera Cia. Ltda.*
***Location**: Puerto Bolívar – Machala, El Oro*
***Date**: 28 of April, 2017*

Photography 4: Pool Zone where Sediments are deposited

POOL AREA WHERE SEDIMENTS ARE DEPOSITED

Source: *Photography taken with Drone MAVIC (7km transmission range, flight speed of 64km/h)*
Created by: *Ecosfera Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *28th of April, 2017*

6.- ENVIRONMENTAL DIAGNOSIS - BASELINE OF THE ASSESSMENT AREA

The Environmental Diagnosis was carried out in two stages:

1. Public and Private Institutions carry out a compilation of specialized information on the assessment. (Plans of Development and Territorial Ordering of Machala and Santa Rosa's districts and parishes of Puerto Bolívar and Jambelí.
2. Update the required information and verify the information obtained through a survey of the site where the project shall be implemented and its direct influence area.

Subsequently, the Physical, Biotic and Socio-Economic Environment components were characterized with the field and office information with the consulting team. The WGS84 reference system and ellipsoid, an internationally managed and accepted system, includes all information regarding the geographical location of the different environmental components' research points.

6.1.- PHYSICAL MEAN

The methodology used in the physical component baseline assessment included a desk phase and a field research phase.
For the cabinet phase, reports and maps of Ecuador were used, including the maps of INERHI, INAMHI, INECEL, CLIRSEN ORSTOM, CEPE, the Geological Sheets of the DGGM (scale 1:50,000), the Geological Map of the Republic of Ecuador of the British Mission (scale 1:500.00), Agrarian Regionalization Program (PRONAREG), Seismic Studies of PETROECUADOR, INECEL, CERESIS Seismic Catalog, 1985, Studies of the National Renewable Natural Resources Directorate (DIÑAREN), National Water Bodies Resource Council, (CNRH), Ministry Of Environment (MAE), Ministry of Agriculture, Livestock, Aquaculture and Fishing (MAGAP), among others.
The information collected for the study was corroborated in the field, in a general way, and used for the preparation of the maps presented in the assessment for each of the physical aspects evaluated.

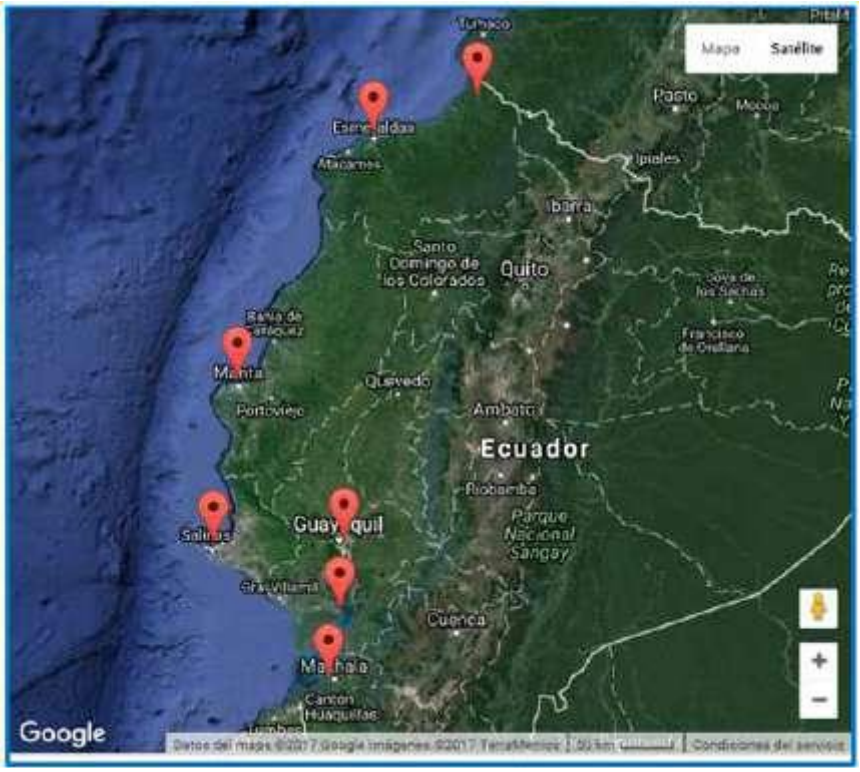
6.1.1.- CLIMATOLOGY

The climate of the Ecuadorian coast is influenced by the changes produced in the ocean and by the movement of the Intertropical Convergence Zone (ZCIT). There are two well-defined seasons. One of rains (hot and humid season) from December to May, and one of no rain (Cold and Dry season) from June to November. These conditions are given by the ocean-atmospheric interaction and the variations in it causing climate change.

To obtain the Climatological data of the project area, information was taken from the Oceanographic Institute of the Ecuadorian Navy INOCAR, created through Official Registry No. 108 - July 25, 1972 at the request of the Ministry of National Defense.
INOCAR's mission is to plan, direct, coordinate and control the technical and administrative activities related to Hydrography, Navigation, Oceanography, Meteorology, Marine Sciences, Nautical Signaling Service as well as the administration of specialized material with its activity.
The Oceanographic Institute of the Ecuadorian Navy is in charge of a network of seven (7) Coastal Meteorological Stations, having updated its Meteorological Data bank and knowing the coastal area's climatic conditions. The stations are:

1. San Lorenzo (Esmeraldas)
2. Esmeraldas
3. Manta (Manabí)
4. La Libertad (La Libertad)
5. Guayaquil (Guayas)
6. Puna (Guayas)
7. **Puerto Bolívar (El Oro)**

Illustration 3: INOCAR Weather Stations



***Source**: www.inocar.com*
***Created by:** Oceanographic Institute of the Navy*
***Date:** April 15, 2017*

Therefore, for the description of this component, data was taken from the Weather Station at Puerto Bolívar, which is located within the Port complex at the following coordinates:

Table 4: Puerto Bolívar Weather Station Coordinates

	Geographic	**WGS84**
Latitude S	03° 15' 30"	610976
Longitude W	80° 00' 03"	9639449

***Source:** www.inocar.com*
***Created by:** Ecosfera Cía. Ltda.*
***Location:** Puerto Bolívar, Machala - El Oro*
***Date:** May 5, 2017*

Photograph 5: Puerto Bolívar Weather Station

***Source**: Photograph taken by the APPB facilities consultant team*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Port Terminal of Puerto Bolívar - Machala, El Oro*
***Date**: May 5, 2017*

The type of characteristic climate in the assessment area corresponds to Tropical Mega Thermal Semi - Arid.

- **TEMPERATURE:**

  Temperature refers to the degree of specific heat of the air in a given place and time and the temporal and spatial evolution of said element in different climatic zones.
  Temperature constitutes the most important meteorological element on the delimitation of most of the climatic types.
  The following tables show the monthly average air temperature, average maximum temperature and average minimum air temperature for the last five years:

AVERAGE TEMPERATURE

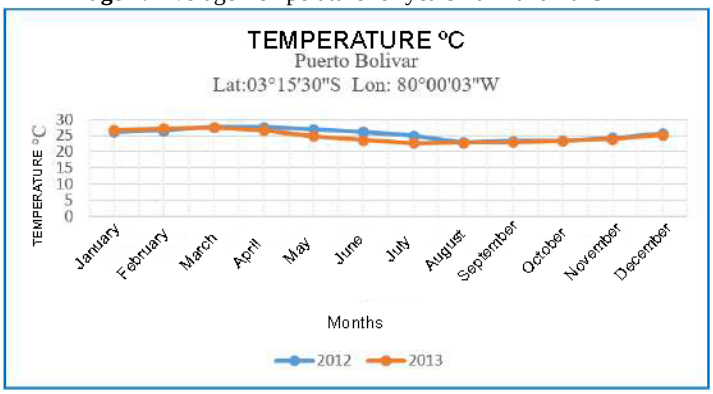
Table 5: Monthly average air temperature

MONTH	2012	2013	2014	2015	2016
January	26.18	26.68	26.98	27.08	27.73
February	26.54	27.23	27.24	27.62	28.1
March	27.58	27.52	27.25	27.56	27.9
April	27.55	26.72	27.55	27.97	28.32
May	26.99	24.87	26.87	28.02	27.92
June	26.12	23.61	26.33	27.24	26.14
July	24.92	22.67	25.28	26.2	25.17
August	22.98	22.79	23.88	24.73	24.19
September	23.35	22.92	23.94	25.67	

MONTH	2012	2013	2014	2015	2016
October	23,51	23,31	23,77	25,74	
November	24,35	23,84	24,8	26,6	
December	25,55	25,24	26,24	28,1	

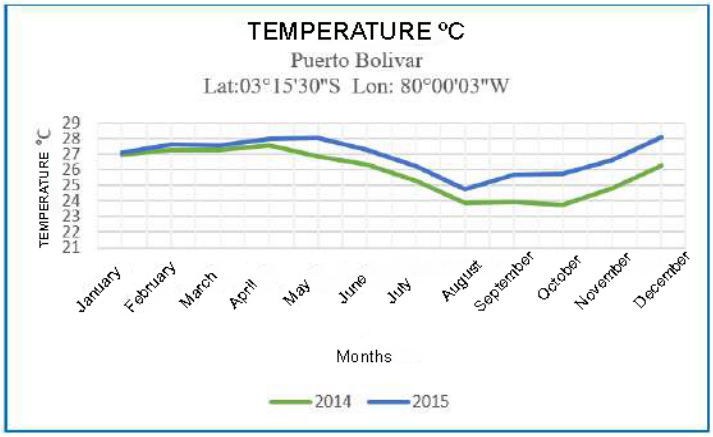
Source: *Weather Station of Puerto Bolívar, INOCAR*
Created by: *Ecosfera Cía. Ltda.*
Location: *APPB, Puerto Bolívar – Machala, El Oro*
Date: *5th of May, 2017*

Image 4: Average Temperature for years 2012 and 2013



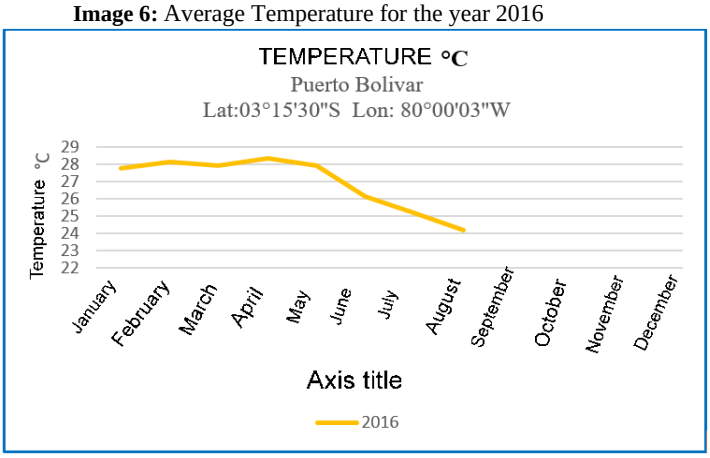
Source*: Weather Station of Puerto Bolívar, INOCAR*
Created by*: Ecosfera Cía. Ltda.*
Location*: Harbour of Puerto Bolívar – Machala, El Oro*
Date*: 5th of May, 2017*

Image 5: Average Temperature for years 2014 and 2015



Source*: Weather Station of Puerto Bolívar, INOCAR*
Created by*: Ecosfera Cía. Ltda.*
Location*: Harbour of Puerto Bolívar – Machala, El Oro*
Date*: 5th of May, 2017*

Image 6: Average Temperature for the year 2016



***Source**: Weather Station of Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: APPB, Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

MAXIMUM AVERAGE TEMPERATURE ºC:

Chart 6: Monthly average for maximum temperature ºC

Month	2012	2013	2014	2015	2016
January	29,09	29,3	29,31	29,58	30,16
February	29,48	30,13	29,63	30,44	30,56
March	30,84	30,27	30,08	30,26	30,32
April	30,69	29,81	30,13	30,67	31,08
May	29,7	27,29	29,49	30,79	30,56
June	28,59	25,78	28,66	29,69	29,73
July	27,39	24,68	27,52	28,51	29,17
August	25,24	25,21	25,68	26,75	27,56
September	25,79	24,76	26,11	27,84	
October	25,6	24,91	25,77	27,51	
November	26,81	25,59	27,28	28,56	
December	28,21	27,66	28,57	30,38	

***Source**: Weather Station of Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 7: Maximum temperature for years 2012 and 2013

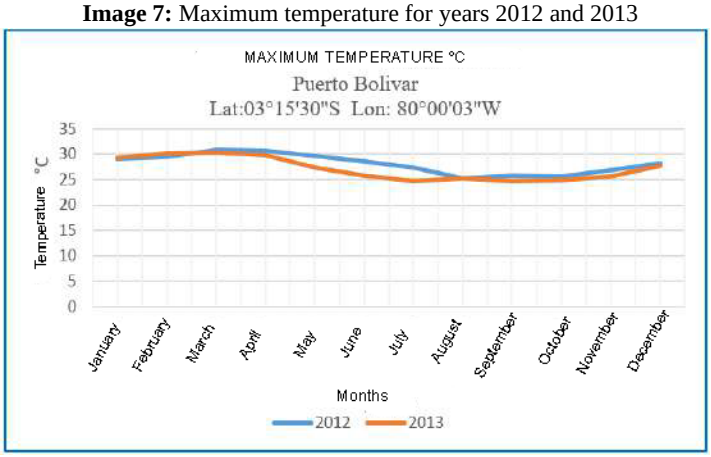


Image 8: Maximum temperature for years 2014 and 2015

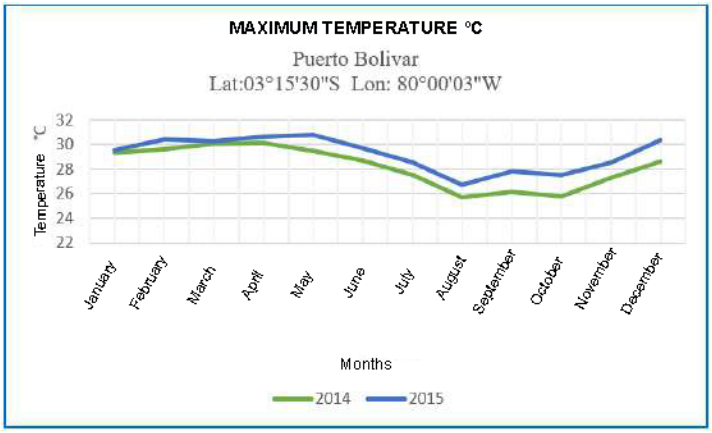
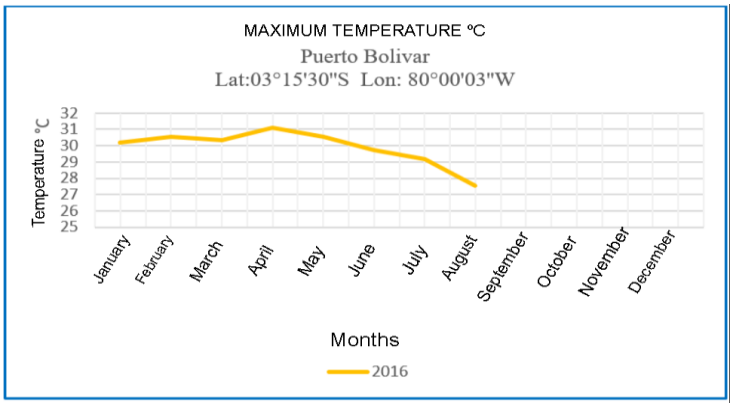


Image 9: Maximum average temperature for the year 2016



Fuente: *Estación Meteorológica Puerto Bolívar, INOCAR*
Elaborada por: *Ecosfera Cía. Ltda.*
Ubicación: *Terminal Portuario Puerto Bolívar – Machala, El Oro*
Fecha: *5 de Mayo del 2017*

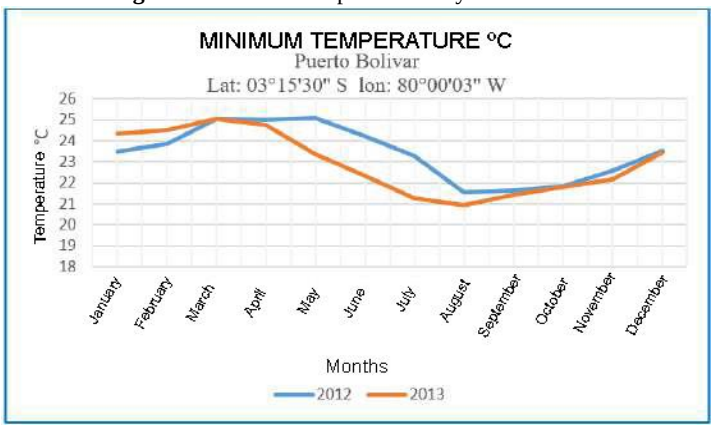
PROMEDIO TEMPERATURA MÍNIMA:

Chart 7: Monthly minimum average air temperature ºC

MONTH	2012	2013	2014	2015	2016
January	23,49	24,35	24,24	24,5	25,42
February	23,86	24,53	24,53	24,81	25,45
March	25,03	25,06	24,73	25,03	25,46
April	24,99	24,76	25,36	25,34	25,73
May	25,1	23,34	24,38	25,44	25,85
June	24,22	22,34	24,29	24,79	23,41
July	23,29	21,26	23,36	24,12	23,3
August	21,56	20,95	22	22,97	22,35
September	21,65	21,41	21,83	23,83	

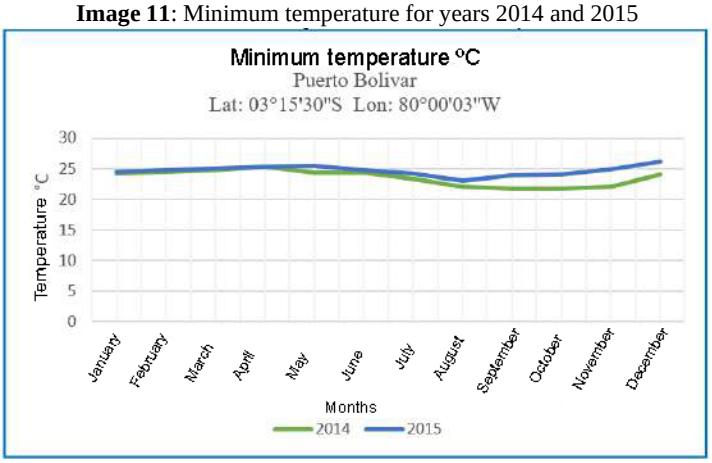
***Source**: Weather Station of Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 10: Minimum temperature for years 2012 and 2013



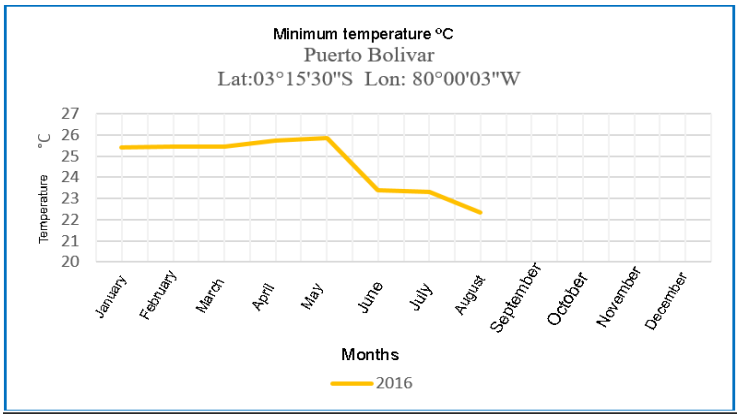
***Source**: Weather Station of Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 11: Minimum temperature for years 2014 and 2015



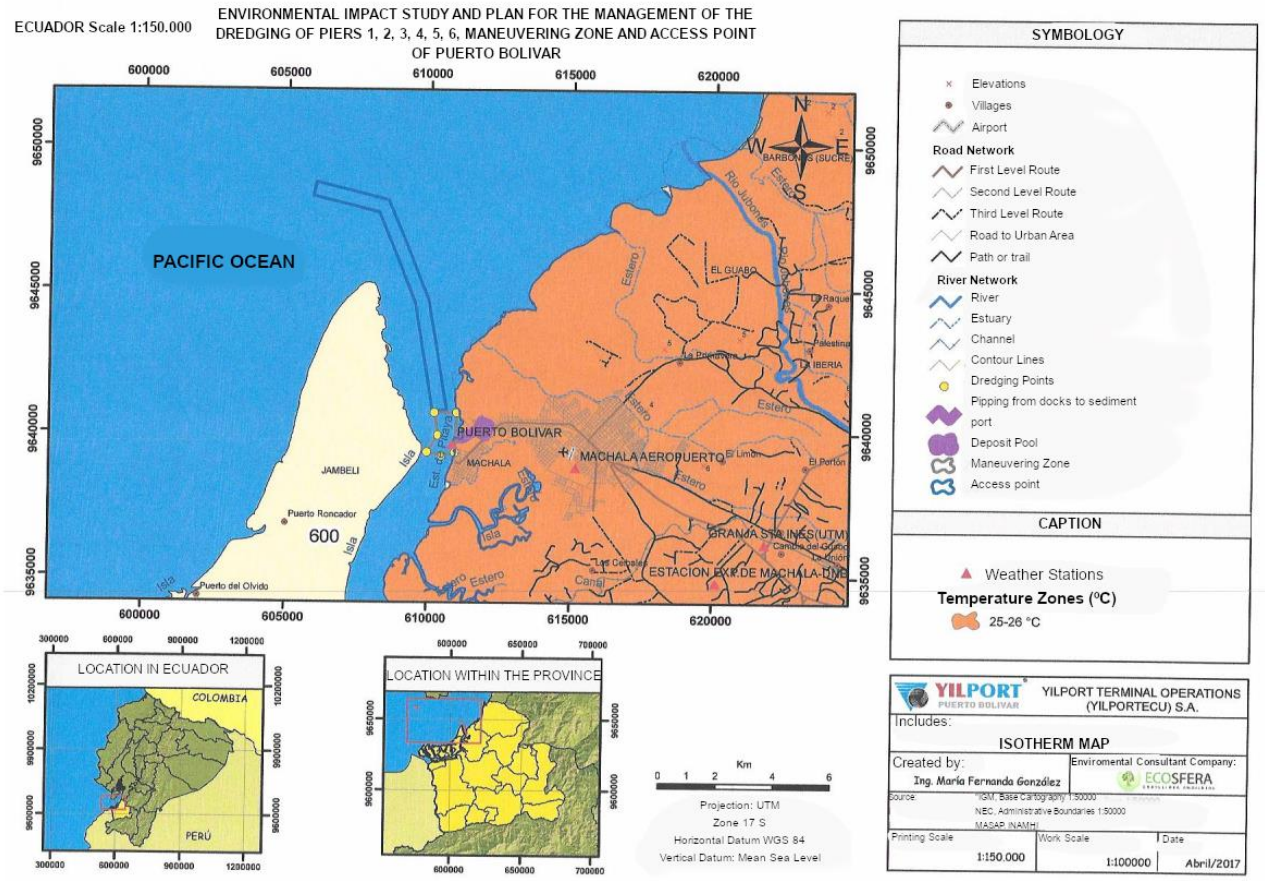
***Source**: Weather Station of Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 12: Minimum temperature for the year 2016



***Source**: Weather Station of Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 13: Isotherm Map

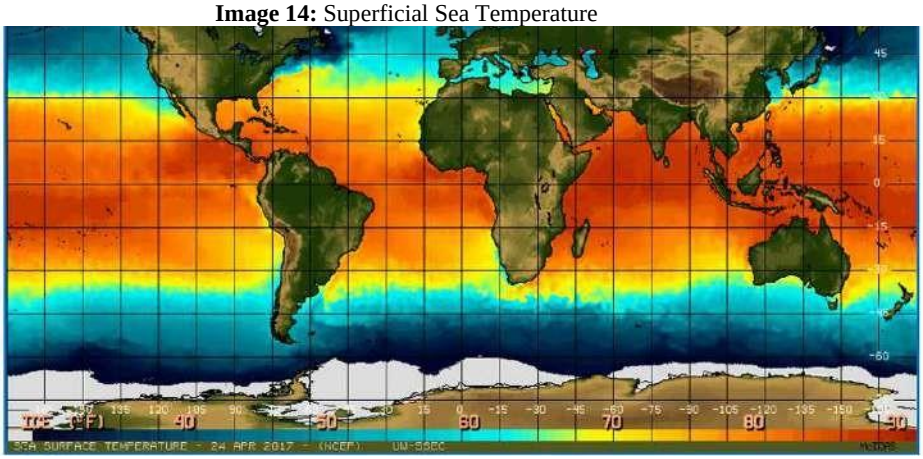


Source: *www.geoportaligm.gob.ec, Instituto Geográfico militar*
Created by: *Ecosfera Cía. Ltda.*
Location: *Harbour of Puerto Bolívar – Machala, Santa Rosa, El Oro*
Date: *6th of April, 2017*

Superficial Sea Temperature

INOCAR, offers superficial sea temperature readings for previous years, which help us establish a yearly seasonal trend. The warmest months being February and March with averages of 27,3 ºC with the lowest months being in the dry season. August having the lowest temperature of 25.5ºC. The warmest years being 1997 and 1998 due to the El Niño phenomenon in which the annual temperatures were from 27.1 to 27.0 ºC accordingly.

Image 14: Superficial Sea Temperature



Source: *www.nasa.com*
Created by: *NASA* ***Date:***
24 of April, 2017

❖ PRECIPITATIONS

Precipitations are any form of hydrometeor that falls from the atmosphere and hits reaches the earth's surface. The amount of precipitations over a specific point of the earth's surface is known as rainfall or precipitation. Precipitations occur in clouds when these reach a certain amount of saturation; at this point, water droplets grow in size till they reach a certain mass and fall due to the force of gravity.

According to the statistical data provided by INOCAR from the weather station of Puerto Bolivar, a typical winter season occurs when the total amount of precipitations during a whole year do not surpass 800 millimeters. The months with the most precipitations are February and march; and the driest months are August and September. The monthly averages for precipitations in the last 5 years are shown in the following charts and images:

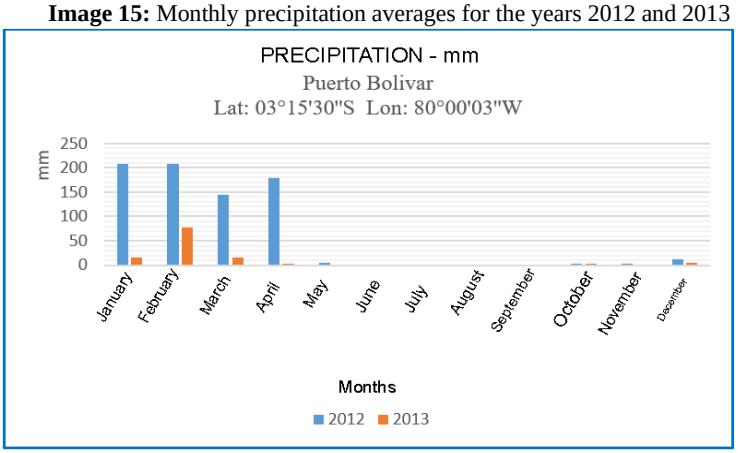
Chart 8: Monthly precipitation averages in mm

MONTH	2012	2013	2014	2015	2016
January	208	15,3	58,4	31,1	101
February	208	76,8	36,9	26,1	412,3
March	144,3	15,9	44,3	125,7	154,5
April	178,8	2,5	0	20,5	117,4
May	3,9	0,8	37,7	136,7	0
June	0	0	5,4	6,1	0
July	1	0	1,6	2	3,4

August	0	0,5	0	0,8	0
September	0	0	0	0	
October	2,9	3,4	5,3	11	
November	3,4	1	0,7	1,6	
December	11,4	5	2,2	5,4	

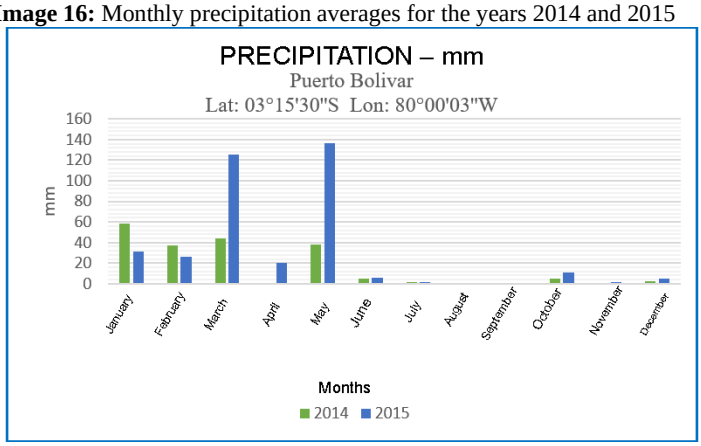
***Source**: www.geoportaligm.gob.ec, Instituto Geográfico militar*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 6th of April, 2017*

Image 15: Monthly precipitation averages for the years 2012 and 2013



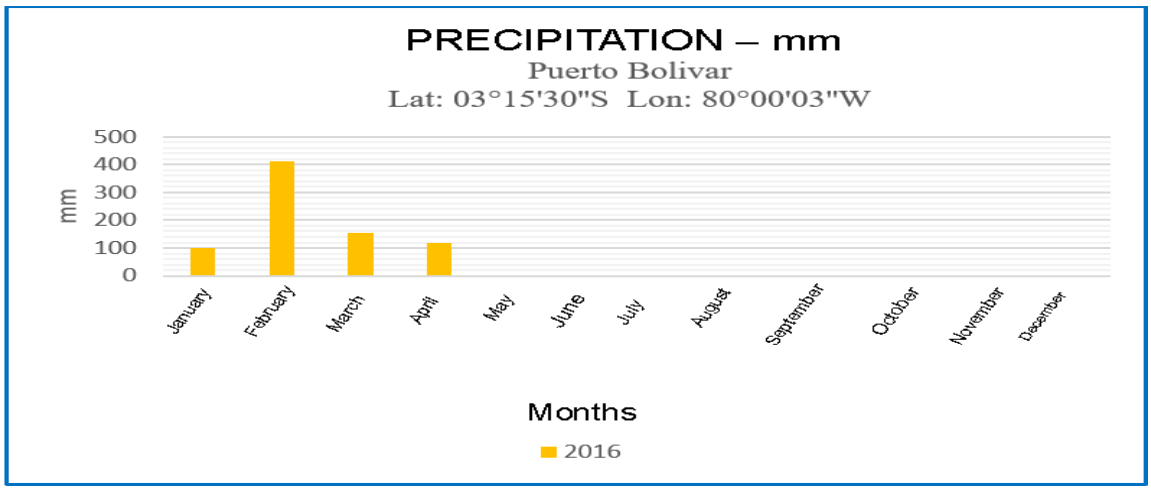
***Source**: www.geoportaligm.gob.ec, Instituto Geográfico militar*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of April, 2017*

Image 16: Monthly precipitation averages for the years 2014 and 2015



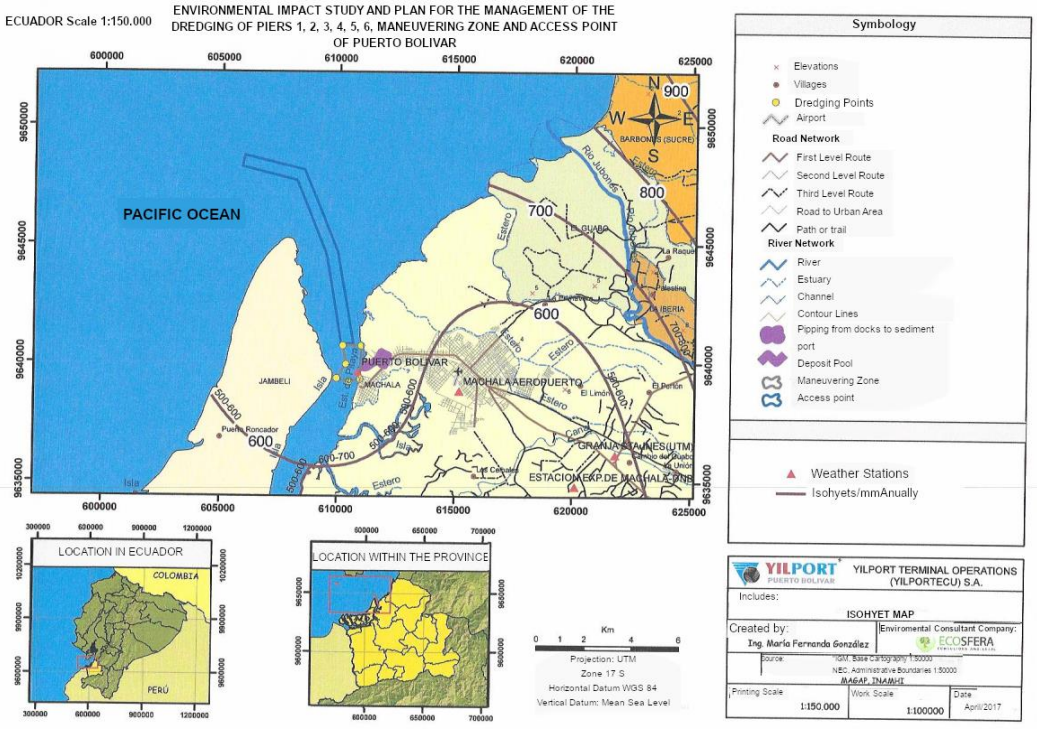
***Source**: www.geoportaligm.gob.ec, Instituto Geográfico militar*
Created by: *Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of April, 2017*

Image 17: Monthly average for the year 2016



***Source**: www.geoportaligm.gob.ec, Instituto Geográfico militar*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of April, 2017*

Image 18: Map of Isohyets



***Source**: www.geoportaligm.gob.ec, Instituto Geográfico militar*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, Santa Rosa, El Oro*
***Date**: 5th of April, 2017*

❖ RELATIVE HUMIDITY

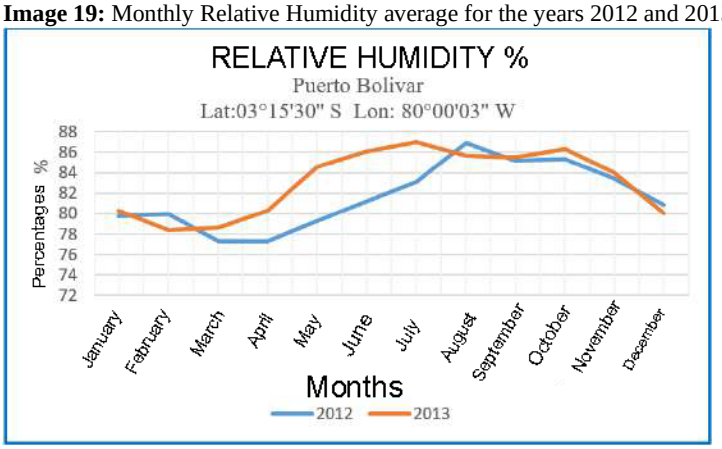
The humidity is due to the water vapor present in the atmosphere. Water vapor comes from the evaporation of seas, oceans, rivers, lakes, plants, and other living creatures.
The average relative humidity in the area of Puerto Bolivar is about 75%, the presence of surrounding water bodies influences this parameter.
Air has a constant humidity concentration during January and March, and humidity decreases due to overheating.
The monthly humidity averages of the last 5 years are as shown in the following charts:

Chart 9: Monthly Relative Humidity average %

MONTH	2012	2013	2014	2015	2016
January	79,81	80,27	78,46	78,76	79,12
February	79,95	78,34	76,3	77,4	78,31
March	77,28	78,61	77,05	78,53	78,99
April	77,29	80,26	77,71	79,54	77,13
May	79,31	84,61	79,52	78,77	78,14
June	81,2	86,04	79,49	79,48	80,2
July	83,09	86,99	82,07	81,71	84,2
August	86,92	85,63	85,16	84,14	86,29
September	85,18	85,46	84,9	81,78	
October	85,29	86,36	85,01	81,95	
November	83,39	84,02	82,64	79,81	
December	80,82	80,04	79,98	77,8	

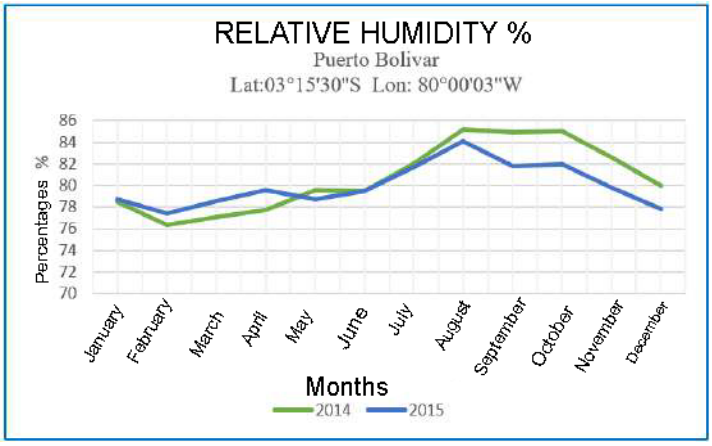
***Source**: www.geoportaligm.gob.ec, Instituto Geográfico militar*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour of Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 19: Monthly Relative Humidity average for the years 2012 and 2013



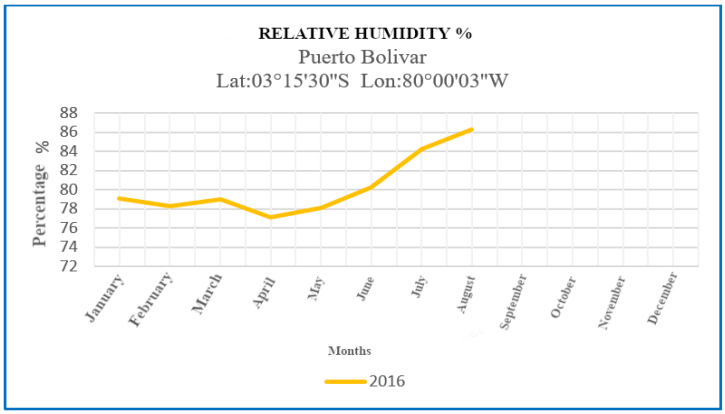
***Source:** Weather Station at Puerto Bolívar, INOCAR*
***Created by:** Ecosfera Cía. Ltda.*
***Location:** Harbour at Puerto Bolívar – Machala, El Oro*

Image 20: Monthly Relative Humidity average for the years 2014 and 2015



Source: *Weather Station at Puerto Bolívar, INOCAR*
Created by: *Ecosfera Cía. Ltda.*
Location: *Harbour at Puerto Bolívar – Machala, El Oro*
Date: *5th of May, 2017*

Image 21: Monthly Relative Humidity average for the years 2014 and 2015



Source*: Weather Station at Puerto Bolívar, INOCAR*
Created by*: Ecosfera Cía. Ltda.*
Location*: Harbour at Puerto Bolívar – Machala, El Oro*
Date*: 5th of May, 2017*

❖ HELIOPHANY

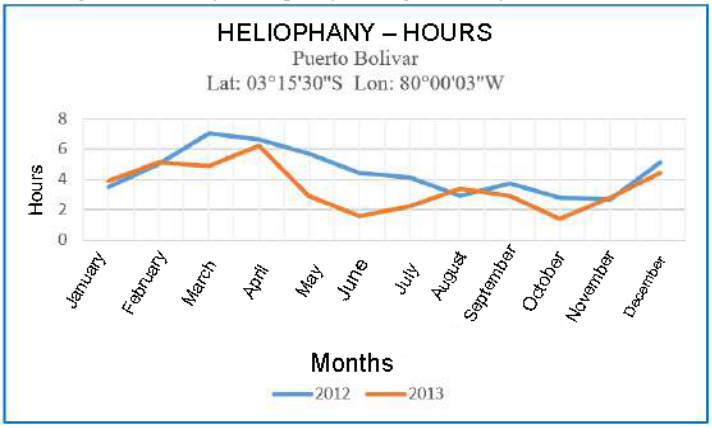
Represents the quality of sunlight. This parameter is very uncertain and is directly influenced by clouds. The monthly average is about 115 hours, with December and May being the months with the most sunlight and August and November with the least monthly sunlight.

Chart 10: Monthly Heliophany average - hours

MONTHS	2012	2013	2014	2015	2016
January	3,5	3,9	4,3	5,2	4,8
February	5	5,1	4,5	5,3	4,4
March	7	4,9	6,1	5,9	4,4
April	6,6	6,2	5,6	6,5	5,2
May	5,7	2,9	5	7	7,2
June	4,4	1,6	3,7	5,1	4,3
July	4,1	2,2	4,4	4,8	3
August	2,9	3,4	2,5	3,4	2,4
September	3,7	2,9	3	3,4	
October	2,8	1,4	2,4	2,6	
November	2,7	2,8	3,7	3,2	
December	5,1	4,4	6	5,5	

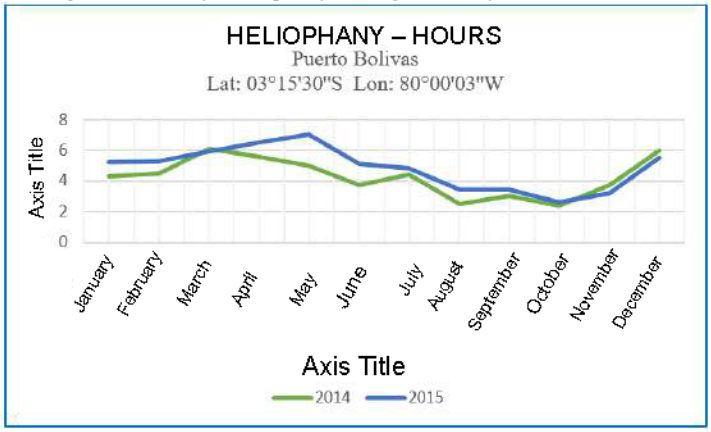
Source: *Weather Station at Puerto Bolívar, INOCAR*
Created by: *Ecosfera Cía. Ltda.*
Location: *Harbour at Puerto Bolívar – Machala, El Oro*
Date: *5th of May, 2017*

Image 22: Monthly Heliophany average for the years 2012 and 2013



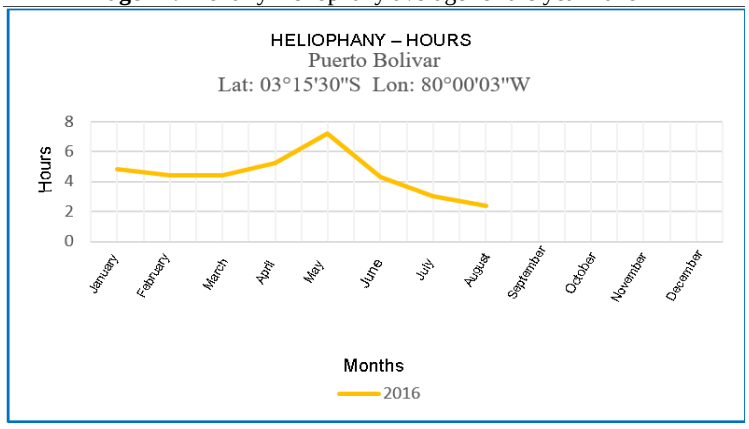
Source: *Weather Station at Puerto Bolívar, INOCAR*
Created by: *Ecosfera Cía. Ltda.*
Location: *Harbour at Puerto Bolívar – Machala, El Oro*
Date: *5th of May, 2017*

Image 23: Monthly Heliophany average for the years 2014 and 2015



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 24: Monthly Heliophany average for the year 2016



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

❖ EVAPORATION

Evaporation is the physical process that consists of a slow and gradual change from a liquid state to a gas, having acquired enough energy to overcome the superficial tension.

The monthly evaporation average at Puerto Bolivar is approximately 94 mm, and the maximum evaporation 108 mm in January, and the minimum evaporation of 80 mm in September.

❖ AIR PRESSURE

Air pressure is the force of air by unit in a given area over the earth's surface.

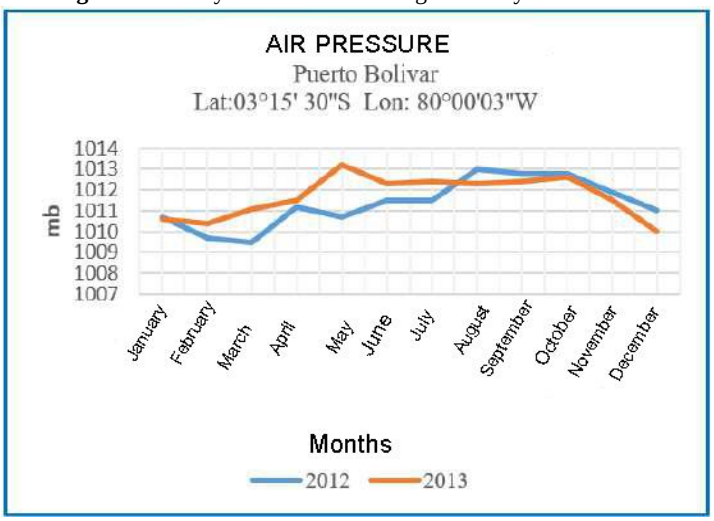
The data regarding air pressure provided by the Weather Station at Puerto Bolivar of the last 5 years before conducting this study are detailed in the following charts and images:

Chart 11: Monthly Air Pressure Average

MONTHS	2012	2013	2014	2015	2016
January	1010,7	1010,6	1009,3	1009,0	1009,3
February	1009,7	1010,4	1009,3	1009,8	1008,3
March	1009,5	1011,1	1009,3	1010,1	1009,4
April	1011,2	1011,5	1008,5	1008,9	1008,7
May	1010,7	1013,2	1010,4	1008,6	1009,5
June	1011,5	1012,3	1009,4	1009,1	1011,4
July	1011,5	1012,4	1010,0	1010,1	1011,1
August	1013,0	1012,3	1011,3	1009,8	1011,3
September	1012,8	1012,4	1010,8	1009,7	
October	1012,8	1012,6	1010,9	1010,1	
November	1011,9	1011,5	1010,9	1008,9	
December	1011,0	1010,0	1009,6	1007,9	

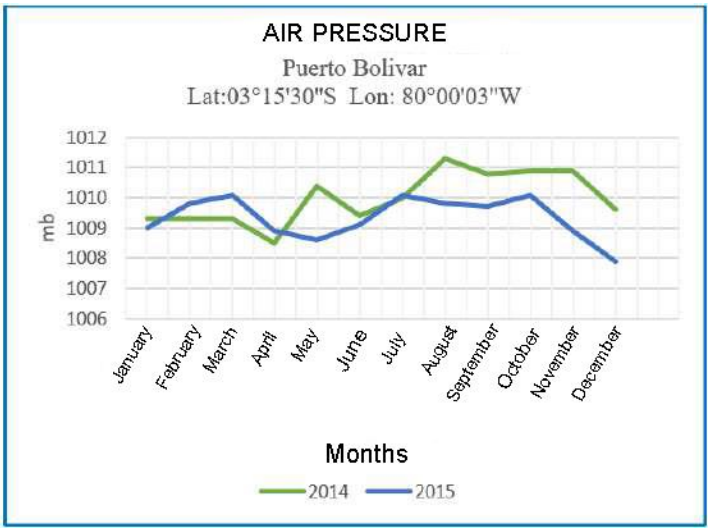
Source: *Weather Station at Puerto Bolívar, INOCAR*
Created by: *Ecosfera Cía. Ltda.*
Location: *Harbour at Puerto Bolívar – Machala, El Oro*
Date: *5th of May, 2017*

Image 25: Monthly Air Pressure Average for the years 2012 and 2013



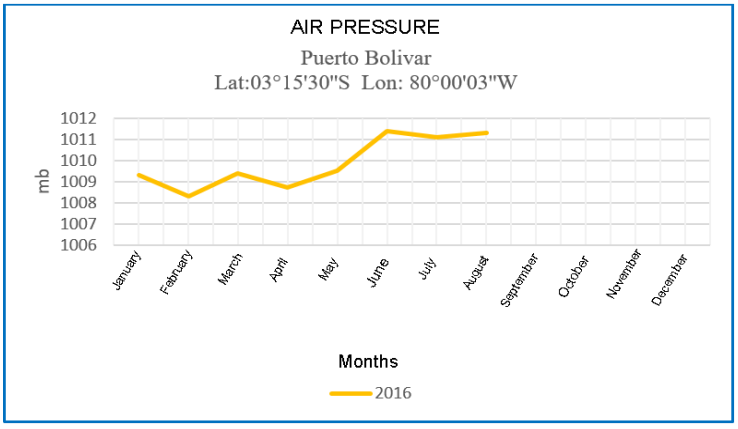
Source: *Weather Station at Puerto Bolívar, INOCAR*
Created by: *Ecosfera Cía. Ltda.*
Location: *Harbour at Puerto Bolívar – Machala, El Oro*
Date: *5th May, 2017*

Image 26: Average Air Pressure for the years 2014 and 2015



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 27: Average Air Pressure for the year 2016



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

❖ VAPOR TENSION

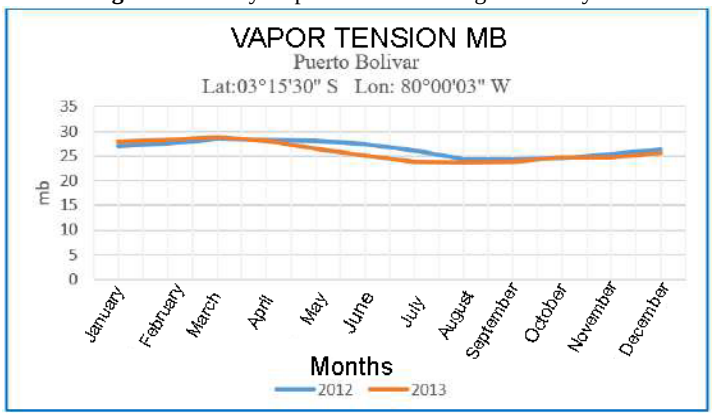
The vapor tension is the pressure at the condensed phase at a given temperature, and the following data is available from the Weather Station at Puerto Bolivar:

Chart 12: Monthly Vapor Tension Average

MONTH	2012	2013	2014	2015	2016
January	27,1	27,94	27,75	28,05	29,26
February	27,54	28,21	27,52	28,45	29,55
March	28,4	28,78	27,78	28,66	29,53
April	28,28	28,04	28,53	29,81	29,54
May	28,14	26,51	28,04	29,66	29,25
June	27,38	25,04	27,08	28,58	27,03
July	26,13	23,9	26,39	27,68	26,91
August	24,36	23,62	25,11	26,15	26,02
September	24,38	23,85	25,19	26,85	
October	24,62	24,72	24,94	27,04	
November	25,35	24,73	25,65	27,7	
December	26,37	25,68	27,17	29,49	

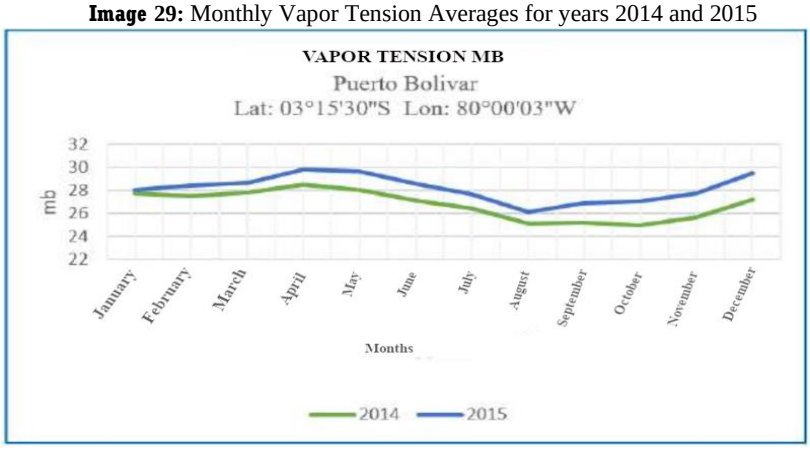
***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 28: Monthly Vapor Tension Averages for the years 2012 and 2013



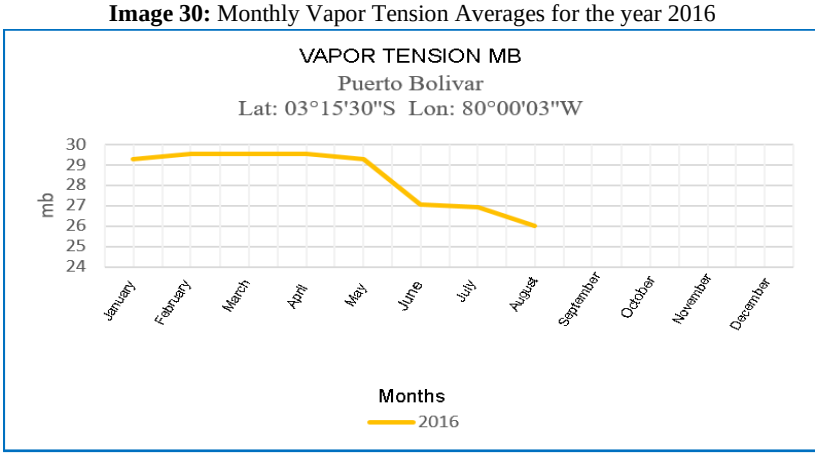
***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 29: Monthly Vapor Tension Averages for years 2014 and 2015



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 30: Monthly Vapor Tension Averages for the year 2016



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

❖ DEW POINT

The dew point or dew temperature is the temperature when the water vapor in the air begins to condense and form dew, fog or any type of cloud, or frost if the temperature is low enough.

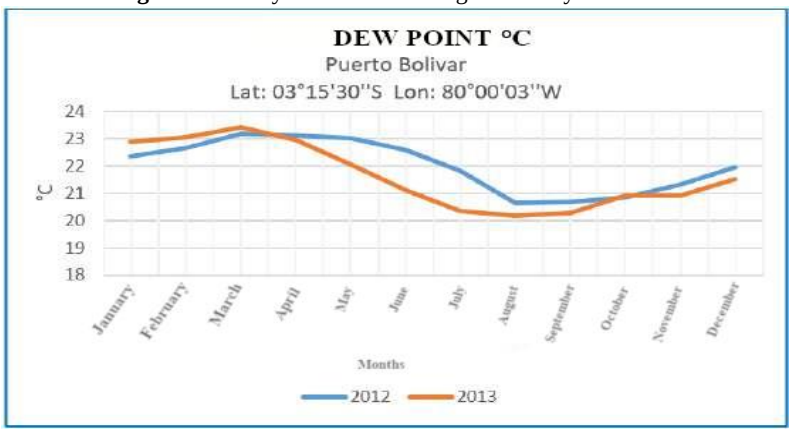
The data for Dew Point for the last five years is as follows:

Chart 13: Monthly Dew Point Average ºC

MONTH	2012	2013	2014	2015	2016
January	22,35	22,9	22,79	22,97	23,67
February	22,66	23,05	22,65	23,2	23,83
March	23,17	23,4	22,79	23,32	23,82
April	23,11	22,96	23,24	24,04	23,82
May	23,02	22,04	22,96	23,89	23,66
June	22,57	21,12	22,4	23,31	22,36
July	21,82	20,35	21,94	22,75	22,29
August	20,65	20,16	21,16	21,82	21,74
September	20,67	20,29	21,2	22,26	
October	20,84	20,9	21,05	22,37	
November	21,31	20,9	21,55	22,74	
December	21,95	21,51	22,45	23,8	

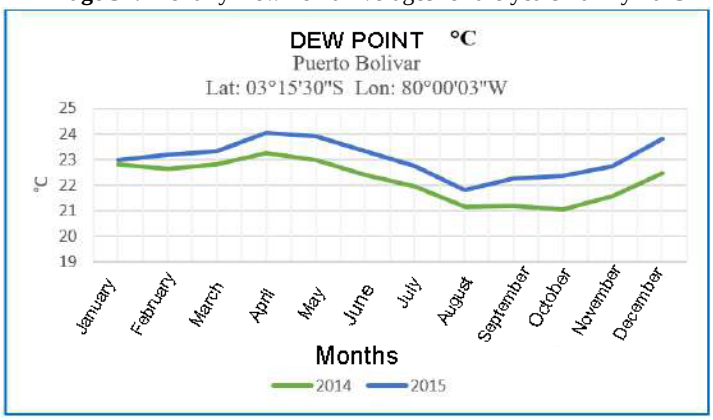
***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 31: Monthly Dew Point Averages for the years 2012 and 2013



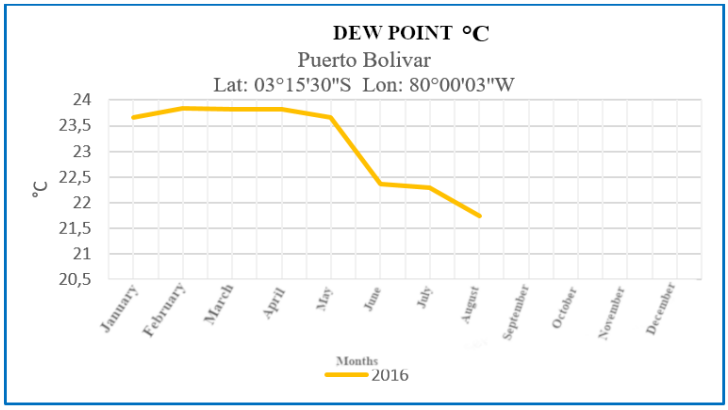
***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 32: Monthly Dew Point Averages for the years 2014 y 2015



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 33: Dew Point Average for the year 2016



***Fuente:** Estación Meteorológica Puerto Bolívar, INOCAR*
***Elaborada por:** Ecosfera Cía. Ltda.*
***Ubicación:** Terminal Portuario de Puerto Bolívar – Machala, El Oro*
***Fecha:** 5 de Mayo del 2017*

❖ CLOUDINESS

Cloudiness is the fraction of the sky that is covered with clouds in a determined area. According to the actual meteorological guidelines, cloudiness is expressed in octas or in eighths regarding the celestial sphere. It is divided into 8 parts by the technician, who analyses the number of parts covered with clouds. This way, it is possible to determine the amount of visibility for the observer.

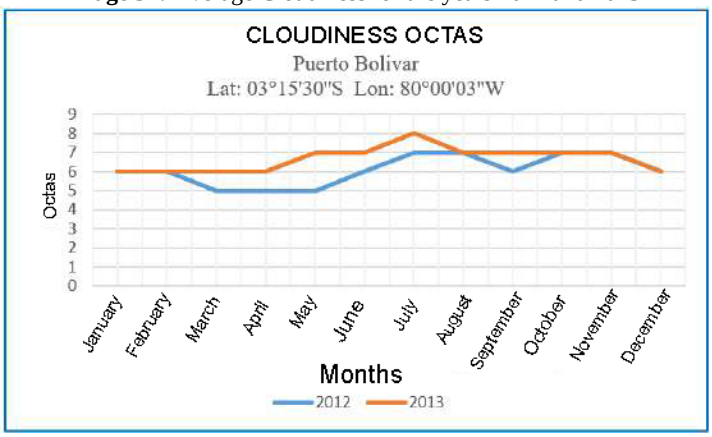
The maximum cloudiness occurs in winter and the minimum in summer. During the day, it usually reaches its maximum point around 14 hundred hours, when the air is at maximum ascent.

Chart 14: Monthly Cloudiness Average Octas

MONTH	2012	2013	2014	2015	2016
January	6	6	6	6	6
February	6	6	6	6	6
March	5	6	6	6	6
April	5	6	5	5	6
May	5	7	6	5	6
June	6	7	6	6	6
July	7	8	6	6	6
August	7	7	7	7	6
September	6	7	7	6	
October	7	7	7	7	
November	7	7	6	6	
December	6	6	5	5	

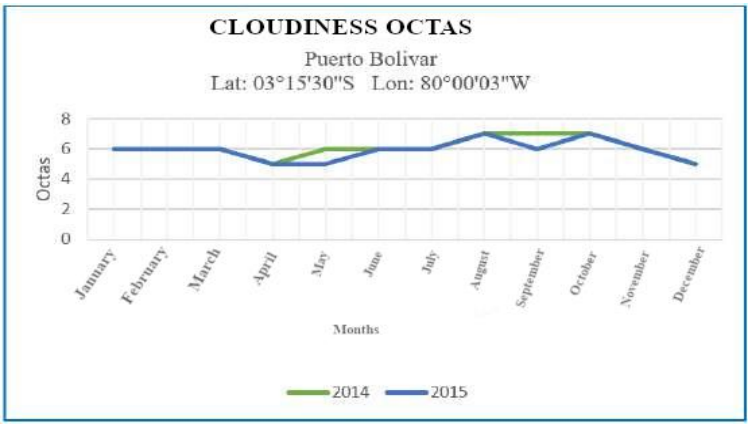
Fuente: *Estación Meteorológica Puerto Bolívar, INOCAR*
Elaborada por: *Ecosfera Cía. Ltda.*
Ubicación: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Fecha: *5 de Mayo del 2017*

Image 34: Average Cloudiness for the years 2012 and 2013



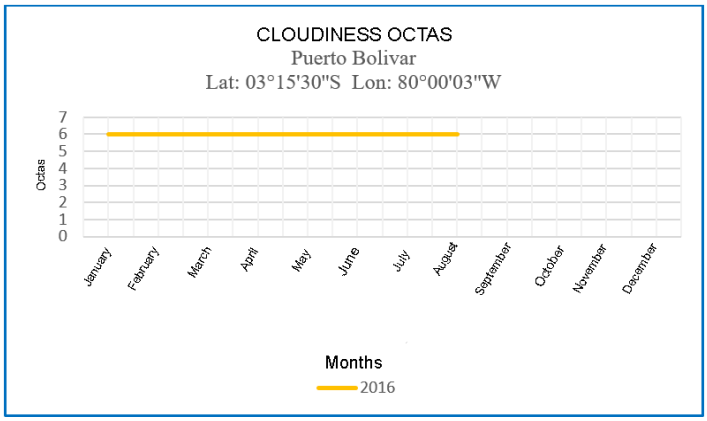
Source*: Weather Station at Puerto Bolívar, INOCAR*
Created by*: Ecosfera Cía. Ltda.*
Location*: Harbour at Puerto Bolívar – Machala, El Oro*
Date*: 5th of May, 2017*

Image 35: Average Cloudiness for the years 2014 and 2015



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

Image 36: Average Cloudiness for the years 2014 and 2015



***Source**: Weather Station at Puerto Bolívar, INOCAR*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Harbour at Puerto Bolívar – Machala, El Oro*
***Date**: 5th of May, 2017*

❖ WINDS

Winds are the flow of gasses at a great scale. On earth, the wind is the mass movement of air in the atmosphere in a horizontal way.

The velocity of wind is the speed and direction of winds. During the year winds, generally maintain W- NW direction at the Station in Puerto Bolivar. In the first hours of the day, it is deficient, with a speed of 0.5 m/s (1 knot), and then it increases till it reaches a speed of 1.5 m/s (3 knots) till mid-day; at the final hours of the afternoon and night, one can perceive a light breeze.

Maximum wind speeds are recorded from June to September, period during which they reach extraordinary figures of up to 8 m/s. The average wind speed for the rest of the year remains at 1.8 m/s. Peak gusts of 15 m/s are occasionally recorded.

The station shows wind currents flowing from the west, with speeds measuring around 3 m/s. In other words, any ship entering Puerto Bolivar has its outer surface exposed to southwest winds with speeds of 3 m/s.

Table 15: Monthly wind frequency of 2012

MONTH	FREQUENCY	N	NE	E	SE	S	SW	W	NW	C
January	Direction	1.08	0	1.08	0	1.08	16.13	32.26	21.51	26.88
	Speed	2	0	3	0	2	2.4	2.23	1.8	0
February	Direction	1.15	1.15	1.15	0	0	18.39	32.18	14.94	31.03
	Speed	3	2	2	0	0	2.25	1.96	1.62	0
March	Direction	2.15	0	0	0	0	23.66	29.03	13.98	31.18
	Speed	2					2.09	1.59	1.62	0
April	Direction	0	1.11	0	0	1.11	21.11	31.11	20	25.56
	Speed		1			1	2.37	1.75	1.78	0
May	Direction	3.23	0	0	0	0	21.51	35.48	20.43	19.35
	Speed	2.33					2.35	2.09	2	0
June	Direction	2.22	0	0	2.22	0	21.11	38.89	25.56	10
	Speed	3.5			2.5		3	2.77	2.17	0
July	Direction	0	1.08	2.15	1.08	3.23	19.35	37.63	27.96	7.53
	Speed		2	2	4	2.67	3.33	2.57	2.19	0
August	Direction	3.23	0	1.08	0	1.08	19.35	40.86	32.26	2.15
	Speed	2.67		4		2	3.83	2.84	2.2	0
September	Direction	1.11	0	0	0	0	16.67	40	24.44	17.78
	Speed	3					3.27	2.67	2.05	0
October	Direction	0	0	0	0	0	19.35	33.33	24.73	22.58
	Speed						3.39	2.61	2.04	0
November	Direction	1.11	0	0	0	2.22	17.78	30	21.11	27.78
	Speed	2				2	2.75	2.22	2	0
December	Direction	1.08	0	0	0	0	15.05	33.33	23.66	26.88
	Speed	2					2.14	1.97	1.95	0

Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

Table 16: Monthly wind frequency of 2013

MONTH	FREQUENCY	N	NE	E	SE	S	SW	W	NW	C
January	Direction	1.08	1.08	0	0	1.08	22.58	35.48	20.43	18.28
	Speed	2	2			1	2.1	2.12	1.95	0
February	Direction	3.61	1.2	0	0	0	14.46	36.14	20.48	24.1
	Speed	2	2				2	1.9	1.94	0
March	Direction	0	0	0	0	0	25.81	33.333	17.2	23.66
	Speed						2.13	1.94	1.94	0
April	Direction	0	1.11	0	1.11	0	21.11	34.44	16.67	25.56
	Speed		2		1		3	2.23	2.4	0
May	Direction	0	0	0	1.08	0	16.13	41.94	26.88	13.98
	Speed				3		3.4	2.74	2.08	0
June	Direction	0	0	0	0	0	22.22	34.44	28.889	14.44
	Speed						3.7	2.74	2.04	0
July	Direction	0	0	0	0	1.08	21.51	34.41	27.96	15.05
	Speed					0	3.7	2.66	2.15	0
August	Direction	0	0	0	0	0	22.58	34.41	25.81	17.2
	Speed						3.67	2.53	2.17	0
September	Direction	3.33	0	0	0	0	17.78	36.67	28.89	13.33
	Speed	2.67					3.25	2.94	2.23	0
October	Direction	1.08	0	1.08	0	0	12.9	32.26	38.71	13.98
	Speed	2		3			3.08	2.77	2.28	0
November	Direction	1.11	0	1.11	0	0	15.56	36.67	28.89	16.67
	Speed	4		4			2.93	2.7	2.08	0
December	Direction	4.3	0	0	0	1.08	13.98	32.26	22.58	25.81
	Speed	2.75				3	2.08	2.07	1.81	0

Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuaria de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

Table 17: Monthly wind frequency of 2014

MONTH	FREQUENCY	N	NE	E	SE	S	SW	W	NW	C
January	Direction	2.15	0	0	1.08	0	19.35	33.33	22.58	21.51
	Speed	3			3		2	1.9	1.86	0
February	Direction	5.95	0	0	1.19	1.19	11.9	30.95	21.43	27.38
	Speed	3.8			2	2	2.5	2.04	1.72	0
March	Direction	0	0	0	0	0	10.75	37.63	22.58	29.03
	Speed						2.1	2.09	1.9	0
April	Direction	2.22	0	0	0	2.22	13.33	33.33	21.11	27.78
	Speed	4				2.5	2.5	2	1.95	0
May	Direction	2.15	0	1.08	0	0	15.05	34.41	25.81	21.51
	Speed	2.5		2			2.79	2.75	2.08	0
June	Direction	0	3.33	1.11	0	0	14.44	37.78	26.67	16.67

MONTH	FREQUENCY	N	NE	E	SE	S	SW	W	NW	C
	Speed		3.67	2			3.08	2.88	2.42	0
July	Direction	0	1.15	1.15	0	1.15	14.94	35.63	20.69	25.29
	Speed		3	3		1	3.69	3.19	2.33	0
August	Direction	2.15	6.45	3.23	0	0	18.28	37.63	20.43	11.83
	Speed	8	2.5	2.67			3.82	2.89	2.26	0
September	Direction	0	0	0	0	1.11	20	37.78	25.56	15.56
	Speed					2	3.22	2.71	2.26	0
October	Direction	0	0	0	0	0	18.28	36.56	27.96	17.2
	Speed						3	2.65	2.31	0
November	Direction	2.25	1.12	0	0	0	16.85	32.58	24.72	22.47
	Speed	3.5	4				2.47	2.62	2.36	0
December	Direction	2.15	1.08	0	0	0	18.28	31.18	20.43	26.88
	Speed	4.5	4				2.24	2.17	2.05	0

Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

Table 18: Monthly wind frequency of 2015

MONTH	FREQUENCY	N	NE	E	SE	S	SW	W	NW	C
January	Direction	2.15	1.08	0	0	0	18.28	33.33	17.2	27.96
	Speed	5	4				2.12	2.03	2	0
February	Direction	3.57	0	0	0	0	20.24	29.76	15.48	30.95
	Speed	2.67					2.12	2	2	0
March	Direction	1.08	0	1.08	0	0	18.28	33.33	20.43	25.81
	Speed	4		3			2.41	2.32	2.11	0
April	Direction	2.22	0	0	0	0	20	32.22	20	25.56
	Speed	2.5					2.17	2.76	2.06	0
May	Direction	2.15	0	0	0	0	16.13	33.33	24.73	23.66
	Speed	2					2.27	2.1	2	0
June	Direction	0	2.25	0	0	0	13.48	40.45	25.84	17.98
	Speed		3.5				2.75	2.56	2.04	0
July	Direction	1.08	0	0	0	0	13.98	37.63	29.03	18.28
	Speed	8					3.69	2.91	2.33	0
August	Direction	1.08	0	0	0	0	23.66	38.71	30.11	6.45
	Speed	2					3.81	2.97	2.43	0
September	Direction	1.11	0	0	0	0	21.11	37.78	17.78	22.22
	Speed	2					3.37	2.79	2.5	0
October	Direction	1.08	0	0	0	0	13.98	37.63	26.88	20.43
	Speed	3					3.31	2.94	2.4	0
November	Direction	3.33	0	0	0	0	16.67	33.33	23.33	23.33
	Speed	3					2.8	2.53	2.05	0

MONTH	FREQUENCY	N	NE	E	SE	S	SW	W	NW	C
December	Direction	2.17	1.09	0	0	0	20.65	21.74	16.3	38.04
	Speed	2.5	3				2.42	2.3	2.13	0

Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

Table 19: Monthly wind frequency of 2016

MONTH	FREQUENCY	N	NE	E	SE	S	SW	W	NW	C
January	Direction	0	2.2	0	0	0	18.68	31.87	20.88	26.37
	Speed		4				2.82	2.59	2.32	0
February	Direction	1.15	1.15	0	0	0	21.84	29.89	20.69	25.29
	Speed	4	6				2.63	2.19	2.44	0
March	Direction	0	1.08	0	0	0	17.2	36.56	23.66	21.51
	Speed		4				2.69	2.44	2.32	1.55
April	Direction	0	3.33	0	0	1.11	20	31.11	21.11	23.33
	Speed		5.33			3	2.28	2.29	2.11	0
May	Direction	2.15	0	0	0	0	20.43	30.11	21.51	25.81
	Speed	2.5					2.63	2.32	2.3	0
June	Direction	1.18	1.18	0	1.18	0	15.29	8.24	38.82	34.12
	Speed	2	2		2		2.5	2.29	2.24	0
July	Direction	0	0	0	1.09	0	6.52	1.09	66.3	25
	Speed				2		2	2	2.34	0
August	Direction	0	0	0	0	0	0	0	66.67	33.33
	Speed								2.43	0

Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

Distribution of atmospheric pollutants requires knowledge of frequency and distribution of wind direction and speed.

The prevailing wind in a given time frame may be represented employing a compass rose showing the percentage of time during which the wind blows from different directions. The graph uses bars or extensions that stretch from the middle of a circle to a specific point, thereby illustrating wind direction, serving the length of each extension as an indication of the percentage of time during which the wind traveled to such direction (*Ahrens, 1998*).

Said measurements may be presented either employing a graph or a table. Data is presented in eight primary directions and eight secondary ones, as follows:

Table 20: Compass rose graph data

Primary	Secondary
N (north)	NNE (north-northeast)
S (south)	ENE (east-northeast)
E (east)	ESE (east-southeast)
W (west)	SSE (south-southeast)
NE (northeast)	SSW (south-southwest)
NW (northwest)	WSW (west-southwest)
SE (southeast)	WNW (west-northwest)
SW (southwest)	NNW (north-northwest)

Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

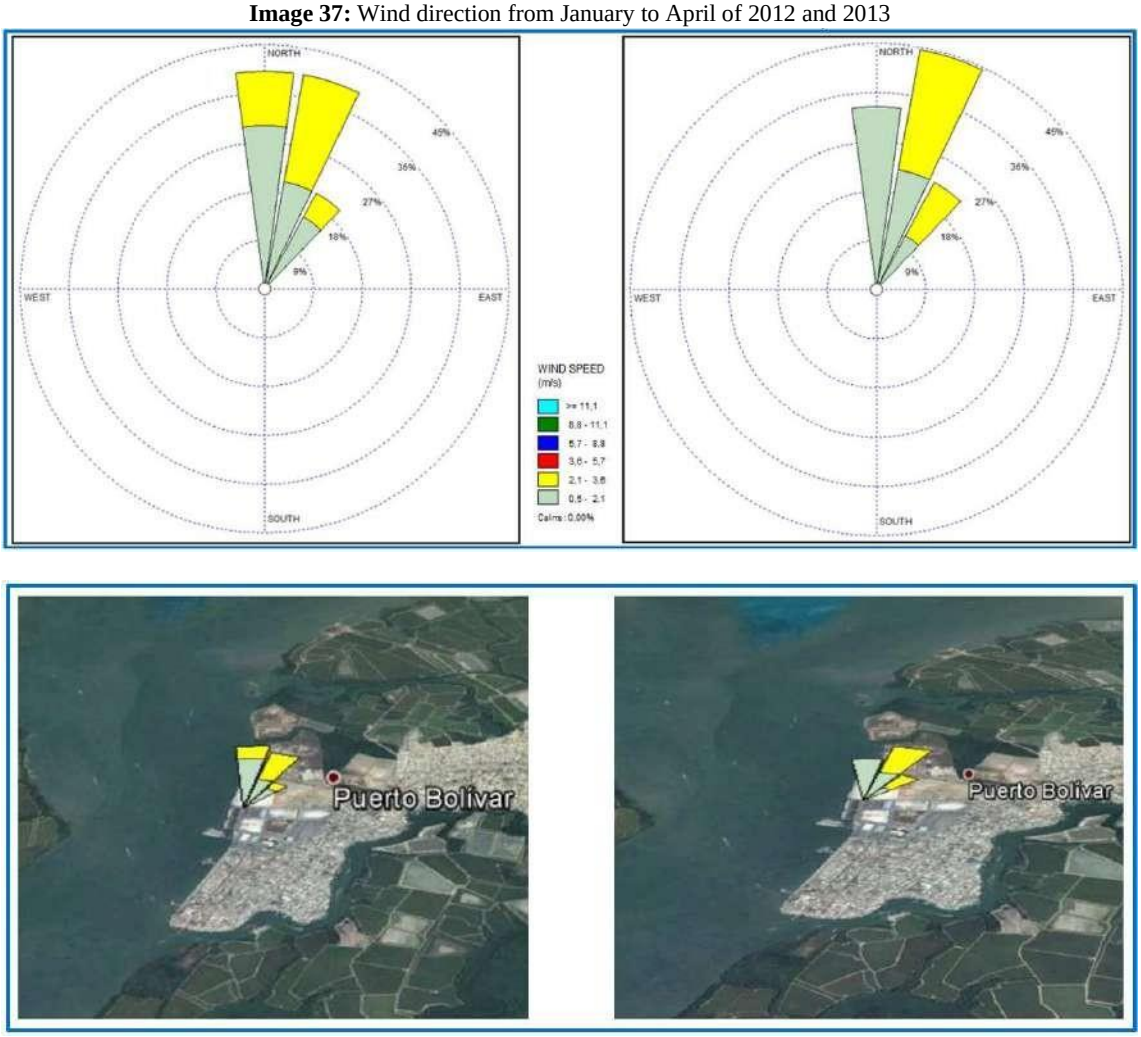
On the other hand, wind speed is divided into categories which may be shown in different units ranging from miles per hour to meters per second. Nevertheless, it is still possible to record periods when wind-speed readings are zero, reported as calm.
Wind direction may also be illustrated in degrees, such as in a 360º circumference. These directions represented by numbers that vary clockwise from 360º in the north to 90º in the east, 180º in the south, and 270º in the west. There are other directions as well, such as NE to which the 45º belong, meaning that the degrees pertaining to all the remaining wind directions can be obtained. Calm is shown as 0º (*Wark et al., 1998*).
Compass rose graphs were designed using the Windows-based software WRPLOT.

A compass rose shows wind frequency in each wind direction provided and speed categories for specific time frames and locations.

Designing the compass roses required data related to wind direction and speed provided by the Oceanographic Institute of the Ecuadorian Navy—INOCAR by its Spanish acronym—that had been recorded in Puerto Bolivar weather station throughout the years 2012, 2013, 2014, and 2015.

For the assessment purposes hereof, the above tables have been drawn considering the direction from which the winds are blowing.
According to the data gathered during the first quarters—from January to April—of 2012 and 2013, the wind is blowing in the north-northeast direction (NNE) at speeds below 3.6 m/s.

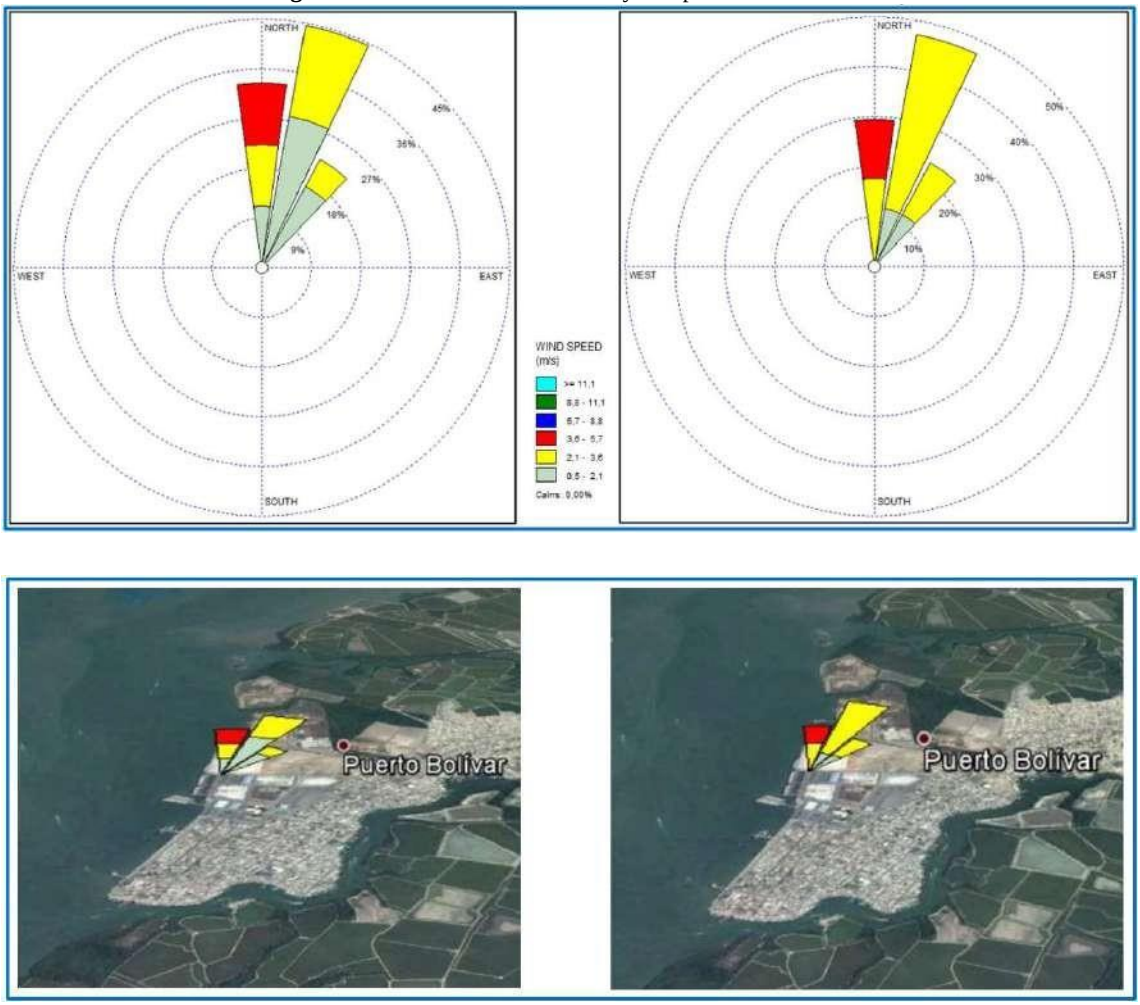
Image 37: Wind direction from January to April of 2012 and 2013



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

However, from January to April of 2014 and 2015 wind speed increased near the north (N) whilst wind direction remained unchanged towards the north and north-northeast (NNE).

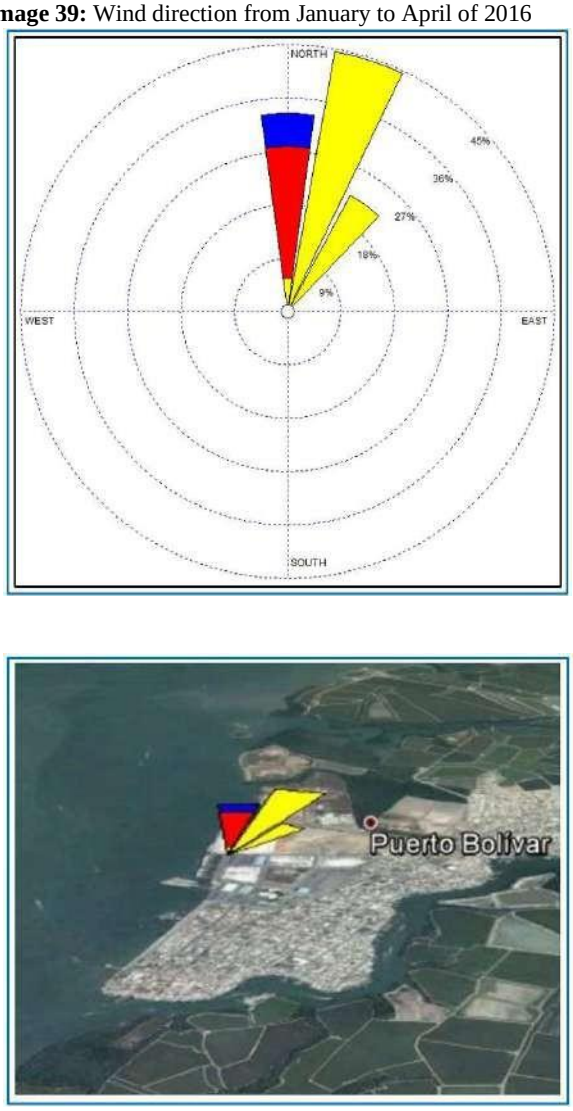
Image 38: Wind direction from January to April of 2014 and 2015



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

As for 2016, the period from January to April showed the same tendency in wind direction as the previous years, yet wind speed increased up to over 5.7 m/s.

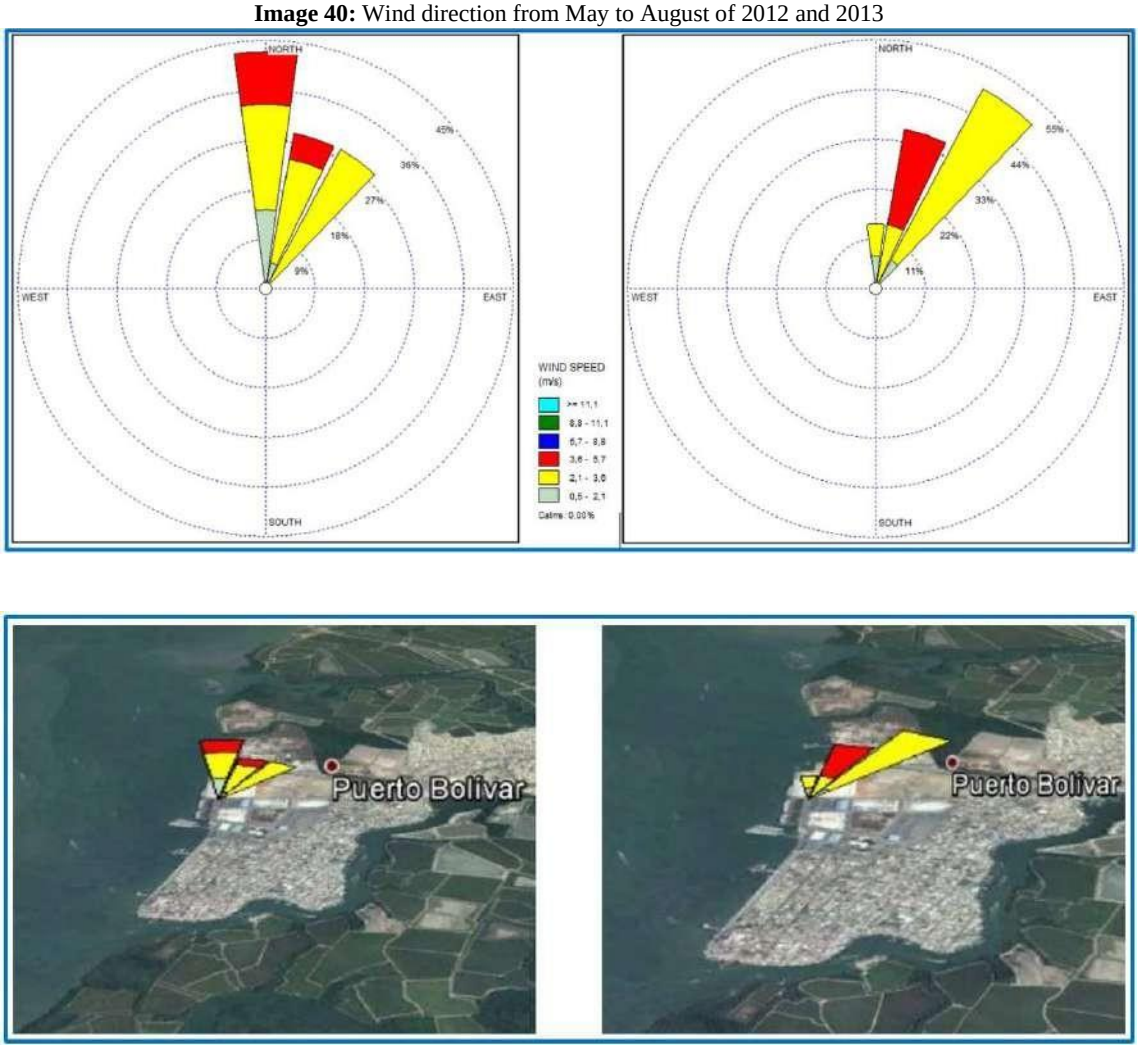
Image 39: Wind direction from January to April of 2016



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

The second quarter—from May to August—of 2012 shows wind blowing in the north (N) and north-northeast (NNE) directions at speeds above 3.6 m/s towards the north; but the period from May to August of 2013 shows wind direction and speed towards the north-northeast (NNE).

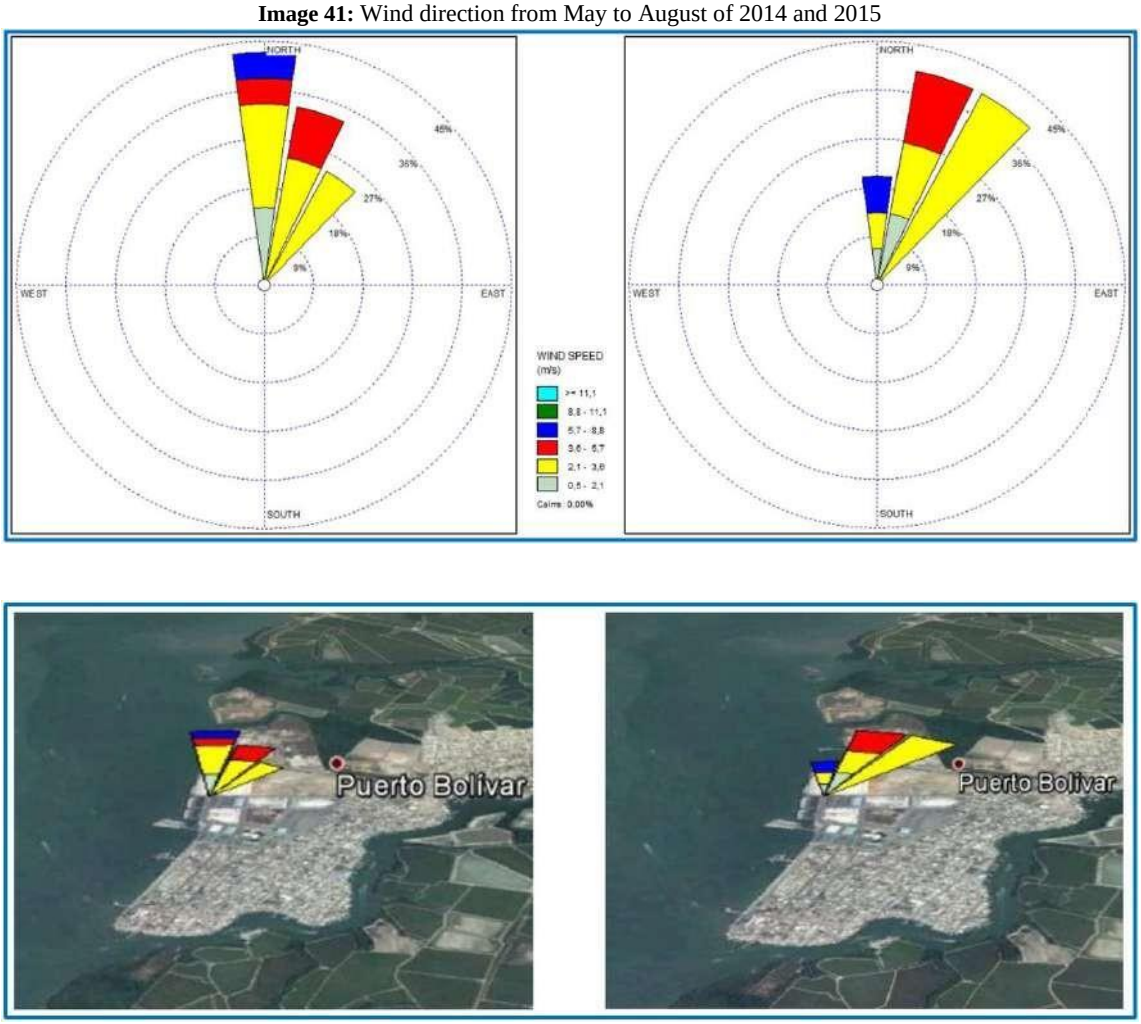
Image 40: Wind direction from May to August of 2012 and 2013



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

From May to August of 2014 and 2015, the wind speed increased up to over 5.7 m/s towards the north (N), while wind direction remained north and north-northeast (NNE).

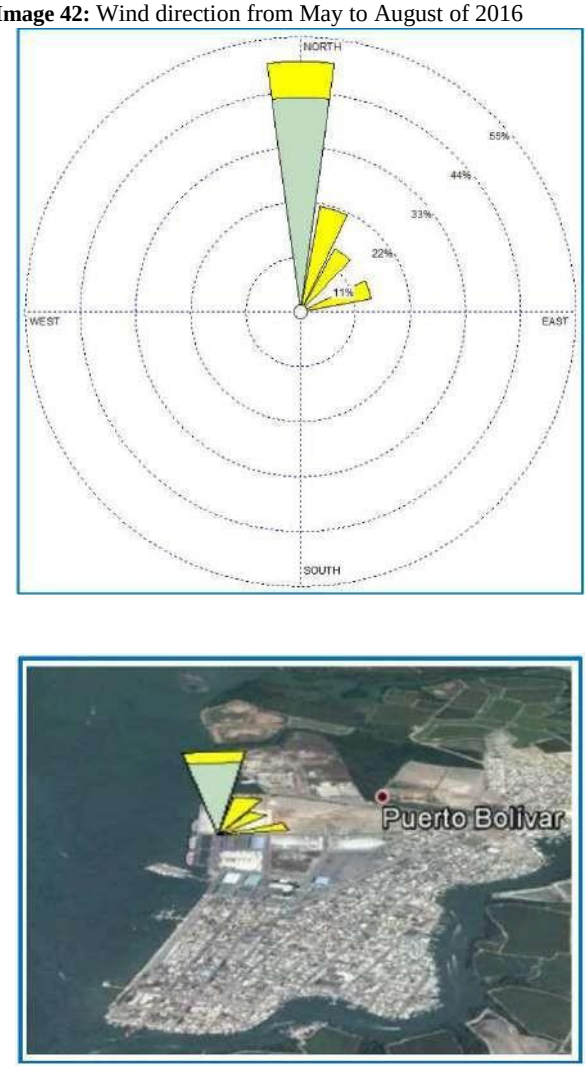
Image 41: Wind direction from May to August of 2014 and 2015



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

From May to August of 2016, wind speed decreased in relation to the previous four years, whilst the wind was observed blowing from the north (N) to the east-northeast (ENE) direction.

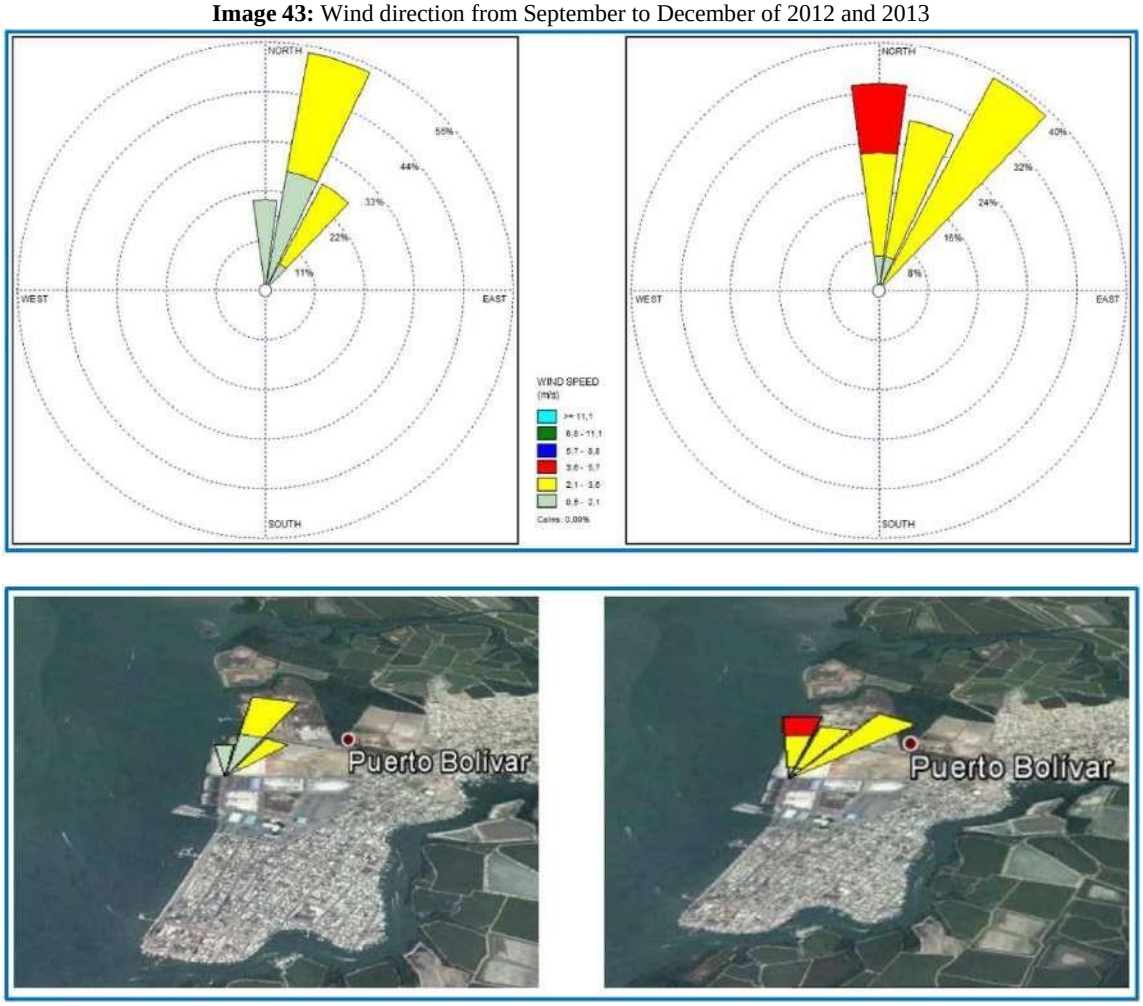
Image 42: Wind direction from May to August of 2016



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

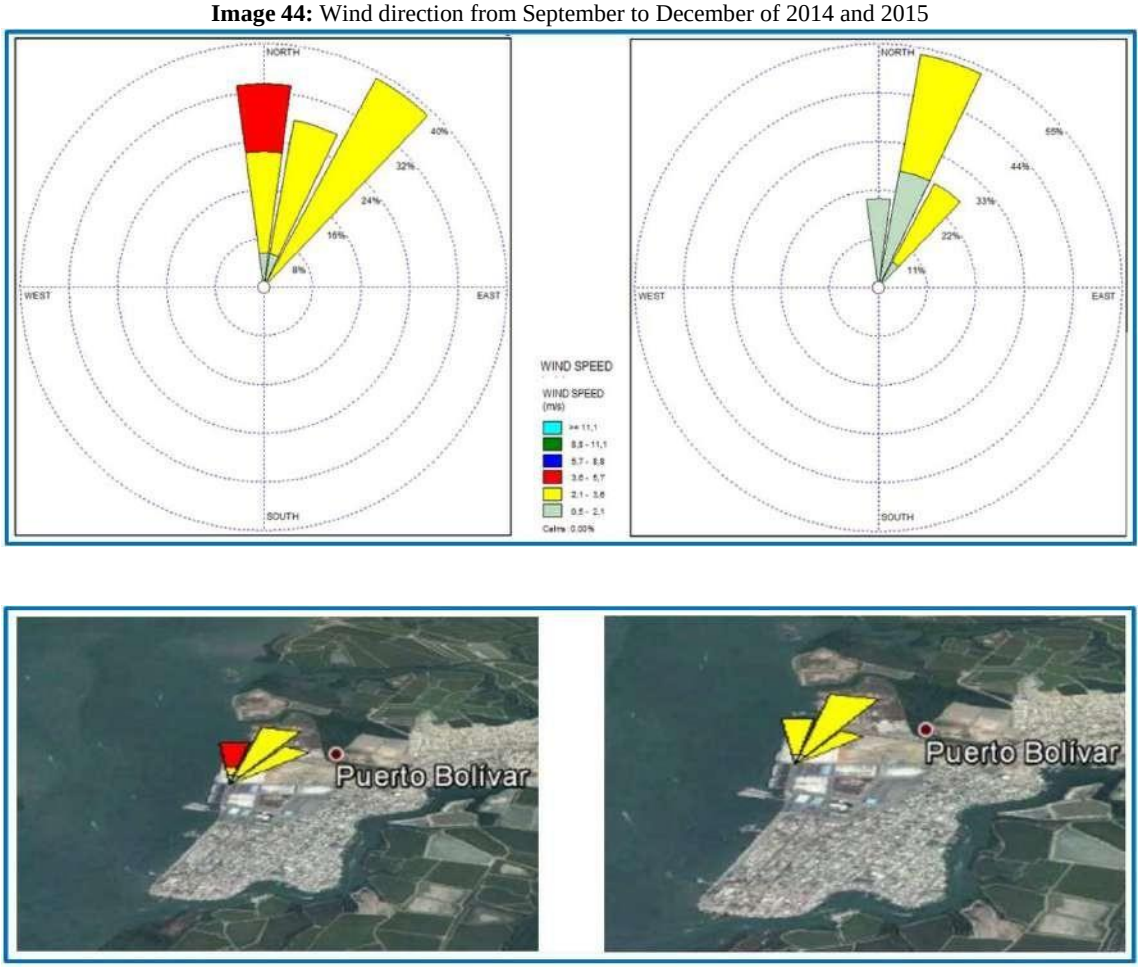
The third quarter—from September to December—of 2012 shows a prevailing wind direction towards the north-northeast (NNE) and a speed of 3.6 m/s, but from September to December of 2013 and 2014, the wind is observed blowing towards the north, and north-northeast directions and records show that speed increases towards the north (N). The last quarter—from September to December—of 2015 shows that wind blew in the north and north-northeast (NNE) directions, reaching speeds of up to 3.6 m/s on record.

Image 43: Wind direction from September to December of 2012 and 2013



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

Image 44: Wind direction from September to December of 2014 and 2015



Source: *Estación Meteorológica Puerto Bolívar, INOCAR*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Terminal Portuario de Puerto Bolívar – Machala, El Oro*
Date: *5 May 2017*

Based on the obtained results, it is possible to conclude that both wind direction and speed do not vary significantly and remain similar across the years.

The prevailing wind direction throughout those five years was towards the north (N) and north-northeast (NNE); it was only during the second quarter of 2016 that records show wind direction towards the east-northeast (ENE).

The lowest wind speeds ranging from 0.5 to 3.6 m/s were recorded during the first quarters (January, February, March, and April) of the years 2012, 2013, 2014, and 2015. It was not until the first quarter of 2016 that wind speed increased up to over 5.7 m/s.

The months of May, June, July, and August of the years 2012, 2013, 2014, and 2015 show records of higher wind speeds of up to over 5.7 m/s, but from May to August of 2016 wind speed decreased to 3.6 m/s in relation to the previous four years.

Wind speeds have gradually decreased during the third quarter of each year until the 3.6 m/s range on record.

Worth to note is that each year during the rainy season (wet period) lesser winds were recorded in relation to the dry season when wind speeds increased significantly. In line with the previous years, only 2016 records show higher wind speeds during the first quarter and less wind during the second quarter, as well as a direction towards the east-northeast (ENE).

6.1.2- GEOLOGY

The Andes Mountains make up Ecuador's main axis and has the highest amount of metal mineralization associated with plutonic rocks in contact with volcanic or carbonate rocks, being this occurrence more marked in the south of the country and directly related to the border of the Huancabamba deflection, which is regarded as a mega deformation structure.
North of El Oro province is the border of the Huancabamba deflection, which meets the rivers Jubones and Piñas at Portovelo. Due to this deflection, the Andes changes direction since, in Peru, the mountain range shows a northwest direction, and in Ecuador, it changes into a predominantly north-south direction.

Two regions define the province's geological feature taking the Jubones fault as reference:

- **Northern region:** This region has the least amount of area and the lowest elevation. Rocks dating from the Cretaceous can be found in this region consisting of rocks from the Macuchi Formation identified as volcaniclastic andesitic, volcanic, tuffs and Quaternary sediments. Most of this region is covered in Tertiary deposits, such as the Saraguro Formation made up of andesitic and rhyolite volcanic rocks as well as pyroclasts. The Tarqui Formation belongs to the Quaternary and is made up of pyroclasts, rhyodacites, volcanic rocks, and Quaternary sedimentary deposits consisting of estuarine, marine clay.
- **Southern region:** it is located south of the Jubones fault, which encompasses most of the province. This region has the oldest rocks, which date from a Precambrian metamorphic sequence, such as the Piedras Group consisting of greenschists, amphibolite and quartzites; the Tahuin Group belongs to the lower Paleozoic, bearing the Capiro and San Roque Formations consisting of schist, gneiss, quartzite and amphibolite; the Cretaceous bears the Raspa Formation made up of schists, the Celica Formation made up of andesitic and pyroclastic volcanic rocks, and the Alamor Group consisting of conglomerates, sandstones, shales, lutites, greywackes and pyroclasts.

The Puyango Petrified Forest is located in Ecuador with unique geological features and is found within El Oro and Loja provinces. It was formed under coastal marine and earth conditions in a relatively narrow sedimentary basin; it is bordered by the Andes Mountains to the east and is volcanically active; it is also bordered by a volcanic archipelago known as the Amotepe Mountains to the west. A forest of large trees pertaining to the Araucanian family grew over the sediments that, after being destroyed, grew once again from at least six eruptions taking place millions of years ago. Water from the Pacific Ocean

reached the buried forest 65 million years ago; it filled wood with silica, quartz crystals were formed, and logs turned into stone.
There are old plutonic rocks throughout the province territory ranging from Paleozoic to Tertiary and being categorized as granitic or acid plutonic, such as granite and granodiorites.

Based on their range and depth, 2 geological faults are worthy of mention:

- Río Jubones
- Río Girón

Río Jubones fault stretches from east to west through the lower area until it reaches its junction with Río Girón fault. This fault spans over 60 km, and its geological dip is yet to be determined. Río Girón fault stretches from northeast to southwest, it spans 15 km and is a regular fault formed by constant uplifts. Río Jubones coastal plains have slopes ranging from 0.1% near the sea to 0.3% near Tres Cerritos, with graceful meanders in the lower area, which causes the energy at the main riverbed to be high. Lower area rivers form beds having both plains and mountain features. Rivers located north of Río Jubones have 0.1% slopes with graceful meanders.
The geological period of the area studied has pertained to the Quaternary for thousands of years in the recent Quaternary geological era, and it has been tied to the inevitable cycles of variable depository energy, as is the case with rainy seasons which are high-energy sedimentary periods, such as during an El Niño event (ENSO period, El Niño-Southern Oscillation), and/or low-energy deposits in drought periods. The ebb and flood of the tides at Santa Rosa marsh also affects this sedimentation process.
The sediments present in the region consist of a series of clay deposits and thin layers of fine and silty sands of medium to large grain size, moderately to highly dense with traces of oxidation, that reach an approximate depth which is determined by the -48 MASL altitude. A silty clay deposit succeeds with traces of organic matter, hard consistency, and medium to high plasticity until the -59.50 MASL altitude. Below this layer follows a highly stiff clay.
Interbedded sediment thickness, with densely compacted silty sands and/or stiff and highly stiff clay, could be higher than 100 m. In the Puerto Bolivar region and beneath its surface lies the Puna or Progreso soft rock geological formation.
The formation of sedimentary terraces, above which cliffs may be shaped, illustrates some of the most distinctive processes in estuary regions. These processes benefit from the great effect mangroves exert on sediments by collecting and retaining them. According to Wolf, extensive regions in the Gulf of Guayaquil, the islands of the Jambelí Archipelago (south of the Gulf) and several islands throughout Río Esmeraldas, could have been formed partly as a result of the above processes.
Hence, in a lithological sense, the studied area is essentially made up of estuarine, marine clays, as shown in the map below:

- **Estuarine marine clays (QE):** The flat and lower areas of the coastal plains consist of well-stratified, fine granular materials deposited in a sedimentary environment transitioning from continental maritime or marshlands and other regions with surfaces affected by tidal flow. Such estuarine marine

clays, as they are referred to in the Geologic Map of Ecuador (CODIGEM & BGS, 1993), are made up of layers of fine sands interbedded with clays and silts that are teeming with organic activity. The water table in these deposits is superficial, and thus they always appear saturated—the argillaceous component grants these materials medium to high plasticity and soft consistency.

Estuarine deposits are found in riverbanks throughout the canals to Jambelí, Puerto Bolívar and the entire region influenced by Huaylá marsh up until the Estadio Nueve de Mayo area.

The Jambelí parish shows limited geological variety. The dominant geological formation pertains to maritime sediments, which is found throughout most part of the parish.

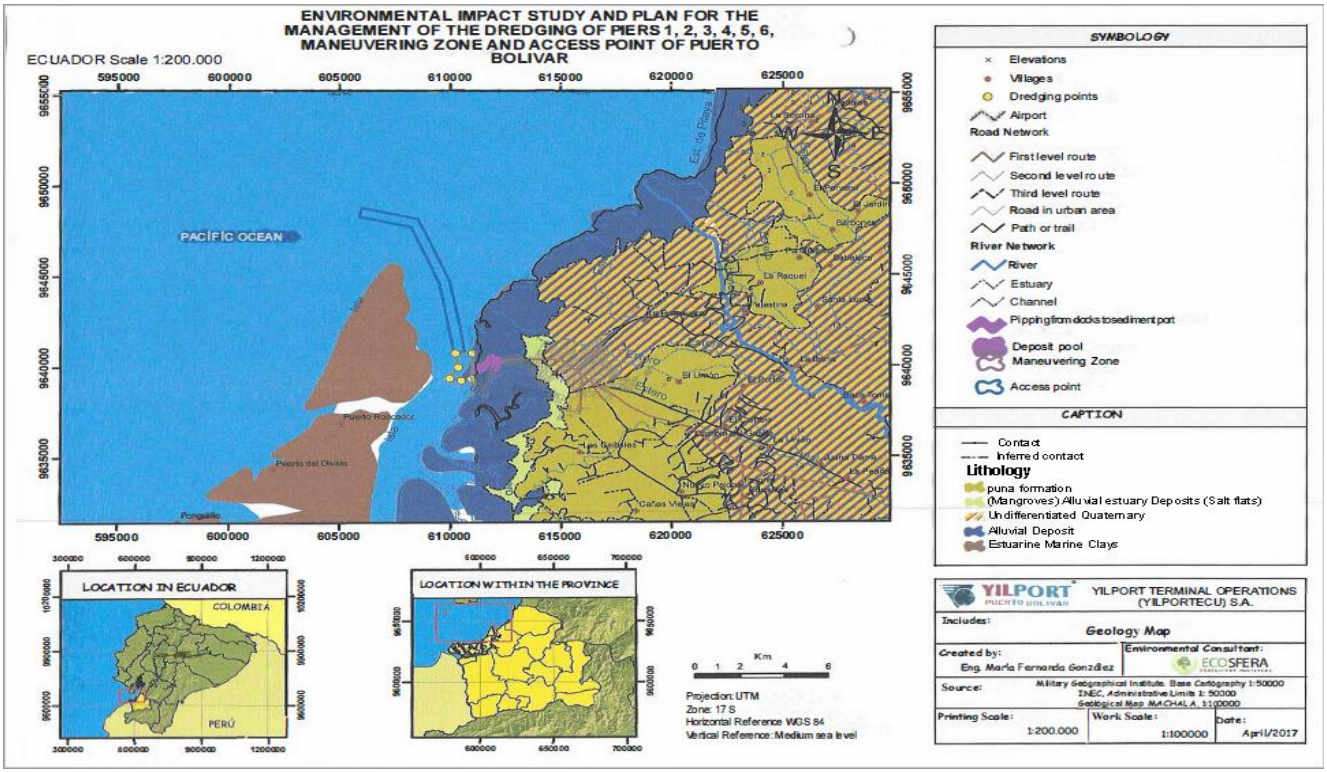
Table 21: Geodynamic processes in the Jambelí parish

GEOLOGY	SURFACE AREA	PERCENTAGE
Maritime deposits	575.42	2.26
Salt deposits	647.86	2.55
Maritime sediments	24204.08	95.19
TOTAL	**25427.36**	**100%**

Source: *Plan de Desarrollo de la parroquia Jambelí (2008 -2015)*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Parroquia Jambelí - Santa Rosa, El Oro*
Date: *20 May 2017*

Santa Rosa marsh consists of alluvial-estuarine sediments. Puerto Bolívar maritime terminal area belongs to Progreso geological riverbed.

Image 45: Geological Map of the Project Site



Source: *www.gooportaligm.gob.ec, Military Geographical Institute, geological Map of Machala*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *6th of april 2017*

6.1.3.- GEOMORPHOLOGY AND TERRAIN

The study site, according to the geomorphological map, corresponds to the Alluvial Terrain and Coastal Terrain.

- **Alluvial Terrain:** Flat terrain where one can perceive small ripples that form the natural dikes and bar ridgescrolls. This is where the river displacement occurs and significant development of the plain capable of flooding
- **Coastal Terrain:** Plains more or less elevated over sea level that occurs due to the degradation caused by sea and lake water

In El Oro's province, the terrain is predominantly flat, with beaches to the province's northeast. Its high ground is comprised of the ridges Tio Loma, Mullopungo, and Chilla. Swamps and marshes are present at the study site, and straight ahead are a group of channels separated by the archipelago of Jambeli from another sub-zone classified as flatlands extending from the Rio Jubones to Santa Elena. The marshes' sub-zone extends from the entrance of Tumbes towards the estuary of Santa Rosa, and this sub-zone is a coast without a beach where exuberant vegetation made up of various

mangrove species found essentially over brackish water where grain-size distribution for soil texture is quite thin. The coastal plain continues in the other area towards the east, with gentle to nonexistent slopes and elevation ranging from 0 to 20 m.

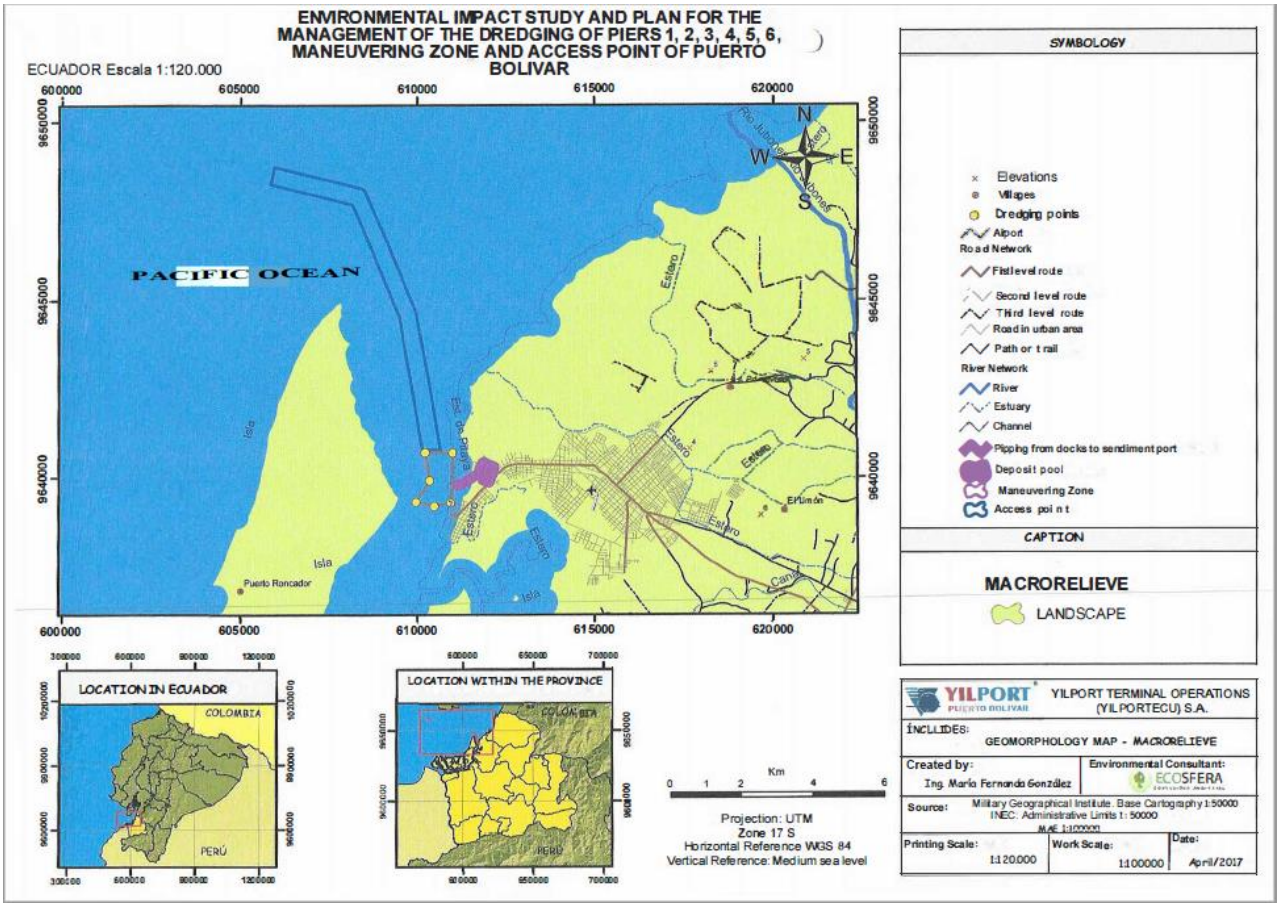
There is also a savanna sub-area from Santa Rosa, passing through the vicinity of Machala, almost reaching Río Jubones. These regions flood during winter, thus rendering them unsuitable for agriculture, though suitable for cattle breeding. Upon summer arrival, savannas run dry and their terrain becomes argillaceous. Savannas are home to Tembladeras, which are stretches of water that remain stagnant and are fed by different rivers.

Based on a visual analysis of the map and its legend, the geomorphology of the Jambelí parish confirms that the coastal plain occupies most of the territory, whereas a minimal area of the tidal plain is found on the edges of the parish, whilst the remaining area corresponds to the central region.

From a geomorphological perspective, the site is fundamentally influenced by the dynamic sedimentation process taking place in Estero Santa Rosa basin, at the mouth sector.

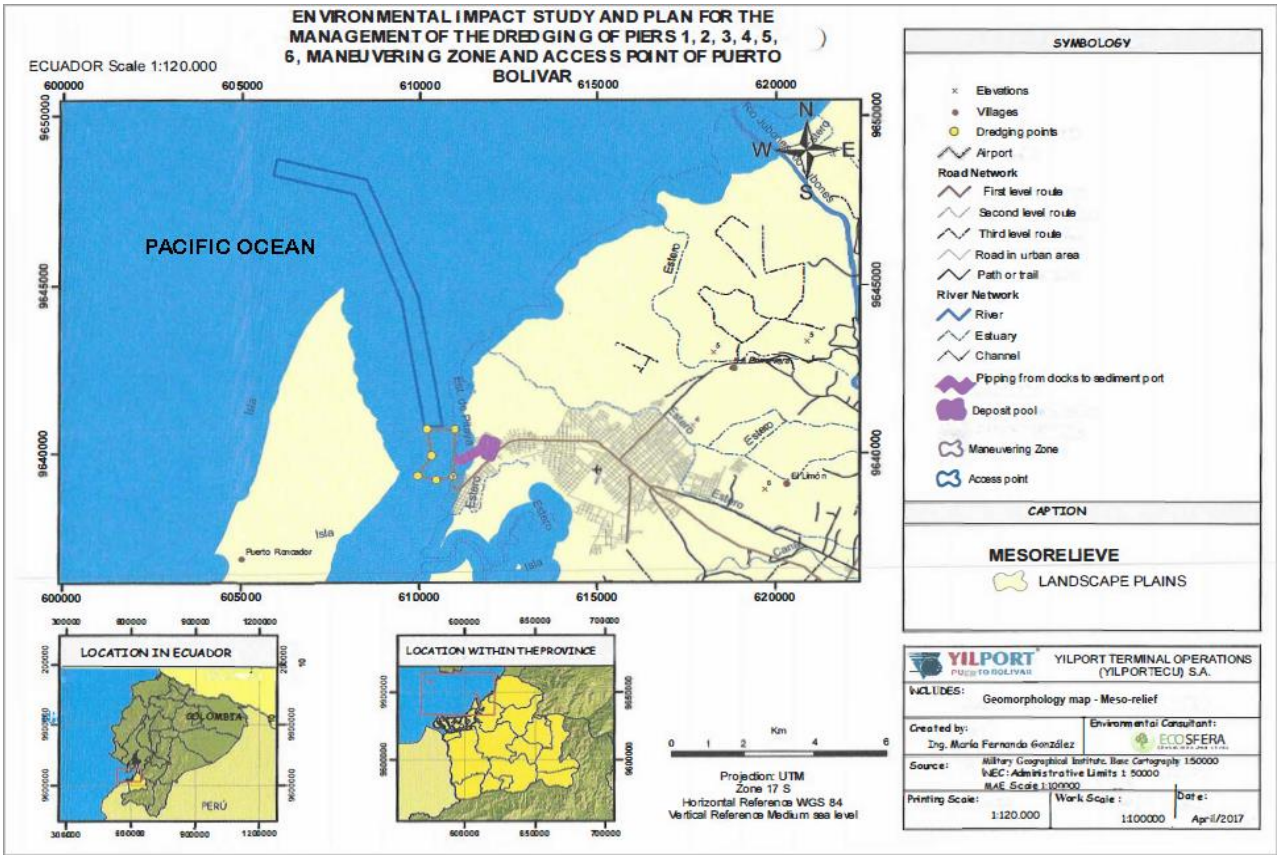
With regards to elevation, the Jambelí parish is located at 7 MASL, and its territory is predominantly flat. The analysis of geographical units in the parish showed that the coastal plain takes up an area of 25,179.79 ha, which represents 99.03% of its total area, whereas the tidal plain occupies 247.61 ha, equal to 0.97%.

Image 46: Map of the Landscape and Geomorphological Area of the Project



Source: *www.gooportaligm.gob.ec, Instituto Geográfico Militar, Geoportal del Ministerio del Ambiente*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *6th of April, 2017*

Image 47: Map of the Landscape and Geomorphological Area of the Project



***Source**: www.gooportaligm.gob.ec, Instituto Geográfico Militar, Geoportal del Ministerio del Ambiente*
***Created by**: Ecosfera Cía. Ltda.*
***Location**: Puerto Bolívar – Machala, Santa Rosa – El Oro*
***Date**: 6th of April, 2017*

6.1.4.- LAND

The province's physical geography is comprised of low mountains that are foothills that correspond to the South-Western mountain range and dry plains that differ in that ocean winds have caused a sub-humid-dry climatic diversity with remarkable productivity of its soils. The physical geographical term used to categorize is fluvial terrace, with alluvial terrain caused by frequent flooding and slight highlands caused by alluvial and colluvial terrain.

The terrains are geologically formed by alluvial sediments with a tertiary alluvial origin, quaternary floodplains, and metamorphic rock from the Paleozoic. Some factors have contributed to the land degradation of the province, which includes farming, mining, and development of shrimp industry and monoculture agriculture as well as high use of agrochemicals, farming in general and mechanical movement of the land, which have caused the appearance of the first symptoms of desertification as is the erosion in the land of some districts which affects the economic development of these areas.

The coastal land is formed by quaternary floodplain detritus materials that fill the coastal basins. During the rainy seasons, in the plain and low areas that do not have good draining, flooding occurs, and entisol soils are formed

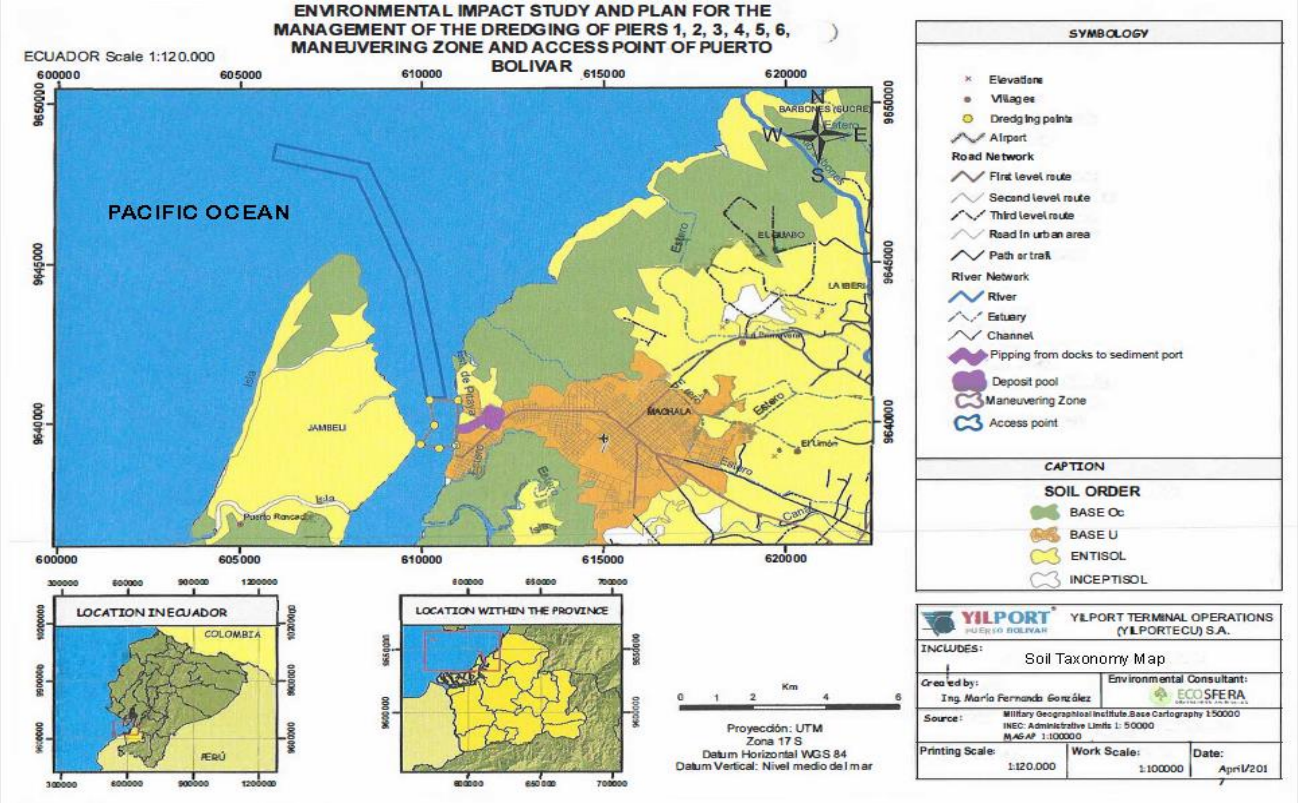
by recent alluvial sediments over the flooded plains, alluvial fans, river deltas and terraces. The main characteristic are the stratigraphic layers of variable texture, which contain irregular organic materials. There are areas exposed to sea effects on the coast, tidal marsh areas plains next to the sea with saltwater, and mangrove forests develop.
The Jambeli archipelago is a mangrove area, formed by recent sediments of silt and clay where occasionally gravel and sand appear. These soils are in first-order entisols and in suborder aquent that remain wet due to water. These are grey, bluish soils with red or black spots that have a considerate amount of salts with a predominance of clay. They can be found primarily in coastal marshes where the water is salty. There is an area of the beach that forms a litoral area formed by sand. These beaches are extended bars parallel to the coast, with few meters wide and directly affected by the waves, the litoral current, and the longshore drift. There are soils of entisol order and psamment sub-order formed by sand and recent sediment materials to the east. They have very low water retention, and when they are dry and uncovered, they are very propene to aeolian erosion, and their organic material content is low.
Machala is located in the lower area of the Jubones river basin, which is characterized by having a slightly flat and wavy terrain with slopes that do not exceed 5%. The texture varies from sand to clay with a predominance of clay -muddy soil.
The soil is formed in most part by muddy and sandy clay soil of fluvial origin with grey tones that extends several meters deep; additionally, layers of thick mud and fine sand are present; its origin is related with processes of sedimentation of materials of quaternary fluvial drag.
Currently, the soil (superficial layer) has been filled with gravel to prevent flooding.
The slight slope and texture characteristics cause limited to moderate draining. We can classify it from moderate to low with a significant lack of nitrogen regarding soil fertility. The organic material is present in varying proportions. Some units present low to high solids and salt values that increment as it reaches salt flat areas.

The soils in the parish of Jambeli are classified and originate due to a combined influence of the weather, terrain, bedrock, vegetation, living organisms, and time. According to the taxonomy of soils, it has been determined there are two types of soils in the study area:

- **Entisol:** Which are defined as soils that do not show any defined profile development. These are younger soils in which the process of formation has not generated diverse horizons. Generally, they present only one horizon, the "A," that has a composition remarkably like rocky materials that gave it its origin and which it rests upon

- **Inceptisol:** Are soils with a weak horizon development, these are soils derived from fluvial deposits as well residual deposits and are formed by lithic materials of volcanic and sedimentary nature. They are superficial to moderately deep with a flat cracky topography.
  They are fewer young soils than the entisols and with an emerging horizon development. They do not present an accumulation of organic materials, iron, or clay.
  Regarding the texture of the soils, there are present soils with fine, medium, thick, and moderately thick textures at the study area.

Image 48: Map of Terrain of the Project Area



Source: *www.gooportaligm.gob.ec, IGM, www.geoportal.agricultura.gob.ec, MAGAP*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *6th April, 2017*

The soils in the parish of Jambeli are classified and originate due to a combined influence of the weather, terrain, bedrock, vegetation, living organisms, and time. However, we shall describe the soils' evolutionary process at an order level, generalizing the characteristics of the most important big groups.

According to the taxonomy of soils, it has been determined that the Jambeli parish possess a taxonomy uniformity that belongs to the Entisol order, soils rich in sediments but with very little depth, as shown in the following chart:

Chart 22: Classification of Soils of the Jambeli parish

ORDER	SUB-ORDER	CHARACTERISTICS	AREA/ HA	%
ENTISOL	Aquent	These are soils with clayish silty texture, with a superficial depth of 0.20cm, they have excessive draining with an alkaline pH > 8.5 with the saltiness of 8-16 c, which is considered highly salty and with little fertility	11144,09	43,83

ORDER	SUB-ORDER	CHARACTERISTICS	AREA/ HA	%
	Psamment	These are soils with a sandy texture, with a depth of > 100 cm considered deep with excessive drainage and a moderately alkaline pH of 7.5 and 8.5, they do not present saltiness and have a very low fertility	85,37	0,34
Natural bodies of water			856,26	3,37
Superficial bodies of water			12902,54	50,74
Others (Sandbank, beach)			439,10	1,73
TOTAL			**25427,36**	**100%**

Source: *Development Plan for the Jambeli parish (2008 -2015)*
Created by: *Ecosfera Cía. Ltda.*
Location: *Jambelí Parish, Santa Rosa – El Oro*
Date: *20th of May, 2017*

As we verify with the map, the soils of the parish that correspond to the Entisol order divide into two big groups: Sulfaquent which are clay-like soils with a superficial depth of 0 to 20 cm, excessive drainage, entirely salty and of low fertility that cover the 43.83% of the territory (11144.09 ha); and the Ustipsamment that is very deep sandy soils > 100cm, that are not salty and have low fertility and they represent a 0.34% (85.37 ha) of the total surface of the parish. The rest of the surface is distributed between natural water bodies (3.37%), artificial water bodies (50.74%), and others (sandbanks, beach) (1.73%).

❖ SOIL USES

The province of El Oro uses 420.028 ha for agricultural, farming, livestock, and forestry purposes. The annual production of bananas in El Oro represents 43.3% of national production, whereas the annual rice production represents a 0.6%. In this province, cow livestock is leading in the livestock sector, with 3.6% of the national total.

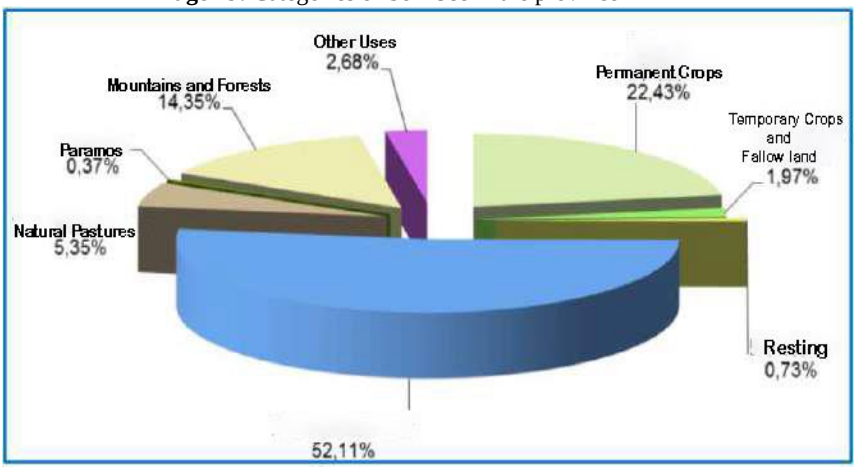
Chart 23: Categories of Soil Use in the province

USE	AREA	PERCENTAGE (%)
Permanent Crops	94215,35	22,43
Temporary Crops	8294,69	1,97
Rest	3078,06	0,73
Farmed Pastures	218863,38	52,11
Natural Pastures	22463,93	5,35
Paramos	1562,14	0,37
Mountains and Forests	60273,33	14,35
Other Uses	11277,09	2,68
TOTAL	**420028,01**	**100%**

Source: *Secretaria de Planificacion GAD El Oro, 2011*
Created by: *Ecosfera Cía. Ltda.*
Location: *Province of El Oro*
Date: *20th of May, 2017*

The distribution of the use of soil for agriculture and forestry is characterized by the significant importance of the soil surfaces destined to be used as livestock pastures (cultivated pastures 52.11% and natural pastures 5.35%) over other types of soil.
In 2013 the province destined 57% of land used for agricultural and forestry purposes to be used as natural and livestock pastures. On the other hand, the surface of agricultural farmland only represents ¼ of the total surface destined for agricultural and forestry purposes in El Oro. Finally, the surface destined for mountains and forests in the province represents 14,35%.
For the most part, the agricultural surface is composed of farmed pastures that represent 52.11% of the total surface of lands destined for agricultural and forestry purposes; permanent crops represent 22.43% of the agricultural surface. In contrast, temporary crops and fallow lands represent 1.97%, paramos a 0.37%, mountains, and forests a 14.35% and 2.68% for other uses.
The province of El Oro has a great diversity of uses spread across its territory. These uses that are derived from the different anthropogenic activities that take place in the province have a direct impact on the natural environment.
According to the data by the Encuesta de Superficie y Produccion Agropecuaria Continua (ESPAC) for the year 2013 the uses devide as shown in the following image:

Image 49: Categories of Soil Use in the province



Source: *Secretaria de Planificacion GAD El Oro*
Created by: *Secretaria de Planificacion GAD El Oro*
Location: *Province of El Oro*
Date: *2012*

According to the National Agricultural Census of the year 2000 crops are classified as temporary or permanent, that when analyzed concerning the UPAS dedicated to these activities, with relation to 57095 existing UPAS in the province, the 26.43% of permanent crops, and the 10.19% of the UPAS are dedicated to temporary crops and fallow lands. With relation to the surface destined for production, for the most part, it is destined to farm pastures, permanent crops, mountains, and forests. The surface destined for permanent crops is 18% and 1% for temporary crops.

The great majority of the provincial surface is occupied for agro livestock production activities, whereas the natural forest surface is relegated to areas of greater slope and are hard to use for agricultural purposes. The province's flat plains are those that concentrate the most part of the intense agricultural uses, whereas the areas used for farmed pastures are usually located in areas with slopes above 25%. The physical geographical and climatic diversity that characterizes the provincial territory in three big differing zones -the Coast, Highlands or transition areas and high areas-, has given place to the different soil uses within the province, a fact that can be verified by the distribution of soils uses present in the different cantons of the province.

The agricultural surface of the province of El Oro is mostly comprised of permanent crops. If we compare permanent crops with temporary crops, we can see that the first represent 91.91% compared to the temporary crops with 8.09% for the year 2013.

To determine the soil uses in the Jambeli parish; the soil's capacity and limitations were analyzed according to its texture and taxonomy, agricultural aptitude, use conflicts, and the type of inclination present in the terrain or slope. Different agricultural aptitudes are present in the Jambeli parish, as well as their extension and percentage in relations to the total area of the parish is detailed in the following chart:

Chart 24: Soil use for the Jambeli parish

USES	AREA	PERCENTAGE (%)
Mixed Farming	16,51	0,06
Water	856,38	3,37
Anthropogenic	12951,85	50,94
Protection and Conservation	11082,59	43,59
Resting Soil	87,22	0,34
Unproductive Soil	432,81	1,70
TOTAL	**25427,36**	**100%**

Source: *Development Plan of the Jambeli parish (2008 -2015)*
Created by: *Ecosfera Cía. Ltda.*
Location: *Jambelí, Santa Rosa – El Oro*
Date: *6th of April, 2017*

We have determined that the soils located in the Jambeli parish are soils not qualified for agricultural activities because they are soils of little thickness and fine to very fine texture, which use should be exclusively for the protection and conservation of the existent vegetation mainly the mangrove.

We can see that the areas with anthropogenic intervention amount to a significant extension of the total surface of the parish with 12951.85 ha that represents a 50.94%; we can likewise verify with the map that the areas of conservation and protection also amount to a significant extension with 11082.59 ha that represents a 43.59% of the total surface of the parish (Figure 5) the aptitude of soil use that present the least number of acres are: unproductive lands with a surface of 432.81 ha (1.70%) followed by resting soils with

87.22 ha (0.34%) and finally the aptitude of mixed agricultural soils with 16.51 ha (0.06%).

From 2008 to 2015 the Janbeli parish has obtained different changes in the uses of soil. In this period, it has obtained an area of 13119.37 ha with the productive change, which represents 51.60% of the parish territory; an area of 7866.39 ha changed, which represents 30.94% of the total area of the parish; whereas an area of 859.57 ha presented an abrupt change, representing 3.38% of the parish territory. Additionally, a change in the use of anthropogenic soil of 3454.15 ha represents 13.58 % of the Jambeli parish territory, and only a 128.17 ha has had no change whatsoever, which represents a 0.50% of the total area of Jambeli.

Chart 25: Change in Use of Soil 2008 – 2015 Jambelí parish

USE	AREA	PERCENTAGE (%)
Anthropogenic	3454,15	13,58
Change	7866,39	30,94
Abrupt Change	859,27	3,38
Productive Change	13119,37	51,60
No Change	128,17	0,50
TOTAL	**25427,36**	**100%**

Source: *Development Plan of the Jambeli parish (2008 -2015)*
Created by: *Ecosfera Cia. Ltda., 2017*
Location: *Jambelí, Santa Rosa – El Oro* ***Date:*** *20th of May, 2017*

Soil types at Jambelí parish

In the following chart, we can see the most common soil types in each of the parish islands and the benefits that each brings to the different types of crop production and marine species like seashells, crabs, and fishes.

Chart 26: Soil types at Jambelí parish

PLACE	TYPES OF SOIL	Characteristics	Color	Depth	Fertility	Soil produce
Costa Rica	Beach sand Sweet sand Mud or mire Salpeter	White Grey Brown and muddy 80% blackish	Grey in the ponds and white in the beach soil	20 cm 2,50 cm 70 cm 1m	All these soils are fertile	Variety of seashells, coconut Corn, watermelon, yucca, cucumber, coconut, tamarind, and plum

PLACE	SOIL TYPES	Characteristics	Color	Depth	Fertility	Produce
		Firm grey soil				Seashell, crabs, mollusks, crustaceous and red crabs
Las Casitas	Sandy Salpeter Muddy	Loose Firm soil Bland	White White Grey or black	1 m 20 cm 1 m	Fertile	
Las Huacas	Sandy Muddy	-	Brow	70 cm	Fertile	Watermelon, melon, cherry, plum,
Bellavista	Sandy	Rocky	White	1 m	Fertile	Cucumber, papaya, watermelon, guava, soursop, plums, tamarind, melon

Source: *Development Plan for the Jambeli parish (2008 -2015)*
Created by: *Ecosfera Cia. Ltda.*
Location: *Jambelí, Santa Rosa – El Oro*
Date: *6th of April, 2017*

According to the imperative and practical systematic order, soil's aptitude for the rural Jambeli parish results from classifying soils based on a previous cartographical and field analysis. This classification allowed us basic information that shows the parish's soils regarding the limitations of the soil, needs, and practical management required.

The most representative corresponds to a type of miscellaneous lands, which occupy a surface area of 15620.14 ha that represents 61.43% of the parish's territory, and characterized by having soils dedicated to intense production of shrimp; following is the type VIII that are soiled with great limitations where salty soils are predominant, and this type occupies a surface of 7859.49 ha that represents a 30.91% of the total territory of the Jambeli parish and can be destined for conservation. Finally, with an area of 1947.73 ha, representing 7.66% of the parish territory, we have the urban area, water bodies, salt marshes, and sandbanks.

6.1.5.- MECHANICAL CHARACTERIZATION AND GRANULOMETRIC OF THE SEDIMENTS

A geotechnical study was conducted in the area of the project for the Mechanical Characterization of the Estuary Santa Rosa sediments to analyze the soil's granulometric distribution and determine the approximate time for the deposit of sediments.

SAMPLES

The field study consists of 11 representative samples taken from the project area to determine the sediments' characteristics along the navigation channel towards Puerto Bolivar to determine the area's geophysics and the subsequent dredging processes.

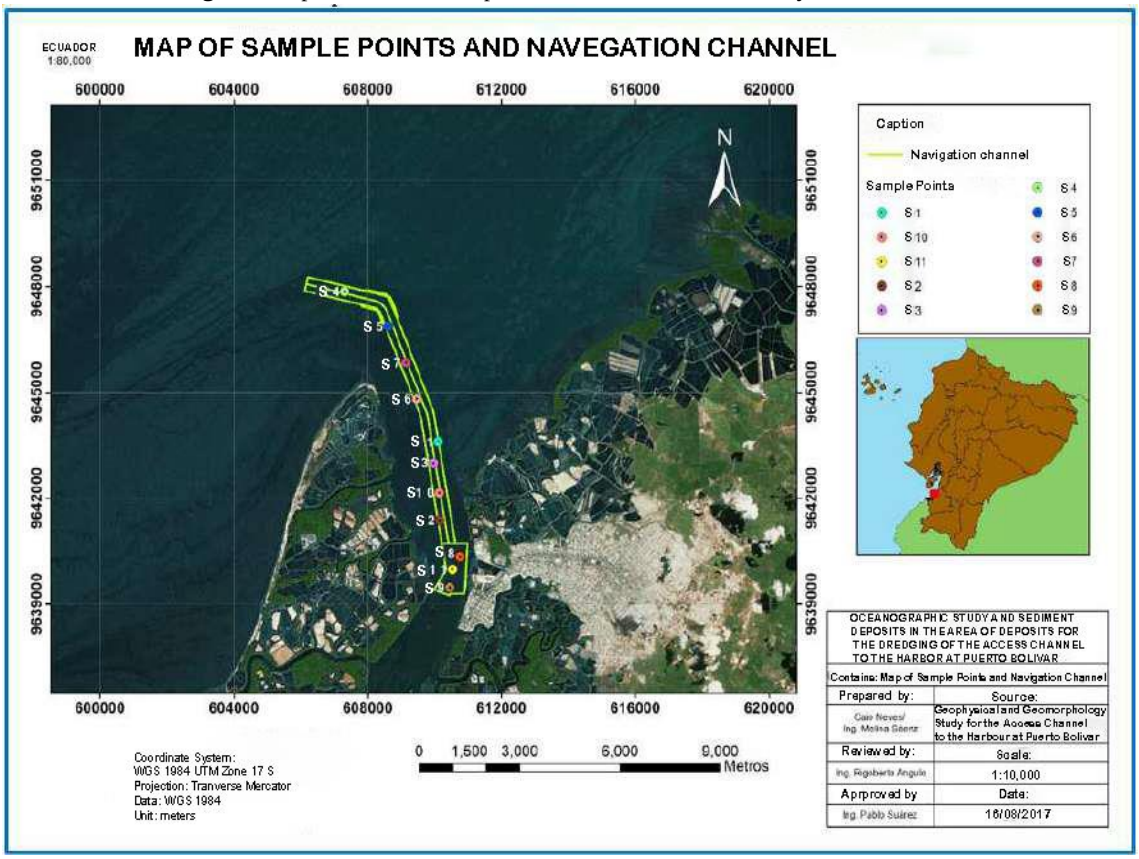
The geographical location where each of the samples was taken is detailed as follows.

Chart 27: Sediment Sample Station Coordinates

SAMPLE N°	GEOGRAPHIC COORDINATE	
	EAST	NORTH
S# 1	610123	9643595
S# 2	610164	9641363
S# 3	609972	9642991
S# 4	607318	9647842
S# 5	608624	9646854
S# 6	609470	9644801
S# 7	609153	9645831
S# 8	610769	9640332
S# 9	610462	9639457
S# 10	610145	9642146
S# 11	610543	9639976

Source: *Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
Created by: *Consulsua C. Ltda.*
Location: *Jambelí, Santa Rosa – El Oro*
Date: *16th of July, 2017*

Image 50: Map of Sediment Sample Points, **Gra**nulometric Analysis



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Jambelí, Santa Rosa – El Oro*
***Date**: 16th of July, 2017*

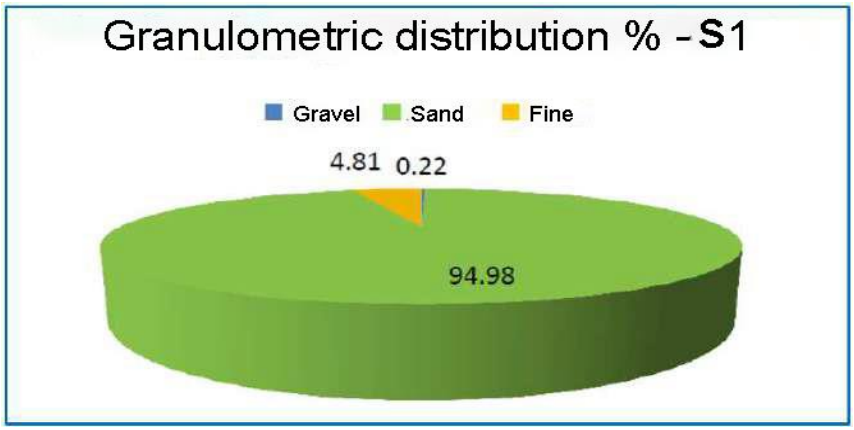
GRANULOMETRIC DISTRIBUTION FROM THE SAMPLE STATIONS

The results from the sediment samples conducted by the laboratory are detailed as follows:

- **SAMPLE# 1 - INTERPRETATION:**

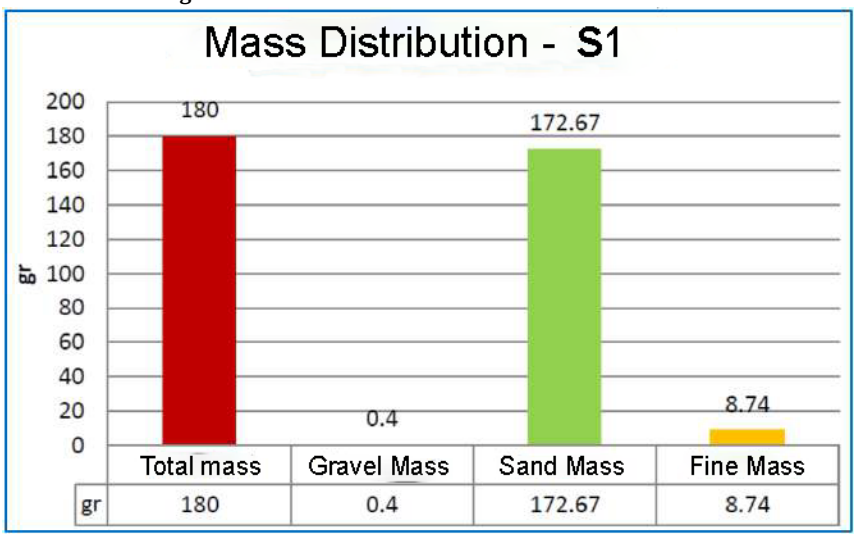
  At point 1, a sample of 180gr was collected, divided in percentages, according to the grain size classification was 94.98% of sand that represents 172.67gr, followed by 4.81% of fine grain size, which subdivides in silts and clay, representing 8.74gr and finally a 0.22% of gravel that represents a 0.4gr.

Image 51: Granulometric Distribution of station S1



Source: *Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
Created by: *Consulsua C. Ltda.*
Location: *Santa Rosa – El Oro*
Date: *August, 2017*

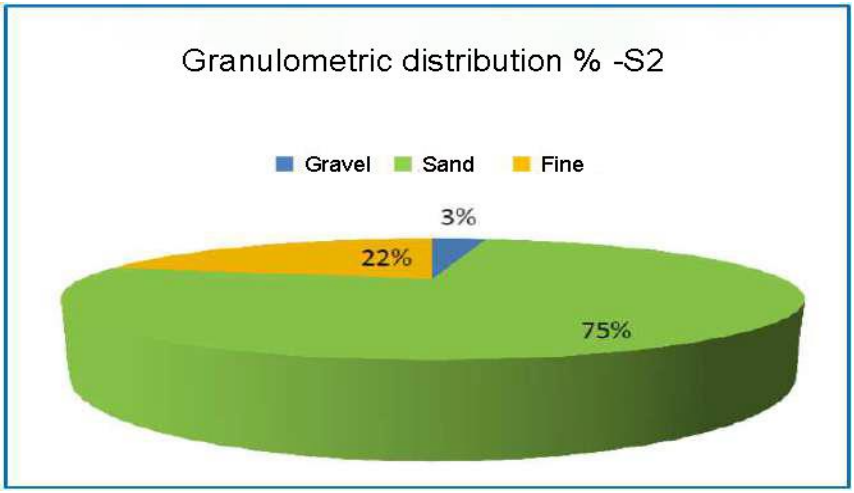
Image 52: Mass Distribution for the S1 Station



Source*: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
Created by*: Consulsua C. Ltda.*
Location*: Santa Rosa – El Oro*
Date*: August, 2017*

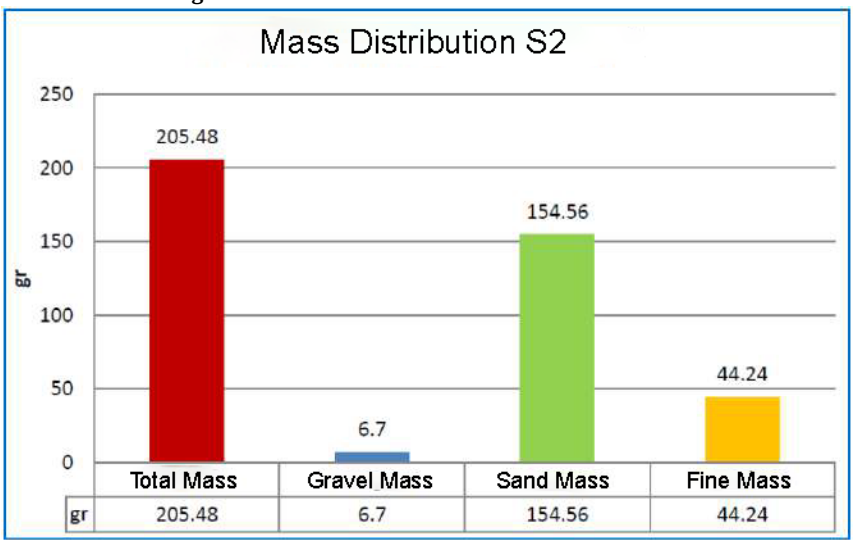
- **SAMPLE #2 - INTERPRETATION:**
  At point 2, a sample of 205.48 gr was collected, which is divided in the following manner: 75.22% sand, 21.53% silt, and clary and 3.26% gravel. Percentages translate to 154.56 gr of sand, 44.24 gr of silt and clay, and 6.7 gr of gravel.

Image 53: Granulometric Distribution for the S2 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 54: Mass Distribution for the S2 Station

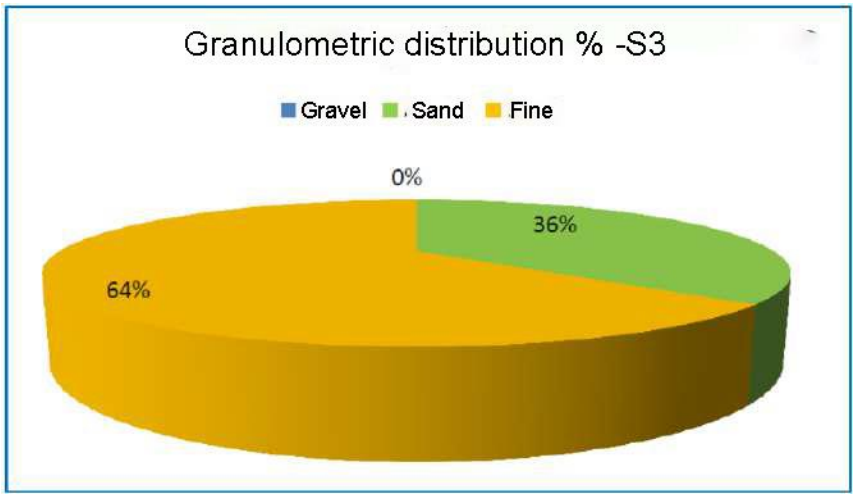


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by:** Consulsua C. Ltda.*
***Location:** Santa Rosa – El Oro*
***Date:** Agosto del 2017*

- **SAMPLE # 3 - INTERPRETATION:**

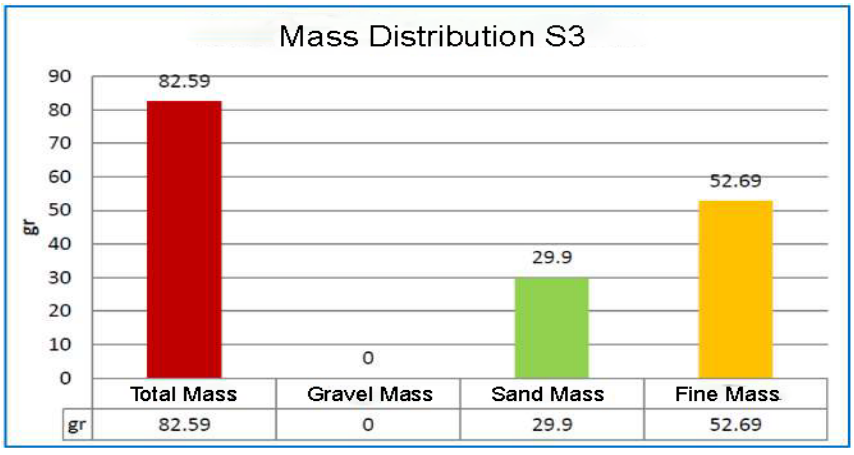
  At point 3 a sample of 82.59 gr was collected, divided into 63.8% of silt and clay and 36.2% of sand. Gravel was not found in this sample according to the grain size analysis that was conducted. Therefore the distribution of mass was 52.69 gr of silt and clay and 29.9gr of sand.

Image 55: Granulometric Distribution for the S3 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 56: Mass Distribution for the S3 Station

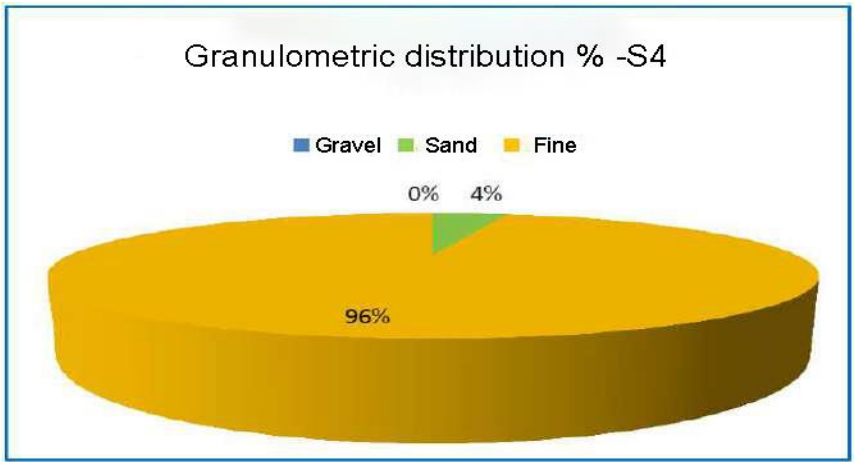


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

- **SAMPLE # 4 - INTERPRETATION:**

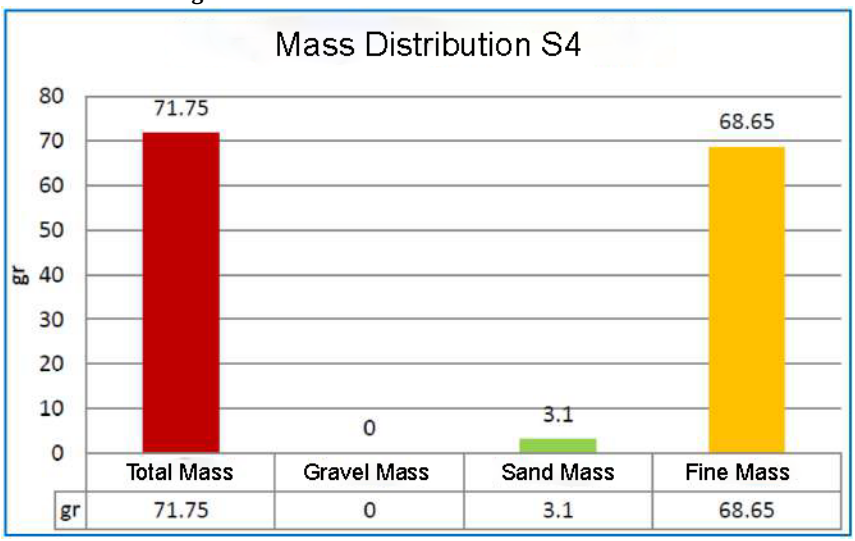
  At point 4, 71.75 gr were collected, of which 95.68% are fine particles (silt and clay) and 4.32% of the rest is sand. Gravel was not present in the analysis conducted; therefore, the mass distribution was 68.65 gr of silt and clay and 3.1 gr of sand.

Image 57: Granulometric Distribution for the S4 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 58: Mass Distribution for the S4 Station

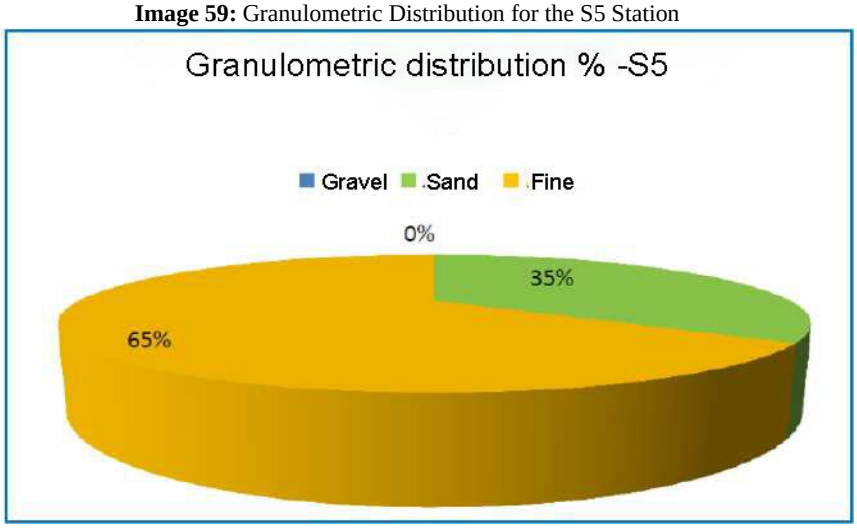


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

- **SAMPLE # 5 - INTERPRETATION:**

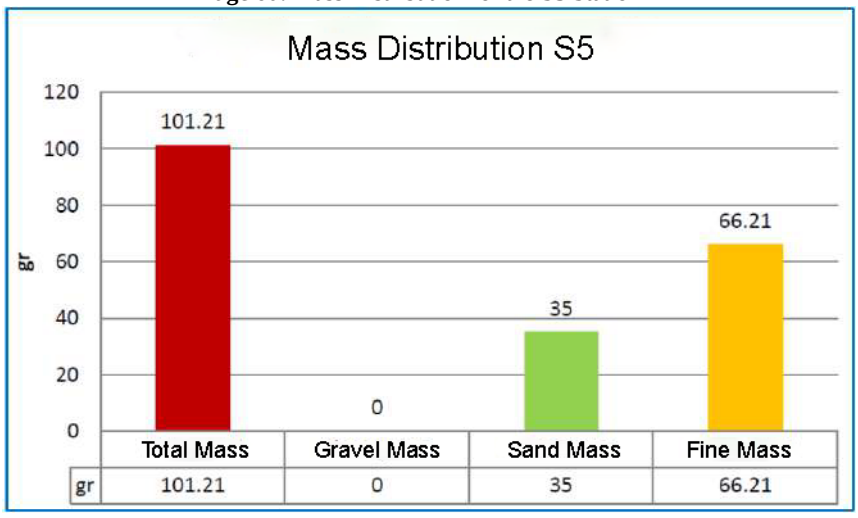
  At point 5, the total mass collected was 101.21 gr, and the percentage of distribution was 65.42% for fine particles like silt and clay and 34.58% of sand. Gravel was not present. Therefore the mass of particles represents 66.21gr and 35gr of sand accordingly.

Image 59: Granulometric Distribution for the S5 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 60: Mass Distribution for the S5 Station

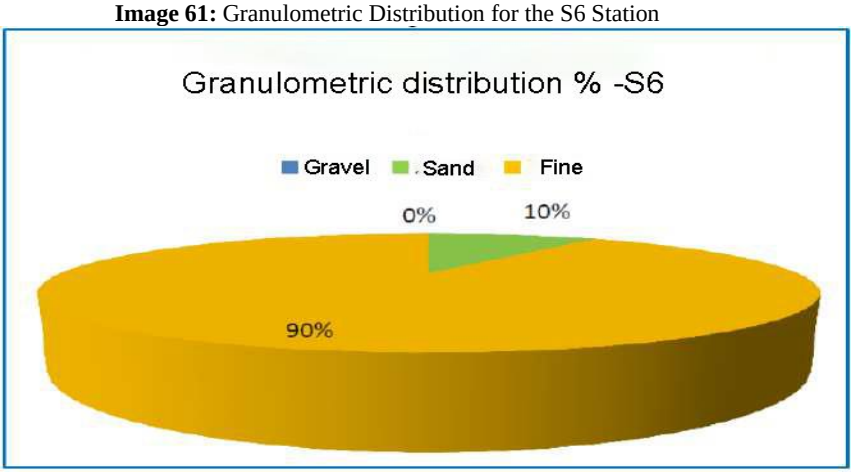


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

- **SAMPLE #6 - INTERPRETATION:**

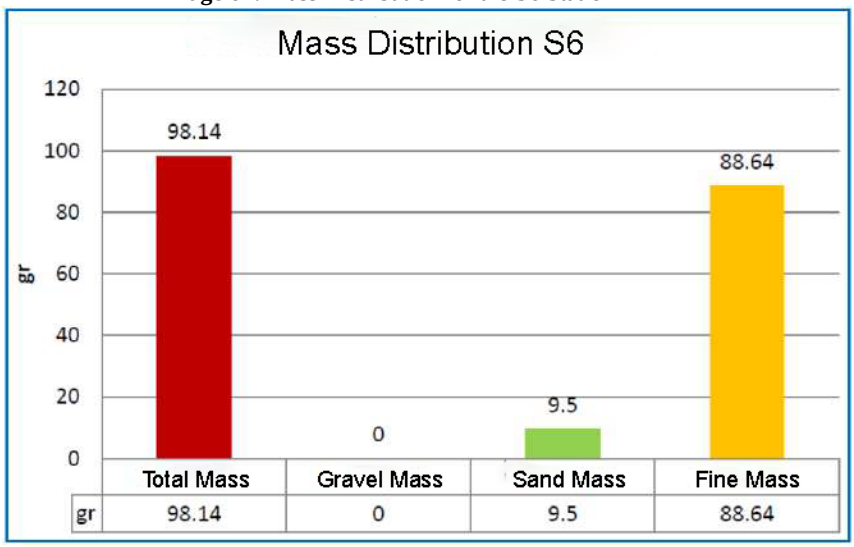
  The sample that corresponds to point 6 presented a mass of 98.14gr and according to the tests conducted, the distribution with regards to the size in percentages is as follows 88.64% of fine particles (silt and clay) and 9.5% sand. The corresponding mass was 88.64gr of silt and clay and 9.5gr of sand. The presence of gravel was not found.

Image 61: Granulometric Distribution for the S6 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 62: Mass Distribution for the S6 Station

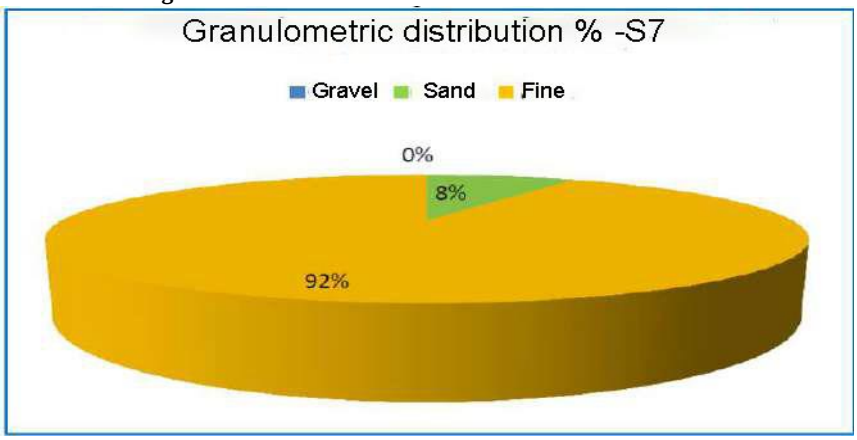


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

- **SAMPLE #7 - INTERPRETATION:**

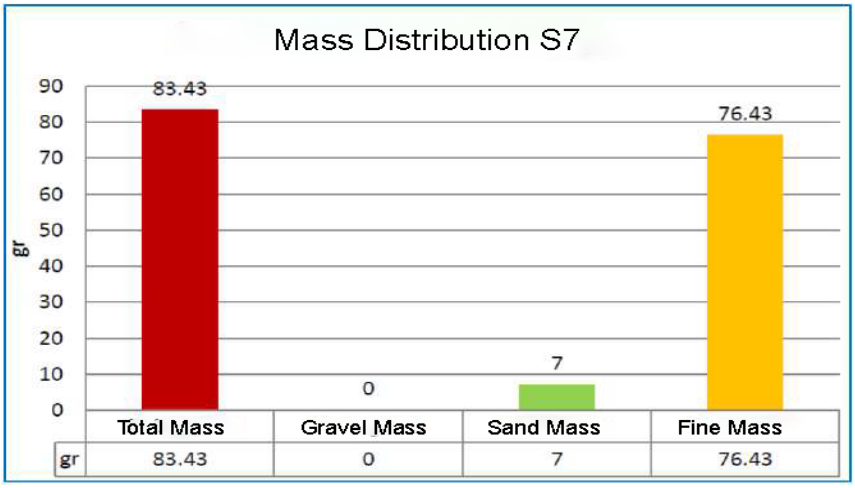
  The sample collected at point 7 had a mass of 83.43% distributed in percentages according to the particle size was 91.61% for fine particles like silt and clay, and 8.39% sand. The reported mass was 76.43 gr for fine particles and 7 gr for sand. No presence of gravel was found in the sample.

Image 63: Granulometric Distribution for the S7 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 64: Mass Distribution for the S7 Station

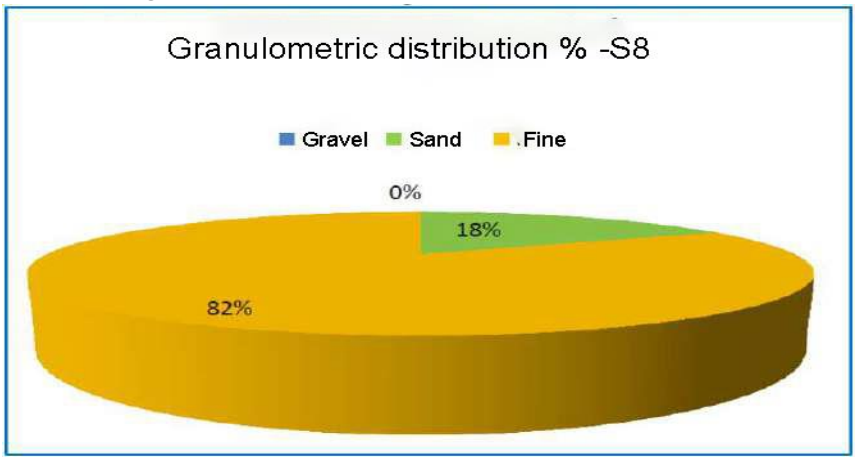


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

- **SAMPLE #8 - INTERPRETATION:**

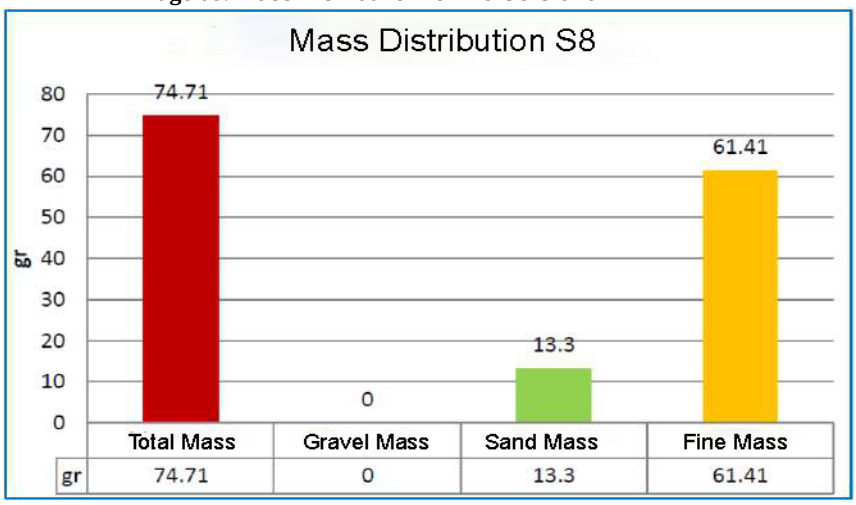
  The sample collected at point 8 had a mass of 74.71 gr with a percentage of distribution of 82.2% fine particles like silt and clay and 17.8% sand. No gravel was found to be present in the sample collected. The mass of fine particles found was 61.41gr, whereas the sand was 13.3gr

Image 65: Granulometric Distribution for the S8 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 66: Mass Distribution for the S8 Station

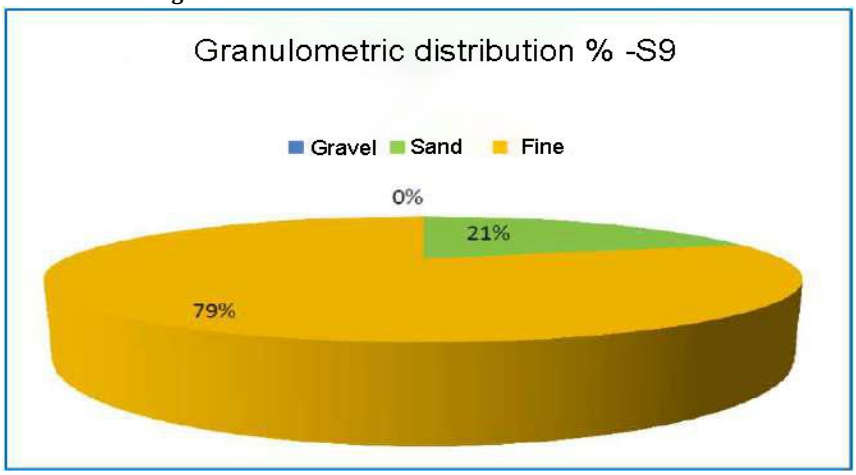


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

- **SAMPLE #9 - INTERPRETATION:**

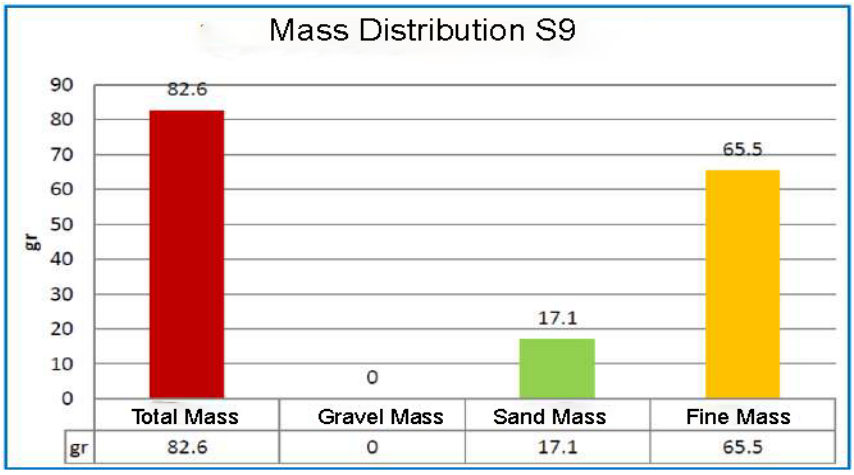
  The sample collected at point 9 weighted 82.6gr of which the percentages of 79.3%, and 20.7% with no presence of gravel. The weight that corresponds to fine particles was 65.5 gr and 17.1 gr for sand.

Image 67: Granulometric Distribution for the S9 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 68: Mass Distribution for the S9 Station

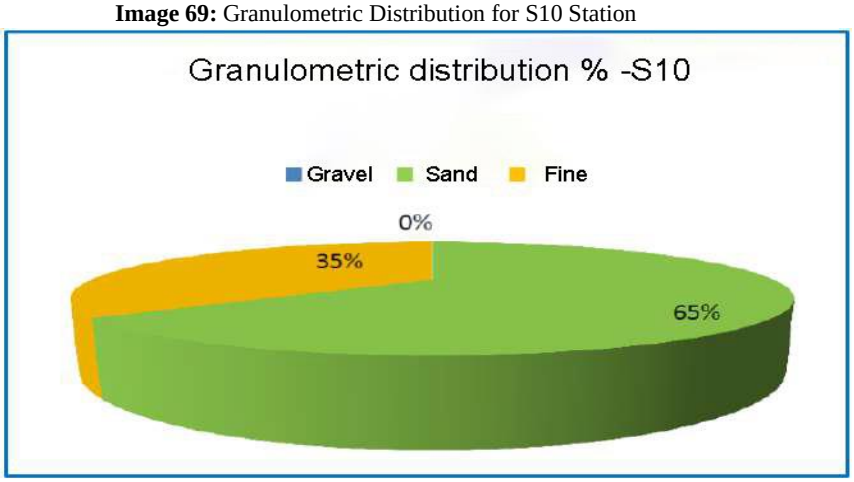


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

- **SAMPLE #10 - INTERPRETATION:**

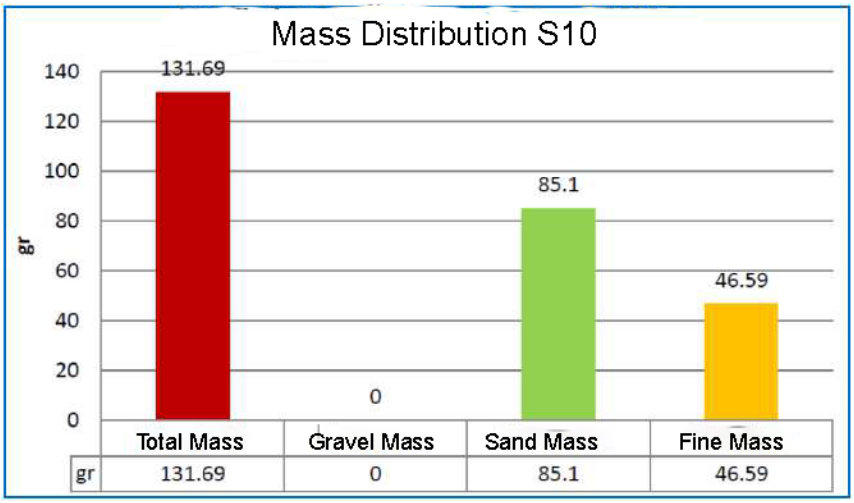
  The sample that corresponds to point 10 had a total mass of 131.69gr. The distribution according to particle type was as follows: 85.1% for sand, whereas 46.59% was for fine particles (silt and clay). No presence of gravel was found. 46.59 gr correspond to the mass of fine particles, whereas for sand, it was 85.1gr.

Image 69: Granulometric Distribution for S10 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
Location*: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 70: Mass distribution for the S10 station

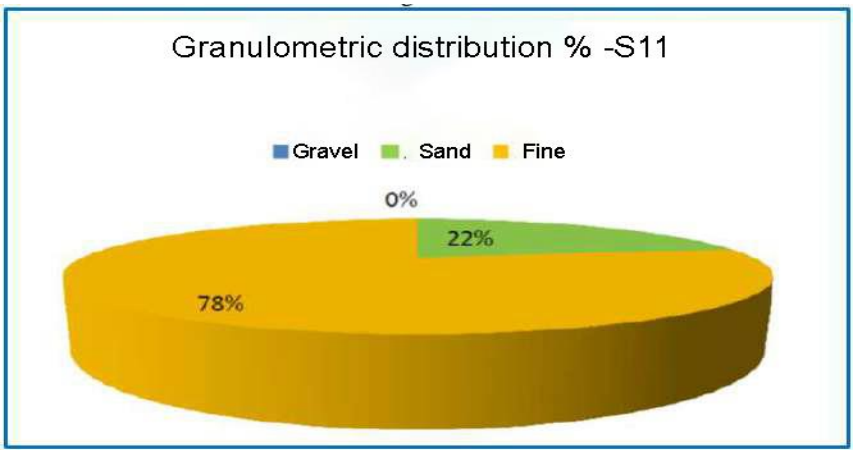


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by:** Consulsua C. Ltda.*
***Location:** Santa Rosa – El Oro*
***Date:** August, 2017*

- **SAMPLE #11 - INTERPRETATION:**

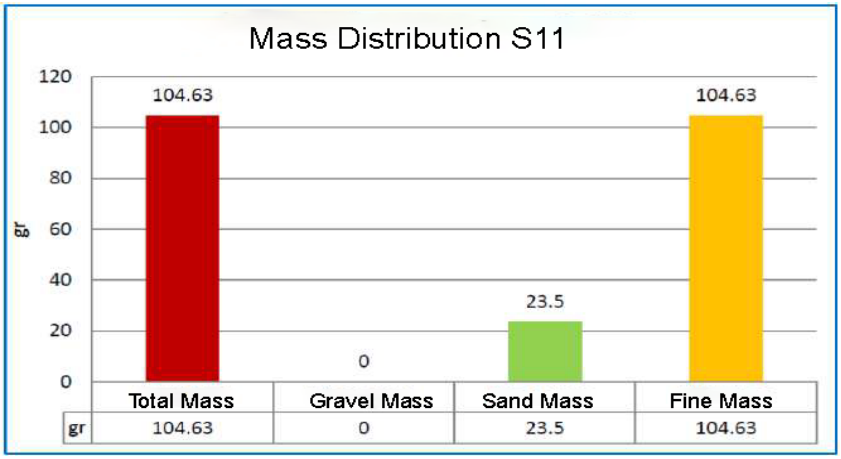
  At point 11 the mass collected was 104.63 gr. According to particle type, the distribution in percentages was 77.54% for fine particles (silt and clay) and 23.5% for sand. The presence of gravel was not found in the sample. The mass that represents fine particles was 104.63gr and 23.5gr for sand, accordingly.

Image 71: Granulometric Distribution for the S11 Station



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

Image 72: Mass Distribution for the S11 Station

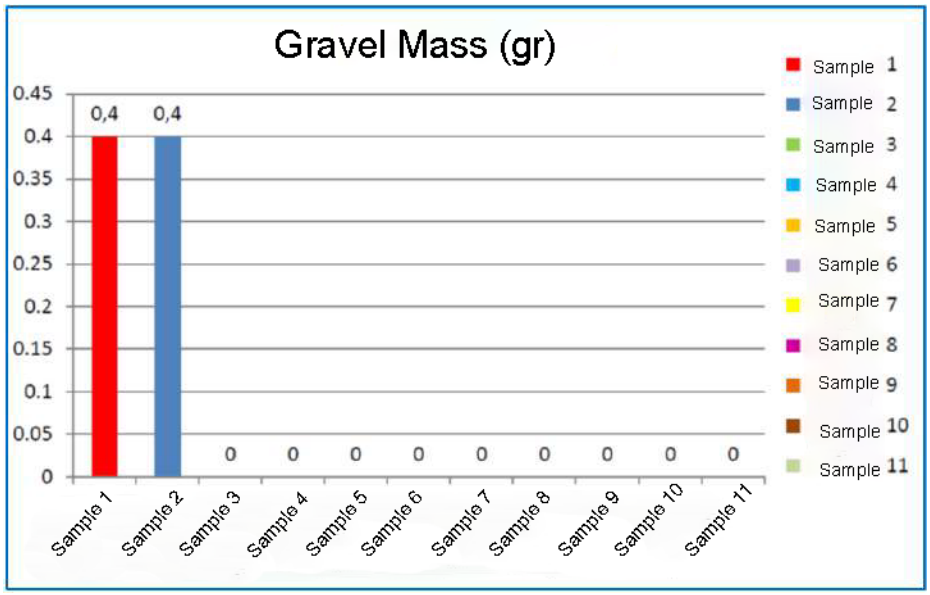


***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

GRAVIMETRIC DISTRIBUTION WITH REGARDS TO PARTICLE TYPE IN EACH SAMPLE

As shown in the image below, the gravel amounts obtained from the samples do not reflect relevant amounts in 2 of 11 samples studied, in which the stations having the presence of gravel are located in the middle part of the access channel of the harbor.

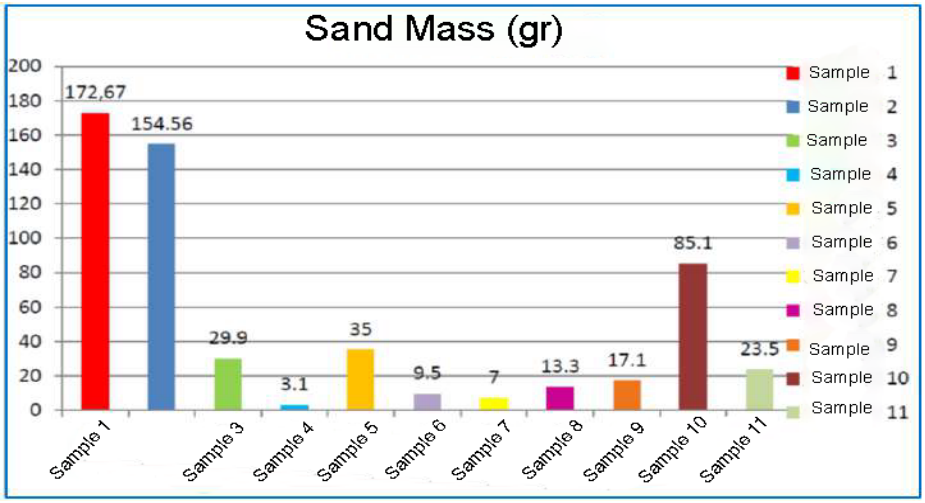
Image 73: Sample stations with Gravel



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

The amount of sand along the access channel can be seen in the following image. A sample station 10 shows a considerable amount of sand with regards to the other samples; this is a consequence of the actual geographical location at each point, where samples 1, 2, and 3 are located adjacent one from the other, which shows that the concentration of sand is due to its location.

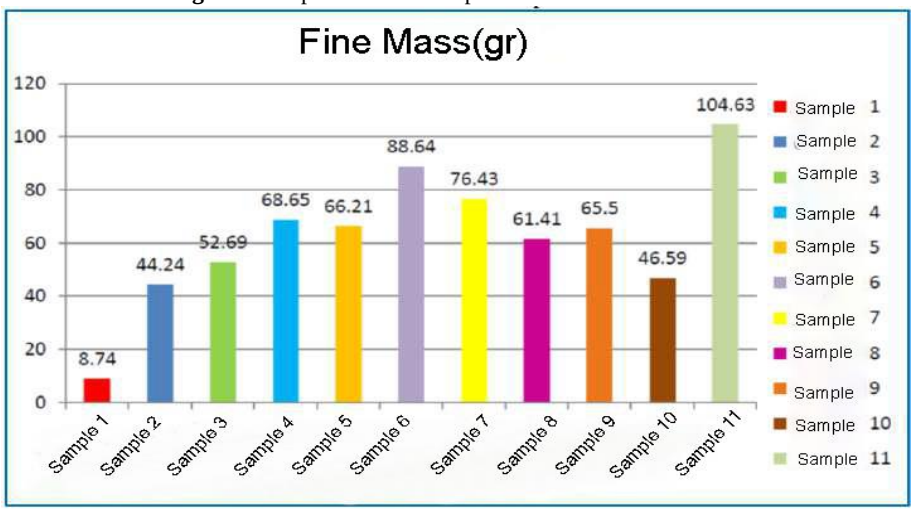
Image 74: Sample stations with Sand



***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

As for the presence of fine materials (silt and clay), as the graphic shows, there are elevated values in general, and at each of the samples collected along the channel, where the major highest values are at points 6 and 11, that geographically correspond to the channel access and the harbor area accordingly. This shows uniformity in the distribution of washed materials along the access channel at Puerto Bolivar.

Image 75: Sample stations with presence of Fine Materials



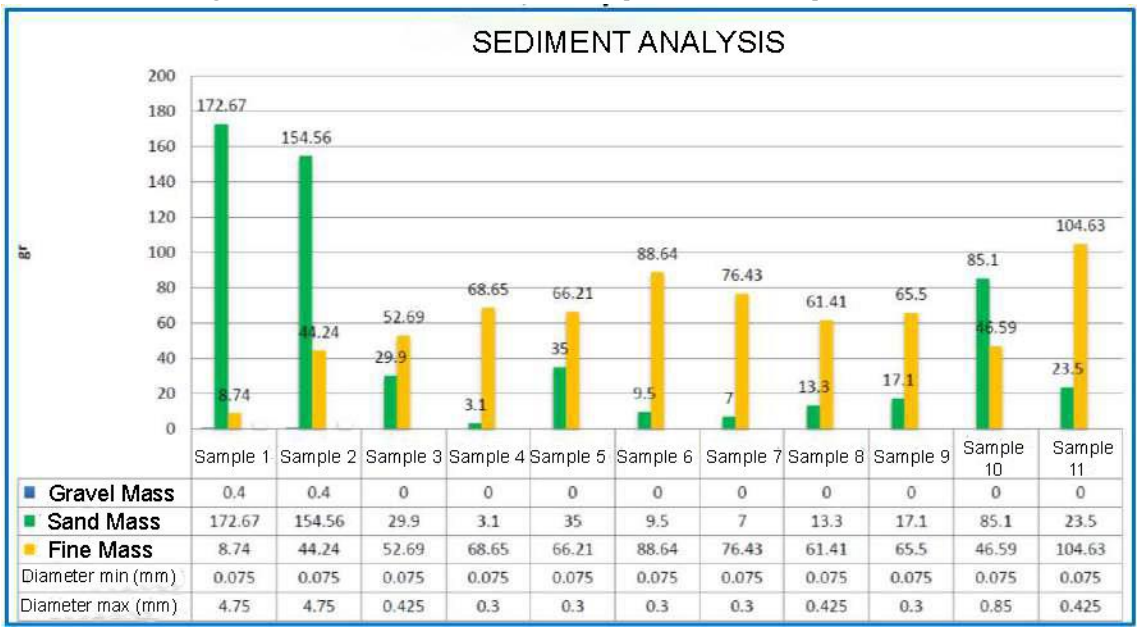
***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

According to the results obtained through the tests carried out, we can reach the conclusion that the samples collected along the access channel at Puerto Bolivar show a predominant amount of fine particles (silt and clay). The solid particles of greater size, also known as bottom drag, were not found in any significant levels, only appearing in 2 of the 11 sample stations, where elevated sand concentrations were also found.

For the objectives of this document, the following determination of distribution is shown:

- Fine (with an average diameter of 0.075 mm)
- Sand (with an average diameter of 0.3 mm)
- Gravel (with an average diameter of 4.75 mm

Image 76: Amounts of Sand, Gravel, and Fine particles at the Sample Stations



	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11
Gravel Mass	0.4	0.4	0	0	0	0	0	0	0	0	0
Sand Mass	172.67	154.56	29.9	3.1	35	9.5	7	13.3	17.1	85.1	23.5
Fine Mass	8.74	44.24	52.69	68.65	66.21	88.64	76.43	61.41	65.5	46.59	104.63
Diameter min (mm)	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Diameter max (mm)	4.75	4.75	0.425	0.3	0.3	0.3	0.3	0.425	0.3	0.85	0.425

***Source**: Oceanographic Study and Sediment Deposits in the deposit area at the access point of the Dredging.*
***Created by**: Consulsua C. Ltda.*
***Location**: Santa Rosa – El Oro*
***Date**: August, 2017*

6.1.6.- HYDROGRAPHY

Due to its geographical location, the province has a dense hydrographic network that ends or that has its river mouth in the Pacific Ocean. The hydrological system is characterized by its significant variability and reliability during the rainy season from January to May.

It is important to highlight that the province's richness and socioeconomic development are fundamentally dependent on water resources. A clear example of this tenet is the valley of the river Jubones that has an excellent banana area.

Other important rivers based on their importance to the province's richness are Buena Vista, the Santa Rosa, and Arenillas. The first two, through direct utilization such as the Caluguro-Bella Vista, Santa Rosa-La Tembladera, and others and the Arenillas that, along with the dam Tahuin, allow the agricultural development of the parish. In the future, El Oro's province can dispose of the project Puyango-Tumbes to take water through transfer to the border zone and serve as irrigation for the parishes Santa Rosa, Arenillas, Las Lajas, and Huaquillas.

The province of El Oro, in general, is made up of various hydrographical areas:

- Basins that begin at the foothills of the western mountain range like the river Jubones shared by the Azuay and Loja provinces and half belong to El Oro's province.
- The Puyango river basin, much like the previous one, begins in the mountain range shared with Peru.
- Basins of Pie de Monte that begin at an altitude of 1500 meters above sea level and end in the Pacific, like Pagua, E Guajabal, Santa Rosa and Arenillas
- Basina of the river Zarumilla, besides being the foot of the mount, is a binational basin shared with Peru.

The surface distribution is presented in the following chart, which states the relative importance of the hydrographical areas of the province:

Chart 28: Hydrographical Basins of the El Oro Province

NAME	AREA Ha	PERCENTAGE (%)
RIVER PUYANGO	150537.1	27.35
RIVER CHIRA	28.7	0.01
RIVER ZARUMILLA	83547.6	15.18
RIVER ARENILLAS	63525.0	11.54
RIVER SANTA ROSA	91806.8	16.68
RIVER PAGUA	54524.0	9.91
RIVER SIETE	2928.3	0.53
RIVER TENGUEL	19.5	0.004
ESTUARY GUAJABAL	12728.2	2.31
RIVER JUBONES	90767.2	16.49
TOTAL	**550412.4**	**100%**

Source: *Secretaria de Planificación GAD El Oro (2012)*
Created by: *Ecosfera Cia. Ltda.*
Location: *Province of El Oro*
Date: *6th of April, 2017*

Hydrographical Basins in the area of the project are detailed in the following chart:

Chart 29: Basins of the Parishes Machala and Santa Rosa

CANTON	PARISH	HYDROGRAPHICAL BASINS
Machala	Machala	River Santa Rosa, River Jubones and Estuary Guajabal
Santa Rosa	Jambelí	River Santa Rosa

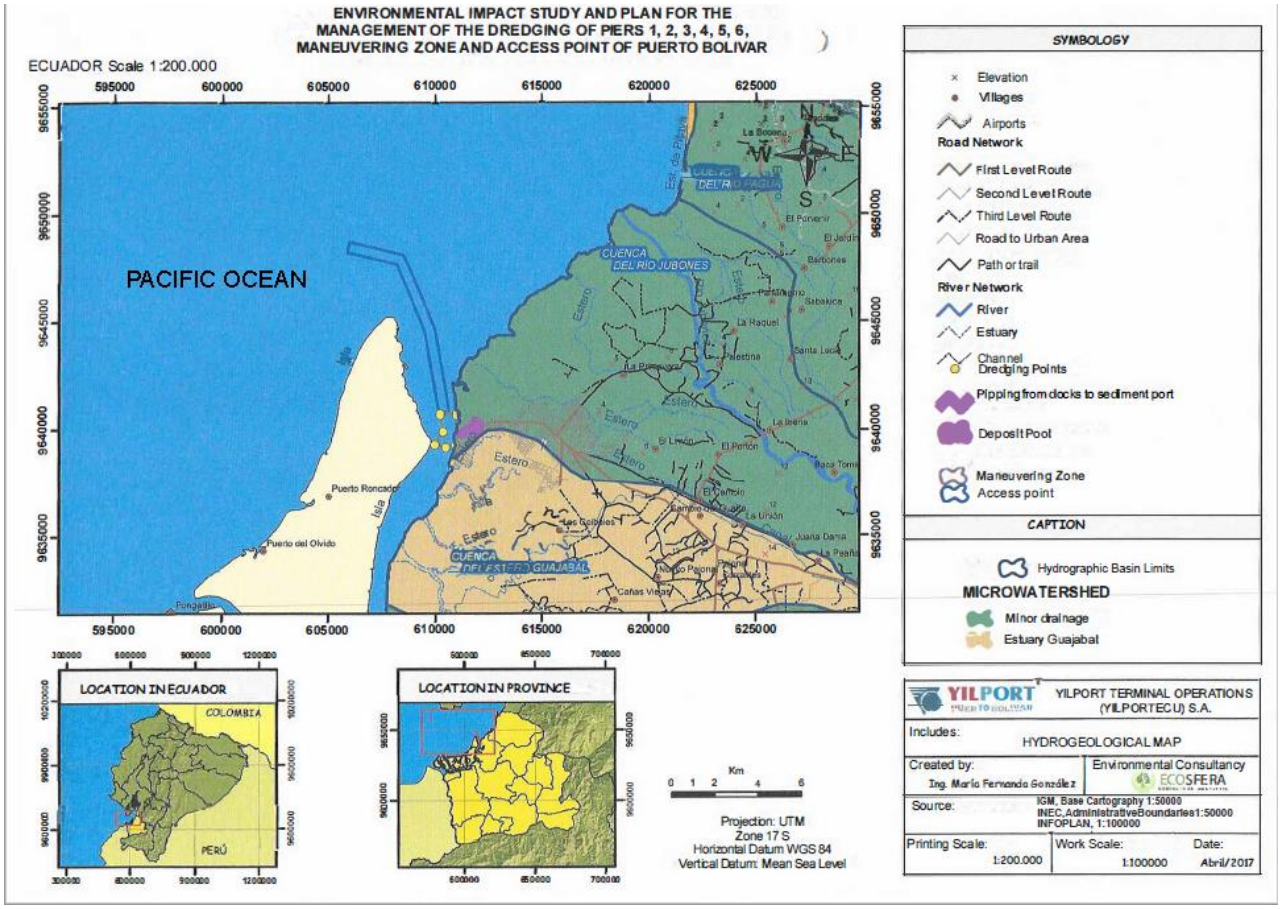
Source: *Development Plan for the Province of El Oro*
Created by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala, Santa Rosa – El Oro*
Date: *6 de Abril del 2017*

In the project area, the Estuary Santa Rosa, rivers Guayas and Jubones are the main draining basins, and their importance lies in their size and water flow. These rivers descend abruptly from the Andes and drain an area of heavy rainfall that sometimes forms destructive currents.

- **River Guayas:** The basin of the River Guayas with a surface area of 32.400 km^2 is the most important river network, not only of the Gulf of Guayaquil, but also of the whole western watershed of the Andes mountain range. The River Guayas accurately put an orientation from north to south, length of 50km ranging from 1.5 to 3km wide, except in front of Guayaquil, where it divides into two branches that surround the Isla Santay. It is formed by six minor basins that come from affluents from the eastern watershed of the Chongon Colonche mountain range and the eastern Andes mountain range.

- **River Jubones:** travels down a length of 3000 km^2 of surface, gradually from 0 to 4000 meters in altitude, with an orientation from east-west. Its hydraulic regime is affected by the two yearly seasons: dry and wet with great water flow changes.
  The lack of dense vegetation and rocky terrain does not help retain rainwater, explaining the rapid increase in rainy seasons and the heavy accumulation of suspended sediments at the river's inferior end.

Image 77: Hydrographic Map



Source: *www.geoportaligm.gob.ec, IGM, INFOPLAN.*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *7th of April, 2017*

❖ COASTAL PROFILE

Suppose the coastal profile is analyzed within the study area and its adjacent zones. In that case, the conclusion reached is that it is an irregular coast extending from Posorja towards the border with Peru, crossing various islands located at the end of the River Guayas.

These irregular coasts are related to significant fluvial networks such as the River Guayas, the River Naranjal, and the Jubones river, which translates into a continual contribution of sediments which causes a significant instability of the coastal profile. According to Ottman's classification, it can also be categorized as Type E, which are low coasts in general whose coastal profile was formed by delta and estuary processes, including tide plains and marshes. The first are vast plains that can only be seen at low tides. The marshes are coasts with no beaches where vast vegetation is formed by various species of mangroves that live practically on the saltwater's surface.

❖ IRRIGATION IN EL ORO PROVINCE

Irrigation canals are a highly valued service in agricultural areas within the province since they ensure constant flow and production all year round.

El Oro province has traditionally been characterized by its water deficit, thus making it difficult to obtain the resource during the dry season (from July to December). This shortcoming must be compensated using hydraulic infrastructure works intended for water acquisition, storage, transportation, and distribution to ensure safe irrigation for modernized agriculture.

The National Secretariat for Water Management (SENAGUA by its Spanish acronym) is the body in charge of regulating and controlling water policies in the province via the Jubones river basin district by licensing the use and exploitation of its tributaries. It is a first instance organization that processes and solves complaints and matters related to the water resource.

Employing the Irrigation and Drainage Secretariat, El Oro Government builds, operates, and maintains a network of primary and secondary irrigation canals jointly stretching 325 km and 506 km of drainage to avoid floods in productive areas, thus covering an estimated 40,000 ha.

It is worth noting that until 1996 irrigation systems in the lower area of the province, which El Oro Government ran, had been the same for the previous 50 years; the year 2000 saw the conclusion of the final assessments for the construction of acquisition, sand removal, and concrete lining works in the main canals of Pasaje-Machala and Pasaje-Guabo-Barbones irrigation systems.

El Oro province belongs to the Jubones river basin district that the National Secretariat runs for Water Management (SENAGUA by its Spanish acronym) and within which the following projects stand out:

- The Tahuín Multipurpose Project located in Río Arenillas river basin.
- Construction of a water intake work for Pasaje-Machala irrigation system
- Assessment of Zarumilla bi-national aquifer

❖ HYDROGRAPHY OF MACHALA CANTON

40.04% of the Machala canton area is located within Guajabal marsh river basin, which belongs to the canton's central region, covering sites Los Ceibales, Nuevo Pajonal, Corralitos, Cañas Viejas, kilometer 15, San Luis and Southern Machala and La Unión.

Furthermore, the sites north of the canton, namely La Primavera, El Limón, La Iberia, El Portón, as well as northern Machala, belong to the Río Jubones subbasin located within the river basin bearing the same name and cover an area of 9,535 ha (28.93% of the canton's area).

The southern area of the canton houses Santa Rosa, Buenavista and Motuche river subbasins, all of which are included within the Santa Rosa river basin covering an area of 10,230 ha, equal to 31.03% of the canton's total area, and is located in the towns of La María, La Y del Enano, San José, El Retiro, El Recreo, Motuche and Guarumal for the most part.

(Machala Land Use Planning 2012)

Table 30: Machala canton river basins

BASIN	SUBBASIN	AREA (Ha)	PERCENTAGE (%)
Río Jubones	Minor Drainages	9,535	28.93
Estuary Guajabal	Estuary Guajabal	13,196	40.04
River Santa Rosa	River Santa Rosa	10,230	31.03
	River Motuche		
	River Buena vista		

Source: *Machala Land Use Planning 2012*
Prepared by: *Ecosfera Cía. Ltda. 2017*
Location: *Machala – El Oro*
Date: *20 April 2017*

❖ HYDROGRAPHY OF SANTA ROSA CANTON

Santa Rosa canton has two water sources: Río Caluguro, a river whose tributaries are Río Chico and Río Byrón; and Río Santa Rosa, a river whose tributaries spring from hills La Chilca, El Guayabo and Sabayán located within Dumarí mountain range, which belongs to the Andes Mountains. Another water source in this canton is Río Buenavista, a geographical feature bordering cantons Machala and Pasaje, and whose tributaries are Río Caluguro, Río Negro, Río San Agustín and Río Dumarí. From the confluence of rivers Santa Rosa and Buenavista springs Río Pital, a river that used to be a place of arrival for vessels engaged in coastal shipping between Guayaquil-Puerto Bolívar and Santa Rosa near the metal bridge that also served as a crossable railroad.

Río Pital, located near the main town, serves as a border with Machala canton and flows into Jelí marsh, which runs into Jambelí Archipelago. Towards the west and bordering canton Arenillas lies Río Arenillas, a river whose waters are exploited by residents for crop irrigation and the main tributary of La Tembladera wetland.

The table below shows the main river basins of Santa Rosa canton and the basins and micro basins contained therein their extent and proportion relative to the canton's total area.

Table 31: Canton Santa Rosa river basins

BASIN	SUBBASINS	MICROBASINS	AREA (ha)	BASIN %
River Arenillas	River Arenillas	Estuary Palma	1,183.58	14.27
		River de Raspas	701.36	
		Minor Drainages	9,886.54	
River Santa Rosa	Estuary Medina	Estuary Culebrero	1,532.60	85.73
	River Bella María	Quebrada La Romero	1,874.86	
	River Buenavista	River Caluguro	9,181.00	
	River Culebrero	River Chico	2,062.34	
	River Negro	River Negro	7,121.49	
	River Panupali	River San Agustín	1,790.96	
	River San Agustín	River Santa Rosa	6,953.14	

BASIN	SUBBASINS	MICROBASINS	AREA (ha)	BASIN %
	River Santa Rosa	Minor Drainages	14,789.31	
No river basins	No subbasins	No microbasins	30.82	30.82
TOTAL			**82,504.55**	**100%**

Source: *Plan de Desarrollo cantón Santa Rosa*
Prepared by: *Ecosfera Cía. Ltda. 2017*
Location*: Santa Rosa – El Oro*
Date: *20 May 2017*

Hydrology of Jambelí parish

Ecuadorian marine waters are found within an area where two water systems converge and mix. Subtropical water bodies are influenced by the relatively cold and more saline Humboldt or Peru Current, after which they flow into the South Equatorial Current and the tropical water bodies; being the latter affected by the flow of warm, low-salinity water from the Gulf of Panama referred to as the Equatorial Counter Current.

The Jambelí Archipelago is influenced by several water systems, such the Pital rivers, which take in the waters from rivers Santa Rosa and Buenavista; Zarumilla; Arenillas, Motuche and Jubones. The area is washed by the Pacific waters adjacent to Santuario Nacional Manglares de Tumbes, a protected natural area in Peru. In turn, these waters become part of the parish's marshes and canals and receive distinctive names.

Table 32: Marshes and canals in the Jambelí parish

PLACE	NAME	STRETCH	START POINT	END POINT
Costa Rica	Estuary Diluvio	3 km	Isla Costa Rica	Estuary Chalen
	Estuary Chalen	4 km	Diluvio	Estuary Chupador
	Estuary San Gregorio	3 km	In front of Isla Costa Rica	Open sea
	Estuary Chupador	7 km	Open sea	Puerto Pitahaya
	Estuary Jesús María	2 km	Cementerio de Costa Rica	----
	Estuary Quinientas Lisas	3 km	---	Rear of Bellavista
	Estuary el Cruce	4 km	Estuary Chupador	Quinientas Lisas forming a single marsh
Las Casitas	Estuary Dos Bocas	2 km	---	---
	Estuary Venado			
	Estuary Carey			
	Estuary Perdición			
	Estuary Ballango			
	Estuary Llora Tigre			
Las Huacas	Estuary Las Hucas	6 km	---	---
	Estuary La Tortuga			

PLACE	NAME	STRETCH	START POINT	END POINT
	Estuary Gallinzao			
	Estuary Llora Tigre			
Bellavista	Estuary El Perro	1500 m	Heart of Quinientas Lisas	Sea inlet
	Estuary el Brujo	2 km	Ancient ponds of the island	

Source: *Plan de Desarrollo parroquia Jambelí (2008 -2015)*
Prepared by: *Ecosfera Cía. Ltda. 2017*
Location*: Jambelí, Santa Rosa – El Oro*
Date: *6 April 2017*

The Jambelí parish territory within Santa Rosa canton is located in the insular area facing rivers Jubones, Guajabal, Santa Rosa, Arenillas and Zarumilla. The parish has primary and secondary natural canals in mangroves and shrimp farming pools and canals. Besides the ocean, its hydrography includes marshes Grande, Santa Rosa, Jambelí, Chupadores, Las Huacas, Cruce de Pongall and canals Capones and Bellavista. A series of shallow and deep wells supply fresh water. The entire parish territory experiences flooding and rough water conditions.

Table 33: Water systems in the Jambelí parish

BASINS	SUBBASINS	MAIN WATER STREAMS
Ocean basin	Marshes and canals	Estuary Grande, Chupadores, Las Huacas, Cruce de Pongal, Canales de Capones, Bellavista, Cruce El Bravo

Source: *Plan de Desarrollo parroquia Jambelí (2008 2015)*
Prepared by: *Ecosfera Cía. Ltda. 2017*
Location*: Jambelí, Santa Rosa – El Oro*
Date: *6 April 2017*

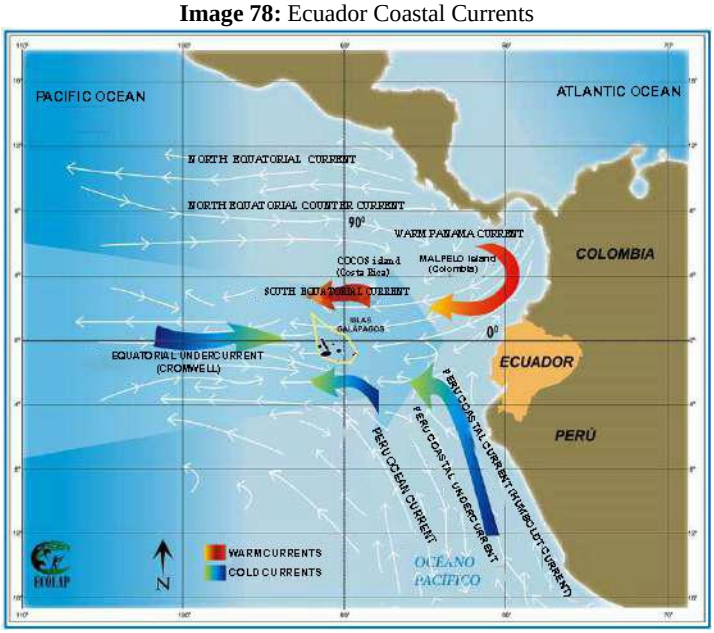
6.1.7- OCEANOGRAPHY

Data collection of the oceanographic component conducted at INOCAR revealed instances of incidental waves, which eventually leads to an increase in depth equal to 1.3 times the height of the wave as the swell approaches the coastline, thereby producing a phenomenon referred to as "shoal".

The coastline around Puerto Bolívar maritime terminal is low, has no visible elevations, and its borders are covered in mangroves (surrounded by shrimp farms) no higher than 10 m.

Puerto Bolívar has regular maritime traffic and is positioned in a highly advantageous location. It has a perfectly calm natural bay sheltered from the effects of the sea.
Its access canal (Estuary Santa Rosa) is deep enough for vessels with drafts of 9 m (30 feet), and wide enough for vessels to maneuver in its inner waters. The port is located 5 miles away from the open sea.
Depths are within regular values, the 10 m edge of shallow waters is being interrupted at eastern Punta Jambelí, in spite of which it reaches the pierhead effortlessly, thus allowing proper vessel maneuverability; additionally, a narrowing is observed between Estuary Salinas and Estuary del Muerto, reaching a width of 182 m.
Santa Rosa canal offers sufficient and regular depths, hence the slight longitudinal gradient. The transverse gradient is 3% at the eastern shore and 0.7% at the western shore, and the bottom has a silty and sandy consistency.

Image 78: Ecuador Coastal Currents



Source: *www.igm.gob.ec*
Prepared by: *Instituto Geográfico Militar*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *10 April 2017*

❖ TIDES

Tides are internal processes of the ocean whose range variations can be considered important for the geomorphology of beaches as well as for oceanic circulation since those are the governing factor of the circulation pattern in areas near the coast and in many situations.

Throughout the coast of Ecuador, tides are categorized as semidiurnal, which indicates that, in approximately 24.5 hours, two high tides and two low tides with minimal diurnal variations occur. A complete tidal cycle lasts

approximately 12 hours and the time frame between consecutive high and low tides is 6 hours.

According to the tide tables published by the Oceanographic Institute of the Ecuadorian Navy (INOCAR by its Spanish acronym), the tidal amplitude can vary between 2.9 and 1.9 meters in syzygy and quadrature, respectively. Syzygy tides occur every 15 days and last around 3 days, when the highest amplitudes occur, whereas quadrature tides have lower amplitudes and occur every 15 days alternating with Syzygy ones.
The rise of mean sea level (MSL) in our coastline is produced due to a crest in the Kevin wave or the Equatorial Counter Current intensification during an El Niño event.

Mean sea level throughout the coast of Ecuador typically varies between -10 and +10 cm from its average value; however, during the last event that took place in 1997-1998, which has been regarded as the worst of the century, the mean sea level rose in November 1997 until it reached a peak of approximately 44 cm.

In 2004, a run of data associated with daily mean sea level values was gathered directly by averaging the hourly values recovered from the Puerto Bolívar tide gauge.
On the one hand, it visually displays data outside the range in accordance with the upper and lower limits of 285 and 224 cm, respectively. Said limits were calculated with the mean and standard deviations of the run (x ±1.96s), considering a normal distribution and a confidence interval of 95%.
High values are associated with El Niño event, and the relation between MSL and said events is confirmed.

At the time of analyzing the data run it is observed that periods of maximum occurrence of mean sea level take place in the years 1974, 1983 and 1998, of which the last two pertain to years associated with El Niño events. Likewise, the lower values pertain to the year 1984-1985, which was documented as a La Niña period.

SEA LEVEL TENDENCY IN PUERTO BOLÍVAR CITY

According to a series of daily averages (40 years of records) from the tide gauge station at Puerto Bolívar run by INOCAR.

A positive slope can be observed at the station, which would indicate a rise in sea level. When comparing complete series tendencies with those in which extreme El Niño events were excluded, it was observed that these extreme events impact sea level variation resulting in a slight increase. The table below shows sea level variation for both scenarios:

Table 34: Sea level tendencies in the coast of Ecuador

STATION	SERIES WITH EXTREME EVENTS (MM/YY)	SERIES WITH NO EXTREME EVENTS (MM/YY)
Puerto Bolívar	+1.786	+1.781
Note: the sign indicates a rise (+) or fall (-) in sea level		

Source: *INOCAR, 2012*
Prepared by: *Ecosfera Cía. Ltda. 2017*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *6 April 2017*

6.1.8.- STUDY OF CURRENTS

STUDY OF CURRENTS IN ESTERO SANTA ROSA

The study of ocean currents in coastal areas is vital for understanding the coastal processes that directly impact the coastline.
Currents in Estuary Santa Rosa are essentially the water inlet and outlet product during each tidal cycle (ebb-flood). Both magnitude and direction depend upon the tidal amplitude and seasonal variations produced by floods during rainy seasons.

In order to establish the general circulation pattern required to carry out dredging works at Puerto Bolívar in Estuary Santa Rosa, the Oceanographic Institute of the Ecuadorian Navy (INOCAR by its Spanish acronym) conducted current measurements during the undertaking of the Environmental Impact Assessment for the dredging of the access canal and Estuary Jambelí in 2002.

Measurements were conducted by establishing 5 stations, located in the coordinates below:

Table 35: Location of current profile stations

STATION	LATITUDE	LONGITUDE
1	3º 15' 31" S	80º 00' 19" W
2	3º 14' 43" S	80º 00' 12" W
3	3º 17' 07" S	80º 01' 23" W
4	3º 12' 10" S	80º 00' 44" W
5	3º 15' 35" S	80º 00' 16" W
6	3º 17' 13" S	80º 01' 18" W

Source: *Estudio de Impacto Ambiental para el Dragado del Canal de Acceso a Puerto Bolívar y Estuary Jambelí, Capítulo V: Current measurements in Estuary Santa Rosa*
Prepared by: *INOCAR*
Location: *Jambelí, Santa Rosa – El Oro*
Date: *July 2002*

Measurements were made using Lagrangian and Eulerian methods during the syzygy and quadrature phases in six monitoring stations.

STUDY OF CURRENTS RESULTS

The results of the study conducted by INOCAR in July 2002 were as follows:

SURFACE AND SUBSURFACE CIRCULATION

Vanes in place showed two highly marked tendencies: the first one pointed to a displacement towards the southeast with directions varying between 162º y 206º, and the second one pointed to a displacement towards the northeast with directions varying between 41º and 354º depending directly on tidal conditions.

CURRENT PROFILES

The data analysis carried out in the study conducted by INOCAR revealed that surface speeds prevail over their deeper counterparts with tidal phases, which evidences a very close relation with tidal conditions, whilst its link to the winds measured in each station is quite weak and sometimes nonexistent. Wind direction was from the NW, reaching values of up to 5.5 m/s in station 1; however, they do not exert much influence in the measured currents.

The syzygy phase shows a predominance of winds flowing from the NW followed by periods of appreciable calm, and the highest wind speed was 5.1 m/s in station 5, without any major influence on current magnitude and direction.

The highest surface speed recorded was 0.44 m/s during the syzygy tide. Overall speed direction matches the Lagrangian method reports both for surface and subsurface levels, which means that current tends to flow towards the inside of the canal with directions varying between 141º and 224º during the ebb period, and towards the outside with directions varying between 284º and 72º during the flood period.

QUADRATURE PHASE

- **Ebb (high tide)**

  Average magnitudes for currents obtained during the ebb period in the sampling stations are within the following ranges: 0.11 m/s - 0.21 m/s on surface level, 0.12 m/s - 0.23 m/s on middle level and 0.01 m/s - 0.13 m/s on bottom level. The highest speed value reaches 0.41 m/s (middle level) in station 1. Current direction is clearly defined towards the southeast and southwest.

- **Flood (low tide)**

  Average speed ranges for this tidal condition are as follows: 0.20 m/s - 0.28 m/s on surface level, 0.14 m/s - 0.22 m/s on middle level and 0.05 m/s - 0.13 m/s on bottom level. The highest value pertains to the surface level and is 0.44 m/s in station 2. Current direction during the flood period is towards the northeast and northwest.

Table 36: Average and highest speed values in Estuary Santa Rosa during the quadrature phase

TIDAL CONDITION: EBB					
STATION	**AVERAGE SPEED (cm/s)**	**DIRECTION Degrees**	**HIGHEST SPEED (cm/s)**	**DIRECTION Degrees**	**LEVEL**
1	0.21	200	0.38	204	Surface*
2	0.15	167	0.33	173	Surface
3	0.11	197	0.27	191	Surface
*Values in this level correspond to a layer of 0-5 m					
1	0.23	203	0.41	193	Middle**
2	0.17	169	0.28	180	Middle
3	0.12	220	0.28	226	Middle
**Values in this level correspond to a layer of 5.1-8 m					
1	0.14	206	0.38	208	Bottom***
2	0.16	168	0.37	173	Bottom
3	002	224	0.11	181	Bottom
***Values in this level correspond to a layer of > 9 m					
TIDAL CONDITION: FLOOD					
STATION	**AVERAGE SPEED (cm/s)**	**DIRECTION Degrees**	**HIGHEST SPEED (cm/s)**	**DIRECTION Degrees**	**LEVEL**
1	0.20	23	0.36	15	Surface
2	0.23	351	0.44	359	Surface
3	0.28	25	0.31	23	Surface
1	0.19	20	0.35	23	Middle
2	0.14	348	0.35	335	Middle
3	0.22	30	0.40	24	Middle
1	0.13	21	0.32	26	Bottom
2	0.05	323	0.30	331	Bottom
3	0.01	314	0.09	306	Bottom

Source: *Estudio de Impacto Ambiental para el Dragado del Canal de Acceso a Puerto Bolívar y Estuary Jambelí, Capítulo V: Current measurements in Estuary Santa Rosa*
Prepared by: *INOCAR*
Location: *Jambelí, Santa Rosa – El Oro*
Date: *July 2002*

SYZYGY PHASE

- **Ebb (high tide)**

  During this tide phase, average current magnitudes obtained in the ebb period are within the following ranges: 0.13 m/s - 0.36 m/s on surface level, 0.05 m/s - 0.35 m/s on middle level and 0.03 m/s - 0.28 m/s on bottom level.

  The highest speed value reaches 0.74 m/s (surface level) in station 4. Current direction is clearly defined towards the southeast and southwest.

- **Flood (low tide)**

  Average speed ranges during the flood period are as follows: 0.24 m/s - 0.44 m/s on surface level, 0.06 m/s - 0.52 m/s on middle level and 0.07 m/s - 0.29 m/s

on bottom level. The highest value is 0.97 m/s at the middle level in station 5. Current direction during the flood period is towards the northeast and northwest.

Table 37: Average and highest speed values in Estuary Santa Rosa during the syzygy phase

TIDAL CONDITION: EBB					
STATION	**AVERAGE SPEED (cm/s)**	**DIRECTION Degrees**	**HIGHEST SPEED (cm/s)**	**DIRECTION Degrees**	**LEVEL**
4	0.36	141	0.74	138	Surface
5	0.36	199	0.66	204	Surface
6	0.13	217	0.59	140	Surface
4	0.24	155	0.65	142	Middle
5	0.34	196	0.66	195	Middle
6	0.05	210	0.48	158	Middle
4	0.05	149	0.19	164	Bottom
5	0.25	190	0.65	195	Bottom
6	0.03	151	0.41	208	Bottom
TIDAL CONDITION: FLOOD					
STATION	**AVERAGE SPEED (cm/s)**	**DIRECTION Degrees**	**HIGHEST SPEED (cm/s)**	**DIRECTION Degrees**	**LEVEL**
4	0.27	311	0.47	321	Surface
5	0.44	25	0.92	21	Surface
6	0.24	36	0.62	33	Surface
4	0.14	288	0.41	295	Middle
5	0.52	26	0.97	22	Middle
6	0.06	28	0.37	335	Middle
4	0.03	37	0.16	29	Bottom
5	0.29	18	0.83	28	Bottom
6	0.07	10	0.77	358	Bottom

Source: *Estudio de Impacto Ambiental para el Dragado del Canal de Acceso a Puerto Bolívar y Estuary Jambelí, Capítulo V: Current measurements in Estuary Santa Rosa*
Prepared by: *INOCAR*
Location: *Jambelí, Santa Rosa – El Oro*
Date: *July 2002*

Through the analysis of the resulting tables and the obtained graphs, it is possible to conclude that the circulation pattern is closely associated with tidal conditions and phases, thus showing a clear tendency to flow into the inside and outside of Santa Rosa canal (in parallel with the canal's axis) during flooding and receding water periods, respectively.

This pattern is relatively independent of wind direction, even though they favor seawater intrusion during the ebb period.

During the ebb period of the quadrature-phase, it is possible to observe minor current variations as depths go shallower, followed by a significant reduction at the bottom until reaching up to 30% of surface currents.

Distribution changes occur in the flood period, and, as a result, surface currents prevail over middle-level ones. The speed variation percentage with which they surpass them is approximately 30%.

Syzygy in its ebb period shows a reduction in currents as depths go shallower, hence the highest speed ranges at surface level, surpassing subsurface level ones by 50%.
Current distribution during flood tidal conditions shows the same distribution as during ebb, reaching the highest average speed of 0.44 m/s (40% above the lowest depth levels).

As a broad observation, currents in the studied area vary from one phase to the other in a small proportion, and higher speeds occur at the half-tide level.
According to the surface and subsurface current directions obtained via the Lagrangian and Eulerian methods, there is a recurring tidal change indicating that a tendency towards the southeast and southwest is indicated during the ebb period observed, whilst that of the flood period is towards the northeast and northwest. This variation in directions takes place due to the canal's geography, which directly impacts the current.

As is expected during the tidal exchange, saltwater flow is observed mainly through the subsurface layers at a faster rate (ebb), the opposite of what occurs during the flood period.
For the most part, it is possible to conclude that currents tend to search for paths with the lowest depth levels, and follow the direction of the Santa Rosa canal axis. *(Source: Estudio de Impacto Ambiental para el Dragado del Canal de Acceso a Puerto Bolívar y Estuary Jambelí, Capítulo V: Mediciones de Corrientes en Estuary Santa Rosa).*

STUDY OF CURRENTS AT THE SEDIMENT DISPOSAL SITE FOR DREDGED MATERIAL (OFFSHORE LOCATION)

The company YILPORTECU S.A. hired the services of the company CONSULSUA to undertake a study of currents at the sediment disposal site for dredged material located 13.75 miles from the sea buoy.

The study aimed to obtain an estimation of the less dense sediment drift when the dredge unloads the dredged material at the site reserved for sediment disposal. Measurements were conducted using the international methods known as Euler and Lagrange.

Works were carried out on August 8 and 9, 2017 (first syzygy of the month), employing a Lagrangian device (vane), an ADCP current meter, and vessels typically used in the industry.

- **LAGRANGIAN METHOD**

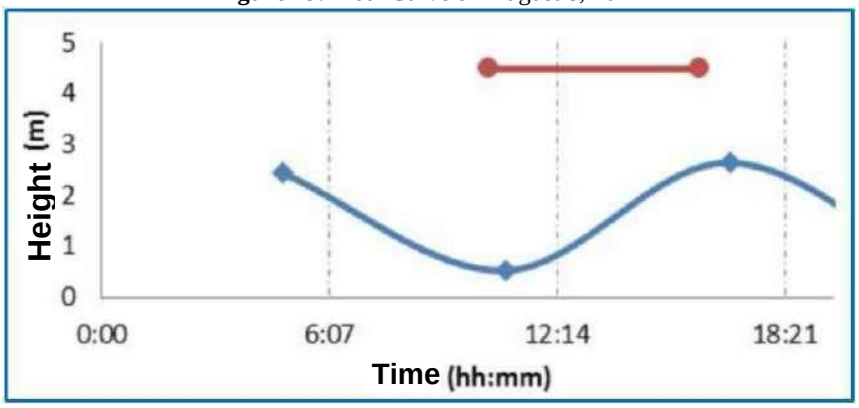
  To that end, the Lagrangian method uses a float or vanes made up of two interlocked marine plywood panels whose upper part is joined to an axis consisting of a thin iron rod which also serves as a support for a small plastic flag of different colors to tell each other apart. The weight of the

weathervane is compensated by three buoyant located on the rod keeping it afloat and allowing to observe the upper part of its axis (rod and flag) on the surface. The weathervanes were positioned using the Global Positioning System - GPS, which gives us the location in X and Y coordinates (longitude and latitude) according to the UTM (Universal Transverse Mercator) coordinate system. The following shows the setting and drifting maneuver of floats.

The measurements were taken on August 8 (Sicily); the work was carried out for 6 continuous hours, working with three weathervanes or lagrangian drifters; one of these was set to take sub-surface measurements (3 m).

We obtained average and maximum velocities recorded during the works and the predominant directions during the flow and backflow from the analysis of the data. The tidal curve is shown below, along with the times when the work was performed.

Figure 79: Tidal Curve on August 8, 2017

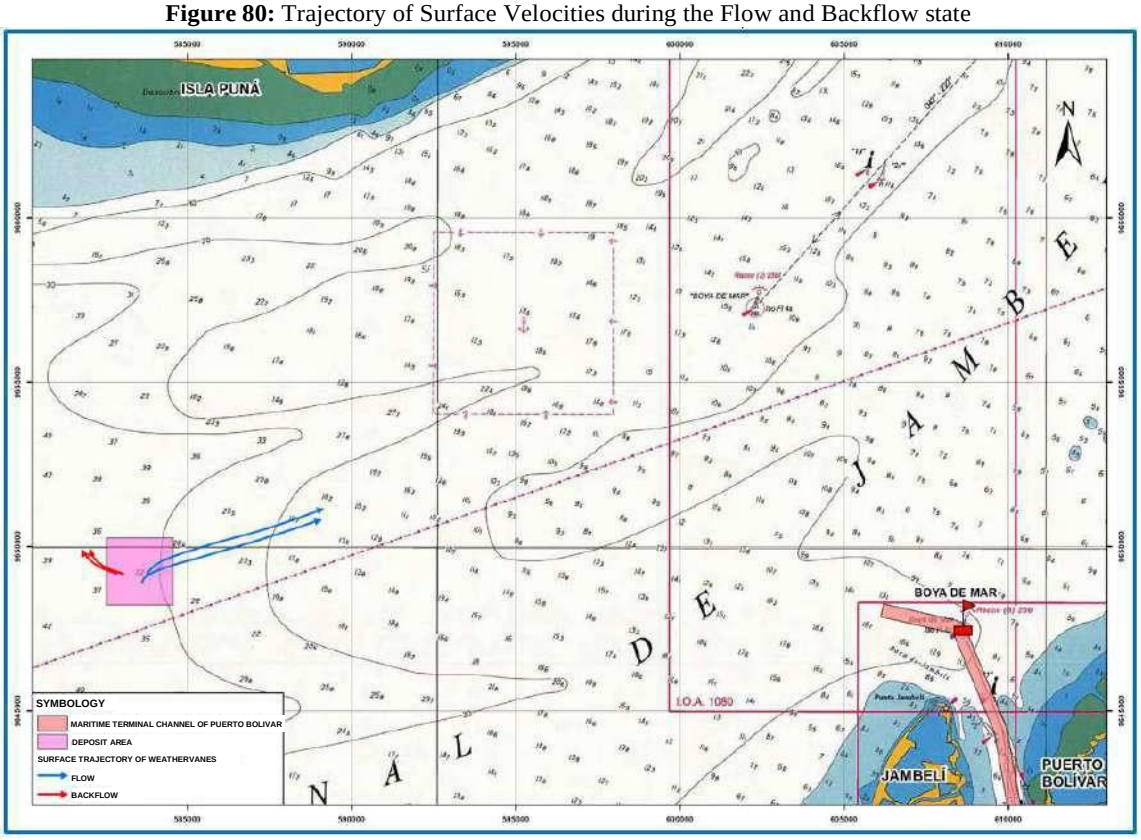


Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Surface velocity

From the analysis performed with the field data corresponding to 08/08/2017, it is concluded that the surface current tends to head towards the Northeast - NE during the flow. The velocities calculated according to the floats' trajectories and the time they took to travel gave us an average velocity during the flow state of 0.43 m/s and the maximum velocity of 0.48 m/s. While for the backflow state it is observed that the floats tend to head to the NW. The average velocity recorded during this state corresponds to 0.21 m/s, while the maximum velocity of 0.32 m/s, the velocities are shown in the figure and table below.

Figure 80: Trajectory of Surface Velocities during the Flow and Backflow state



Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Table 38: Surface Velocities during Flow and Backflow

DEPTH	Tidal State	Average Speed (m/s)	Direction	Maximum Speed (m/s)	Direction
Surface	FLOW	0,43	NE	0,78	NE
	BACKFLOW	0,21	NW	0,32	NW

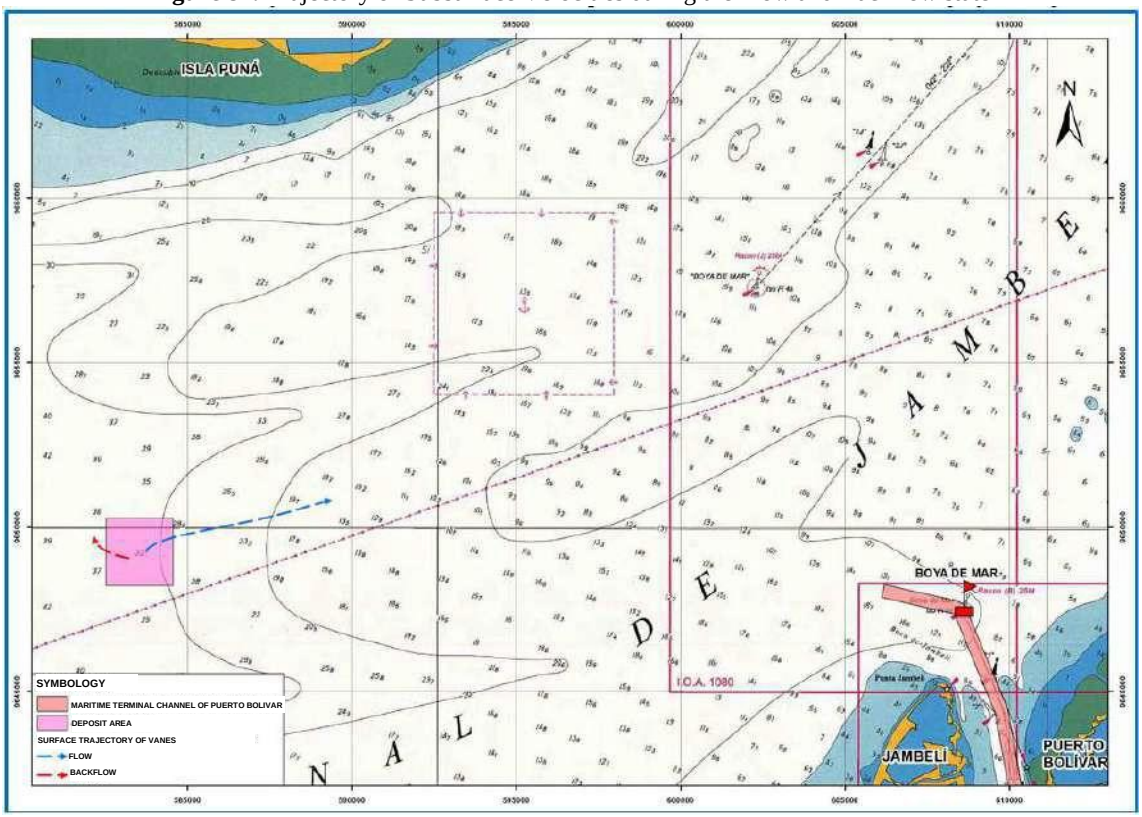
Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

Subsurface Velocity

From the analysis of the Subsurface vane trajectories during the flow state, it is indicated that the average velocity was 0.42 m/s, while the maximum velocity was recorded at 0.77 m/s, with NW direction. During the backflow state, the Subsurface current moves in the same direction as the surface current during this tidal phase, with NE direction, with a maximum velocity of 0.31 m/s and average velocity of 0.19

m/s. The following figure and table show the results of the average and maximum velocities of the subsurface current.

Figure 81: Trajectory of Subsurface Velocities during the Flow and Backflow state



Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Table 39: Subsurface Velocities during Flow and Backflow

DEPTH	Tidal State	Average Speed (m/s)	Direction	Maximum Speed (m/s)	Direction
Subsurface	FLOW	0,42	NE	0,77	NE
	BACKFLOW	0,19	NW	0,31	NW

Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

❖ EULERIAN METHOD

The Eulerian method for measuring currents consists of mechanical or dynamic measurements of flow passing through a fixed point; in the case of currents, they are made using current meters with bottom or surface anchors.

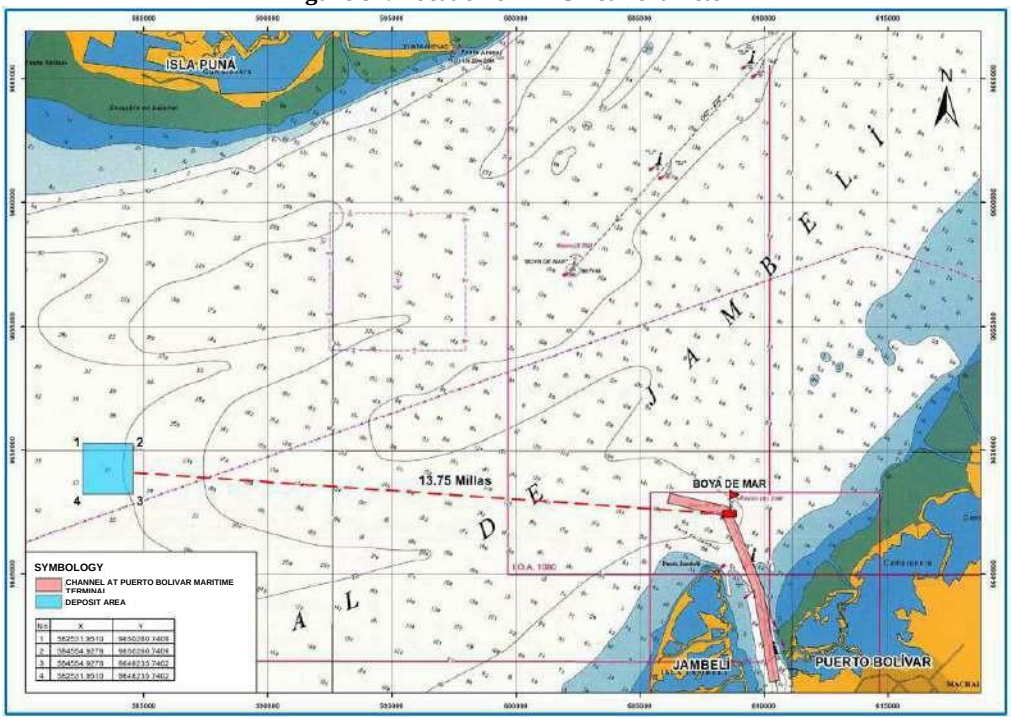
YILPORTECU S.A. with the objective of having a current register in the area that has been destined as a deposit site located in the Jambelí Channel, has requested the anchorage of a Nortek Aquadopp Profiler self-contained equipment (technical data sheet of the equipment is attached in Annex D for 24 hours, in the 30 m depth slope, the following figure and table identify the location of the anchorage site.

Table 40: Geographical location of ADCP current meter

STATION	Coordinates		Measurement date	
	X	Y	Anchoring	Withdrawal
Currents	583542	9649248	08/08/2017	09/08/2017

Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

Figure 82: Location of ADCP current meter



Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

The equipment was programmed to obtain data every 10 minutes, it was installed on the side of the working boat, in a special structure elaborated in the shape of a triangle, which in each of its vertices has "ears" or curved spaces that help the fastening and tension of the equipment, in the following photographs you can see the assembly and anchoring of the equipment.

Photo 6: Current Measurement

Preparation of drifter to initiate measurements

Derived from weathervane

ADCP current meter inside anchor case

Equipment assembly

ADCP current meter anchoring

Current meter withdrawal

Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

With the data collected, an analytical study of the measurements was carried out, the results obtained are presented broken down into surface current velocities, average current velocities, and bottom current velocities for both flow and backflow. A summary table presents the average and maximum velocities for each station and vector graphics to present a clear idea of the study area's current behavior.

For the current time series analysis and visualization procedure, the Matcor1 application was used, which allows a systematic study of the current time series. This process was automated to simplify as much as possible the obtaining of results.

SURFACE LEVEL

The analysis of the information obtained shows that at a surface level during the state of flow or high tide, the most frequent current velocities are between 0.15 m/s, 0.35 m/s, and 0.40 m/s, while the directions are located in the first quadrant, with the most frequent directions ranging between 80° and 90°NE (Figure No. 57). During the backflow phase, it is observed that the surface current velocities with the highest incidence are in the range of 0.20 m/s and 0.30 m/s, while the directions are distributed in the fourth quadrant, with the highest frequency being between 270° and 280° NW (Figure 58). The following figures show the frequency histograms of the surface current and vector graphs' velocity and direction.

Figure 83: Histogram of current velocity and direction at surface level during flow

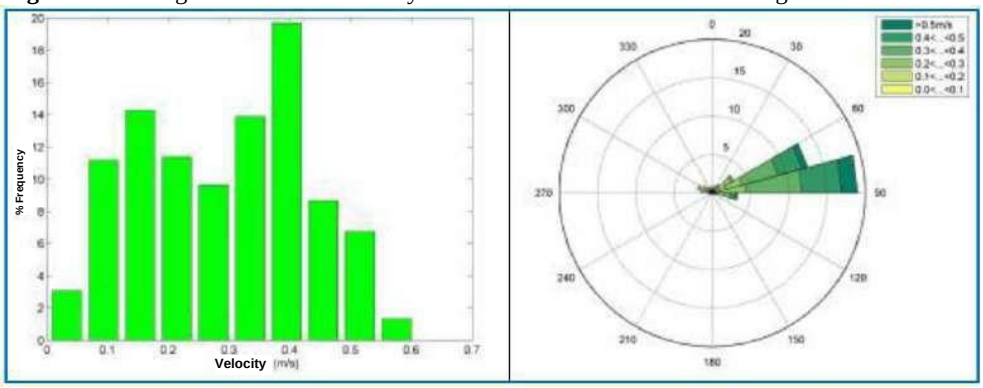


Figure 84: Histogram of current velocity and direction at surface level during backflow

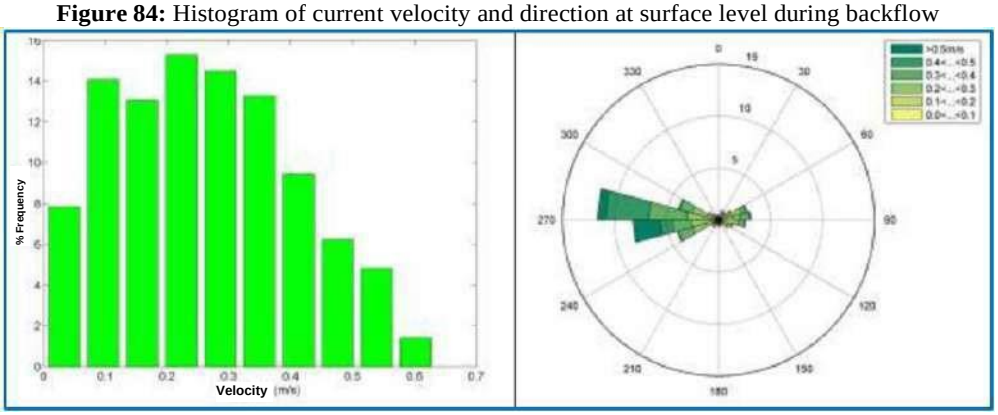
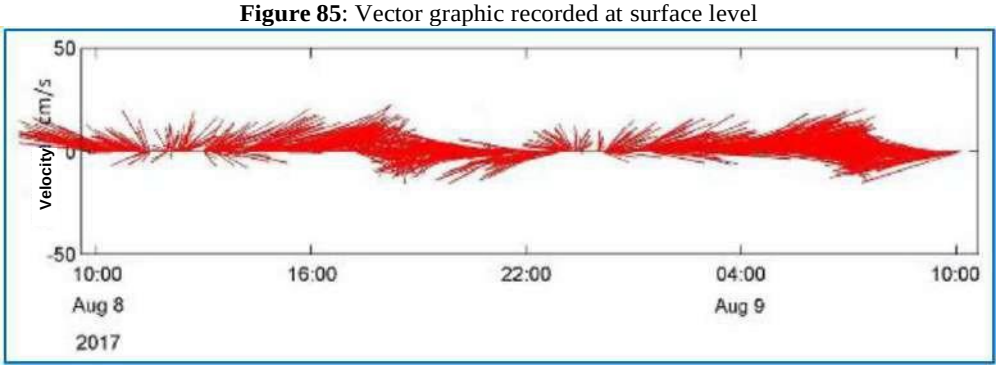


Figure 85: Vector graphic recorded at surface level



Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

MEDIUM LEVEL

It is observed for the middle layer that the velocities with the highest frequency index are those in the range between 0.35 m/s and 0.40 m/s. The directions are mostly grouped in the first quadrant, oscillating between 80° and 90° NE (Figure 60). The highest frequency index velocities are found during the backflow phase in the range of 0.25 m/s and 0.30 m/s. Regarding directions, these are found in the third quadrant, oscillating between angles of 240° and 270° NW (Figure 61). The following figures show histograms of velocity and direction frequencies, as well as a vector graphic that clearly shows the direct connection with the tide (Figure 62).

Figure 86: Histogram of current velocity and direction at medium level during flow

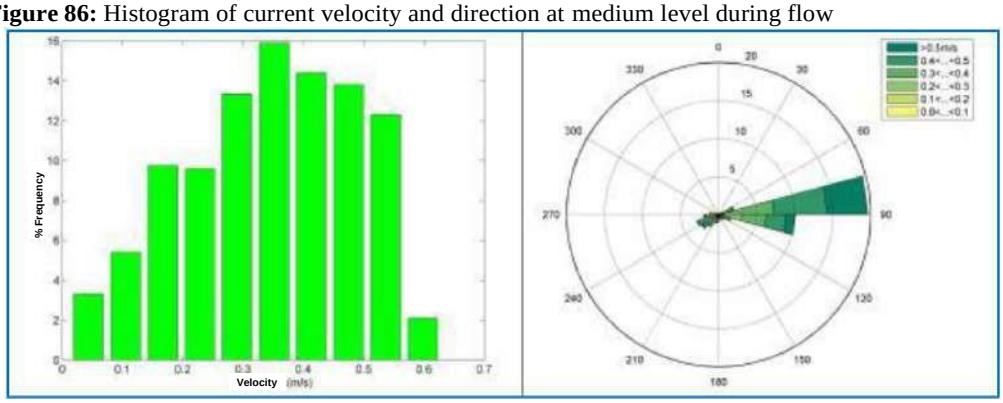


Figure 87: Histogram of current velocity and direction at a medium level during backflow

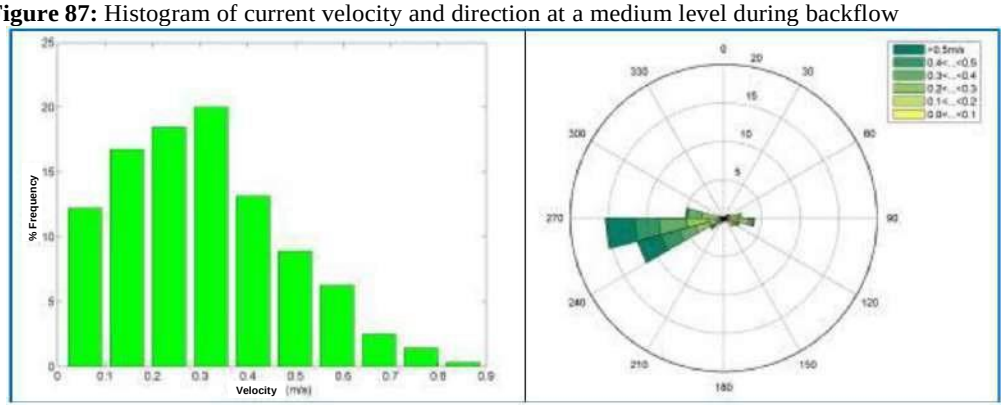
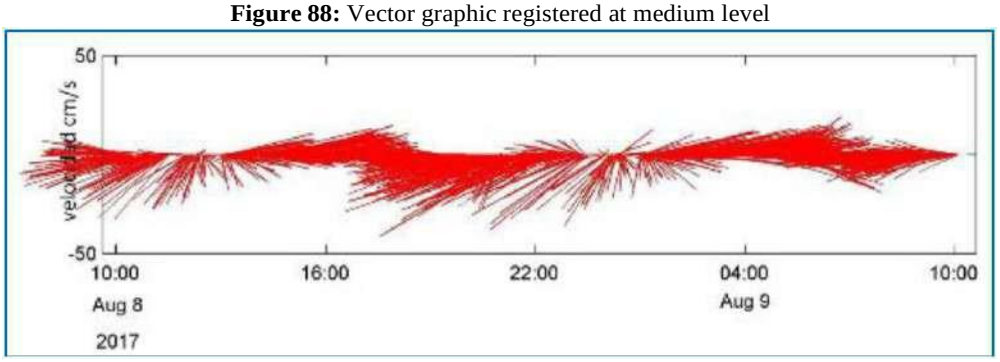


Figure 88: Vector graphic registered at medium level



Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

BOTTOM LEVEL

The bottom velocities with the highest frequency rate recorded by the Jambelí Channel sector equipment correspond to 0.50 m/s, while the directions are oscillating with NE direction (Figure 63). In the backflow phase (Figure 64), the bottom velocities with the highest percentage of the frequency corresponding to the range 0.50 m/s and 0.60 m/s, while the directions are found oscillating between 250° SW and 270°NW, as shown in the following figures:

Figure 89: Histogram of velocity and direction of the current at a bottom level during flow

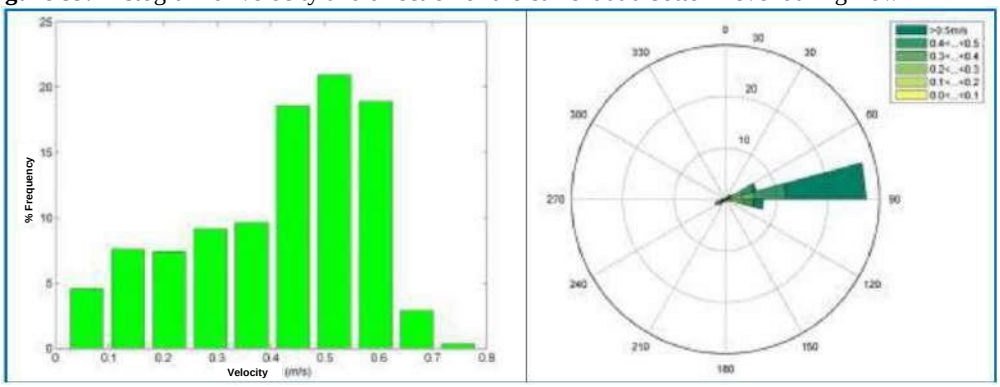


Figure 90: Histogram of velocity and direction of the current at a bottom level during backflow

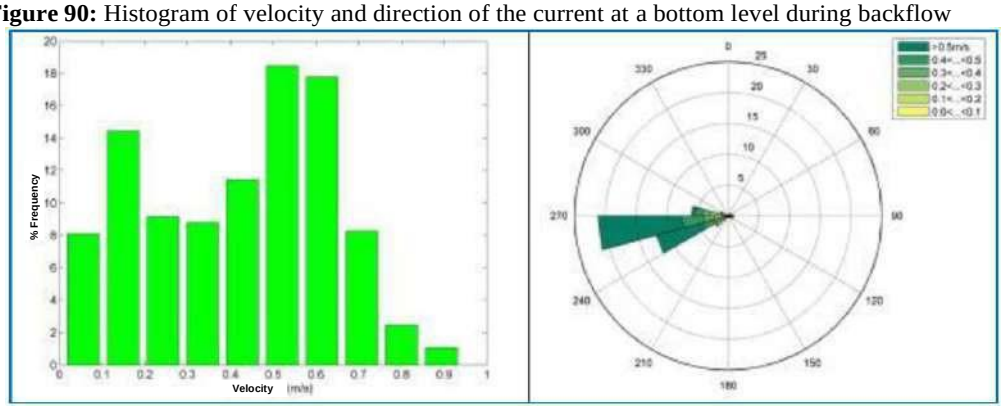
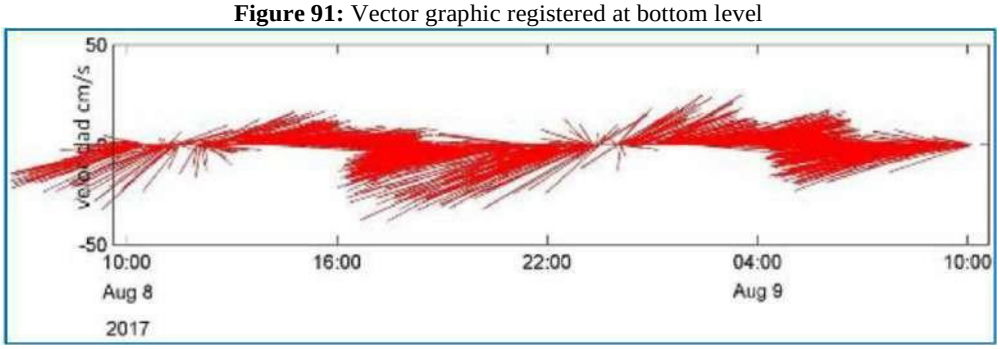


Figure 91: Vector graphic registered at bottom level



Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

The following table shows the average and maximum speeds recorded by the equipment for each of the levels, with the highest average at the surface level during the backflow phase with a value of 0.47 m/s, while at the bottom level lower speeds are recorded compared to the surface and average level; likewise, concerning the directions, there is a clear distinction for each tidal phase, which is oscillating between the first and third quadrant.

Table 41: Average and maximum deposition area velocities

STATION	Date	Level	Average Speed (m/s)	Direction (grades)	Maximum Speed (m/s)	Direction (grades)	Tidal Phase
Currents	08/08/2017 09/08/2017	Surface	0.29	90	0.61	70	Flow
			0.27	244	0.65	266	Backflow
		Medium	0.35	90	0.59	92	Flow
			0.31	270	0.89	251	Backflow
		Bottom	0.41	90	0.66	83	Flow
			0.41	255	094	253	Backflow

Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

MODELING FOR SEDIMENT DECANTATION

Numerous processes condition the dynamics of sediment transport in river mouths and estuaries and its effect on morphology. These include river discharges, tidal currents, and the effect of waves, with the importance of each one is characteristic of the different case studies.
Sedimentation of water bodies is a natural phenomenon caused by the effects of climate and the physiography of watersheds. All watersheds are subject to erosion due to wind and precipitation on the different soil types found on the land surface. Soil erosion is mainly caused by runoff from rainfall that does not evaporate or infiltrate into the soil.

In the case of ports, sedimentation is a problem that results in the accumulation of edaphic material, which impedes the operation of the port, due to the obstruction of the fluid traffic of ships and other vessels that transport cargo and are part of the main economic activity of the area.

In Puerto Bolivar, in the province of El Oro, the situation is no different with respect to the accumulation of sediments, and this problem is a cause for concern, which has given rise to the proposal of solutions such as the dredging of this material to facilitate the development of commercial activities that begin with the maritime transport of cargo in this port.

It should be noted that the sediment extracted during the dredging process will be deposited in an area that has the physical characteristics for proper sedimentation; however, YILPORTECU S.A. requires mathematical modeling to determine the area in which sedimentation will occur and to determine if it will interfere with some productive activities such as shrimp farming.

METHODOLOGY

The present mathematical modeling of sedimentation is based on the formulas instituted for the description of Stokes' Law following the conditions established for fluids, were the

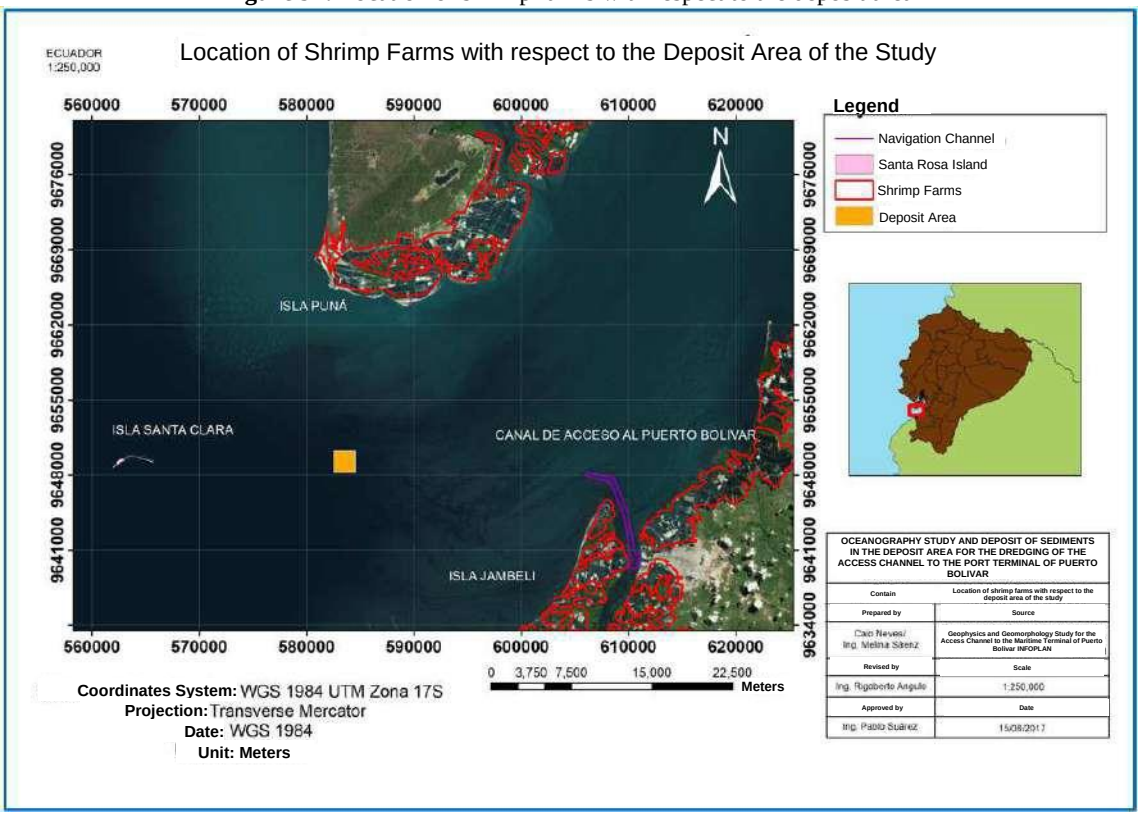
dimensionless Reynolds's coefficient is used as a method that the formula has been correctly applied.

Geographically, the modeling area is around the sediment deposition site, which corresponds to the Inner Gulf of Guayaquil, between Jambelí Island and Puná, whose reference coordinates in WGS 84 Zone 17 South projection is 583542.17, 9649247.17 UTM.

Description of the Modeling Area

The study area comprises two sectors, the "dredging area" and the "final disposal area of the dredged material." The dredging area is located in the Santa Rosa estuary and corresponds to the navigation axis line to access the Puerto Bolívar Maritime Terminal; the final disposal area is located between Puná Island and Jambelí Island around 13.75 miles. The productive activities that take place in the areas surrounding the disposal area are shrimp farms.

Figure 92: Location of shrimp farms with respect to the deposit area

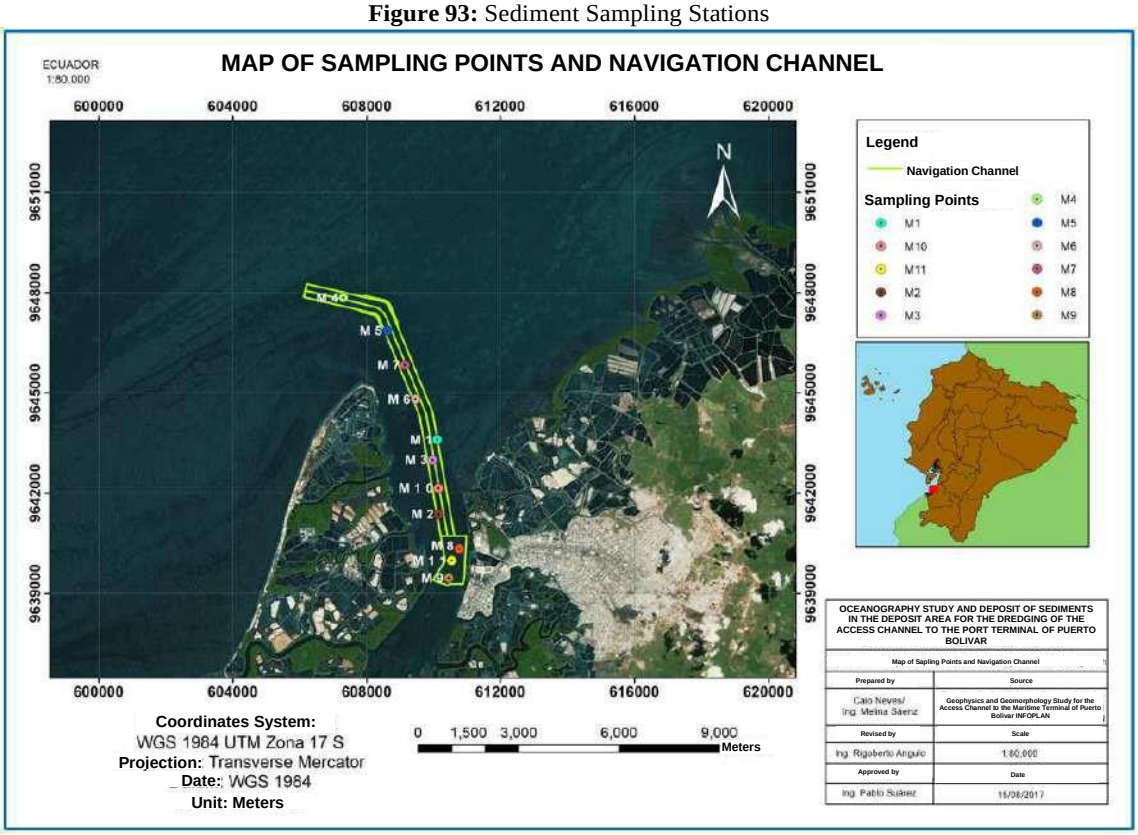


Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Sediment Sample Analysis

YILPORTECU S.A conducted in May 2017 a sediment sampling campaign along the navigation channel to Puerto Bolivar in order to determine the Geophysics of the site and the Respective Dredging Processes, as a result of the sediment sampling process came to have a total of 11 samples which allow determining the size of the grain to be dredged and will be transferred to the deposit site, the following figure and table shows the location of the 11 sampling stations.

Figure 93: Sediment Sampling Stations



Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Table 42: Geographical coordinates of sediment sampling stations

POINT	X	Y
S1	610123	9643595
S2	610164	9641363
S3	609972	9642991
S4	607318	9647842
S5	908624	9646854
S6	609470	9644801
S7	909153	9645831
S8	910769	9640332

POINT	X	Y
M9	610462	9639457
M10	610145	9642146
M11	610543	9639976

Source: *Currents Study of Deposit Area of Dredging Material*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

PARTICLE SIZE DISTRIBUTION OF SAMPLING STATIONS

The results of the sediment sampling performed by the laboratory are listed below:

- **Sample #1 - Interpretation:**
  In point 1, a sample of 180 grams was collected, whose distribution in percentages according to its granulometric classification was 94.98% sand, corresponding to 172.67 grams, followed by fines, which are subdivided into silts and clays, with 4.81% corresponding to 8.74 grams, and finally, 0.22% gravel, corresponding to 0.4 grams.

- **Sample #2 - Interpretation:**
  At point 2, 205.48 g of sample were collected, the distribution of which was as follows: 75.22% sand, 21.53% silt and clay, and 3.26% gravel. The same percentages translate to 154.56 g of sand, 44.24 g of silt and clay, and 6.7 g of gravel respectively.

- **Sample #3 - Interpretation:**
  At point 3, a sample of 82.59 grams was collected, with a distribution of 63.8% silt and clay and 36.2% sand. No gravel was found in this sample according to the granulometric analysis carried out. Therefore, the mass distribution was 52.69 g for silt and clay and 29.9 g for sand.

- **Sample #4 - Interpretation:**
  At point 4, a sample of 71.75 g was collected, of which 95.68% corresponded to fine particles (silt and clay) and the remaining 4.32% to sand. No gravel was found in the analyses carried out; therefore, the mass distribution was 68.65% gr of silt and clay and 3.1 gr of sand.

- **Sample #5 - Interpretation:**
  At point 5 the total mass collected was 101.21 g, and the percentage distribution given was 65.42% for fine particles, such as silt and clay, and 34.58% sand. The presence of gravel was not reported. Therefore, the mass of fine particles was 66.21 g and of sand 35 g respectively.

- **Sample #6 - Interpretation:**
  The sample corresponding to point 6 presented a mass of 98.14 g, and according to the tests carried out, the distribution given according to its size in percentage was

88.64% of fine particles (silt and clay) and 9.5% of sand. The corresponding mass was 88.64 g for silt and clay and 9.5 g for sand. No gravel was present.

- **Sample #7 - Interpretation:**
  The sample collected at point 7 had a mass of 83.43%, whose percentage distribution according to particle size was 91.61% for fine particles such as silt and clay and 8.39% for sand. The reported mass was 76.43 g for fine particles and 7 g for sand. No gravel was found in the sample.

- **Sample #8 - Interpretation:**
  The sample collected at point 8 had a mass of 74.71 g with a percentage distribution of 82.2% of fine particles such as silt and clay. And 17.8% for sand. No gravel was found in the collected sample. The mass of fine particles found was 61.41gr while sand was 13.3gr.

- **Sample #9 - Interpretation:**
  The sample taken at point 9 had a weight of 82.6 g, of which the percentage distribution according to the type of particle was as follows: fine particles 79.3%, and 20.7% without gravel. The weight corresponding to fine particles was 65.5 g, while for sand it was 17.1 g.

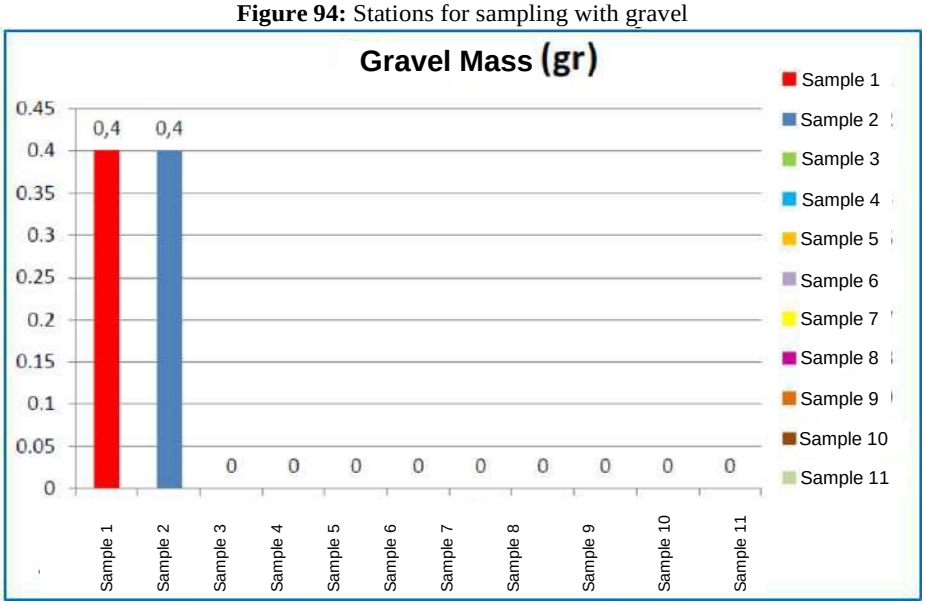
- **Sample #10 - Interpretation:**
  The sample corresponding to point 10 had a total mass of 131.69gr. The distribution according to particle type was as follows: 85.1% corresponded to sand, while 46.59% were fine particles (silt and clay). No gravel found. The mass corresponding to fine particles was 46.59 g, while for sand, it was 85.1 grams.

- **Sample #11 - Interpretation:**
  At point 11 the sample was collected with 104.63 g mass. According to the type of particles, the distribution given in percentage was 77.54% for fine particles (silt and clay) and 23.5% for sand. The presence of gravel was not found in the sample. The mass corresponding to fine particles was 104.63gr and sand 23.5gr, respectively.

Gravimetric distribution by type of particle in each sample

As shown in the figure below, the gravel levels obtained from the monitoring do not reflect significant amounts in terms of mass at 2 of the 11 points sampled, where the stations with gravel presence are located in the middle part of the access channel to the port.

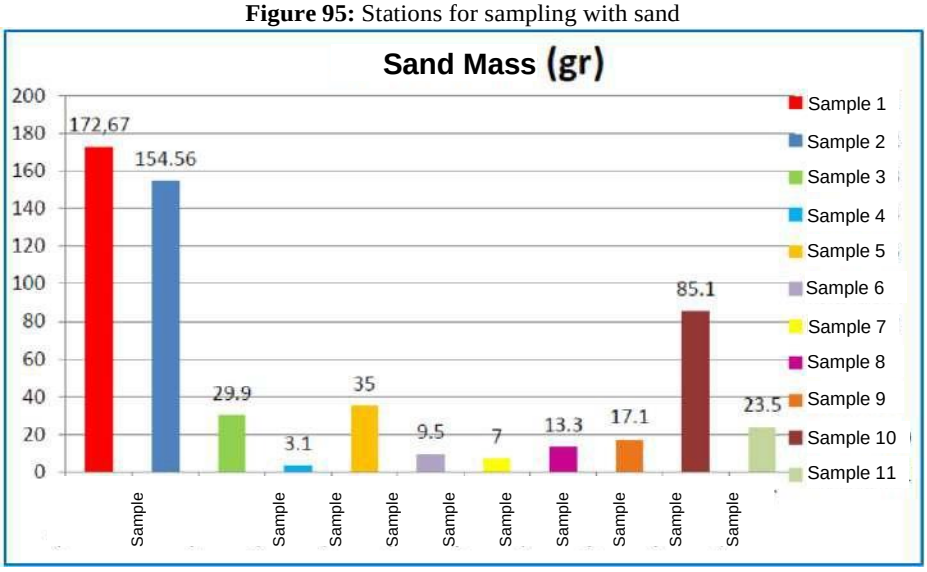
Figure 94: Stations for sampling with gravel



Source: *YILPORTECU S.A. Granulometry Study*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

The distribution of the amount of sand along the access channel can be seen in the following figure. Sampling station 10 shows a considerable amount of sand compared to the other samples, this reflects the actual geographic location of each point, where samples 1, 2 and 10 are located adjacent to each other, which explains that the accumulation of sand is due to their location.

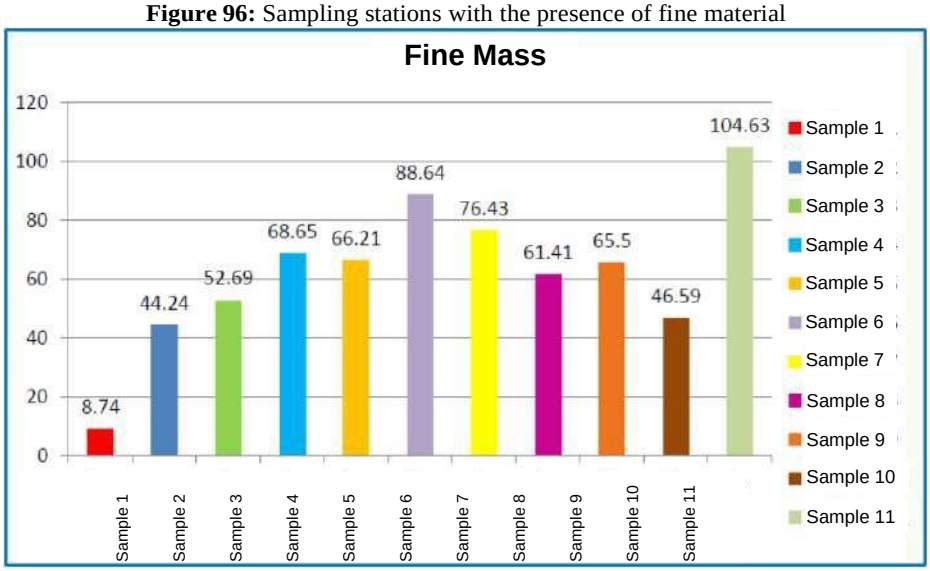
Figure 95: Stations for sampling with sand



Source: *YILPORTECU S.A. Granulometry Study*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

As for the presence of fine material (silt and clay), as shown in the graph, there are high values in general, and in each of the samples collected along the channel, where the highest values are located at points 6 and 11, which geographically correspond to the entrance of the channel and the port area, respectively. This denotes a homogeneous distribution of wash material along the access channel to Puerto Bolivar.

Figure 96: Sampling stations with the presence of fine material



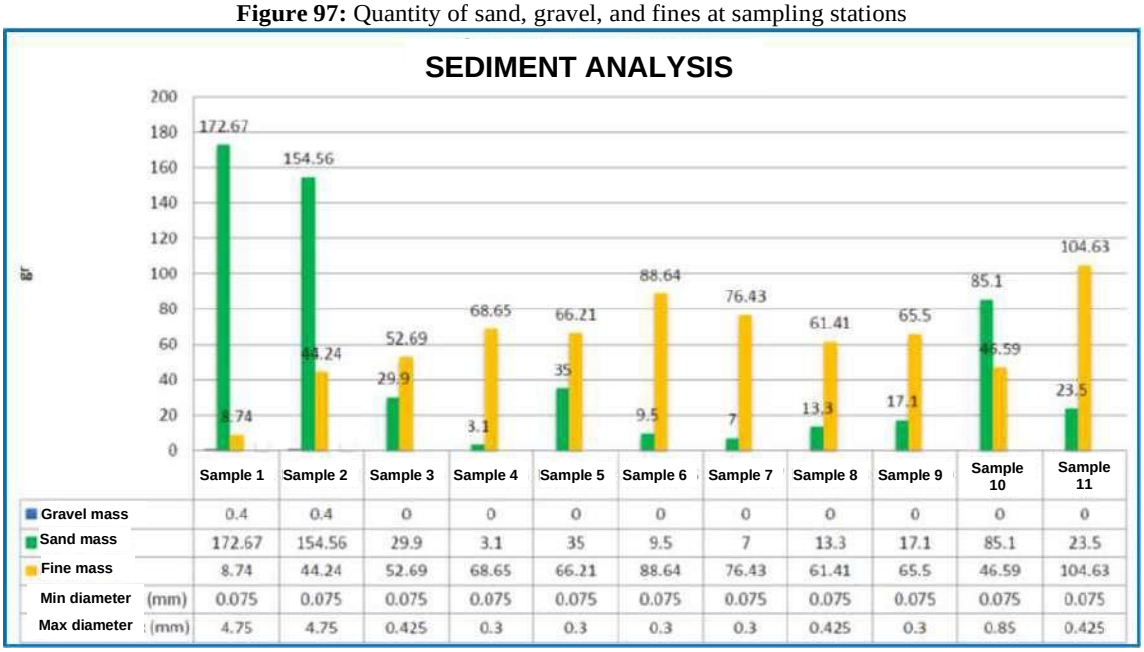
Source: *YILPORTECU S.A. Granulometry Study*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Based on the results obtained from the tests carried out, it can be concluded that the samples collected along the Puerto Bolívar access channel show a predominant number of fine particles (silts and clays). Larger solid particles, also called bottom drag, were not found at significant levels, appearing in only 2 of 11 sampling stations, where high sand concentrations were also found.

For this document, the following distribution is determined:

- Fine (with an average diameter of 0.075 mm)
- Sand (with an average diameter of 0.3 mm)
- Gravel (with an average diameter of 4.75 mm)

Figure 97: Quantity of sand, gravel, and fines at sampling stations



	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11
Gravel mass	0.4	0.4	0	0	0	0	0	0	0	0	0
Sand mass	172.67	154.56	29.9	3.1	35	9.5	7	13.3	17.1	85.1	23.5
Fine mass	8.74	44.24	52.69	68.65	66.21	88.64	76.43	61.41	65.5	46.59	104.63
Min diameter (mm)	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Max diameter (mm)	4.75	4.75	0.425	0.3	0.3	0.3	0.3	0.425	0.3	0.85	0.425

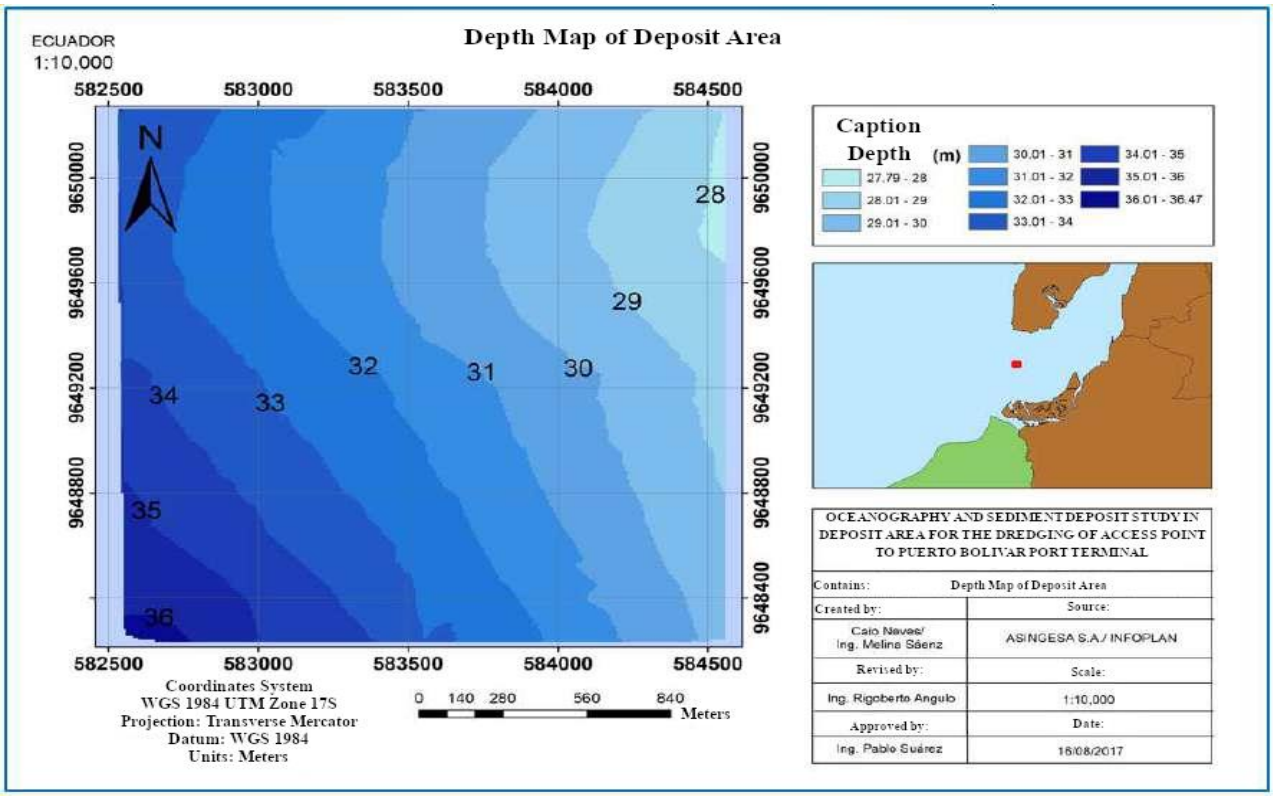
Source: *YILPORTECU S.A. Granulometry Study.*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

ANALYSIS OF CURRENTS AND TIDES

Prior to the modeling of sedimentation in the study area, it was pertinent to collect oceanographic information, such as the deposition site's depth and the velocity and direction data regarding the marine currents (flow and backflow) intercept it.

The depth information was obtained from the bathymetry carried out by the consulting team, which was used to create a map of the deposition area's underwater profile. The final disposal of the sediment will occur.

Figure 98: Variation of deposit area depth



Source: *Current study Dredging Material Deposit area*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

The depths covered by the deposit area comprise from elevation -27 m to elevation -36 m. However, the distance covered by the sediment from the surface until reaching -27 m was taken into account to execute the modeling at three depth levels: surface, medium, and bottom.

It is necessary to highlight that this modeling study considered both the horizontal and the vertical movement of the sediment particles by the action of the tidal that influence at each depth level. Being this the case, the dispersion model was stratified as follows: for the surface layer, from 0 to 9 m, from the medium layer from 9 to 18 m, and from the bottom layer, from 18 to 27 m.

Table 43: Stratified depths

DEPTH	(m)
SURFACE	0 – 9 m
MIDDLE	9 – 18 m
BOTTOM	18 – 27 m

Source: *Current study Dredging Material Deposit area*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

Based on the results obtained in the oceanographic studies described above, it was determined that the water body velocities to be used for the execution of the sediment dispersion model for the deposition site will be distributed at different depths, as shown in the following table:

Table 44: Current velocities at the deposition site

DEPTH	Speed (m/s)	Direction	Tidal Status
Sur. (9 m)	0,61	NE	Flow
	0,65	SW	Backflow
Medium (18 m)	0,59	NE	Flow
	0,89	SW	Backflow
Deep (27 m)	0,66	NE	Flow
	0,94	SW	Backflow

Source: *Current Study of Dredging Material in Deposit Area*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

Application of modeling

For the determination of the sedimentation rate, information obtained from the granulometry reports described in the previous paragraphs was used; the different sizes identified should be considered, so it was considered appropriate to classify them into fine, medium, and coarse particles differentiated by particle diameter.

In addition, from the analyses carried out by the consulting team on the study area's oceanographic characteristics, it was possible to obtain the fluid viscosity and density of the fluid.

For this purpose, the following considerations are considered:

- The particle is considered a sphere expressed through equivalent diameter according to the previous paragraph's size distribution.
  The diameter of the smallest particle found in the particle size analysis was 0.75x10-5 m, this size represents the finest components that exist at the site, 0.075 millimeters, as a medium diameter representing coarse sands 0.0003 m, i.e., 0.8 millimeters and as a maximum diameter representing the gravel fraction found in the analysis 0.425x10-3 m, i.e., 4.25 millimeters.
- The sediment density is considered homogeneous and in accordance with what was described by the laboratory, which allows us to determine a value of 2,297.7 kg/m3.
- A standard Pacific Ocean temperature of 24.5°C is considered, which allows determining the density value of 1023 kg/m3 and viscosity 967 x 10-6 N sec/m2 of the ocean.
- The body of water is considered according to the Reynolds Number as laminar fluid, given its velocity of motion.
- The depths covered by the deposition site area range from -27m to -36m. However, the distance the sediment travels from the surface to reach -27m, at 3 depth levels: surface, medium, and depth was considered for the modeling.

RESULTS

The approximate distances that the sediments will travel by the currents' effect under the different velocities and at the different depths of the deposition site are detailed in the following tables and figures.

FINE (0.075 mm)

FLOW:

Table 45: Time and distance of fine particle sedimentation in Flow

DEPTH		Sedimentation time Hours	Current velocity (m/s)	Sedimentation distance	
				m	km
Surface	0 – 9	0,67	0,61	1480.80	1,48
Medium	9 – 18	0,67	0,60	1456.53	1,45
Bottom	18 - 27	0,67	0,76	1844,90	1,84
		2,02			4,78

BACKFLOW:

Table 46: Time and distance of fine particle sedimentation in Backflow

DEPTH		Sedimentation time Hours	Current velocity (m/s)	Sedimentation distance	
				m	km
Surface	0 – 9	0,67	0,65	1577.90	1,57
Medium	9 – 18	0,67	0,89	2160.52	2,16
Bottom	18 - 27	0,67	0,94	2292.89	2,28
		2,02			6,02

SANDS (0.3 mm)

FLOW:

Table 47: Sedimentation time and distance for sand in Flow

DEPTH		Sedimentation time Hours	Current velocity (m/s)	Sedimentation distance	
				km	m
Surface	0 – 9	0.042	0,61	0.013	13.01
Medium	9 – 18	0.042	0,60	0.012	12.80
Bottom	18 - 27	0.042	0,76	0.016	16.21
		0.13			42.03

BACKFLOW:

Table 48: Sedimentation time and distance for sand in Backflow

DEPTH		Sedimentation time Hours	Current velocity (m/s)	Sedimentation distance	
				km	m
Surface	0 – 9	0.042	0,65	0.013	13.86
Medium	9 – 18	0.042	0,89	0.018	18.98
Bottom	18 - 27	0.042	0,94	0.020	20.05
		0.13			52.91

GRAVEL (4.75 mm)

FLOW:

Table 49: Sedimentation time and distance for gravel in Flow

DEPTH		Sedimentation time Hours	Current velocity (m/s)	Sedimentation distance	
				km	m
Surface	0 – 9	0.00016811	0.61	0.00036918	0.36
Medium	9 – 18	0.00016811	0.60	0.00036312	0.36
Bottom	18 - 27	0.00016811	0.76	0.00045996	0.45
		0.00			1.19

BACKFLOW:

Table 50: Sedimentation time and distance for gravel in Backflow

DEPTH		Sedimentation time Hours	Current velocity (m/s)	Sedimentation distance	
				km	m
Surface	0 – 9	0.00016811	0,65	0.00039338	0.39
Medium	9 – 18	0.00016811	0,89	0.00053863	0.53
Bottom	18 - 27	0.00016811	0,94	0.00056889	0.56
		0.00			1.42

Source: *Current Study of Dredging Material in Deposit Area*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *August 2017*

ANALYSIS OF RESULTS

According to the analysis and calculations performed, it was determined that fine materials would travel the longest distance before sedimentation, this being the factor used to determine the area that the sediment will need to occupy to carry out its sedimentation process for fine sand and gravel materials.

For the state of tidal Flow, it was determined that the fine sediment would travel a distance of approximately 4.78 kilometers, and for the tidal state, the fine sediment will travel 6.02 kilometers.

The following figure shows in a georeferenced map the distance that the sediment requires for its total sedimentation, in which we can see that this area does not intersect with the shores of Isla Puna or Isla Jambelí; therefore, there would be no effect on the activities carried out on the shores closest to the sediment deposit site.

Figure 99: Sediment Dispersion Model in Flow

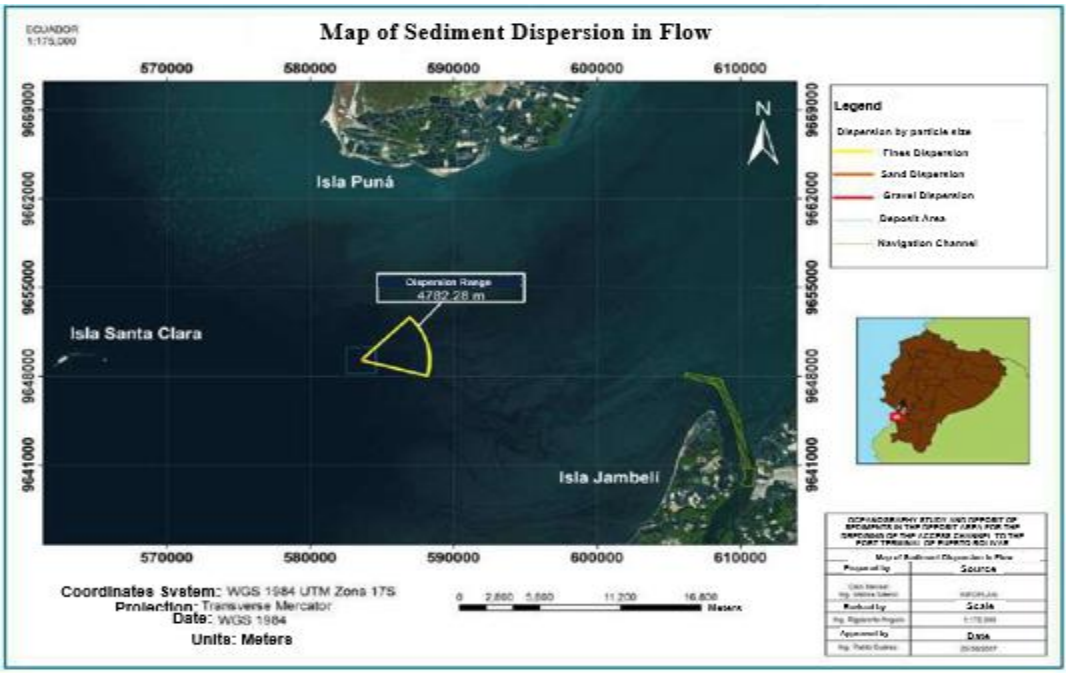
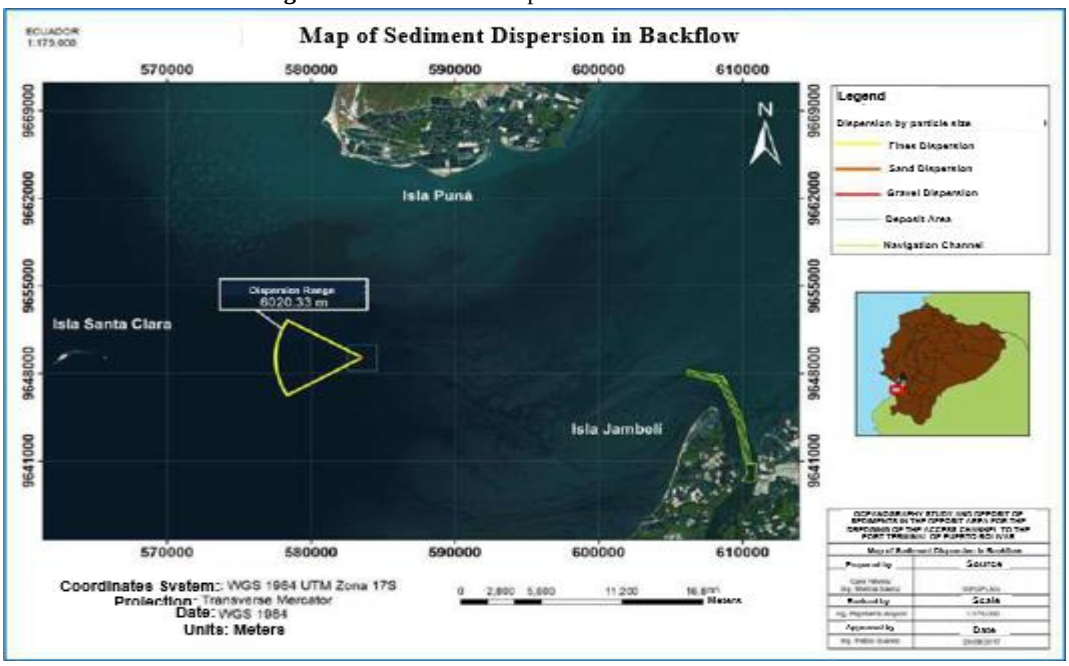
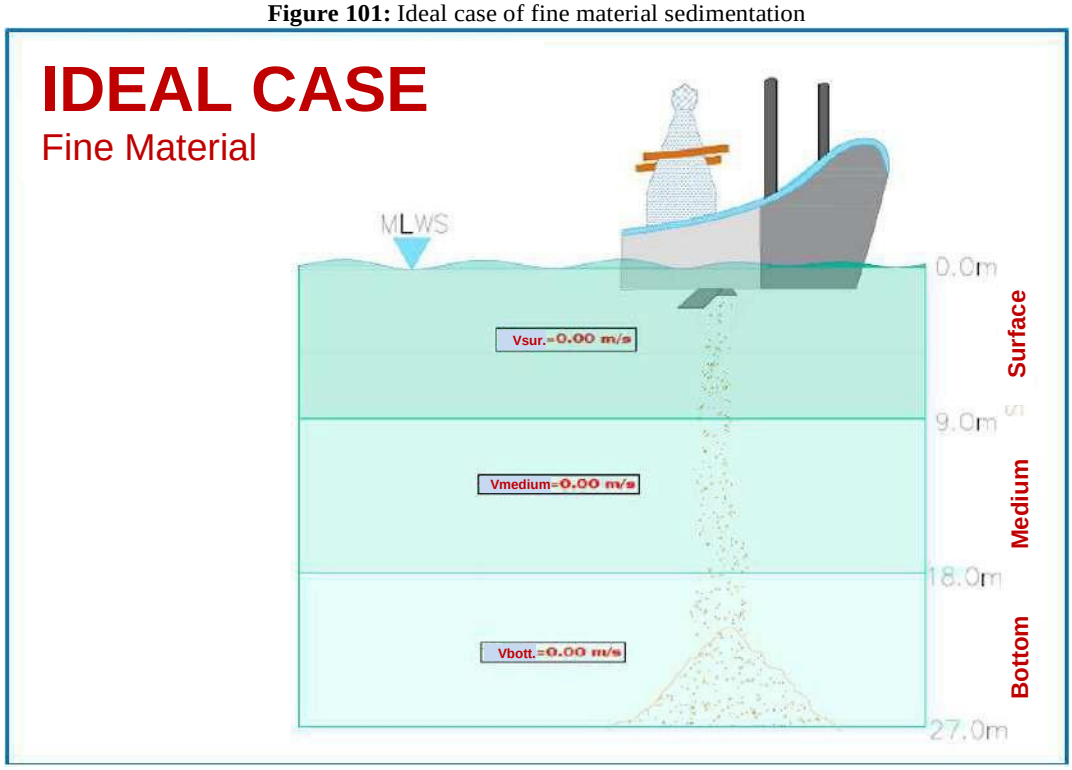


Figure 100: Sediment Dispersion Model in Backflow



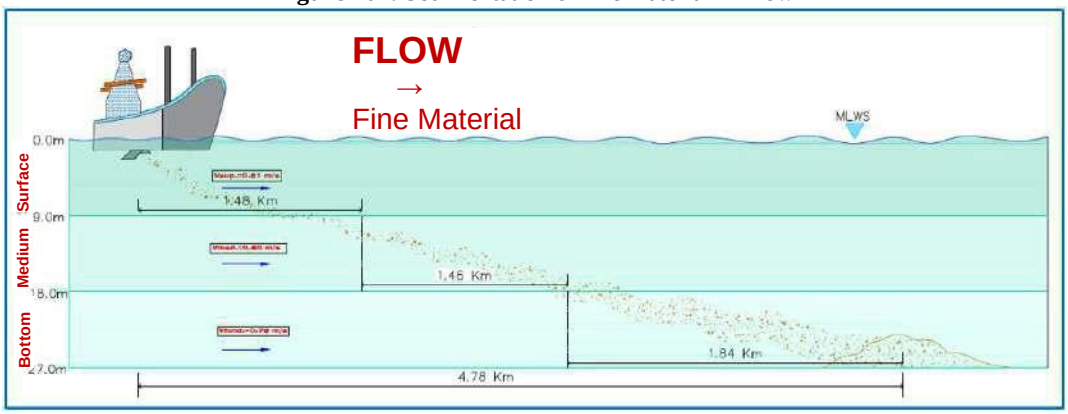
Source: *Current Study of Dredging Material in Deposit Area*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Figure 101: Ideal case of fine material sedimentation



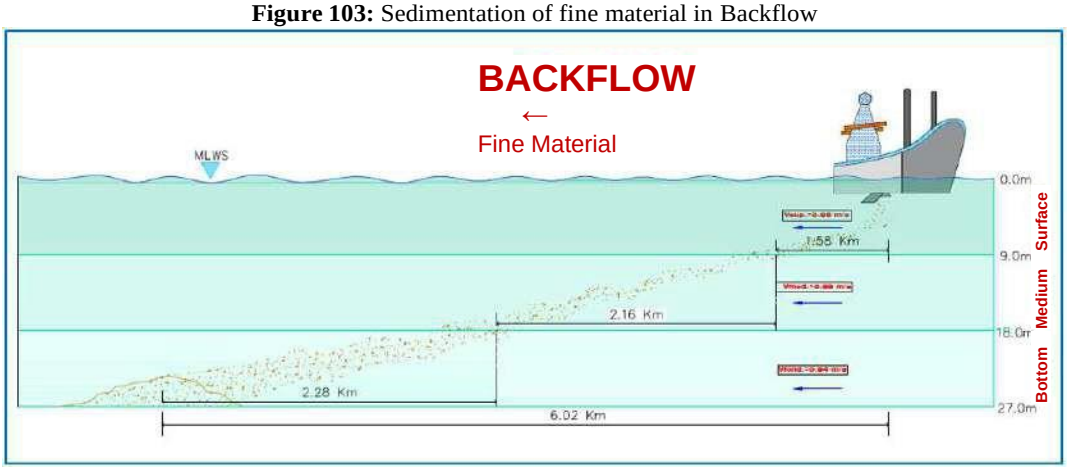
Source: *Current Study of Dredging Material in Deposit Area*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Figure 102: Sedimentation of fine material in Flow



Source: *Current Study of Dredging Material in Deposit Area*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

Figure 103: Sedimentation of fine material in Backflow



Source: *Current Study of Dredging Material in Deposit Area*
Prepared by: *Consulsua C. Ltda.*
Date: *August 2017*

STUDY OF CURRENTS CONCLUSIONS

The currents at the site corresponding to tidal currents since they directly influence the tidal phase change; from the measurements made, it is determined that the current velocity is higher during the ebb or outflow than the Flow. The direction of the current is clearly defined: during the Flow or fullness, it has to head towards the NE, while during the ebb or emptying, it heads SW.

Both velocity and direction measurements are related to records of researchers who made measurements in the sector.
According to the sediment dispersion modeling and its results, it was concluded that the area required for the sedimentation of fine materials under extreme and conservative tidal conditions will not interfere with the activities related to the use of water resources that are carried out on the banks near the area of the deposition site, such as shrimp farms, since the sediments will move a distance of 1.48 km from the deposition site, when the tide is in a state of Flow at the surface level (0 to -9 m depth), at the medium depth level the fine sediment will move a distance of 1.48 km. 48 km from the deposition site, when the tide is in a state of Flow at the surface level (0 to -9 m depth), at the medium depth level, the fine sediment will move a distance of 1.46 km (-9 to -18 m depth), and finally at the bottom level (-18 to -27 m depth), due to its characteristics, the fine sediment will move about 1.84 km, which is related to the results obtained in the field, referring to current measurements. Similar behavior is evidenced when performing the modeling in the ebb tide state, presenting an approximate displacement of fine sediments of about 6.02 km from the deposit site.

The meteorology for the deposit site is very well established according to the country's seasonality; with information from Puná Island and Jambelí Island, we have an excellent reference of the meteorological behavior of the site.

6.1.9.- BATHYMETRIC STUDY

Bathymetry consists of the measurement of the relief of underwater surfaces, the seabed, watercourses, lake areas, or reservoirs, in order to obtain nautical cartography to describe the characteristics of the aquatic bottom, which is used to verify the bottom conditions, technical studies of dredging and to ensure the safety of navigation and maneuvering of vessels.

In March and May 2017, the company CONSULSUA C. Ltda. requested the concessionaire YILPORTECU S.A., to measure the depths of the areas where the dredging project will be carried out (docks, maneuvering area, access channel, and sediment deposit area in Altamar)

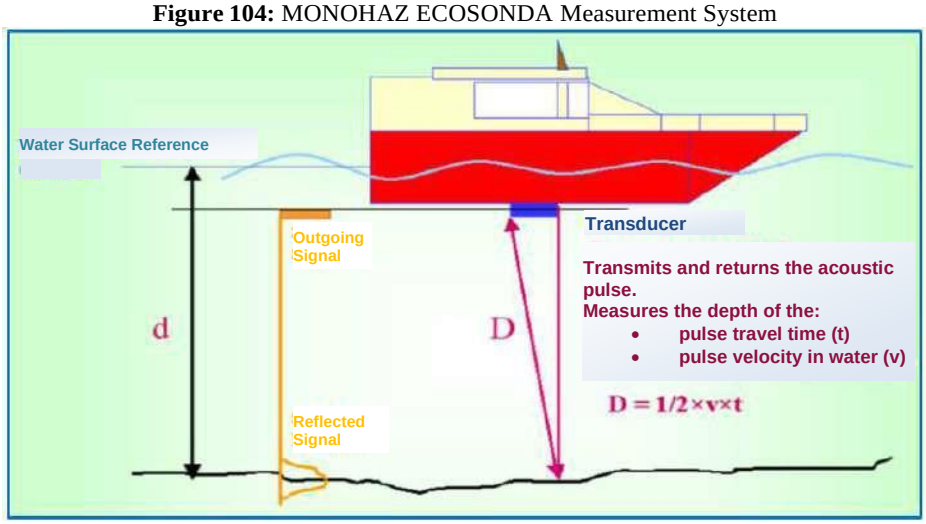
Bathymetric studies were carried out using hydrographic equipment and software for data collection and positioning to describe the characteristics of the seabed.

BATHYMETRY OF DOCK AREA AND MANEUVERING AREA

BATHYMETRIC SURVEY

The bathymetry was carried out at high frequency, following the standards established by the IHO-International Hydrographic Organization. To correct for tidal effect, a tide gauge was installed at pier 3 near the old INOCAR-Ecuadoran Oceanographic Institute of the Naval Forces tide gauge. Also, to verify the data, the water mirror's height was measured from the pier and reduced to NRS.
The bathymetric survey was carried out in a total area of 103.07 ha. of which 9 ha. correspond to the area surveyed in the docking areas of both the breakwater type pier and the marginal areas and 94.07 ha. correspond to the maneuvering area.

Figure 104: MONOHAZ ECOSONDA Measurement System



Source: *Bathymetric study in the maneuvering and docking area of the Port Terminal of Puerto Bolivar*
Prepared by: *Consulsua C. Ltda.*
Date: *March 2017*

WORK METHODOLOGY

In order to meet the objectives of the study, fieldwork, data processing, and preparation of reports and plans were carried out. The methodology required the adaptation of the bathymetric equipment for data collection and positioning, equipment calibration, and finally, the bathymetric information survey.

- **FieldWorks**

  For the bathymetric survey, hydrographic equipment and information gathering and positioning software were used to explore, analyze, and compression the bathymetry obtained, which allows describing the bottom characteristics.

  For the bathymetric survey, main lines were made every 5 meters perpendicular to the piers and 2 check lines every 50 meters. Before executing the bathymetric survey, all equipment was calibrated, as established by the International Hydrographic Organization.

  In the areas where data that create doubts about the existence of obstacles were detected, the survey was intensified to discard erroneous data and even verify by physical inspection the existence or not of such data; while the bathymetric survey was carried out, the tide control was performed.

RESULTS

The results obtained from the Bathymetric Survey of Piers and Maneuvering Area indicate that the most relevant depths were found between pier 3, 4, and 5, where rock beds were ranging from 7 m to 12.5 m. on average in the area near the dock, gaining depth as they move away from these to approximately 350 m in length where rock beds were shown up to the order of 13 m for pier 5 and 14 m for pier 3 and 4.

BATHYMETRY ACCESS CHANNEL AND OFFSHORE AREA

BATHYMETRIC SURVEY

The bathymetry was carried out at high frequency, following the standards established by the IHO (International Hydrographic Organization). To correct for tidal effect, a tide gauge was installed at pier 3 near the old INOCAR (Ecuadoran Oceanographic Institute of the Naval Forces) tide gauge. In addition, in order to verify the data, the height of the water mirror was measured from the pier and reduced to NRS.

The bathymetric survey was carried out in 400 ha, corresponding to the access channel and the site proposed as a deposit area with a similar area of 2 km by 2 km.

WORK METHODOLOGY

In order to meet the objectives of the study, fieldwork, data processing, and the preparation of reports and plans were carried out. The methodology required the adaptation of the

bathymetric equipment for data collection and positioning, equipment calibration and finally the survey of bathymetric information.

For the bathymetric survey, hydrographic equipment and software were used to collect information and positioning for exploration, analysis, and compression of the bathymetry obtained, which allows describing the seabed characteristics; the fieldwork time was 7 days. For the bathymetric survey of the access channel, main lines were made every 20 meters perpendicular to the navigation track and check lines parallel to the channel axis every 25 meters, while for the survey of the deposit site, 4 sounding lines were made with a separation between lines of 500 meters and 3 check lines perpendicular to the sounding lines. Before executing the bathymetric survey, all equipment was calibrated, as established by the International Hydrographic Organization.

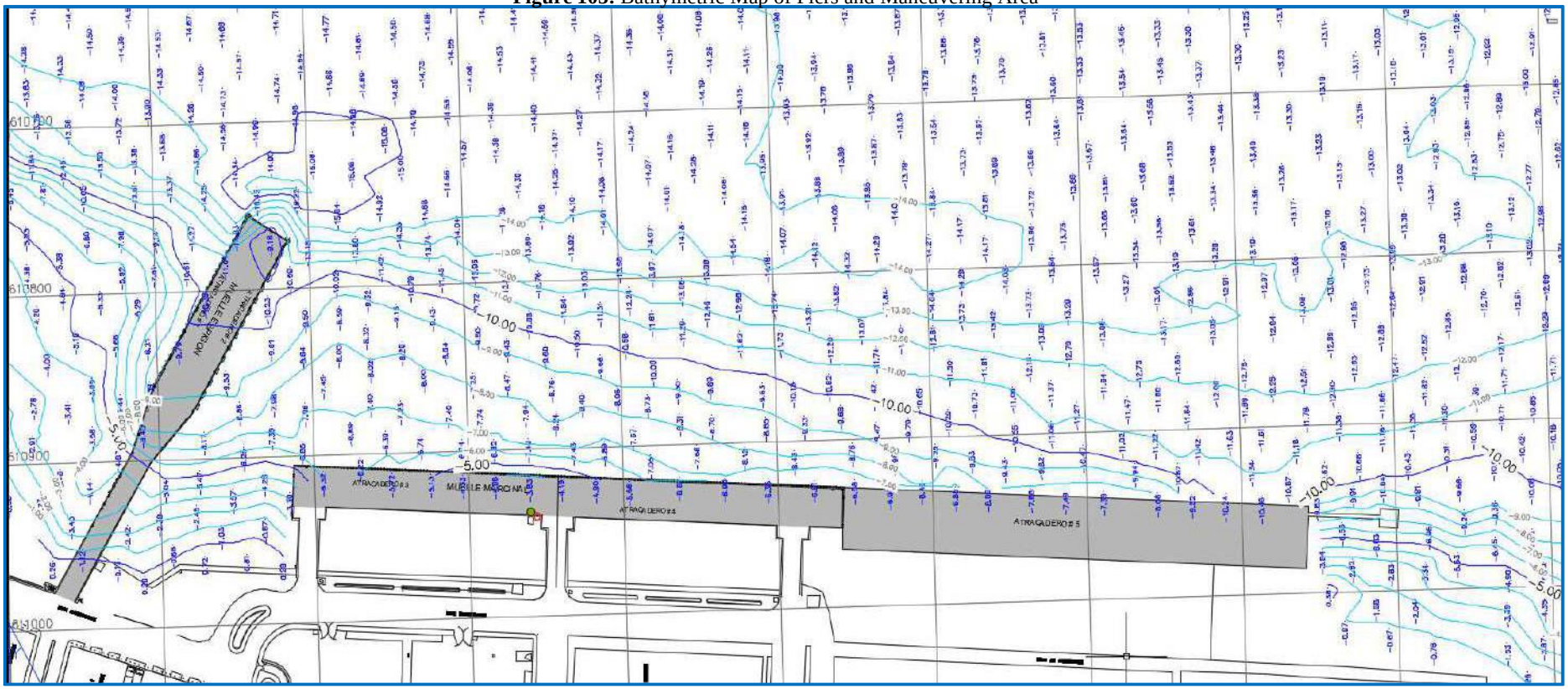
In the areas where data that could create doubts about the existence of obstacles were detected, the survey was intensified to discard erroneous data and even verify by physical inspection the existence or not of such data bathymetric survey was carried out, the tide control was performed.

RESULTS

From the bathymetry, it was observed that there is a notable reduction in depth between abscissae 4+650 and 6+300, finding a morphology somewhat similar to the formation of a low, presenting the most considerable reductions on the right side of the Track with depths of less than 9 m, following the path from the sea buoy towards the Port Terminal of Puerto Bolivar.

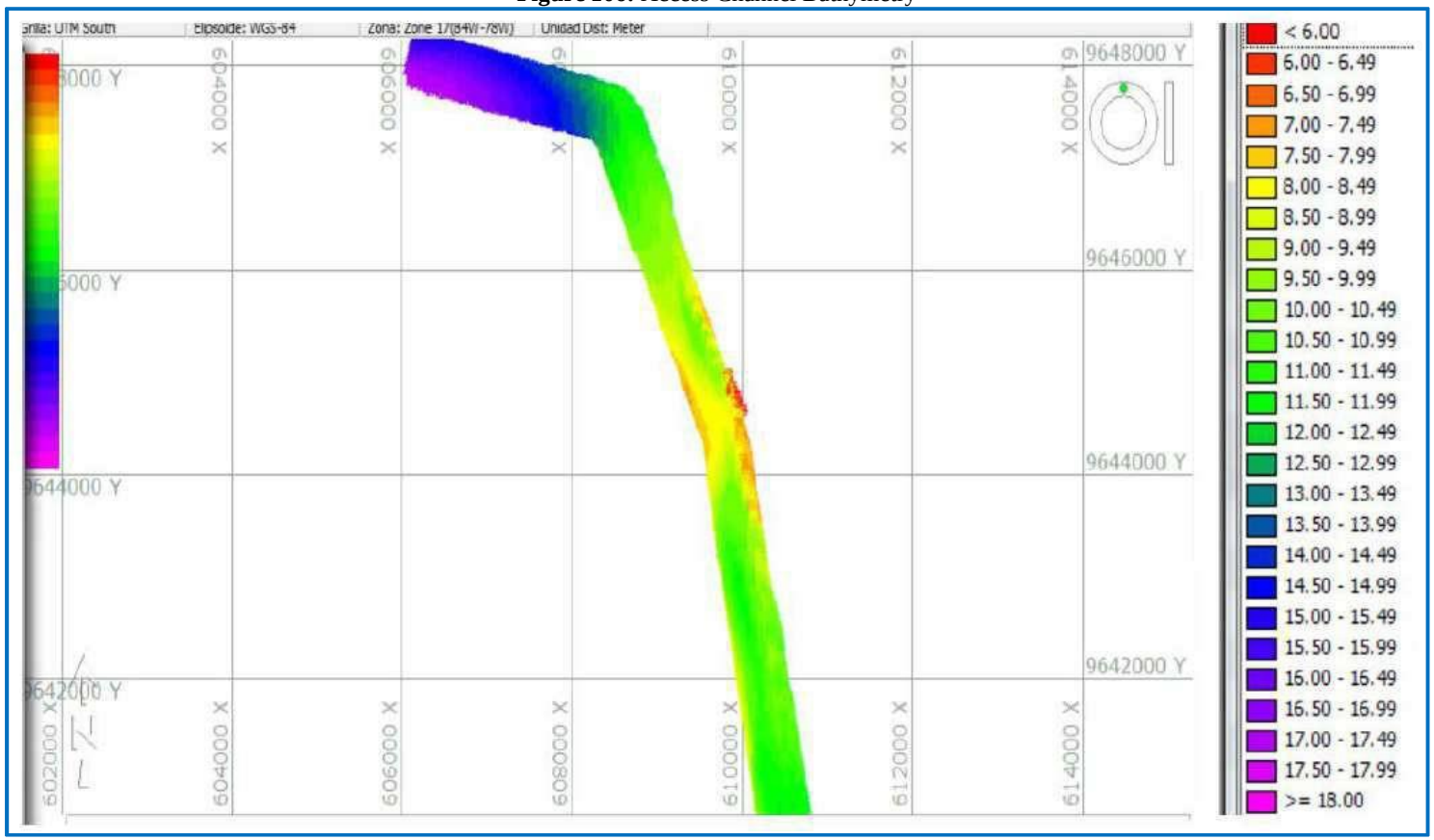
As for the deposition site, we obtained rock beds ranging from 27.77 m to 36.51 m depth, referred to as the MLWS.

Figure 105: Bathymetric Map of Piers and Maneuvering Area



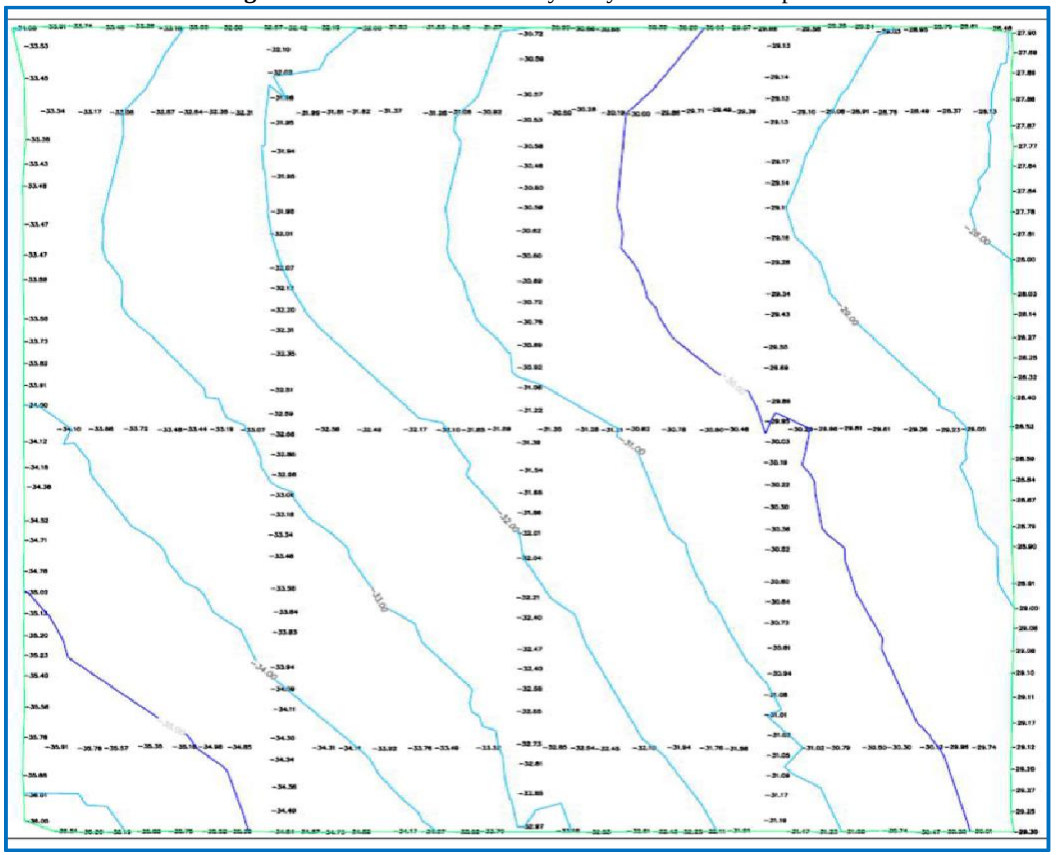
Source: *Bathymetric study of the maneuvering and docking area of the Puerto Bolivar Maritime Terminal*
Prepared by: *Consulsua Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *March 2017*

Figure 106: Access Channel Bathymetry



Source: *Bathymetric Study of the Access Channel to the Port Terminal of Puerto Bolivar*
Prepared by: *Consulsua Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *March 2017*

Figure 107: Offshore Zone bathymetry for sediment deposit



Source: *Bathymetric Study of the Altamar Area*
Prepared by: *Consulsua Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *March 2017*

6.1.10.- WATER QUALITY ANALYSIS

In the Irrigation and Drainage Plan of the Province of El Oro, a water quality study was carried out to analyze the water quality in the Province's basins.

In the project area, the basins involved are the Jubones River Basin and the Santa Rosa River Basin, whose water quality is described below:

- **Jubones River Basin:**

  This basin's waters show high levels of sodium and chloride salts; the other parameters are within normal ranges except for coliforms. The manganese reported in the SENAGUA samples is within the permissible levels for irrigation water, except for one sample that shows high levels in the Chillayacu system.

  In almost all the samples, the sodium content is close to the limit that defines poor quality for irrigation, and in two samples of the Chillayacu System, values exceeding the permissible limits are found.

  None of the samples have contents that exceed the permissible limits, as reported in the SENAGUA analysis.

  It is noteworthy that there is a high content of chlorides in the Jubones River basin waters, and almost all samples exceed the permissible limits. In this case, before using water for irrigation, the chloride content is monitored since these salts in excess affect the soil and are toxic to plants.

  The waters' pH is close to neutral, with a slight tendency to basicity; with these results, the waters cannot be considered rough.

  Coliforms are present to a high degree in almost all the samples, this being the result of the occurrence of sewage discharges from the existing populations in the basin.

- **Santa Rosa River Basin**

  The surface waters of the Santa Rosa River basin are considered suitable for irrigation use.

  Carbonates, chlorides, and sodium are present, which are close to the non-permissible limits.

  In the Buena Vista, Raspas, Calaguro, and Santa Rosa Rivers samples, the carbonate content is close to the non-permissible limits; in the rest of the samples, the carbonate content is within the permissible limits. In all the samples, chlorides' presence is evidenced in limits close to the non-permissible limits, except one sample in the Calaguro River and one sample in the Santa Rosa River. However, this is not considered to be a severe problem for the use of water for irrigation. It will always be appropriate to monitor the irrigation water to prevent these salts from causing adverse effects on the soil and plants.

  The samples' results show that there is a significant magnesium content in the samples analyzed, but they do not impair the quality of the water for irrigation. The coliforms outside the permissible limits were reported in the samples corresponding to the Calaguro and Santa Rosa Rivers.

WATER QUALITY ANALYSIS OF THE PROJECT AREA

Based on the stipulations of Ministerial Agreement 061 of the Ministry of the Environment, a Water Quality Analysis of the project area was carried out for this Environmental Impact Study: ***"Dredging of Piers 1, 2, 3, 4, 5 and 6, maneuvering area and access channel of Puerto Bolívar".***

Before proceeding with the sampling, a meeting was held to define the parameters to be analyzed in each sample with the members of the Consulting Team, technical staff of the Autonomous Provincial Government of El Oro as Cooperating Environmental Authority, and technical staff of the Ministry of Environment of the Provincial Directorate of El Oro as Competent Environmental Authority, in the Green Room of said Institution on Wednesday, March 24, 2017 *(meeting minutes are attached as Annex 6).*

With this background, the company Consultora Ecosfera Cía. Ltda. proceeded to contract the Laboratorio Grupo Químico Marcos of the city of Guayaquil, which is accredited by the Ecuadorian Accreditation Service, planning the sampling and analysis to be performed.

Photo 7: Water and Sediment Sampling Technical Team

Source: *Photograph taken by Consulting Team*
Location: *Puerto Bolívar – Machala, El Oro* ***Date:*** *March 29, 2017*

❖ LEGAL FRAMEWORK OF WATER QUALITY ANALYSIS

MINISTERIAL AGREEMENT 061: REFORM OF BOOK VI OF THE UNIFIED TEXT OF ENVIRONMENTAL LEGISLATION

CHAPTER VIII: QUALITY OF BIOTIC AND ABIOTIC COMPONENTS

· **Art. 192 Obligation**.- All natural or legal persons, public or private, community or mixed, national, or foreign, are obliged to submit to the norms contained in this Book, prior to the development of a work, activity, or project that may negatively alter the biotic and abiotic components in order to prevent and minimize the impacts, whether such work, activity or project is their responsibility, or when a third party carries it out.

· **Art. 193 Technical standards.-** In accordance with current legislation and the provisions of this Book, and in coordination with the competent agencies when appropriate, the National

Environmental Authority shall issue and periodically update the technical standards for the control and monitoring of the quality of biotic and abiotic components and the permissible limits and appropriate quality criteria through the corresponding legal body.

Any technical rule issued for the prevention and control of environmental pollution, as from the issuance of this Book, at a national, provincial, municipal, or sectoral level, shall be under the national environmental technical rule in force and, consequently, shall not diminish the level of environmental protection provided by it, under the principle of non-retroactivity.

Quality standards may be issued in the exercise of the powers that may correspond to the responsible Environmental Enforcement Authorities, as long as they are more stringent than those issued by the National Environmental Authority; for such purpose, the favorable report of the National Environmental Authority shall be required. If a regulation is issued despite not having this requirement, its illegality will be demanded.

In all cases, regulatory development will be based on at least the following criteria: by sector, activity, and ecosystem.

· **Art. 194 Evaluation, control, and monitoring.-** The National Environmental Authority, the responsible Environmental Enforcement Authorities, or the entities of the Decentralized National Environmental Management System, within the framework of their competencies, shall evaluate and control the quality of the biotic and abiotic components through the environmental control and monitoring mechanisms established in this Book, under the technical standards issued for this purpose.

· **Art. 195 Responsibility.-** The Competent Environmental Authority will in no case be responsible for emissions, discharges, and spills that contain different components or that do not comply with the established limits reported by the Control Subject, who will be liable in the administrative, civil, or criminal sphere. In addition to the imposition of administrative, civil, or criminal penalties for non-compliance with applicable environmental regulations, non-compliance with contingency measures for the cleanup, remediation, and restoration of a contaminated area, which in turn becomes a source of environmental contamination, may lead to the generation of environmental liabilities, the responsibility for which will fall on the person or persons who generated the contamination, on the Control Entity that fails to take immediate corrective measures and on whoever prevents the application of the appropriate corrective measures, as the case may be.

PARAGRAPH I: WATER

· **Art. 209 Water quality.-** These are the physical, chemical, and biological characteristics that establish water composition and make it suitable to satisfy the population's health, welfare, and ecological balance. The evaluation and control of water quality will be carried out with analytical procedures, sampling, and monitoring of discharges, spills, and receiving bodies; these guidelines are detailed in Annex I.

In any case, the Competent Environmental Authority may order the Control Subject responsible for discharges and spills to carry out sampling of its discharges as well as of the receiving water body.

All human activities must take the necessary preventive actions to avoid altering and ensure the quality and quantity of water in the watersheds, the alteration of the physical-chemical and biological composition of water sources due to discharges and liquid spills or disposal of waste in general or other negative actions on its components, will entail the corresponding penalties in each case.

Art. 210 Prohibition.- Under current legislation:

a) The use of water from any source, including groundwater, to dilute untreated liquid effluents, is prohibited;
b) Discharges and spills that exceed the permissible limits or corresponding quality criteria established in this Book, in the technical standards or annexes of application are prohibited;
c) The discharge and dumping of sewage or industrial waters into dry streams or water bodies or springs is prohibited; and,
d) The discharge and dumping of sewage or industrial water into water bodies whose minimum annual Flow is not able to support the discharge, i.e., that it exceeds the carrying capacity of the water body, is prohibited.

In coordination with the competent water authorities and regulatory agencies, the National Environmental Authority will establish the criteria under which the aforementioned water bodies' carrying capacity will be defined.

CHAPTER X
ENVIRONMENTAL CONTROL AND MONITORING

- **Art. 247 Scope of application.-** The Competent Environmental Authority will monitor and control all activities of the Subjects of Control, whether they are natural or legal persons, public or private, national, or foreign, that generate or may generate environmental impacts and risks, and whether they have the corresponding environmental permit or not. Environmental monitoring will be carried out on non-regularized or regularized activities using control and monitoring mechanisms for the activities carried out and compliance with applicable environmental regulations.

The environmental control and monitoring of activities that have not been regularized initiate the sanctioning procedure without prejudice to the Controlled Parties' regularization obligations and the legal actions that may be applicable.

- **Art. 248 Object.-** Verify compliance with environmental regulations and environmental obligations in the corresponding environmental permits, based on monitoring the evolution of environmental impacts and the effectiveness of prevention, impact mitigation, restoration, and compensation measures over time.

SAMPLINGS

- **Art. 257 Sampling.-** It is the activity of taking samples for environmental quality assessment purposes. In addition to the provisions established in the Environmental Monitoring Plan, sampling may require specific provisions on the sampling site, the timing of sampling, the type, and frequency of sampling, the sampling procedures or methods, the types of containers, and

preservation procedures for the sample according to the parameters to be analyzed. These should be based on Ecuadorian technical norms or, failing that, on internationally accepted norms or standards; a sample custody protocol should also be maintained.

Sampling must be carried out in compliance with the technical standards established for this purpose. The analyses must be carried out by laboratories whose parameters are accredited by the competent body.

For the sampling of discharges, emissions and spills, the Control Subject shall have adequate sites for sampling and gauging of the same and shall provide all the facilities for this purpose, as well as the data of the raw material and chemical products used, among others, so that the technical personnel in charge of the control can carry out their work in accordance with the provisions of the environmental technical standards.

Any characterization of discharges, emissions, or spills shall state the respective conditions and circumstances under which the samples were taken.

For sampling in receiving bodies, the area of influence of the emission or discharge and the temporality of the events shall be considered.

· **Art. 258 Sampling results information.-** When the Competent Environmental Authority carries out sampling for the control of emission, discharge, or spill, it shall inform the respective Control Subject of the results obtained, together with the pertinent technical observations.

MINISTERIAL AGREEMENT 097 A

ANNEX 1: ENVIRONMENTAL QUALITY AND EFFLUENT DISCHARGE STANDARD: WATER RESOURCE

This revised and updated environmental technical standard is issued under the Environmental Management Law and the Regulations to the Environmental Management Law for the Prevention and Control of Environmental Contamination and is subject to the provisions of these, is mandatory, and applies throughout the national territory.

This technical standard determines or establishes:

1. The basic principles and general approach to water pollution control.
2. The definitions of important terms and competencies of the different actors established in the law.
3. Water quality criteria for different uses.
4. Permissible limits, provisions, and prohibitions for discharges into bodies of water or sewage systems.
5. Discharge permissions
6. The parameters for monitoring discharges to water bodies and sewage systems from industrial or productive activities, public or private services
7. Methods and procedures to determine physical, chemical, and biological parameters with potential risk of water contamination.

- **OBJECT**

The purpose of the regulation is the Prevention and Control of Environmental Contamination concerning water resources.

This standard's main objective is to protect the quality of water resources to safeguard and preserve the assigned uses, the integrity of people, ecosystems and their interrelations, and the environment in general. Actions aimed at preserving, conserving or recovering water resources' quality must be carried out under the terms of this standard.

- **CLASSIFICATION**

Water quality criteria for different water uses:

1. Quality criteria for water intended for human consumption and domestic use before its potabilization.
2. Quality criteria for the preservation of aquatic life and wildlife in cold fresh waters or quality and in marine and estuarine waters
3. Water quality criteria for agricultural irrigation.
4. Quality criteria for water for livestock use.
5. Quality criteria for waters for recreational purposes
6. Quality criteria for water for aesthetic use.

GENERAL EFFLUENT DISCHARGE STANDARDS

GENERAL STANDARDS OF QUALITY CRITERIA FOR SURFACE, GROUND, MARINE AND ESTUARINE WATER USES

The standard will consider the following water uses:

a) Human Consumption and Domestic Use
b) Aquatic and Wildlife Preservation
c) Agricultural or Irrigation Use
d) Livestock Use
e) Recreational Use
f) Aesthetic Use

- **WATER QUALITY CRITERIA FOR THE PRESERVATION OF AQUATIC LIFE AND WILDLIFE IN FRESHWATER AND ESTUARINE MARINE WATERS**

The use of water for the preservation of aquatic and wildlife is understood as its use in activities aimed at maintaining the natural life of the associated ecosystems, without causing alterations in them, or for activities that allow the reproduction, survival, growth, extraction, and exploitation of bio-aquatic species in any forms, such as in cases of fishing or aquaculture.

The quality criteria for preserving aquatic life and wildlife in fresh, marine, and estuarine waters are presented in Table 2.

In addition to the parameters indicated in this standard, the following criteria shall be considered:

a) Natural condition (background value) plus 5%, if the natural turbidity varies between 0 and 50 NTU (Nephelometric Turbidity Unit)
b) Natural condition (background value) plus 10%, if the natural turbidity varies between 50 and 100 NTU, and

c) Absence of anthropogenic substances that produce changes in color, odor, and taste of the water in the receiving body, so as not to harm aquatic life and wildlife and also not to prevent the optimal use of the receiving body.

Table 51: Admissible quality criteria for the preservation of aquatic life and wildlife in fresh, marine, and estuarine waters

PARAMETERS	EXPRESSED AS	UNIT	QUALITY CRITERIA	
			SWEET WATER	SEA AND ESTUARINE WATER
Aluminum	Al	mg/l	0,1	1,5
Total Ammonia	NH3	mg/l	-	0,4
Arsenic	As	mg/l	0,05	0,05
Barium	Ba	mg/l	1,0	1,0
Beryllium	Be	mg/l	0,1	1,5
Polychlorinated biphenyls	Total PCBs concentration	µg/l	1,0	1,0
Boron	B	mg/l	0,75	5,0
Cadmium	Cd	mg/l	0,001	0,0,5
Cyanide	CN^-	mg/l	0,01	0,01
Zinc	Zn	mg/l	0,03	0,015
Total residual chlorine	Cl_2	mg/l	0,01	0,01
Chlorophenols		mg/l	0,05	0,05
Cobalt	Co	mg/l	0,2	0,2
Copper	Cu	mg/l	0,005	0,005
Total Chromium	Cr	mg/l	0,032	0,05
Tin	Sn	mg/l		2,00
Monohydric phenols	Expressed in phenols	mg/l	0,001	0,001
Oils and fats	Hexane-soluble substances	mg/l	0,3	0,3
Total petroleum hydrocarbons	TPH	mg/l	0,5	0,5
Iron	Fe	mg/l	0,3	0,3
Manganese	Mn	mg/l	0,1	0,1
Floating matter of anthropic origin	Visible		Absence	Absence
Quicksilver	Hg	mg/l	0,0002	0,0001
Nickel	Ni	mg/l	0,025	0,1
Dissolved Oxygen	OD	% saturation	>80	>60
Pyrethroids	Total pyrethroid concentration	mg/l	0,05	0,05
Total organochlorine pesticides	Total Organochlorine	µg/l	10,0	10,0
Total organophosphorus pesticides	Total Organophosphorus	µg/l	10,0	10,0
Silver	Ag	mg/l	0,01	0,005
Lead	Pb	mg/l	0,001	0,001
Potential Hydrogen	pH	pH units	6,5 - 9	6,5 – 9,5
Selenium	Se	mg/l	0,001	0,001

PARAMETERS	EXPRESSED AS	UNIT	QUALITY CRITERIA	
			SWEET WATER	SEA AND ESTUARINE WATER
Surfactants	Methylene blue active substances	mg/l	0,5	0,5
Nitrites	NO_2	mg/l	0,2	
Nitrites	NO_3	mg/l	13	200
DQO	DQO	mg/l	40	-
DBO5	DBO5	mg/l	20	-
Total Suspended Solids	SST	mg/l	Max. 10% increase in natural condition	-

Source: *Ministerial Agreement 097 A, Annex 1, Table 2*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 6, 2017*

In the case of water bodies in which there is a presumption of contamination, the control subject must also analyze fecal coliforms to establish the level of affectation and variation in the concentration of fecal coliforms in the area of influence.

❖ SAMPLING POINTS OF WATER QUALITY ANALYSIS

The water quality sampling points, as mentioned above, were determined in a meeting with technical personnel from the Competent Environmental Authority (Ministry of the Environment), technical personnel from the Cooperating Environmental Authority (Autonomous Provincial Government of El Oro), and members of the consulting team, and the following points were determined:

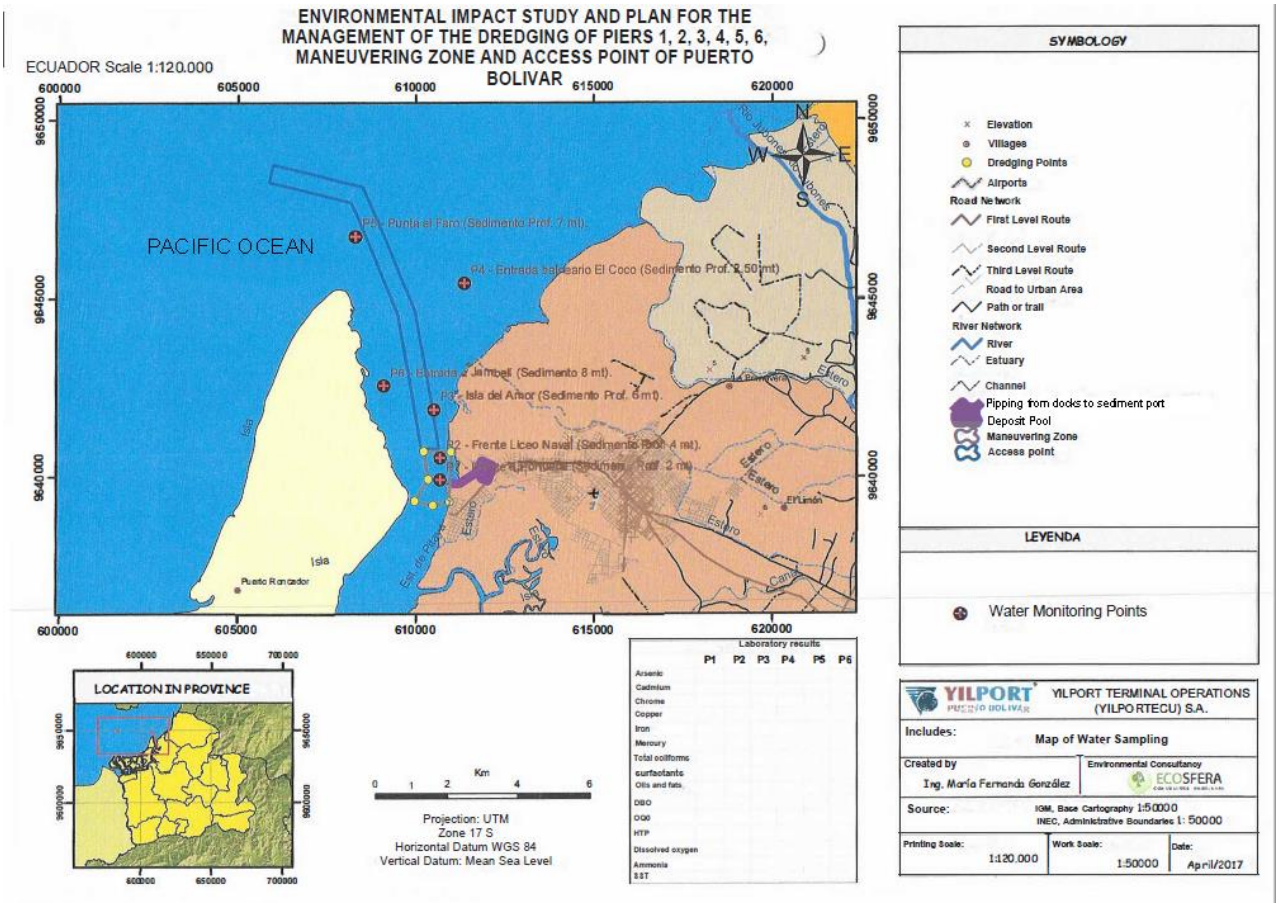
Table 52: Water Quality Sampling Points

SAMPLING No.	SAMPLING POINT	Coordinates	Sampling Time
SAMPLING 1	In front of Port Authority	X: 610680 Y: 9639902	11:35
SAMPLING 2	In front of the Navy School	X: 610682 Y: 9640521	11:19
SAMPLING 3	Isla del Amor	X: 610505 Y: 9641879	10:59
SAMPLING 4	El Coco Spa Entrance	X: 611365 Y: 9645418	10:31
SAMPLING 5	El Faro Point	X: 608302 Y: 9646721	09:03
SAMPLING 6	Jambeli Entrance	X: 609094 Y: 9642541	09:37
SAMPLING 7	Altamar Between Puna Island and Santa Clara Island	X: 585628 Y: 9651120	14:00

Prepared by: *Ecosfera Cía. Ltda., 2017*
Source: *Grupo Quimico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 21, 2017*

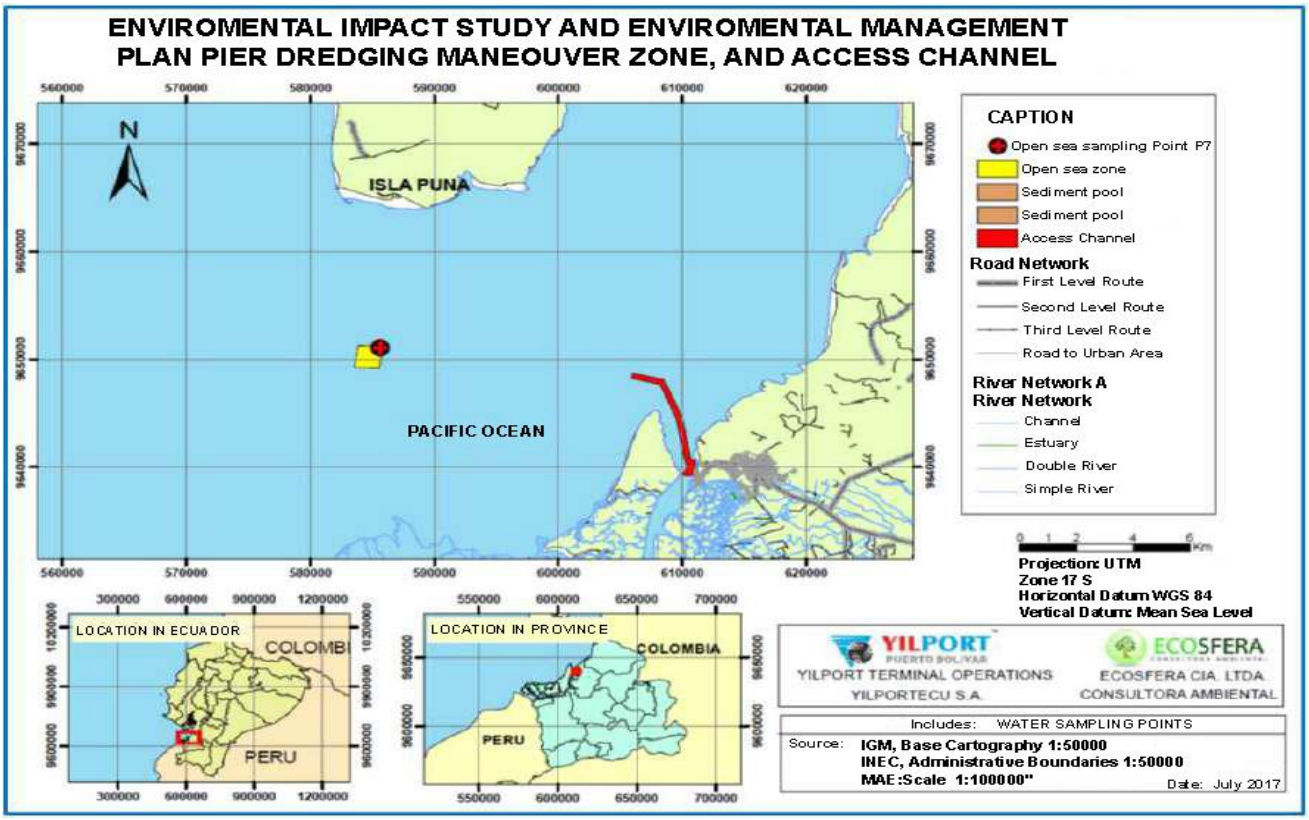
Samples 1, 2, 3, 4, 5, and 6 were specific and simple at 0.60 meters depth, on Friday, March 17, 2017, and Sample 7 on July 16, 2017, following sampling Technical Standard INEN 2169:98 – 2176:98.

Figure 108: Water Quality Sampling Points 1, 2, 3, 4, 5, and 6



Source: *Www.geoportaligm.gob.ec, Military Geographic Institute*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Bolivar Port - Machala, Santa Rosa - El Oro*
Date: *April 6, 2017*

Figure 109: Open Sea Sampling Point



Source: *Www.geoportaligm.gob.ec, Military Geographic Institute*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Bolivar Port - Machala, Santa Rosa - El Oro*
Date: *July 20, 2017*

Photography 8: Water sample collection Point 1

SAMPLE 1
In front of Port Authority



Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Santa Rosa Marsh, Santa Rosa - El Oro*
Date: *March 29, 2017*

Photography 9: Water sample collection Point 2

SAMPLE 2
Next to the naval school

Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Santa Rosa Marsh, Santa Rosa - El Oro*
Date: *March 29, 2017*

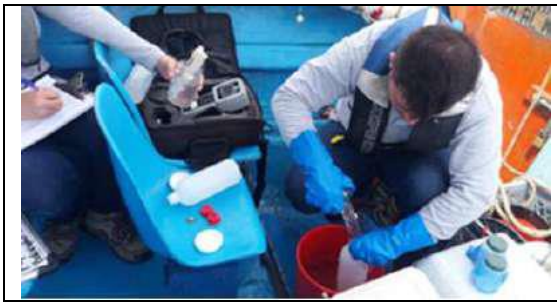
Photography 10: Water sample collection Point 3

SAMPLE 3 **Isla del Amor**	
	
	

Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Santa Rosa Marsh, Santa Rosa - El Oro*
Date: *March 29, 2017*

Photography 11: Water sample collection Point 4

SAMPLE 4 **Entrance to the Health Resort El Coco**


Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Santa Rosa Marsh, Santa Rosa - El Oro*
Date: *March 29, 2017*

Photography 12: Water sample collection Point 5

SAMPLE 5
Punta El Faro



Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Santa Rosa Marsh, Santa Rosa - El Oro*
Date: *March 29, 2017*

Photography 13: Water sample collection Point 6

SAMPLE 6
Entrance to Jambeli




Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Santa Rosa Marsh, Santa Rosa - El Oro*
Date: *March 29, 2017*

WATER QUALITY EVALUATION PARAMETERS

The parameters determined for water quality analysis are physical and chemical. The parameters to analyze are:

Table 53: Parameters to be analyzed re. Water Quality

PARAMETERS
Arsenic
Cadmium
Total chromium
Copper
Iron
Mercury
Fecal coliforms
Surfactants - Detergents
Oils and Fats
Biochemical Oxygen Demand
Chemical Oxygen Demand
Total Petroleum Hydrocarbons
Dissolved Oxigen in situ
Ammonia
Total suspended solids

Prepared by: *Ecosfera Cia. Ltda.*
Source: *Test Report Grupo Químico Marcos*
Date: *April 21, 2017*

- **ARSENIC**

Arsenic (As) is a quite common element in the atmosphere, in rocks and soils, in the hydrosphere and the biosphere. It is mobilized into the environment through a combination of processes that include both natural processes (weathering, biological activity, volcanic emissions) as well as anthropogenic processes (mining activity, use of fossil fuels, use of pesticides, herbicides, desiccants, wood preservatives, and use as feed additives).
Arsenic is an extremely toxic element for the human organism. And not only in high concentrations, where exposure causes acute effects that can become lethal, but also long-term exposure to low relative concentrations of arsenic. For this reason, arsenic in surface water (rivers, lakes, reservoirs) and groundwater (aquifers) that can be used for drinking constitutes a major threat to health. This has led organizations such as the World Health Organization (WHO), the European Union (Directive 98/83) or the United States Environmental Protection

Agency (USEPA) to reduce the limit for arsenic content in drinking water from 50 to 10 µg/l (e.g., WHO, 1993). High arsenic contents have been cited from natural waters in a variety of environments, although the highest concentrations are found in groundwaters (Smedley and Kinninurgh, 2002). High concentrations in the latter are not restricted to certain conditions or environments, appearing in aquifers under oxidizing and high pH conditions, aquifers under reducing conditions, aquifers with geothermal circulation, aquifers affected by processes linked to mining activity or related to mineral deposits, and aquifers linked to other anthropogenic processes.

However, most of the aquifers with high arsenic contents have an origin linked to natural geochemical processes. Unlike anthropogenic contamination, which is more local in nature, naturally occurring high arsenic concentrations affect large areas. The numerous cases of natural arsenic "contamination" of groundwaters that exist in the world are related to quite different geological environments: Metasediments with mineralized seams, volcanic formations, volcano-sedimentary formations, mining districts, present-day hydrothermal systems, tertiary and quaternary alluvial basins, etc. (Boyle et al, 1998; BGS and DPHE, 2001; Smedley and Kinniburgh, 2002).

Prolonged exposure to inorganic arsenic, mainly through the consumption of contaminated water or food prepared with it, and food crops irrigated with arsenic-rich water can cause chronic intoxication. The most characteristic effects are the appearance of skin lesions and skin cancer.

Arsenic poses a significant threat to public health when found in contaminated groundwaters. Inorganic arsenic is naturally present at high levels in groundwaters in several countries, including Argentina, Bangladesh, Chile, China, India, Mexico, and the United States of America. The main sources of exposure are: Drinking water, crops irrigated with contaminated water, and food prepared with contaminated water.

Fish, seafood, meats, poultry, dairy products, and cereals can also be dietary sources of arsenic, although exposure through these foods is usually much lower than exposure through contaminated groundwater. In seafood, arsenic is present mainly in its less toxic organic form.

The mean value of arsenic concentration in open seawater generally shows truly little variation and is around 1.5 µg l-1 (Navarro et al. 1993). In contrast to these values, concentrations in estuarine environments are more variable, because of inland water inputs and local variations in salinity and redox gradients, although they remain in most cases, not anthropogenically affected, below 4 µg l-1. In these mixed environments, complex physicochemical processes take place because of the mixing of waters of different density, temperature, pH, salinity - processes that can control the entry of arsenic from land

into the sea (e.g., flocculation of iron oxide colloids at the freshwater-saltwater interface contributes to the reduction of arsenic flux to the sea according to Cullen and Reimer, 1989).

- **CADMIUM**

Relatively rare chemical element, symbol Cd, atomic number 48; it is closely related to zinc, with which it is associated in nature. Cadmium is divalent in all its stable compounds, and its ion is colorless.
Cadmium is not found in its free state in nature, and greenockite (cadmium sulfide), the only cadmium ore, is not a commercial source of the metal. Almost all that is produced is obtained as a by-product of the smelting and refining of zinc ores, which generally contain 0.2 to 0.4%. The United States, Canada, Mexico, Australia, Belgium, Luxembourg, and the Republic of Korea are important sources, although producers are not all producers.
In the past, an important commercial use of cadmium was as an electroplating coating deposited on iron or steel to protect against corrosion. The second application is in nickel-cadmium batteries, and the third is as a chemical reagent and pigment.
Large amounts of cadmium are naturally released into the environment, over 25,000 tons per year. Half of this cadmium is released into rivers through the decomposition of rocks and some cadmium is released into the air through forest fires and volcanoes. The rest of the cadmium is released by human activities, such as manufacturing.
Cadmium-containing wastewater from industries mostly ends up in soils. The causes of these waste streams are e.g., zinc production, phosphate ores and manure bio-industries. Cadmium from waste streams can also enter the air by burning municipal waste and burning fossil fuels.
Cadmium is strongly adsorbed by soil organic matter. When cadmium is present in the soil, it can be extremely hazardous, and food uptake can increase. Soils that are acidic increase the uptake of cadmium by plants. This is potentially harmful to animals that depend on plants for survival. Cadmium can accumulate in their bodies, especially when they eat many different plants.
In aquatic ecosystems cadmium can bioaccumulate in oysters, shrimps, lobsters, and fish. Cadmium susceptibilities can vary widely among aquatic organisms. Saltwater organisms are known to be more resistant to cadmium poisoning than freshwater organisms.

- **TOTAL CHROMIUM**

Chemical element, symbol Cr, atomic number 24, atomic weight 51.996; it is a silvery-white, hard, and brittle metal. However, it is relatively soft and ductile when unstressed or very

pure. Its main uses are producing anticorrosive alloys of high hardness and heat resistance and as a coating for galvanizing. The elemental chromium is not found in nature. Its most important mineral by abundance is chromite.
Its mechanical properties, including hardness and tensile strength, determine usability. Chromium has a relatively low capacity for forging, rolling, and handling properties. However, when absolutely free of oxygen, hydrogen, carbon and nitrogen, it is very ductile and can be forged and handled. It is difficult to store it free of these elements. (Wright J, 2003)
There are several different classes of chromium that differ in their effects on organisms. Chromium enters the air, water, and soil in the form of chromium (III) and chromium (VI) through natural processes and human activities.
The major human activities that increase chromium (III) concentrations are the steel and textile industries, electrical painting, and other industrial applications of chromium (VI).
These applications will increase the concentrations of chromium in water. Through the combustion of coal, the chromium will also be emitted to water and eventually dissolve.
Crops contain systems to manage chromium uptake so that it is low enough not to cause cancer. But when the amount of chromium in the soil increases, this can increase concentrations in crops. Soil acidification can also influence chromium uptake by crops. Plants usually take up only chromium (III).
Chromium is not known to accumulate in fish, but high concentrations of chromium, due to metals' availability in surface waters, can damage the gills of fish swimming near the point of discharge. In animals chromium can cause respiratory problems, low availability can lead to disease, birth defects, infertility, and tumor formation. (Greenwoo and Earnshaw. 1997)

- **COPPER**

Symbol is Cu, it is the chemical element with atomic number 29. It is a transition metal with a reddish color and metallic luster that, together with silver and gold, is part of the so-called copper family, characterized by being one of the best conductors of electricity (second only to silver).
Thanks to its high electrical conductivity, ductility, and malleability, it has become the most widely used material for manufacturing electrical cables and other electrical and electronic components. It is the third most used metal in the world, after iron and aluminum.
It has an atomic weight of 63.546 and has two stable isotopes (63Cu and 65Cu), although nine radioactive isotopes are also known. Its melting point is 1083.0 ± 0.1ºC and the normal boiling point is 2595ºC. This metal can be found on the continent as a deposit in soils, in rivers, either in the water or in the sediments on their banks due to copper-contaminated wastewater discharge.

It can also be found in the air, released by natural processes (dust storms, forest fires and marine aerosols) or anthropogenic processes (industrial activity, mining, etc.). It can be transported long distances in surface waters, either as a free ion or adsorbed on sludge particles.
It can also be found in sediments, interstitial waters, manganese nodules, and even in sediments of hydrothermal origin in the oceans. It is therefore a metal with a wide dispersion within the earth system.
Copper is characterized as an essential micronutrient for marine producers, but it can also become toxic when its concentration exceeds certain levels. Thus, it is interesting to know the concentration and chemical species that can affect organisms in the marine environment. Several studies in algal cultures have shown that copper toxicity is related to the concentration of free copper ions rather than to the total Cu concentration in the medium (Sunda and Guillard, 1976; Oxidation of Cu (I) in seawater 14 Anderson and Morel, 1978; Vermeij, 1991), so that it is the concentration of free ionic copper that determines the toxicity of the metal. (González, A. Oxidación de Cobre en agua de mar. 2006).
Although copper is a trace element necessary for life, high copper levels in the body can be harmful to health. Inhalation of high levels of copper can irritate the respiratory tract. Ingestion of high levels of copper can cause nausea, vomiting and diarrhea. Excess copper in the blood can damage the liver and kidneys and even cause death.
Oral ingestion of 30 g of copper sulfate is potentially lethal in humans.
Copper reacts with strong oxidizers such as chlorates, bromates and iodides, creating an explosion hazard. In addition, the use of personal protective equipment such as gloves, goggles and face masks may be necessary. In addition, it may be advisable for workers to shower and change clothes before returning home each day. (ecured.cu)

- **IRON**

Iron is the fourth most abundant chemical element in the earth's crust and makes up about 4% of the total mass. It is an essential micronutrient for all living things. The most important source of iron in the oceans is dust, which comes almost entirely from the Earth's desert areas.
There are large oceans regions where nutrients such as nitrogen and phosphorus are abundant, yet there is little phytoplankton. These areas are far from deserts and we think it is the lack of iron that prevents phytoplankton from growing.
The atmosphere is probably the major source of iron for the oceans, and such iron generally comes from dust formed by wind erosion of soils. The dust comes mainly from arid and semi-arid desert regions, most of which are in the Northern Hemisphere's mid-latitudes. The amount of dust produced by deserts depends on

the amount of precipitation and wind strength. The highest concentrations of dust have been observed near deserts, while the lowest concentrations are seen in the Southern Ocean's air near Antarctica, as this is the region farthest from the desert.
Large dust particles are quickly separated from the atmosphere, but particles with a diameter of less than 10 μm (i.e., 0.00001 m) can travel long distances. The wind causes the particles to rise rapidly into the air, up to 5 km over the Atlantic and 8 km over the Pacific. Dust from the Sahara takes about a week to cross the Atlantic Ocean and dust from the Chinese deserts takes about two weeks to cross the Central Pacific Ocean. Dust particles can be released from the air as dry particles or can be surrounded by water droplets and enter the oceans as rain. (Spoke, L. Environmental Sciences, 2003)

- **MERCURY**

Chemical element, symbol Hg, atomic number 80, and atomic weight 200.59. It is a silvery-white liquid at room temperature (melting point -38.4ºC or -37.46ºF); it boils at 357ºC (675.05ºF) at atmospheric pressure. It is a noble metal, soluble only in oxidizing solutions. Solid mercury is as soft as lead. The metal and its compounds are very toxic. Mercury forms solutions called amalgams with some metals (e.g., gold, silver, platinum, uranium, copper, lead, sodium, and potassium).
The surface tension of liquid mercury is 484 dynes/cm, six times higher than that of water in contact with air. Therefore, mercury cannot wet any surface with which it is in contact.
Mercury enters the environment because of the breakdown of minerals in rocks and soils through exposure to wind and water. The release of mercury from natural sources has remained at the same level over the years. Yet the concentrations of mercury in the environment are increasing; this is due to human activity.
Most of the mercury released by human activities is released into the air through the burning of fossil fuels, mining, smelting and solid waste combustion.
Some forms of human activities release mercury directly to soil or water, for example, fertilizer application in agriculture and industrial wastewater discharges. All mercury that is released into the environment will eventually end up in soils or surface waters.
The effects of mercury in animals are kidney damage, stomach disorders, intestinal damage, reproductive failure, and DNA alteration.
At greater depths, algae can be decomposed by aquatic bacteria and if this decomposition process occurs in the presence of mercury, the formation of methylmercury takes place. Thus, once this organic mercury has formed, it enters the food chain through marine fish such as tuna.

Methylmercury is a highly toxic form of mercury that rapidly accumulates in the food chain to levels that can cause serious health problems for those who consume seafood. (Wright J, 2003)

- **FECAL COLIFORMS**

The name coliforms are given to that group of bacteria with certain biochemical characteristics in common and are of great importance as indicators of water and food contamination.
The term coliforms comes from Coli, the main bacterium of this group, which is Escherichia coli. As already known, E. Coli bacteria are of fecal origin; to distinguish the others that are not of fecal origin, the term total coliforms is used, and those of intestinal or fecal origin are called fecal coliforms.
These terms help differentiation since it gives more veracity and a high degree of certainty if the water contamination is of fecal origin.
Fecal coliform tests are sufficiently simple to assess fecal contamination of water and food.
The human body excretes large amounts of fecal coliforms daily.
Because one of the primary objectives of wastewater treatment is to prevent wastewater from becoming a focus of infectious disease, it is of particular interest to reduce these coliforms to levels that can be eliminated in nature.

- **SURFACTANTS – DETERGENTS**

Surfactants are substances that influence the contact surface between two phases (e.g., two liquids insoluble in each other) by means of surface tension. When used in household technology, they are referred to as emulsifiers or emulsifying agents, i.e., substances that make it possible to achieve or maintain an emulsion.
Surfactants include synthetic substances that are extensively used in washing, including products such as laundry detergents, dishwashing detergents and products for removing dust from surfaces.
Surfactant systems are of enormous industrial interest due to their many technological applications. All sectors of the chemical industry use them in the production or application of their products. They are essential in the pharmaceutical, food, cosmetics, textile, pigment, paint, and lubricant industries, among others. The surfactant industry consumes large quantities of petrochemical raw materials such as linear alkanes, 1-alkenes, n-alcohols, alkylbenzenes and ethylene oxide, among others, and natural fats. (Química orgánica industrial.com)

- **OILS AND FATS**

Fats and oils are organic compounds consisting mainly of fatty acids of animal and vegetable origin and petroleum hydrocarbons.

It applies to a wide variety of organic substances that are extractable from solution or aqueous suspension with hexane or trichloro trifluoroethane (freon); chemically fats and oils, are esters of glycerol with fatty acids. The main compounds dissolved by these solvents are hydrocarbons, esters, oils, waxes, and high molecular weight fatty acids.
All these compounds produce a "greasy feel" and are associated with grease-related problems in waste treatment. Motor oil is an oil used to lubricate various internal combustion engines.
Motor oils are derived from synthetic petroleum chemical compounds and other products used in the manufacture of synthetic oil. Motor oil consists mainly of hydrocarbons, organic compounds composed entirely of carbon and hydrogen.

- **BIOCHEMICAL OXYGEN DEMAND (BOD)**

Biochemical Oxygen Demand (B.O.D.) of a liquid is defined as the amount of oxygen that microorganisms, especially bacteria (aerobic or facultative anaerobes: Pseudomonas, Escherichia, Aerobacter, Bacillus), fungi and plankton, consume during the degradation of the organic substances contained in the sample. It is expressed in mg / l.
It is an indispensable parameter for determining the state or quality of water in rivers, lakes, lagoons, or effluents.
The more organic matter the sample contains, the more oxygen its microorganisms need to oxidize (degrade) it.
As the decomposition process varies with temperature, this analysis is performed in standard form for five days at 20 °C; this is indicated as B.O.D.5.
According to the regulations, maximum B.O.D. values are set for wastewater to be discharged into rivers and other watercourses. According to these values, it is established if it is possible to discharge them directly or if they must undergo a previous treatment. (Ferrero, J.M., 1974 - Duran, D. and Lara, A., 1994).

- **CHEMICAL OXYGEN DEMAND**

Chemical Oxygen Demand (COD) is defined as any substance, both organic and inorganic, that can be oxidized by a strong oxidant. The amount of oxidant consumed is expressed in terms of its equivalence in oxygen. COD is expressed in mg/l O2.
The COD method is often used to measure contaminants in natural and waste waters and to evaluate the strength of wastes such as municipal and industrial wastewater. The COD method is also used in applications in power plants, chemical industry, paper industry, laundries, environmental assessments, and general education.

- **TOTAL PETROLEUM HYDROCARBONS**

The term total petroleum hydrocarbons (abbreviated TPH) is used to describe a large family of several hundred chemical compounds originating from crude oil. Because there are so many different chemicals

in crude oil and other petroleum products, it is impractical to measure each separately.
How an oil spill drifts at sea is determined by several environmental factors: current speed and direction (including tidal), wind speed and direction, and wave system.
Some TPH are colorless or light-colored liquids that evaporate easily, while others are thick, dark-colored, or semi-solid liquids that do not evaporate. Many of these products have a characteristic odor of gasoline, kerosene, or oil.

- **DISSOLVED OXIGEN**

Clean surface waters are usually saturated with oxygen, which is essential for life. Low dissolved oxygen levels indicate contamination with organic matter, poor water quality and an inability to support certain forms of life. (Echarri, Luis. 2007).
Dissolved oxygen (DO) is necessary for respiration of aerobic microorganisms as well as other aerobic life forms. However, oxygen is only slightly soluble in water; the actual amount of oxygen that may be present in solution is determined by a) the solubility of the gas, b) the partial pressure of the gas in the atmosphere.

- **AMMONIA**

It is a chemical compound in its natural gaseous state, widely used in the chemical industry and as a refrigerant. It dissolves easily in water forming ammonia water. It is a very corrosive and toxic substance, so its handling requires safety measures to avoid damage to health and even death.
Liquid ammonia is a very efficient refrigerant used in refrigeration machines and in ice making.
It is also used in the fertilizer industry as an essential raw material to produce nitrogenous fertilizers: Urea, ammonium nitrate and others. As it removes temporary hardness from water, it is used for cleaning and washing, with the consequent saving of soap.
The presence of ammonia in rivers and aqueducts generally indicates the existence of agricultural or civilian pollutants. If excessive, it alters the odor and taste of drinking water. In both freshwater and seawater fisheries, the control of ammonia is important, as it is highly toxic to human life. Mujlionov, I. P. 1985.

- **TOTAL SUSPENDED SOLIDS**

The term solids refers to matter suspended or dissolved in an aqueous medium.

❖ WATER QUALITY ANALYSIS METHODS

The analysis of dissolved compounds in water is based on standardized methods, which include a series of procedures both in the field and

in the laboratory. These procedures include a series of physical, chemical, and biological measurements.

To determine the values and concentrations of the parameters determined, the methods established in the manual "Standard Methods for the Examination of Water and Wastewater" should be applied in its most recent edition. In addition, the following standards of the Ecuadorian Institute for Standardization (INEN) should be considered

- Ecuadorian Technical Standard NTE INEN 2169:98. Water: Water quality, sampling, handling and conservation of samples.
- Ecuadorian Technical Standard NTE INEN 2176:98. Water: Water quality, sampling, sampling techniques.

Depending on the parameters to be analyzed for each of the samples, the following methods were used for the analysis:

Table 54: Water Quality Analysis Methods

PARAMETERS	METHOD
Arsenic	PEE – GQM – FQ - 33
Cadmium	PEE – GQM – FQ - 33
Total chrome	PEE – GQM – FQ - 33
Copper	PEE – GQM – FQ - 33
Iron	PEE – GQM – FQ - 33
Mercury	ICP - OES
Fecal coliforms	9222 D
Surfactants - Detergents	PEE – GQM – FQ - 21
Oils and Fats	PEE – GQM – FQ - 03
Biochemical Oxygen Demand	PEE – GQM – FQ - 05
Chemical Oxygen Demand	PEE – GQM – FQ - 04
Total Petroleum Hydrocarbons	PEE – GQM – FQ - 07
Dissolved oxygen in situ	PEE – GQM – FQ - 65
Ammonia	PEE – GQM – FQ - 31
Total Suspended Solids	PEE – GQM – FQ - 06

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

❖ WATER QUALITY ANALYSIS EQUIPMENT AND MATERIALS

The following is a general list of the implements required at the time of sampling:

- Global Positioning System (GPS).
- Portable equipment for temperature, pH and electrical conductivity measurements.
- 10 L capacity plastic buckets

- Isopor or polyurethane cooler with enough ice packs to maintain a temperature close to 4°C.
- Absorbent paper towel.
- Ballpoint pen and indelible ink marker.
- Board
- Gloves
- Plastic and glass containers.
- Comfortable coveralls or work clothes that provide adequate protection

❖ WATER QUALITY ANALYSIS RESULTS

The following tables and graphs detail the results obtained in the samples from the six water quality sampling points and their relationship with the maximum permissible limit established in the current environmental legislation.

SAMPLE 1: IN FRONT OF PORT AUTHORITY

Table 55: Results Water Sample 1

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/l	**<0,0031**	0,05
Cadmium	mg/l	**<0,0004**	0,005
Total chrome	mg/l	**<0,0024**	0,05
Copper	mg/l	**<0,0037**	0,005
Iron	mg/l	**<0,0047**	0,3
Mercury	NMP/100 ml	**<0,00500**	0,0001
Fecal coliforms	mg/l	**2**	---
Surfactants - Detergents	mg/l	**0,027**	0,5
Oils and Fats	mg/l	**<0,44**	0,3
Biochemical Oxygen Demand	mgO2/l	**9,12**	---
Chemical Oxygen Demand	mgO2/l	**18**	---
Total Petroleum Hydrocarbons	mg/l	**<0,04**	0,5
Dissolved oxygen in situ	mgO2/l	**5,17**	>5
Ammonia	mg/l	**0,06**	0,4
Total Suspended Solids	mg/l	**106**	---

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

SAMPLE 2: IN FRONT OF NAVAL SCHOOL

Table 56: Results Water Sample 2

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/l	**<0,0031**	0,05
Cadmium	mg/l	**<0,0004**	0,005
Total chrome	mg/l	**<0,0024**	0,05
Copper	mg/l	**<0,0037**	0,005
Iron	mg/l	**<0,0047**	0,3
Mercury	NMP/100 ml	**<0,00500**	0,0001
Fecal coliforms	mg/l	**2**	---
Surfactants - Detergents	mg/l	**0,045**	0,5
Oils and Fats	mg/l	**<0,44**	0,3
Biochemical Oxygen Demand	mgO2/l	**19**	---
Chemical Oxygen Demand	mgO2/l	**36**	---
Total Petroleum Hydrocarbons	mg/l	**<0,04**	0,5
Dissolved oxygen in situ	mgO2/l	**4,65**	>5
Ammonia	mg/l	**<0,036**	0,4
Total Suspended Solids	mg/l	**87**	---

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

SAMPLE 3: ISLA DEL AMOR

Table 57: Results Water Sample 3

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/l	**<0,0031**	0,05
Cadmium	mg/l	**<0,0004**	0,005
Total chrome	mg/l	**<0,0024**	0,05
Copper	mg/l	**<0,0037**	0,005
Iron	mg/l	**<0,0047**	0,3
Mercury	NMP/100 ml	**<0,00500**	0,0001
Fecal coliforms	mg/l	**1**	---
Surfactants - Detergents	mg/l	**0,016**	0,5
Oils and Fats	mg/l	**<0,44**	0,3
Biochemical Oxygen Demand	mgO2/l	**18**	---
Chemical Oxygen Demand	mgO2/l	**34**	---
Total Petroleum Hydrocarbons	mg/l	**<0,04**	0,5
Dissolved oxygen in situ	mgO2/l	**5,93**	>5
Ammonia	mg/l	**<0,036**	0,4
Total Suspended Solids	mg/l	**66**	---

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

SAMPLE 4: ENTRANCE TO THE HEALTH RESORT EL COCO

Table 58: Results Water Sample 4

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/l	**<0,0031**	0,05
Cadmium	mg/l	**<0,0004**	0,005
Total chrome	mg/l	**<0,0024**	0,05
Copper	mg/l	**<0,0037**	0,005
Iron	mg/l	**<0,0047**	0,3
Mercury	NMP/100 ml	**<0,00500**	0,0001
Fecal coliforms	mg/l	**2**	---
Surfactants - Detergents	mg/l	**0,016**	0,5
Oils and Fats	mg/l	**<0,44**	0,3
Biochemical Oxygen Demand	mgO2/l	**20**	---
Chemical Oxygen Demand	mgO2/l	**40,2**	---
Total Petroleum Hydrocarbons	mg/l	**<0,04**	0,5
Dissolved oxygen in situ	mgO2/l	**6,32**	>5
Ammonia	mg/l	**<0,036**	0,4
Total Suspended Solids	mg/l	**93**	---

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

SAMPLE 5: PUNTA EL FARO

Table 59: Results Water Sample 4

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/l	**<0,0031**	0,05
Cadmium	mg/l	**<0,0004**	0,005
Total chrome	mg/l	**<0,0024**	0,05
Copper	mg/l	**<0,0037**	0,005
Iron	mg/l	**<0,0047**	0,3
Mercury	NMP/100 ml	**<0,00500**	0,0001
Fecal coliforms	mg/l	**5**	---
Surfactants - Detergents	mg/l	**0,016**	0,5
Oils and Fats	mg/l	**<0,44**	0,3
Biochemical Oxygen Demand	mgO2/l	**17**	---
Chemical Oxygen Demand	mgO2/l	**32**	---
Total Petroleum Hydrocarbons	mg/l	**<0,04**	0,5
Dissolved oxygen in situ	mgO2/l	**6,64**	>5
Ammonia	mg/l	**<0,036**	0,4
Total Suspended Solids	mg/l	**182**	---

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

SAMPLE 6: ENTRANCE TO JAMBELI

Table 60: Results Water Sample 6

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/l	**<0,0031**	0,05
Cadmium	mg/l	**<0,0004**	0,005
Total chrome	mg/l	**<0,0024**	0,05
Copper	mg/l	**<0,0037**	0,005
Iron	mg/l	**<0,0047**	0,3
Mercury	NMP/100 ml	**<0,00500**	0,0001
Fecal coliforms	mg/l	**8**	---
Surfactants - Detergents	mg/l	**0,016**	0,5
Oils and Fats	mg/l	**<0,44**	0,3
Biochemical Oxygen Demand	mgO2/l	**23**	---
Chemical Oxygen Demand	mgO2/l	**44**	---
Total Petroleum Hydrocarbons	mg/l	**<0,04**	0,5
Dissolved oxygen in situ	mgO2/l	**5,95**	>5
Ammonia	mg/l	**<0,036**	0,4
Total Suspended Solids	mg/l	**177**	---

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

SAMPLE 7: OFFSHORE
(Between Isla Puna and Isla Santa Clara)

Table 61: Results Water Sample 7

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/l	**<0,0031**	0,05
Cadmium	mg/l	**<0,0004**	0,005
Total chrome	mg/l	**<0,0024**	0,05
Copper	mg/l	**<0,0037**	0,005
Iron	mg/l	**<0,0047**	0,3
Mercury	NMP/100 ml	**<0,00500**	0,0001
Fecal coliforms	mg/l	**<1**	---
Surfactants - Detergents	mg/l	**<0,023**	0,5
Oils and Fats	mg/l	**<0,44**	0,3
Biochemical Oxygen Demand	mgO2/l	**4,02**	---
Chemical Oxygen Demand	mgO2/l	**16,00**	---
Total Petroleum Hydrocarbons	mg/l	**<0,04**	0,5
Dissolved oxygen in situ	mgO2/l	**6,02**	>5
Ammonia	mg/l	**<0,034**	0,4
Total Suspended Solids	mg/l	**56**	---

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

❖ ANALYSIS OF WATER QUALITY RESULTS

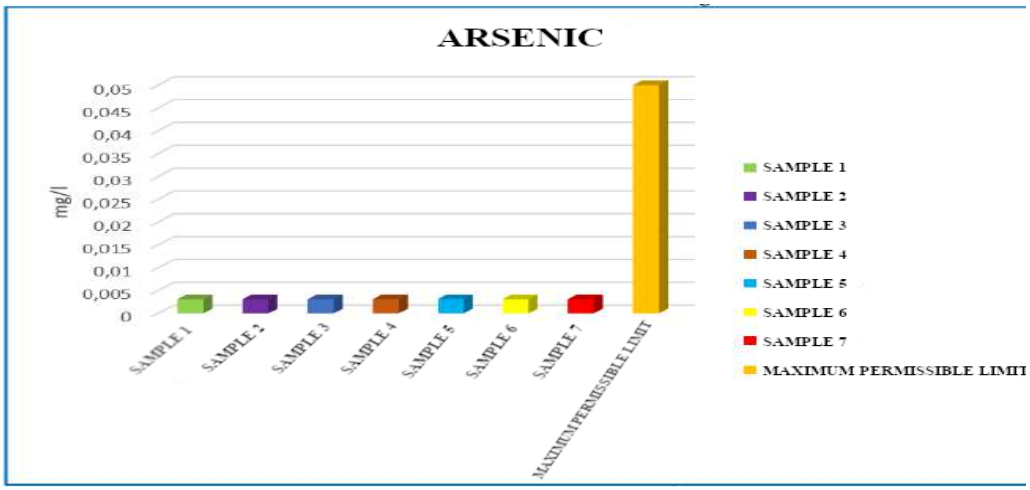
RESULTS ARSENIC

Table 62: Results Arsenic in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,0031**	0,05
SAMPLE 2: In front of Naval School	mg/l	**<0,0031**	0,05
SAMPLE 3: Isla del Amor	mg/l	**<0,0031**	0,05
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,0031**	0,05
SAMPLE 5: Punta El Faro	mg/l	**<0,0031**	0,05
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,0031**	0,05
SAMPLE 7: Offshore	mg/l	**<0,0031**	0,05

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 110: Results Arsenic in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

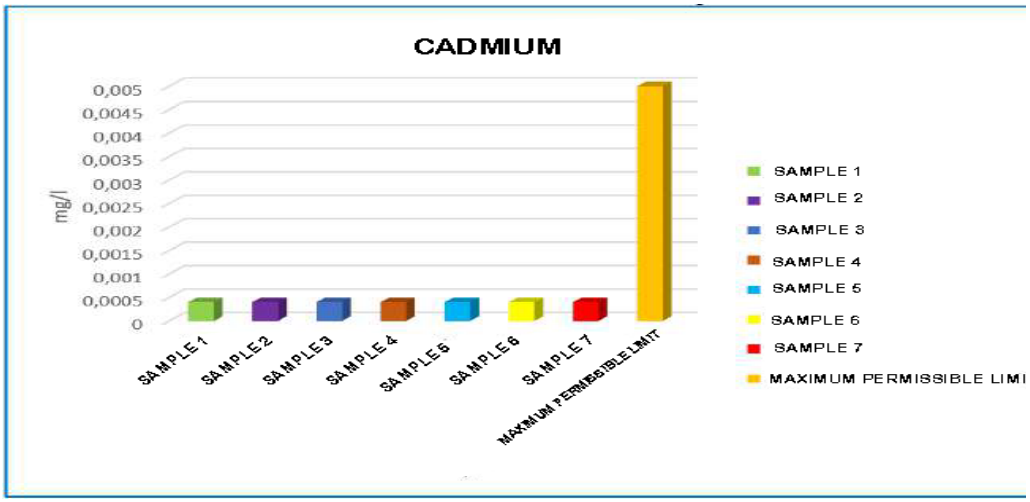
RESULTS CADMIUM

Table 63: Results Cadmium in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,0004**	0,005
SAMPLE 2: In front of Naval School	mg/l	**<0,0004**	0,005
SAMPLE 3: Isla del Amor	mg/l	**<0,0004**	0,005
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,0004**	0,005
SAMPLE 5: Punta El Faro	mg/l	**<0,0004**	0,005
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,0004**	0,005
SAMPLE 7: Offshore	mg/l	**<0,0004**	0,005

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 111: Results Cadmium in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

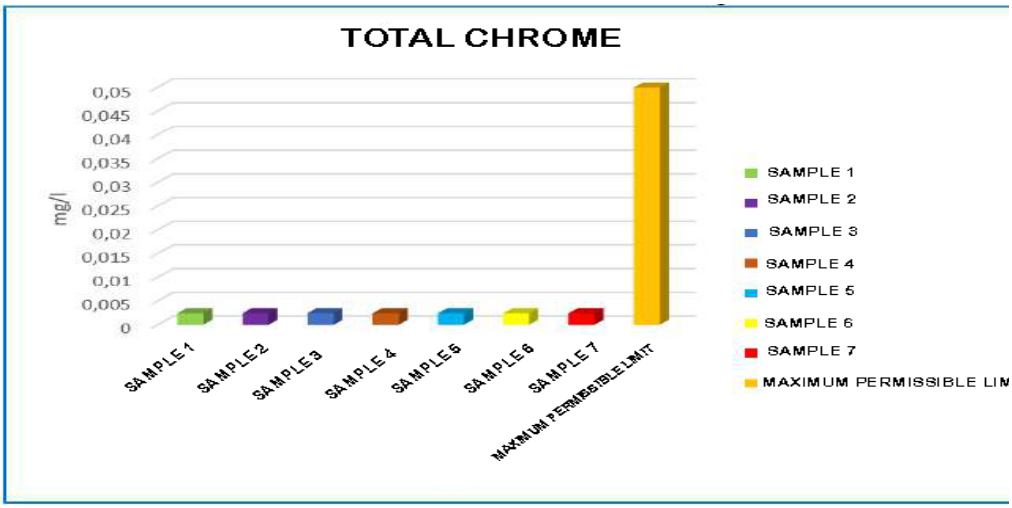
RESULTS TOTAL CHROME

Table 64: Results Total Chrome in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,0024**	0,05
SAMPLE 2: In front of Naval School	mg/l	**<0,0024**	0,05
SAMPLE 3: Isla del Amor	mg/l	**<0,0024**	0,05
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,0024**	0,05
SAMPLE 5: Punta El Faro	mg/l	**<0,0024**	0,05
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,0024**	0,05
SAMPLE 7: Offshore	mg/l	**<0,0024**	0,05

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 112: Results Total Chrome in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

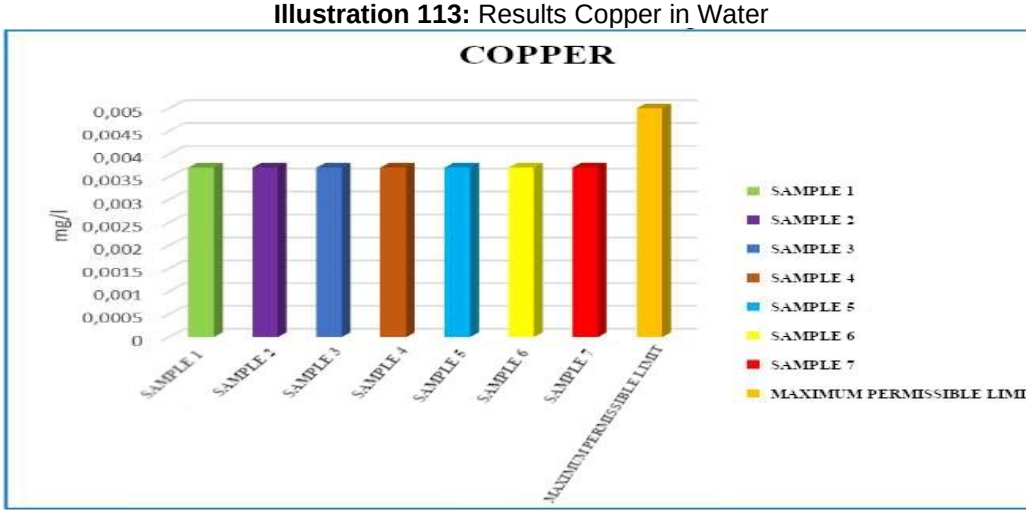
RESULTS COPPER

Table 65: Results Copper in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,0037**	0,005
SAMPLE 2: In front of Naval School	mg/l	**<0,0037**	0,005
SAMPLE 3: Isla del Amor	mg/l	**<0,0037**	0,005
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,0037**	0,005
SAMPLE 5: Punta El Faro	mg/l	**<0,0037**	0,005
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,0037**	0,005
SAMPLE 7: Offshore	mg/l	**<0,0037**	0,005

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 113: Results Copper in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

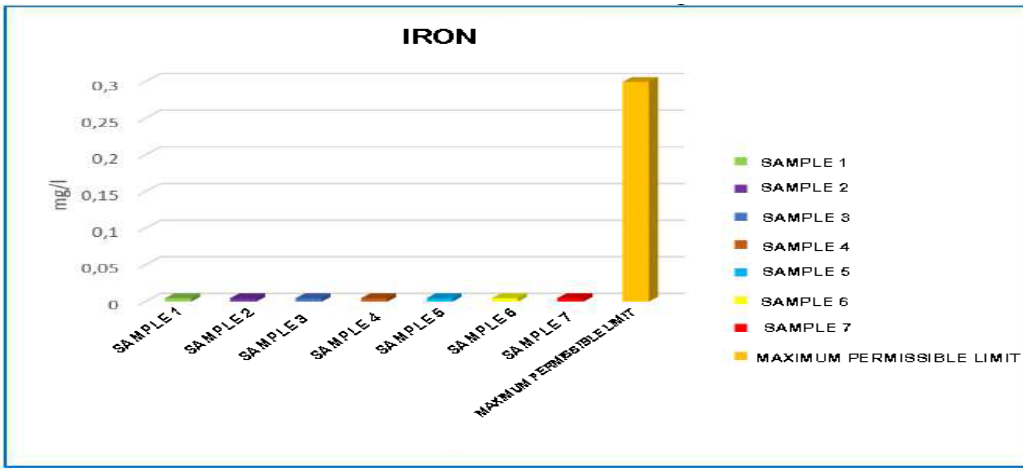
RESULTS IRON

Table 66: Results Iron in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,0047**	0,3
SAMPLE 2: In front of Naval School	mg/l	**<0,0047**	0,3
SAMPLE 3: Isla del Amor	mg/l	**<0,0047**	0,3
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,0047**	0,3
SAMPLE 5: Punta El Faro	mg/l	**<0,0047**	0,3
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,0047**	0,3
SAMPLE 7: Offshore	mg/l	**<0,0047**	0,3

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 113: Results Iron in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

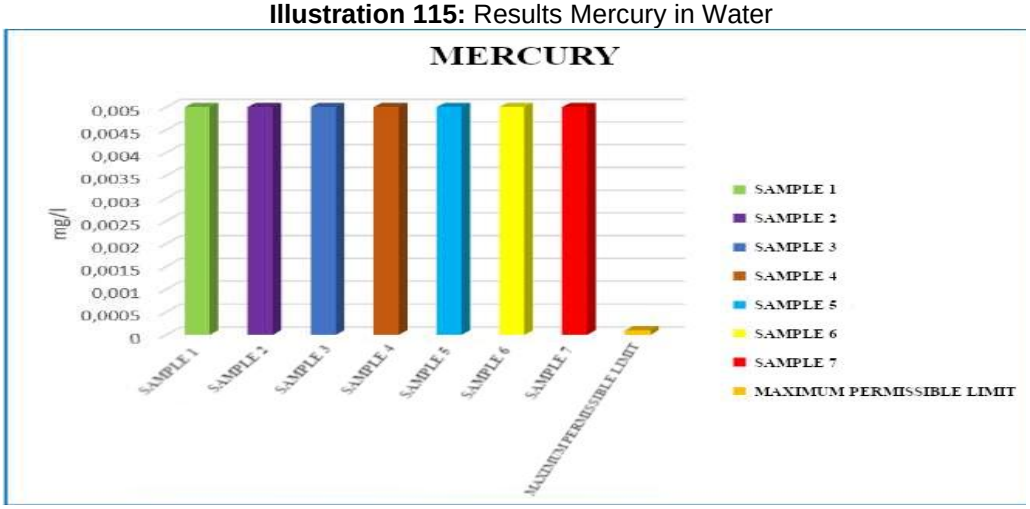
RESULTS MERCURY

Table 67: Results Mercury in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,00500**	0,0001
SAMPLE 2: In front of Naval School	mg/l	**<0,00500**	0,0001
SAMPLE 3: Isla del Amor	mg/l	**<0,00500**	0,0001
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,00500**	0,0001
SAMPLE 5: Punta El Faro	mg/l	**<0,00500**	0,0001
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,00500**	0,0001
SAMPLE 7: Offshore	mg/l	**<0,00500**	0,0001

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 115: Results Mercury in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

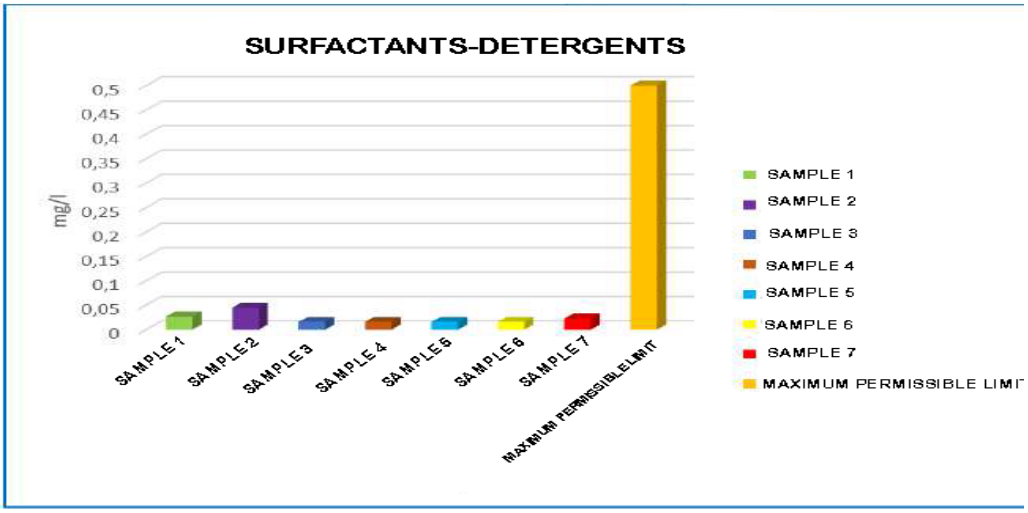
RESULTS SURFACTANTS

Table 68: Results Surfactants in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**0,027**	0,5
SAMPLE 2: In front of Naval School	mg/l	**0,045**	0,5
SAMPLE 3: Isla del Amor	mg/l	**<0,016**	0,5
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,016**	0,5
SAMPLE 5: Punta El Faro	mg/l	**<0,016**	0,5
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,016**	0,5
SAMPLE 7: Offshore	mg/l	**<0,023**	0,5

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 116: Results Surfactants in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

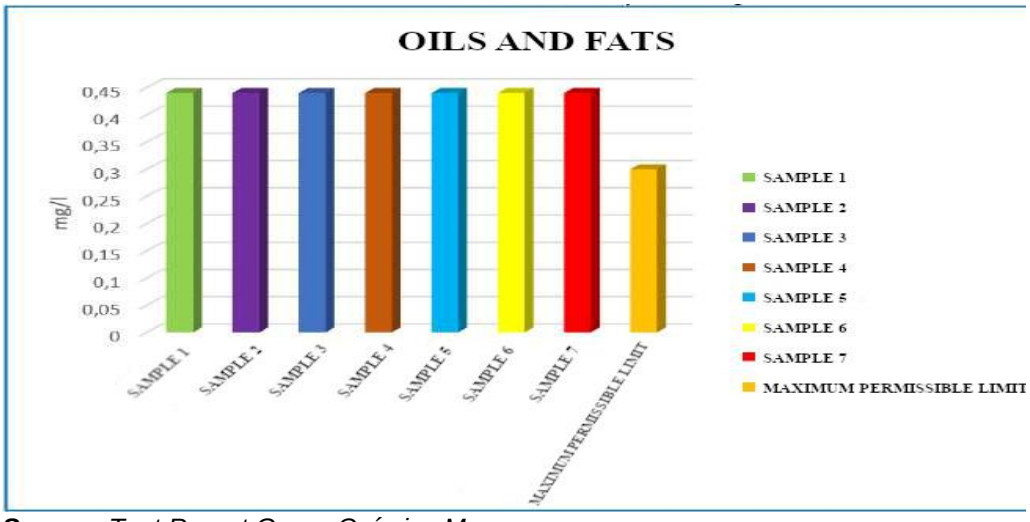
RESULTS OILS AND FATS

Table 69: Results Oils and Fats in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,44**	0,3
SAMPLE 2: In front of Naval School	mg/l	**<0,44**	0,3
SAMPLE 3: Isla del Amor	mg/l	**<0,44**	0,3
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,44**	0,3
SAMPLE 5: Punta El Faro	mg/l	**<0,44**	0,3
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,44**	0,3
SAMPLE 7: Offshore	mg/l	**<0,44**	0,3

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 117: Results Oils and Fats in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

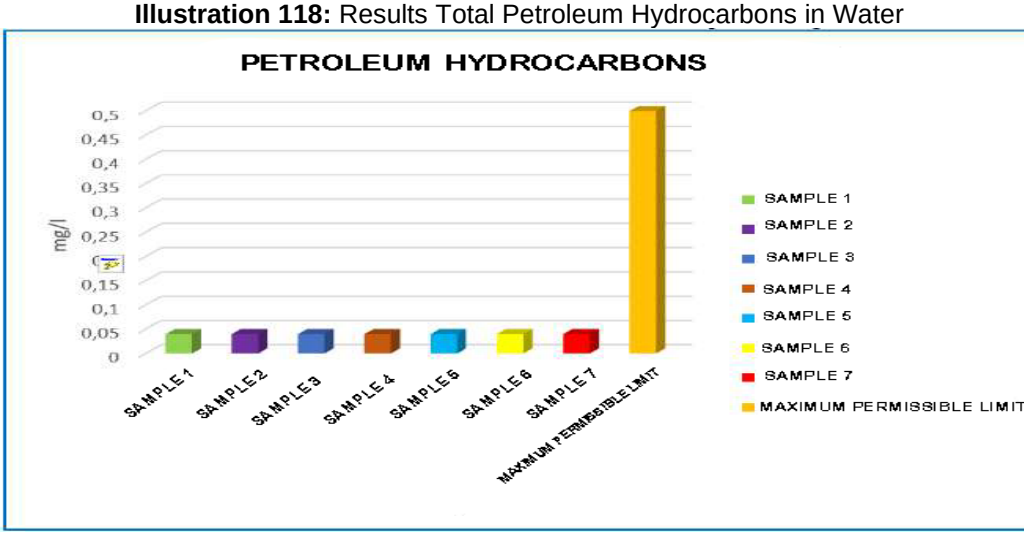
RESULTS TOTAL PETROLEUM HYDROCARBONS

Table 70: Results Total Petroleum Hydrocarbons in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**<0,04**	0,5
SAMPLE 2: In front of Naval School	mg/l	**<0,04**	0,5
SAMPLE 3: Isla del Amor	mg/l	**<0,04**	0,5
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,04**	0,5
SAMPLE 5: Punta El Faro	mg/l	**<0,04**	0,5
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,04**	0,5
SAMPLE 7: Offshore	mg/l	**<0,04**	0,5

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 118: Results Total Petroleum Hydrocarbons in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

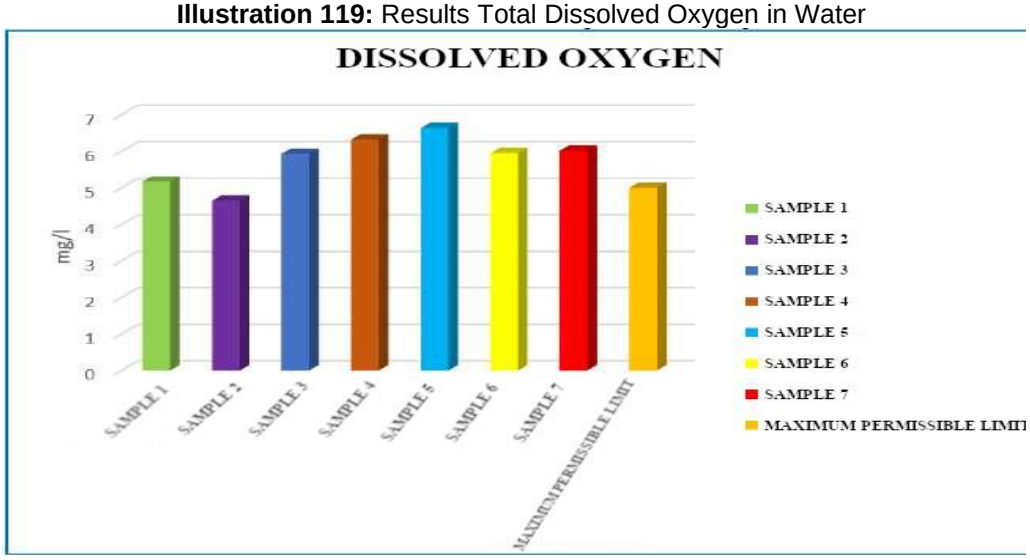
RESULTS DISSOLVED OXYGEN

Table 71: Results Dissolved Oxygen in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mgO2/l	**5,17**	>5
SAMPLE 2: In front of Naval School	mgO2/l	**4,65**	>5
SAMPLE 3: Isla del Amor	mgO2/l	**5,93**	>5
SAMPLE 4: Entrance to the Health Resort El Coco	mgO2/l	**6,32**	>5
SAMPLE 5: Punta El Faro	mgO2/l	**6,64**	>5
SAMPLE 6: Entrance to Jambeli	mgO2/l	**5,95**	>5
SAMPLE 7: Offshore	mgO2/l	**6,02**	>5

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 119: Results Total Dissolved Oxygen in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

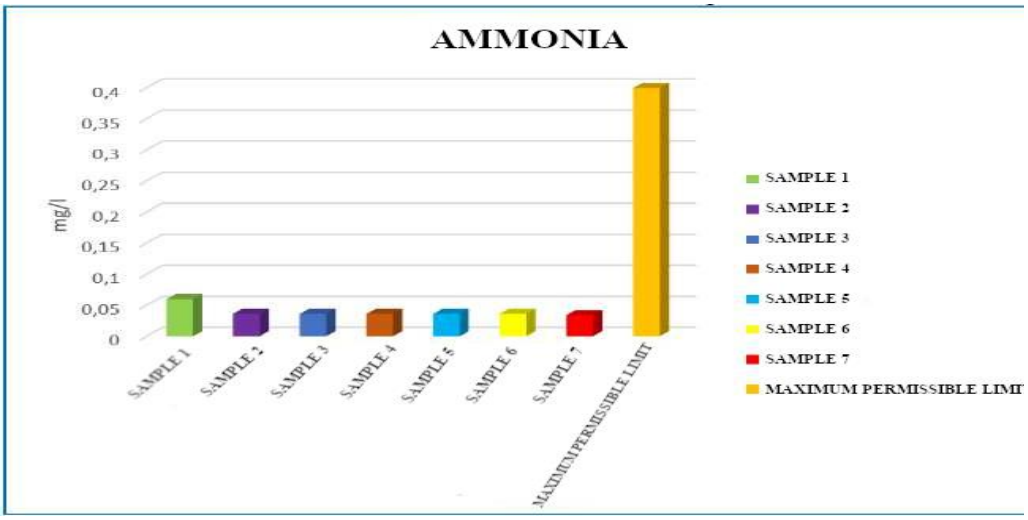
RESULTS AMMONIA

Table 72: Results Ammonia in Water

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
SAMPLE 1 In front of Port Authority	mg/l	**0,06**	0,4
SAMPLE 2: In front of Naval School	mg/l	**<0,036**	0,4
SAMPLE 3: Isla del Amor	mg/l	**<0,036**	0,4
SAMPLE 4: Entrance to the Health Resort El Coco	mg/l	**<0,036**	0,4
SAMPLE 5: Punta El Faro	mg/l	**<0,036**	0,4
SAMPLE 6: Entrance to Jambeli	mg/l	**<0,036**	0,4
SAMPLE 7: Offshore	mg/l	**<0,034**	0,4

Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

Illustration 120: Results Total Ammonia in Water



Source: *Test Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

ANALYSIS OF WATER QUALITY COMPLIANCE WITH REGULATIONS

Table 73: Analysis of Water Quality Compliance with Regulations

SAMPLE NUMBER	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*	COMPLIANCE
SAMPLE 1 IN FRONT OF PORT AUTHORITY	Arsenic	**<0,0031**	0,05	COMPLIES
	Cadmium	**<0,0004**	0,005	COMPLIES
	Total chrome	**<0,0024**	0,05	COMPLIES
	Copper	**<0,0037**	0,005	COMPLIES
	Iron	**<0,0047**	0,3	COMPLIES
	Mercury	**<0,00500**	0,0001	DOES NOT COMPLY
	Fecal coliforms	**2**	---	---
	Surfactants - Detergents	**0,027**	0,5	COMPLIES
	Oils and Fats	**<0,44**	0,3	DOES NOT COMPLY
	Biochemical Oxygen Demand	**9,12**	---	---
	Chemical Oxygen Demand	**18**	---	---
	Total Petroleum Hydrocarbons	**<0,04**	0,5	COMPLIES
	Dissolved oxygen in situ	**5,17**	>5	COMPLIES
	Ammonia	**0,06**	0,4	COMPLIES
	Total Suspended Solids	**106**	---	---
SAMPLE 2: IN FRONT OF NAVAL SCHOOL	Arsenic	**<0,0031**	0,05	COMPLIES
	Cadmium	**<0,0004**	0,005	COMPLIES
	Total chrome	**<0,0024**	0,05	COMPLIES
	Copper	**<0,0037**	0,005	COMPLIES
	Iron	**<0,0047**	0,3	COMPLIES
	Mercury	**<0,00500**	0,0001	DOES NOT COMPLY
	Fecal coliforms	**2**	---	---
	Surfactants - Detergents	**0,045**	0,5	COMPLIES
	Oils and Fats	**<0,44**	0,3	DOES NOT COMPLY
	Biochemical Oxygen Demand	**19**	---	---

	Chemical Oxygen Demand	**36**	---	---
	Total Petroleum Hydrocarbons	**<0,04**	0,5	COMPLIES
	Dissolved oxygen in situ	**4,65**	>5	DOES NOT COMPLY
	Ammonia	**<0,036**	0,4	COMPLIES
	Total Suspended Solids	**87**	---	---
SAMPLE 3: ISLA DEL AMOR	Arsenic	**<0,0031**	0,05	COMPLIES
	Cadmium	**<0,0004**	0,005	COMPLIES
	Total chrome	**<0,0024**	0,05	COMPLIES
	Copper	**<0,0037**	0,005	COMPLIES
	Iron	**<0,0047**	0,3	COMPLIES
	Mercury	**<0,00500**	0,0001	DOES NOT COMPLY
	Fecal coliforms	**1**	---	---
	Surfactants - Detergents	**0,016**	0,5	COMPLIES
	Oils and Fats	**<0,44**	0,3	DOES NOT COMPLY
	Biochemical Oxygen Demand	**18**	---	---
	Chemical Oxygen Demand	**34**	---	---
	Total Petroleum Hydrocarbons	**<0,04**	0,5	COMPLIES
	Dissolved oxygen in situ	**5,93**	>5	COMPLIES
	Ammonia	**<0,036**	0,4	COMPLIES
	Total Suspended Solids	**66**	---	---
SAMPLE 4: Entrance to the Health Resort El Coco	Arsenic	**<0,0031**	0,05	COMPLIES
	Cadmium	**<0,0004**	0,005	COMPLIES
	Total chrome	**<0,0024**	0,05	COMPLIES
	Copper	**<0,0037**	0,005	COMPLIES
	Iron	**<0,0047**	0,3	COMPLIES
	Mercury	**<0,00500**	0,0001	DOES NOT COMPLY
	Fecal coliforms	**2**	---	---
	Surfactants - Detergents	**0,016**	0,5	
	Oils and Fats	**<0,44**	0,3	DOES NOT COMPLY

	Biochemical Oxygen Demand	**20**	---	---
	Chemical Oxygen Demand	**40,2**	---	---
	Total Petroleum Hydrocarbons	**<0,04**	0,5	COMPLIES
	Dissolved oxygen in situ	**6,32**	>5	COMPLIES
	Ammonia	**<0,036**	0,4	COMPLIES
	Total Suspended Solids	**93**	---	---
SAMPLE 5: PUNTA EL FARO	Arsenic	**<0,0031**	0,05	COMPLIES
	Cadmium	**<0,0004**	0,005	COMPLIES
	Total chrome	**<0,0024**	0,05	COMPLIES
	Copper	**<0,0037**	0,005	COMPLIES
	Iron	**<0,0047**	0,3	COMPLIES
	Mercury	**<0,00500**	0,0001	DOES NOT COMPLY
	Fecal coliforms	**5**	---	---
	Surfactants - Detergents	**0,016**	0,5	COMPLIES
	Oils and Fats	**<0,44**	0,3	DOES NOT COMPLY
	Biochemical Oxygen Demand	**17**	---	---
	Chemical Oxygen Demand	**32**	---	---
	Total Petroleum Hydrocarbons	**<0,04**	0,5	COMPLIES
	Dissolved oxygen in situ	**6,64**	>5	COMPLIES
	Ammonia	**<0,036**	0,4	COMPLIES
	Total Suspended Solids	**182**	---	---
SAMPLE 6: ENTRANCE TO JAMBELI	Arsenic	**<0,0031**	0,05	COMPLIES
	Cadmium	**<0,0004**	0,005	COMPLIES
	Total chrome	**<0,0024**	0,05	COMPLIES
	Copper	**<0,0037**	0,005	COMPLIES
	Iron	**<0,0047**	0,3	COMPLIES
	Mercury	**<0,00500**	0,0001	DOES NOT COMPLY
	Fecal coliforms	**8**	---	---

	Surfactants - Detergents	**0,016**	0,5	COMPLIES
	Oils and Fats	**<0,44**	0,3	DOES NOT COMPLY
	Biochemical Oxygen Demand	**23**	---	---
	Chemical Oxygen Demand	**44**	---	---
	Total Petroleum Hydrocarbons	**<0,04**	0,5	COMPLIES
	Dissolved oxygen in situ	**5,95**	>5	COMPLIES
	Ammonia	**<0,036**	0,4	COMPLIES
	Total Suspended Solids	**177**	---	---
SAMPLE 7: OFFSHORE	Arsenic	**<0,0031**	0,05	COMPLIES
	Cadmium	**<0,0004**	0,005	COMPLIES
	Total chrome	**<0,0024**	0,05	COMPLIES
	Copper	**<0,0037**	0,005	COMPLIES
	Iron	**<0,0047**	0,3	COMPLIES
	Mercury	**<0,00500**	0,0001	DOES NOT COMPLY
	Fecal coliforms	**<1**	---	---
	Surfactants - Detergents	**<0,023**	0,5	COMPLIES
	Oils and Fats	**<0,44**	0,3	DOES NOT COMPLY
	Biochemical Oxygen Demand	**4,02**	---	---
	Chemical Oxygen Demand	**16,00**	---	---
	Total Petroleum Hydrocarbons	**<0,04**	0,5	COMPLIES
	Dissolved oxygen in situ	**6,02**	>5	DOES NOT COMPLY
	Ammonia	**<0,034**	0,4	COMPLIES
	Total Suspended Solids	**56**	---	---

PHYTOPLANKTON AND ZOOPLANKTON ANALYSIS

METHODOLOGY

As part of the water quality sampling in Santa Rosa Marsh, an analysis of phytoplankton and zooplankton was carried out by performing surface dragging to obtain a sample of zooplankton and a sample of phytoplankton at a speed of 2 knots/hour in a time of 2 minutes.

Sampling determined that the zooplankton net had a mouth opening of 0.30 m diameter and mesh length of one meter with a net pore opening of 300 µ. Samples were poured into 500 ml plastic bottles and preserved in 70% alcohol. For phytoplankton capture, a 0.30 m diameter and 1.00 m long net with a 60 µ mesh eye opening was used, samples were emptied into 500 ml plastic bottles and preserved with lugol.

The samples were subjected to refrigeration before analysis, and microscopy was used for observation. For quantitative analysis we used bibliography from Tapia 2002, Actas Oceanográficas 2002, Cajas 1998, Jiménez 1983, Luzuriaga 1998 and Zambrano 1983.

Photography 14: Phytoplankton and Zooplankton Sampling

SAMPLE 1
PHYTOPLANKTON AND ZOOPLANKTON
Entrance to Jambeli

Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *March 29, 2017*

RESULTS

- **Phytoplankton Analysis (60µ net)**
  The species with the highest abundance found in the sample were in order:
  - *Skeletonema costatum* with $10.5x10^5$ cells/m^3
  - *Biddulphia sinensis* with $4.7x10^4$ cells/m^3
  - *Coscinodiscus concinnus* with $4.3x10^4$ cells/m^3
  - *Biddulphia mobiliensis* with $2.19\ x10^4$ cells/m^3
  - *Chaeroceros debilis* with $1.8x10^4$ cells/m^3
  - *Coscinodiscus radiatus* with $1.6X10^4$ cells/m^3
  - *Navicula sp.* with $1.46x10^4$ cells/m^3
  - Chaetoceros sp. with 8463 cells/ m^3
  - *Ditylum brighwellii* with 457 cells/ m^3
  - *Chaeroceros affinis* with 343 cells/ m^3
  - *Dinophuysis caudatas* and *Paralia sulcata* with 229 cells/ m^3

- **Zooplankton Analysis (60µ net)**
  In this sample the species with the highest abundance were the copepods in *Copepodito* state with $24.4x10^4$ org/$10m^2$, followed by the copepods in *Nauplio* state with $21.9x10^4$ org/$10m^2$, *Tintinnopsis dadayi* with $7.3x10^4$ org/$10m^2$; and finally with the lowest abundance was the tintinnid *Tintinnopsis campanula* with 4575x104 org/10m.

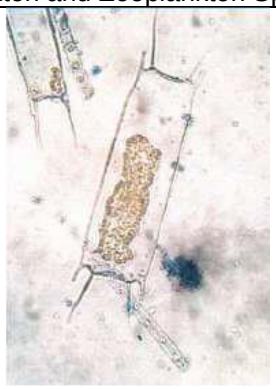
- **Zooplankton Analysis (300µ net)**
  In this sample, only the species *Acartia tansa* was found, which had a low abundance of 343 org/$10m^2$ cells/m^3.

CONCLUSIONS

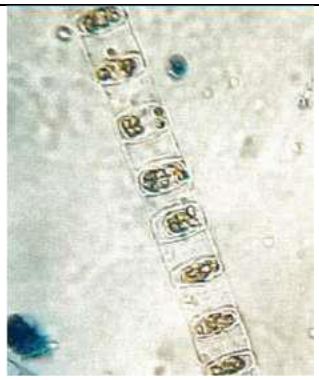
- The analysis found 16 phytoplanktonic species grouped into two divisions: *Bacillariophyta* (15 species) and the *Dinophyta* division (1 species).
- The total phytoplankton captured was $16.6x10^5$ cells/m3; The most abundant species was *Skeletonema costatum*, which comprised 83% of the total phytoplankton collected.
- In the microzooplanktonic analysis (60µ) the following groups were found: *Copepoda* and *Ciliophora*.
- The total microzooplankton collected was $54.2x10^4$ org/10m^2; where copepods in the copepod stage reached the highest abundance, with 45% of the total microzooplankton collected.
    - In the zooplanktonic analysis (300µ) only one species was found, which was the copepod *Acartia tonsa*, with an abundance of 343 org/10m^2.

Illustration 121: Phytoplankton and Zooplankton Species of Santa Rosa Marsh

Biddulphia mobiliensis



Biddulphia sinensis

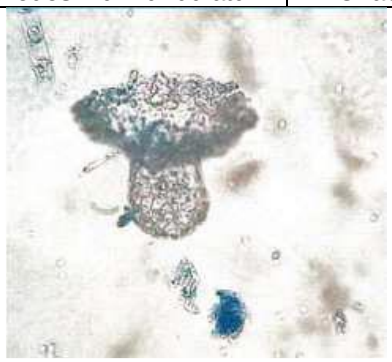


Skeletonema costat

Lithodesmium undulatu

Chaetoceros debillis

Nauplio copépodo



Tintinnopsis campanula

Acartia tonsa

Source: *Water Quality Report 6755 (Grupo Químico Marcos)*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 21, 2017*

❖ CONCLUSIONS ON WATER QUALITY ANALYSIS

The samples taken were simple and specific, covering the entire project area. For this purpose, Grupo Químico Marcos, a laboratory in Guayaquil that the Ecuadorian Accreditation Service accredits, was contracted.

Water quality samples taken at different points in Santa Rosa Marsh show that the parameters Arsenic, Cadmium, Total Chromium, Copper, Iron, Surfactants, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Petroleum Hydrocarbons, Dissolved Oxygen, Ammonia, and Fecal Coliforms meet the Water Quality Criteria for the preservation of aquatic life in marine waters (Ministerial Agreement 097 A, Annex 1, Table 2). However, the Mercury and Oils, and Fats parameters do not meet this criterion.

The results of the water quality samples that present values such as metals like Arsenic with a value of <0.0031 in all samples is because the value found is below the limit of quantification of the laboratory Grupo Quimico Marcos, so the limit of quantification is reported as the lowest value that can be analytically detected with a statistical certainty of at least 95.45 % with 2 effective degrees of freedom.

Santa Rosa Marsh is a semi-enclosed marginal seawater body where freshwater discharges significantly dilute salinity.
It is important to note that about 70%-75% of global marine pollution is a product of human activities that take place on the land surface. Rivers transport some 90% of pollutants to the sea.

The contamination level of Santa Rosa Marsh is mainly due to daily wastewater discharges from domestic sources, fuel residues, and ocean currents and high and low tide mechanisms that allow metal-enriched sediments to enter the marsh.

Another factor contaminating the waters of Santa Rosa Marsh is the presence of chemical products from the shrimp farms in the area.
An important parameter of marine water quality in terms of aquatic life is dissolved oxygen, which indicates the ecosystems' health. In the samples obtained, the results indicate ranges between 5.2 - 6 mgO2/l, values that comply with the regulations.

The presence of fecal coliforms in the water samples is due to contamination from excreta, specifically from domestic sewage that is discharged into the Santa Rosa Marsh through the Huayla Marsh and other water vectors in the area.

❖ 6.1.11.- SOIL QUALITY ANALYSIS - SEDIMENTS

Marine sediments are defined as a set of solid materials of different particle sizes that are deposited on the bottom of seas and oceans by different transport agents. Their study is one of the most interesting topics in geochemistry and oceanography, since their characterization can help to better understand the current system, the state of the oxide-reductive condition, the type and abundance of the benthic fauna, the activity of microorganisms and the texture of the deposits.

Within aquatic ecosystems, sediments play an important role as an efficient natural trap for various substances and as a regulator of the depths' processes. They constitute the main reservoir for most of the anthropogenic substances that interact with living organisms and other components of the biota, through geochemical and biological processes that make possible the flow of these materials into the water column and the food chain.

Therefore, sediments represent an important source of information on human-ocean interaction and on man's effects on the environment. As in the previous point, in compliance with the provisions of Ministerial Agreement 061 of the Ministry of the Environment, sediment sampling was carried out for soil quality analysis in the project area.
For sampling and analysis, the Grupo Químico Marcos Laboratory services in the city of Guayaquil were contracted, which is accredited by the Ecuadorian Accreditation Service.

The parameters to be analyzed were defined at the consulting technical team's meeting, technical personnel from the Ministry of the Environment as the Competent Environmental Authority, and technical personnel from the Autonomous Provincial Government of El Oro as the Cooperating Environmental Authority.
Sediment analysis has been widely used as an environmental indicator to evaluate the magnitude of contamination in an aquatic system, as these continuously interact with the liquid phase, it is convenient to combine sediment and water analysis.

❖ LEGAL FRAMEWORK FOR SEDIMENT ANALYSIS

MINISTERIAL AGREEMENT 061: REFORM OF BOOK VI OF THE UNIFIED TEXT OF ENVIRONMENTAL LEGISLATION
PARAGRAPH II: OF THE SOIL
PARAGRAPH III: OF THE SEDIMENTS

- **Art. 215 Sediments Quality. -** Sediments may be of natural origin, such as those existing in the sea, the beds of lakes and lagoons, rivers, streams, and other water bodies, whether they have permanent or temporary flows; And those of industrial origin, such as those coming from treatment plants, storage tanks or others. To evaluate environmental quality through sediment analysis, sampling and monitoring of the areas directly influenced by the regulated activity must be carried out, following the protocols established by the National Environmental Authority and, if they do not exist, following internationally accepted protocols.

- **Art. 216 Technical standards. -** The National Environmental Authority or the entities of the Decentralized National Environmental Management System, within the framework of their competencies, will issue technical standards for sediment quality, by means of the corresponding legal figure.
- **Art. 217 Evaluation, monitoring, and control -** Without prejudice to the application of the control mechanisms established in this book, the National Environmental Authority shall evaluate and control environmental quality by means of sediment analysis or shall order the control bodies to carry out the pertinent assessments.

OF THE SAMPLING

- **Art. 257 Sampling. -** It is the activity of taking samples for environmental quality assessment purposes. In addition to the provisions established in the Environmental Monitoring Plan, sampling may require specific provisions on the sampling site, the timing of sampling, the type and frequency of sampling, sampling procedures or methods, types of containers and preservation procedures for the sample according to the parameters to be analyzed. These should be based on Ecuadorian technical norms or, failing that, on internationally accepted norms or standards; a sample custody protocol should also be maintained.
  Sampling must be carried out in compliance with the technical standards established for this purpose. The analyses must be carried out by laboratories whose parameters are accredited by the competent body.
  For taking samples of discharges, emissions and spills, the control body shall have adequate sites for sampling and gauging and shall provide all facilities for this purpose, as well as data on raw materials and chemical products used, among others, so that the technical personnel in charge of the control can carry out their work in accordance with the provisions of the environmental technical standards.
  Any characterization of discharges, emissions or spills must include the respective conditions and circumstances under which the samples were taken. For sampling in receiving bodies, the area of influence of the emission or discharge and the temporality of the events shall be considered.
- **Art. 258 Sampling results information -** When the Competent Environmental Authority carries out a sampling for the control of an emission, dumping or discharge, it shall report the results obtained to the respective control body, together with the pertinent technical observations.

SOIL QUALITY CRITERIA

Table 74: Soil Quality Criteria

PARAMETERS	UNITS	VALUE
General parameters		
Conductivity	uS/cm	200
pH		6 to 8
Sodium Absorption Ratio (SAR index)		4*
Inorganic parameters		
Arsenic	mg/kg	12

PARAMETERS	UNITS	VALUE
Sulfur (elemental)	mg/kg	250
Barium	mg/kg	200
Boron (soluble in hot water)	mg/kg	1
Cadmium	mg/kg	0,5
Cobalt	mg/kg	10
Copper	mg/kg	25
Total chrome	mg/kg	54
Chrome VI	mg/kg	0,4
Cyanide	mg/kg	0,9
Tin	mg/kg	5
Fluorides	mg/kg	200
Mercury	mg/kg	0,1
Molybdenum	mg/kg	5
Nickel	mg/kg	19
Lead	mg/kg	19
Selenium	mg/kg	1
Vanadium	mg/kg	76
Zinc	mg/kg	60
Organic parameters		
Benzene	mg/kg	0,03
Chlorobenzene	mg/kg	0,1
Ethylbenzene	mg/kg	0,1
Styrene	mg/kg	0,1
Toluene	mg/kg	0,1
Xylene	mg/kg	0,1
PCBs	mg/kg	0,1
Aliphatic Chlorinated Aliphatics (each type)	mg/kg	0,1
Chlorobenzenes (each type)	mg/kg	0,05
Hexachlorobenzene	mg/kg	0,05
Hexachlorocyclohexane	mg/kg	0,1
Non-chlorinated phenolics (each type)	mg/kg	0,1
Chlorophenols (each type)	mg/kg	0,05
Total Hydrocarbons (TPH)	mg/kg	<150
Polycyclic Aromatic Hydrocarbons (PAHs) each type	mg/kg	0,1

Source: *Ministerial Agreement 097 A, Annex 1, Table 1*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 20, 2017*

❖ SAMPLING POINTS FOR SEDIMENT ANALYSIS

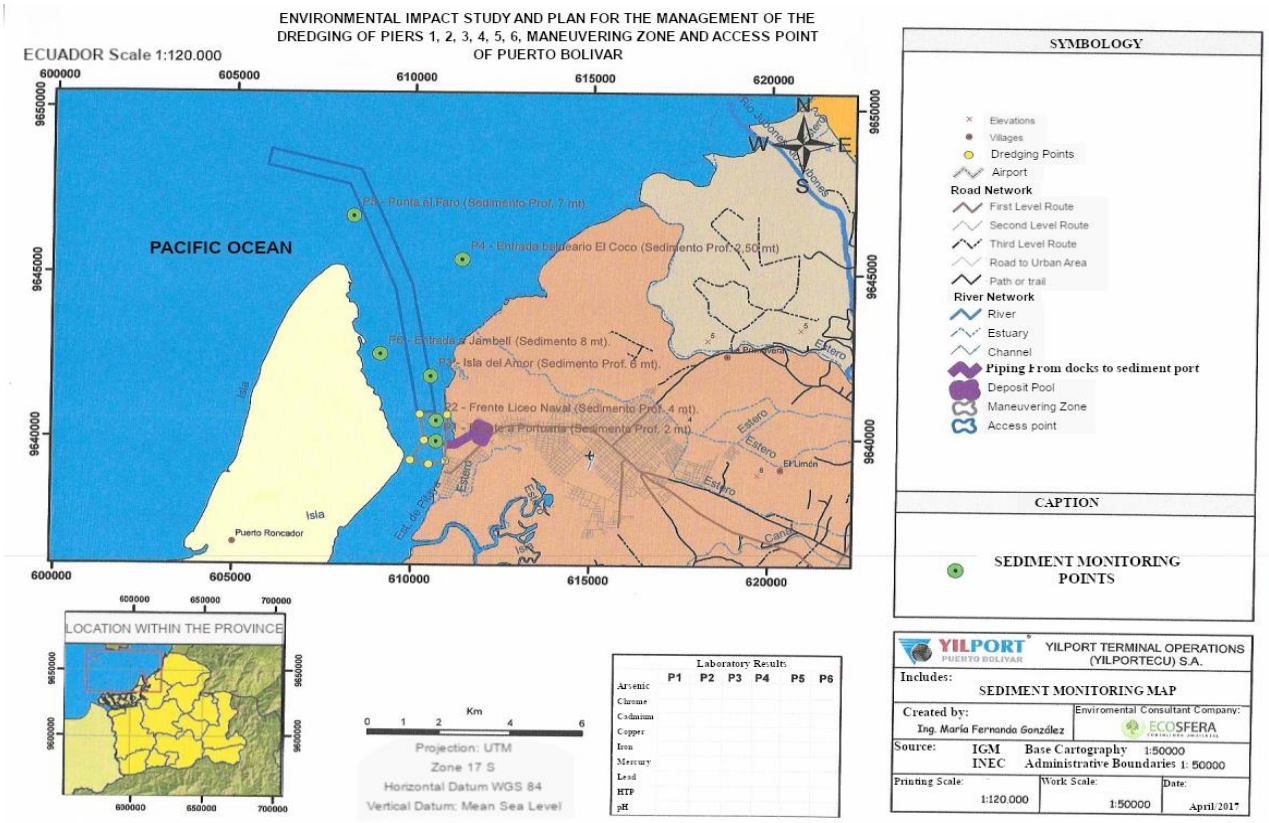
The sampling points as mentioned above were determined in a meeting with technical personnel from the Competent Environmental Authority (Ministry of Environment), technical personnel from the Cooperating Environmental Authority (Autonomous Provincial Government of El Oro), and members of the consulting team, and were the following:

Table 75: Sediment Sampling Points

SAMPLE NO.	SAMPLING POINT	Coordinates	Sampling Time	Depth
SAMPLE 1	In front of Port Authority	X: 610680 Y: 9639902	11:40 AM	2 m
SAMPLE 2	In front of Naval	X: 610682 Y: 9640521	11:25 AM	4 m
SAMPLE 3	Isla del Amor	X: 610505 Y: 9641879	11:07 AM	6 m
SAMPLE 4	Entrance to El Coco Beach	X: 611365 Y: 9645418	10:36 AM	2,5 m
SAMPLE 5	Punta El Faro	X: 608302 Y: 9646721	9:16 AM	7 m
SAMPLE 6	Entrance to Jambeli	X: 609094 Y: 9642541	9:43 AM	8 m

Source: *Trial Report Grupo Químico Marcos*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20, 2017*

Figure 122: Sediment Sampling Point



Prepared by: *Ecosfera Cia. Ltda., 2017*
Source: *Www.geoportaligm.gob.ec, Military Geographic Institute*
Date: *April 6, 2017*

Photograph 15: Sediment Sampling Point 1

SAMPLING 1
In front of Port Authority
(2 meters deep)

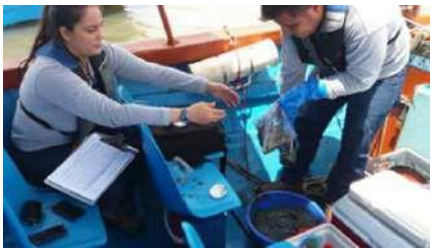




Source: *Photographs taken by the consultant team*
Prepared by: *Ecosfera Cia Ltda.*
Location: *Estero Santa Rosa, Santa Rosa - El Oro*
Date: *March 29th of 2017*

Photograph 16: Sediment Sampling Point 2

SAMPLING 2
In front of the Liceo Naval
(4 meters deep)



Source: *Photographs taken by the consultant team*
Prepared by: *Ecosfera Cia Ltda.*
Location: *Estero Santa Rosa, Santa Rosa - El Oro*
Date: *March 29th of 2017*

Photograph 17: Sediment Sampling Point 3

SAMPLING 3
Isla del Amor
(6 meters deep)

Source: *Photographs taken by the consultant team*
Prepared by: *Ecosfera Cia Ltda.*
Location: *Estero Santa Rosa, Santa Rosa - El Oro*
Date: *March 29th of 2017*

Photograph 18: Sediment Sampling Point 4

SAMPLING 4
Entrance to El Coco Water Park
(2.5 meters deep)

Source: *Photographs taken by the consultant team*
Prepared by: *Ecosfera Cia Ltda.*
Location: *Estero Santa Rosa, Santa Rosa - El Oro*
Date: *March 29th of 2017*

Photograph 19: Sediment Sampling Point 5

SAMPLING 5
Punta El Faro

Source: *Photographs taken by the consultant team*
Prepared by: *Ecosfera Cia Ltda.*
Location: *Estero Santa Rosa, Santa Rosa - El Oro*
Date: *March 29th of 2017*

Photography 20: Sediment Sampling Point 6

SAMPLING 6
Entrance to Jambeli
(8 meters deep)

Source: *Photographs taken by the consultant team*
Prepared by: *Ecosfera Cia Ltda.*
Location: *Estero Santa Rosa, Santa Rosa - El Oro*
Date: *March 29th of 2017*

EVALUATION PARAMETERS SEDIMENT ANALYSIS

The determined parameters for sediment analysis are:

Table 76: Parameters to be analyzed Sediments

PARAMETERS
Arsenic
Cadmium
Chromium Total
Copper

Iron
Mercury
Lead
pH
Total Petroleum Hydrocarbons

Source: *Grupo Quimico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

❖ SEDIMENT ANALYSIS METHODS

The following methods were used for the analysis of each of the samples, according to the parameters to be analyzed:

Table 77: Sediment Analysis Methods

PARAMETERS	METHOD
Arsenic	PEE – GQM – FQ – 54
Cadmium	AAA – PE –S011
Chromium Total	AAA – PE –S011
Copper	AAA – PE –S011
Iron	AAA – PE –S011
Mercury	PEE – GQM – FQ – 54
Lead	PEE – GQM – FQ – 54
pH	PEE – GQM – FQ – 53
Total Petroleum Hydrocarbons	PEE – GQM – FQ – 56

Source: *Grupo Quimico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

❖ SEDIMENT ANALYSIS EQUIPMENT AND MATERIALS

The following is a general list of the implements required at the time of sampling:

- Dragline Excavator
- Global Positioning System (GPS).
- Portable equipment for temperature, pH, and electrical conductivity measuring
- 10 L capacity plastic buckets
- Isopor or polyurethane cooler with enough ice packs to maintain a temperature of about 4°C.
- Absorbent paper towel.

- Pen and indelible ink marker.
- Board
- Gloves
- Plastic and glass containers.
- Comfortable overalls or work clothes that provide adequate protection

❖ SEDIMENT ANALYSIS RESULTS

The following tables and graphs detail the results obtained in the samples from the six sediment sampling points and their relationship with the Maximum Permissible Limit established in the current Environmental Legislation.

SAMPLING 1: IN FRONT OF PORT

Table 78: Results Sampling 1 Sediment

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/kg	**<0,6**	12
Cadmium	mg/kg	**1**	0,5
Total Chromium	mg/kg	**23**	54
Copper	mg/kg	**15**	25
Iron	mg/kg	**>500**	---
Mercury	mg/kg	**<0,26**	0,1
Lead	mg/kg	**10,3**	19
pH		**7,9**	6 - 8
Total Petroleum Hydrocarbons	mg/kg	**1103**	<150

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A.
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

SAMPLING 2: IN FRONT OF LICEO NAVAL

Table 79: Results Sampling 2 Sediment

PARAMETERS	UNIT	RESULTS	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/kg	**1,7**	12
Cadmium	mg/kg	**1**	0,5
Total Chromium	mg/kg	**17**	54

Copper	mg/kg	**9**	25
Iron	mg/kg	**>500**	---
Mercury	mg/kg	**<0,26**	0,1
Lead	mg/kg	**12,6**	19
pH	---	**8,14**	6 - 8
Total Petroleum Hydrocarbons	mg/kg	**1131**	<150

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

SAMPLING 3: ISLA DEL AMOR

Table 80: Results Sampling 3 Sediment

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/kg	**<0,6**	12
Cadmium	mg/kg	**2**	0,5
Total Chromium	mg/kg	**20**	54
Copper	mg/kg	**8**	25
Iron	mg/kg	**>500**	---
Mercury	mg/kg	**<0,26**	0,1
Lead	mg/kg	**12,6**	19
pH	---	**8,14**	6 - 8
Total Petroleum Hydrocarbons	mg/kg	**1131**	<150

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

SAMPLING 4: ENTRANCE TO EL COCO WATER PARK

Table 81: Results Sampling 4 Sediment

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/kg	**1,6**	12
Cadmium	mg/kg	**2**	0,5

Total Chromium	mg/kg	**15**	54
Copper	mg/kg	**9**	25
Iron	mg/kg	**>500**	---
Mercury	mg/kg	**<0,26**	0,1
Lead	mg/kg	**7,1**	19
pH	---	**7,99**	6 - 8
Total Petroleum Hydrocarbons	mg/kg	**1256**	<150

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

SAMPLING 5: PUNTA EL FARO

Table 82: Results Sampling 5 Sediment

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/kg	**<0,6**	12
Cadmium	mg/kg	**<1,0**	0,5
Total Chromium	mg/kg	**19**	54
Copper	mg/kg	**11**	25
Iron	mg/kg	**>500**	---
Mercury	mg/kg	**<0,26**	0,1
Lead	mg/kg	**6,5**	19
pH	---	**8**	6 - 8
Total Petroleum Hydrocarbons	mg/kg	**1090**	<150

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

SAMPLING 6: ENTRANCE TO JAMBELI

Table 83: Results Sampling 6 Sediment

PARAMETERS	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT*
Arsenic	mg/kg	**<0,6**	12
Cadmium	mg/kg	**<1,0**	0,5
Total Chromium	mg/kg	**17**	54
Copper	mg/kg	**10**	25
Iron	mg/kg	**>500**	---
Mercury	mg/kg	**<0,26**	0,1
Lead	mg/kg	**9,7**	19
pH	---	**8,21**	6 - 8
Total Petroleum Hydrocarbons	mg/kg	**1005**	<150

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A.
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

❖ **RESULTS ANALYSIS SEDIMENTS ANALYSIS**

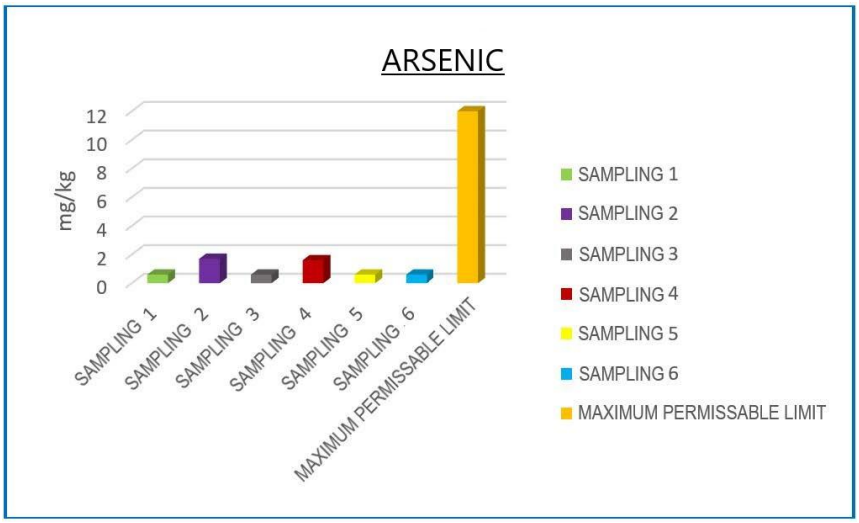
ARSENIC RESULTS

Table 84: Arsenic Sediments Results

N⁰ SAMPLING	UNIT	RESULTS	MAXIMUM LIMIT
SAMPLING 1 In Front of Port	mg/kg	**<0,6**	12
SAMPLING 2 In Front of Liceo Naval	mg/kg	**1,7**	12
SAMPLING 3 Isla del Amor	mg/kg	**<0,6**	12
SAMPLING 4 Entrance to El Coco Water Park	mg/kg	**1,6**	12
SAMPLING 5 Punta El Faro	mg/kg	**<0,6**	12
SAMPLING 6 Entrace to Jambelí	mg/kg	**<0,6**	12

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A.
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*

Illustration 123: Arsenic Sediments Results



Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

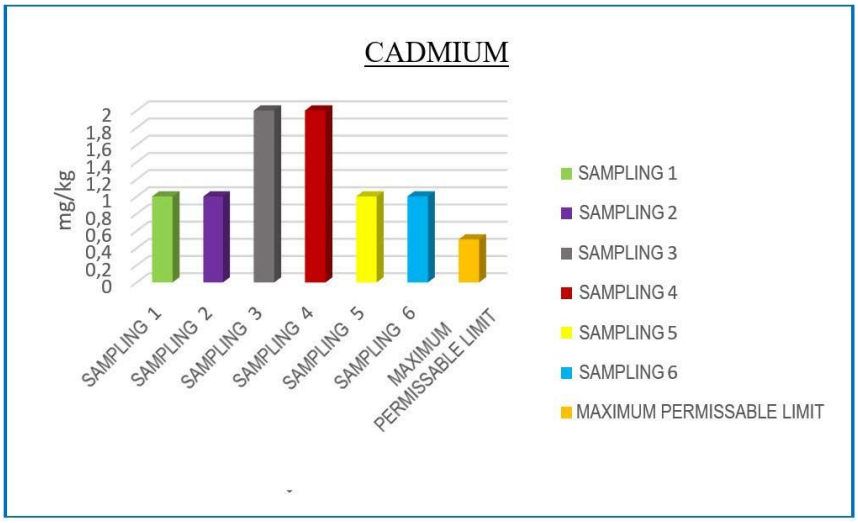
CADMIUM RESULTS

Table 85: Cadmium Sediments Results

N⁰ SAMPLING	UNIT	RESULT	MAXIMUM PERMISSABLE LIMIT
SAMPLING 1 In Front of Port	mg/kg	**1**	0,5
SAMPLING 2 In Front of Liceo Naval	mg/kg	**1**	0,5
SAMPLING 3 Isla del Amor	mg/kg	**2**	0,5
SAMPLING 4 Entrance to El Coco Water Park	mg/kg	**2**	0,5
SAMPLING 5 Punta El Faro	mg/kg	**<1,0**	0,5
SAMPLING 6 Entrance to Jambelí	mg/kg	**<1,0**	0,5

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A.
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

Illustration 124: Cadmium Sediments Results



Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

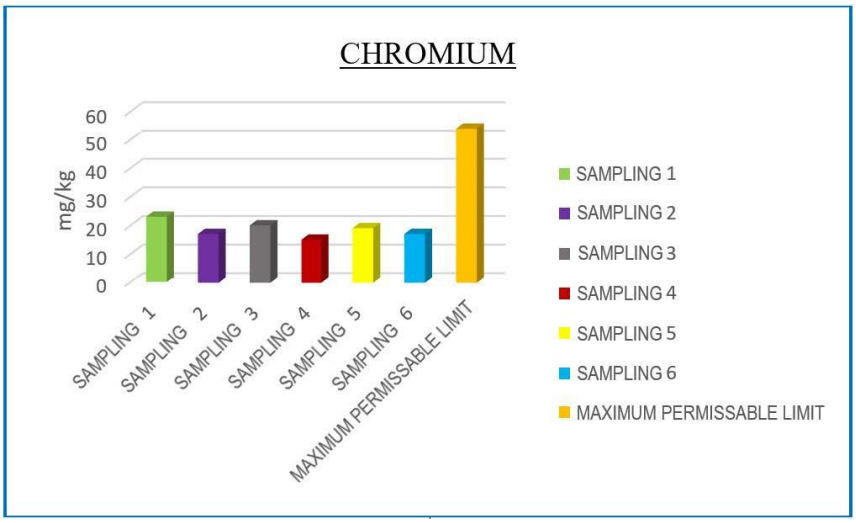
CHROMIUM RESULTS

Table 86: Chromium Sediments Results

N⁰ SAMPLING	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT
SAMPLING 1 In Front of Port	mg/kg	**23**	54
SAMPLING 2 In Front of Liceo Naval	mg/kg	**17**	54
SAMPLING 3 Isla del Amor	mg/kg	**20**	54
SAMPLING 4 Entrance to El Coco Water Park	mg/kg	**15**	54
SAMPLING 5 Punta El Faro	mg/kg	**19**	54
SAMPLING 6 Entrance to Jambelí	mg/kg	**17**	54

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

Illustration 125: Chromium Sediments Results



*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

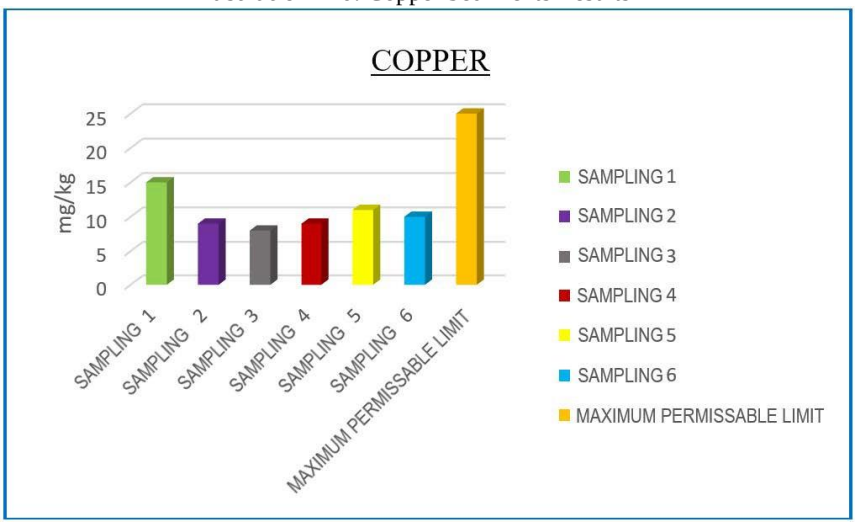
COPPER RESULTS

Table 87: Copper Sediments Results

N⁰ SAMPLING	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT
SAMPLING 1 In Front of Port	mg/kg	**15**	25
SAMPLING 2 In Front Liceo Naval	mg/kg	**9**	25
SAMPLING 3 Isla del Amor	mg/kg	**8**	25
SAMPLING 4 Entrance to El Coco Water Park	mg/kg	**9**	25
SAMPLING 5 Punta El Faro	mg/kg	**11**	25
SAMPLING 6 Entrance to Jambelí	mg/kg	**10**	25

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

Illustration 126: Copper Sediments Results



*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

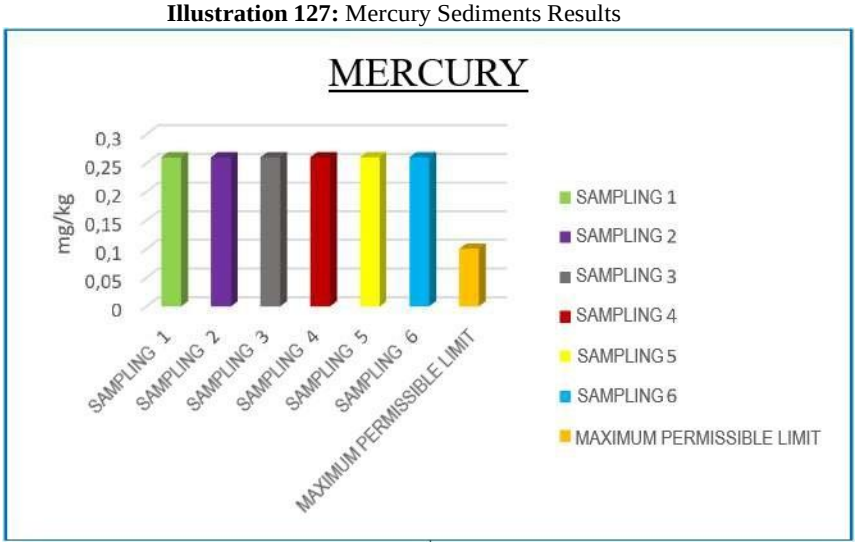
MERCURY RESULTS

Table 88: Mercury Sediments Results

N⁰ SAMPLING	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT
SAMPLING 1 In Front of Port	mg/kg	**<0,26**	0,1
SAMPLING 2 In Front of Liceo Naval	mg/kg	**<0,26**	0,1
SAMPLING 3 Isla del Amor	mg/kg	**<0,26**	0,1
SAMPLING 4 Entrance to El Coco Water Park	mg/kg	**<0,26**	0,1
SAMPLING 5 Punta El Faro	mg/kg	**<0,26**	0,1
SAMPLING 6 Entrance to Jambelí	mg/kg	**<0,26**	0,1

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

Illustration 127: Mercury Sediments Results



Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

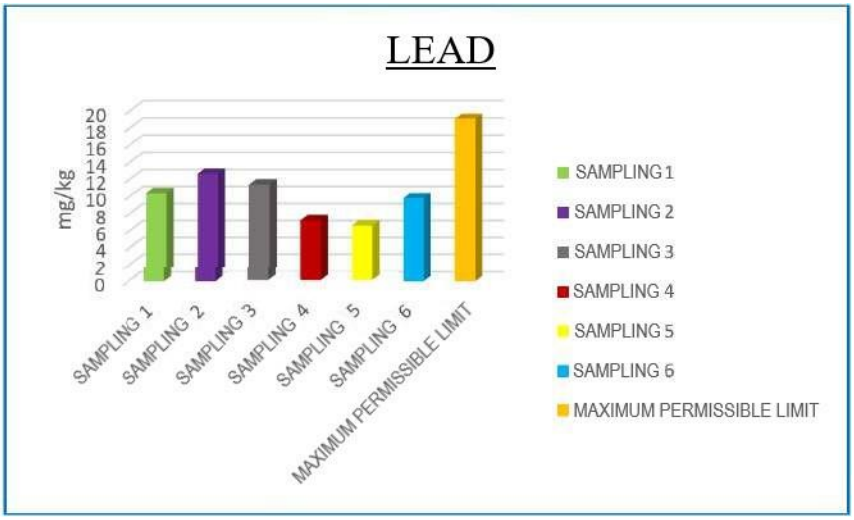
LEAD RESULTS

Table 89: Lead Sediments Results

N⁰ SAMPLING	UNIT	RESULTADO	MAXIMUM PERMISSIBLE LIMIT*
SAMPLING 1 In front of Port	mg/kg	**10,3**	19
SAMPLING 2 In Front of Liceo Naval	mg/kg	**12,6**	19
SAMPLING 3 Isla del Amor	mg/kg	**11,3**	19
SAMPLING 4 Entrance to El Coco Water Park	mg/kg	**7,1**	19
SAMPLING 5 Punta El Faro	mg/kg	**6,5**	19
SAMPLING 6 Entrance to Jambelí	mg/kg	**9,7**	19

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

Illustration 128: Lead Sediments Results



Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

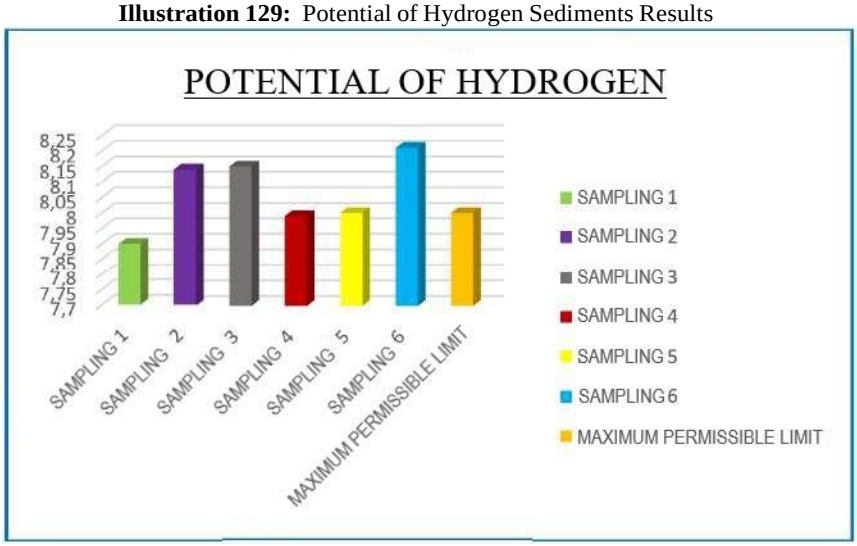
POTENTIAL OF HYDROGEN RESULTS

Table 90: Potential of Hydrogen Sediments Results

N⁰ SAMPLING	RESULT	MAXIMUM PERMISSIBLE LIMIT
SAMPLING 1 In Front of Port	**7,9**	6 – 8
SAMPLING 2 In Front of Liceo Naval	**8,14**	6 - 8
SAMPLING 3 Isla del Amor	**8,15**	6 – 8
SAMPLING 4 Entrance to El Coco Water Park	**7,99**	6 - 8
SAMPLING 5 Punta El Faro	**8**	6 – 8
SAMPLING 6 Entrance to Jambelí	**8,21**	6 - 8

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

Illustration 129: Potential of Hydrogen Sediments Results



Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

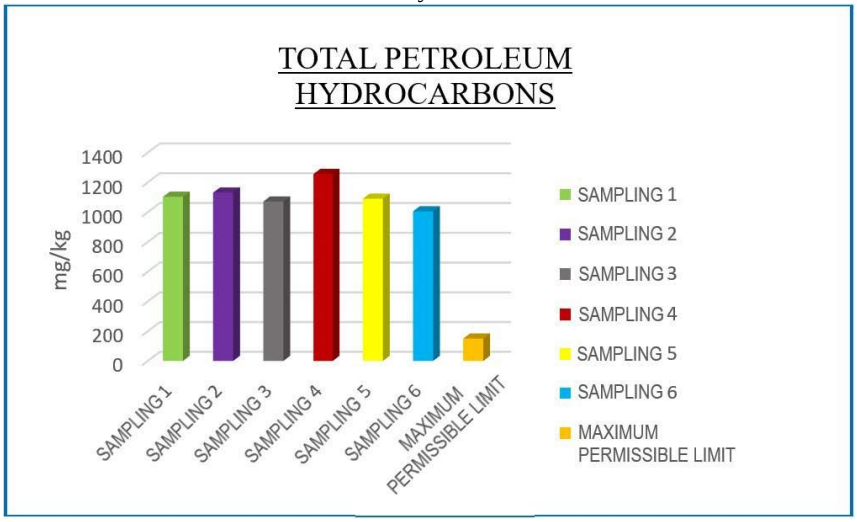
Total Petroleum Hydrocarbons

Table 91: Total Petroleum Hydrocarbons Sediments Results

N⁰ SAMPLING	UNIT	RESULT	MAXIMUM PERMISSIBLE LIMIT
SAMPLING 1 In Front of Port	mg/kg	**1103**	<150
SAMPLING 2 In Front of Liceo Naval	mg/kg	**1131**	<150
SAMPLING 3 Isla del Amor	mg/kg	**1071**	<150
SAMPLING 4 Entrance to El Coco Water Park	mg/kg	**1256**	<150
SAMPLING 5 Punta El Faro	mg/kg	**1090**	<150
SAMPLING 6 Entrance to Jambeli	mg/kg	**1005**	<150

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

Illustration 130: Total Petroleum Hydrocarbons Sediments Results



Source: Grupo Químico Marcos Test Report
Prepared by: Ecosfera Cía. Ltda.
Date: April 21st of 2017

❖ ANALYSIS OF COMPLIANCE OF SEDIMENT ANALYSIS WITH REGULATIONS

Table 92: Sediments Analysis of Compliance with Regulation

N⁰ SAMPLING	PARAMETERS	RESULT	MAXIMUM PERMISSIBLE LIMIT*	COMPLIANCE
SAMPLING 1 IN FRONT OF PORT	Arsenic	**<0,6**	12	COMPLIES
	Cadmium	**1**	0,5	DOESN'T COMPLY
	Chromium	**23**	54	COMPLIES
	Copper	**15**	25	COMPLIES
	Iron	**>500**	---	---
	Mercury	**<0,26**	0,1	DOESN'T COMPLY
	Lead	**10,3**	19	COMPLIES
	pH	**7,9**	6 - 8	COMPLIES
	Total Petroleum Hydrocarbons	**1103**	<150	DOESN'T COMPLY
SAMPLING 2 IN FRONT OF LICEO NAVAL	Arsenic	**1,7**	12	COMPLIES
	Cadmium	**1**	0,5	DOESN'T COMPLY
	Chromium	**17**	54	COMPLIES
	Copper	**9**	25	COMPLIES
	Iron	**>500**	---	---
	Mercury	**<0,26**	0,1	DOESN'T COMPLY

	Lead	**12,6**	19	COMPLIES
	pH	**8,14**	6 - 8	DOESN'T COMPLY
	Total Petroleum Hydrocarbons	**1131**	<150	DOESN'T COMPLY
SAMPLING 3 Isla Del Amor	Arsenic	**<0,6**	12	COMPLIES
	Cadmium	**2**	0,5	DOESN'T COMPLY
	Chromium	**20**	54	COMPLIES
	Copper	**8**	25	COMPLIES
	Iron	**>500**	---	---
	Mercury	**<0,26**	0,1	DOESN'T COMPLY
	Lead	**11,3**	19	COMPLIES
	pH	**8,15**	6 - 8	DOESN'T COMPLY
	Total Petroleum Hydrocarbons	**1071**	<150	DOESN'T COMPLY
SAMPLING 4 Entrance to COCO	Arsenic	**1,6**	12	COMPLIES
	Cadmium	**2**	0,5	DOESN'T COMPLY
	Chromium	**15**	54	COMPLIES
	Copper	**9**	25	COMPLIES
	Iron	**>500**	---	---
	Mercury	**<0,26**	0,1	DOESN'T COMPLY
	Lead	**7,1**	19	COMPLIES
	pH	**7,99**	6 - 8	COMPLIES
	Total Petroleum Hydrocarbons	**1256**	<150	DOESN'T COMPLY
SAMPLING 5 PUNTA EL FARO	Arsenic	**<0,6**	12	COMPLIES
	Cadmium	**<0,1**	0,5	COMPLIES
	Chromium	**19**	54	COMPLIES
	Copper	**11**	25	COMPLIES
	Iron	**>500**	---	---
	Mercury	**<0,26**	0,1	DOESN'T COMPLY
	Lead	**6,5**	19	COMPLIES
	pH	**8**	6 - 8	COMPLIES
	Total Petroleum Hydrocarbons	**1090**	<150	DOESN'T COMPLY
SAMPLING 6 ENTRANCE TO JAMBELÍ	Arsenic	**<0,6**	12	COMPLIES
	Cadmium	**<1,0**	0,5	DOESN'T COMPLY
	Chromium	**17**	54	COMPLIES
	Copper	**10**	25	COMPLIES
	Iron	**>500**	---	---

	Mercury	**<0,26**	0,1	DOESN'T COMPLY
	Lead	**9,7**	19	COMPLIES
	pH	**8,21**	6 - 8	DOESN'T COMPLY
	Total Petroleum Hydrocarbons	**1005**	<150	DOESN'T COMPLY

*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
*Soil quality criteria, Table 1, Annex 2, Ministerial Agreement 097A
Source: *Grupo Químico Marcos Test Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 21st of 2017*

❖ SEDIMENT ANALYSIS CONCLUSIONS

The analysis of sediments was done in the Santa Rosa Estuary. However, there are no regulations for the control of sediment levels in the Ecuadorian Environmental Legislation, so the results obtained were compared with Table 1 of Annex 2 of Ministerial Agreement 097 A, where the Criteria for soil quality are determined. At present, the Santa Rosa Estuary has become a great sink for different substances and the natural levels of contaminants and metals areunknown before receiving the impact of the diverse and numerous human activities that take place in its surroundings. The main contributions of suspended sediments to the Santa Rosa Estuary are the drainage basins of the Guayas River and the Jubones River and the extracted material produced by the construction or remodeling of the shrimp farm pools.

As for the results obtained in the sediment sampling, the parameters of Arsenic, Chromium, Copper, Iron, Lead and Hydrogen Potential comply with the quality criteria, while the parameters: Mercury, Cadmium in Samples 3 and 4 and the parameter of Total Petroleum Hydrocarbons are exceeding the limits established in the regulations. The mercury parameter present in the Santa Rosa Estuary sediments ismainly caused by the Jubones and Santa Rosa River basins' waters, wherethere are several mining areas where this metal is used for gold extraction. Mercuryis very toxic because it affects the nervous system (brain, nerves, vision, immune system, and the cardiovascular system (heart, circulation).
Cadmium usually enters the marine environment by atmospheric deposition and through effluent discharges.
The high level of petroleum hydrocarbons is due to the fact that the Santa Rosa Estuary is one of the main maritime transportation routes for ships, artisanal fishing boats, and tourist boats, considering that the estuary provides access to JambelíIsland and shrimp farming areas in the area that use diesel and bunker in their pumping stations.

In addition, in the Santa Rosa Estuary, there is penetration of marine biogenic energy from periphyton (superficial benthic microalgae), macrophytes, sulfate-reducing bacteria, together with alkanes from plankton and the great influence of leaves and mangrove remains.

It is important to mention that according to previous studies carried out in the Santa Rosa Estuary, it has been determined that the main contribution of heavy metals comes from mining activities and erosion caused by rainfall. The presence of metals in the marine environment is of great concern worldwide, the most toxic being mercury, cadmium, and lead because they diminish aquatic life.

In Ecuador, there are no guide levels for sediment quality, and it is necessary to generate studies to establish legislation for the analysis of marine sediments and the specific effects on the environment.

❖ 6.1.12.- AMBIENT AIR QUALITY ANALYSIS

All industrialized countries, and a growing number of developing countries, have created regulations that control and limit the number of emissions from their industries. Due to the increasing commitment of industry to the environment and the legislation in force, monitoring their emissions and verifying that they comply with national regulations is of crucial importance.

Air pollution is the term used to describe the presence of one or more pollutants in the atmosphere, the quantities and characteristics of which may be harmful or interfere with health, welfare, or other natural environmental processes.

Various human activities pollute the air. Pollutants originating from human activity can come from stationary sources (factories, thermal power plants, homes, etc.) or mobile sources (vehicles, airplanes, trains, ships, etc.). There are also natural sources, such as pollen emitted by flowers, dust from wind erosion, and volcanic eruptions.

When the air contains pollutants in the form of particles, gases, or biological agents, there is a potential for adverse health effects.

Air monitoring is the result of air pollutant sampling and analysis procedures. Important air pollutants commonly monitored are: SO2, CO, PST, PM10, ozone, and nitrogen oxides (NOx). These pollutants are known as criteria pollutants, for which air quality regulations exist.

❖ AIR QUALITY LEGAL FRAMEWORK

MINISTERIAL AGREEMENT 061: AMENDMENT TO BOOK VI OF THE UNIFIED TEXT OF SECONDARY LEGISLATION OF THE ENVIRONMENTAL MINISTRY
SECTION III: QUALITY OF ABIOTIC COMPONENTS
PARAGRAPH IV: AIR QUALITY AND ATMOSPHERIC EMISSIONS

Art. 219 Air quality - Corresponds to characteristics of the surrounding air such as the type of substances that compose it, their concentration, and the period in which they are present in a determined place and time; these characteristics must guarantee the ecological balance, health, and wellbeing of the population.

Art. 220 Ambient Air Quality - The National Environmental Authority shall issue the technical regulation for the control of ambient air quality or immission levels through the corresponding legal figure, which shall be of mandatory compliance. If necessary, the National Environmental Authority may provide for the evaluation and control of ambient air quality by means of biological indicators, for which purpose it shall establish the respective technical regulations and guidelines.

MINISTERIAL AGREEMENT 097 A
ANNEX 4: ENVIRONMENTAL AIR QUALITY STANDARD OR IMMISSION LEVEL

This technical regulation is issued under the Environmental Management Law and the Regulations to the Environmental Management Law for the Prevention and Control of Environmental Pollution and is subject to the provisions of these, is mandatory, and applies throughout the national territory.
This regulation establishes:

- Ambient air quality objectives
- Permissible limits for criteria pollutants and non-conventional pollutants in ambient air.
- Methods and procedures for the determination of pollutants in ambient air.

· **OBJECTIVE**

The main objective of this regulation is to preserve people's health, the qualityof the ambient air, the wellbeing of ecosystems, and the environment in general. This regulation establishes the maximum permissible limits of contaminants in ambient air at ground level to meet this objective. The regulation also provides methods and procedures for the assessment of ambient air pollutant concentrations.

· **CLASSIFICATION**

This regulation establishes the maximum permissible limits for pollutants' concentrations and non-conventional pollutants at ground level in ambient air. The regulation establishes the present classifications:

- Ambient air quality regulation:

a) Ambient air pollutants
b) General regulations for ambient air concentrations of criteria pollutants
c) Air quality alerts, alarms, and emergency plans

d) Methods for measuring concentrations of criteria pollutants in ambient air.
e) General regulations for concentrations of non-conventional pollutants in ambient air.
f) Methods of measuring concentrations of non-conventional ambient air pollutants
g) Nuisance or hazardous by other air pollutants.

- **REQUIREMENTS**

Ambient Air Quality Regulation

- **Ambient air pollutants**

For the purposes of this regulation, the following are established as criteria pollutants of ambient air:

- Suspended Particles
- Particulate Matter of aerodynamic diameter less than 10 (ten microns) PM10
- Particulate Matter of aerodynamic diameter less than 2.5 (two whole five-tenths microns) PM2.5
- Nitrogen Dioxide NO2
- Sulfur Dioxide SO2
- Carbon Monoxide CO
- Ozone O3

- The National Environmental Authority may request projects, works, or activities that emit or are likely to emit pollutants into the ambient air, to carry out ambient air quality monitoring, as indicated in this regulation, to prevent future deterioration of air quality.

- **General regulations for concentrations of criteria pollutants in the air ambient**

- The following maximum allowed concentrations are established for criteria air pollutants:

Table 93: Maximum allowed concentrations for air quality

POLLUTANT	TIME	MAXIMUM CONCENTRATION
Sulfur Dioxide (SO2)	24 h 10 min	125 µg/m^3 500 µg/m^3
Carbon Monoxide (CO)	8 h 1 h	10.000 µg/m^3 30.000 µg/m^3
Ozone	8 h	100 µg/m^3
Nitrogen Dioxide (NO2)	1 h	200 µg/m^3

Source: *Ministerial Agreement 097 A, Annex 4*
Prepared by: *Ecosfera Cia Ltda.*
Date: *April 15th of 2017*

- The concentration values for criteria for air pollutants established in thisregulation and those determined in public measurement programs are subject to the reference conditions of 250C and 760 mmHg.

❖ AIR QUALITY ANALYSIS METHODOLOGY

For the realization of the Air Quality Monitoring in the Project: Dredging of Piers 1, 2, 3, 4, 5, and 6, Maneuvering Zone and Waterway of Puerto Bolivar, the services of the Elicrom laboratory of the city of Guayaquil were hired, which is accredited by the Ecuadorian Accreditation Agency (OAE for its initials in Spanish).

The monitoring was carried out on Thursday, April 20, 2017. The procedures used for the measurement are based on the Ecuadorian Air Quality Legislation, Annex 4 - Ministerial Agreement 097 A.

❖ AIR QUALITY ANALYSIS EQUIPMENTUSED

- GPS
- SUPELCO PUMP
  - Internal code: EL.EA.071
  - Brand: Micro Air Sampler
  - Model: Not Specified
  - Series: Not specified
  - Calibrated: May 9, 2016
- THERMO HYGROMETER
  - Internal code: EL.PT.211
  - Brand: ATM
  - Model: HT9214
  - Series: Not specified
  - Calibrated: January 7, 2017
- ANEMOMETER
  - Internal code: EL.PT.567
  - Brand: Control Company
  - Model: 3655
  - Calibrated: March 4, 2016
- BAROMETER
  - Internal code: EL.PT.547
  - Make: Control Company
  - Model: 1081
  - Calibrated: March 1, 2016

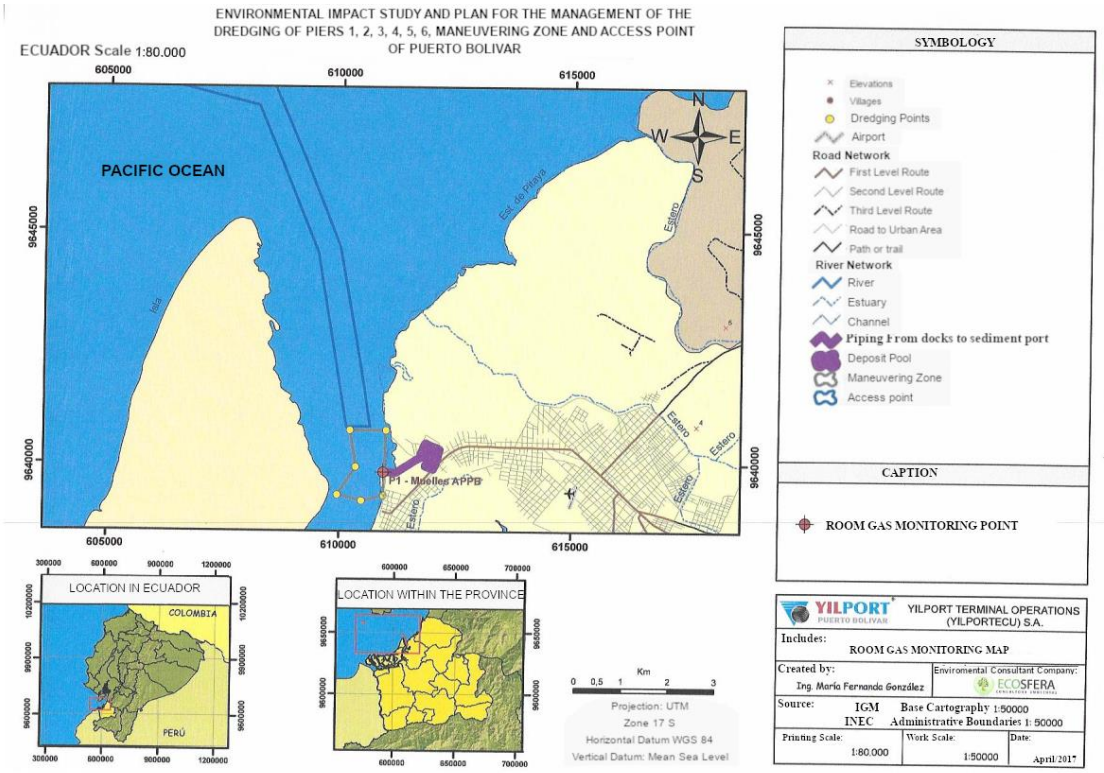
❖ AIR QUALITY ASSESSMENT MONITORING POINTS

Table 94: Air Quality Monitoring Points

MONITORING POINT	LOCATION	COORDINATES
POINT 1	Pier 5	X: 610951 Y: 9639819

Source: *Air Quality Monitoring Report Elicrom*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Bolivar Port - Machala, Santa Rosa - El Oro*
Date: *April 20, 2017*

Figure 131: Air Quality Monitoring Points



Source: *www.geoportaligm.gob.ec, Military Geographic Institute*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Bolivar Port - Machala, Santa Rosa - El Oro*
Date: *April 6, 2017*

Photograph 21: Air Quality Monitoring

AIR QUALITY MONITORING
PIER 5





Source: *Photographs taken by the consultant team*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar, Machala – El Oro*
Date: *April 20th of 2017*

❖ AMBIENT CONDITIONS FOR AIR QUALITY ANALYSIS

The Ambient conditions on the day of monitoring (April 20th of 2017) were:

- Average Temperature = 31,6 ºC
- Relative Humidity = 69,3% hr
- Wind Speed = 1,5 m/s
- Air Pressure = 753,6 mmHg

❖ AIR QUALITY ANALYSIS MONITORING RESULTS

Table 95: Air Quality Monitoring Results

PIER 5		
POLLUTANT EMITTED	**ADJUSTED CONCENTRATION µg/m³**	**MAXIMUM ALLOWED ***
Carbon Monoxide CO	**2086,62**	10.000
Nitrogen Dioxide NO2	**11,29**	200
Sulfur Dioxide SO2	**8,90**	125
Ozone	**23,56**	100

*Air Quality Standard or immission level, Annex 4, Ministerial Agreement 097 A
Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

❖ AIR QUALITY RESULTS ANALYSIS

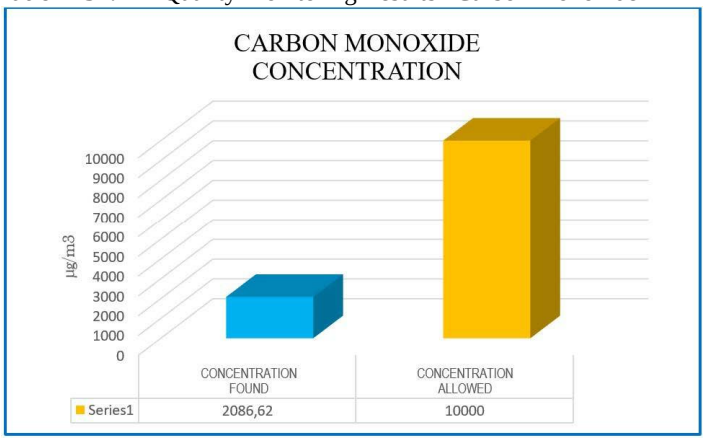
CARBON MONOXIDE CONCENTRATION

Tabla 96: Air Quality Monitoring Results – Carbon monoxide

POLLUTANT EMITTED	CONCENTRATION	MAXIMUM CONCENTRATION LOST *
MONÓXIDO DE CARBONO CO	**2086,62**	10.000

*Air Quality Standard or immission level, Annex 4, Ministerial Agreement 097 A
Source: Elicrom Air Quality Monitoring Report
Prepared by: Ecosfera Cía. Ltda.
Date: April 20th of 2017

Illustration 132: Air Quality Monitoring Results - Carbon Monoxide



Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

The result of the Air Quality Monitoring for Carbon Monoxide Pollutant obtained a value of 2086.62 µg/m3, which complies with the allowed concentration set at a value of 10,000 µg/m3.

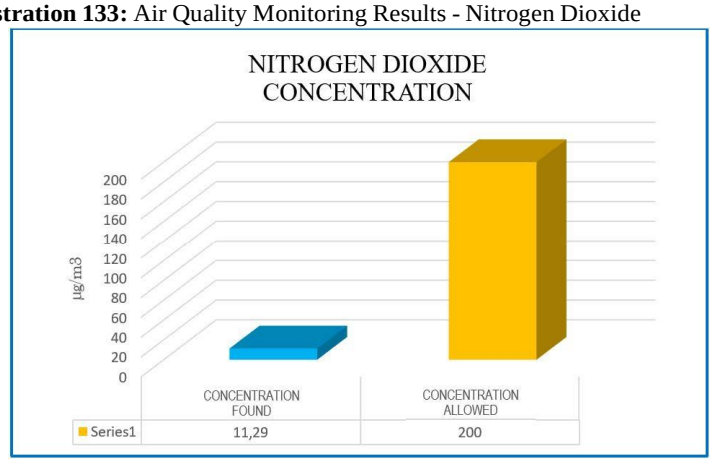
NITROGEN DIOXIDE CONCENTRATION

Table 97: Air Quality Monitoring Results - Nitrogen Dioxide

POLLUTANT EMITTED	CONCENTRATION	MAXIMUM CONCENTRATION ALLOWED *
NITROGEN DIOXIDE NO2	11,29	200

*Air Quality Standard or immission level, Annex 4, Ministerial Agreement 097 A
Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

Illustration 133: Air Quality Monitoring Results - Nitrogen Dioxide



Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

Regarding the concentration of the pollutant Nitrogen Dioxide, the monitored value was 11.29 µg/m3, which indicates compliance with environmental regulations.

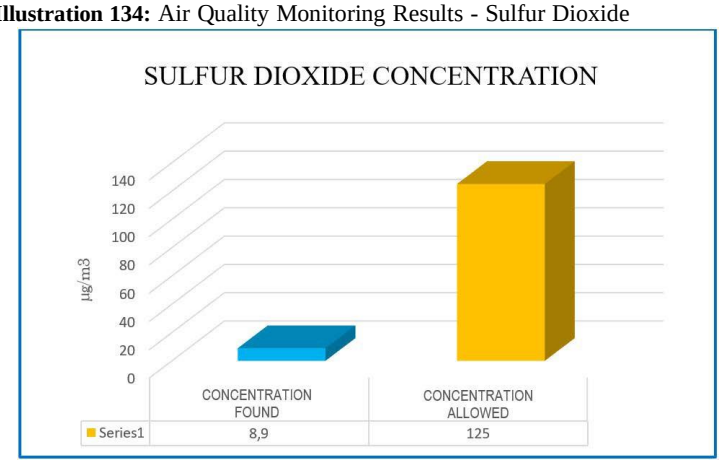
SULFUR DIOXIDE CONCENTRATION

Table 98: Air Quality Monitoring Results - Sulfur Dioxide

POLLUTANT EMITTED	CONCENTRATION	MAXIMUM CONCENTRATION ALLOWED *
SULFUR DIOXIDE NO2	8,90	125

*Air Quality Standard or immission level, Annex 4, Ministerial Agreement 097 A

Illustration 134: Air Quality Monitoring Results - Sulfur Dioxide



Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

The sulfur dioxide pollutant monitored obtained a value of 8.9 µg/m3; this value complies with the allowed concentration of 125 µg/m3.

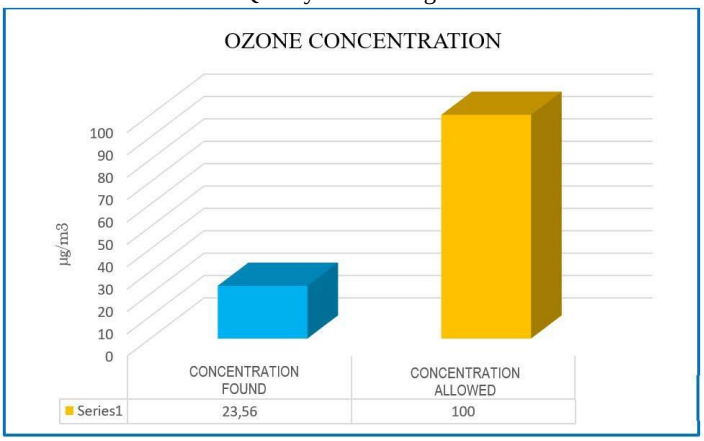
OZONE CONCENTRATION

Table 99: Air Quality Monitoring Results -Ozone

POLLUTANT EMITTED	CONCENTRATION	MAXIMUM CONCENTRATION ALLOWED *
OZONE	23,56	100

*Air Quality Standard or immission level, Annex 4, Ministerial Agreement 097 A
Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

Illustration 135: Air Quality Monitoring Results -Ozone



Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

The pollutant Ozone concentration complies with the allowed concentration,having obtained a result of 23.56 µg/m3 in the Air Quality Monitoring.

❖ AIR QUALITY MONITORING ANALYSIS IN COMPLIANCE WITH REGULATIONS

Table 100: Analysis of Compliance with Air Quality Monitoring Regulations

PIER 5			
POLLUTANT EMITTED	**ADJUSTED CONCENTRATION µg/m³**	**MAXIMUM ALLOWED ***	**EVALUATION**
Carbon Monoxide CO	**2086,62**	10.000	MET
Nitrogen Dioxide NO2	**11,29**	200	MET
Sulfur Dioxide SO2	**8,90**	125	MET
Ozone	**23,56**	100	MET

*Air Quality Standard or immission level, Annex 4, Ministerial Agreement 097 A
Source: *Elicrom Air Quality Monitoring Report*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

❖ AIR QUALITY MONITORING CONCLUSIONS

Air quality monitoring was performed by Elicrom Laboratory, which is accredited by the Ecuadorian Accreditation Organization (OAE for its initials in Spanish). A single monitoring point was determined, which was determined at Pier 5 of the Port Authority of Puerto Bolivar, a site within the project's area of influence. On Thursday, April 20, 2017, monitoring was conducted under regulations described in the Ministerial Agreement 097 A, Annex 4: Ambient Air Quality Standard or Immission Level.

The Air Quality Monitoring results show compliance with the Maximum Allowed Concentrations for the pollutants: Carbon Monoxide, Nitrogen Dioxide, Sulfur Dioxide, and Ozone.

6.1.13.- NOISE MONITORING

As part of the environmental baseline for this Environmental Impact Study, noise monitoring was carried out at several points in the project's area of influence.

❖ LEGAL FRAMEWORK FOR NOISE MONITORING

MINISTERIAL AGREEMENT 061: REFORM OF BOOK VI OF THE UNIFIED TEXT OF SECONDARY LEGISLATION OF THE ENVIRONMENTAL MINISTRY
SECTION III: QUALITY OF ABIOTIC COMPONENTS
PARAGRAPH V: OF PHYSICAL PHENOMENA NOISE

- **Art. 224 Evaluation, control, and follow-up.-** The Competent Environmental Authority, at any time, may evaluate or order the Control Subject to evaluate the environmental quality by means of sampling of environmental noise and/or noise emission sources established in the environmental evaluation and control mechanisms.
  For the determination of noise from fixed or mobile sources by means of programmed monitoring, the Control Subject must indicate the sources used daily and the power at which they operate for the sampling or monitoring to be valid; the omission of such information or its partial or altered delivery will be penalized with the corresponding sanctions.
- **Art. 225 Technical regulations.-** The National Environmental Authority will issue the technical regulations for the control of environmental noise pollution, stipulated in Annex V or in the corresponding technical regulations. These regulations will establish maximum permissible noise levels according to land use and source and indicate the methods and procedures for the determination of noise levels in the environment and provisions for noise prevention and control. Theregulations on the generation of industrial noise are complementary, which will bedealt with by the competent Authority on health and labor matters.
- **Art. 226 Noise emission.-** Control Subjects that generate noise must consider all methodological and technological alternatives in order to prevent, minimize and mitigate noise generation.

MINISTERIAL AGREEMENT 097 A
ANNEX 5: MAXIMUM NOISE EMISSION LEVELS AND MEASUREMENT METHODOLOGY FOR STATIONARY AND MOBILE SOURCES

This technical regulation is issued under the Environmental Management Law and the Regulations to the Environmental Management Law for the Prevention and Control of Environmental Pollution and is subject to the provisions of these, it is mandatory and applies throughout the national territory.

This technical regulation determines or establishes:

- Maximum noise emission levels emitted into the environment by stationary noise sources (FFR by its initials in Spanish).
- Maximum noise emission levels emitted into the environment by mobile noise sources (FMR by its initials in Spanish).
- Methods and procedures for determining compliance with maximum noise emission levels for FFRs and FMRs.

- **OBJECT**
  This regulation aims to preserve the health and welfare of people and the environment in general by establishing maximum noise emission levels for FFRs and FMRs.
  All FFRs and FMRs, public or private, are subject to the provisions of this regulation, with the following exclusions:
    - Exposure to noise pollution produced in work environments shall be subject to the Labor Code and the corresponding regulations.

- Aircraft will be governed by the General Directorate of Civil Aviation regulations and ratified internationalconventions and treaties.
- Others determined by the National Environmental Authority.

- **GENERAL CONSIDERATIONS**
  - The competent Environmental Authority may practice the visits, inspections, measurements, and verifications that are necessaryto verify adequate compliance with the provisions containedin this regulation. The cost of inspections, visits, or measurements shall be covered by those responsible for the activities that generate emissions.
  - The Community Relations Plan of the Environmental Management Plan must consider noise perception and disturbance surveys.
  - It is a fundamental duty of the regulated party to report to the competent environmental entity the results of the monitoring corresponding to its noise emissions according to what is established in its approved Environmental Management Plan at least once a year.
  - For the approval of environmental studies of those activities involving FER, the environmental noise assessment and the noise control measures proposed to mitigate their impact will be considered.
  - The regulated party must demonstrate documentation and technical evidence of the proposed noise control measures' effectiveness when required.
  - Municipal governments must control the use of alarms in vehicles and buildings and the use of horns, bells, sound application systems, sirens, or similar devices.
  - The Municipal Governments may authorize, for reasons of general interest or of special public significance or for the organization of events with special official, cultural, religious, oranalogous nature, the temporary modification or suspension ofthe levels established in Table 1.
  - Laboratories that perform noise evaluations must be accredited by the Official Accreditation Body and carry out these activities with competent personnel.

- **MAXIMUM NOISE EMISSION LEVELS FOR FFR AND FMR**

Maximum Noise Emission Levels for FFR

The corrected equivalent continuous sound pressure level, LKeq in decibels, obtained from the evaluation of noise emitted by an FFR, shall not exceed the levels outlined in Table 1 according to the land use in which it is located.

Table 101: Maximum Noise Levels (LKed) for Fixed Noise Sources

MAXIMUM NOISE EMISSION LEVELS FOR FFR		
USO DE SUELO	LKeq (dB)	
	Daytime Period 07:01 to 21:00 hr	**Nighttime Period 21:01 to 07:00 hr**
Residential (R1)	55	45
Social Services Equipment (EQ1)	55	45
Public Services Equipment (EQ2)	60	50
Commercial (CM)	60	50
Agricultural Residential (AR)	65	45
Industrial (ID1/ID2)	65	55
Industrial (ID3/ID4)	70	65
Multiple uses	When there are multiple or combined land uses, the lowest LKeq of any of the uses that make up the combination will be used. Example: Land Use: Residential + ID2 LKeq for this case = Daytime 55 dB and Nighttime 45 dB	
Agricultural Protection (EP) Natural Resources (NR)	The determination of the LKeq for these cases shall be carried out according to the procedure described in Annex 4.	

Source: *Ministerial Agreement 097 A, Anexo 5, Table 1*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 16th of 2017*

- The FFR must comply with the maximum noise emission levels at the measurement points determined for the evaluation, for which it must obtain from the corresponding municipal administration the certificate indicating the specific land use in which it is located.
- In those situations where conflicts or non-existence of the definition of land use are verified, the competent Environmental Authority will determine the maximum emission level of the FFR to be evaluated based on the PCAs. If the competent Environmental Authority is still unable to determine the maximum emission level, this regulation's objective, which is to preserve the health and welfare of people and the environment, shall be applied as a criterion.

- **DETERMINATION OF THE NOISE EMISSION LEVELS PRODUCED BY A FFR**

Environmental Noise Baseline Assessment

- The baseline environmental noise assessment objective is to identify the noise emitting sources, the highest sound pressure levels at the perimeter of theFFR, and the PCAs that could be affected by the FFR.

- This assessment shall determine any activity, operation, or process that involves noise emission and that constitutes a noise emitting source (FER) and its contribution in time and level of noise emitted by the FFR.
- The locations on the perimeter of the FFR where the highest noise levels are emitted should be identified, as well as the nearby PCAs.
- At least the following information should be collected and reported:
    - NPS and where these are highest on the perimeter.
    - The land use where it is located
    - Identification of noise sources contributing to residual noise.l
- For each of the FER of the FFR:
    - Description of the process and its simultaneity with other processes.
    - Equipment and machinery involved
    - Temporary periods of operation
    - Corresponding points of the potential impact
    - Emission of impulsive noise or noise with significant low-frequency content.
    - Others that are relevant
- Other:
    - Map of the FFR with the location of the observed FERs
    - Map of the location of any potentially affected sites and the external FFRs in the environment.
- The critical points will be defined by the subject of control within their environmental studies (EsIA, Environmental File, PMA, etc.).

- **METHODOLOGY FOR THE MEASUREMENT, QUANTIFICATION, ANDDETERMINATION OF THE NOISE LEVEL FOR FFR.**

Measurement Points:

For the purposes of this regulation a specific noise measurement of an FFR shall be made:

- At critical measurement points (PCA for its initials in Spanish) determined in the baseline environmental noise assessment and environmental studies, or those determined by the competent Environmental Authority.
- At sites and times where the FFR emits the highest NPS at the outer perimeter.

Minimum Number of Measurement Points

There is no minimum number of measurement points; however, it is recommended that the following criteria determine the minimum number of measurement points:

- Taking into account the PCAs close to the FFR
- Taking into account the highest NPS emitted by the FFR at its outer perimeter.

Determination of the Sites where the Measurement should be carried out

Sites where nearby PCAs exist

These sites will be determined through the baseline environmental noise assessment performed by the subjects of control within the baseline or environmental diagnosis.

In the absence of a baseline environmental assessment, a specific noise level probe should be conducted at the outer perimeter of the FFR, and measurement points should be defined based on the Measurement Point criteria.

Sites where the FFR noise emission is higher.

These sites will be determined through the baseline environmental noise assessment carried out by the control subjects within the baseline or environmental diagnosis ofthe activity or project to be executed.

In the absence of the baseline environmental assessment, a specific noise level probe should be conducted at the outer perimeter of the FFR, and the measurement points will be defined based on the criteria for Measurement Points.

Measurement Point Criteria

The measurement point shall be determined by considering the site/point where the specific noise is higher, outside the perimeter, physical boundaries, boundaries, or factory lines of the FFR. The topography of the environment and the location of the PCA shall be taken into consideration.

The Measurement should be taken at the determined point, and the evaluator should minimize the effect of sound-reflecting surfaces.

Times at which the Measurement should be taken

Evaluation personnel is responsible for measuring at the time(s)at which the FFR emits the highest SPLs for each evaluation point under normal operating conditions.

Measurement Equipment Requirements

Evaluations must be performed using class 1 or class 2 integrating sound level meters, according to the International Electrotechnical Commission IEC 61672-1: 2002 Standard, or any that replaces it.

To verify the sound level meter's correct operation during the measurements, an acoustic calibrator that is appropriate for the sound level meter shall be used. Thecalibrator's SPL shall be measured with the sound level meter before and after the Measurement; these SPLs shall be recorded in the measurement report. The sound level meter can be used for the Measurement only if the average NPS with the calibrator has a maximum deviation according to the Ecuadorian Accreditation Organization criteria.

Noise measuring equipment and its components must be in good working condition and have the proper calibration certificates issued by a competent laboratory. It is recommended that calibration certificates for acoustic calibrators be renewed every calendar year and for sound level meters every two years. Measurements will not be allowed with instruments whose calibration certificates have expired.

Environmental Conditions during Measurement

Measurements should not be carried out in adverse conditions that may affect the measurement process, such as rain, thunder, etc.

The microphone should be protected with a windshield during measurements. Measurements should be carried out only when the wind speed is less than or equal to 5 m/s/

Sound Level Meter Location

The sound level meter shall be placed on a tripod and located at a height equal toor higher than 1.5 meters from the ground, directing the microphone towards the source with an inclination of 45 to 90 degrees on its horizontal plane. During the Measurement, the operator must be at least 1 meter away from the equipment.

Residual Noise at the Time of Measurement

During the Measurement the residual noise should be such that it has a minimal influence on the total noise, i.e. the contribution of the specific noise of the FFR tothe total noise is maximized.

- **METHODOLOGY FOR DETERMINING SPECIFIC NOISE LEVELS AND Lkeq**
  - **Methods for noise sampling and determination and Lkeq**
    For the Measurement of total and residual noise, this regulation contemplatesthe use of two methods that can be used as the case may require.
  - **15-second method (Leq 15s)**
    In this method, a minimum of 5 samples of 15 seconds each will be taken and reported.
  - **5-second method (Leq 5s)**
    In this method, a minimum of 10 samples of 5 seconds each will be taken and reported.
  - **Sampling considerations**
    The same method (Leq 15s or Leq 5s) will be used to measure total andresidual noise.
    The series of samples reported will be considered valid when the differencebetween the external values obtained in it, is less than or equal to 4dB.
    To validate the noise levels during the measurements and to facilitatethe analysis and comparison of the samples, the minimum NPS (LAmin) and the maximum NPS (LAmax) measured for each sample shall be reported.

REGULATIONS FOR WORKERS' SAFETY AND HEALTH AND IMPROVEMENT OF THE WORK ENVIRONMENT

- **Art. 55. NOISE AND VIBRATIONS**
  1. The prevention of noise and vibration risks shall be carried out by applyingthe methodology expressed in paragraph 4 of Article 53.
  2. The anchoring of machines and equipment that produce noise or vibrationsshall be carried out with the techniques that allow achieving their optimum static and dynamic equilibrium, isolation of the structure, or use of anti-vibration supports.
  3. The machines that produce noise or vibrations shall be located in isolated enclosures if the manufacturing process allows it, and shall be subject to an adequate maintenance program that minimizes as much as possible theemission of such physical pollutants.
  4. (Reformed by Art. 31 of D.E. 4217, R.O. 997, 10-VIII-88) It is prohibited to install machines or devices that produce noise or vibrations,

attached to walls or columns, excluding alarm devices or acoustic signals.

5. (Reformed by Art. 32 of D.E. 4217, R.O. 997, 10-VIII-88) The ducts with forced circulation of gases, liquids, or solids in suspension, especially when they are directly connected to machines that have moving parts as long as they contribute notably to the increase of noise and vibrations, shall be provided with devices that prevent the transmission of the vibrations generated by them by means of absorbent materials in their anchorages and in the parts of their route that cross walls or partitions.
6. (Reformed by Art. 33 of D.E. 4217, R.O. 997, 10-VIII-88) The maximum sound pressure limit is set at 85 decibels, scale A, of the sound level meter, measured in the place where the worker usually keeps his head, for the case of continuous noise with 8 hours of work. However, workplaces that require mainly intellectual activity, or regulatory or supervisory tasks, concentration or calculation, shall not exceed 70 decibels of noise.
7. (Reformed by Art. 34 of D.E. 4217, R.O. 997, 10-VIII-88) For the case of continuous noise, the sound levels measured in decibels with filter "A" in slow position, which shall be allowed, shall be related to the exposure time according to the following table:

Table 102: Noise level per exposure time per shift

NOISE LEVEL /dB (A-SLOW)	EXPOSURE TIME PER SHIFT/HOUR
85	8
90	4
95	2
100	1
110	0.25
115	0.125

Source: *Reglamento de Seguridad y Salud de los trabajadores y Mejoramiento del Ambiente,*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 16, 2017*

The different sound levels and their corresponding permitted exposure times indicated correspond to equivalent continuous exposures in which the daily noise dose (D) is equal to 1.
In no case will it be allowed to exceed the level of 115 dB (A) regardless of the type of work.
Workers subjected to such conditions must be subject to an annual study and audiometric control.

❖ NOISE-MONITORING STAFF

The noise measurement was carried out by staff of the company ELICROM Laboratorio who are accredited to the Ecuadorian Accreditation Service (SAE), under the supervision of the Ing. José Marcial Technical Coordinator and with the technicians who have been trained in the respective topics.

❖ NOISE MONITORING SOURCE EVALUATION

Table 103: Source Identification Noise Monitoring

PROJECT NAME	PIER DREDGING 1, 2, 3, 4, 5 6, WATERWAY AND MANEUVERING AREA OF PUERTO BOLÍVAR
ACTIVITY	STORAGE, LOADING, AND UNLOADING OF CONTAINERS
CRITICAL POINTS OF IMPACT	**RECEIVERS:** - Nearby housing Administrative Staff - Port Staff
NEARBY SOUND-REFLECTING SURFACES	**Emitter:** No Physical Boundaries **Receiver:** Concrete Walls
OPERATING REGIME	**Turns:** 3 (or hours per shift) **Days per month:** 30 days **Hours per month:** 720 hours
RESIDUAL NOISE DESCRIPTION	– P1: Passage of vehicles to warehouse – P2: Behind administrative areas – P3: Empty lot near maneuvering area, Pier 5 – P4: Near the Parish Council. **Contributing Sources:** There were no sources of noise disturbance.
SPECIFIC NOISE DESCRIPTION	– **P1:** Taken at the passage of vehicles for loading and unloading of products. – **P2:** Taken next to administrative areas – **P3:** Taken at the maneuvering area or vehicle passageway. – **P4:** Taken at the passage of vehicles

Source: *Noise Monitoring Report Elicrom Cia. Ltda.*
Prepared by: *Ecosfera Cia. Ltda.*
Date: *April 20th of 2017*

❖ NOISE MONITORING POINTS

Table 104: Noise Monitoring Measurement Points

POINT	MEASURING LOCATION	COORDINATES	
		X	Y
1	Pier 1	610941	9639369
2	Administrative Areas	611136	9639401
3	Pier 5	611014	9640135
4	Cabotage Dock	610892	9639050

POINT	MEASURING LOCATION	Rating	Start Time	End Time	Measuring Time	Total Samples
1	Pier 1	A	15:15:26	15:17:26	00:02:00	5
		C	15:21:19	15:23:19	00:02:00	5
2	Administrative Areas	A	15:31:40	15:33:40	00:02:00	5
		C	15:34:00	15:36:00	00:02:00	5
3	Pier 5	A	15:57:31	15:59:31	00:02:00	5
		C	16:00:00	15:02:00	00:02:00	5
4	Cabotage Dock	A	16:39:39	16:41:39	00:02:00	5
		C	16:42:10	16:44:10	00:02:00	5

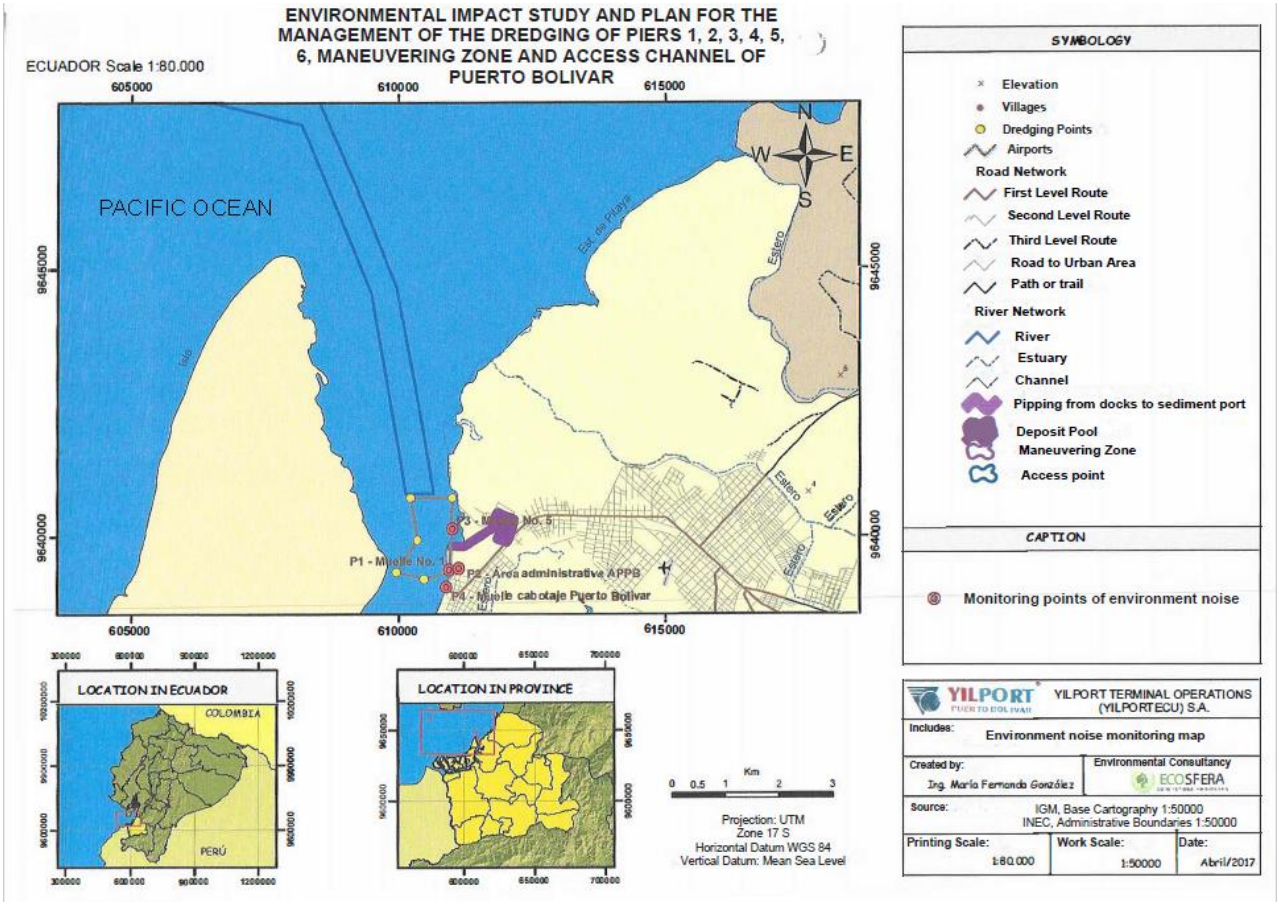
Source: *Noise Monitoring Report Elicrom Cia. Ltda.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 20th of 2017*

JUSTIFICATION OF THE METHOD USED

The type of Measurement performed in the external Ambient Noise Monitoring project was as follows:

- The sound level meter was placed on a tripod and located at a height equal to or higher than 1.5 meters from the ground, directing the microphone towards the source with an inclination of 45 to 90 degrees on its horizontal plane. The operator during the Measurement should be at least 1 meter away from the equipment.
- The Measurement was carried out for a time of 2 minutes at each selected point, taking 5 samples at each one.
- The Measurement of noise in an outdoor environment will be made by means ofa standardized decibel meter (sound level meter), previously calibrated, withits selectors in the A rating filter and in slow response (slow).

Figure 136: Noise Monitoring Points



Source: *Www.geoportaligm.gob.ec, Military Geographic Institute*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Bolivar Port - Machala, Santa Rosa - El Oro*
Date: *April 6, 2017*

Figure 22: Point 1 Noise Monitoring

POINT 1: PIER 5	
	

Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar, Machala - El Oro*
Date: *April 20, 2017*

Photography 23: Noise monitoring point 2

NOISE MONITORING
POINT 2: ADMINISTRATIVE AREAS

Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar, Machala – El Oro*

Photography 24: Noise monitoring point 3

NOISE MONITORING POINT 3: PIER 5	
	
	
	

Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar, Machala - El Oro*
Date: *April 20, 2017*

Photography 25: Noise monitoring point 4

NOISE MONITORING POINT 4: CABOTAGE PIER	
	

Source: *Photographs taken by consulting team*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar, Machala - El Oro*
Date: *April 20, 2017*

❖ MEASUREMENT INSTRUMENTS NOISE LEVEL

Chart 105: Sound level meter description

SOUND LEVEL METER	
CODE	EL.EM.022
BRAND	CENTER
MODEL	0390
SERIES	150207044
CALIBRATED	MAY 12, 2016

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

Chart 106: Calibrator description

CALIBRATOR	
CODE	EL.EM.003
BRAND	SPER SCIENTIFIC
MODEL	850016
SERIES	081202542
CALIBRATED	Jan 07, 2016

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

Chart 107: Thermo-hygrometer description

THERMO HYGROMETER	
CODE	EL.PT.211
BRAND	ATM
MODEL	HT9214
CALIBRATED	January 7, 2017

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

Chart 108: Anemometer description

ANEMOMETER	
CODE	EL.PT.567
BRAND	CONTROL COMPANY
MODEL	3655
SERIAL	160252813
CODE	March 4, 2016

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

Chart 109: Barometer description

BAROMETER	
CODE	EL.PT.547
BRAND	CONTROL COMPANY
MODEL	1081
SERIAL	160253706
CODE	March 1, 2016

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

❖ WEATHER CONDITIONS NOISE MONITORING

Date measurement of environmental conditions described in the following chart:

Chart 110: Environmental conditions noise monitoring

ENVIRONMENTAL CONDITIONS		
MEASUREMENT PLACE	**FACTOR**	**REGISTERED VALUE**
PIER 1	Temperature	31,6 ^{0}C
	RH	69,3%
	Wind speed	1,5
	Pressure	753,6 mmHg

ENVIRONMENTAL CONDITIONS		
MEASUREMENT PLACE	**FACTOR**	**REGISTERED VALUE**
ADMINISTRATIVE AREA	Temperature	31,9 ^{0}C
	Relative Humidity	67,9%
	Wind speed	1,3
	Pressure	753,6 mmHg
PIER 5	Temperature	32,1 ^{0}C
	Relative Humidity	66,5%
	Wind speed	1,1
	Pressure	753,6 mmHg
CABOTAJE PIER	Temperature	32,3 ^{0}C
	Relative Humidity	66,5%
	Wind speed	0,9
	Pressure	753,6 mmHg

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

❖ NOISE MONITORING RESULTS

Chart 111: External environment noise measurement results

N^0	POINTS	Weighing	Total Noice Leq, t	Max L (dB)	Min. L (dB)	Residual Noise Leq, r	Specific Noise Lkeq= le (dB)	Specific Noise Lkeq (dB)
1	Pier 1	**A**	65,2	69,8	62,7	50,9	65,0	**68,0**
		C	77,6	79,3	77,3	58,5	77,5	
2	Administrative Area	**A**	65,1	71,4	59,1	62,3	61,9	**64,9**
		C	78,5	81,9	77,0	75,0	76,0	
3	Pier 5	**A**	63,7	66,1	62,4	61,3	59,9	**65,9**
		C	81,8	87,1	79,6	78,5	79,1	
4	Cabotaje Pier	**A**	58,0	63,1	55,0	51,3	57,0	**60,0**
		C	72,1	77,2	70,4	60,9	71,7	

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

❖ NOISE MONITORING COMPLIANCE EVALUATION

Chart 112: Noise monitoring compliance results

POINT	MEASUREMENT AREA	SPECIFIC NOISE LKEQ=LE DB (A)	PERMISSIBLE LIMIT VALUE	
			Fixed Noise Sources (*)	Sound level by exposure time per day (**)
1	Pier 1	**68,0**	70 COMPLIES	85 COMPLIES
2	Administrative Area	**64,9**	60 DOES NOT COMPLY	85 COMPLIES
3	Pier 5	**65,9**	70 COMPLIES	85 COMPLIES
4	Cabotaje Pier	**60,0**	60 COMPLIES	85 COMPLIES

(*) The permissible limit value for Ambient Noise, Ministerial Agreement N0097A, Annex 5, Chart 1,
Commercial and Industrial Zone ID3

(**) The maximum permissible limit for occupational noise Regulation of Health and Safety of workers and Improvement of the Work Environment Art. 55

Source: *Elicrom Cia. Ltda. Noise Monitoring Report.*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 25, 2017*

❖ NOISE MONITORING CONCLUSIONS

Noise monitoring conducted throughout the influence area of the project: ''Dockyard Dredging 1, 2, 3, 4, 5 and 6, Maneuvering Zone and Access Channel of Puerto Bolívar'', is generally determined it meets the 70 dB established in environmental regulations for this type of zone (Industrial zone and commercial zone). It also complies with other law requirements such as Workers Health and Safety Regulation, which establishes a level of 85 dB for an 8-hour working day; schedule in which the staff of the Port Authority of Puerto Bolívar works.

Point 2 appears to be no compliance with the regulations corresponding to Administrative Areas, exceeding 4.9 points up to the level established in the standard for a commercial area (60 dB). In this sense, it is necessary to clarify that the measurements were performed in an outdoor environment, and the receivers are the administrative staff inside the offices.

Compared to Regulations established in Ministerial Agreement 097, Annex 5, the corresponding measurement is 75% satisfying the permissible limits. Compared with the Occupational Health and Safety Regulations established at 85 dB, the results are 100% fulfilled in the project's influence area.

6.2. BIOTIC ENVIRONMENT

Biotic Components are understood as flora, fauna, and other living organisms at their different organization levels.

According to the project's area and characteristics, the environmental quality will be further evaluated and controlled through biotic studies, depleting the tools established in the existing environmental regulation and control mechanisms.

The biotic component's characterization aims to establish preventive measures to guarantee biodiversity conservation, maintenance and regeneration of vital cycles, structure, functions, and evolutionary processes of nature. The purpose of the control and monitoring of the biotic components is to verify the environmental quality utilizing indicators, detect possible alterations in diversity, determine and apply the corrective measures, if applicable.

In general, when studying this component, the current status is evaluated, and the relationships between this component and socioeconomic variables are determined. The results of field campaigns carried out in the sector and areas with physical and biotic characteristics similar to those of interest areas were taken as a foundation for comparison. This information will allow enhancing establish sites to be sampled and the expected results of the field campaigns developed explicitly in the direct area of influence of the project.

Characterization of biotic resources of the area will be based on the processing and systematization of the information generated in field campaigns to be carried out. Classification will be complemented with information available in public and private entities (for planning the field trip); this will make it possible to evaluate, in a more objective method, the current situation of flora and fauna in the area of a direct influence of the development project.

The unit of representation of this classification system is the ecosystem, conceptualized as a group of vegetation communities on a local scale that tend to coexist within landscapes with biophysical variables, environmental gradients, and similar dynamic processes (Comer et al. 2003).

❖ METHODOLOGY

For the flora and fauna characterization, a rapid ecological evaluation with reconnaissance gathered, observed, and data collection tours made, photographs for identification; considering the first kilometer to the area of influence, where most of the land is residential, aquaculture and touristic. Observation and identification methodology has been chosen; all data was collected in parallel transects.

Two phases were applied:

1. Field phase to fulfill objectives set, is developed with the use of a series of tools, utensils and for specific cases of monitoring equipment; Materials such as: GPS-navigator (GARMIN-Etrex), digital camera, camcorder, binoculars, dashboards, field notebook, field guide for flora and fauna species identification among others; reference book, sheets (A4) to collect data in the field.

2. Desks, computing equipment, multifunction equipment (scanner, copier, printer), calculator, office supplies and accessories, etc... used for office work.

The purpose is to inventory, determine, and evaluate the current state of conservation, diversity, and number of flora and fauna species in the project's direct and indirect influence. The specific objective is to classify, quantify, and interpret taxonomic groups of flora and fauna specimens, identifying dominant, rare, threatened, and endemic species that survive in the study area.

6.2.1.-ECOSYSTEM

We define an ecosystem classification organization as a set of methodologies that allow grouping and delimiting biotic communities and their interactions with the environmental elements logically and orderly and arranging them in categories with hierarchical and comprehensive order. Since vegetation is the most visible element of an ecosystem, it is used to differentiate and specialize them geographically.

The unit of representation of this classification organization is the ecosystem, conceptualized as a group of local-scale vegetation communities that tend to coexist within landscapes with biophysical variables, environmental gradients, and similar dynamic processes (Comer et al. 2003).

Due to the characteristics of the area of direct influence of the project, transept or quadrant methods were applied, considering that there are forests, shrubs or other types of wild plant formation.

To identify the plant diversity present in the direct and indirect area, a walking tour was carried out following trails accompanied by a guide from the study area, the same one who empirically helped identify the plant species in the area (citing the common names).

All species were recorded at the same time as a complete photographic record was made here. For the species that could not be identified in the field, a fertile botanical sample was taken (when possible) for later recognition in the laboratory phase. Woody species that had a diameter at breast height (DBH) greater than or equal to 10 cm were registered, according to Ministerial Agreement No. 134 dated December 25, 2012 provisions, and published by Official Registry No. 812 of October 18, 2012. Thus, its DBH and height were recorded as part of the inventory.

After knowing the species surviving in the study area, they were compared with the national and international conservation lists to find out if they are cataloged within any conservation category or are endemic to the country or area.

Using the information published by Sierra (1999), it was determined that the project is located within a single Life Zone. Moreover, the Ministry of the Environment of Ecuador, in its 2012 publication, Classification Systems of the Ecosystems of Continental Ecuador, describes the study zone as an intervened area and does not describe any natural ecosystem.

ECOSYSTEM CLASSIFICATION OF STUDY AREA

Once the monitoring and field visits were executed in the study area, located in the Jambelí Parish of the Santa Rosa Canton and in the Puerto Bolívar parish of the Machala canton, it was considered, among other environmental parameters, type of vegetation, ecological dynamics, height, location and it was determined that it shows the following ecological classification:

Chart 113: Ecosystem definition of the project area

BsTc05 Manglar del Jama-Zapotillo	
Classification:	Plant Formation / Ecosystem Classification
Cerón et al. 1999	Mangrove, central and southern subregion, lowland sector
Josse et al. 2003:	CES402.599 Estuarine and Pacific Coast Mangroves.
Diagnostic factors	
Physiognomy: Forest	
Bioclimate: Xeric, Ombrotype (Io): Dry	
Biogeography: Region: Litoral, Province: Equatorial Pacific, Sector: Jama-Zapotillo	
Phenology: Evergreen	
Bioclimatic floor: Lowlands (0-10 masl), Thermotype (It): infratropical	
Geoform: General relief: Coast, Macro relief: Plain, Mesorelieve: Tidal plain.	
General Flooding: Flood Regime: Floodable, Water Type: Brackish	

Source: *El Oro Province Development Plan*
Prepared by: *Ecosfera Cía. Ltda.*
Location: *El Oro Province*
Date: *April 25, 2017*

The Ecosystem Mangrove forests, frequently less developed concerning the forests of this type. Located towards the northwest of the country in the biogeographic province of Chocó (this corridor crosses the equator and passes through Esmeraldas, hence comparing the mangroves of southern Ecuador according to the classification system of the ecosystems of Continental Ecuador of the Ecuadorian Environment Ministry, MAE). Mangroves advance at the interface of the mainland to the open sea and display a closed canopy that ranges from 10 to 12 meters, typical vegetation with the presence of wading roots, besides, within this matrix are several species of herbs, ferns, and occasionally some epiphytes, especially from the Bromeliaceae family.

As in most mangroves, the plant communities are distributed according to their specificity; towards the outside is Rhizophora spp. (Mangle Rojo), followed by Avicennia germinans (Mangle Negro), then Laguncularia racemosa (white mangrove), and finally Conocarpus erectus (button mangrove).

This categorization depends a lot on the degree of tolerance to salinity that each species presents. This type of vegetation is characteristic of the Jubones-Santa Rosa-Arenillas River's estuary, with a significant representation in the Guayas River's estuary and the Gulf of Guayaquil.
This ecosystem's soils are generally swampy (poorly consolidated), saturated with moisture, poor in oxygen, slightly acidic, composed of silt, clay, sand, and decomposing organic matter. These soils contain a high content of water and salts product of the tides' intrusions and the washing by the run-on generated. (Sierra, 1999).

In the rural parish of Jambelí, fragile ecosystems were determined to be those that have been or are being intervened of an anthropic nature and could trigger a series of alterations to the parish ecosystems. According to the parish's total area, the following chart details the existing ecosystems in the Jambelí Parish with their respective area and percentage.

Chart 114: Fragile Ecosystems of Jambelí parish

ECOSYSTEM	AREA (Ha)	PERCENTAGE
Water bodies	856,38	3,37
Intervened	13028,66	51,24
Mangrove swamp	10698,71	42,08
Spiny coastal scrub	82,26	0,32
Others	459,73	1,81
Salines	301,62	1,19
TOTAL	**25427,36**	**100%**

Source: *Jambelí Parish Development Plan (2008 - 2015)*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Jambelí parish, Santa Rosa - El Oro Cantons*
Date: *April 25, 2017*

Based on the analysis of cartographic information and relying on the map, it was evident that the intervened areas in the Jambelí Parish occupy the largest extension at parish level with 13028.66 ha, equivalent to 51.24%. These areas are distributed in spots across the length and width of them. The mangrove, despite being under constant pressure from deforestation processes, still maintains a large area of 10698.71 ha equivalent to 42.08% of the territory, these mangroves are found in the same way in spots distributed throughout the Jambelí Parish, and they are a priority zone for conservation due to their high degree of anthropic intervention.

6.2.2.-LIFE ZONES

Canton Santa Rosa has two different life zones or biomes, the description of which is shown in the following chart, and the meters above sea level of each biome are also included. It is important to consider that the life zones described in this section refer to the group of plant associations that can develop as a natural division of the climate, edaphic conditions and succession stages. The description of the different Life Zones is shown below:

Chart 115: Life zone or vegetable formations of Santa Rosa Canton

Biome Description (msnm)	Ecological system	Zoogeographical floor	Biome Remanent area (Km²)	Percentage in El Oro %
Lowland Dry Forest (0 - 300 masl)	Low forest and deciduous shrubland of the Jama-Zapotillo	Southwestern Tropical	468	2,34
	Deciduous lowland forest of Jama-Zapotillo			4,72
	Semi-deciduous lowland forest of Jama-Zapotillo			
	Lowland seasonal evergreen forest of Jama-Zapotillo			1,15
Mangrove and Coastal Marine	Mangrove Jama- Zapotillo	Tropical Southwestern	239	4,02

Source: *MECN-INB-GADPEO. 2015. Birds, Amphibians and Reptiles of the Province of El Oro.*
Prepared by: *Ecosfera Cía. Ltda. 2017*
Location: *Santa Rosa - El Oro Cantons*
Date: *April 25, 2017*

- **DRY LOWLAND FOREST**

  Dry forests are plant formations where annual rainfall is less than 1600 mm, a dry season of five to six months; consequently, ecological processes are markedly seasonal, and net primary productivity is lower than in humid forests. Because it only occurs in the rainy season (Barquero et al. 2004, Aguirre et al. 2006).

  On the coast of Ecuador and north of Peru, this forest forms a coastal strip 100 to 150 km wide (Vanegas 2005). Dry Tumbes forests are divided into two floristic areas separated by the Gulf of Guayaquil. On the north gulf, there are approximately 22,771 km² within the Ecuadorian Provinces of Guayas, Manabí, and Esmeraldas. On the Southwest, more than 64,588 km² in the Ecuadorian Provinces of El Oro and Loja and the Peruvian departments of Tumbes, Piura, Lambayeque, and La Libertad (Aguirre et al. 2006). In Ecuador, the coast's dry forests are continuous, while in the dry valleys of the inter-Andean alley, they are isolated (MAE 2013).

- **MANGROVES AND COASTAL MARINE AREA**

  Mangroves are forested ecosystems that surround tropical coasts, lagoons, and oceanic islands. They extend throughout the tropical zone from South Florida in the United States to the South along the Atlantic and Pacific coasts (Kricher 2006). These biomes are characterized by the arboreal vegetation found in the zone of direct influence with the tides.

  It is a transition ecosystem between the marine zone and the mainland, characterized by numerous estuaries, channels, lagoons, and muddy soils. The high tide floods, and when it retreats, long and wet sandy and silt beaches, with extensions of 2 to 7 km in length, are revealed. Various vertebrates use these locations, mainly birds, as roosting and foraging sites (Kricher 2006). Mangroves tend to form monospecific or low-species richness forests. The most prominent elements are mangroves, which can be present up to six species, and they often reproduce by creating new plants (viviparous) rather than with seeds. These trees can exceed 30 meters in height; their wading and aerial roots are strongly adapted to tolerate high immersion levels in saltwater (Cerón et al. 1999). These roots are associated with species of the families Bromeliaceae, Orchidaceae, and Polypodiopsida (ferns).

Jambelí Archipelago corresponds to the southern subregion (dry), located at 3º south latitude, on the Jubones river basin's southern slope where vegetation adapted to the dry climate and saline soils.
The following chart describes the Life Zones of the Jambeli parish:

Chart 116: Life Zones of Jambeli Parish

ZONES	CHARACTERISTICS	LOCATED
Mangroves	Mangrove Evergreen trees	On islands and islets of the communities of Costa Rica, Las Casitas, Las Huacas, Bellavista and Pongalillo
Dry forest	Herbs, deciduous shrubs, evergreen trees	

Source: *Jambeli Parish Development Plan (2008 - 2015)*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Santa Rosa - El Oro Cantons, Jambeli Parish*
Date: *April 25, 2017*

6.2.3.-PROTECTED AREAS AND PROTECTIVE FORESTS

The declaration of Protected Areas within the province of El Oro is an essential and irreplaceable way to protect ecosystems, biodiversity, and environmental services; the objectives of protected areas in the international context respond to different purposes, activities, or forms of human use, and with this, a wide range of biological and social realities.

In the province, there are two areas within the SNAP (National System of Protected Areas) which are:

- Isla Santa Clara Wildlife Refuge, which is one of the most important refuges on the Ecuadorian coast for hosting large concentrations of seabirds (frigates, pelicans, and blue-footed boobies),
- Arenillas Ecological Reserve, an important site for the endemic birdlife of the Tumbes region.

Besides the protected Area of the Petrified Forest of Puyango of 2,659 ha, which constitutes a wealth of fauna, flora, and paleontology, which shelters more than 130 species of birds, and more than 1150 species of flora and fauna, these are important for their level of endemism.

On the other hand, in the province there are five areas declared as Protective Forests:

- BP016: B.P. Casacay
- BP054: B.P. Arenillas River Tahuin Dam
- BP116: B.P. River Moro - Moro Basin
- BP181: P.C. Puyango Petrified Forest
- BP225: Uzchurrumi, La Cadena, Peña Dorada, Brazil

Considering the total protected area of the province, it represents 81,491.2 protected hectares; 14% of the total provincial area.

Chart 117: Protected Areas and Forests of the Province of El Oro

PROTECTED FORESTS	AREA KM^2
Casacay	125,77
Arenillas River Tahuin Dam	472,10
River Moro - Moro Basin	31,38
Puyango Petrified Forest	15,54
Uzchurrumi, La Cadena, Peña Dorada, Brazil	250,86
PROTECTED AREAS	**AREA KM^2**
Arenillas Ecological Reserve	131,57
Isla Santa Clara Marine Reserve	74,5

***Source**: Ministry of the Environment*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Province of El Oro*
***Date**: April 25, 2017*

6.2.4.- PLANT COVERAGE- FLORA

In the study area, the influence region was evaluated, including general aspects of the vegetation, such as structure, physiognomy, indicator species, and soil geomorphology; it has been classified into the following types of vegetation: Mangrove forest and forest lowland dry.

Mangroves are amphibian associations of woody arboreal or shrubby plants, perennial plants of various families (Dinerstein et al. 1995; Pinto 1993), per high tolerance to salinity (Huber and Alarcón 1988). They occur in flat areas of estuaries and other zones of interaction between the tides and the freshwater of rivers and estuaries. They form a dense forest, whose trees have fulcreatic roots (waders) with pneumatophores.

❖ METHODOLOGY

Vegetal and Flora Covering's study was divided into two phases to get the results that will be presented below. The field phase was first and performed during March 16 and 17, 2017, while the laboratory phase was performed in the following days, the difficult-to-identify botanical specimens were photographed, and others were collected too far ahead identification, based on the comparison with specimens from the Herbarium's botanical collection, together with specialized bibliography.

❖ FIELD PHASE

- **Qualitative Inventories**

  Qualitative sampling consisted of characterizing different types of vegetation in the evaluated locations for Santa Rosa Estuary Dredging Project and Pool area, where dredging sludge would settle, and the reason why direct observation tours were carried out, obtaining; as a result, data on the species that serve to characterize the different common and dominant floristic groups, existing in the plant covers located within the study area.

  For observation tours, the quantitative and qualitative sampling points considered in the characterization of flora in the baseline were used. These observation tours were held on both March 16 and 17, 2017.

- **Quantitative Inventories**

  For the evaluation of flora components, transect methodology was used. Two linear transects of 50x20m (1,000 m2) were drawn. All the individuals with a Diameter at Breast Height (DBH) equal to or greater than 10 cm were identified, tabulated, measured, and documented within each transect. (Approximately 1.3 m from the ground).

  Transect results obtained provided data related to the basal area, relative density, relative dominance, frequency, and importance value.

- **Qualitative Inventories**
  It consisted of characterizing vegetation types in the area described above in the shortest possible time, for which direct observations were made, with a range of 20 m in all directions. Sampling taking in these sites implied identifying common and dominant floristic groups in different strata in each type of vegetation. A summary of the sampling areas is presented in the following chart, including site, date, coordinates, habitat, and description.

Chart 118: Location of the Quantitative and Qualitative Sampling points of Flora

SITE	DATE	COORDINATES		HABITAT	DESCRIPTION
		EAST	NORTH		
FL001	16/03 2017 17/03/2017	PI 610968	9640466	Mangrove Forest	**Quantitative Inventory** Two 50x20 m linear transects (1000 m2), measuring individuals with a Chest Height Diameter (DBH) equal to or greater than 10 cm
		PF 611071	9640820		
FL002	16/03 2017 17/03/2017	PI 610191	9641056		
		PF 610992	9641134		
POF-1	16/03/2017	610997	96441767	Mangrove	Qualitative inventory Direct observations, with a range of 20 m around
POF-2	17/03/2017	611419	9643210	Mangrove	

SYMBOLOGY:
- FL001/2 = Flora Sample Point
- POF = Flora Observation Point
- PI = End Point of the Transect

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda., 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

Botanical specimens of difficult identification were photographed, and others collected to be classified later, based on the comparison with specimens from the botanical collection of the National Herbarium of Ecuador.
The common and scientific names registered in the field were verified with the Catalog of Vascular Plants of Ecuador (Jorgensen & León, 1999), collections of the National Herbarium, Ecuadorian Museum of Natural Sciences (QCNE), and Topics of the Missouri Botanical Garden (MO) (Tropics, 2012) database.

❖ **LABORATORY PHASE**

For the analysis of the quantitative inventory, the formulas proposed by Campbell et al. 1986 were used.

- **BASAL AREA (AB) m²**

The basal area of a tree is defined as the Diameter's area at Breast Height (DBH) in a cross-section of the individual's stem or trunk.

The basal area of a given species in the plot is the sum of the basal areas of all individuals with DBH equal to or greater than 10 cm.

$$AB = \left(\frac{\pi D^2}{4} \right)$$

Where:

D = Diameter at Breast Height
π = Constant 3, 1416

- **RELATIVE DENSITY (rd)**

The relative density of a given species is proportional to the number of individuals of that species with respect to the total number of individuals in the plot.

$$RD = \frac{\text{\# of individuals of a species} \quad x\ 100}{\text{\# Total of individuals in the plot}}$$

- **RELATIVE DOMINANCE (dmr)**

Relative dominance of a given species is the proportion of that species' basal area, with respect to all the individuals' basal area in the transects.

$$DMR = \frac{\text{Species basal area} \quad x100}{\text{All species basal area}}$$

- **IMPORTANCE VALUE INDEX (IVI)**

Two parameters are added (Relative Density and Relative Dominance) to arrive at the Importance Value.

The sum of the Importance Value for all species in the plot is always equal to 200. It can be considered, then, the species that reach an importance value greater than 20 in the plot (10% of the total value) are "important" and common components of the sampled forest.

$$IVI = DR + DMR$$

- **RICHNESS AND ABUNDANCE OF SPECIES**

The term "richness" refers to the abundance of species per individual; that is, the number of species divided by the number of individuals sampled. This data allows a direct comparison regarding the diversity (richness) of botanical individuals species, even when the number of individuals is variable between samplings. The data is always a value between 0 and 1; if all individuals of sampling were

from different species, it would have a value of 1, and a value of 0.5 means a high diversity of species.

- **SIMPSON DIVERSITY INDEX**

This index measures the probability that two randomly selected individuals from a population of ***N*** individuals come from the same species.

Suppose a given species i (i = 1, 2, ..., S) is represented in the community by Pi (Proportion of individuals). In that case, the probability of randomly drawing two individuals belonging to the same species is the joint probability [(Pi) (Pi), o Pi^2].

$$\lambda = \sum pi^2$$

Where:

Σ = sum pi = is the number of individuals of species i, divided by the total number of individuals in the sample.

It is strongly influenced by the importance of the most dominant species (Magurran, 1988). Since the Simpson index (λ) reflects the degree of dominance in a community, its diversity can be calculated as:

$$D = \frac{1}{\lambda}$$

- **SPECIES ABUNDANCE CURVES**

Includes representative graphs of the most frequent species within the plot, allowing the rapid identification of dominant groups and rare species.

Photo 26: Flora sampling

SAMPLING OF FLORA SPECIES

Consultant team-flora sampling

Rhizophora mangle (Mangle Rojo)

Avicennia germinans (salty mangrove)

***Source**: Photographs taken by consulting team*
***Prepared by**: Ecosfera Cía. Ltda.*
***Location**: Puerto Bolivar, Machala– El Oro*
***Date**: April 17, 2017*

❖ FLORA STUDY RESULTS

POINT 1: DREDGING ZONE

Chart 119: Registration of Individuals in the Dredging Zone

Registration of Individuals						
N°	**Family**	**Scientific name**	**Identification level**	**Local Name**	**DAP (cm)**	**AB (m^2)**
1	Rhizophoraceae	*Rhizophora mangle*	cf.	Mangle Rojo	17	0,02269801
2	Rhizophoraceae	*Rhizophora mangle*	cf.	Mangle Rojo	23	0,04154756
3	Rhizophoraceae	*Rhizophora mangle*	cf.	Mangle Rojo	13	0,01327323
4	Rhizophoraceae	*Rhizophora mangle*	cf.	Mangle Rojo	18	0,02544690
5	Rhizophoraceae	*Rhizophora mangle*	cf.	Mangle Rojo	15	0,01767146

Registration of Individuals						
N°	Family	Scientific name	Identification level	Local Name	DAP (cm)	A B
6	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	27	0,05725553
7	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	31	0,07547676
8	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	33	0,08552986
9	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	24	0,04523893
10	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	27	0,05725553
11	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	21	0,03463606
12	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	16	0,02010619
13	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	22	0,03801327
14	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	14	0,01539380
15	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	17	0,02269801
16	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	12	0,01130973
17	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	20	0,03141593

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda., 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

- **QUANTITATIVE CHARACTERIZATION**

PMF-1

This quantitative sampling point is located in a sector influenced by the tide and the mainland; there are several woody species in a mangrove forest intervened between 0 meters above sea level and 15 meters above sea level, which shows an open canopy, consisting of 2 species such as:

Chart 120: Flora species identified in the Dredging Zone

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME
Malpighiales	Rhizophoraceae	Rhizophora mangle	Mangle Rojo
Lamiales	Acanthaceae	Avicennia germinans	Salty mangrove

* Only 2 individuals were spotted on all tours
***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

In the study area, it was identified that there are a total of 2 orders, 2 species belonging to 2 families.

- **RESULTS USING CAMPBELL FORMULAS**

Chart 121: Flora species identified in the Dredging Zone

FAMILY	SCIENTIFIC NAME	Fr	∑AB	DnR	DmR	IVI
Rhizophoraceae	Rhizophora magle	26	1,361	68,42	72,78	141,20
Acanthaceae	Avicennia germinans	12	0,509	31,58	27,22	58,80
TOTAL		**38**	**1,870**	**100**	**100**	**200**
– 38 individuals >10 cm DAP – 2 species of plant individuals – Total Basal Area: 1,870 m^2						
SYMBOLOGY: – **Fr:** Frequency – **AB:** Basal Area – **DnR:** Relative Density – **DmR:** Relative Dominance – **IVI:** Index						

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

- **IMPORTANCE VALUE INDEX (IVI)**

A single species is considered with a high Importance Value Index, Rhizophora mangle (*Rhizophoraceae*) with a value of 141.20; and to a lesser extent are: *Avicennia germinans* (Acanthaceae) with 58.80.

- **RICHNESS AND ABUNDANCE OF SPECIES**

In the quantitative sampling accomplished in the intervened forest, a total of 38 individuals distributed in 2 species were registered, with 0.12 representing an average richness of plant species equal to or greater than 10 cm DBH. Regarding the total basal area, it can be suggested that the sampled forest is little intervened; in addition, there is the presence of abundant individuals with large shafts and few individuals with small shafts. According to the abundance of individuals, the predominant species are: *Rhizophora mangle* with 26, followed by *Avicennia germinans* with 12 individuals.

- **SIMPSON DIVERSITY INDEX**

  The Simpson diversity index value in the intervened forest represents a low diversity index since the sampling point FL001 and FL002 have values of 0.42 and 0.44 correspondingly.

- **SHANNON-WIENER DIVERSITY INDEX**

  The Shannon-Wiener diversity index's value in the intervened forest at point FL001 represents an index of 0.61, and at point FL002 an index of 0.64, which, based on 2 species and registered in the study area, indicates that the diversity for the sampled area is low.

Chart 122: Diversity of Species in the dredging area

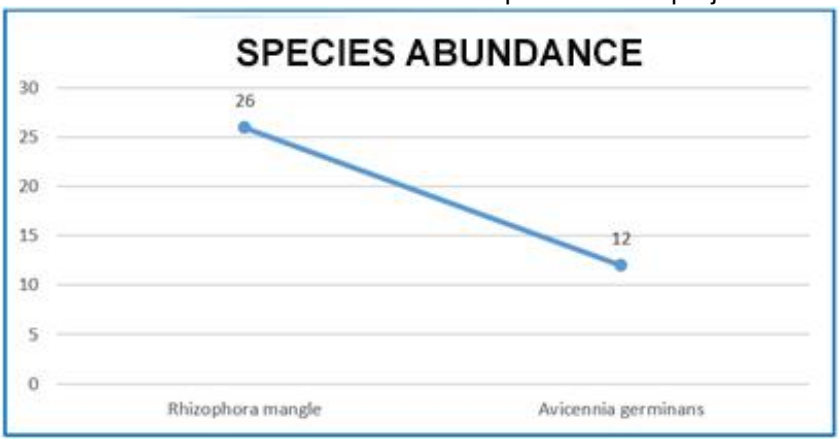
DIVERSITY					
Richness	**Relative Abundance**	**Shannon-Wiener**	**Simpson**	**Jaccard**	**Sorensen**
0,12	Common	0,61	0,42	50%	100

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

- **SPECIES ABUNDANCE CURVE**

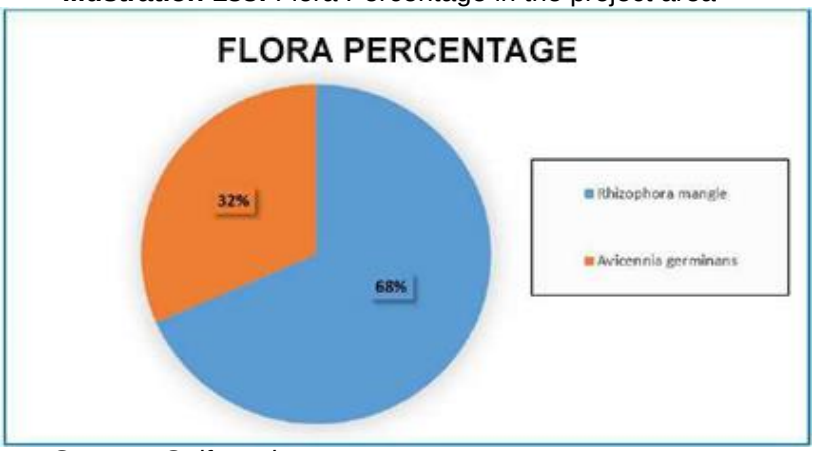
  The following illustration shows the species abundance curve in the mangrove forest (FL001):

Illustration 137: Abundance of Flora species in the project area



***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

Illustration 138: Flora Percentage in the project area



***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

The previous illustration indicates the species' dominance, with a group, with a dominant species and a second group with other species considered uncommon.

- **STATE OF FLORA CONSERVATION**

In situ sampling is accomplished. The dredging project's area shows a low anthropic intervention, generating a small deterioration of the space, consisting mainly of patches of intervened riverside forest in different stages of succession and accompanying shrub and herbaceous flora.

Chart 123: Conservation Status of Species in the Dredging Zone

Conservation status		
UICN	**Ecuador Red Book**	**CITES***
Minor concern	Low risk	NC
Minor concern	Low risk	NC

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

** CITES - International Trade in Endangered Species of Wild Fauna and Flora*

- **ENDEMIC SPECIES**

  After analyzing the data and reviewing the Red Book of Endemic Plants of Ecuador (Valencia et al, 2000), no endemic species were recorded.

POINT 2: POOL AREA WHERE THE RESIDUES WILL BE DEPOSITED

Chart 124: Registration of Individuals in the Pool Area where residues will be deposited

N°	Family	Scientific name	Identification Level	Local Name	DAP (cm)	AB (m^2)
1	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	32	0,08042477
2	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	38	0,11341149
3	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	21	0,03463606
4	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	15	0,01767146
5	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	19	0,02835287
6	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	25	0,04908739
7	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	36	0,10178760
8	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	43	0,14522012
9	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	28	0,06157522
10	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	34	0,09079203
11	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Rojo	13	0,01327323
12	Rhizophoraceae	*Rhizophora mangle*	cf.	Mangle Rojo	17	0,02269801
13	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Negro	11	0,00950332
14	Rhizophoraceae	*Rhizophora mangle*	cf	Mangle Negro	35	0,09621128
15	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	24	0,04523893
16	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	13	0,01327323
17	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	17	0,02269801
18	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	36	0,10178760
19	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	39	0,11945906
20	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	21	0,03463606
21	Acanthaceae	*Avicennia germinans*	cf	Mangle Negro	26	0,05309292

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

- **RESULTS USING CAMPBELL FORMULAS**

Chart 125: Diagnosis of Flora present in the Sedimentation Pool Area

FAMILY	SCIENTIFIC NAME	Fr	∑AB	DnR	DmR	IVI
Rhizophoraceae	Rhizophora mangle	5	0,157	55,56	56,12	111,68
Acanthaceae	Avicennia germinans	4	0,123	44,44	43,88	88,32
TOTAL		**9**	**0,280**	**100**	**100**	**200**

- 9 individuals >10 cm DBH
- 2 species of plant individuals
- Total Basal Area: 0.280 m^2

SYMBOLOGY:

- **Fr:** Frequency
- **AB:** Basal Area
- **DnR:** Relative Density
- **DmR:** Relative Dominance
- **IVI:** Index

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

- **IMPORTANCE VALUE INDEX (IVI)**

There is only one species considered with a high Importance Value Index, *Rhizophora mangle* (Rhizophoraceae), with a value of 111.68; and to a minor extent are: *Avicennia germinans* (Acanthaceae) with 88.32.

Photography 27: Pool's area where sediments are deposited

***Source**: Photography taken by consulting team*
***Prepared by**: Ecosfera Cía. Ltda.*
***Location**: Puerto Bolivar, Machala– El Oro*
***Date**: April 16 and 17, 2017*

- **RICHNESS AND ABUNDANCE OF SPECIES**

In the quantitative sampling completed in the intervened forest, a total of 9 individuals distributed in 2 species were registered, with 0.22 representing an average richness of plant species equal to or greater than 10 cm DBH. Regarding the total basal area. It can be suggested that the sampled forest is little intervened; in addition, there is the presence of abundant individuals with large shafts and few individuals with small shafts. According to the abundance of individuals, the predominant species are: *Rhizophora mangle* with 5, followed by *Avicennia germinans* with 4 individuals.

- **SIMPSON DIVERSITY INDEX**

Simpson diversity index value in the intervened forest represents an index of medium diversity since the FL001 sampling point has a value of 0.49.

- **SHANNON-WIENER DIVERSITY INDEX**

Shannon-Wiener diversity index value in the intervened forest at point FL001 represents an index of 0.69, which, based on 2 species registered in the study area, indicates that the sampled area's diversity is low.

Chart 126: Diversity of Species in the Pool Zone

DIVERSITY					
Richness	**Relative Abundanc**	**Shannon-Wiener**	**Simpson**	**Jaccard**	**Sorensen**
0,10	common	0,64	0,44	50%	100

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

Chart 127: State of Conservation of Species in the Pool Zone

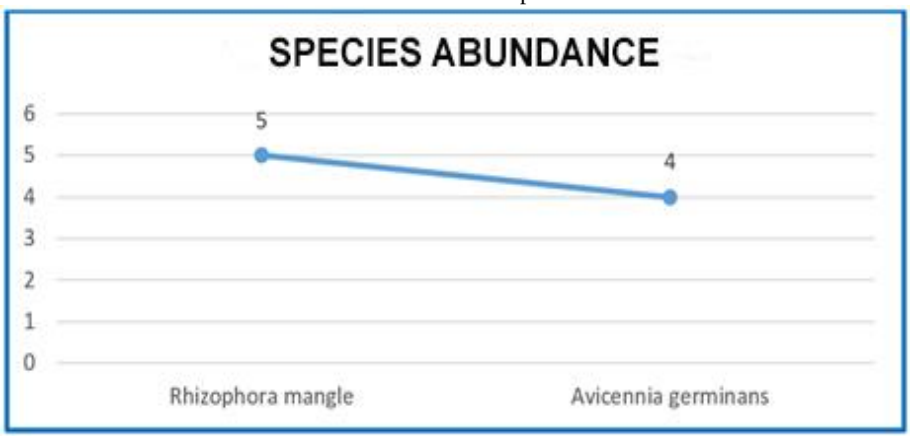
State of Conservation		
UICN	**Ecuador Red Book**	**CITES**
Minor Concern	Low Risk	NC
Minor Concern	Low Risk	NC

***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

- **SPECIES ABUNDANCE CURVE**

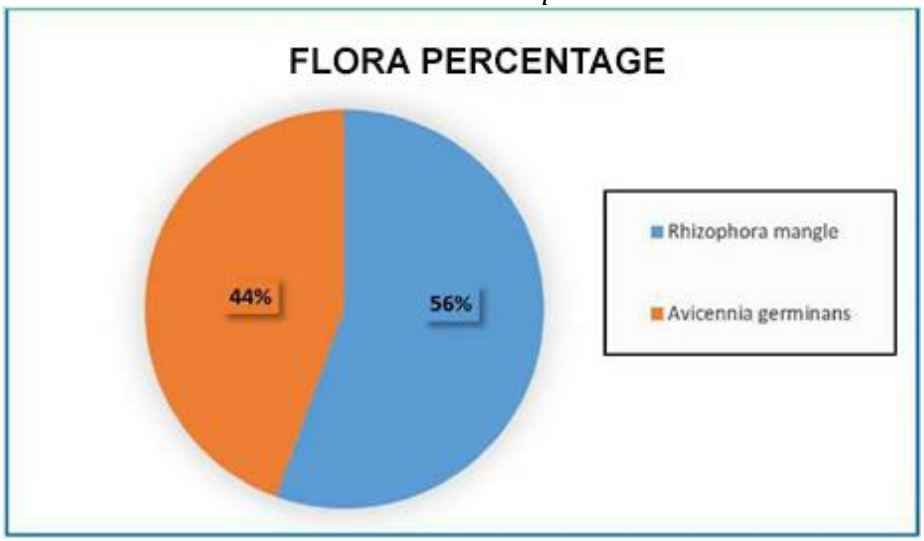
The following illustration shows the species abundance curve in the mangrove forest (FL001):

Illustration 139: Abundance of Species in the Pool Area where the residues will be deposited



***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

Image 140: *Percentage of Flora in Pool Area where sediments will be deposited*



***Source**: Self-made*
***Prepared by**: Ecosfera Cía. Ltda. 2017*
***Location**: Puerto Bolívar Parish, Machala - El Oro*
***Date**: April 16 and 17, 2017*

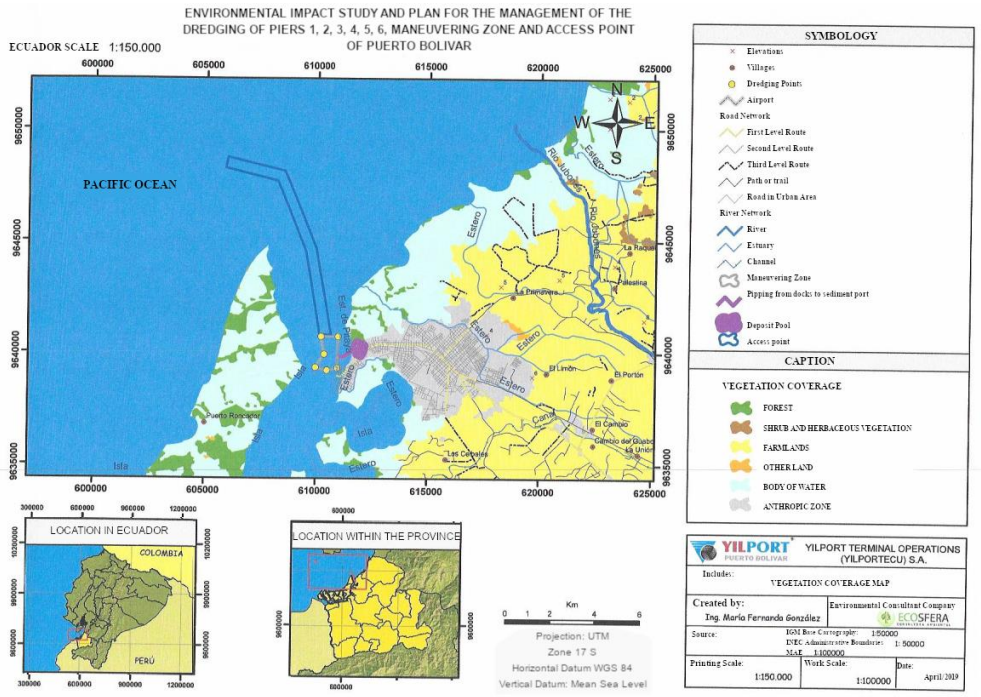
The previous illustration indicates the species' dominance, having a group with a dominant species and a second group considered uncommon.

❖ FLORA STUDY CONCLUSIONS

- The Dredging Project area of the Santa Rosa Estuary in front of the Port shows an ecosystem predominated by mangroves, which does not present anthropic alteration.
- According to the Libro Rojo de Plantas Endémicas del Ecuador (Valencia et al, 2000), endemic species were not recorded.
- There are 2 very marked groups, with 1 species considered dominant and a second group with 1 species considered scarce.
- Given that its location at the waterfront, the mangrove ecosystem allows better control and monitoring by the control authorities.
- The flora we find in the area intended for sediment pools has the same characteristics as the one existing in the water front, where the dredging will be performed.
- Flora species deposit

  The Ecuadorian Herbarium (QCNE) reserves the right of only processing the fertile, endemic species, or species in any threat category, UICN and CITES, new species for science, of ancestral, economic, and medical importance, or coming from unexplored places. For this reason, there is no receipt record of the collected species by the consulting team.

Figure 141: Vegetation Coverage Map of the project area



Source: *www.geoportaligm.gob.ec, Military Geographic Institute, INEC*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Bolivar Port Parish, Machala - El Oro*
Date: *April 20, 2017*

6.2.5.-FAUNA

The Study area makes up an ecosystem intervened years ago by shrimp farming. Today, it is protected by the state, generating little space on the incidence area for an adequate habitat that shelters representative species. The most distinctive group is the birds.

❖ OVERVIEW OF FAUNA

The southern region of Ecuador is recognized for its diversity of species found there. In the forest remnants of the area, it is possible to find some species of birds and certain reptiles that have managed to adapt to the environment's degradation.

Bird species that have adapted to humans' presence and the alteration caused by them and other species in the sector and among the most common we can find: Herons, pelicans, frigates, gulls, and ducklings. Concerning the existing reptiles in the sector, we find iguana and lizard.

❖ METHODOLOGY

For the present study, we proceeded to locate the examination area directly affected by the dredging project in a cartographic way over the IGM topographic charts at a 1: 50000 scale and a base map at a 1: 1000 scale.

The fieldwork was essentially developed identifying and verifying the most representative areas, applying the *Methodology of Rapid or Direct Ecological Assessments*; at that time, information was validated with the existing bibliography's support.

The starting points and network for tracking fauna species. Due to the physiognomies required by the study, the current situation of the fauna in the project area will be assessed, sampling at strategic sites taking into account the impact that the development of the project will cause.

Bibliographic support

For taxonomic classification of birds and their nomenclature in Spanish, the systematic references of Ridgely el al., (1998), Ridgely & Greenfield (2001), and *MECN (Ecuadorian Museum of Natural Sciences) – GADPEO (Autonomous Decentralized Government of the Province of El Oro),* (2015) are used. For mammals, the text's bibliographic reference, Mammals of Ecuador (Tirira, 1999), and Mammals of Ecuador's field guide (Tirira, 2007) were used. The scientific names of the amphibians and reptiles species were updated by reviewing Amphibians, Reptiles and Birds of the Province of El Oro: A guide for Andean-Coastal ecosystems. 2015. Ecuadorian Museum of Natural Sciences of the National Institute of Biodiversity *MECN-INB*; Autonomous Decentralized Government of the Province of El Oro, *GADPEO*.

For the location of endangered or endemic species, the criteria is the one exposed in the publication of the Red Book of the Birds of Ecuador (Granizo, et al., 2002) and an annotated list of the birds of continental Ecuador (Ridgely el al., 1998). While for mammals, the criteria of the publication of the Red Book of Mammals of Ecuador (Tirira, 2001), Diversity and Conservation of Neotropical Mammals

(Albuja 2002 and 1999) and the field guide of the Mammals of Ecuador (Tirira, 2007).

Description

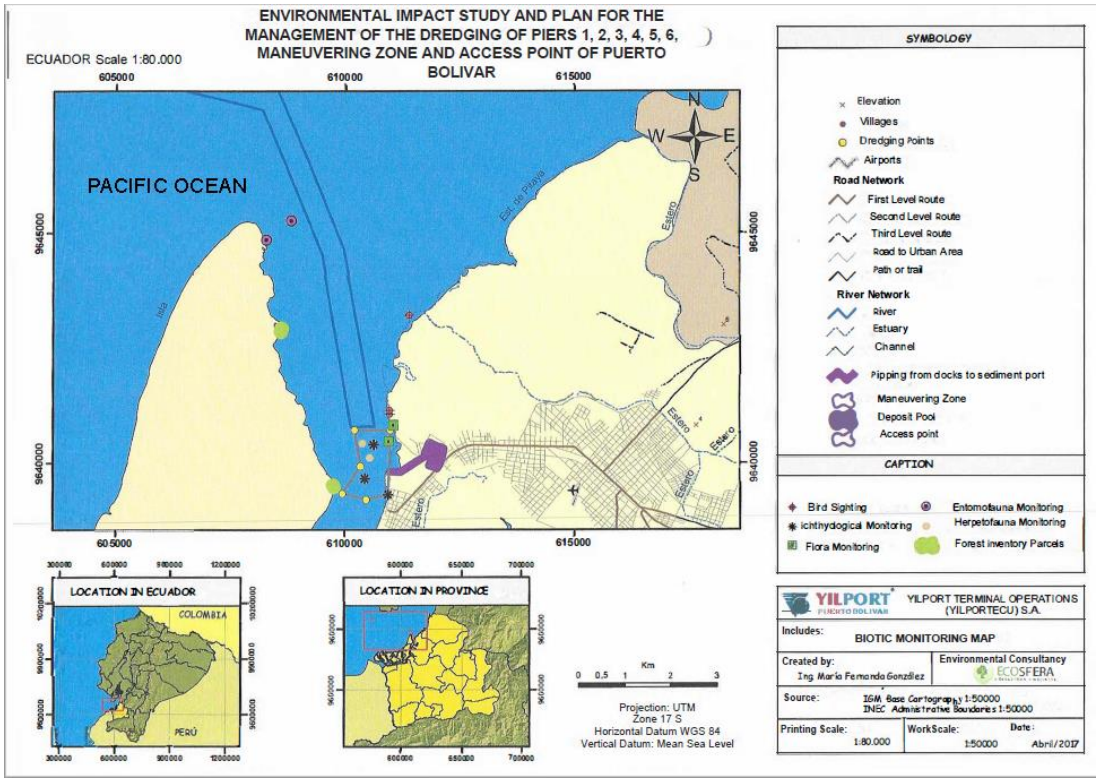
- Zoogeographic ground corresponding to the project's influence area will be identified and described to know the appropriate distribution of existing species.
- A diagnosis of the fauna of vertebrates found in the area will be made, indicating abundance, diversity, and sensitive areas that could be identified (salt licks, mortals, water bodies, feeders, swamps, relicts of primary vegetation in intervened areas, etc.).
- Lists of existing species will be drawn up with the proper taxonomic classification: group, family, genus and species, common name (with emphasis on local nomenclature), use (scientific, commercial, aesthetic, cultural, and self-consumption value).
- Conservation status and categories will be determined according to IUCN Red Book and by CITES. Endemic and indicator species and the uses of the resource will also be included. Location maps of the study sites will be presented.
- A diagnosis of terrestrial invertebrates found in the area will be made.

For terrestrial evaluation of fauna, techniques established in the *Rapid Ecological Evaluations* [EER] of Sobrevilla and Bath [1992] will be applied.

Methodologies will consist of tours with visual and auditory records of the fauna groups in the area; furthermore, interviews with residents of the sector on the presence of native fauna.

The fauna group includes the following groups: Birds, mammals, reptiles, fish and insects. This diagnosis also includes the qualitative evaluation of the fauna, impacts and prevention and mitigation measures.

Figure 142: Fauna Monitoring Points



Source: *www.geoportaligm.gob.ec, Military Geographic Institute, INEC*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Bolivar Port Parish, Machala - El Oro*
Date: *April 20, 2017*

6.2.5.1.- AVIFAUNA

Within fauna, this is the most frequent group in the study area. Given the great capacity, birds have to adapt to humans' presence and move and cover significant occupation areas. Many birds of intervened zones and estuarine mangroves were identified in the area.

DREDGING ZONE AVIFAUNA

- **METHODOLOGICAL CRITERIA**

  The field information was obtained on March 16 and 17, 2017, in the influence zone where the project is located. A tour onboard a vessel along the waterfront and acknowledgment walks were performed between 8 a. m. and 3 p. m.; during that time with binoculars, GPS, photo cameras, and area fauna sighting were recorded.

  The field study was supplemented with the literature research analysis and interviews with the area inhabitants that helped with the interpretation of some species not recorded during the fieldwork.

The information obtained in the field phase was used to analyze, identify, and taxonomically classify the different species, with the help of the systematic references of Ridgley et al. 1998 and Ridgley and Greenfield 2001. It is important to point out that specific data were taken from interviews with the area's inhabitants.

The following scale was used to determine the relative abundance of the species recorded: rare (one individual), uncommon (2-4 individuals), common (5-9 individuals), and abundant (10 or more individuals).

Photography 28: Avifauna Dredging Zone

<table>
<tr><th colspan="2">AVIFAUNA SPECIES</th></tr>
<tr><td colspan="2">Coordinates: X= 610992; Y= 9641134</td></tr>
<tr><td> 
Fragata magnificens (female)</td><td> 
Fragata magnificens (male)</td></tr>
<tr><td colspan="2">Coordinates: X= 611419; Y= 9643210</td></tr>
<tr><td> 
Himantopus mexicanus (black-necked stilt)</td><td> 
Pelecanus occidentalis (pelican)</td></tr>
<tr><td colspan="2">Coordinates: X= 610991; Y= 9641105</td></tr>
<tr><td> 
Egretta caurelea (little blue heron)</td><td> 
Egretta thula (snowy egret)</td></tr>
</table>

AVIFAUNA SPECIES	
Coordinates: X= *611487;* ***Y=*** *9643278*	
	
Phalacrocorax brasilianus (neotropic cormorant)	*Platalea ajaja (roseate spoonbill)*

Source: *Photography taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Table 128: List of Bird Species in the Dredge Zone

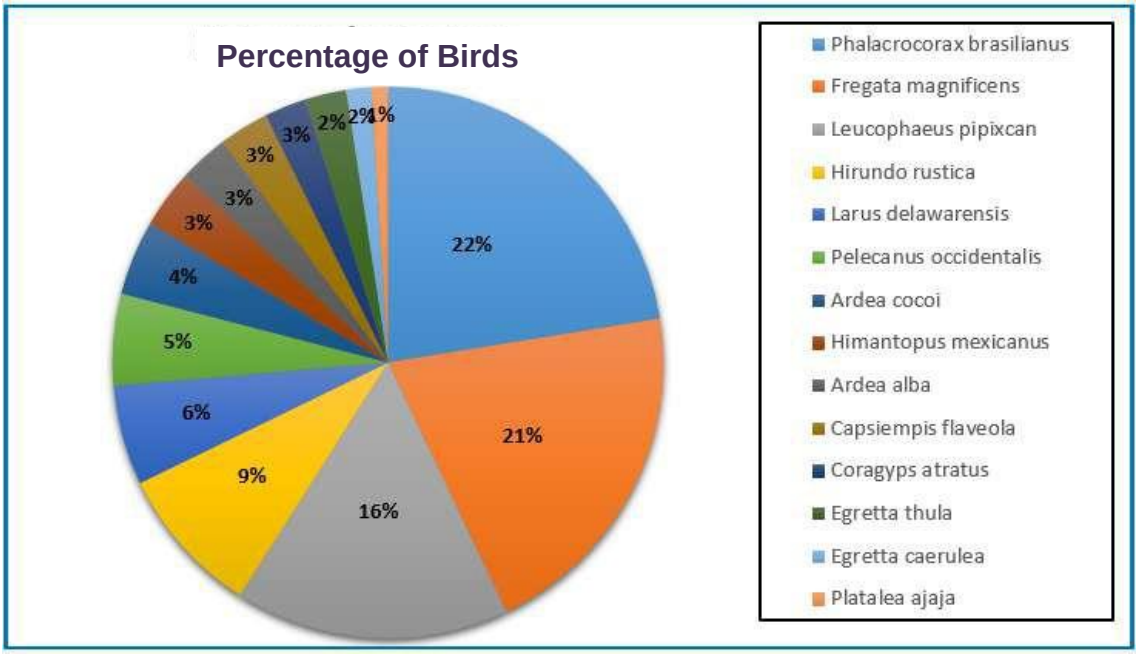
Order	Family	Scientific Name	Common Name	Abundancy
Pelecaniformes	Fregatidae	*Fregata magnificens*	Magnificent Frigatebird	Ab
Pelecaniformes	Pelecanidae	*Pelecanus occidentalis*	Brown Pelican	Ab
Pelecaniformes	Phalacrocoracid	*Phalacrocorax brasilianus*	Neotropic Cormorant (Duckling)	Ab
Ciconiiformes	Ardeidae	*Ardea alba*	Great Egret	C
Charadriiformes	Laridae	*Leucophaeus pipixcan*	Franklin's Gull	Ab
Charadriiformes	Recurvirostridae	*Himantopus mexicanus*	Black-necked stilt	C
Charadriiformes	Laridae	*Larus delawarensis*	Ring-billed Gull	Ab
Ciconiiformes	Ardeidae	*Egretta caerulea*	Little blue heron	Pc
Ciconiiformes	Threskiornithidae	*Platalea ajaja*	Roseate Spoonbill	Pc
Ciconiiformes	Cathartidae	*Coragyps atratus*	Black Vulture	C
Passeriformes	Hirundinidae	*Hirundo rustica*	Barn Swallow	Ab
Passeriformes	Tyrannidae	*Capsiempis flaveola*	Yellow Tyrannule	C
Ciconiiformes	Ardeidae	*Ardea cocoi*	Cocoi Heron	C
Ciconiiformes	Ardeidae	*Egretta thula*	Snowy Egret	C

* Resident	**Category of relative species abundance**
** Boreal Migratory	C: Common; Pc: Uncommon; R:rare; Ab. Abundant
*** South Migratory	
E Endemic	**IUCN Categories (2014)**
	(EN): Endangered; (VU): Vulnerable; (NT): Near Threatened; (DD): Data Deficient; (NE): Not Evaluated; (LC): Least Concern;

Category of relative abundance of species recorded:	**Range**
R: Rare	0-1
Pc: Not very common	2-4
C: Common	5-9
Ab: Abundant	10 more

Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Figure 143: Percentage of Bird Species Dredge Zone



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

The study area acts as a feeding, nesting, mating, or migratory passage area for easily adaptable species in fishing and commercial activity areas. The area has a large vegetation cover that gives the avifauna options to increase. The families with the highest percentage of diversity are the closest or most adaptable concerning the land use found through this diagnosis.

The highest abundance families are the *Phalacrocoracid* with 22%, *Fregatidae* with 21%, and *Laridae* with 16%. It is an area that hosts concentrations of resident waders (herons) and migratory birds (ducks).

❖ RELATIVE ABUNDANCE

The relative abundance of species recorded was determined through monitoring by direct observation, using digital Photography for identification, and comparing it with the following scale: rare (one individual), uncommon (2-4 individuals), common (5-9 individuals), and abundant (10 or more individuals).

Where 20% of the birds observed are uncommon, 40% are considered common, 40% are considered abundant, and there are no rare species).

❖ DIVERSITY

The study area is located in the lowland semi-deciduous forest ecosystem of the Jama-Zapotillo; due to its land use, it harbors a low diversity of bird species, considering the ecological contribution to the ecosystem, it was monitored and calculated using the Shannon index for the quantitative analysis of diversity. The formula to be applied is:

$$\mathbf{H= - \sum pi\ LN\ pi.}$$

The Shannon index indicates that values below 0 - 1 are considered and related to low diversity areas (generally the result of anthropogenic effects), and values above 2.5 are considered high biodiversity indicators.

As a result of the formula development, the following was determined:

$$\mathbf{H= - \sum pi\ LN\ pi.}$$

Where:

S= 101

ni= 15

N= 107

Pi= 0,11

$$\mathbf{H = - S\ (pi\ x\ log2\ pi)}$$

$$H = - 101(0.11 \times 0047)$$

$$H = - 25(5.17 \times 10^{-3})$$

$$H = 1,94$$

According to Shannon's index, the monitoring results indicate that the study area would be classified as a very medium diversity zone.
For the evaluation criteria of the diversity index, the following scale was used:

Table 129: Shannon Index Evaluation Criteria

SHANNON	
Diversity	**Condition**
0 -1	Very Low
> 1 – 1,8	Low
> 1,8 – 2,1	Medium
> 2,1 – 2,3	High
> 2,3	Very High

Source: *Guide to Biodiversity Measurement Methods, 2016*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Date: *April 20, 2017*

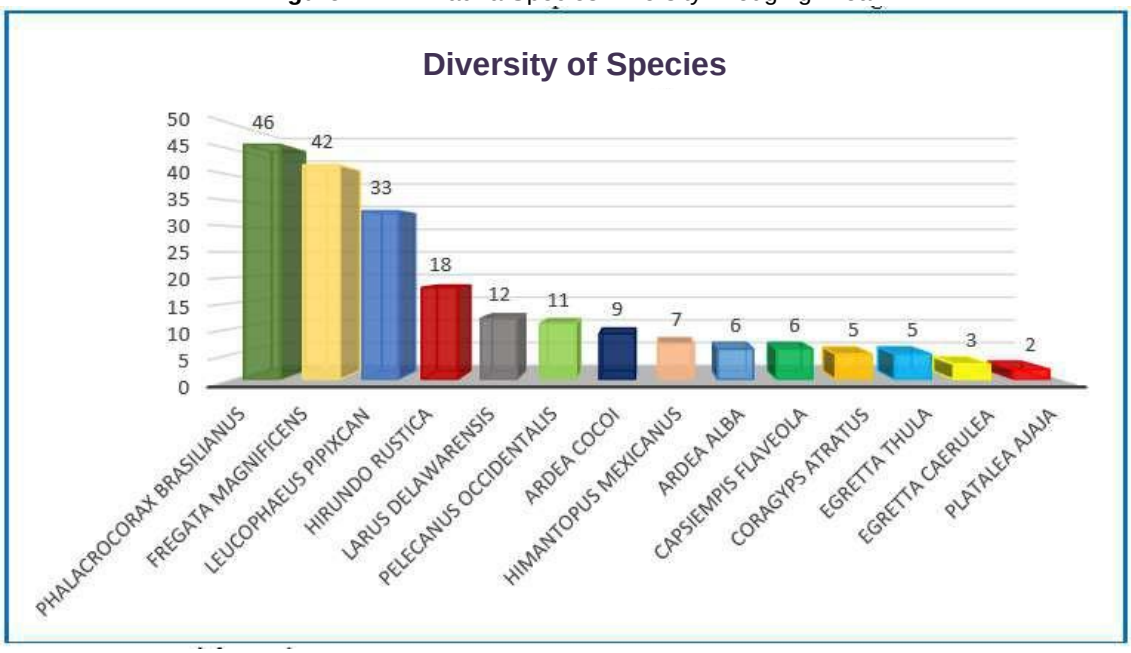
The Diversity Index (Shannon-Wiener, Simpson, Jaccard, and Sorensen) of the ornithofauna was determined based on the data obtained.

- **Shannon-Wiener Index**
  When calculating the diversity data, the Shannon-Wienner Index at Point No. 1 showing a value of 1.60 and at Point No. 2 a value of 1.94. These data are remarkably similar; therefore, it is considered an average biodiversity index.

- **Simpson Index**
  When analyzing the diversity data, Simpson's Index showed 0.88 for point 1. For point 2 it gave an index of 0.83, which concerning the total number of species, which is 15, interpreted as average diversity.

- **Jaccard and Sorensen Index**
  The Jaccard and Sorensen indexes measure the similarity between the two sampled points. Calculating these indexes gave us a value of 0.57 or 29% similarity between the two points. This data indicates that there is an average similarity between the two points.

Figure 144: Avifauna Species Diversity Dredging Area



Source: *Own preparation*
Prepared by*: Ecosfera Cía. Ltda. 2017*
Location*: Puerto Bolívar, Machala Parrish — El Oro*
Date*: April 16-17, 201*

❖ NATIONAL AND INTERNATIONAL CONSERVATION STATUS

An analysis of the species' conservation status recorded in the Red Book of Birds of Ecuador (Granizo et al. 2002), the 2012 Red List of the International Union for Conservation of Nature (IUCN), and the species recorded are of Least Concern and/or Low Risk.

Considering the 2012 Appendices of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), no threatened and/or protected species are registered in the project area.

❖ ENDEMIC SPECIES

The endemism present in the sector demonstrates the interactivity of the species and that the presence of anthropic activities does not bother or alter their habitat; since despite their conservation status, they have adapted to the impact produced by fishing and commercial activities; the area has developed other activities (tourism), and the birds have remained in the area.

❖ INDICATOR SPECIES

An essential ecological aspect to consider in the studies is bird species' sensitivity to habitat quality changes. According to Stotz et al. (1996), birds have different degrees of sensitivity to alterations in their environment; species of high sensitivity (H), prefer habitats in a good conservation state, whether natural or secondary forests of old regeneration and depending on their action ranges, can adapt to remnants of natural forest mildly intervened.

Species of medium sensitivity (M), those that can withstand slight environmental changes and can be found in areas of forest in good conservation status and/or in forest edges or areas with slight alteration and finally species of low sensitivity (L), those capable of adapting and colonizing altered areas.

According to the information obtained from the project area's sampling, all species recorded are classified as low sensitivity; no species classified as medium sensitivity or high sensitivity were recorded. The dominance of low-sensitivity species is an indicator of alterations in the sampling areas.

❖ EXISTING AVIFAUNA IN THE SEDIMENTATION PONDS

The field information from the sediment pool area located adjacent to the Liceo Naval school was collected on March 17; a walking tour was conducted around the pools, where machines were working to clean up the place, from 09h00 to 14h00, during that time with binoculars, GPS, and camera, the sighting of the sectors' fauna was recorded.

The following scale was used to determine the relative abundance of the species recorded: rare (one individual), uncommon (2-4 individuals), common (5-9 individuals), and abundant (10 or more individuals).

Photography 29: Avifauna Sedimentation Ponds Area

AVIFAUNA SPECIES

AVIFAUNA SPECIES

Ardea alba (great egret)

Coordinates: *X*= *611931;* ***Y*=***9640328*

Source: *the Consulting Team took photography*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Table 130: List of Bird Species in Sedimentation Ponds Area

Order	Family	Scientific Name	Common Name	Abundancy
Pelecaniformes	Phalacrocoracid	*Phalacrocorax brasilianus*	Neotropic Cormorant or Duckling	Pc
Pelecaniformes	Pelecanidae	*Pelecanus occidentalis*	Brown Pelican	C
Ciconiiformes	Ardeidae	*Egretta thula*	Snowy Egret	C
Ciconiiformes	Ardeidae	*Ardea alba*	Great Egret	R
Charadriiformes	Laridae	*Leucophaeus pipixcan*	Franklin's Gull	Pc
Charadriiformes	Laridae	*Larus delawareins*	Ring-billed gull	Pc
Passeriformes	Hirundinidae	*Hirundo rustica*	Barn Swallow	Pc
Passeriformes	Tyrannidae	*Capsiempis flaveola*	Yellow Tyrannulet	R

* Resident
** Boreal Migratory
*** South Migratory
E Endemic

Category of relative abundance of species recorded:
R: Rare

Category of Relative Species Abundance
C: Common; Pc: Uncommon; R:rare; Ab. Abundant.

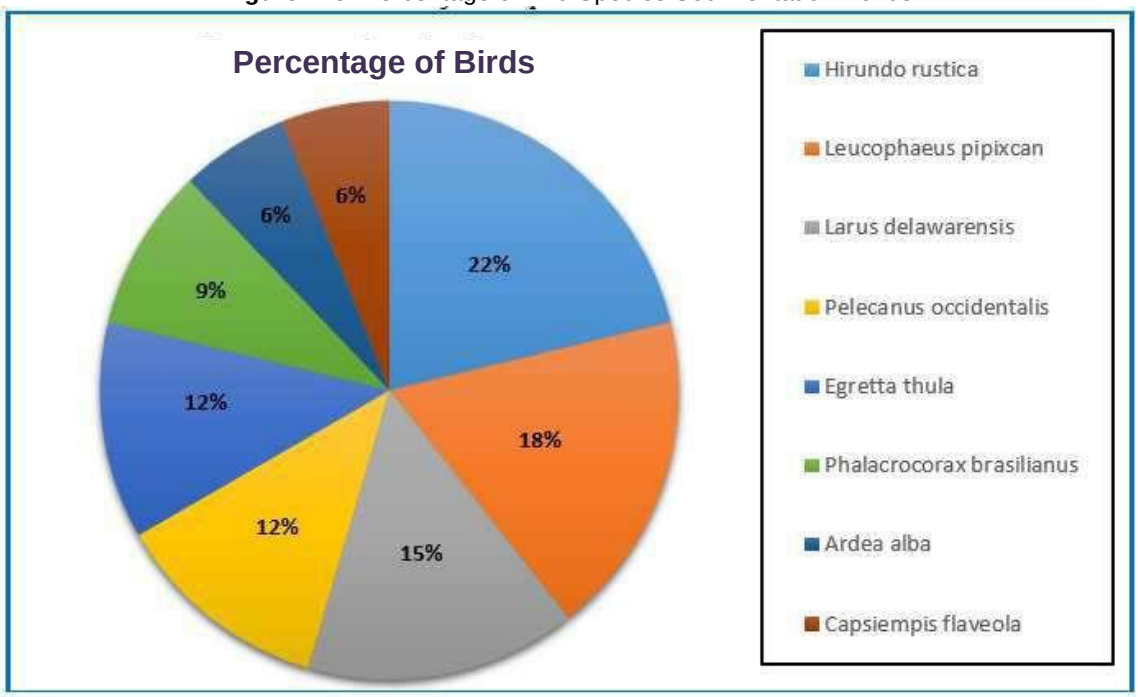
IUCN Categories (2014)
(EN): Endangered; (VU): Vulnerable; (NT): Near Threatened; (DD): Data Deficient; (NE): Not Evaluated; (LC): Least Concern;

Range
0-1

Pc: Uncommon	2-4
C: Common	5-9
Ab: Abundant	10 plus

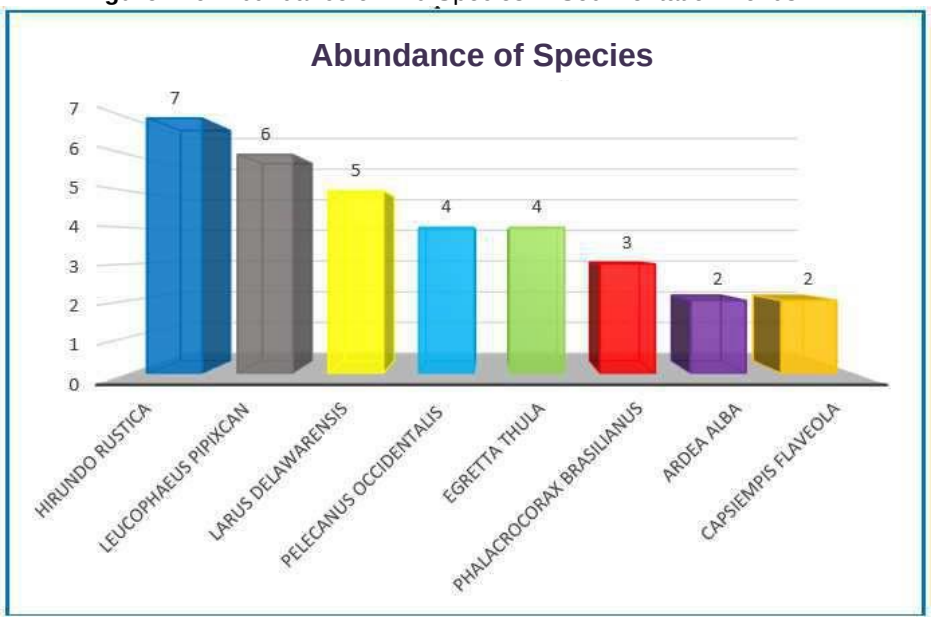
Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Figure 145: Percentage of Bird Species Sedimentation Ponds



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Figure 146: Abundance of Bird Species in Sedimentation Ponds



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

The study area acts as a feeding, nesting, mating, or migratory passage area for easily adaptable species in fishing and commercial activity areas. The area has a large vegetation cover that gives the avifauna options to increase. The families with the highest percentage of diversity are the closest or most adaptable concerning the land use found through this diagnosis.

The highest abundance families are Laridae with 31% (between two genera), Hirundinidae with 19%, and Pelecanidae with 14%. It is an area that harbors concentrations of resident waders (herons) and migratory birds (ducks).

❖ RELATIVE ABUNDANCE

The relative abundance of species recorded was determined through monitoring by direct observation, using digital Photography for identification, and comparing it with the following scale: rare (one individual), uncommon (2-4 individuals), common (5-9 individuals), and abundant (10 or more individuals).

Where 15% of the birds observed are uncommon, 35% are considered common, 40% are considered abundant, and 10% are rare species.

❖ DIVERSITY

- **Shannon-Wiener Index**

  When calculating the diversity data, the Shannon-Wienner Index at Point No. 1 showed a value of 1.64; therefore, it is considered an average biodiversity index.

- **Simpson's Index**

  When analyzing the diversity data, the Simpson Index showed 0.87 for point 1, which concerning the total number of species, which is 36, is interpreted as average diversity.

❖ **CONCLUSIONS OF THE AVIFAUNA STUDY**

- The original vegetation cover has been replaced by remnants of vegetation in certain sectors of the project's area of influence; however, this alteration of the birds' habitat tends to adapt to environmental changes, and they modify this adaptation to survive the new survival conditions.
- No species were recorded with any degree or criteria of threat.
- All bird species recorded in the project show low sensitivity, demonstrating that the study area is affected by various anthropogenic activities.
- The species that inhabit the project area are not used for commercial or food activities.
- The species have been able to adapt to the alteration of their habitat years ago and develop their activities in the mangrove ecosystem.
- The area where the sedimentation ponds are located allows the birds that carry out their activities at the project site to have a place to continue their activities because they have optimal environmental conditions for them.

6.2.5.2.- MAMMAL FAUNA

No species of mammals were recorded in the study area, as it is heavily disturbed by anthropogenic activities. When interviewing the inhabitants, we were told that there are rodent mammals such as rats, mice and domestic mammals such as cats and dogs.

For this reason, no qualitative or quantitative calculations were made for this study.

6.2.5.3.- HERPETOFAUNA

For the identification, direct observations were made by conducting free walks in particular habitats of this faunal group and conversations with the sector's inhabitants.

The materials to be used will be binoculars and a species registry table.

The species identified in the study area belong to individuals with generalist characteristics, demonstrating their high degree of adaptability. Species such as lizards, iguanas, and toads were identified; they are adapted to live next to intervened areas in the shelter of houses or weeds and feed on a great variety of insects, fruits, and leaves.

❖ METHODOLOGY

The methodologies used for the study of herpetofauna correspond to sampling techniques detailed by Heyer et al., (1994), and standardized in the Manual to Coordinate Efforts for Amphibian Monitoring in Latin America (Lips, K, Rehacer, J, Young, E., 1999-.2001).

HERPETOFAUNA IN DREDGING AREA

❖ FIELD PHASE

Free Walks: This methodology consisted of observation walks in the different habitats of the project area, within a radius of 100 m, where substrates such as logs, stones, leaf litter, etc., which are microhabitats where amphibians and reptiles hide, were collected.

Photography 30: Herpetofauna Determination Tour

ROUTE FOR DETERMINATION HERPETOFAUNA	
	

Source: *the Consulting Team took photography*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

❖ DATA PROCESSING PHASE

The project area is in an intertidal zone and subject to anthropogenic activities; few herpetofauna specimens were found during the surveys. Thus, interviews with residents and secondary information were also used to identify the area's species, mainly in the winter season.

❖ ANALYSIS OF RESULTS

HERPETOFAUNA OF THE DREDGING AREA

The procedure was carried out by analyzing and comparing the richness and abundance of the data obtained based on the methodology established to evaluate the different species of amphibians and reptiles at the sampling point.

Photography 31: Herpetofauna Species

HERPETOFAUNA SPECIES	
Coordinates: *X= 616557; Y= 9609719*	
 *Iguana iguana (Iguana)*	
 *Ameiva edracantha (Bocourt's Ameiva or lizard)*	 *Barycholos pulcher (Frog)*
 *Ameiva edracantha (Bocourt's Ameiva)*	 *Iguana (Iguana)*

Source: *Photography taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Table 131: List of Herpetofauna Species in Dredging Area

Order	Family	Scientific Name	Common Name	No. of Species
Saurian	Teiidae	*Ameiva edracantha*	Bocourt's Ameiva (Lizard)	3
Anura	Craugastoridae	*Pristimantis achatinus*	Frog (Toad)	2
Saurian	Iguanidae	*Iguana*	Iguana (Pacaso)	2
Anura	Craugastoridae	*Barycholos pulcher*	Frog	1

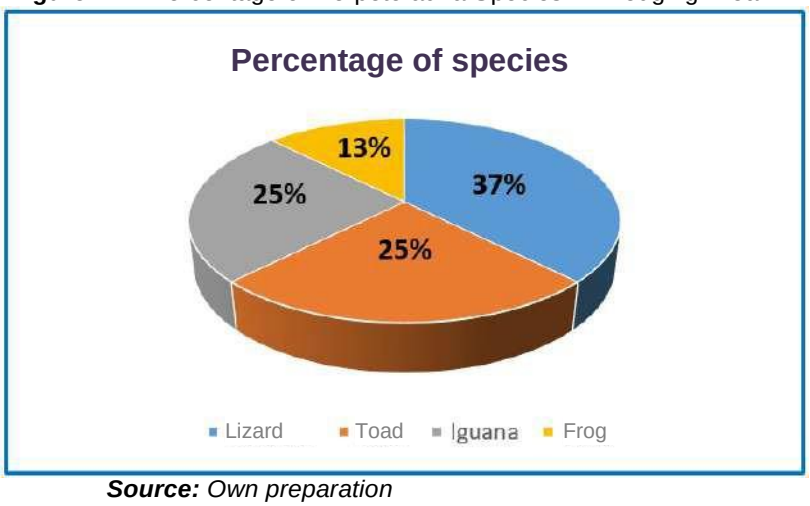
Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

According to the analysis of the data in the table above, it can be seen that the reptile class is the most representative in the dredging project area, concerning the amphibian class.

The project area is generally disturbed, which made it challenging to use quantitative sampling techniques, so the Shannon-Wiener and Simpson's diversity indexes were calculated.

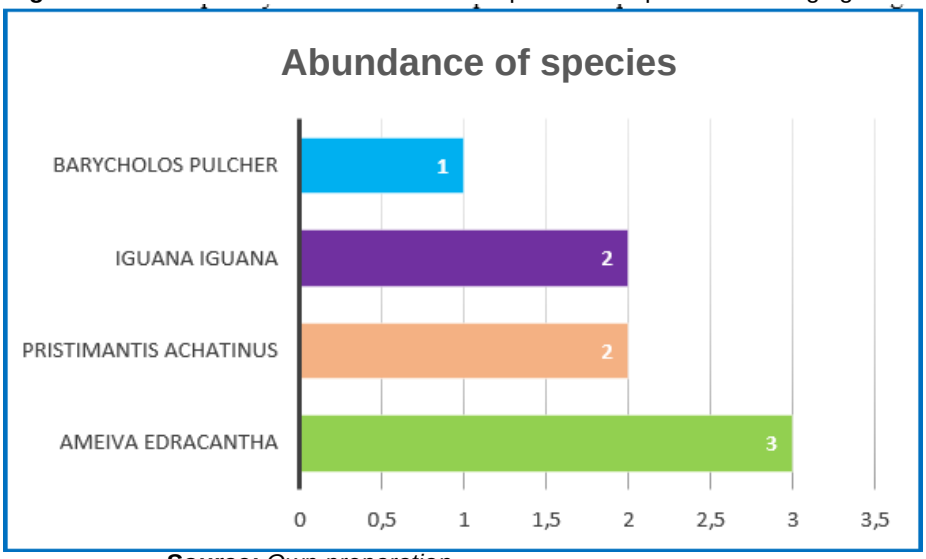
In the sampling conducted in the project area, 4 species were recorded within the Classes: *Amphibia* (2 sp) and *Reptilia* (2 sp), the most abundant species was the lizard (*Ameiva edecantha*) (3 individuals), *Pristimantis achatinus* (toad) and *Iguana* (iguana) with two individuals each.

Figure 147: Percentage of Herpetofauna Species in Dredging Area



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Figure 148: Richness and Abundance of Herpetofauna Species in Dredging Zone



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

- **Shannon-Wiener Index**
  When analyzing the diversity data, the Shannon-Wiener Index showed a diversity value of 1.32. It is therefore considered as a mean equity index.

- **Simpson's Index**
  When analyzing the diversity data, Simpson's Index showed a diversity value of 0.72. The total number of species, which is 4, is interpreted as average diversity.

❖ RELEVANT ECOLOGICAL ASPECTS

Trophic Niche

One of the amphibians' particular characteristics is that they are important links in the food chain's energy flow in aquatic and terrestrial ecosystems (Stebbins and Chen, 1995). This same characteristic in lizards makes it possible to determine species' use of habitat and microhabitat, their activity, and foraging behavior (Vitt et al., 1996). Understanding food web interactions allow us to evaluate the close relationship between habitats' conservation status and amphibian and reptile communities' stability.

❖ HERPETOFAUNA SENSITIVITY

Amphibians and reptiles are susceptible to environmental conditions and are generally closely tied to a particular habitat, making them more vulnerable than other vertebrate groups to habitat change. Increasing threats to biodiversity caused by humans have marked a negative impact on reptiles and especially amphibians (Houlahan et al. 2000) which are considered valuable indicators of environmental quality and play multiple functional roles within aquatic and terrestrial ecosystems (Blaustein and Wake 1990, Stebbins and Cohen 1995).

According to the information from the 2017 sampling, indicated that low sensitivity group, representing 100% of recorded herpetofauna, is the most representative; this proportion indicates the area is highly fragmented, leading to the development of generalist colonizing species, which support changes in their environment and have adapted to anthropogenic activities.

❖ CONSERVATION STATUS

One way of knowing the ecological quality of an area is to evaluate the type of species present and their conservation status at the national and regional levels; thus, two important elements can be defined: the sensitivity of the site and the degree of sensitivity of the species.

According to the Red List Conservation Status of Amphibians of Ecuador (Ron, S. R., Guayasamin, J. M, Menéndez-Guerrero, P., 2011; Coloma and Quiguango, 2008; Frost, 2005), the 2 amphibian species are in the category of Least Concern (Low Risk).

According to the Red List of Reptiles of Ecuador (Carrillo et al., 2005), the 2 species recorded are in the Least Concern species category. According to CITES, none of the species recorded are in conservation concern.

❖ RESOURCE USE

According to local attendees' comments, none of the species recorded in the dredging project area used in any economic or food activity.

DIAGNOSIS OF THE HERPETOFAUNA IN THE SEDIMENTATION PONDS AREA

For identification, direct observations made by walking along the sedimentation ponds' edges and the mangrove's edge near them. The materials to be used are binoculars and a species registry table.

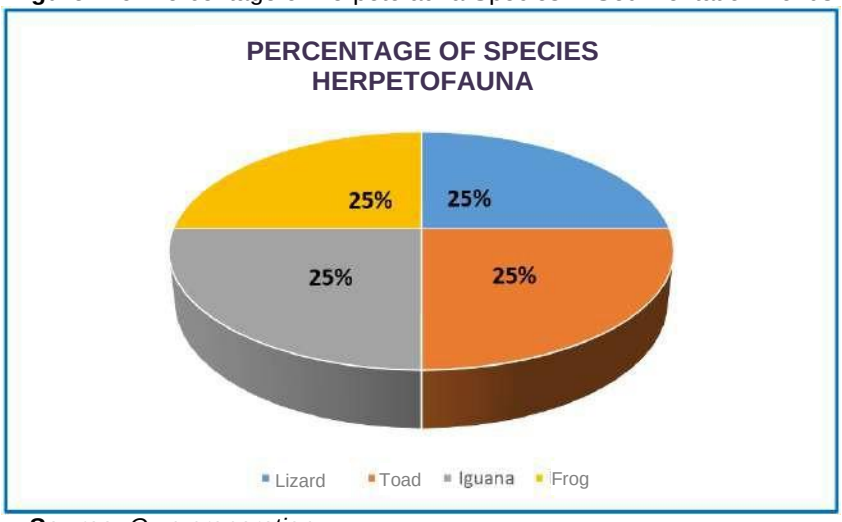
The species identified in the study area belong to individuals with generalist characteristics, which demonstrates a high degree of adaptability. Species such as lizards, iguanas, and toads were identified; the same adapt to living next to disturbed areas in the shelter of dwellings or weeds and feed on a wide variety of insects and leaves.

Table 132: List of Herpetofauna Species in Sedimentation Ponds

Order	Family	Scientific Name	Common Name	No. of Species
Saurian	Teiidae	*Ameiva edracantha*	Bocourt's Ameiva (Lizard)	1
Anura	Craugastoridae	*Pristimantis achatinus*	Frog (Toad)	1
Saurian	Iguanidae	*Iguana iguana*	Iguana (Pacaso)	1
Anura	Craugastoridae	*Barycholos pulcher*	Frog	1

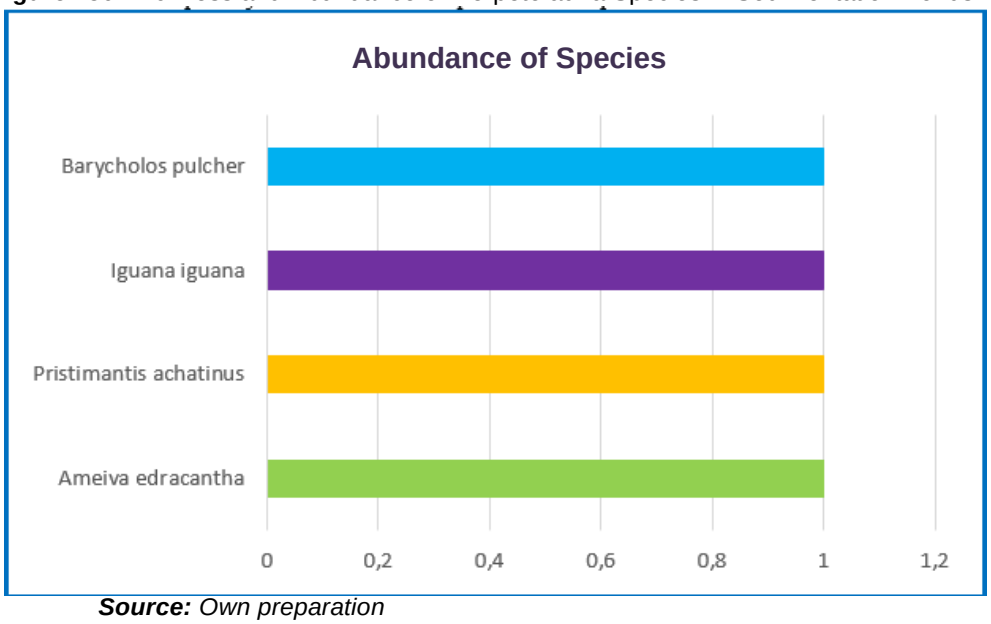
Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Figure 149: Percentage of Herpetofauna Species in Sedimentation Ponds



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Figure 150: Richness and Abundance of Herpetofauna Species in Sedimentation Ponds



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

- **Shannon-Wiener Index**
  When analyzing the diversity data, the Shannon-Wiener Index showed a diversity value of 1.39. It is considered a mean equity index.

- **Simpson's Index**
  When analyzing the diversity data, Simpson's Index showed a diversity value of 0.75. The total number of species, which is 4, is interpreted as average diversity.

❖ CONCLUSIONS OF THE HERPETOFAUNA STUDY

- In the dredging project area, the reptile class is the most representative of the amphibian class.
- In the project area, the most abundant species were the lizard(s) *Ameiva Edrecantha* (3 individuals), *Pristimantis achatinus* (toad), and *Iguana iguana* (iguana) with two individuals each.
- According to the sampling carried out, we can indicate that all species have low sensitivity.
- The herpetofauna species recorded are not under any threat category, which shows that even though the area is moderately disturbed, the few existing species have adapted to these fragile biomes.

- None of the species recorded in the project area are used for commercial or food activities.
- Some species of this kind could be seen in the vicinity of the sedimentation ponds, which allows us to affirm that this sector provides the conditions for developing their activities.

6.2.5.4.- ENTOMOFAUNA

Of all the planet's biological diversity, insects are considered the group with the most significant number of species, with a minimal proportion formally described. Although some authors consider an order of 30 million, this number is subject to debate. It seems that a reasonable estimate would be in the range of 5 to 10 million species according to the evaluation made by Ødegaard in 2000.

It is evident that insects are important because they provide environmental services such as soil fertilization, effects on soil physical and chemical properties, change in vegetation composition, among others. The position in key trophic levels makes insects essential regulators of matter and energy flow and important landscape designers. This highlights the fact that insects are capable of modulating the functioning of ecosystems (Guzmán 2010).

Another importance of their study and conservation lies in the use of insect populations in the applicability of ecological models that are known, even more so because of the influence of man on ecosystems and the end of them have become an essential tool for the evaluation of habitats used as ecological bioindicators (Bustamante-Sánchez et al 2004).

Within the study area, we were able to identify some insects, especially of the following orders: Diptera (flies and mosquitoes), Hymenoptera (bees and wasps), Lepidoptera (butterflies), and Odonata (dragonflies). Most of these insects have an omnivorous diet that consists mainly of insects, nectar, leaves, others.

Photography 32: Entomofauna Species

ENTOMOFAUNA SPECIES
Coordinates: ***X=*** 608267*;* ***Y=*** *9644855*

Vespula sp (Wasp)

ENTOMOFAUNA SPECIES	
 *Tramea abdominalis* (vermilion saddlebags)	 *Danaus plexippus* (Monarch Butterfly)
 *Tramea abdominalis* (vermilion saddlebags)	 *Apis mellifera* (Bee)

Source: *Photography taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

❖ METHODOLOGY

FIELD PHASE

To quantify entomofauna, a 150 m long observation transect was carried out, located in habitats within the Project area, manual collection technique used, log review, direct collection of entomofauna associated with fallen logs in a state of decomposition, manual capture of entomofauna on floral and herbaceous substrates, under stones, Photographic record of observed specimens and subsequent release of the same.

❖ DATA REGISTER

For identifying the entomofauna, specialized literature on this faunal group was used (Celi and Dávalos, 2001; Medina and Lopera, 2001). In most cases, the present work results are presented based on taxonomic identifications at the family level.

❖ DATA ANALYSIS

The terrestrial insect community was evaluated under the following parameters:

- **Species richness (S)**
  Total number of species in each sampling area (Magurran, 1989).

- **The abundance of individuals (N)**
  Corresponds to the total number of individuals recorded in each sampling zone (Yánez, 2005).

- **Relative abundance (%)**
  The number of individuals of each species multiplied by one hundred and divided by the total abundance recorded in each sampling area. Corresponds to the proportion of each species in the sample (Yánez, 2005).

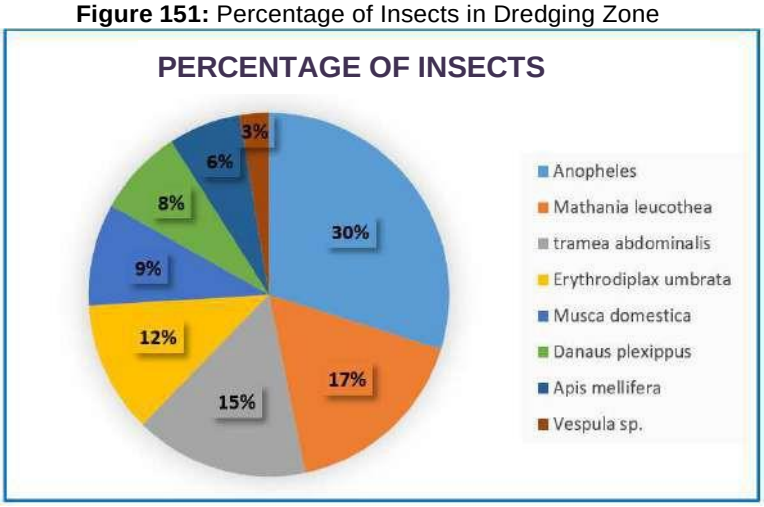
Table 133: List of Entomofauna Species in Dredging Zone

Order	Family	Scientific Name	Common Name	No. of Species
Diptera	Culicidae	*Anopheles*	Mosquito	23
Diptera	Muscidae	*Musca domestica*	Domestic Fly	7
Hymenoptera	Apidae	*Apis mellifera*	Bee	5
Hymenoptera	Vespidae	*Vespula sp.*	Wasp	2
Odonata	Libellulidae	*Tramea abdominalis*	Vermilion saddlebags	12
Odonata	Libellulidae	*Erythrodiplax umbrata*	Band-winged dragonlet	9
Lepidoptera	Nymphalidae	*Danaus plexippus*	Monarch Butterfly	6
Lepidóptera	Pieridae	*Mathania leucothea*	White Butterfly	13

Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

A quantitative point was established in the study area, in which a total of 77 individuals were recorded, 7 families distributed within 4 orders. The most representative family was Culicidae with 23 individuals, followed by Pieridae with 13 individuals.
The following figure shows the percentages of terrestrial insects recorded in the dredging project's area of influence.

Figure 151: Percentage of Insects in Dredging Zone



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

The Diversity Index (Shannon-Wiener and Simpson) of the entomofauna was determined based on the data obtained.

- **Shannon-Wiener Index**
  When calculating the diversity data, the Shannon-Wiener Index showed a value of 1.89, considered a low equity index. This index usually presents values between 1.5 and 3.5 and only rarely exceeds 4.5 (Margalef 1972, quoted in Magurran 1987).

- **Simpson's Index**
  When analyzing the diversity data, Simpson's Index showed a value of 0.83. The total number of species, which is 8, is interpreted as low diversity.

❖ TROPHIC NICHE AND GUILD

The Entomofauna recorded in the project area has the following benefits within the study habitats:

- Recycle nutrients: leaf litter, wood degradation.
- Disperse fungi, decompose carrion, excrement and aerate the soil.
- Propagate plants: pollination and seed dispersal.
- Maintain the composition and structure of plant communities via phytophagy.

- Maintain the animal community's structure via the transmission of diseases to animals, predation, and parasitism. Food for insectivorous invertebrates, from fish to mammals. Variety of life story, dominate food chains and food webs, both in mass and species richness (Marín, 2007)

❖ SPECIES OF INTEREST

Entomofauna recorded in the dredging project area does not record species within the IUCN Red Book lists (IUCN, 2011) or on CITES lists of trafficked species (Inskipp and Gillett eds, 2011).

❖ RESOURCE USE

The entomofauna recorded in the sampled area is not used for commercial or food purposes by local inhabitants.

ENTOMOFAUNA EXISTENT IN SEDIMENTATION PONDS

The area destined for the sedimentation ponds located next to Liceo Naval School grounds.

Table 134: List of Entomofauna Species in Sedimentation Ponds Area

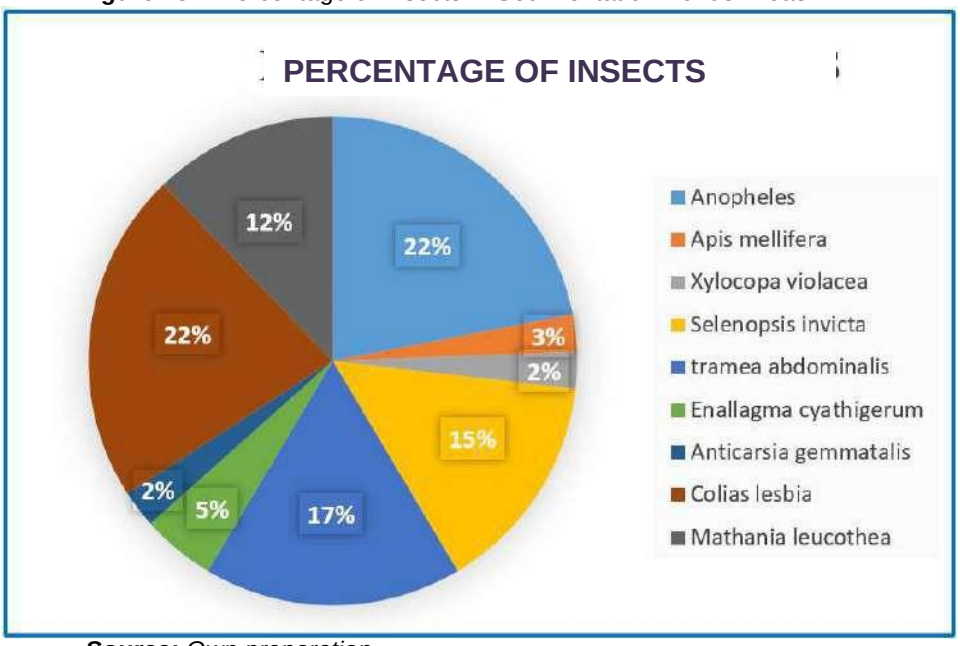
Order	Family	Scientific Name	Common Name	No. of Species
Diptera	Culicidae	*Anopheles*	Mosquito	9
Hymenoptera	Apidae	*Apis mellifera*	Bee	1
Hymenoptera	Apidae	*Xylocopa violacea*	Black bumblebee	1
Hymenoptera	Formicidae	*Solenopsis invicta*	Red Imported Fire Ant	6
Odonata	Libellulidae	*Tramea abdominalis*	Vermilion saddlebags	7
Odonata	Coenagrionidae	*Enallagma cyathigerum*	Common Blue Damselfly	2
Lepidoptera	Noctuidae	*Anticarsia gemmatalis*	Velvetbean Caterpillar	1
Lepidóptera	Pieridae	*Colias lesbia*	Lesbia Clouded Yellow	9
Lepidóptera	Pieridae	*Mathania leucothea*	White butterfly	5

Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

In the study area (sedimentation ponds) a quantitative point was established, in which a total of 41 individuals were recorded, 7 families distributed within 4 orders. The most representative families were Culicidae and Pieridae, with a total of 9 individuals each, followed by Libellulidae with 7 individuals.

The following figure shows the percentages of terrestrial insects recorded in the dredging project's area of influence.

Figure 152: Percentage of Insects in Sedimentation Ponds Areas



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

The Diversity Index (Shannon-Wiener and Simpson) of the entomofauna was determined based on the data obtained.

- **Shannon-Wiener Index**
  When calculating the diversity data, the Shannon-Wiener Index showed a value of 1.92. It is therefore considered to be a low equity index. This index usually presents values between 1.5 and 3.5 and only rarely exceeds 4.5 (Margalef 1972, cited in Magurran 1987).

- **Simpson's Index**
  When analyzing the diversity data, Simpson's Index showed a value of 0.83. concerning the total number of species, which is 9 interpreted as low diversity.

❖ **ENTOMOFAUNA CONCLUSIONS**

- In the area of influence of the dredging project, 77 individuals were recorded, 7 families were distributed within 4 orders. The most representative family was *Culicidae* with 23 individuals, followed by *Pieridae* with 13 individuals.
- According to index results obtained for the entomofauna, it was found that the diversity in the project area is low.
- Entomofauna recorded in the dredging Project area does not record species within the IUCN Red Book lists (IUCN, 2011) or on CITES lists of trafficked species (Inskipp and Gillett eds, 2011).
- None of the species recorded in the project area are used for commercial or food activities.
- The entomofauna found around the sedimentation ponds is similar to that found at the edge of the coastal profile, the dredging project site.

6.2.5.5.- ICHTHYOLOGY

Ichthyology is a branch of zoology dedicated to the study of fish. Ichthyology has as its main themes the study of fish's behavior and biology, which is why it makes it possible to determine these species' behavior and develop methods to counteract their overexploitation.

The presence of the first primitive fish on earth dates back several hundred million years long before human presence (*Granado, Ecologia de los peces, 1996*), where the characteristics of the environment differed significantly from what the planet is today. This presence is estimated to have started in the Primary Era, in the Ordovician Period, more precisely 500 million years ago in time *(M. Vegas, 1987)*

The first studies of Ichthyology in Ecuador began in 1821 with Humboldt, in which he referred to the taxonomy of inland water fishes. Subsequent research by Wagner, Boulenger, Fowler, Bohlke, and Ovchinnyk (*Instituto Nacional de Pesca, Estudio sobre la Biologia 1974*), followed this line of study.Barriga (*R. Barriga, Lista de Peces de agua dulce e intermarales, 2012*), in his work, broadly summarizes the ichthyological richness of Ecuador.

The National Fishing Institute **(INP)** revealed that the ichthyological richness in the Ecuadorian sea reaches 4.2 million tons of species. The study was elaborated from the south in Puerto Bolivar, in El Oro's province, to the north of Esmeraldas. The report indicates that the sector with the highest concentration of fish is the **GULF OF GUAYAQUIL** with 2.4 million tons of fish, followed by the Chone river's mouth with 1 million tons of fish.

In Puerto Bolivar, the INP conducted a study to determine the amount of catch in this process and obtained the following conclusions: May, June, and December are the

months of greatest catch and the species most caught were corvina, feather catfish, menudo, ray, and box catfish, which together with the rest of the months it was determined that the approximate amount of catch is 500 thousand tons.

Considering the importance of artisanal fishing in Ecuador and the need to provide development strategies to their communities concerning their fishing resources, in the parish of Puerto Bolivar, belonging to the canton Machala.

Among the fishing gears, the one with the highest catch is the bottom gillnet; we can highlight that the species with the highest catch with this fishing gear are the menudo and the corvina; the months with the highest operating expenses are May, June, and December, which register the highest amount of catch, this is since they register a higher number of departures and therefore a higher operating expense. The most effective fishing effort is that which does not require many casts or a long waiting time; for example, in a cast of one hour of effective fishing, the most significant amount of fish was caught. The most used boats in Puerto Bolivar are easy to use, such as canoes and fiberglass boats and low propulsion (outboard motor), since the greatest amount of catch is directed by the boats described above.

Within the study area, some fish species were identified, being the Perciformes, the order with the highest presence of species in the project's influence area.

Photography 33: Ichthyology Species

ICHTHYOLOGY SPECIES

Coordinates: X= 610956*; Y=9639311*

Mugil cephalus (flathead grey mullet)

Cynoscion analis (Peruvian weakfish)

Galeichthys jordani (Catfish)

ICHTHYOLOGY SPECIES

Centropomus viridis (White

Source: *Photography taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

❖ METHODOLOGY

FIELD PHASE

To quantify the ichthyological component, a tour of the sector located in front of the docks and the area of influence of the project was conducted. The technique used by local fishermen to catch fish was observed.

The description of catches or catches of the fish community present in the study area (along the access channel and in front of the docks) included 3 standardized sets of 3.5" nets (mesh eye) of which the number of panels will be known (each panel or trammel net measures approximately 150 meters in length), and the method of notching after several hours have elapsed, they collect the trammel net and proceed to remove the fish that have fallen into the net.

During the sampling, the start time and coordinates, the end time recorded, and the species captured were Photographed for later identification. We also talked to the fishermen to determine which species were caught in the area.

The technique used is the hand net or trammel net set by the fishermen and removed after several hours; however, some people prefer to use hooks or lines, but few use this technique. Species identification was carried out using the guide text Peces marinos del Ecuador continental, Volume 2; Guía de especies by Pedro Jiménez and Philippe Bearez. 2004.

Photography 34: Fishing Operation

FISHING OPERATION
Coordinates: X= 610441; Y:= 9639658


Source: *Photography taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

❖ DATA ANALYSIS

The fish species found in the study area are detailed in the following table:

Table 135: List of Fish Species in the Dredging Area

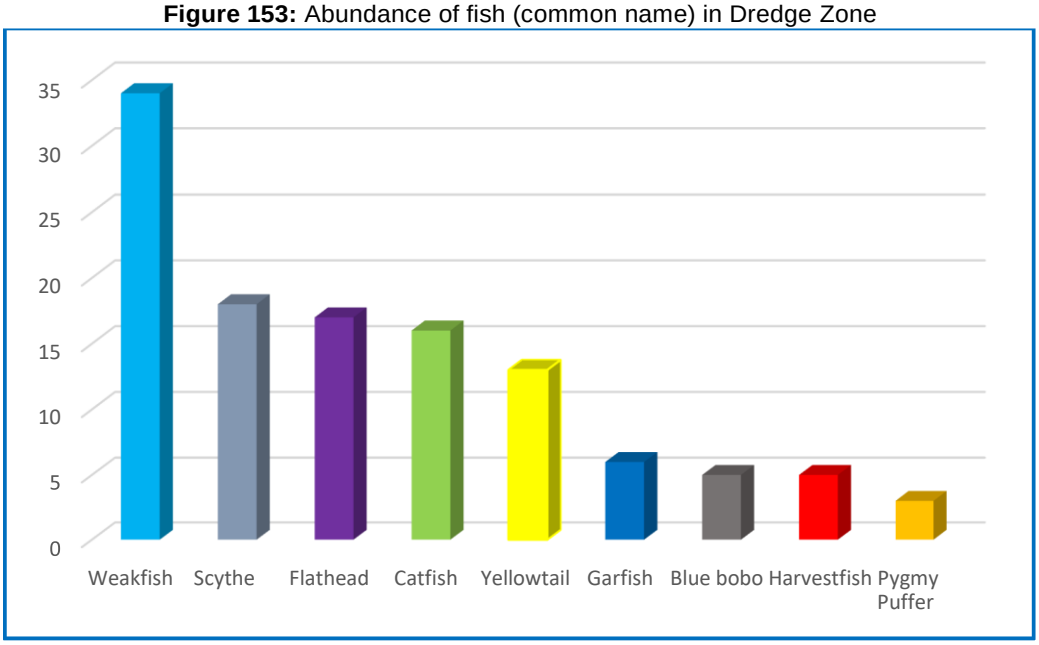
Order	Family	Scientific Name	Common Name
Mugiliformes	Mugilidae	*Mugil cephalus*	Flathead grey mullet
Perciformes	Sciaenidae	*Cynoscion analis*	Peruvian weakfish
Perciformes	Centropomidae	*Centropomus undecimalis*	White snook or scythe
Percformes	Sciaenidae	*Umbrina xanti*	Common Yellowtail Croaker
Perciformes	Polynemidae	*Polydactylus approximans*	Blue bobo
Siluriformes	Ariidae	*Galeichthys jordani*	Catfish
Beloniformes	Belonidae	*Belone*	Garfish
Perciformes	Stromateidae	*Peprilus medius*	Pacific Harvestfish
Tetraodontiformes	Tetraodontidae	*Sphoeroides trichocephalus*	Pygmy Puffer

Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Three quantitative points were established in the study area, in which a total of 117 individuals were recorded, 8 families distributed within 5 orders. The most representative family was *Sciaenidae* with 15 individuals, followed by *Mugilidae* with 12 individuals.

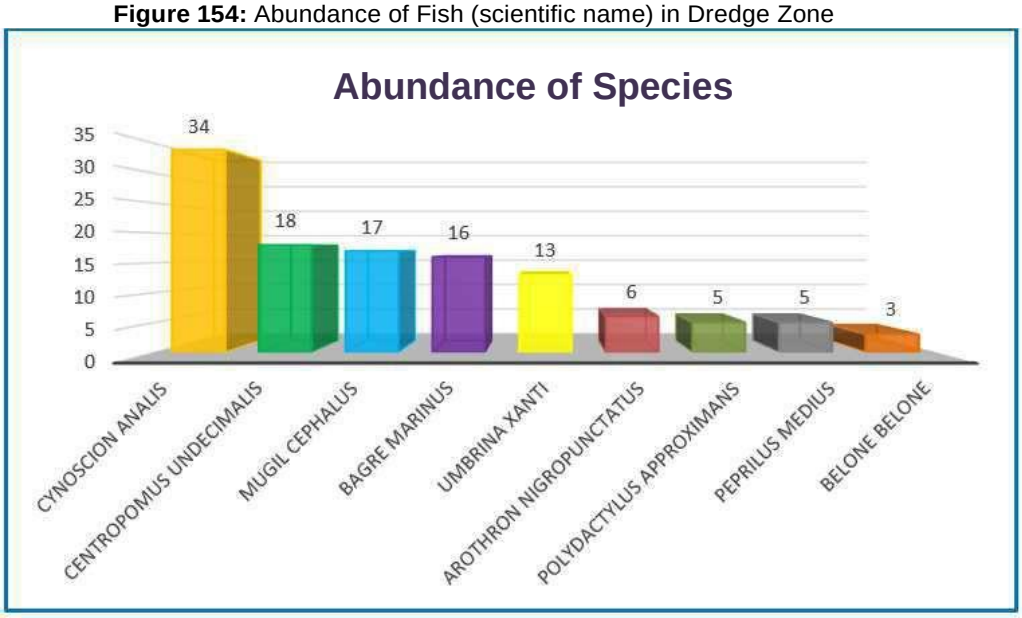
The following figure shows the species of fish recorded in the area of influence of the dredging project:

Figure 153: Abundance of fish (common name) in Dredge Zone



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

Figure 154: Abundance of Fish (scientific name) in Dredge Zone



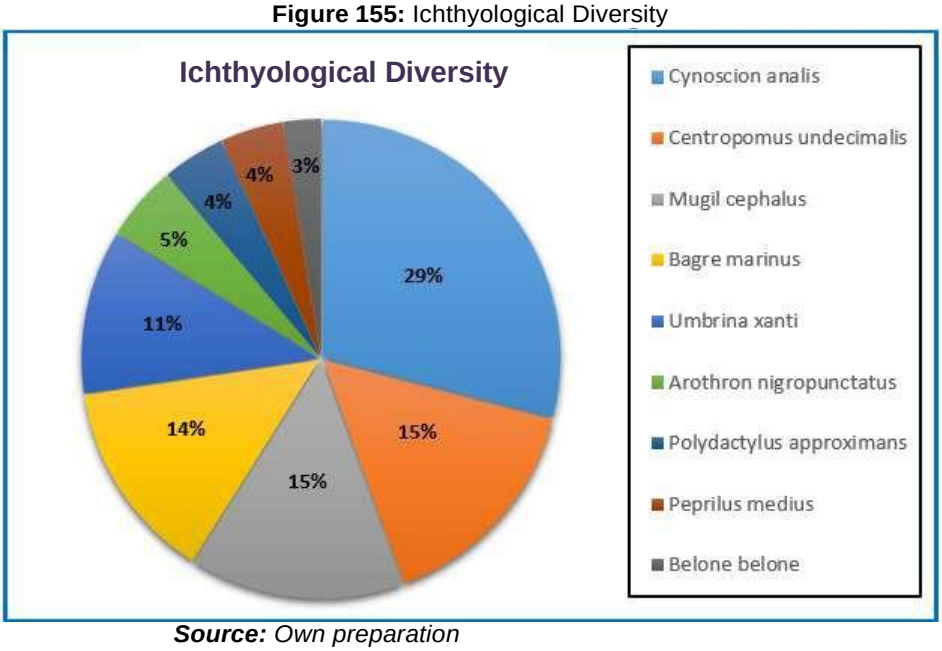
Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

- **Shannon-Wiener Index**
  In calculating the diversity data, the Shannon-Wiener Index showed a value of 1.82 for point one, 1.45 for point 2, and 1.75 for point 3. This index usually presents values between 1.5 and 3.5 and only rarely exceeds 4.5 (Margalef 1972, cited in Magurran 1987).

- **Simpson's Index**
  When analyzing the diversity data, Simpson's Index showed a value of 0.18 for point 1, 0.26 for point 2, and 0.18 for point 3. Concerning the total number of species, which is 9, this is interpreted as low diversity.

- **Jaccard and Sorensen Index**
  The Jaccard and Sorensen indexes measure the similarity between the two sampled points. Calculating these indexes gave us a value of 43% or 0.67 of similarity between the two points. This data indicates that there is an average similarity between the two points.

Figure 155: Ichthyological Diversity



Source: *Own preparation*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

❖ CONCLUSIONS OF THE ICHTHYOFAUNA STUDY

- In the area of influence of the dredging project, 117 individuals were recorded, 8 families were distributed within 5 orders. The most representative family was *Sciaenidae* with 34 individuals, followed by *Mugilidae* with 17 individuals.

- According to obtained index results for the Ichthyofauna, the project area's diversity was medium.

- The Ichthyofauna recorded in the dredging project area does not record species within the IUCN Red Book lists (IUCN, 2011) or on the CITES lists of trafficked species (Inskipp and Gillett eds, 2011).

- All species recorded in the project area used for commercial or food activities.

Photography 35: Biotic Environment Information Gathering

Biotic Environment Information Gathering








Source: *Photography taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda., 2017*
Location: *Parish of Puerto Bolívar, Machala – El Oro*
Date: *April 16 and 17, 2017*

6.2.6.- CHARACTERIZATION OF PLANT AND BENTHIC FLORA AND FAUNA, MARINE MAMMALS AND ICHTHYOFAUNA IN THE OFFSHORE DEPOSITION AREA

The ecological state of water and sediments in the dredging reception quadrant will be reflected in the ecological descriptions of its biological communities (plankton, nekton, and benthos), while the quality of water and marine sediments must be established by analyzing samples in accredited laboratories and interpreted under the current regulations described in Book VI, Environmental Quality of the Unified Text of Secondary Environmental Legislation, and in the absence of local criteria, as is the case with marine sediments, international reference standards must be used.

LOCATION OF SAMPLING POINTS

The following table shows the vertex coordinates of the reference polygon where the sediments were deposited at sea.

The sector corresponds to an open sea area located at 40 minutes of navigation with a 75 Hp outboard motor from Puerto Bolivar with a predominance of soft bottoms and depths that oscillate in the 30-meter slope.

Table 136: Coordinates of the vertexes where sediments will be deposited

POINT	X	Y
P 1	583544	9649248
P 2	583880	9651278
P 3	585837	9651184
P 4	585560	9649187

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and ichthyofauna*
Prepared by *Ecosfera Cía. Ltda. 2017*
Location: *Province of El Oro*
Date: *July 16, 2017*

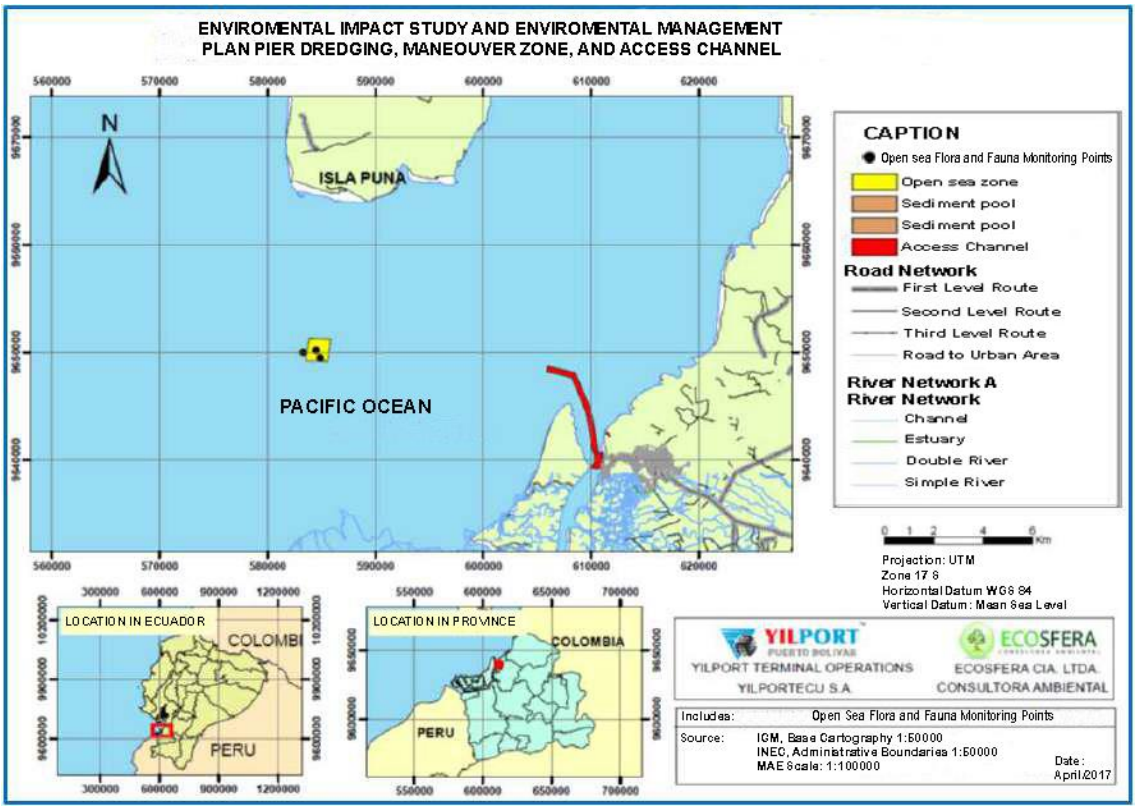
Within this quadrant 3 reference coordinates were located where biotic sampling was performed; the sampling coordinates are:

Table 137: Sampling Stations

POINT	X	Y
Station 1	584470	9650238
Station 2	584882	9649593
Station 3	583280	9650045

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and ichthyofauna*
Prepared by *Ecosfera Cía. Ltda. 2017*
Location: *Province of El Oro*
Date: *July 16, 2017*

Figure 156: Offshore Flora and Fauna Monitoring Points Map



Source: *www.geoportaligm.gob.ec, Military Geographic Institute, INEC*
Prepared by: *Ecosfera Cía. Ltda., 201*
Location: *El Oro Province*
Date: *July 20, 2017*

WORK TEAM

The sampling personnel was comprised by

- Eduardo Rebolledo, biologist
- Rommel Molina Villalba, biologist
- Rodolfo Arias, park-keeper of Santa Clara Island Wildlife Refuge
- José Guerrero, environmental engineer, MAE officer
- Jesús Alberto Caicedo, mechanic, sampling assistant
- Vessel captain

After obtaining the Environment Department Authorization through official letter no. MAE-DPAEO-2017-1542-O, on Sunday, July 16, the vessel set sail from Bolivar Port at 8:30 a. m. in a small vessel fiberglass-like of 7.5 m long, driven by a 75 hp Yamaha engine.

The equipment used in the sampling were the following:

a) GPS Garmin etrex HCX view

b) Oceanographic profiler CTD YSI EXO 2
c) 4 L capacity Van Dorn bottle
d) Bongo type net with 60 and 300-micron mesh and removable plastic flakes
e) Network type conical sieve of 500 microns
f) Network of 4.5" inches electronic type of a cloth
g) 9 plastic bottles with a security seal of 1L
h) 3 1.75L wide-mouth plastic jars
i) 4 wide-mouth plastic jars of 0.75 L
j) Thermal containers
k) 1 liter of 37% Formaldehyde
l) 1 Gallon of 96% industrial alcohol
m) Acrylic tablet for wet writing
n) Waterproof camera

WORK METHODOLOGY

FIELD PHASE

Registration of physicochemical variables in situ

It corresponds to the use of the EXO 2 oceanographic profiler, which is submerged at a constant speed, and a connecting cable is uniformly delivered to a depth of 30m and then also lifted at a uniform speed. This equipment records the following variables every 0.5 seconds that are subsequently downloaded to a computer:

- Temperature (°C)
- Electrical conductivity (µS/cm)
- Electrical conductance (µS/cm)
- Total dissolved solids (ppm)
- Salinity (ppt)
- Percent oxygen saturation (%)
- Dissolved Oxygen (mgO_2/L)
- pH

Photograph 36: Registration of physicochemical variables with YSI signature EXO2 CTD

Sampling area variable register

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

ACQUISITION OF PLANKTONIC SAMPLES

Quantitative Samples

In each analysis station, 3 water samples were acquired, a surface sample and two deep samples at 15m or half water and 30m close to the bottom; for this, a 4L Van Dorn bottle was used; for each sample, one liter of water was collected raw in dark plastic containers of 1 liter with a security seal and kept cold, once on the ground, 3 ml of 37% formalin was added as a fixing agent. Transporting 9 liters of water to the EGA PUCESE laboratory in Esmeraldas.

Photograph 37: Van Dorn bottle

Van Dorn bottle used

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

QUALITATIVE PLANKTON ANALYSIS. CAPTURE WITH NETS

In two sectors, between points 1 and 2 and later 2 and 3, a bongo-type net was dragged for 3 minutes in a double oblique manner with mouths of 0.38 cm in diameter (0.113 m^2 of surface) and filter cloths of 1.60 m in diameter long, one of 60 microns to obtain a sestonic fraction with a predominance of algae and few zooplanktons and a 300-micron mesh to capture zooplankton and ichthyoplankton.

Each mesh ends in a 0.75 L threaded plastic flake, concentrating the samples on these when lifting the net proceeding to eliminate excess water and then remove them from the net, being fixed by adding 5 ml of 37% formalin and 5 ml of 70% alcohol, each previously labeled bottle was kept cold in a cooler with ice.

Photograph 38: Trawling with bongo net

CONCENTRATION OF PLANKTONIC SAMPLES	
	
	

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

ACQUISITION OF BENTHONIC SAMPLES

At each station, a bottom sample was collected with a Van Been type dredge that is kept pendulum of the boat, giving it an orderly line in free fall so that it barely impacts the bottom, being collected, avoiding the dragging of the same, having to correct the superficial drift of the currents that move the boat. Upon impacting

the dredge, a mechanism is activated, being lifted by hand and depositing its content in a rectangular mesh of 500 microns to eliminate excess sediment and reduce the sample of benthic beings, roughly observing the sample and releasing beings that after registration it is not necessary to sacrifice them if it were the case.

The already reduced sample is deposited in 1.75 L wide-mouth plastic containers that were completed with 96% industrial alcohol; the bottles are labeled and kept cold until they are transferred to the EGA PUCESE laboratory.

Photograph 39: Acquisition of benthic sample and sample reduction

BENTONIC SAMPLE

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

STANDARDIZED FISH CATCHES

At each analysis station, a 4.5" electro-welded mesh net of only a 180 m cloth was cast; time is taken from the moment the net was watered, letting all the artwork for 45 minutes. The net's watering took 5 minutes and its charge about 10 minutes, estimating the total artwork time of 1 hour.

At the time of collection, the captured pieces were separated. A specimen of each captured species was photographed, and the catch of each set was deposited in differentiated polypropylene bags inside a cooler with ice.

Once on land, each catch's fish were measured and weighed, obtaining ecological descriptions of the catches made and using CPUE1 as a synonym for abundance of fish, estimated in Kg/hour of fishing.

Photograph 40: Ichthyological Sampling

ART USED IN ICTIOLOGICAL SAMPLING




Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

RECORDS OF PROTECTED MARINE FAUNA

For this study, protected marine beings are considered all those beings protected by Ecuadorian legislation and by international agreements signed by the Ecuadorian State, referring to protected marine fauna such as the International Whaling Commission, the Convention on Biological Diversity[2] CBD, and the Convention on migratory species. CMS[3]. Therefore, all the crew of the sampling day was considered as observers, giving instructions that if any interaction with marine mammals, marine

[1] Catch per unit of effort
[2] https://www.cbd.int/doc/legal/cbd-es.pdf
[3] http://www.cms.int/es

reptiles, whale sharks, giant mantas occurs, the course of navigation or activity that is being carried out shall be stopped, and data recorded of the interaction in relation suggested by the Whale and Dolphins Conservation Society[4] such as:

- Time and coordinates of the sighting
- Species involved
- Numerical estimation of them and, if possible, age structure
- The activity they are doing
- Distance and bearing of the direction and direction in which they are going
- Oceanographic conditions at the time of the sighting
- Registration of graphic testimonials

LABORATORY PHASE

ALGAE ESTIMATION IN UTERMOHL CHAMBERS

The samples were analyzed following the guidelines of the document Standard Operating Procedure for Phytoplankton Analysis, LG401, of the Environmental Protection Agency EPA of the United States, which specifies the estimation of algae with an inverted microscope at 600x magnification following the Utermohl method.

For this, the bottles were shaken in rotation for 2 minutes to then deposit 50 ml of the same into 50 ml decantation tubes, allowing suspended solids to settle on a fine glass base plate for direct observation in an inverted microscope. The samples remained in decantation for 24 hours and were observed at 600x magnification, identifying the genera present with the following guide texts:

- Acta Oceanoráfica del Pacifico Volume 19, N.1, 2014 ISSN N° 1390-129X, of the Oceanographic Institute of the Ecuadorian Navy that has descriptions of Diatoms, silicoflagellates and coccolithophores of the Phytoplankton of the Gulf of Guayaquil, By Roberto Jiménez; Dinoflagellates of the phytoplankton of the Gulf of Guayaquil, By Flor Pesrantes and Tinntinidos of the Gulf of Guayaquil, by Iván Zambrano
- Carmelo R. Tomas, Grethe R. Hasle, Karen A. Steidinger, Erick, E. Syvertsen, Karl Jangen, 1995. Identifyng marine Diatoms and Dinoflegellates. Academic Press, Inc.
- Online digital catalog www.algaebase.org.

When observing phytoplankters in the inverted microscope, algae and zooplankters present in sweeps or diametrical observation "strips" were counted in the Utermohl settling base, proceeding to estimate the abundance or concentration of algae present per milliliter according to the formula:

$$\textbf{\textit{Cells /ml}}^{5}\textbf{= (C*TA) / (L*W*V*S)}$$

Where:
C = Cells counted

[4] http://ar.whales.org/
[5] For the present study interpreted as algae/ml.

TA = surface of the base of the settling chamber in mm²
L = length of the strip counted in mm
W = Width of transept in mm
V = Settling volume of the chamber in milliliters
S = number of counted strips

In the present study, the filamentous algae and minor zooplankters of a multicellular nature were counted as a single individual, hence the fact that they are reported as algae/ml. The observation strip's width was estimated by locating a reference of known dimensions, in this case, a microscope caliper and magnifying glasses to adjust the sharpness of images captured by a digital camera. The width of the observation strip was 0.08mm at 600X magnification.
After ordering the count data in an Excel spreadsheet, the counts by species and station were exported to the PAST 3X statistical processor, obtaining multiple ecological descriptions, in the same way, graphs made to observe differences between the different stations and samples.

Picture 41: Quantification and description of algae with the Utermohl Method

LABORATORY ANALYSIS	
	

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

QUALITATIVE PLANKTON ANALYSIS

- **PHYTOPLANKTON**

  The samples from the 60 µm mesh were filtered and concentrated with 60 µm sieves for 5 minutes to remove the excess water with tissue paper, acquiring a moldable shape deposited on 0.45-micron filter papers previously weighed on a Mettler Toledo semi-analytical balance with a sensitivity of ten-thousandths of a gram proceeding to record the difference in masses in grams for each sampling station. The samples were rehydrated in their original solution and concentrated into 60 ml flasks that are kept in the Plankton collection of the EGA PUCESE Faunistic and Herbarium Museum.

Photograph 42: Estimation of Planctonic Mass

PLANKTON MASS ESTIMATION Sestonic fraction greater than 60 microns	
	

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

- **ZOOPLANKTON**

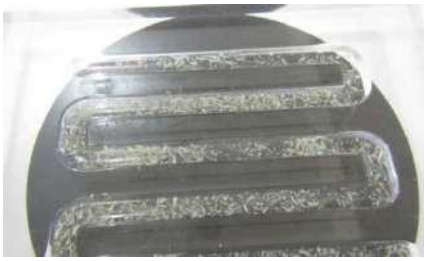
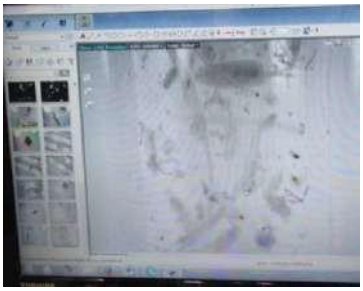
The zooplanktonic mass was estimated following the same procedure described for the samples from 60-micron meshes, except that the samples' filtering and concentration were carried out with a 100-micron sieve. Once the total mass of a sample is known, a fraction fewer than 0.5 grams determined with a semi-analytical balance is separated, which is disseminated in a Bogorov chamber, identifying and counting the organisms present in it with a DINOLITE digital microscope. or failing that, a stereoscopic magnifying glass, taking a photographic collection of zooplankters. In this way, we have a numerical estimate of the different zooplankters that make up a sample using a volumetric extrapolation.

For the identification of zooplanktonic groups, the following guide texts were used:

- Oceanographic Institute of the Ecuadorian Navy, INOCAR. Oceanographic Proceedings of the Pacific Volume 2, No. 2, 1983:
- *Tintinnidos del Golfo de Guayaquil*, Iván Zambrano
- *Taxonomic study of the Quetognaths of the Gulf of Ecuador*, Dolores Bonilla A.
- *Pteropods and Heteropods of the Gulf of Guayaquil*, Helena Gualancanay
- Demetrio Boltovkoy, 1981. Atlas of the zooplankton of the Southwest Atlantic and working methods with marine zooplankton.
- Robert D Barnes, 1983. Invertebrate zoology" Editorial Limusa Mejico D.F.

The samples, once analyzed, were rehydrated in their original solution to be concentrated in 60 ml flasks, remaining in a collection at the EGA PUCESE Faunistic and Herbarium Museum in the city of Esmeraldas.

Photograph 43: Zoo-planktonic Subsample

Zooplanktonic Sample	
 Zooplanktonic subsample disseminated in Bogorov chamber	 Images provided by DINOLITE microscope

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

BENTONIC COMMUNITY ANALYSIS

Already in the laboratory, the samples are scattered on trays to be scrutinized with good lighting and the support of manual magnifying glasses, the benthic beings being removed from each sample to be deposited in 120 ml wide-mouth bottles, and the industrial alcohol is replaced by drinkable alcohol at 70%. For identification and counting purposes, the beings found in each sample are separated by main groups in Petri dishes to be observed with a DINOLITE digital microscope with up to 200 magnification.

For identification of species, the following guide texts were used:

- Sea Tropical Shells of Western America by Myra A. Keen, reissued in 1971. Stanford University Press
- Polychaetes (Annelida: Polychaeta) from Mexico and Tropical America" (De León-González et al., 2009)
- Volume 1, FAO Guide for the Identification of Species for Fishing Purposes, Eastern Central Pacific, 1995. Algae and Marine Invertebrates
- Acta Oceanoráfica del Pacifico Volume 19, N.1, 2014 ISSN N ° 1390-129X, of the Oceanographic Institute of the Ecuadorian Navy, Bivalves of the Gulf of Guayaquil
- The digital base World register of marine species WoRMS[6]
- Catalog of life[7] digital database

Once the abundance data of the species found were digitized, they were exported to the PAST 3X processor, obtaining their main ecological descriptions. Once the samples had been analyzed,

[6] http://www.marinespecies.org/
[7] http://www.catalogoflife.org/

the specimens were deposited in 250 ml wide-mouthed flasks with 70% alcohol, remaining in the PUCESE Fauna and Herbarium Museum collection.

Picture 44: Cleaning of a benthic sample, observation, and identification of genera in the laboratory

OBSERVATION AND IDENTIFICATION IN LABORATORY



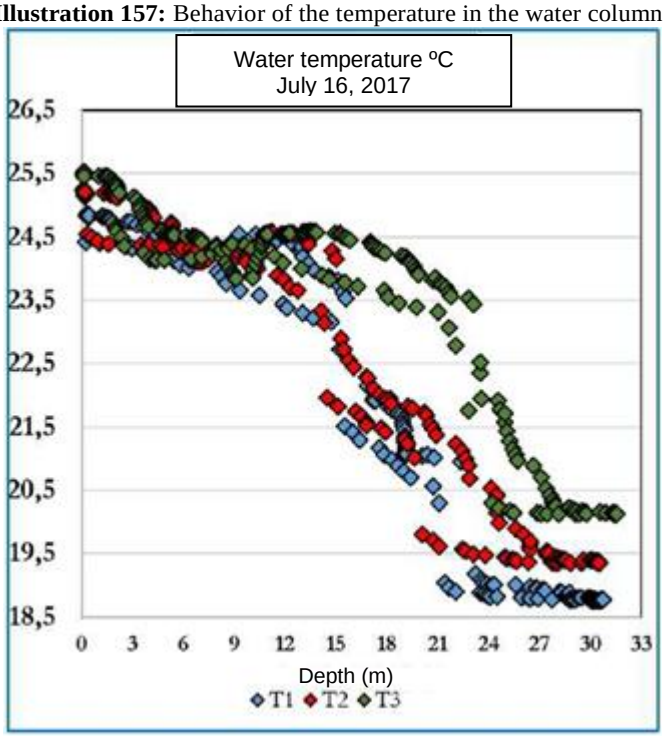

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Prepared by: *Pictures taken by the work team*
Location: *Province of El Oro*
Date: *July 16, 2017*

ANALYSIS OF RESULTS

RECORD OF PHYSICAL-CHEMICAL VARIABLES OF THE WATER COLUMN

The following figure shows the behavior of the water temperature within the sampling quadrant.

Illustration 157: Behavior of the temperature in the water column

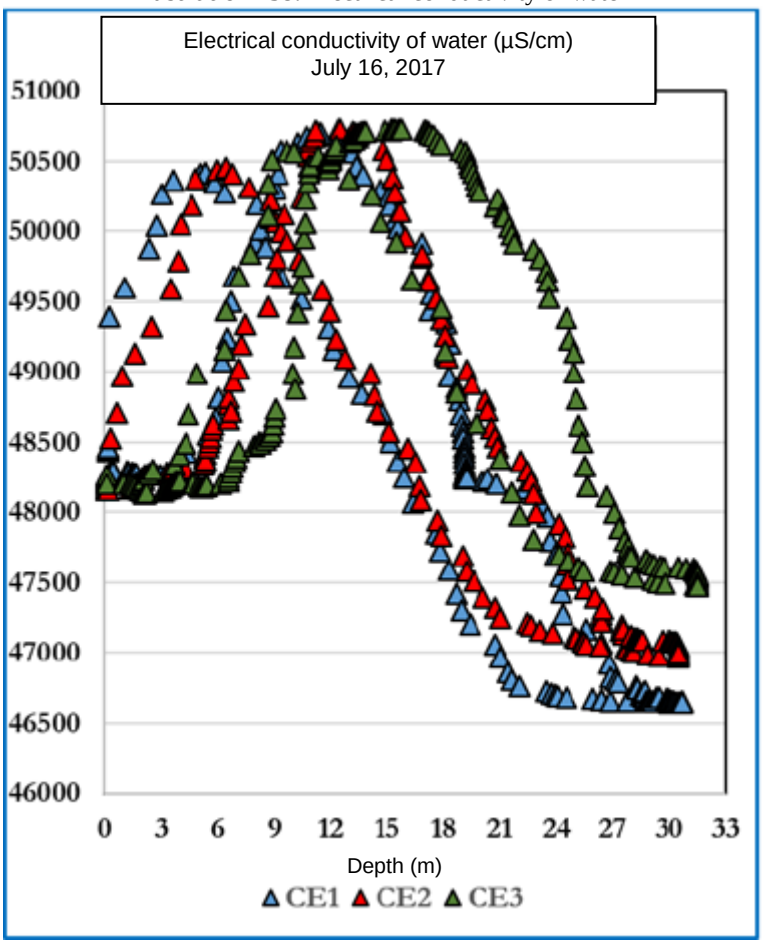


Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

The previous figure shows a thermocline depth located at 12m depth, although it showed oscillations since the records occurred at a change in tide, that is, in station 1 it coincided with high tide, while in station 2 and 3 it was they had readings of ebb tide or low tide.

However, the temperature is not the parameter that best illustrates the differentiation of water strata in the column; in fact, the studied system corresponds to an estuarine sector where a mixture of water from the continent with lower salinity and oceanic water will occur, appreciating the stratification of the area in a better way by observing the electrical conductivity of the water that appears in the following figure:

Illustration 158: Electrical conductivity of water



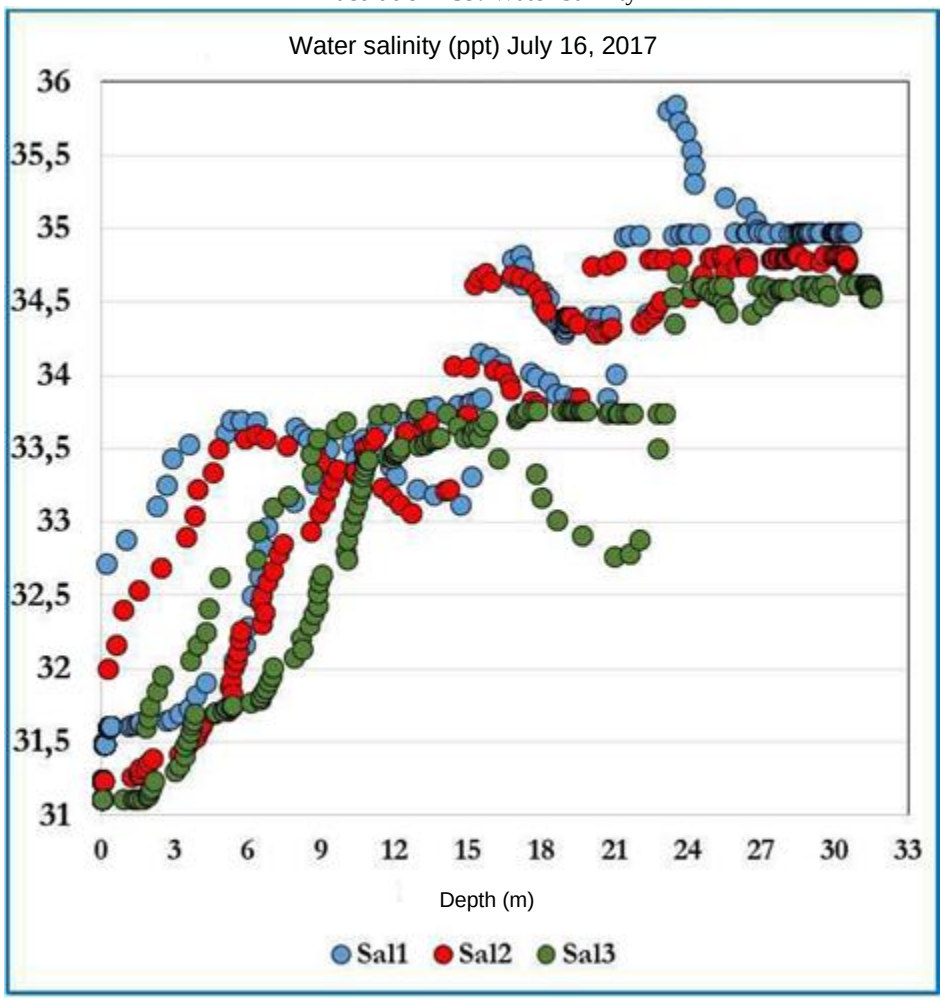
Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

Water's electrical conductivity shows us 2 layers of water, a superficial one up to 12 meters deep and then a bottom layer.

The water's salinity in the figure below tests for a less salty, more mixed surface layer that flows over a salty oceanic wedge. This parameter is important because it guides us that the dredging discharge could be concatenated with tidal periods. A considerable turbidity plume is generated, which is directed out to sea.

It is an advantage to have a thermocline and stratification of the water in around 12m, being practically a column of 7-8 meters that the sediments must sink at the moment of discharge to be confined in the deep water column of smaller temperature, being little possible the return of the same on this layer.

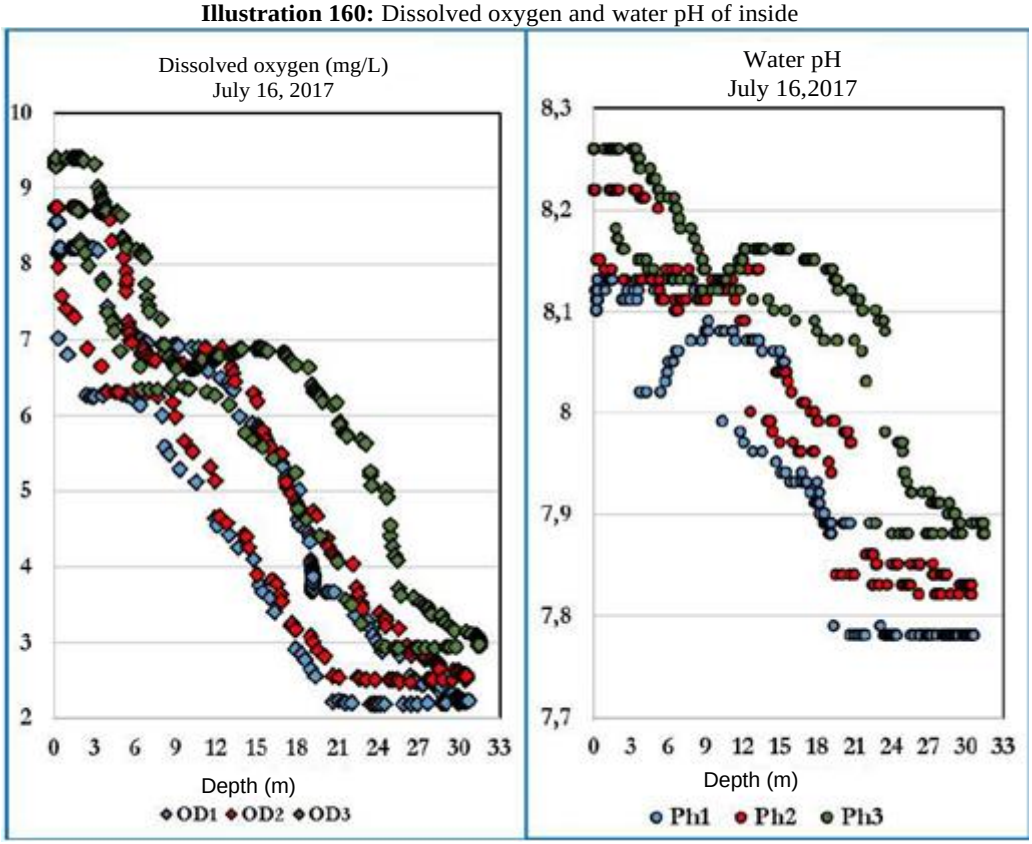
Illustration 159: Water Salinity



Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

When observing the dissolved oxygen and pH patterns in the water column, we see that they decrease as the depth increases, as observed in the following figures respectively; however, they show a break of both precisely around 12m deep, thermocline depth.

Illustration 160: Dissolved oxygen and water pH of inside



Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

PLANKTONIC COMMUNITY

PHYTOPLANKTON, QUANTITATIVE ANALYSIS OF UTERMOHL

In the 9 water samples analyzed, a total of 58 phytoplanktonic genera were found, plus an unidentified being, apparently an outbreak of freshwater aquatic fungus.

The following table shows the estimate of algae (algae/ml) according to the Utermohl method. From the algae count data, it can be mentioned that normal conditions would have existed for the date on July 16; the analyzed marine body is considered normal conditions, where 3 main groups make up the Phyto-planktonic community, predominantly diatoms (*Phyllum Bacillariophyta*) followed by Dinoflagellates (*Phyllum Phyrrophyta*) and finally Tintinid protozoa.

Table 138: Phytoplankton species in the study sector

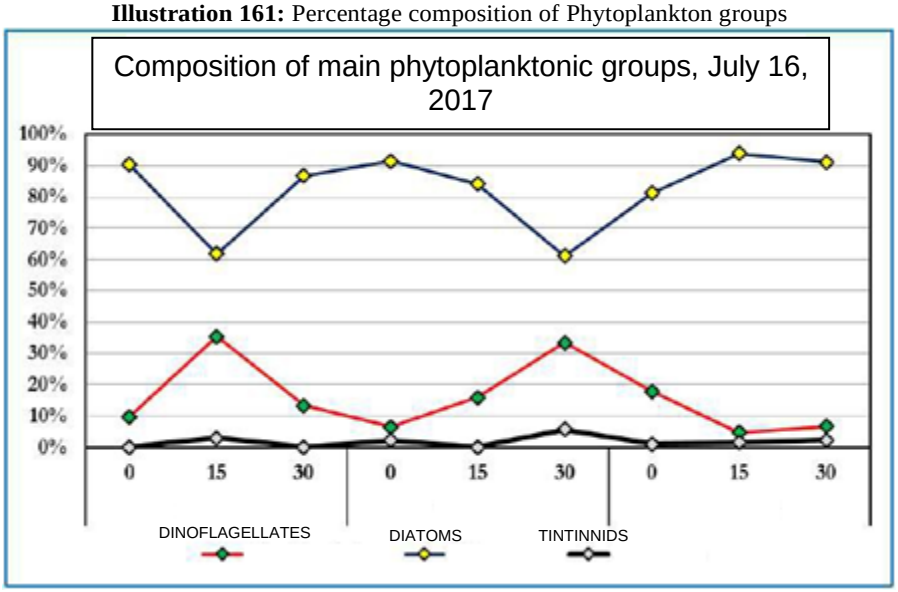
Major taxa	Genre/species	Point 1			Point 2			Point 3		
		0	15	30	0	15	30	0	15	30
DINOFLAGELLATES	*Protoperidinium sp1*	20	41	7	7	58	20	154	27	10
	Ceratium candelabrun	3	0	0	0	3	0	0	0	0
	Protoperidinium obtusum	0	0	0	0	7	0	9	0	0
	Ceratium falcatiforme	3	0	0	0	3	0	0	0	0
	Protoperidinium pentagonum	3	0	0	0	0	0	0	0	0
	Ceratium fusus	7	0	0	0	3	0	0	0	0
	Gonyaulux sp	3	0	0	0	0	0	0	0	0
	Dinophysis	0	0	0	0	3	0	5	0	0
	Dinophysis sp2		0	0	0	3	0	18	0	0
	Pyrophacus steinii	0	0	0	3	0	0	0	0	0
	Prorocentrum micans	34	0	0	0	51	0	45	10	0
	Noctiluca scintillans	0	0	0	0	0	0	14	7	0
DIATOMS	*Rhizosolenia delicatula*	51	3	0	20	41	0	27	17	7
	Rhizosolenia setigera	27	3	0	3	27	0	23	68	20
	Rizhosolenia hyalina	7	7	0	0	0	0	5	7	0
	Rhizosolenia alata	0	3	0	3	3	0	0	0	0
	Rhizosolenia acuminata	0	0	0	0	0	0	5	0	0
	Bacteriastrum hyalina	7	0	0	0	3	0	9	24	10
	Bacteriastrum elegans	10	0	0	0	10	0	5	0	0
	Chaetoceros curvisetus	10	0	0	0	24	0	41	17	3
	Chaetoceros peruvianus	0	0	0	0	0	0	9	0	0
	Chaetoceros costatus	14	0	3	0	14	0	9	7	0
	Chaetoceros affinis	34	0	3	3	75	0	109	58	3
	Coscinodiscus sp	7	0	0	0	0	0	0	3	0
	Aulacodiscus sp	27	14	17	31	17	7	41	10	14
	Coscinodiscus granu	0	3	0	0	0	7	0	0	0
	Coscinodiscus centralis	0	0	3	3	0	0	9	0	0
	Nitzschia sp	55	0	0	14	55	7	50	37	3
	Bacteriastrum sp	0	0	0	0	0	0	5	0	0
	Nitzchia pungens	102	7	0	0	85	0	123	112	20
	Stauroneis sp	0	0	0	3	0	0	5	0	0
	Navicula sp	0	3	0	0	0	0	0	0	0
	Pseudonitzchia sp	3	0	0	0	10	0	0	0	0
	Stephanopixis palmeriana	0	0	0	0	0	0	23	0	3
	Bidulphia mobiliensis	0	0	0	3	3	0	41	37	0
	Thalassiosira subtilis	58	10	3	14	51	0	45	89	14
	Climacodium biconcovus	7	0	0	0	0	0	0	24	0
	Bidulphia regia	0	0	0	0	0	0	91	41	0
	Amphora sp	7	0	3	0	0	3	0	0	3
	Bidulphia sinensis	3	0	0	0	0	0	0	0	0
	Thallasiotrix mediterranea	0	0	0	0	0	0	18	0	0
	Dictyota fibula	37	0	0	0	106	0	95	27	7

	Thalassionema nitzchoides	0	0	3	3	0	0	23	0	3
	Thallasiotrix fraenfeldu	3	0	0	0	0	0	5	0	0
	Lauderia Borealis	31	10	0	14	31	3	27	61	14
	Coscinocira polychorda	65	3	3	10	48	7	82	82	7
	Skeletonema costatum	48	0	0	3	37	3	50	37	0
	Hemiaulus sinensis	10	0	0	7	3	0	14	20	3
	Dytilum brigthwellu	17	0	0	0	20	0	27	41	0
	Ebria antigua	20	0	0	0	20	0	36	20	0
	Lithodesmiun undulatun	0	0	0	0	0	0	14	0	0
	Leptocilindricus danucum	34	3	0	10	24	0	59	44	0
	Cymbella sp	0	0	3	0	0	0	0	0	0
	Diploneis	0	0	0	0	0	0	0	0	3
TINTINNIDS	*Hemicostomella longa*	0	3	0	0	0	0	0	0	3
	Favella sp	0	0	0	3	0	3	14	3	0
	Amphorelopsis sp	0	0	0	0	0	0	0	7	0
	Favella campanula	0	0	0	0	0	0	0	3	0
UNIDENTIFIED	Mushroom	0	0	0	0	0	3	0	0	0

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

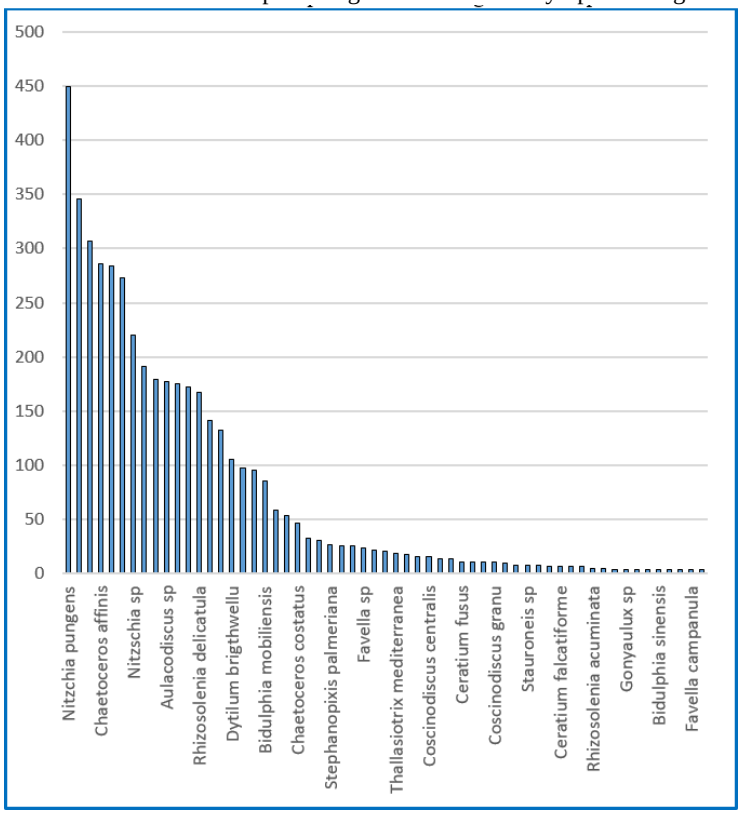
The percentage composition of these three groups appears in the following figures, the total percentage composition of species registered in the area appears. The richness, abundance, and Phytoplankton distribution appear in the 3 stations analyzed in 3 depth strata: 0, 15, and 30m.

Illustration 161: Percentage composition of Phytoplankton groups



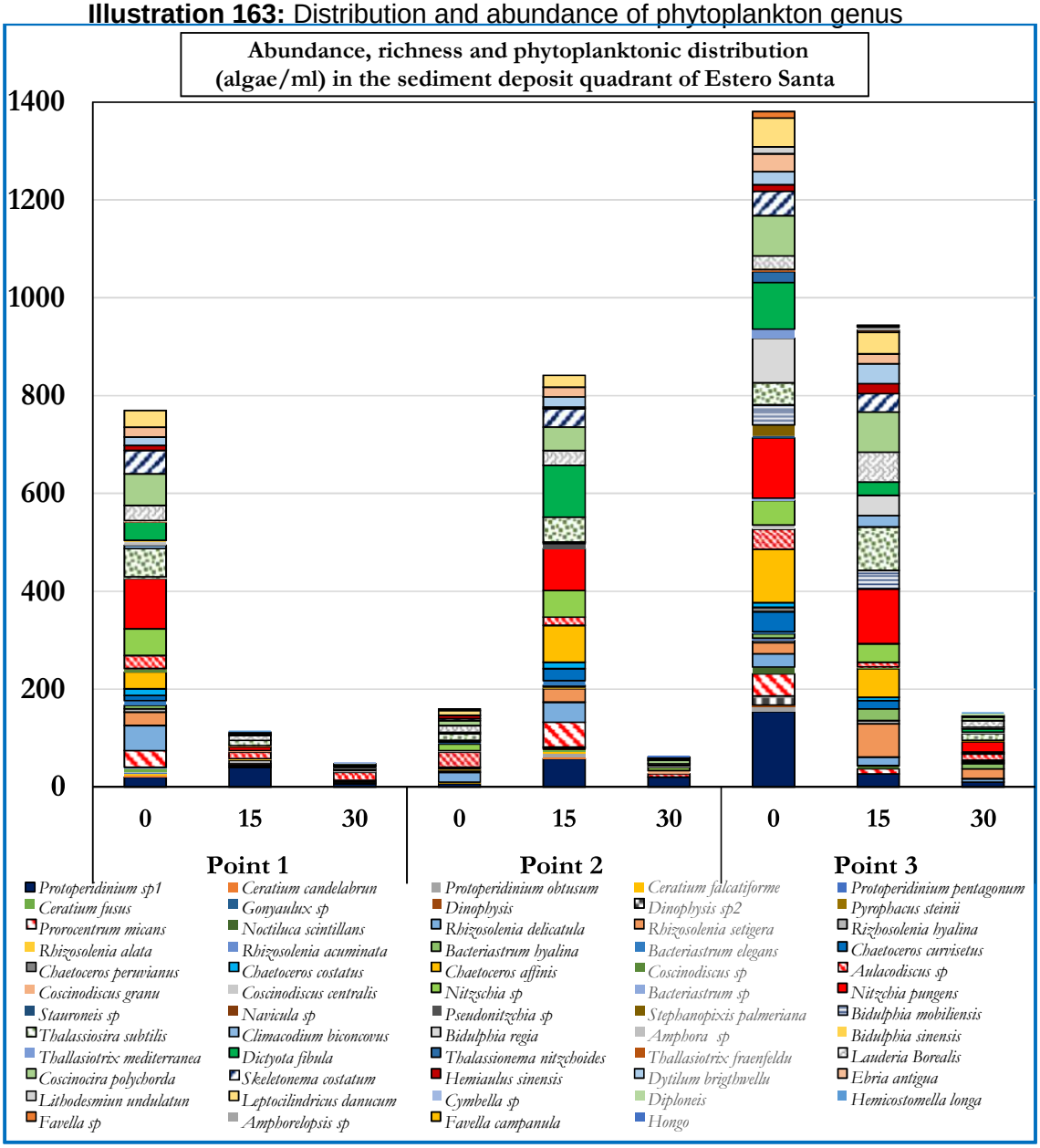
Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

Illustration 162: Total percentage abundance of Phytoplankton genus



Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

Illustration 163: Distribution and abundance of phytoplankton genus



Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

In the previous figure, an increase in the population of algae is observed as the tide begins to go down, a situation that coincided in point 3 that exhibited the highest concentration of algae; the ecological descriptions of the Phyto-planktonic community appear in the following table:

Table 139: Ecological descriptions of the Phytoplankton community

Descriptive	Point 1			Point 2			Point 3			Total Quadrant
	0m	15m	30m	0m	15m	30m	0m	15m	30m	
Wealth	33	14	10	19	30	10	39	29	19	59
abundance	770	116	51	160	842	65	1381	944	153	4483
Dominance_D	0,06	0,17	0,16	0,09	0,06	0,16	0,05	0,06	0,08	0,05
Simpson_1-D	0,94	0,83	0,84	0,91	0,94	0,84	0,95	0,94	0,92	0,95
Shannon_H	3,08	2,21	2,08	2,65	2,97	2,09	3,23	3,03	2,72	3,30
Evenness_e^H/S	0,66	0,65	0,80	0,74	0,65	0,81	0,65	0,71	0,80	0,46
Brillouin	2,99	2,02	1,81	2,45	2,89	1,86	3,16	2,96	2,51	3,27
Menhinick	1,19	1,30	1,40	1,50	1,03	1,24	1,05	0,94	1,53	0,88
Margalef	4,81	2,74	2,29	3,55	4,31	2,16	5,26	4,09	3,58	6,90
Equitability_J	0,88	0,84	0,90	0,90	0,87	0,91	0,88	0,90	0,92	0,81
Fisher_alpha	7,01	4,17	3,72	5,61	6,08	3,31	7,46	5,66	5,71	9,60
Berger-Parker	0,13	0,35	0,33	0,19	0,13	0,32	0,11	0,12	0,13	0,10

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

When observing the ecological descriptions of the Phyto-planktonic community, we see that it does not present a very high diversity except for the surface sample of point 3 that presented the highest number of genera present, as well as the highest abundance and diversity according to the Shannon and Margalef indices, according to the first (Shannon) when considering all the study data we would have a moderate diversity 3.3 in the quadrant, however, according to Margalef there would be a high diversity because it exceeds 5.

PLANKTON QUALITATIVE ANALYSIS

The masses recorded with a semi-analytical balance of two planktonic fractions are then observed after dragging a bongo-type net for 5 minutes. It shows higher planktonic productivity in the coastal sector of the quadrant.

Table 140: Biomass of collected planktonic fractions

Station	Mass > 60 µm (gr)	Mass > 300 µm (gr)	Total Biomass (gr)
Trawling 1	3,207	6,830	10,037
Trawling 2	5,298	8,197	13,495

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

In the table below, counts are observed in a Bogorov chamber where the abundance of individuals counted in a fraction of the sample is extrapolated to each trawl's total biomass for the fraction greater than 300 microns or zooplankton.; The ecological descriptions of the fractions surveyed from both trawls appear in the following table.

Table 141: Zooplankton analysis

PLANKTONIC FRACTION GREATER THAN 300 MICRONS	Trawling 1				Trawling 2			
	Analyzed fraction (gr)	Biomass Trawling (gr)	Counted Ind	Total estimate sample	Analyzed fraction (gr)	Biomass Trawling (gr)	Counted Individuals	Abundance estimative
Copepods	0,163	6,8303	165	6914	0,4425	8,1965	430	7965
Decapod larva			80	3352			120	2223
Chaetognatos			130	5447			180	3334
Amphipods			10	419			5	93
Fish larva1							4	74
Appendicularia			2	84			6	111
Salted			3	126			1	19
Hydromedusa			1	42			2	37
Fish eggs			21	880			81	1500
Young crab							2	37

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
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Table 142: Ecological descriptions of the zooplankton community

Descriptive	Trawling 1	Trawling 2	Total
Wealth	8	10	10
Abundance	412	831	1243
Dominance_D	0,3009	0,3451	0,3242
Simpson_1-D	0,6991	0,6549	0,6758
Shannon_H	1,367	1,308	1,346
Evenness_e^H/S	0,4904	0,3698	0,3841
Brillouin	1,332	1,286	1,329
Menhinick	0,3941	0,3469	0,2836
Margalef	1,163	1,339	1,263
Equitability_J	0,6574	0,568	0,5844
Fisher_alpha	1,408	1,599	1,486
Berger-Parker	0,4005	0,5174	0,4787

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

The photographic record of observed beings appears in Annex 2, Planktonic Zoo Catalog.

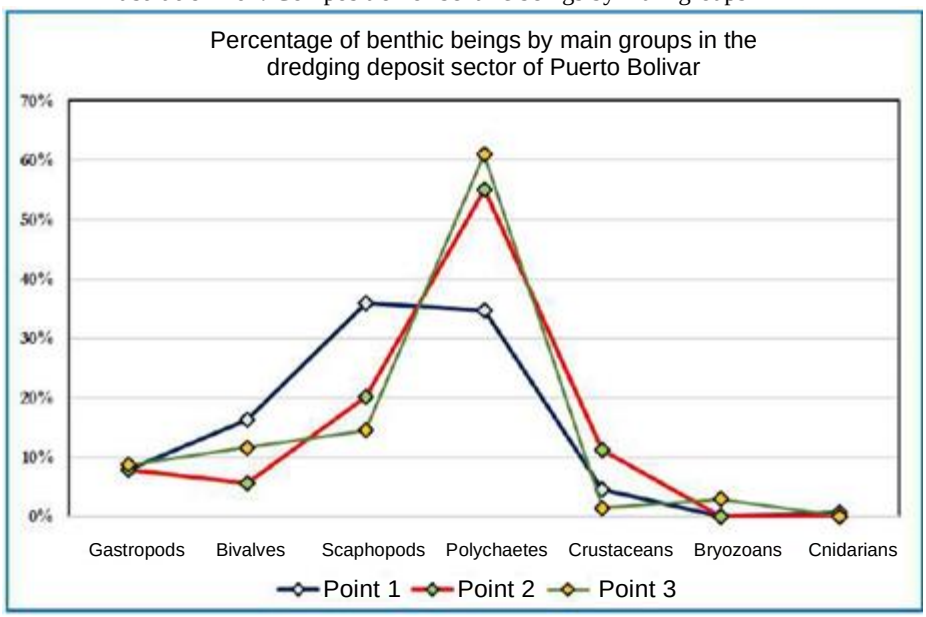
The ecological descriptions of this community are not favorable, showing conditions of a sector with great disturbances, and that does not represent reality, in fact, at the international level, the bioindicator role of zooplankton is questioned; however, a greater zooplankton abundance is evident at low tide, corresponding to drag 2 that exhibited more life forms and numerical abundance.

BENTONIC COMMUNITY

In 3 samples of dredging obtained with the Van Been dredge within the polygon where the Puerto Bolívar dredging was unloaded, a total of 311 benthic beings belonging to 44 genera/species were found, showing a community structure of soft bottoms where polychaetes and scaphopods turned out to be dominant groups.

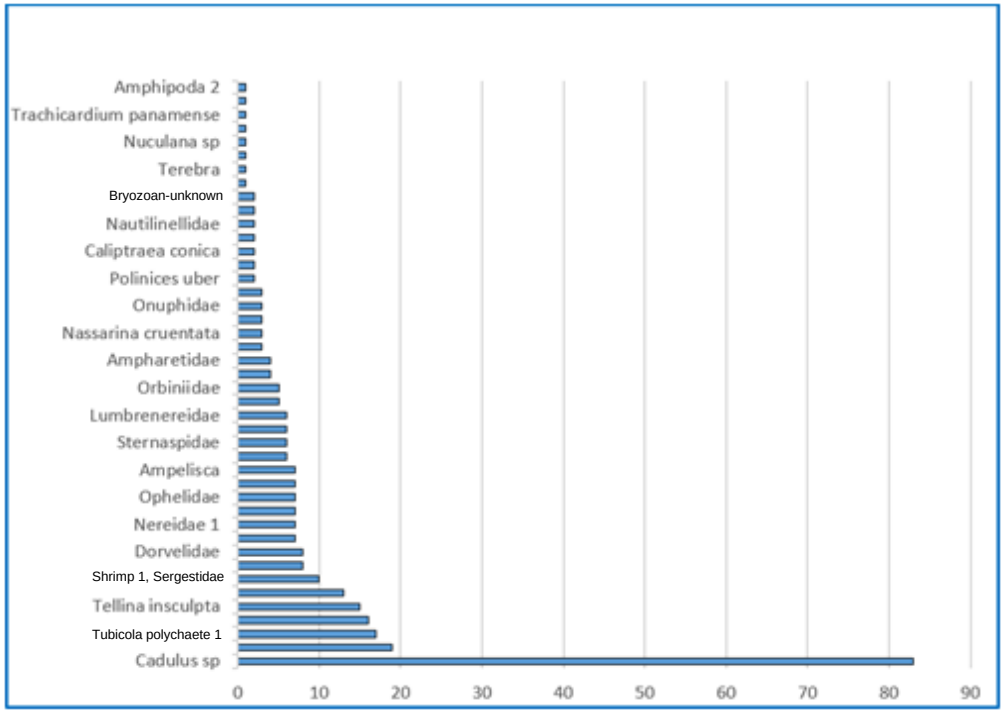
The abundance of the genus found by the analysis station is observed in the following table, the percentage composition of the total of specimens counted appears in the following figure, and their distribution among the 3 stations appears in the figure.

Illustration 164: Composition of benthic beings by main groups



Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

Illustration 165: Percentage of accumulation of benthic beings in quadrant



Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

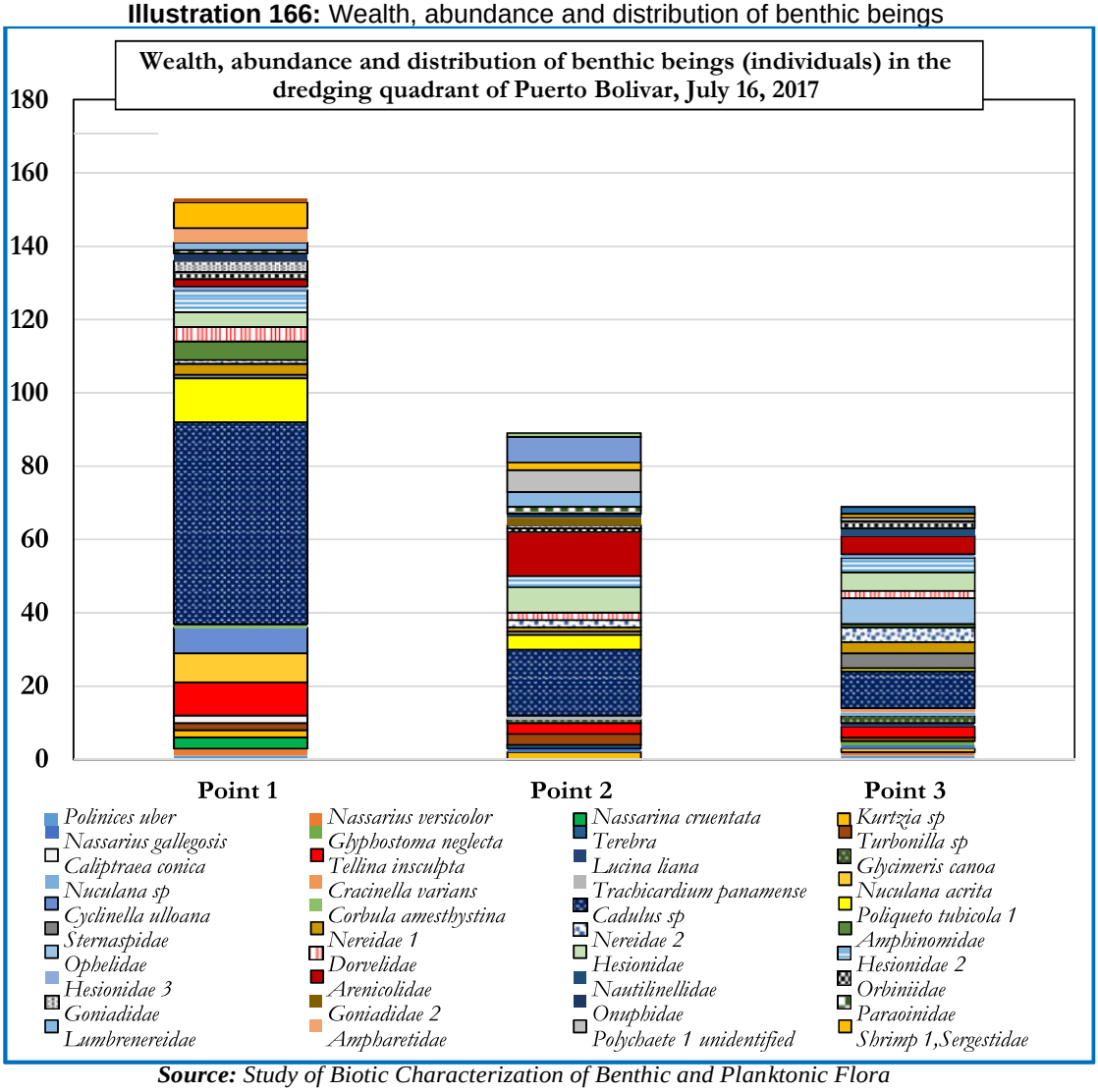
Table 143: Community of benthic beings collected in the quadrant

	Phyllum	Class	Family/Genus/species	Point 1	Point 2	Point 3
1	Mollusca	Gastropoda	*Polynices uber*	1		1
2			*Nassarius versicolor*	2		1
3			*Nassarina cruentata*	3		
4			*Kurtzia sp*	2	2	1
5			*Nassarius gallegosis*		1	1
6			*Glyphostoma neglecta*			1
7			*Terebra*		1	
8			*Turbonilla sp*	2	3	1
9			*Caliptraea conica*	2		
10			*Tellina insculpta*	9	3	3
11			*Lucina liana*			1
12			*Glycimeris canoe*		1	2
13			*Nuculana sp*			1
14			*Cracinella varians*			1
15			*Trachicardium panamense*		1	
16			*Nuculana acrita*	8		
17			*Cyclinella ulloana*	7		
18			*Corbula amesthystina*	1		
19		Scaphopoda	*Cadulus sp*	55	18	10
20	Annelida	Polychaete	*Tubicola polychaete 1*	12	4	1
21			*Sternaspidae*	1	1	4

	Phyllum	Class	Family/Genus/species	Point 1	Point 2	Point 3
22			*Nereidae 1*	3	1	3
23			*Nereidae 2*	1	2	4
24			*Amphinomidae*	5		1
25			*Ophelidae*			7
26			*Dorvelidae*	4	2	2
27			*Hesionidae*	4	7	5
28			*Hesionidae 2*	6	3	4
29			*Hesionidae 3*	1		1
30			*Arenicolidae*	2	12	5
31			*Nautilinellidae*			2
32			*Orbiniidae*	2	1	2
33			*Goniadidae*	3	1	
34			*Goniadidae 2*		2	
35			*Onuphidae*	2	1	
36			*Paraoinidae*	1	2	
37			*Lumbrenereidae*	2	4	
38			*Ampharetidae*	4		
39			*Polychaete 1 unidentified*		6	1
40	Arthropoda Crustacea	Decapoda	*Shrimp 1, Sergestidae*	7	2	1
41		Amphipod	*Ampelisca*		7	
42			*Amphipoda 2*		1	
43	Bryozoa		*Bryozoan-unknown*			2
44	Cnidaria		*Anthozoa*	1		
				153	**89**	**69**

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

Illustration 166: Wealth, abundance and distribution of benthic beings



Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

The photographic catalog of identified species can be seen in the document Annex 3, Benthic Catalog.

The ecological descriptions of the benthic community of the 3 points analyzed are observed, it reveals considerable differences in the type of bottoms despite having very similar depths, point 1 at the time of dredging had a depth close to 35 m as it was necessary to notch one more line after 30m that the dredger had in place, the second point showed a depth of 30.47m and the third point a depth of 31.5m according to the depth sensor of the CTD EXO2 with which the recorded variables of the water column.

Table 144: Ecological descriptions of the benthic community

	Point 1	Point 2	Point 3	Total
Wealth	29	26	28	44
Abundance	153	89	69	311
Dominance_D	0,1532	0,08774	0,0628	0,09325
Simpson_1-D	0,8468	0,9123	0,9372	0,9068
Shannon_H	2,61	2,813	3,033	3,092
Evenness_e^H/S	0,4691	0,6407	0,7412	0,5003
Brillouin	2,35	2,447	2,557	2,873
Menhinick	2,345	2,756	3,371	2,495
Margalef	5,566	5,57	6,377	7,492
Equitability_J	0,7752	0,8634	0,9101	0,817
Fisher_alpha	10,6	12,35	17,54	13,99
Berger-Parker	0,3595	0,2022	0,1449	0,2669
Chao-1	31,33	32,43	43,17	48,5

Source: *Study of Biotic Characterization of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna*
Location: *Province of El Oro*
Date: *July 16, 2017*

The ecological descriptions used contradict themselves slightly when contrasting the evaluations of Shannon Weiner versus Margalef, the first accusing an acceptable diversity exclusively in the third point, while both stations 1 and 2 show levels that would show an intermediate disturbance, Margalef instead shows values that they exhibit high diversity at all points.

Although the ecological indicators show better indices in the most coastal sector of the quadrant, an important criterion to consider is the biomass reflected in the abundance of beings; from this point of view, it is considered more sensitive to the sector that is more distant from the coast towards the Santa Clara Island which also holds the category of Wildlife Refuge.

Faced with this dilemma, the AMBI-AZTI software developed by the University of the Basque Country was used. The benthic species' population data are entered, categorized into 5 sensitivity groups, and related to their abundance, allowing the Marine Biotic Index calculation. , synonymous with environmental quality and that evolved from the Benthic Index of Biotic Integrity.

The AMBI index allows classifying the environmental quality of a particular area on a scale from 0 (normal) to 7 (azoic) calculated based on the categorization of the benthic macrofauna species present in five ecological groups according to their degree of sensitivity. environmental stress (Borja, A., J. Franco, V. Pérez, 2000)

Pollution classification based on the biotic coefficient

Pollution Classification	Biotic coefficient	Biotic Index	Dominant ecological group	Benthic Community Health
Without pollution	0.0 < BC ≤ 0.2	0	I	Normal
Without pollution	0.2 < BC ≤ 1.2	1		Impoverished
Slightly polluted	1.2 < BC ≤ 3.3	2	III	Unbalanced
Contaminated	3.3 < BC ≤ 4.3	3		Transition to
Contaminated	4.5 < BC ≤ 5.0	4	IV - V	contamination
Heavily polluted	5.0 < BC ≤ 5.5	5		Contaminated
Heavily polluted	5.5 < BC ≤ 6.0	6	V	Transitional to high pollution
Extremely polluted	Lifeless	7	Azoic	High Pollution

Source: *Borja, A., J. Franco, V. Pérez, 2000*

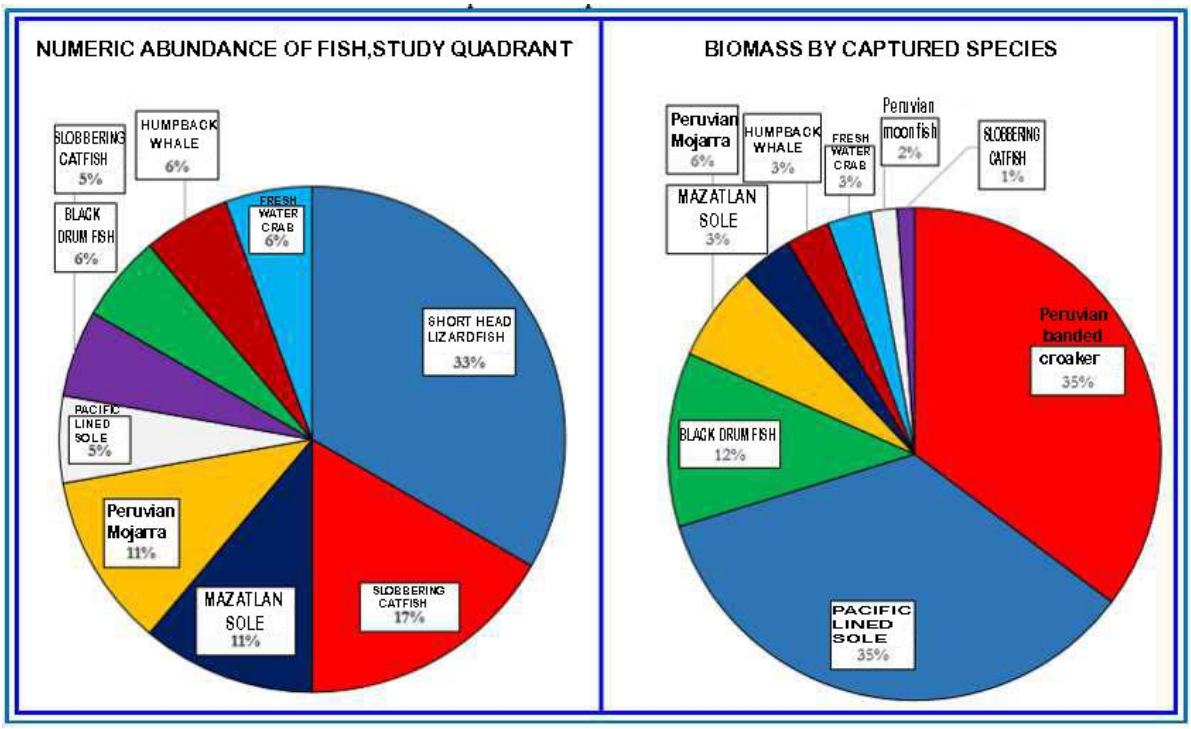
Station 1 gave a value of 1,298, station 2 gave 1,615, and finally, station 3 had a value of 1,722. Based on the categorization of the AMBI software Developer (Dr. Angel Borja), this result falls into Category III, which ranges from 1.2 to 3.3 of the Biotic Coefficient. (Borja, A., J. Franco, V. Pérez, 2000). Therefore, applying this categorization, the Altamar site classification is Slightly Contaminated, where the benthic community's health is Unbalanced.

ICTIOLOGICAL COMMUNITY

In the 3 sets of one hour each, 18 pieces were achieved that yielded biomass of 8.74 Kg, which gives an average CPUE of 2.91 ± 3.295 Kg/hour.

In the 3 sets, 8 different species of fish and a crustacean (a crab) were caught; the percentage composition of pieces collected and biomass achieved is observed in the following figures:

Figure 167: Total capture description in the study quadrant



Source: *Biotic Characterization Study of Benthic and Planktonic Flora and Fauna, Sea Mammals and ichthyofauna*
Location: *El Oro Province*
Date: *July 16, 2017*

The fish community captured is typical of the coastal soft bottom sectors. None of the captured species are considered as part of reefs or rocky bottoms near Santa Clara Island.
Only two lances resulted in success. The first lace that met the maximum high tide did not result in any captured species, which would be attributed to the temporary calmed water. The fishes detect better the gill net.

Once the water started to move, the art resulted effectively and achieved the captures detailed in the table below, and the achieved captures' ecological descriptions.
The photographic record of the captured fishes appears in the attached document.

Table 145: Detail of the fish captures in the quadrant that shall receive dredging of P*uerto* Bolivar

FISHING RESOURCES		Lance 1		Lance 2		Lance 3		Total	
Common name	**Scientific name**	**n**	**Biomass**	**n**	**Biomass**	**n**	**Biomass**	**n**	**Biomass**
Shorthead lizardfish	*Synodus scitulicep*			2	1.2	4	1.86	6	3.06
Pacific lined sole	*Achirus mazatlanicu*			1	0.1	1	0.2	2	0.3

Peruvian moonfish	*Selene peruviana*			1	0,15			1	0,15
Peruvian mojarra	*Diapterus peruvianus*			2	0,55			2	0,55
Steindachner's sea catfish	*Cathorops steindachneri*					1	0,1	1	0,1
Panama kingfish	*Menticirrhus panamensis*					1	1	1	1
Peruvian banded croaker	*Paralonchurus peruanus*					3	3,08	3	3,08
Hairfin lookdown	*Selene brevoortii*					1	0,25	1	0,25
Blue crab	*Callinectes*			1	0,25			1	0,25
	Subtotals			**7**	**2,25**	**11**	**6,49**	**18**	**8,74**

Source: *Biotic Characterization Study of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna.*
Location: *El Oro Province*
Date*: July 16, 2017*

Table 146: Ecological descriptions of the ichthyological community in the study quadrant

Descriptions	Lance_2	Lance_3	Total
Richness	5	6	9
Abundance	7	11	18
Dominance_D	0,2245	0,2397	0,179
Simpson_1-D	0,7755	0,7603	0,821
Shannon_H	1,55	1,594	1,956
Evenness_e^H/S	0,9421	0,8207	0,7857
Brillouin	1,02	1,139	1,48
Menhinick	1,89	1,809	2,121
Margalef	2,056	2,085	2,768
Equitability_J	0,963	0,8897	0,8902
Fisher_alpha	7,824	5,403	7,163
Berger-Parker	0,2857	0,3636	0,3333
Chao-1	6	12	12,33

Source: *Biotic Characterization Study of Benthic and Planktonic Flora and Fauna, Marine Mammals and Ichthyofauna.*
Location: *El Oro Province*
Date*: July 16, 2017*

As shown in the table above, the diversity of fish in the study area is not high. It approaches the limits of marine areas with poor ecological conditions; at this point, it is important to mention the bias that has this community widely exploited, being rather a synonym of biological productivity (fishing).

It is estimated that there is an artisanal fishing fleet of more than 1000 vessels in the Jambeli channel and archipelago that operates mainly with nets of different mesh sizes,

they are replaced according to the season and the resources to be exploited.

CONCLUSIONS OF THE BIOTIC CHARACTERIZATION OF PLANT, BENTHIC, MARINE MAMMAL AND ICHTHYOFAUNA FLORA AND FAUNA OF THE OFFSHORE DEPOSITION AREA

The quadrant where the dredged material from the access channel and maneuvering area of Puerto Bolivar would be deposited is a sector where oceanic waters and coastal waters are conjugated at the sway of the tide, a situation that was confirmed by profiling physical-chemical variables in the water column and analyzing the abundance of phytoplankton using the Utermohl method.

At the first sampling point, offshore, coincided with the high tide time and had saltier water with lower primary productivity that is more inclined to oceanic conditions; in less than an hour after a short navigation time towards the coast at point 2 there was lower surface salinity water, the same trend occurred closer to the coast and performed the analysis at point 3, where the water in terms of phytoplankton abundance proved to be much more productive.

The dynamics of tidal currents that occur in the middle of the mouth of the Guayas River outlet allow inferring an active sediment movement given its intermediate depth and possibly during the dredging discharge work; it coincides with seasons of high rainfall that would increase turbidity, suspended solids and sediment movement on the bottom naturally, a situation that would favor the dredging deposit as it would mask the turbidity plume that could be generated at the time of unloading the dredged material and would contribute to disseminate the unloaded material on the seabed.

The dredge to be used has gates in its living work that, when opened, let fall a rain of sediments to a depth of 6 meters (dredge draft) intermediate depth between the surface and the thermocline if conditions similar to those existing on July 16, 2017, were given, here the turbulent mixture would be visible on the surface but will be scattered by local currents disappearing as it sinks and is diluted. It is clear that this process would temporarily diminish the planktonic community, but this effect will be of noticeably short duration as the planktonic community in the open ocean renews itself instantaneously.

The benthic community of the reference quadrant where the dredged material will be deposited exhibits good ecological indicators in terms of richness according to the Margalef index, averaging 5.837, which is interpreted as a sector of high diversity, however its Shannon index averages a mean H' value of 2, 818, which is interpreted as a sector of intermediate diversity that shows disturbances, but these would not be drastic, a situation corroborated by the AMBI index that averaged a value of 1.545, based on the categorization of the AMBI software developer (Dr. Angel Borja), this result falls in Category III ranging from 1.2 to 3.3 of Biotic Coefficient, classifying the offshore deposition site as Slightly Contaminated. *(Borja, A., J. Franco, V. Pérez, 2000)*

Although this community's indicators do not place it as a degraded site, it shows indicators much lower than nearby benthic communities present in the vicinity of the gas platforms of the shore of the Amistad Field and Santa Clara Island.

In general terms, the ecological status of the marine water body in the quadrant that will receive the dredging is acceptable, it is not bad, nor can it be considered a pristine sector because it is influenced by the largest population settled on the coastal edge of continental Ecuador (Guayas and El Oro).

Therefore, it is of great importance to observe the fluctuations that occur both in the physical-chemical parameters of the water column and in its associated communities, when the maneuvers are initiated to understand it correctly, only in this way will it be possible to dimension the local effect of the deposit of dredged material, Without discarding even the probability of favorable events such as temporary increases in benthic diversity because depositing solid material such as gravel and pebbles would increase the availability of new hard-bottom habitats that would, in turn, allow greater biological encrustation processes that would result in the diversity and productivity of the sector.

RECOMMENDATIONS OF THE BIOTIC CHARACTERIZATION OF PLANTONIC, BENTHIC, MARINE MAMMAL AND ICHTHYOFAUNA FLORA AND FAUNA OF THE OFFSHORE DEPOSITION AREA

- Ecological monitoring at the offshore sediment deposition site during the dredging of the access channel and maneuvering zone of Puerto Bolivar at the frequency stipulated in the Environmental Management Plan approved by the Environmental Authority.
- Conduct research in the local environment of the area receiving the dredged material to assess its similarity to the predecessor benthic community and for such research to be used to understand future dredging.

6.2.7.- DETERMINATION OF MEAN LETHAL CONCENTRATION IN SHRIMP LARVAE

As part of the Environmental Impact Assessment for the dredging of the piers, maneuvering area, and access channel, an ecotoxicological study was conducted to determine the degree of toxicity in shrimp postlarvae using a study of mean lethal concentration with the sampling of suspended sediments in the dredging area.

- **PLACE OF PERFORMANCE**

  The studies were carried out at the Phytoplankton Laboratory of the Faculty of Agricultural Sciences of the Technical University of Machala,

considering the methodology for determining the Mean Lethal Concentration (CL50-96-168), it was applied to *Litopenaeus vannamei* shrimp postlarvae.

❖ MATERIALS

LABORATORY MATERIALS

- 1000 ml Precipitation vessel
- 100 ml flask
- Gloves
- Control sheets
- Precision balance
- Multiparameter YSI Pro DSS
- 1ml measuring pipettes
- Aquariums
- Aerators
- Hoses
- Diffuser stones
- 40 aquariums of 2 lts/cap.

BIOLOGICAL MATERIALS

- 1000 shrimp post larvae (*Litopenaeus vannamei*)

REAGENTS

- Distilled water
- Buffer solution

❖ METHODS

FIELD METHODOLOGY

1,000 post-larvae of shrimp Litopenaeus vannamei, in stages between Pl. 12, were acquired thanks to the collaboration of the BIOFONS and PANEMA larvae laboratory at the El Coco Site, which was subjected to the respective packaging with oxygen and activated carbon; and later transferred to the Phytoplankton Laboratory of the FCA-UTMACH for their respective acclimatization. For the execution of the bioassays, the methodology for estimating the Mean Lethal Concentration (LC50-96) was considered, combined with the norms and protocols approved by the Environmental Protection Agency (EPA) of the United States of America.

The shrimp post larvae *Litopenaeus Vannamei*, once transferred to the Phytoplankton Laboratory, were placed in a 20-liter plastic container. Simultaneously, aeration was installed for their adaptation and acclimatization to be subjected to the bioassay.

According to their biomass and size, the shrimp post-larvae were acclimatized and fed with a balanced diet, and live food, such as Artemia Salina, was provided to enhance their quality. The parameters that allowed the organisms' survival and quality were considered to carry out this research.

Method of Estimation of the Mean Lethal Concentration (CL50)

By the CL50-96 estimation method, the number of post-larvae shrimp Litopenaeus vannamei surviving at concentrations somewhat above and below the estimated limit for LC50 was recorded. Daily reports of the information were kept, later tabulated by the Probit method, identifying the impact of suspended sediments on shrimp post larvae with a simulation of dredging of the access channel to Puerto Bolivar. Initially, the test post-larvae were sought in the different larvae laboratories of the sector, which due to the great demand of the shrimp sector, almost all of them were recently planted, so they had to go through all of them to have the respective organisms and develop the necessary tests for the selection of the tank.

From the larval laboratories visited, one was selected with the best specimens of shrimp post-larvae *Litopenaeus vannamei* "in situ", ensuring, as far as possible, uniformity in size, good health, gill development, without protozoa, among other observations, and proceeding to acclimatize them in their physical-chemical and biological parameters so that there are no immediate mortalities due to animal stress and the bioassay will be altered.

Once the shrimp larvae used in this study are wholly acclimatized to the laboratory conditions imposed, they were transferred to the 40 2-liter aquaria used for the sensitivity bioassays. Each of the aquariums was filled with 1 liter of water with suspended sediments and whose physicochemical and biological characteristics would be similar to those of the dredged water in the Puerto Bolivar Access Channel, taking into consideration each of the treatments developed in this study.

The preparation of concentrations was carried out from the standard solution prepared with suspended sediments from the areas to be dredged, using the different concentrations in post-larvae of shrimp *Litopenaeus vannamei* in the different aquariums, applied with the treatments evaluated in this research.

For this purpose, suspended sediments were prepared in concentrations of 0%, 10%, 50%, and 100% in laboratory conditions, the same ones used in the present sensitivity study with shrimp post-larvae for 96 hours, with 2 repetitions and in the five sampling points.

After preparing the different concentrations of sediments from the sites where the dredging of the access channel to Puerto Bolivar will take place, they were filled with water of the same salinity as the larvae, that is, 22 ppt, each aquarium was homogenized, and oxygen added so that the solids would be in constant suspension.

Subsequently, 10 shrimp larvae of the species *Litopenaeus vannamei*, chosen from among those in good condition, were carefully transferred into the acclimatization container to finally be placed in each of the aquariums in the different treatments and control.

❖ SAMPLING POINTS

Table 147: Sampling Points

Puerto Bolivar Access Channel Sampling Point	Sampling Points Code	TREATMENTS			
		0%	10%	50%	100%
In front of Liceo Naval	AD2 R1	1	2	3	4
	AD2 R2	5	6	7	8
In front of Isla del Amor	AD3 R1	9	10	11	12
	AD3 R2	13	14	15	16
In front of the entrance to El Coco Spa	AD4 R1	17	18	19	20
	AD4 R2	21	22	23	24
In front of Punta El Faro Jambeli	AD5 R1	25	26	27	28
	AD5 R2	29	30	31	32
In front of the entrance Jambelí	AD6 R1	33	34	35	36
	AD6 R2	37	38	39	40

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

❖ APPLIED LABORATORY METHODOLOGY

ESTIMATION OF THE SENSITIVITY OF SIMULATED DREDGING OF THE ACCESS CHANNEL TO PUERTO BOLIVAR

For the present study, 40 glass aquariums were used, in which each treatment would have two replicates, including the control, to obtain a good evaluation. After filling the containers, post-larvae shrimp were placed in each of the bioassays, where the solutions were previously applied in their different concentrations of suspended sediments. Simultaneously, dissolved oxygen and pH parameters were monitored to verify the impact of suspended sediments on water quality.
Once the research results were obtained, the respective statistical analyses carried out to estimate the Mean Lethal Concentration (MLC) (CL50-96).

ESTIMATION OF RESULTS

The estimation of the Mean Lethal Concentration CL50 was achieved by monitoring the animals' biological behavior subjected to the test. Observations regarding the number of surviving post-larvae shrimp were made at 24, 48, 72, and 96 hours, respectively, in each treatment.
From the standard solution of suspended sediment concentration, the amounts specified above were dosed at different concentrations. Complementary aeration was also provided so that the oxygen levels would not affect the monitoring of the possible contaminating agent in the *Litopenaeus vannamei* shrimp postlarvae

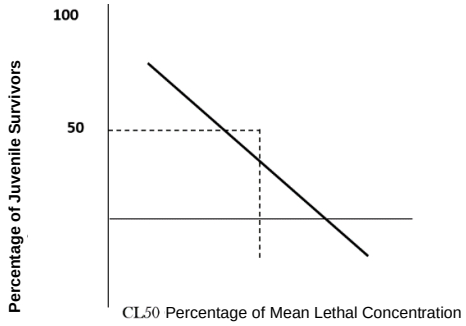
and to maintain the sediments in suspension during the sensitivity tests.
The observations regarding the number of surviving shrimp larvae were made after the respective exposure periods were completed to determine in which period the contaminant affected 50% of the shrimp monitored and obtain a statistical database that allows us to evaluate their sensitivity better.

EVALUATION

From the mortality obtained in this ecotoxicological study, the respective LC50-96 values were extrapolated at the times and conditions specified by the test, comparing the results obtained and interpreting the toxicity of suspended sediments and the level of incidence by dredging action on post-larvae of shrimp *Litopenaeus vannamei* simulated in the access channel to Puerto Bolivar.

RESULTS CHART

To plot results at 24, 48, 72, and 96 hours of testing, the numbers of surviving shrimp post-larvae at each concentration (0%, 10%, 50%, and 100%) were taken their percentage of survival calculated. These results were interpolated with the concentration value so that each survival percentage corresponded to the concentration at which the shrimp post larvae survived.



EXPERIMENTAL DESIGN

The Mean Lethal Concentration (LC50-96) was plotted on semilogarithmic paper, the experimental data with the test concentrations on the logarithmic scale, and the percentages of survivors on the arithmetic scale.
The Mean Lethal Concentration (LC50-96) resulted from plotting the intercept between the 50 % of survivors with the plotted line, to which corresponded a value on the logarithmic scale.
The bioassay results were compiled in a notebook and entered into the Excel program, and the corresponding calculations were made. The results were statistically analyzed by applying the PROBIT Analysis method to determine the Mean Lethal Concentration (CL50).

STATISTICAL ANALYSIS

The statistical analysis applied in the present ecotoxicological study was Probit analysis.

DESCRIPTION OF THE PROBIT ANALYSIS

Probit analysis is a type of regression used to analyze binomial response variables. It transforms the sigmoid dose-response curve to a straight line that can be analyzed by least squares or maximum likelihood regression. Different techniques can perform probit analysis:

- Use of tables to estimate the Probit.
- Calculation of the Probit, regression coefficient, and confidence intervals.
- Having a statistical package such as SPSS

Many computer programs calculate this value (Probit, logit, binomial, trinnedSpearmanXarber

STEPS TO PERFORM PROBIT ANALYSIS

a) Set up a Probit calculation table.
b) Enter the concentrations to transform it into logarithm 10.
c) Enter the numbers of organisms used at each concentration.
d) Enter the numbers of dead organisms at each concentration.
e) Calculate the percentage of mortality.
f) Use the Probit table.
g) Calculate the Mean Lethal Concentration (LC50) using the graphical method.

ESTIMATION OF THE MEDIAN LETHAL CONCENTRATION (CL50)

We apply the logarithmic transformation in each volume of the standard solution; then, we assign the Probit value from tables concerning each treatment's mortality percentage. (See Annex 10)

❖ RESULTS AND DISCUSSION

SHRIMP POST LARVAE SURVIVAL DURING THE SENSITIVITY TEST WITH POINT 2 SUSPENDED SEDIMENTS

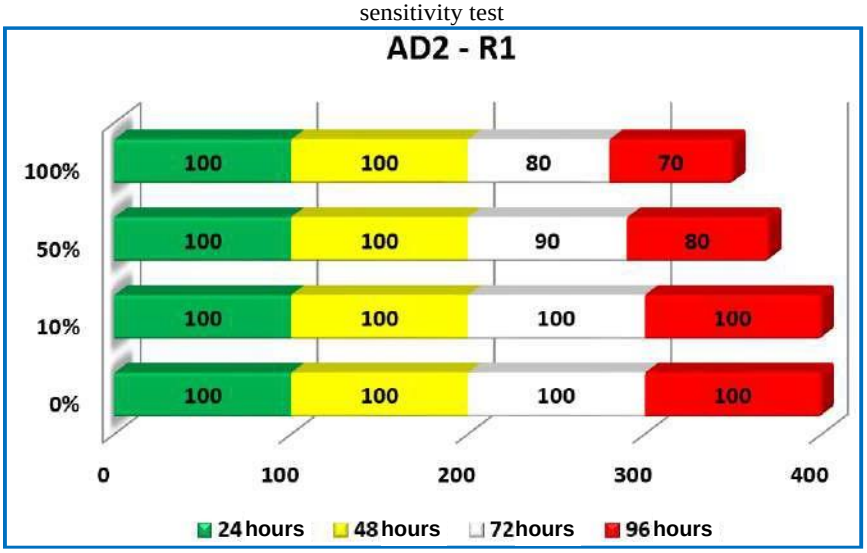
For this treatment, the post-larvae were in optimal conditions, acclimatized, most of the larvae were strong and resisted the impact of suspended sediments, the same that occurred in more significant quantity from the replicates where 100% concentrations were applied in the final test.

Table 148: Survival of shrimp post larvae AD2-R1 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	90	80
100%	10	100	100	80	70

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Figure 168: Survival of shrimp post larvae AD2-R1 sensitivity test



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 149: Determination of LC50-96 of Suspended Sediments by Probit Replicate 1

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	8	2	20	20	4,16
100	2.000	7	3	30	30	4,48

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in Replicate 1, we evidenced that the different concentrations of suspended sediments applied in shrimp post larvae *Litopenaeus vannamei*, **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used, and it is determined as of little significant impact, the same that reaches 30% in 96 hours, which is considered low.

REPLICATE 2 IN POST LARVAE OF SHRIMP *Litopenaeus vannamei* WITH SEDIMENTS FROM POINT AD2

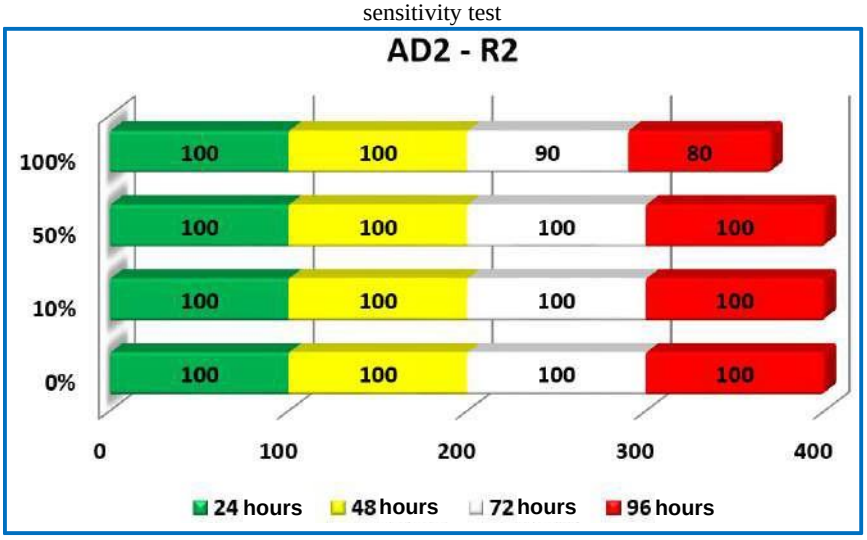
Table 150: Survival of post larvae suspended sediment concentrations in the AD2-R2 sensitivity test.

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	100	100

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The illustration shows the survival of *Litopenaeus vannamei* shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 2 of Point AD2

Figure 169: Survival of shrimp post larvae AD2-R2 sensitivity test



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 151: Determination of LC50-96 of Suspended Sediments by means of Probit in AD1-RA final test

Conc. original %	Log 10 Conc.	Total of Indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	1	10	10	3,72
100	2.000	10	2	20	20	4,16

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in Replicate 2-AD2, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having a low significant impact, which reaches 20% in 96 hours, which is considered low.

AVERAGE SURVIVAL RATE BY APPLYING SUSPENDED SEDIMENTS POINT AD2

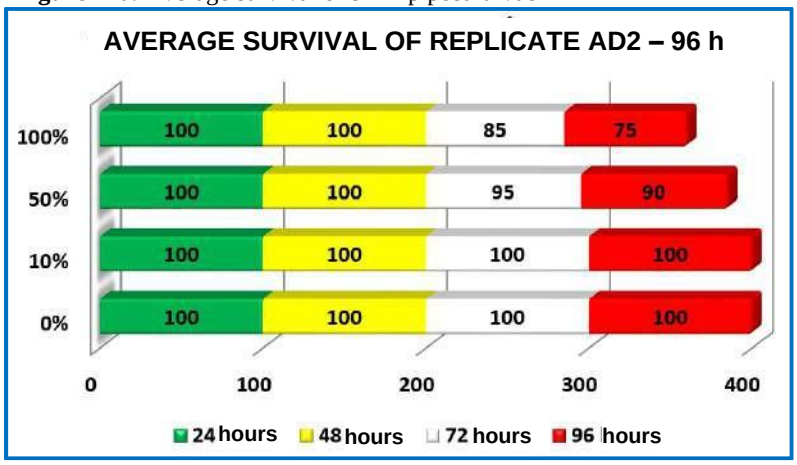
Table 152: Average survival of exposure to various concentrations of suspended sediment in the final test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	95	90
100%	10	100	100	85	75

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the average survival of Litopenaeus vannamei shrimp post-larvae at various suspended sediment concentrations in the sensitivity test of the AD2 Point Replicates.

Figure 170: Average survival of shrimp post larvae in AD2



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 153: Average determination of LC50-96 of Suspended Sediments using the Probit in the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	1	10	10	3,72
100	2.000	10	2,5	25	20	4,33

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in R1-2-PAD2/96h, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used, and it is determined as having little significant impact, which reaches 25% in 96 hours, which is considered low.

POST LARVAE SURVIVAL SENSITIVITY TEST WITH SUSPENDED SEDIMENTS IN POINT 3 (AD3)

The following tables and figures show and graph the effects of suspended sediments in different concentrations on shrimp (*Litopenaeus vannamei*) postlarvae at intervals of 24, 48, 72, and 96 hours after their application.
For this treatment, the post larvae were in optimal conditions, acclimatized, most of the larvae were strong and resisted the impact of suspended sediments, which occurred in greater quantity in the replicates where concentrations of 100% were applied in the final test.

REPLICATE 1 IN SHRIMP POST LARVAE AT 96 HOURS OF EXPOSURE WITH SEDIMENT FROM POINT AD3

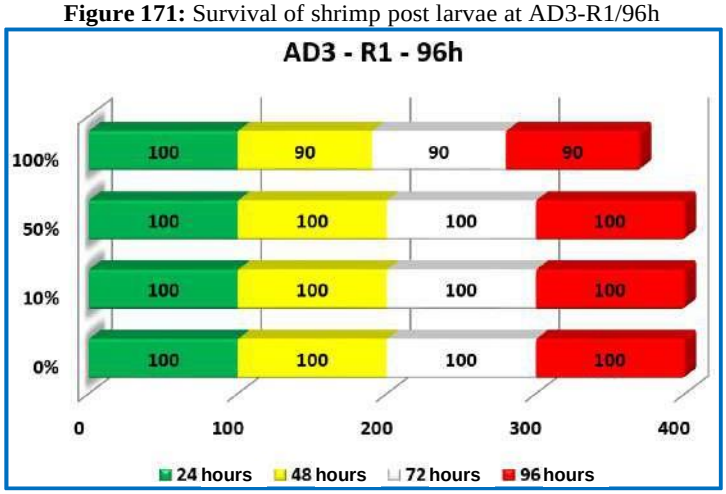
Table 154: Survival of shrimp post-larvae to exposure to various concentrations of suspended sediment in the AD3-R1 sensitivity test.

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	100	100
100%	10	100	90	90	90

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 1 of Point AD3.

Figure 171: Survival of shrimp post larvae at AD3-R1/96h



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 155: Determination of LC50-96 of Suspended Sediments using the Probit inAD3-Replicate 1 of the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	0	0	0	0
100	2.000	10	1	10	10	3,72

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in AD3-Replicate 1, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used, and it is determined as having little significant impact, which reaches 10% in 96 hours, which is considered very low.

REPLICATE 2 IN POST LARVAE OF SHRIMP *Litopenaeus vannamei* WITH SEDIMENTS FROM POINT AD3-2

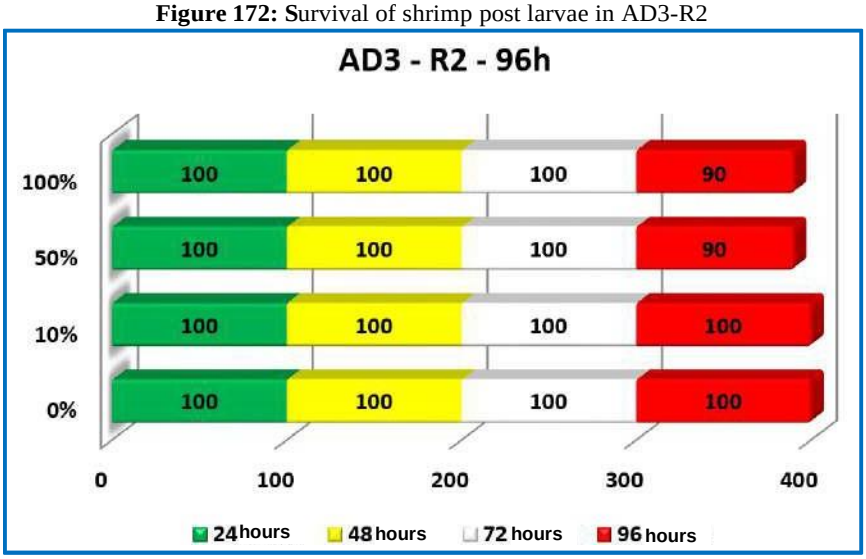
Table 156: Survival of shrimp post larvae to various suspended sediment concentrations in the AD3-R2 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	100	90
100%	10	100	90	100	90

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the survival of *Litopenaeus vannamei* shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 2 of Point AD3.

Figure 172: Survival of shrimp post larvae in AD3-R2



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 157: Determination of LC50-96 of Suspended Sediments using Probit in AD3-R2 of the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	1	10	10	3,72
100	2.000	10	1	10	10	3,72

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in Replicate 2-AD3, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having little significant impact, which reaches 10% in 96 hours, which is considered very low.

AVERAGE SURVIVAL IN POST LARVAE APPLYING SUSPENDED SEDIMENTS AT POINT AD3

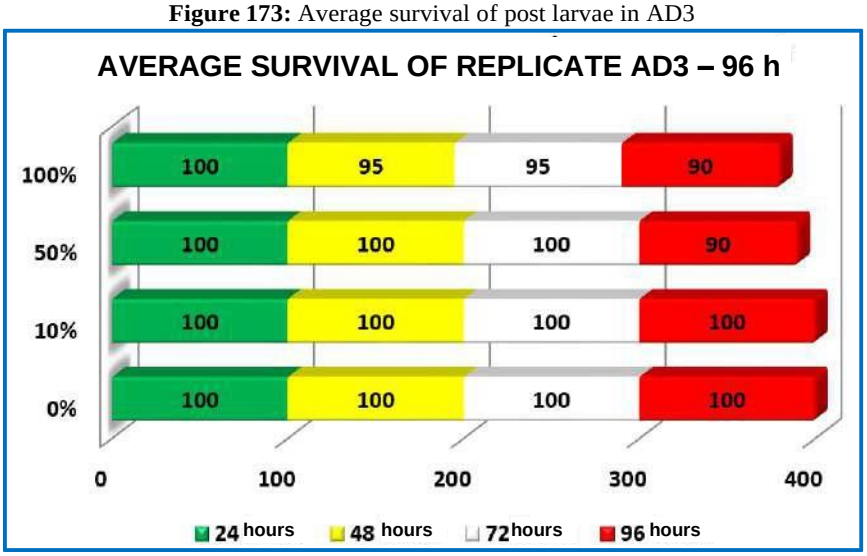
Table 158: Average survival of shrimp post larvae at various suspended sediment concentrations in the final test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	100	90
100%	10	100	95	95	90

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the average survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of the AD3 Replicates.

Figure 173: Average survival of post larvae in AD3



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 159: Average determination of LC50-96 of Suspended Sediments by Probit in the final test

Conc. original %	Log 10 Conc.	Total of Indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	1	10	10	3,72
100	2.000	10	1	10	10	3,72

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in R1-2-AD3/96h, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used, and it is determined as having little significant impact, which reaches 10% in 96 hours, which is considered exceptionally low.

SHRIMP POST LARVAE SURVIVAL DURING SENSITIVITY TEST IN POINT 4 (AD4)

The following tables and figures show and plot the effects of Suspended Sediments at different concentrations on shrimp (*Litopenaeus vannamei*) post larvae at intervals of 24, 48, 72, and 96 hours after application.

For this treatment, the post-larvae were in optimal conditions, acclimatized, most of the larvae were strong and resisted the impact of suspended sediments, which occurred in greater quantity in the replicates where concentrations of 100% applied in the final test.

REPLICATE 1 IN SHRIMP POST LARVAE AT 96 HOURS OF EXPOSURE WITH SEDIMENT FROM POINT AD4

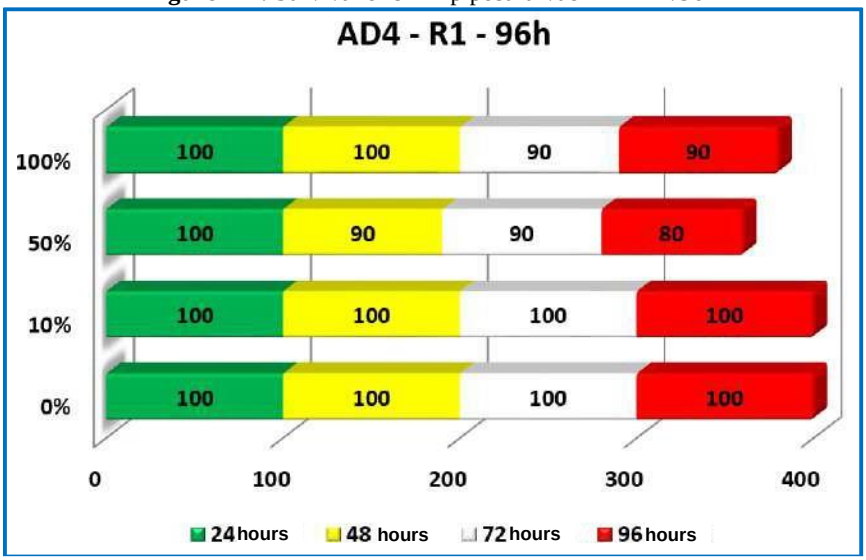
Table 160: Survival of shrimp post larvae to various suspended sediment concentrations in the AD4-R1 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	90	90	80
100%	10	100	100	90	90

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 1 of Point AD4.

Figure 174: Survival of shrimp post larvae AD4-R1/96h



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 161: Determination of LC50-96 of Suspended Sediments by Probit in AD4-Replicate 1 of the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	2	20	20	4,16
100	2.000	10	1	10	10	3,72

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in AD4-Replica 1, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having a low significant impact, which reaches 20% in 96 hours, which is considered low.

REPLICATE 2 IN POST LARVAE OF SHRIMP *Litopenaeus vannamei* WITH SEDIMENTS FROM POINT AD4-2

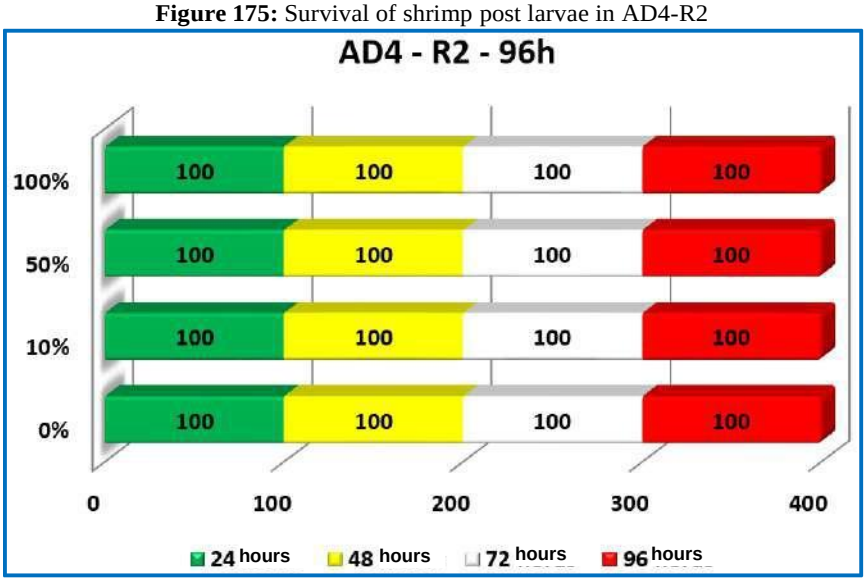
Table 162: Survival of shrimp post larvae at various suspended sediment concentrations in the AD4-R2 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	100	80
100%	10	100	100	100	90

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the total survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 2 of Point AD4.

Figure 175: Survival of shrimp post larvae in AD4-R2



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 163: Determination of LC50-96 of Suspended Sediments by Probit in AD4-R2 of the final test with Litopenaeus vannamei shrimp post larvae.

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	0	0	0	0
100	2.000	10	0	0	0	0

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in Replicate 2-AD4, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **dO not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having little significant impact, due to the presence of sediments without toxic metabolites.

AVERAGE SURVIVAL RATE APPLYING SUSPENDED SEDIMENTS AT POINT AD4

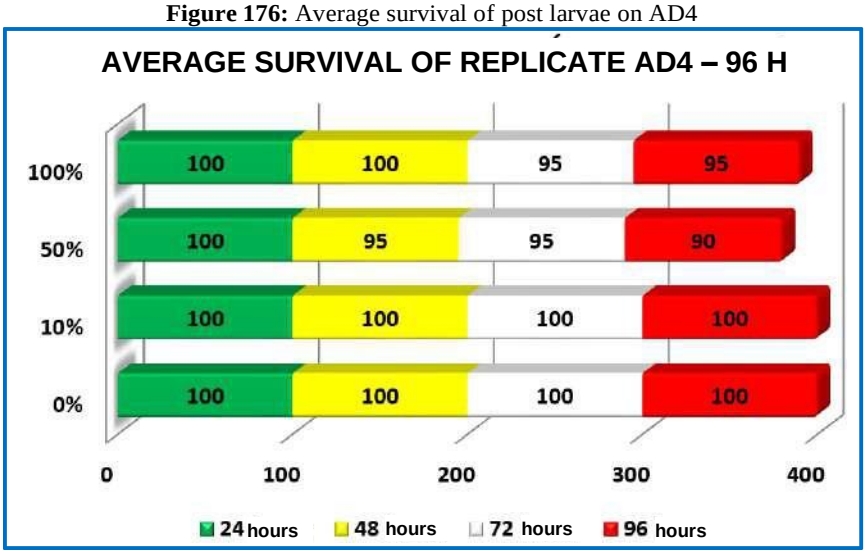
Table 164: Average survival of shrimp post larvae intervals at various suspended sediment concentrations in the final test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	95	95	90
100%	10	100	100	95	95

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the average survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of the Replicates of Point AD4.

Figure 176: Average survival of post larvae on AD4



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 165: Average determination of LC50-96 of Suspended Sediments by Probit in the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	1	10	10	3,72
100	2.000	10	0,5	5	5	3,36

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in R1-2-AD4/96h, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used, and it is determined as having little significant impact, which reaches 10% in 96 hours, which is considered low.

SHRIMP POST LARVAE SURVIVAL DURING THE SENSITIVITY TEST WITH SUSPENDED SEDIMENTS OF POINT 5 (AD5)

The effects of suspended sediments in different concentrations on shrimp (*Litopenaeus vannamei*) postlarvae at intervals of 24, 48, 72, and 96 hours after their application are shown and plotted below. For this treatment, the post-larvae were in optimal conditions, acclimatized, most of the larvae were strong and resisted the impact of the presence of suspended sediments, which occurred in greater quantity in the replicates where concentrations of 100% were applied in the final test.

REPLICATE 1 IN POST LARVAE WITH SEDIMENTS FROM POINT AD5

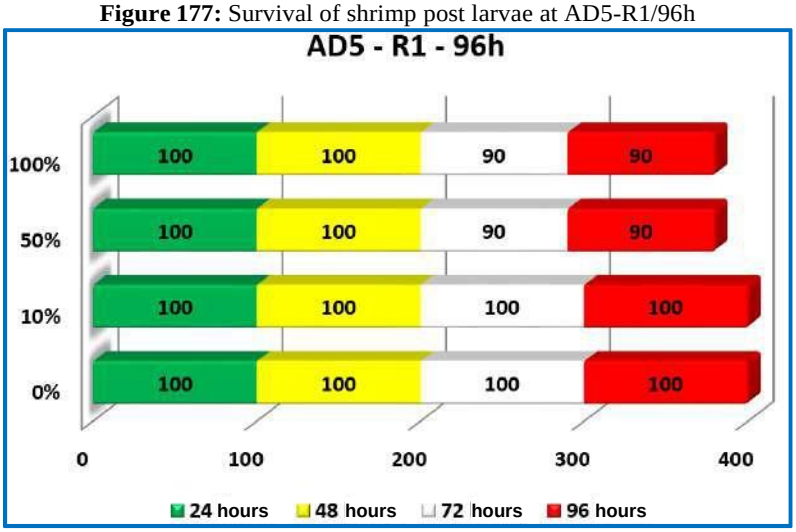
Table 166: Survival of interval shrimp post larvae at various suspended sediment concentrations in the AD5-R1 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	90	90
100%	10	100	100	90	90

Source: *Eco toxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 1 of Point AD5.

Figure 177: Survival of shrimp post larvae at AD5-R1/96h



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 167: Determination of LC50-96 of Suspended Sediments by Probit in AD5-Replicate 1 of the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	1	10	10	3,72
100	2.000	10	1	10	10	3,72

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in AD4-Replicate 1, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having an insignificant impact, which reaches 10% in 96 hours.

REPLICATE 2 IN POST LARVAE OF SHRIMP *Litopenaeus vannamei* WITH SEDIMENTS FROM POINT AD5-2

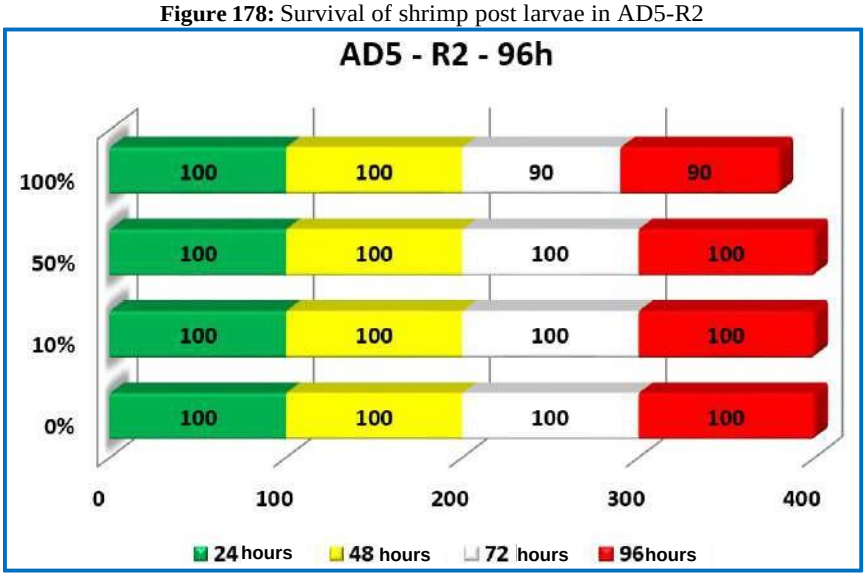
Table 168: Survival of shrimp post larvae to various suspended sediment concentrations in the AD5-R2 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	100	100
100%	10	100	100	90	90

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the total survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 2 of Point AD5.

Figure 178: Survival of shrimp post larvae in AD5-R2



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 169: Determination of LC50-96 of Suspended Sediments by Probit in AD5-R2 of the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	0	0	0	0
100	2.000	10	1	10	10	3,72

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in Replicate 2-AD5, we found that the different concentrations of suspended sediments applied on *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having little significant impact, with a mortality value of 10%, due to the low presence of sediments with toxic metabolites.

AVERAGE SURVIVAL IN POST LARVAE OF SHRIMP *Litopenaeus vannamei* APPLYING SUSPENDED SEDIMENTS FROM THE ACCESS CHANNEL TO PORT BOLIVAR AT POINT AD5

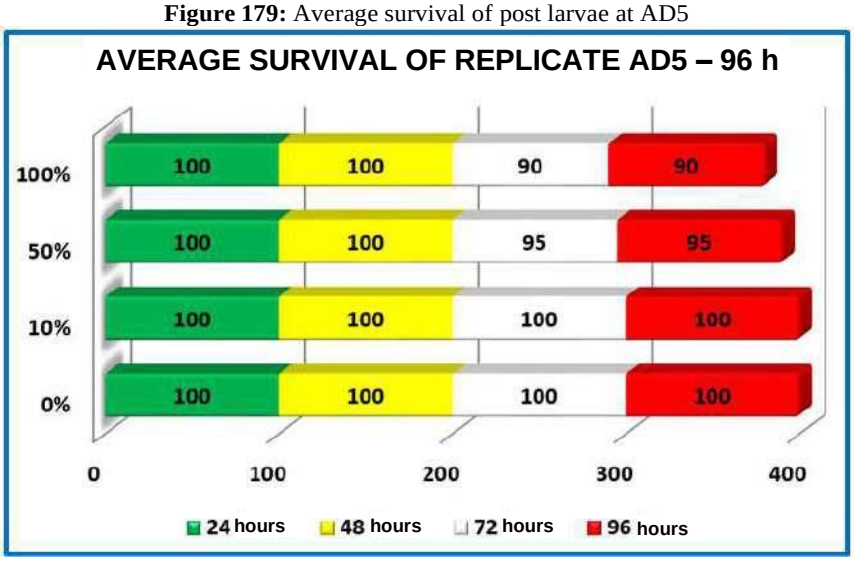
Table 170: Average survival of post larvae at various suspended sediment concentrations in the final test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	100	95	95
100%	10	100	100	90	90

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the average survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of the AD5 Replicates.

Figure 179: Average survival of post larvae at AD5



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 171: Average determination of LC50-96 of Suspended Sediments by Probit in the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	0,5	5	5	3,36
100	2.000	10	1	10	10	3,72

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in R1-2-AD5/96h, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used, and it is determined as having little significant impact, which reaches 10% in 96 hours, which is considered low.

POSTLARVAE SURVIVAL OF SHRIMP (Litopenaeus vannamei) DURING SENSITIVITY TESTING WITH SUSPENDED SEDIMENTS OF POINT 6 (AD6)

The following tables and figures show and plot the effects of suspended sediment at different concentrations on shrimp (Litopenaeus vannamei) postlarvae at

24, 48, 72, and 96-hour intervals after its application. For this treatment, the post-larvae were in optimal conditions, acclimatized, most of the larvae were strong and resisted the impact of suspended sediments, which occurred in greater quantity in the replicates where concentrations of 100% were applied in the final test.

REPLICATE 1 IN POST LARVAE POINT AD6

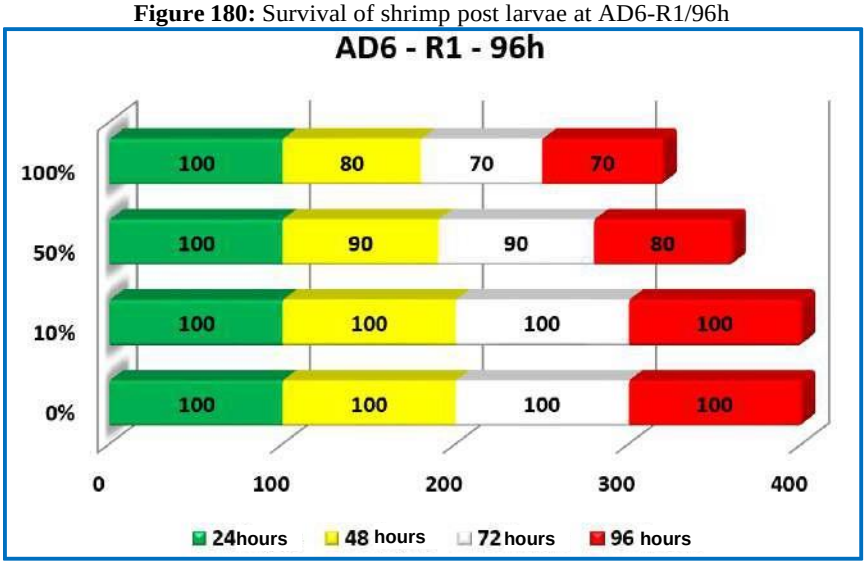
Table 172: Survival of post larvae of at various suspended sediment concentrations in the AD6-R1 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	90	90	80
100%	10	100	80	70	70

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the survival of Litopenaeus vannamei shrimp post larvae at various concentrations of suspended sediment in the sensitivity test of Replicate 1 of Point AD6.

Figure 180: Survival of shrimp post larvae at AD6-R1/96h



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 173: Determination of LC50-96 of Suspended Sediments by Probit in AD6-Replicate 1 of the final test with *Litopenaeus vannamei* shrimp post larvae.

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	2	20	20	4,16
100	2.000	10	3	30	30	4,48

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in AD6-Replica 1, we found that the different concentrations of suspended sediments applied to *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having little significant impact, which reaches 30% in 96 hours.

REPLICATE 2 IN POST LARVAE OF SHRIMP *Litopenaeus vannamei* WITH SEDIMENTS FROM POINT AD6-2

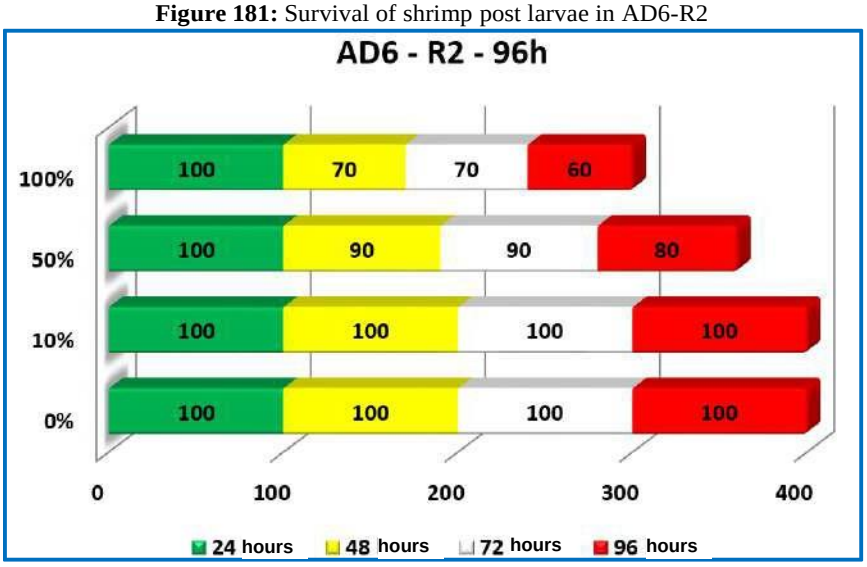
Table 174: Survival of shrimp post larvae suspended sediment concentrations in the AD6-R2 sensitivity test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	90	90	80
100%	10	100	70	70	30

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following image shows the total survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of Replicate 2 of Point AD6.

Figure 181: Survival of shrimp post larvae in AD6-R2



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 175: Determination of LC50-96 of Suspended Sediments by Probit in AD6-R2 of the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	2	20	20	4,16
100	2.000	10	4	40	40	4,75

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in Replicate 2-AD6, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used; however, it is determined as having a slightly significant impact, since it reaches 40% mortality in 96 hours, which can put marine biodiversity at risk if dredging is not handled correctly, considering the biotic and faunal sensitivity of the marine ecosystem.

AVERAGE SURVIVAL IN POST LARVAE AT POINT AD6

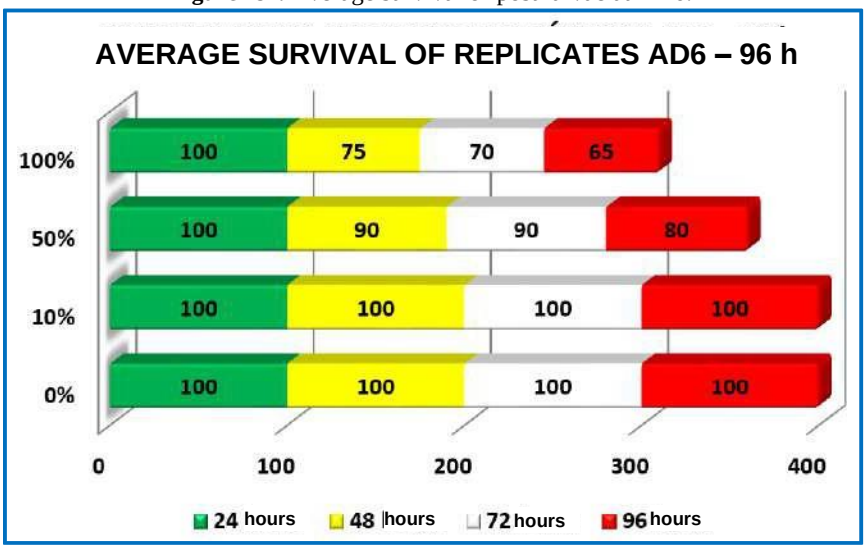
Table 176: Average post larvae survival
Suspended sediment concentrations in final test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	90	90	80
100%	10	100	75	70	65

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the average survival of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of the Replicate of Point AD6.

Figure 182: Average survival of post larvae at AD6.



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

Table 177: Average determination of LC50-96 of Suspended Sediments by Probit in the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	2	20	20	4,16
100	2.000	10	3,5	35	35	4,61

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay in R1-2-AD6/96h, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having little significant impact; however, it is determined as having a slightly significant impact, since it reaches 35% mortality in 96 hours, which can put marine biodiversity at risk if dredging is not effectively managed.

MEAN AVERAGE SURVIVAL IN POST LARVAE APPLYING SUSPENDED SEDIMENTS FROM THE ACCESS CHANNEL TO PUERTO BOLIVAR AT THE 5 SAMPLING POINTS AT 96 HOURS

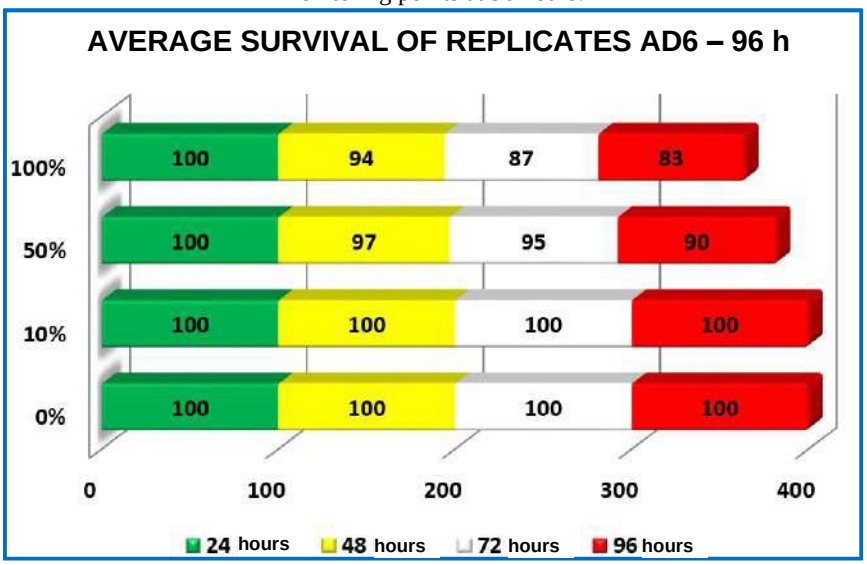
Table 178: Mean average survival of shrimp post larvae at various suspended sediment concentrations in the final test

SSD concentration	No. of post larvae	Exposure time			
		24 h	48 h	72 h	96 h
0%	10	100	100	100	100
10%	10	100	100	100	100
50%	10	100	97	95	90
100%	10	100	94	87	83

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolivar, Machala - El Oro*
Date: *April 25, 2017*

The following figure shows the average survival rate of Litopenaeus vannamei shrimp post larvae at various suspended sediment concentrations in the sensitivity test of the replicas of the five monitoring points of the Puerto Bolivar access channel at 96 hours.

Figure 183: Average Survival of shrimp post larvae in the replicates of the 5 monitoring points at 96 hours.



Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolívar, Machala - El Oro*
Date: *April 25, 2017*

Table 179: Mean of averages of the determination of LC50-96 of Suspended Sediments by Probit in the final test

Conc. original %	Log 10 Conc.	Total of indiv.	No.. of Dead	% Mortality	Correlation % Mortality	Probit (Y)
0	0	10	0	0	0	0
10	1.000	10	0	0	0	0
50	1.698	10	1	10	10	3,72
100	2.000	10	1,7	17	17	4,05

Source: *Ecotoxicological study of the Determination of the Mean Lethal Concentration in shrimp larvae with suspended sediments from the access channel*
Prepared by: *Ecosfera Cia Ltda, 2017.*
Location: *Parish of Puerto Bolívar, Machala - El Oro*
Date: *April 25, 2017*

After the bioassay, evaluating the average, we found that the different concentrations of suspended sediments applied in *Litopenaeus vannamei* shrimp post-larvae **do not influence** 50% of the organisms in the bioassay; therefore, Probit cannot be used and is determined as having little significant impact; however, Point AD6 was slightly significant in terms of impact since it reaches 40% in its Replicate 1 and on average 35% of the organisms in the bioassay.

❖ INTERPRETATION AND DISCUSSION OF THE ECOTOXICOLOGICAL STUDY

Previous studies:

In the present monitoring and bioassay of determination of the Lethal Mean Concentration (LC50), carried out with suspended sediments from dredging of the access channel to Puerto Bolivar, we can see that in previous dredging activities carried out in the access channel to Puerto Bolivar there have been no significant impacts that could alter the marine biodiversity of the mangrove ecosystem, estimating that these suspended solids were not toxic and below the permissible ranges; However, it is necessary to maintain these monitoring and biotic sensitivity studies before, during and after the respective dredging to ensure our natural heritage.

Valarezo, C. (2015) conducted biennial toxicity tests on dredged suspended sediments in the access channel to Puerto Jelí, showing that 100% SSD concentrations resulted in 37% mortality at 96 hours, which is considered a slightly significant impact.

Valarezo, C. (2014) conducted toxicity tests on shrimp larvae *Litopenaeus vannamei* with suspended sediments from dredging in the access channel to Puerto Jelí, determining as a result that concentrations of 100% SSD had a 15% mortality at 96 hours of exposure. Chacon and Villamarin (2013) used industrial effluents in the bay of Cartagena, obtaining as a result that at a concentration of 20.33%, the mean lethal time was 32.09 hours.

Ramos, Bastidas, and Garcia (2012) worked with impacted and non-impacted sediment from the north coast of Paraguana, Venezuela, concluding that the impacted sediment has higher toxicity with the survival of larvae four times lower than in the non-impacted sediment being lethal only at 10% concentration.

CEMA (2008) obtained results where survival levels are high with a minimum of 60% survival, indicating that suspended sediments are not harmful to shrimp larvae.

Villamar (2002) determined that at concentrations of 50% and 100% of sediment, survival reached 85%, concluding that there is no negative effect on shrimp larvae.

Villamar (1990) conducted a study to determine the toxicity of the oil dispersant BP1100-WD, finding the LC50 at 96 hours at the concentration of 4.77 PPM.

After this ecotoxicological study, where the biotic sensitivity was evaluated through the simulated use of Suspended Dredged Sediments (SSD) in real-time, with shrimp (*Litopenaeus vannamei*) postlarvae, it can be established that the physical and chemical conditions of the water were considered acceptable for the extreme conditions in which the different concentrations were worked. The environmental conditions did not have a negative effect on the normal development of the organisms in the study, and the following observations can be noted:

SURVIVAL:

- Evaluated the Witness, that is, at 0% concentration, it was evidenced that the shrimp post larvae did not suffer changes in their normal and pathological conditions since the development, metabolism, and survival were acceptable, obtaining a final survival of 100%. This implies that the quality of the post larvae remained stable during the whole process of the ecotoxicological studies, which shows a good biological and technical control of the BIOFONS Y PANEMA Laboratory and a good selection of laboratory larvae for the present study.
- For the treatment with a 10% concentration of suspended sediments, at 96 hours, an average survival rate of 100% was obtained in *Litopenaeus vannamei* shrimp postlarvae, which shows a non-significant impact of the possible toxins generated by the simulated dredging and that they have not caused any effect on the organisms exposed and monitored during the study. This demonstrates that this concentration in each of the research points, it will not affect the marine biodiversity of Puerto Bolivar.
- In the evaluation of the treatment with a 50% concentration of suspended sediments at 96 hours, the average survival rate of shrimp post-larvae was 90%, which is considered low; however, in the treatments at the points in front of the Liceo Naval (AD2), the entrance to El Coco (AD4) and the entrance to Jambelí (AD6), the survival rate decreased to 80%, possibly due to the impact of the massive evacuation of rainwater discharge into the sea due to the effects of the current winter.
- Finally, for the treatment with the 100% concentration of suspended sediments at 96 hours, there was an average survival of 83% in *Litopenaeus vannamei* shrimp postlarvae, a value that decreased compared to the treatments at the points in front of the Liceo Naval (AD2) R1 70%, and the entrance to Jambelí (AD6) R1 70%; and even more so in R2 where survival decreased to 60%, possibly due to the physical-chemical condition of the sediments and the impact of the massive evacuation of rainwater discharge into the sea due to the effects of the current winter.

BIOLOGICAL BEHAVIOR:

- During the monitoring of the ecotoxicological study, no changes in biological behavior were observed due to exposure to Suspended Sediments from Simulated Dredging, as well as extreme stress conditions in the organisms used; Neither by the feeding conditions that were avoided in the present investigation to expose the shrimp larvae *Litopenaeus vannamei* to direct exposure to the bottom, so it is deduced that the sludge in general at the time of the present investigation, did not develop dangerous conditions, nor were their signs of pathological alteration, so an impact on external tissues and internal organs is ruled out.

PARAMETERS:

- In parallel, water quality monitoring is carried out in the laboratory for each aquarium with their respective treatments and repetitions; it is also carried out for sampling to verify its impact on the exposed organisms. For this, dissolved oxygen (DO), pH, and temperature parameters have been taken.
- The final reports do not indicate any major changes in the sampling's dissolved oxygen values, with the lowest value being found for Point AD2-R1 (in front of the naval school), corresponding to 6.40 mg/l, and the highest value is found at point AD3-R1 (in front of Isla del Amor), at 7.39 mg/l; the overall mean for this variable was 7.07 mg/l, considered to be a normal value for marine ecosystems. Lower ranges were found for treatments having SSD concentrations of 10%, corresponding to the AD6 treatment (in front of Jambelí) with values of 2.29 mg/l; whereas the AD5-R1 treatment (in front of Punta del Faro Jambelí) had values of 4.59 mg/l. Overall mean values were 3.39 mg/l, suggesting a minor impact on water quality due to the treatments. This appears to be more the result of the presence of dissolved solids than toxicity. After analyzing the dissolved oxygen parameters for the treatments of 50%, a considerable decrease is found, especially for the AD6-R2 treatment, having minimal values of 0.10 mg/l, corresponding to a large presence of dissolved solids in its sediments, although no toxicological alterations are reported. The highest value corresponds to AD5 (in front of Punto del Faro Jambelí), having a mean range of 3.90 mg/l with sediments having a low biological impact. The overall mean for dissolved oxygen in the treatments of 50% was 1.71 mg/l. This is relatively low, but it has not been found to be toxic in the eco-toxicological study. Finally, in treatments corresponding to 100% of the SDD, very low dissolved oxygen values were reported, corresponding to 0.09 mg/l for treatment AD6-R1-R2, indicating that the high quantity of SSD may alter the medium if there is not constant monitoring throughout the dredging operation. The highest value corresponded to the AD5-R1 treatment, which, given its condition, is one of the best.

❖ CONCLUSIONS

- Having evaluated the studies on mean lethal concentration (CL50-96) in suspended settlements of dredging for shrimp post-larvae (*Litopenaeus vannamei*), it is determined that the treatments carried out in the SSD concentrations of 50% and 100% were not toxic during the dredging simulation. This minimizes the possibility of problems arising during the handling of the Acuicola Production Units' shrimp crop established in the areas of influence or during the normal development of the artisanal fishing sector.
- Once this eco-toxicological study has completed, both "on-site" in the field as well as in the laboratory, we can conclude that there is no significant impact on the biological conditions of the shrimp post-larvae (*Litopenaeus vannamei*) that were used and exposed to extreme conditions in the presence of suspended sediments in the laboratory conditions; in static time and up to an exposure of 96 hours. The dredging simulation results demonstrate that in real-time, this activity will not directly affect the marine biodiversity, assuming that the respective and constant monitoring is carried out for the chemistry of the water and its biotic sensitivity.

- The Litopenaeus vannamei post-larvae's survival values at an exposure of 96 hours were situated at 100% for the treatment with 0% of SSD, 100% for 10%, 90% for 50% and 83% for 100%. This translates to a mortality rate of 17%, considered low, but reflects ongoing care, given its decrease over the long term.
- During this eco-toxicological study and in the distinct treatments performed with *Litopenaeus vannamei* shrimp post-larvae exposed to different concentrations of SSD (suspended sediments from dredging operations); some observations were made with no significant novelties; among others, the minor presence of level 1 red uropods, black stomach content resulting from rumination of organic material, the normal coloration of the exoskeleton, high activity, normal swimming without evidence of stress, given the concentration and presence of a large number of suspended solids. This is considered to be an indicator of normal development in bio-aquatic species.
- The monitoring of the water quality at the distinct sample points revealed the presence of acceptable dissolved oxygen parameters; this was corroborated by the "on-site" parameter-taking of suspended solids from dredging operations (SSD), whose values were also found to be acceptable for bio-aquatic species and which were similar to the values found in the natural medium, thereby not theoretically affecting marine biodiversity.
- As for the monitoring of the water quality with suspended sediments from simulated "on-site" dredging operations, in terms of dissolved oxygen, we see that at point AD2 (in front of the naval school), values of 3.93 mg/l were found with an oxygen saturation of over 54.4%; however, in the measurements with SSD, the values already decreased considerably to 0.11 mg/l, due to the high presence of dissolved solids, with oxygen saturation decreasing to 1.4%. For point AD3 (in front of Isla del Amor), the DO conditions were 3.62 mg/l with an SO^2 of 52.9%; and in the SSD, a DO of 3.25mg/l and an SO^2 of 49.7%, considered normal given the low tide. Similarly, in point AD4 (in front of the El Coco resort) the values were 3.92 mg/l with an SO^2 of 56.6%; and in the SSD, values were 3.12 mg/l with an SO^2 of 44.6&; similar to that found for point AD5 (in front of Punta del Faro Jambelí) with 3.61 mg/l and 3.51mg/l in SSD, and with an SO^2 of 50.7 to 49.1%. The impact of the decrease in DO was registered in point AD6 (in front of Jambelí) with values of 3.59 mg/l with an SO^2 of 56.2% and with a DO of 0.02mg/l and an SO^2 of 0.3%, very low, due to the number of solids found in their sediments.
- The salinity values found at the 5 monitored points were presented in a similar manner, being less than 26.77 ppm (AD4) and greater than 20.23 ppm (AD2), which does not imply stress. However, there was no evidence of impact on the marine ecosystem at the time of the monitoring. In assessing the salinity with SSD, values exceeding 18.5 ppm were reported (AD2) as well as values over 25.10 ppm (AD4), without registering biological variations.

- The temperature values that were recorded at the distinct sampling points also failed to reveal dramatic changes, with high values of 31.3ºC (AD3-AD4-AD6) and low values of 30.2ºC (AD2). When taking temperatures with SSD, minimum values of 30.1ºC (AD2) and high values of 31.7ºC (AD3) were recorded.
- The monitored ranges of turbidity were recorded at between 0.30 and 1.50m, with the lower values being found for AD3, AD4, and AD5, at 0.30, 0.60, and 0.70, respectively; these values do not reflect any of the realities assumed in the laboratory with the simulated dredging operation. The highest value was found for points AD2 and AD6, with 0.80 cm of turbidity.
- The depth of the monitored points is accentuated in point AD5 with 1.50 cm, while the lowest level was represented by points AD3 and AD6 with values of 1.10cm, respectively.

❖ RECOMMENDATIONS

After completing this eco-toxicological study, the following technical recommendations have been made, offered by mutual agreement of all of the involved participants:

- To develop ongoing monitoring to offer continual follow-up of the impact of the dredging activities of the Access Channel to Puerto Bolivar at each of the established sampling points, being sure to take into consideration the physical, chemical and biological parameters; to obtain all of the respective information to establish suitable environmental conditions in real-time for this fragile ecosystem, and thereby carry out the respective dredging activities under regulations imposed by the Environmental Ministry.
- To program appropriate technical control during the dredging activities, especially in Point 6, which corresponds to the entry of Jambelí, which is already a muddy area that is prone to the bioaccumulation of toxic agents. Therefore, respective measures should be taken by the technical personnel of the operating company to reduce any potential impact.
- It is recommended that a larger study is carried out on the environmental conditions, including ongoing technical-scientific monitoring and having a greater number of repetitions, SSD, during and after the dredging activities of the access channel to Puerto Bolivar, to measure the "on-site" and real-time impact that may result to the marine biodiversity in each of the areas of influence.
- The participation of the involved authors was considered to monitor with the Universidad Tecnica de Machala collectively and based on the development of a "Program Monitoring the Dredging Activities in the Access Channel to Puerto Bolivar", sponsored by the Ministry of the Environment and the Secretary of Environmental Management of the El Oro prefecture.

6.3. – SOCIO-ECONOMIC ENVIRONMENT

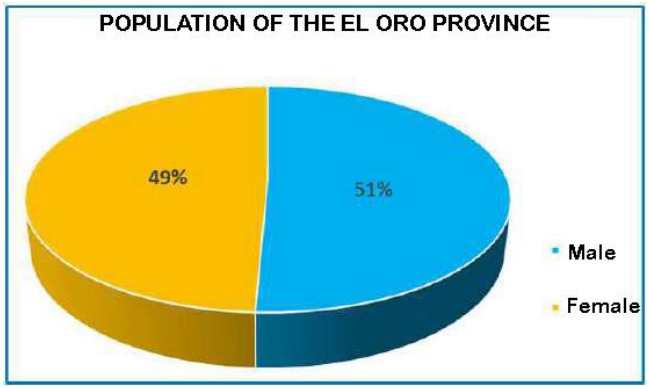
The socio-economic characterization process for this Environmental Impact Assessment is based on rapid research processes, organized in two sources: the primary sources that consist of the application of three research techniques: surveys, interviews, and direct observation. And secondary techniques that are based on bibliographical information such as the population and housing census created by the National Statistics and Census Institute (INEC) in 2010 and the Plans for Regional Development and Planning of the El Oro province, Machala canton, Santa Rosa canton, Puerto Bolivar parish, and Jambelí parish.

6.3.1. – DEMOGRAPHIC ANALYSIS

POPULATION

According to the 2010 census, the El Oro province has a population of 600,659 inhabitants, 304,362 of which are male and 296,297 of which are female.

Illustration 184: Population of the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In relation to all of the provinces of Ecuador, in 2010, the El Oro province represented 4.15% of Ecuador's total population, being the fifth most populated province of the entire country.

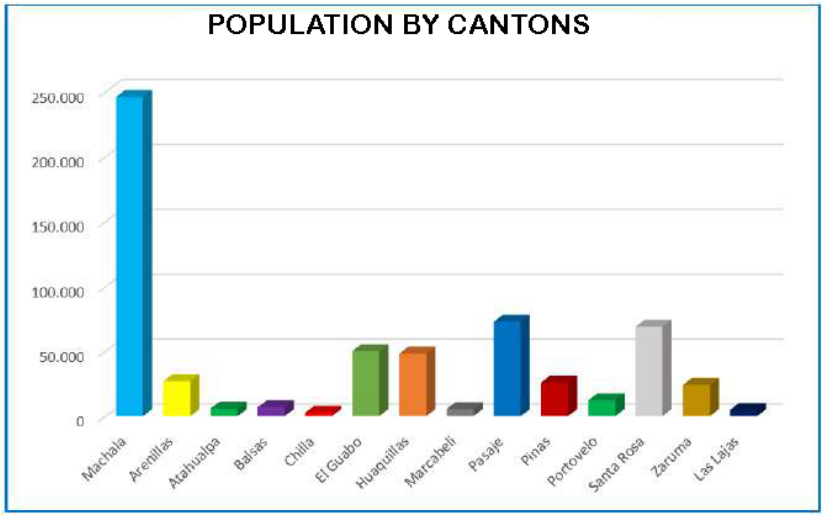
As for the cantons making up the El Oro province, the following information is available with regard to the population of each of these:

Table 180: Population and surface area of the cantons of the El Oro province

CANTON NAME	SURFACE AREA KM2	NUMBER OF INHABITANTS
Machala	330.18	245,972
Arenillas	268.44	26,844
Atahualpa	58.33	5,833
Balsas	69.56	6,861
Chilla	332.26	2,484
El Guabo	606.55	50,009
Huaquillas	63.78	48,285
Marcabeli	148.68	5,450
Pasaje	455.79	72,806
Pinas	616.90	25,988
Portovelo	288.07	12,200
Santa Rosa	821.84	69,036
Zaruma	648.74	24,097
Las Lajas	298.23	4,794

Source: Development Plan of the El Oro province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

Illustration 185: Population by cantons of the El Oro province



Source: Development Plan of the El Oro province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

❖ MACHALA CANTON POPULATION

According to the census conducted in November of 2010 by INEC (the Ecuadorian Institute of Statistics and Censuses), Machala has 245,972 inhabitants, of which 122,948 are female, and 123,024 are male.

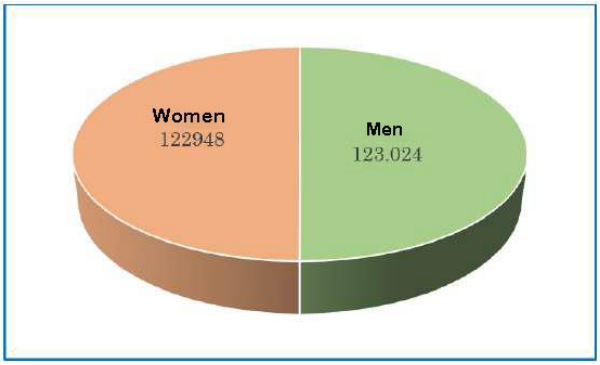
That is, 50.02% of the population of Machala consists of men and 49.98% are female. There is a minimal difference of 0.04%, corresponding to only 76 more male inhabitants than female ones.

Table 181: Population of the Machala canton

POPULATION BY SEX	NUMBER OF INHABITANTS	PERCENTAGE (%)
Men	123,024	**50.02%**
Women	122,948	**49.98%**
TOTAL	245,972	**100%**

Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: Machala Canton - El Oro
Date: April 25, 2017

Illustration 186: Population of the Machala Canton



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: Machala Canton - El Oro
Date: April 25, 2017

With these numbers, Machala, in the category of urban clusters of Ecuador, is the fifth most populated, being surpassed by Guayaquil-Duran-Milagro-Daule (3,200,205), Quito-Sangolqui (2,325,043), the center of Manabi (676,140), and Cuenca-Azogues (602,566).

The population of the Puerto Bolivar parish is 6,174 individuals, consisting of 3235 men and 2939 women.

❖ SANTA ROSA CANTON POPULATION

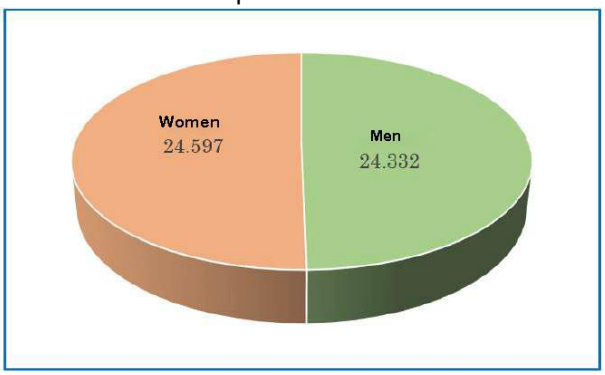
The Santa Rosa canton has a population of 69,036 individuals, distributed as indicated in the table below:

Table 182: Population of the Santa Rosa canton

SEX	URBAN		RURAL
	Population	%	Population
Men	24,332	10.895	35,227
Women	24,597	9.212	33,809
TOTAL	**48,929**	**20.107**	**69,036**

Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: Santa Rosa Canton - El Oro
Date: April 25, 2017

Illustration 187: Population of the Santa Rosa Canton



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: Santa Rosa Canton - El Oro
Date: April 25, 2017

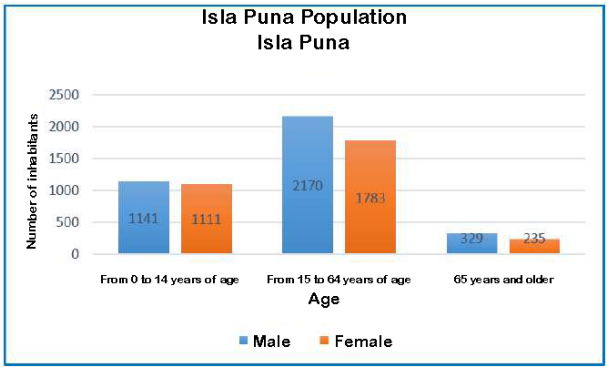
The population of the Jambelí parish is approximately 1,718 individuals. This archipelago consists of a set of five islands containing the following beaches of distinct sizes:

- Payana
- Tembleque
- San Gregorio
- Pongal
- Costa Rica

❖ ISLA PUNA POPULATION

According to the VII census conducted in 2010 by the INEC (Ecuadorian Institute of Statistics and Censuses), the Isla Puna parish has a total population of 6,769, of which, 58% are part of the age group ranging between 15 and 64 years. The male population represents 53% of the total population.

Illustration 188: Population of Isla Puna



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: Isla Puna - El Oro
Date: April 25, 2017

AGE GROUPS

In the El Oro province, according to five-year age groups, 10.51% of the inhabitants are under the age of 14, therefore, the largest quantity of inhabitants of this province are youth. There are no significant differences based on sex.

The population aged 1 to 14 represents a considerable increase both in men as well as women. As of the age of 15, there are incomers to the pyramid, especially in the ages of 25 to 30 years. This may be justified by those from this population group that leave the province for study, work and other reasons.

The population of the city of Machala, in accordance with the three considered age groups, is distributed as follows:

- 160,321 inhabitants of Machala are aged between 15 and 64 years.

- 72,219 inhabitants are between the ages of 0 and 14.

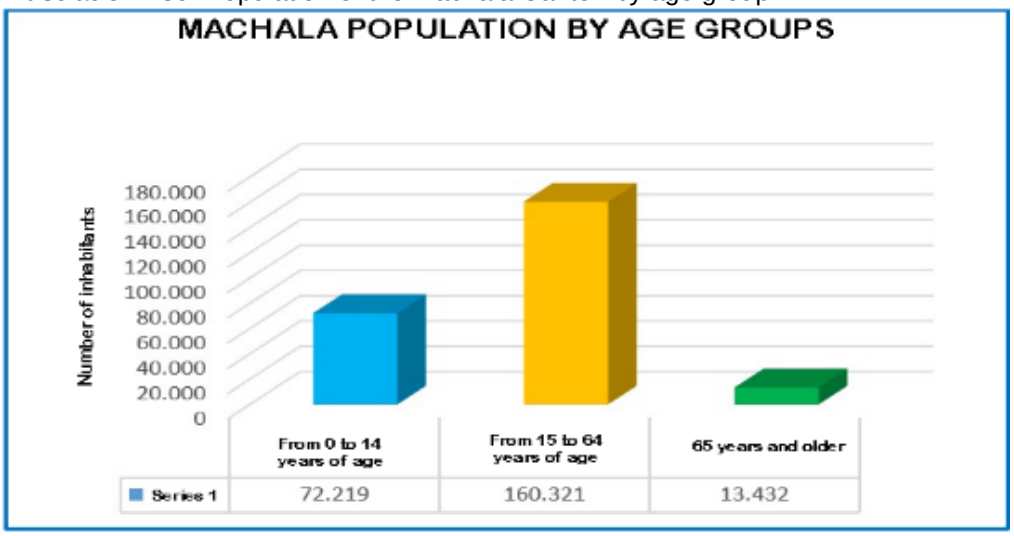
- 13,432 are aged 65 or over.

Table 183: Population of the Machala canton by age groups

DETAIL	TOTAL	PERCENTAGE %
0 to 14 years of age	15 to 64 years of age	65 and older
72,219	160,321	13,432

Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: Machala Canton - El Oro
Date: April 25, 2017

Illustration 189: Population of the Machala Canton by age group



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: Machala Canton - El Oro
Date: April 25, 2017

In the Santa Rosa canton, the 5-year groups with the most cases correspond to the following: 5 to 9 years of age; 10 to 14 years; 15 to 19 years; 20 to 24 years, with over three thousand cases, revealing that this is a canton with a population of preadolescents, adolescents and young men and women. This is followed by over two thousand cases in the following 5-year groups: from 1 to 4 years of age; 25 to 29 years; 30 to 34 years; 35 to 39 years; 40 to 44 years; representing a population of youth and adult men and women. And the following 5-year groups have over a thousand cases: 45 to 49 years of age; 50 to 54 years; 55 to 59 years; 60 to 64 years, representing adults and older adults, men and women. And senior citizens decrease from over 700, the elderly and those under one year of age, in a balance of population decline and increase for men and women of the Santa Rosa canton.

- **POPULATION GROWTH RATE**

As for the evolution of the population of the El Oro province over the last decades, the population of the province has grown continuously and intensely, although over recent years, this growth has slowed down considerably, a tendency that has been seen across the population of Ecuador.

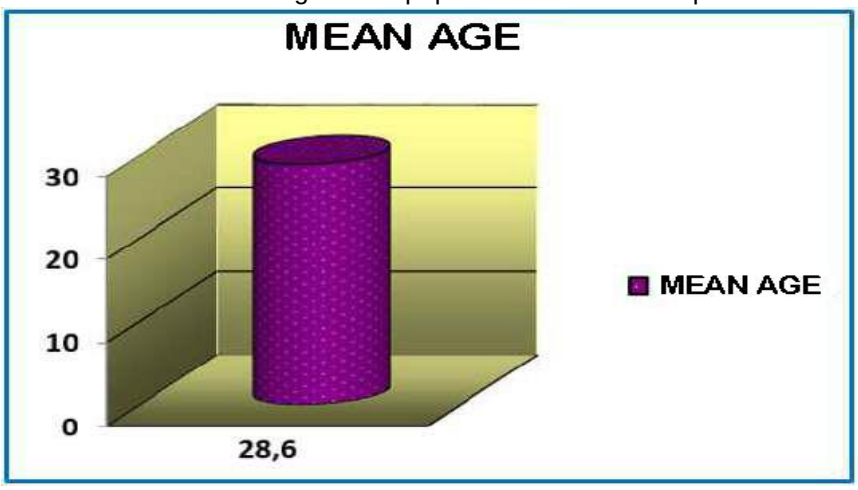
The evolution of mean rates of annual growth for the inter-census periods of 1990, 2001 and 2010, for all of the El Oro province cantons, reveal significant differences in growth.

Of the demographic projections made by the INEC in 2010, it can be seen that in the El Oro province, the population aged 14 to 65 (Economically Active Population) reveals an ongoing decline from 2010 until 2020. This phenomenon may be due to the ever-declining birth rate.

❖ MEAN AGE OF THE POPULATION

According to the 2010 census created by the INEC, the mean age of the inhabitants of El Oro's province is between 28 and 29 years.

Illustration 190: Mean age of the population of the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

❖ SELF-IDENTIFICATION OF THE POPULATION

According to the customs and traditions of the citizens, the results of the 2010 Population and Housing Census determined that the citizens of the El Oro province identified themselves as shown in the following table:

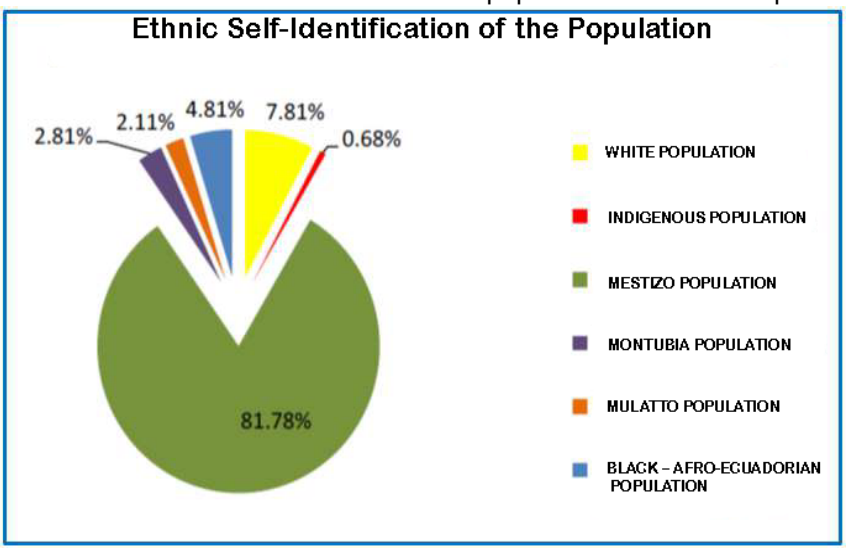
Table 184: Self-identification of ethnicity by the population of the El Oro province

INDICATOR	POPULATION	PERCENTAGE
White	46,801	7.81
Indigenous	4,060	0.68
Mestizo	489,843	81.78
Montubia	16,858	2.81
Mulatto	12,613	2.11

Black – Afro Ecuadorian	28,828	4.81
TOTAL	**599,003**	**100%**

Source: SISE, 2010
Created by: Ecosfera Cia. Ltda.
Location: Canton Machala - El Oro
Date: April 25, 2017

Illustration 191: Self-identification of the population of the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

According to the last census from 2010, most of the El Oro province population identified itself, in terms of race, as mestizo (81.78%). Mestizo (mixed race) is understood to be a complex process of biological and cultural contact between the indigenous, white, black, and other races. The mestizo population is linked to diverse economic activities, including agriculture, construction, professional areas, and self-employment. A minority percentage of the El Oro population (7.81%) refers to itself as white; 4.81% consider themselves black/Afro-Ecuadorian; 2.81% refer to themselves as Montubian; 2.11% consider themselves to be mulatto, and only 0.68% identify themselves as indigenous.

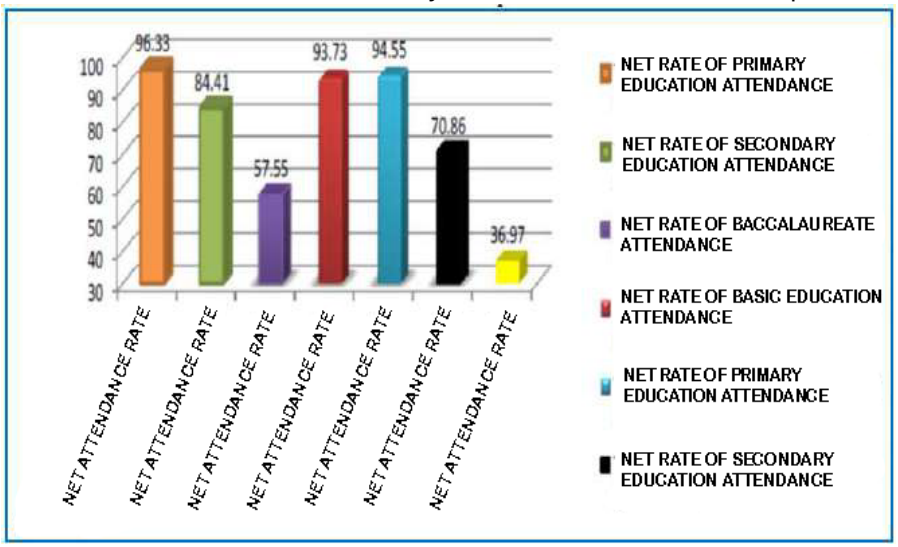
According to statistics collected by the INEC during the 2010 census, 79% of the Machala canton inhabitants identified themselves as MESTIZO when considering their culture and customs. And 9% of this population considered themselves to be WHITE. On the other hand, 5% identify themselves as AFRO-ECUADORIAN, and 3% consider themselves MULATTO.
Some 2% affirm that they are MONTUBIAN and only 1% identify themselves as INDIGENOUS. Another 0.08% does not choose to identify themselves with any of the listed variables.

In the Santa Rosa canton, 84% of the population identified themselves as mestizo; 6% as white, 5% of African descent; 2% as mulatto and Montubian; and 1% as black or indigenous.

6.3.2.- EDUCATIONAL CHARACTERISTICS

One of the most important aspects to be considered concerning the development of any country, province, city, etc. is its population's education. A population with good education levels is a sign of development, advancement, increased participation, and citizenship quality. In short, it is a sign of a society that is the engine of its advance and an active participant in the steps to be taken for the same.

Illustration 192: Attendance rates by education level in the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

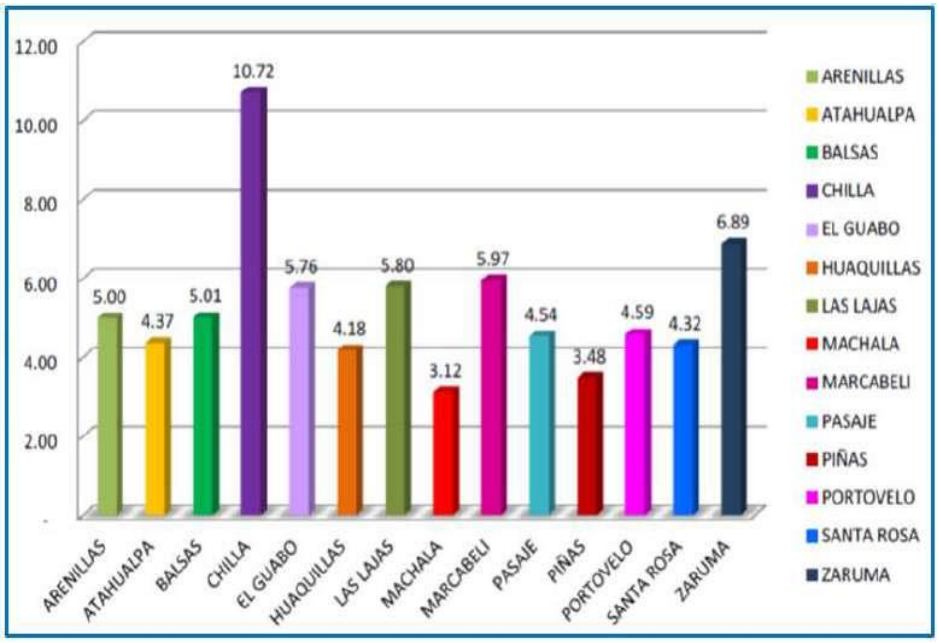
Education in Ecuador is the central government's responsibility and is regulated by the Ministry of Education, divided into the areas of federal education, state – missionary, municipal, and specific; secular or religious and Hispanic bilingual.

El Oro has a slightly lower rate (-4.1%) than the country's mean, and it is the third-lowest province in terms of education rates, behind Galapagos and Pichincha, having 1.31 and 3.6, respectively. However, it continues to be above the UN's rate for a "territory free of illiteracy."

❖ ILLITERACY

Illiteracy, in addition to limiting the overall development of individuals and their participation in society, has other repercussions on the life cycle, affecting the family environment, restricting access to the benefits of development, and hindering access to other human rights.
In Ecuador, despite having gradually recorded a slight decrease in illiteracy rates over recent years, illiteracy rates are 6.8%, some 2.2 points lower than that recorded in the 2001 census, when the rate was 9%.

Illustration 193: Illiteracy rate by canton in the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

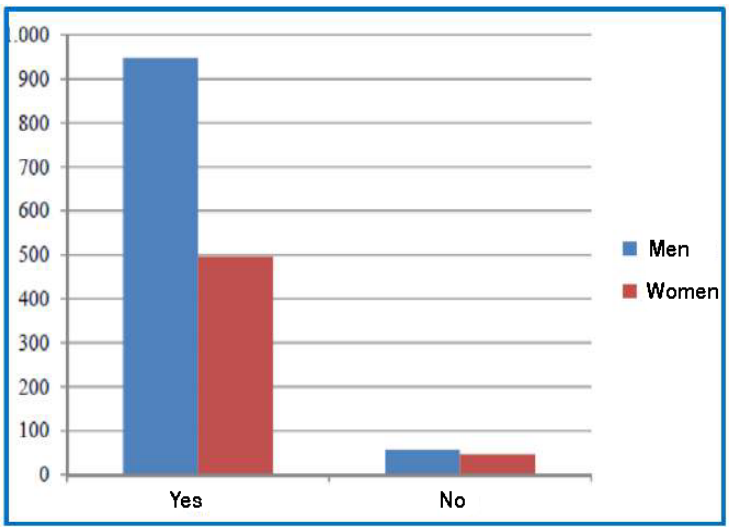
The percentage of illiteracy in the El Oro province is 4.12%, the third-lowest rate as compared to the other provinces of the country.

The illiteracy rate in the Machala canton is 3.10%, meaning that this percentage of the population is considered ILLITERATE, while 96.90% are literate.

In the Santa Rosa canton, 98.98% can read, while 1.02% are illiterate, and public policy should be applied.

In the Jambelí parish, a total of 1443 individuals are able to read and write, while 102 are illiterate. The main causes of illiteracy in the parish are: lack of schools in certain rural areas, the need to work from an early age, and, perhaps the largest cause, deficient political, economic, and cultural structure due to poor resource distribution.

Illustration 194: Illiteracy rate in the Jambelí parish



Source: Jambelí parish Development Plan
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

According to the 2010 census by the INEC, 44% of the total population of Isla Puna has received a primary and secondary education while 78% of the total Isla Puna population can read and write.

❖ SCHOOL DROPOUT

According to the 2010 Population and Housing Census results, 9% of the population over the age of 15 that regularly attended a school has not completed the basic education (school dropout). This is 2.07 points less than in 2001, when a rate of 11.07% was reported.

This report indicates that the province having the lowest school dropout rate is El Oro, with 7.25%, and Cotopaxi, with 7.82%. Napo and Morona Santiago, on the other hand, have the highest dropout rates, at 13.15% and 14.53%, respectively.

Table 185: School dropout in the El Oro province

CANTON	Number of students that drop out of the school system	TOTAL ENROLLED	DROPOUT RATE (%)
Arenillas	40	1188	3.4
Atahualpa	40	548	7.3
Balsas	19	349	5.4
Chilla			
El Guabo	304	4759	6.4
Huaquillas			
Las Lajas	3	354	0.8

Machala	40	796	5.0
Marcabeli	2	46	4.3
Pasaje	101	3568	2.8
Piñas	35	1537	2.3
Portovelo	6	449	1.3
Santa Rosa	132	3174	4.2
Portovelo	118	2780	4.3

Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In the El Oro province, the Atahualpa canton has the highest school dropout rate, 7.3%, followed by el Guabo with 6.4% and Balsas with 5.4%. The cantons with the lowest dropout rates were Chilla and Las Lajas.
It should be noted that the school attendance rate in the El Oro province averages **9.2** years on average.

In the Jambelí parish, a total of 319 individuals currently attend regular education establishments, and 1226 do not.

❖ SCHOOLS AND LEVEL OF INSTRUCTION

According to the 2010 INEC census, the Machala canton has 79,994 regular learning establishments.
Of these, 57,956 are federal or state-managed, and 20,821 are private or individually-managed. This makes up 72% and 26%, respectively.
Of these, 802 are state-missionary, and 415 are municipal.
From these data, it may be concluded that the public education system's coverage is 74% (considering the state establishments, state missionaries, and municipal).
According to the 2010 INEC census, in Machala, 68,681 inhabitants affirmed that their highest education level was *primary education*. A total of 58,079 inhabitants indicated that they had received *secondary education*. As for higher education, university education, 36,790 inhabitants reported having accessed this level.
And the result of this is that only 2,218 inhabitants have received *post-graduate* instruction.
Meanwhile, the *pre-school* level corresponds to 2630 inhabitants, and basic education corresponds to *17,958. Baccalaureate studies* correspond to *21,738,* and post-Baccalaureate studies correspond to 3125 inhabitants.
*571 inhabitants have attended literacy center*s, and 5410 individuals indicate that they *have not attended any school*. This appears to indicate that 6433 inhabitants ignore their education level.

In the Santa Rosa canton, 88.83% of all of the male and female students of the Santa Rosa canton attend public schools while 8.87% attend private ones, 2.15% attend state missionary schools, and 0.15% attend municipal schools.
The education level that was attended by the largest portion of the population was primary education, completed by 36%. It was followed by secondary education, with 24% and 12% for higher education. Basic education, Baccalaureate, and high school studies were the highest levels completed by 9% of the population, and the other levels were completed by 1%, except for higher education (12%).

In the five communities of the rural Jambelí parish, there are schools but they have certain structural and equipment deficiencies, reflecting conditions that are not considered apt for offering a quality education.

In addition, they lack necessary school equipment, such as desks, computers and projectors, preventing students from receiving a proper education.

6.3.3.- HEALTH CHARACTERISTICS

Suitable and timely healthcare ensures the availability of maximum vital energy. This is an essential factor for the overall individual, allowing for an improved quality of life.

The Jambelí parish population faces certain disadvantages, given that in the case of emergencies, the population lacks the necessary means to handle potential complications. This is further exacerbated by the fact that in some cases, given the need to leave the islands, high tides are necessary to seek attention at the healthcare centers, especially those of Huaquillas or Machala.

❖ MORTALITY

One of the most important aspects to analyze in terms of health is mortality, especially infant and maternal mortality.

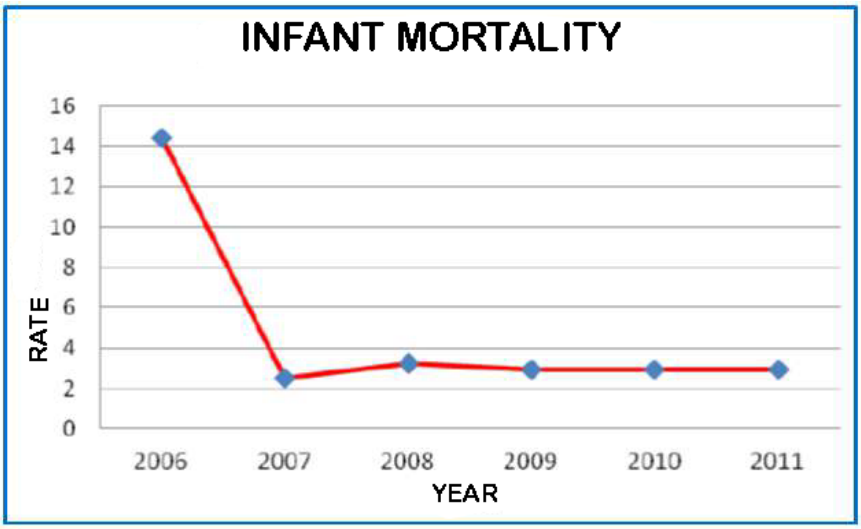
According to data, since 2009 infant mortality rates have remained constant, after experiencing a considerable decline in comparison to recent years.

Table 186: Infant mortality rate in the El Oro province

YEAR	INFANT
2006	14.4
2007	2.5
2008	3.2
2009	2.9
2010	2.9
2011	2.9

Source: INEC Annual of Health Resources and Activities
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

Illustration 195: Infant mortality rate in the El Oro province



Source: INEC Annual of Health Resources and Activities
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

As for maternal mortality, an increased attempt has been made to combat this problem, given that it has reported a very high percentage as compared to recent years. However, it has been declining with the implementation of programs to address it.

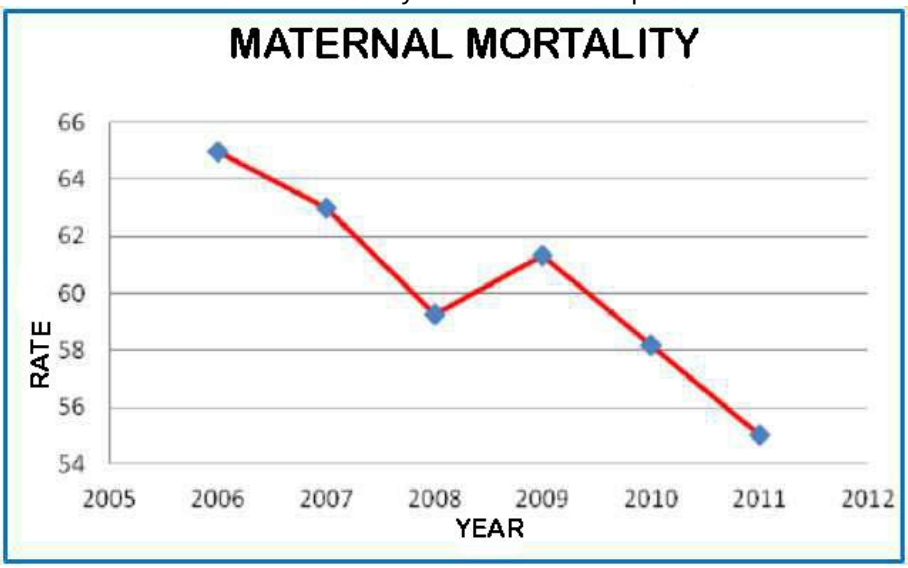
Table 187: Maternal mortality rate in the El Oro province

YEAR	MATERNAL
2006	65
2007	63
2008	59.24
2009	61.36
2010	58.2
2011	55

Source: INEC Annual of Health Resources and Activities
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In the Jambelí parish, concerning mortality causes, we find mainly natural death due to aging as well as: cancer, epilepsy, cardiac/respiratory, diabetes and strokes.

Illustration 196: Maternal mortality rate in the El Oro province



Source: INEC Annual of Health Resources and Activities
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In general, we can observe the mortality rate (per 100 thousand inhabitants) by canton, statistical data collected by the INEC in 2012.

Table 188: The mortality rate for inhabitants of the El Oro province

CANTON	Number of deaths	Population projection	Mortality rate (per 100,000 inhabitants)
Machala	1060	266,638	397.5
Arenillas	109	29,566	368.7
Atahualpa	38	6,216	611.3
Balsas	23	7,714	298.2
Chilla	14	2,548	549.5
El Guabo	206	55,385	371.9
Huaquillas	173	53,237	325.0
Marcabeli	23	5,871	391.8
Pasaje	351	79,451	441.8
Piñas	95	28,086	338.2
Portovelo	65	13,146	494.4
Santa Rosa	293	75,089	390.2
Zaruma	110	25,432	432.5
Las Lajas	20	5,021	398.3
TOTAL	**2580**	**653,400**	**394.9**

Source: INEC Annual of Health Resources and Activities
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

❖ HEALTHCARE COVERAGE

Certain fundamental factors allow society to achieve a higher level of development, more fairly and collectively. One of these factors is health, a key indicator of human development. Therefore, healthcare should be considered a fundamental need that should be guaranteed by the state (guaranteed in the 2008 constitution) to ensure the wellbeing of all social participants. And it should go hand in hand with the creation of infrastructure, expanded physical and human resources, qualitative extension and improvement of healthcare services, provision of resources, medicine, healthcare systems, etc. Preventive healthcare practices should be implemented as a necessary measure to ensure the population's overall wellbeing.

Healthcare coverage in the El Oro province has a major influence on the northern part, corresponding to the high population concentration, although this does not ensure access to these services.

Table 189: Healthcare coverage for the population of the El Oro province

CANTON	PHYSICIANS	POPULATION	RATE
Machala	884	263,161	33.59
Arenillas	23	29,002	7.93
Atahualpa	8	6,175	12.96
Balsas	2	7,507	2.66
Chilla	3	2,569	11.68
El Guabo	28	54,212	5.16
Huaquillas	14	52,200	2.68
Marcabeli	3	5,808	5.17
Pasaje	70	78,213	8.95
Piñas	21	27,752	7.57
Portovelo	9	13,005	6.92
Santa Rosa	57	74,013	7.7
Zaruma	21	25,361	8.28
Las Lajas	5	5022	9.96

Source: Development Plan for the El Oro province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

Table 190: Rate of physicians per inhabitant in the El Oro province

CANTON	PHYSICIANS	POPULATION
Machala	34	26
Arenillas	8	9
Atahualpa	13	7
Balsas	3	0
Chilla	12	0
El Guabo	5	0

Huaquillas	3	11
Marcabeli	5	0
Pasaje	9	16
Piñas	8	24
Portovelo	7	0
Santa Rosa	8	11
Zaruma	8	11

Source: Development Plan for the El Oro province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

The number of physicians and beds per patient continues to be very low as compared to the high demand that currently exists in many cantons such as Balsas, Las Lajas, Portovelo, which do not have duly equipped hospitals or the necessary human resources to ensure patient care.

The rural parish of Jambelí does not have medical centers, and individuals must go to the cantons of Huaquillas, Santa Rosa, and Machala.

There is the necessary infrastructure in three communities but a lack of equipment and personnel available to offer care. Therefore, the local population does not have this type of service available.

- The community of Isla Costa Rica does not have a health center. Care is provided only on Tuesdays in the parish house.
- The Casitas community does not have a health center. When there are medical visits, they take place in a private home, the community house or the school.
- The community of Las Huacas does have a health center but it is not equipped.
- The community of Pongalillo does have a health center but it is not equipped and has no personnel.
- The community of Bellavista does not have a health center. Private home has been adapted to serve as a health center. This property belongs to a shrimp businessman. Services are offered on Mondays, but only during certain seasons.

Access to the health center in the parish is deficient; in many cases, inhabitants live quite a distance from the care facilities and prefer to remain in their home, using ancient forms of medicine to avoid the mishaps often suffered when transferring the sick to a health center.

In the Jambelí parish, due to the difficulty in leaving the islands to go to hospitals, clinics or health centers of nearby cities, there are midwives in the parish who, using their traditional knowledge and use of home remedies, offer their assistance to pregnant women.

❖ EPIDEMIOLOGICAL PROFILE

The El Oro province is mainly affected by the issue of alcoholism that exists in the population. There is an abundance of bars, discos, and other adult nightlife venues in the province, and alcoholic beverages are easily available.

During the winter season, Dengue fever is a common illness, possibly caused by pollution sources, stagnant rainwater, etc.

There are a number of programs and projects being implemented in the El Oro province in response to this, mainly in the Machala canton and SOLCA, together with the support of the Machala municipality, carrying out ongoing campaigns to help prevent cervical, uterine and breast cancer. This campaign was utilized by 1067 women, with the support of mobile clinics of the Municipal Health Network, Hospital Municipal del Sur and Hospital Pomerio Cabrera.

Table 191: Epidemiological profile of the El Oro province

POPULATION HEALTH	RATE PER 10,000 INHABITANTS
Alcoholism	26.5
Dengue fever	66.4
Diabetes	102.3
Drug dependence	1.3
High blood pressure	138.5
Malaria	1.5
Measles	0.6
AIDS	5.2
Tuberculosis	33.1
Victims of abuse and violence	10.8

Source: Development Plan for the El Oro province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In the Jambelí parish, the health of the island inhabitants has not been prioritized in a representative manner; sporadic campaigns are carried out with minimal efforts, failing to solve this parish's needs. It should be noted that regular medical visits are carried out in the islands, led by the Santa Rosa canton's health centers, for vaccination campaigns and medical checkups.

In the epidemiological profile, spontaneous birth is considered one of the parish's major concerns due to the difficulty of leaving the islands and reaching hospitals, clinics or health centers in nearby cities. Pregnant women tend to rely on midwives who offer their traditional knowledge to assist them. However, these midwives do not receive any type of training from healthcare authorities to ensure the newborns' wellbeing or mothers.

The most common illnesses faced by the rural parish population of Jambelí include: respiratory illnesses, infections, allergies, intestinal illnesses, chickenpox, parasitism, hepatitis, diarrhea, high blood pressure, diabetes, high cholesterol, etc. To treat these, medical as well as home remedies are used.

As for high risk illnesses, the Jambelí rural parish reports (in low levels) the following: cancer, epilepsy, cardio/respiratory illnesses, diabetes and strokes.

❖ FERTILITY RATE

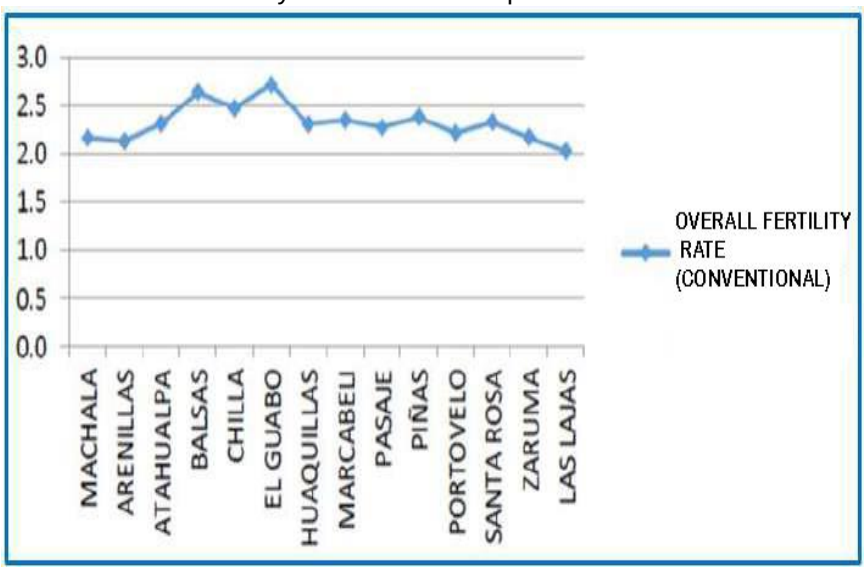
This indicator reveals the potential of the demographic changes of the country. An average of two children per woman is considered the replacement rate for a population, leading to relative stability in overall figures. Averages that exceed two children per woman indicate rising populations and a decreasing mean age. Higher rates may indicate difficulties for families to feed and educate their children and women wishing to enter the labor force. Means below two children per woman indicate a decrease in population sizes and a rising mean age.

Table 192: Overall fertility rate in the El Oro province

CANTON	OVERALL FERTILITY RATE
Machala	2.2
Arenillas	2.1
Atahualpa	2.3
Balsas	2.6
Chilla	2.5
El Guabo	2.7
Huaquillas	2.3
Marcabeli	2.3
Pasaje	2.3
Piñas	2.4
Portovelo	2.2
Santa Rosa	2.3
Zaruma	2.0

Source: Development Plan for the El Oro province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

Illustration 197: Fertility rate in the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In the El Oro province, the average fertility rate is 2.3%, indicating that the population is on the rise.

- **MALNUTRITION**

According to statistics, malnutrition affects 22 out of every 100 children under the age of 5. Due to a lack of iron in the Ecuadorian population, anemia is approaching 60% of all minors under the age of 2 and 44% of all females aged 15 to 49.

Over the past 20 years, Ecuador has decreased its malnutrition rate in children under the age of 5 by 18%. Informative data from the Observatory of the Rights of Children and Adolescents (ODNA) indicate that in the 1980s, malnutrition rates affected approximately 41% of the childhood population, while in 2011, the percentage was reduced to 23%. Despite this major reduction, the government seeks to achieve a free country of chronic malnutrition and anemia.

Poor and inadequate nutrition affects the normal physical and intellectual development of individuals. A decreased intellectual capacity, learning difficulties, deficient development, decreased defenses against illnesses, excess weight and obesity are just some of the associated inconveniences.

Over recent years in El Oro, malnutrition has been reduced thanks to the implementation of programs that were promoted by the MSP, intended to service the most vulnerable sectors. According to the National Survey of Health and Nutrition, in 2012, the malnutrition rate is 4.1.

Table 193: Malnutrition rate in the El Oro province

Mortality rate	Malnutrition
2.9%	4.1

Source: Development Plan for the El Oro Province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

6.3.4.- ECONOMIC ACTIVITIES

PRODUCTIVE STRUCTURE OF THE EL ORO PROVINCE

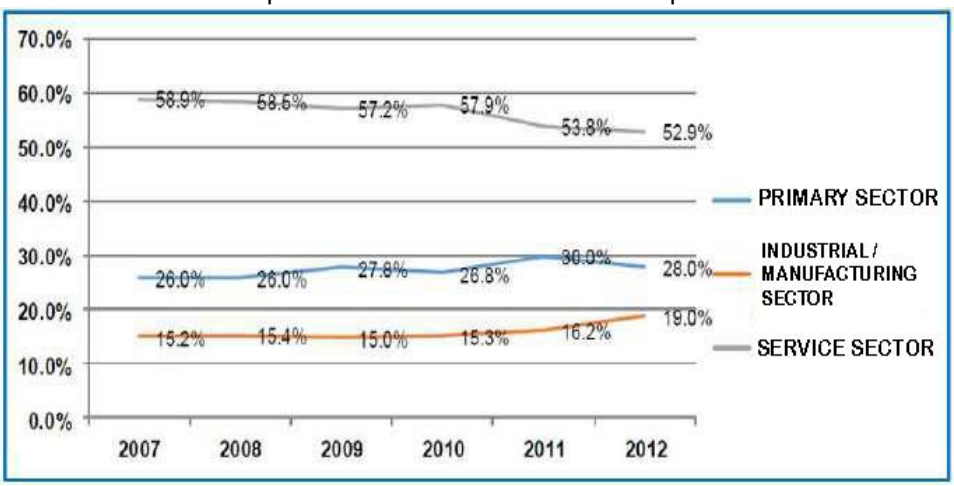
The productive structure of the El Oro province is described in the following tables and illustrations.

Table 194: GVA per economic sector in the El Oro province

GVA	2007	2008	2009	2010	2011	2012
PRIMARY SECTOR	385,765	484,923	571,662	562,118	752,524	800,182
INDUSTRIAL SECTOR	225,070	287,423	307,126	320,201	407,201	544,305
SERVICE SECTOR	874,541	874,541	1,090,100	1,174,465	1,213,081	1,512,858
TOTAL	**1,485,376**	**1,862,446**	**2,096,129**	**2,096,129**	**2,510,806**	**2,857,345**

Source: Development Plan for the El Oro Province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

Illustration 198: GVA per economic sector in the El Oro province



Source: Development Plan for the El Oro Province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

PRIMARY SECTOR

In 2007, the primary sector represented 26% of the provincial GVA, remaining constant until 2011 when it made up 30% of the GVA and in 2012, at 28%.

It consists of all of the activities related to the extraction of goods and resources from the natural environment: agriculture, livestock, fishing, hunting, forest exploitation, and mining.

The employment situation and the origin of income in Ecuador's rural population is paramount for various reasons. First, because it is one of the Latin American societies in which the significance of the rural population is the largest…", devoted to agricultural works as the primary activity. Second, the majority of the poor population is found in the rural environment, affecting the country sector and "unskilled" agricultural workers.

- **INDUSTRIAL/MANUFACTURING SECTOR**

The industrial and manufacturing sector represents the lowest percentage of the GVA of the El Oro province, reaching 15.2% of the provincial GVA in 2007. This percentage increased to 16.2% in 2011, and by 2012, it reached 19% of the GVA of the province. It groups economic activities that are related to the transformation of goods and resources extracted from the natural environment (raw materials) into created products. The essential activities of the sector are construction and industry. The number of workers employed in the secondary sector is quite small in underdeveloped countries (approximately 10%) and is moderate in developed countries (around 30%) due to technological advances.

In the case of Ecuador, this sector includes a series of subsectors that, being transformers of raw goods, belong to this large division; this is the case for the so-called "artisan goods" which, given the weak use of capital, offer goods with high production and sales costs, unlike industry which, with its heavy investments in construction, assembly and operation, rely on cutting-edge technology and economies of scale, allowing costs to be cut and final prices to lower, discouraging and depressing the competition.

- **SERVICE SECTOR**

The tertiary sector of the El Oro province economy represents the largest percentage of the Gross Value Added (GVA). In 2007, it represented 58.9% of the provincial GVA, remaining stable until 2011 and 2012, when it decreased to 53.8% and 52.9%, respectively.

It includes all of the activities that do not directly produce material goods and do not fall within the primary and secondary sectors. These activities are known as "services". Currently, the following are considered to be part of this sector: commerce, hotels and restaurants, transport and communication, finance, a set of auxiliary activities (assessment, computer services, etc.), social and personal services, activities related to leisure, and other diverse activities.

Table 195: Branches of activity by economic sector in the El Oro province

BRANCH OF ACTIVITY	2007	%	2012	%
Agriculture, livestock, forestry, fishing	344,957.47	23%	688,447.47	24%
Mine and quarry exploitation	40,807.674	3%	111,734.117	4%
Manufacturing	47,644.423	3%	105,368.037	4%
Supply of electricity, gas, steam and air conditioning	8,081.59303	1%	30,666.918	1%
Construction	169,344.364	11%	408270.115	14%
Commerce	296,821.209	20%	507,196.43	18%
Transport and communication	105,451.263	7%	170,801.729	6%
Lodging and food service activities	24,181.6614	2%	43,092.6285	2%
Financial activities	27,479.4548	2%	56,971.3758	2%
Professional and real estate activities	95,530.2363	6%	173,724.484	6%
Public administration	115,717.22	8%	192,631.346	7%
Education	118,598.803	8%	181,704.187	
Health	51,459.4205	3%	105,070.979	6%
Arts, entertainment and recreation	3,430.3731	2%	70,237.2731	4%
TOTAL	**1,485,376.5**		**2,857,345.1**	**2%**

Source: Development Plan for the El Oro Province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In 2007, the gross provincial production of the farming, forestry, fishing and aquaculture sectors, with constant prices since 2000, reached 545,553,000 dollars, representing 11.9% of this sector's production in Ecuador 18.8% of the production of the same in the Costa region. Growth of the sector since 2001 has been very significant, coming almost to duplicate its gross production. The fishing and aquaculture subsectors' considerable dynamism is especially relevant, which has multiplied by over three times its gross product in this period. This, in the face of an increase of 24% of the farming subsector's gross product.

The farming sector is considered to be one of the most important productive pillars of Ecuador's economy, given its contribution to the GDP. It is also a major source of foreign currency thanks to the export of traditional and non-traditional products, the generation of employment, and a foundation of food sovereignty policy.

Over recent years, the farming sector has faced diverse problems, such as high input costs, increasing costs of living of inhabitants, favoring imports and preventing access to other markets. This also prevents the creation of economies of scale given the low association level.

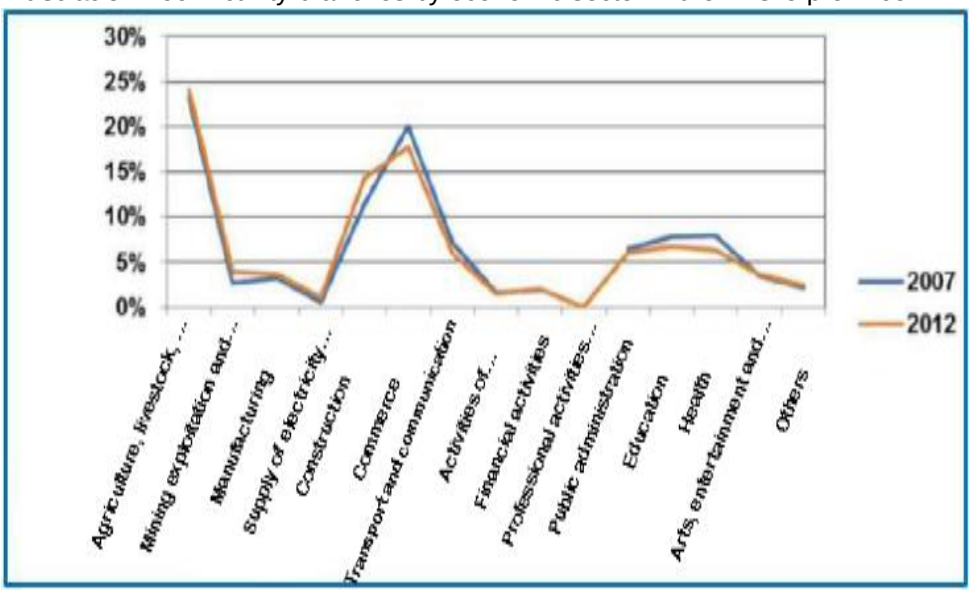
Another sector's problem is the low productivity level of products for internal consumption, low in comparison to those of other Latin American countries.

And we should also recognize that poverty levels are higher in rural areas compared to urban locations. This results from factors such as a lack of credits for rural sectors, limitations in technology, inadequate infrastructures in health, education, basic services, storage, irrigation, fishing docks and others, leading to migration to large cities to ensure the wellbeing of families.

In addition, access to land is not equal, leading to major discrepancies between social sectors.

One of the government's main challenges is the redesigning of its territorial structure to ensure greater equality. Therefore, priority has been given to small and medium-sized producers, creating a positioning for differentiated products and adding value to local and external production through technological innovation. This will help ensure the wellbeing of its inhabitants.

Illustration 199: Activity branches by economic sector in the El Oro province



Source: Development Plan for the El Oro Province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

REGIONAL CONTRIBUTION TO THE GROSS VALUE ADDED BY ECONOMIC SECTOR

Table 196: GVA by economic sector in the El Oro province

GVA	PRIMARY SECTOR	%	INDUSTRIAL SECTOR	%	SERVICE SECTOR	%
National	12579905	100%	15067622	100%	33840133	100%
El Oro	8001815897	1%	5443050701	1%	1512858447	2%

Source: Development Plan for the El Oro Province
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

Table 197: Economically Active Population of the El Oro province

SECTORS	EAP	%
PRIMARY SECTOR	68337	27%
INDUSTRIAL SECTOR	15061	6%
SERVICE SECTOR	144516	57%
Not declared	17391	7%
New worker	9702	4%
	255,007	

Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In 2010, the agriculture, livestock, forestry, and fishing sector constituted the main employment source for 61,592 residents of the province. That is, more than one-quarter of the economically active population (EAP).

The agriculture, livestock, forestry, and fishing sectors are characterized by a very high level of masculinization, with 9 out of 10 workers being male. On the other hand, almost half of the province's active population of 65 years and older (46%) belongs to this sector.

In El Oro, 15,061 (6%) economically active individuals work in the secondary sector. This represents 6% of the provincial EAP. In the El Oro province, 4062 men and 1274 women aged 15 to 29 work in the secondary sector of the economy, representing 7% of the EAP of the province for the 15 to 29-year-old age group.

In Ecuador, the tertiary sector of the economy is the sector having the oldest working population. It is also the most heterogeneous one, including 55% of the population's economically active population.

In El Oro, 144,516 economically active individuals worked in the service sector in 2010. The "commerce" branch makes up 35% of the sector while construction makes up 11% and 9% is found in "transport and storage".

In the El Oro province, 48% of men and 69% of the women aged 15 to 29 work in the tertiary sector of the economy regarding the economically active population aged 15 to 29.

Over the past two decades, the commerce sector's active population, with 50,792 individuals, has more than doubled. This represents 20% of the active Orense population. In addition, the commerce sector is playing a major role in the inclusion of women in the Orense labor market.

Public Administration and Defense consist of 10981 individuals, of which 8058 are male and 2923 are female; men continue to predominate in this sector. However, in other activities of this sector, women are seen to take the lead, as is the education case, making up 7.2% of the sector's workers, of which 7890 are female, and 4401 are male. Similarly, there are 3318 women and 1409 men in healthcare activities, revealing the predominance of women in these sectors. A clear male predominance

characterizes public Administration and Defense. On the other hand, Education and Health are characterized by a clear feminization. The Construction sector reached a record figure in 2010 with 15,781 individuals. This is the most male-predominated sector and is characterized by its youth.

The Manufacturing Industries sector, with 15,061 active workers from the province, has reported a clear stagnation and even a slight decline with regard to its weight in the overall Orense active population in economic sectors.

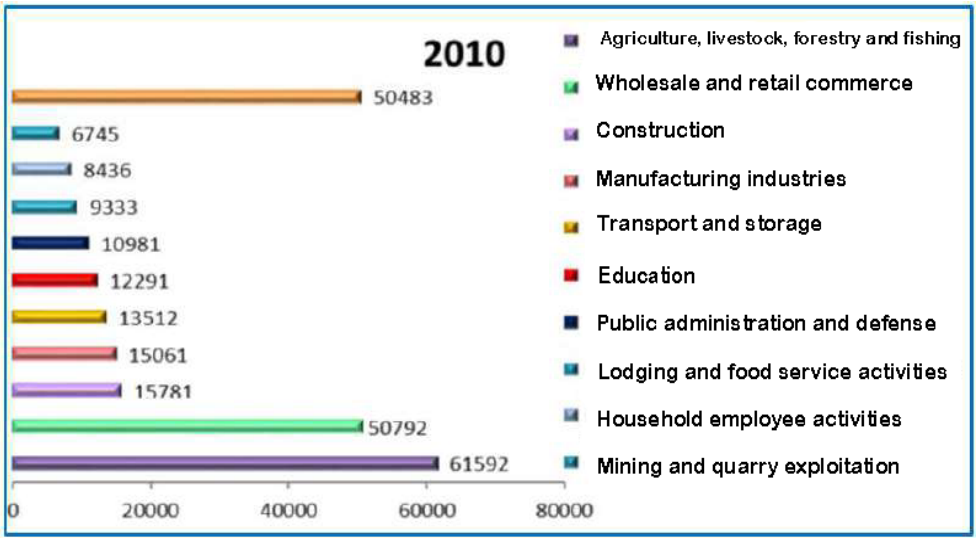
Three subsectors make up approximately two thirds of the active population of the sector: (i) the food and drink industry; (ii) the textile, clothing and leather industry; (iii) the furniture and wood manufacturing industry.

The Food Industry is the source of activity for only one out of every five industrial sector employees and 1.5% of the active Orense workers. This indicates the agro-food industry's limited capacity in collectively generating value added and taking advantage of its great economic potential. For every active individual in the agriculture sector, it is estimated that the province has 0.06-0.08 active workers in the agro-food industry. This industry is characterized by a limited presence of female workers, one out of every four women.

The textile, clothing and leather industry is highlighted by a high presence of female workers, representing 2 out of every 3 female workers.

The industrial sector of furniture manufacturing represents only 16% of the industrial sector's active population, with high levels of masculinization in this industry, even higher than those of the agro-food sector.

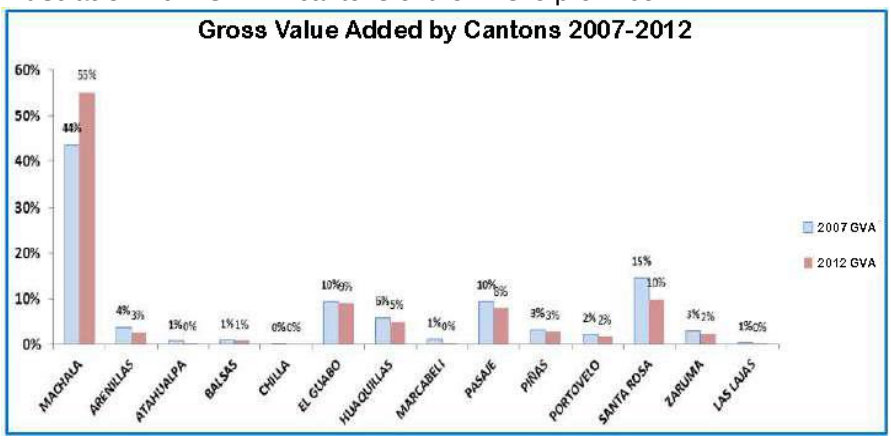
Illustration 200: Economically active population by activity branch in the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

In the Machala canton, with 668,620 thousand dollars in 2007, it made up 44% of the provincial Gross Value Added, with an increase to 1,161,720 thousand dollars in 2012, making up 55% of the province's GVA. The Santa Rosa canton represented 15% of the provincial GVA in 2007 but decreased to 10% by 2012. The same occurred in El Guabo and Pasaje's cantons, with the GVA decreasing to 9% and 8%, respectively.

Illustration 201: GVA in cantons of the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

❖ EMPLOYMENT AND WORK – ECONOMICALLY ACTIVE POPULATION

According to data from the National Survey of Employment, Unemployment and Underemployment for June 2014, the El Oro province has contributed to the Economically Active Population: EAP with 55% of Region 7 and 4.3% of the country's labor force. Economically, it is the most significant contributor to the Zone of Region 7, with 59% of the gross domestic product.

According to data from the 2010 INEC census, 62.56% overall active population in the Machala canton is engaging in some work activity. Of these, 96% are working, that is, engaged in paid labor, while 6% are not working, either because they are seeking employment (for the first time) or because they are unemployed.

According to the National Survey of Employment, Unemployment, and Underemployment for June 2014, the El Oro province population has 662,671 inhabitants; that is, 4.13% of the entire national population. The economically active population of the El Oro province is 297,213 inhabitants as of June 2014. It represents 45% of all of the province's population and 4.3% of the national EAP. The population under the age of 15 in the El Oro province has 187,587 inhabitants, and the working-age population consists of 475,084 inhabitants.

The province's labor market's vigor when incorporating workers from the working-age population should be ensured. This has mainly done for younger labor generations, between 15 and 29 years of age, some twenty years ago.

As a result of all of this, the El Oro province currently has employment rates that are very similar to those of the rest of the country, concerning the working-age population as compared to the large groups that make it up, that of 15 to 64 years of age and that of 65 years of age and older.

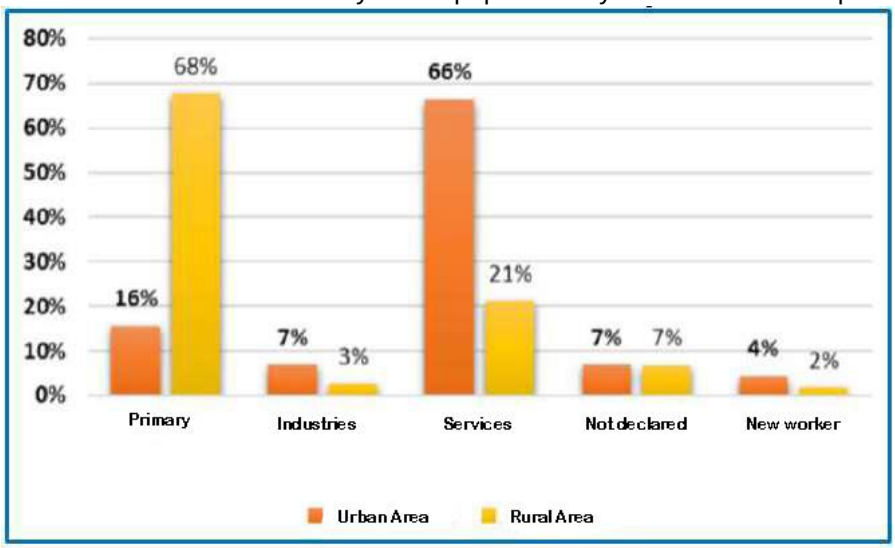
The employment rates in El Oro for those over the age of 15, currently situated at 60.02%, resulting from limited growth over recent decades, coinciding with decreased employment rates for men and very significant increases in employment rates for women. There have also been increasing employment rates for the population aged 15 to 64 and decreases in the employment rates for those aged 65 and over.

In 2010, 2733 minors aged 5 to 14 performed some sort of economic activity in the El Oro province. This figure represents 2.2% of the registered population for this age group in the province. Comparing the situation of this province with the rest of Ecuador, El Oro is in a better situation than the others, especially given the lower percentage of working minors aged 9 to 14.

Employed population by economic sector according to the rural and urban area.

Approximately 79% of the EAP corresponds to the urban area, and 21% corresponds to the rural area. Here, the EAP of the primary sector (farming, livestock, forestry, and fishing) is found in the rural area (68%), while the EAP of the service sector is concentrated in the urban area (66%), as compared to 21% of the rural EAP.

Illustration 202: Economically active population by area of the El Oro province



Source: 2010 INEC census
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

❖ EMPLOYED POPULATION BY ACTIVITY BRANCH ACCORDING TO RURAL AND URBAN AREAS

According to the 2010 Population and Housing Census, all of the EAP of the El Oro province is represented by 171,622 (67%) men and 82,993 (33%) women.

Approximately 22% of the EAP is concentrated in rural areas, mainly in those who carry out farming activities (62.24%). The remainder is distributed amongst the following areas: mine and quarry exploitation (5.53%), manufacturing industries (2.54%), construction (2.53%), wholesale and retail commerce (5.71%), transport and storage (2.23%), and the supply of electricity, water distribution, education, etc. (19.22%).

The economic active population's intense growth is based on changes reflecting the unstoppable incorporation of Orense women into the labor market.

❖ UNEMPLOYMENT

According to the data from the Survey of Employment, Unemployment, and Underemployment from June 2014, the El Oro province's unemployment rate is 3.91% as of June 2014. Compared to the previous year (3.03%), this represents an increase of 0.88%. In 2013, underemployment affected 40,421 individuals, while in 2014, underemployment decreased to 39,437 inhabitants.

Table 198: Unemployment and underemployment rates in the El Oro province

UNEMPLOYMENT RATE	UNEMPLOYMENT (%)	UNDEREMPLOYMENT (%)
National	4.65	12.26
El Oro	3.91	13.27

Source: ENEMDU, June 2014
Created by: Ecosfera Cia. Ltda.
Location: El Oro province
Date: April 25, 2017

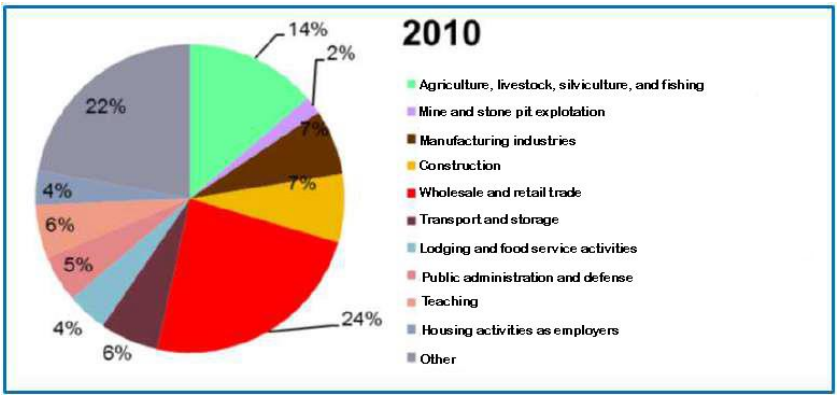
The unemployment rate from June 2014 is lower than the national rate, which is situated at 4.65% as of June 2014. On the other hand, El Oro's province's underemployment rate is greater than the national rate, at 13.27%.

❖ PRODUCTION IN THE PROVINCE

Favored by the western plains' excellent climatic and ecological conditions, the province has excellent productive potential, highlighted by the following crops: banana, cocoa, rice, coffee, sugar cane, corn, citric fruit other fruit and vegetable crops. The province has cattle production milk and beef, poultry farming, pig farmers, and wine-making for livestock production. The province also has a strong potential for aquaculture

particularily shrimp and tilapia harvesing, artesanal fishing and seafood collection which is an important economic activity. Mining is another important economic activity, being gold, silver, and stone materials the primary deposits.

Figure 203: Population occupied by activity branch, urban area, El Oro province



Source: *Census INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *El Oro Province*
Date: *April 25, 2017*

❖ BANANA PRODUCTION AND SALE

The annual banana production at El Oro represents 43.3 % of the national banana production; it occupies 29 % of the planted annual surface and 33 % of the national banana production's harvested annual surface.

Table 199: Banana production in El Oro Province

YEARS	Planted	Harvested	Production (Tm)	Sales
2005	50402	49290	2257812	2033675
2006	52347	50648	2273532	1992146
2007	53439	50496	2179639	1950380
2008	57994	52721	2421374	2252980
2009	65285	62046	3744583	3105517
2010	67934	63975	3887126	3446460
2011	55163	54625	2443673	2279247
2012	63892	62836	2259688	2220666
2013	64094	62667	2594000	2490056

Source: *Development Plan, El Oro Province*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *El Oro Province*
Date: *April 25, 2017*

The Coastal Region is the main banana producer in Ecuador. With 185,827 ha cropped and 160,920 ha harvested in 2013, it represented 85% of the cropped area and 85% of the country's harvested area. Its production, with 5,730,329 mt, represented 96% of Ecuador's production for that year. Three provinces concentrate both the area used for cropping and the production obtained therein in the Region: El Oro, Esmeraldas y Los Ríos. The three together account for 82.1% of the cropped area in the region, 82.7% of the harvested area, and 95% of the Coastal Region production.

El Oro's province has the highest percentage of harvested area at a national level, with 33.22% of the agricultural area. In contrast, Los Ríos has the second-highest percentage, with 33.43% of the cropped area at the country level.
In 2013, El Oro's province was ranked as the main producer with 2, 594,000 tons per year, representing 43.3% of total national production, leaving the province of Los Ríos in second place, with 28.84% of the national banana production.
The mean cropped area during the 2005-2013 period in El Oro was 57,720 ha, with an average harvested area of 55 431 ha and an average production of 2,
020,044 mt.

With a mean annual yield of 36.44 mt/ha over the 2005-2013 period, El Oro has a mean yield 7% lower than that of Guayas and 24% lower than that of Los Ríos. The mean annual national production yield per hectare is 32.81 tons during the 2005-2013 period.
At a national level, the area where the banana was harvested has maintained a downward trend with a mean growth rate of -0.66% between 2005 and 2013. During 2013, there was a growth of 9.86%, i.e., approximately 18,921 ha; despite the aforementioned, production showed a mean growth rate of 1.92% between 2005 and 2013. In 2013, there was a decrease of 5.59% as compared with the previous year. The activities related to banana exports are located mainly in the Coastal Region. In 2013, the provinces of Los Ríos, El Oro, and Guayas accounted for 78.54% of this product's total harvested area. It is noted that the province of El Oro is the most dedicated to the cultivation of bananas, with a share of 29.42% and a production percentage of 33.22% of the metric tons of bananas harvested in 2013 at a national level. The provinces that follow in importance are Los Ríos and Guayas, having 28.23% and 21.21% of the harvested surface, respectively. They, in turn, account for 28.84% and 23.16% of the total metric tons of bananas produced. Several reasons explain the lower yields in the province, apart from possible climatic circumstances or plant health that may have affected the plants' production cycle. Among the most significant reasons, those related to the size of the farms, the plantations' productive age, their level of technology, access to irrigation, and the degree of intensity with which production processes are carried out should be mentioned. The size of the banana farms, especially the size of the plots cultivated by the farms, conditions the producers' access to agricultural inputs, limits their applications, and causes production costs to vary across farms. In this sense, El Oro has the smallest production structure in the Coastal Region.

El Oro has a greater polarization between small and large farms in the province, having a greater number of small farms than in the region as a whole, although possibly with a smaller surface area assigned to them. The age composition of banana plantations in El Oro reflects higher average aging than that of the region. As plantations get older, their average yields decrease.

According to figures provided by the Asociación Ecuatoriana de Exportadores de Banano [Ecuadorian Association of Banana Exporters], 61 million 368 thousand 396 boxes of fruit were exported from the province of El Oro to the international market during 2014.
In 2013, the export volume was lower. From January to December of 2013, a total of 55,555,669 boxes were exported. Exports levels were maintained during all these months at an average of five million boxes per month. This does not consider the month of January, in which 7 million boxes were exported, nor September, which was the lowest month, with 4 million exported boxes. For 2013, the national average calculated up to October was 246,195,861 boxes of fruit, according to the Asociación Ecuatoriana de Exportadores de Banano.

The monthly evolution of shipments at Puerto Bolivar shows that banana production and export activities are kept going throughout the year, ensuring a permanent flow of income to producers and the sector as a whole. On the other hand, the higher level of export activity, and therefore of production, which occurs between the months of December and May, where there is a higher export of boxes, coincides with the decrease in the production activity of competing Caribbean countries, which greatly benefits the market position of Ecuadorian bananas and, in this case, of bananas from El Oro.

In 2010, four exporting companies from El Oro were among the top 30 banana exporters in Ecuador. These four companies accounted for 8.04% of Ecuador's banana exports that year. The Agencia Ecuatoriana de Aseguramiento de la Calidad del Agro [Ecuadorian Agency for Agricultural Quality Assurance] has a Border Control Unit center (Huaquillas), a Port Control Unit center (Puerto Bolivar) and an Airport Control Unit center (Santa Rosa Regional Airport) in El Oro.

PRODUCTIVE ECONOMIC SYSTEM OF THE MACHALA CANTON

Machala, capital of El Oro's province, is a productive agricultural canton with a large commercial and banking activity, causing it to become the economic center of southern Ecuador. Its population is mainly dedicated to the banana industry, so it is internationally recognized as the "Banana Capital of the World." Shrimp farming and harvesting are other productive activities. In addition, a large part of the population is dedicated to the commercialization of machinery, vehicles, household appliances, clothes, etc. Furthermore, there has been a noticeable increase in tourism activities in nearby beaches and rivers. Therefore, tourism has become an important commercial activity for those who offer tourist services. Also, the capital has recently become the center for the execution of important business activities and large companies setting up.

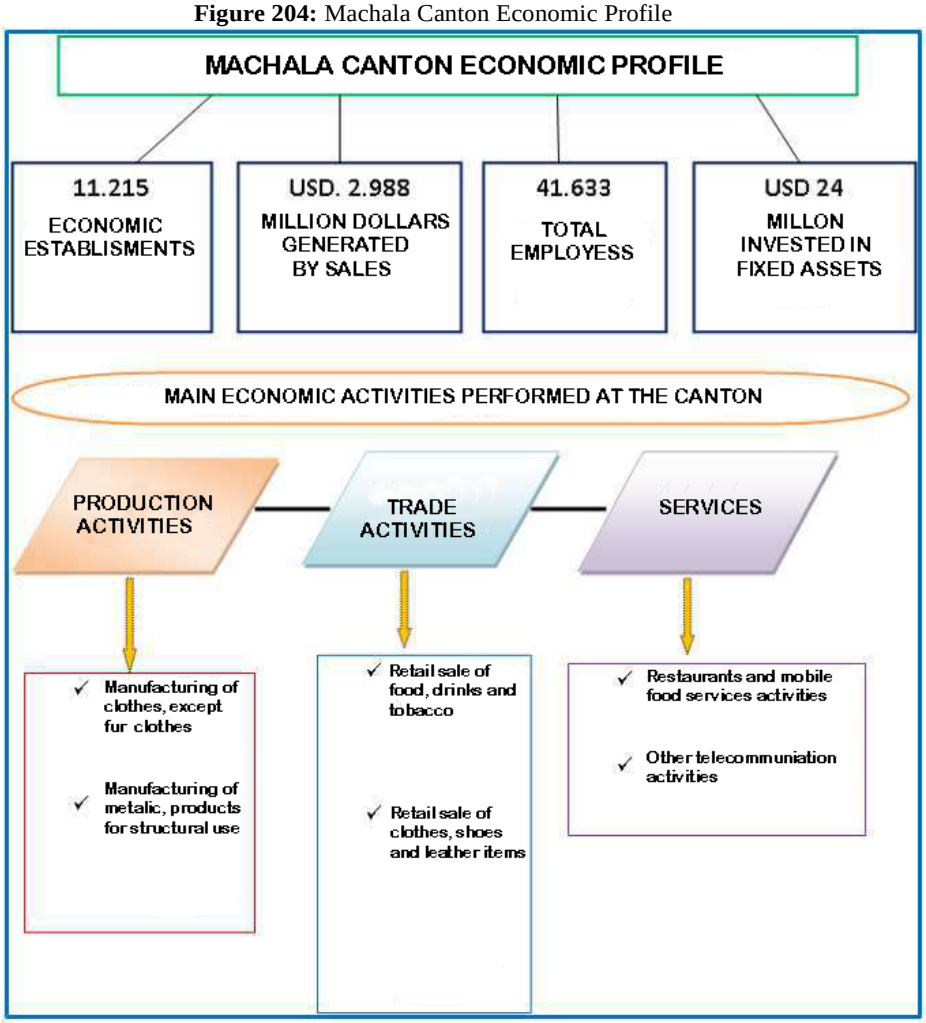
From the point of view of productivity, the population of a community is classified into two groups. One group is referred to as the economically active population (EAP). Its members make up the labor force and produce goods and services. They may have the status of employed or unemployed: in the first case, there is sub employment. The other group is the economically inactive population (EIP) and comprises housewives, students, retirees, and people with work-related disabilities.

The economically active population (EAP) is that part of the population dedicated to the production of goods and services of a society. This concept's basics maintain consistency throughout the various population censuses carried out in the country, allowing comparison of census data.

For the purposes of INEC (Instituto Nacional de Estadística y Censos [National Institute of Census and Statistics])'s 2010 Census, the ECONOMICALLY ACTIVE POPULATION (EAP) is made up of persons 10 years of age and older who worked at least 1 hour in the week of reference, or who did not work, but had employment (employed), or those who were not employed, but were available for work and were looking for work (unemployed).

In the Machala canton, the Economically Active Population (EAP), according to INEC's 2010 Census, is 38%.
As per the latest report released at the end of 2011 by the Instituto Nacional de Estadísticas y Censos (INEC), and the survey conducted by the agency in 127 population centers of Ecuador, the cities that report a sharp decline in unemployment are Guayaquil and Machala, after suffering the greatest impact of the international financial crisis in 2009.
Machala went from a rate of 9.5% in the third quarter of 2009 to 6% this year, a figure even lower than the 7.9% recorded between July and September of 2008. Likewise, Guayaquil fell from 13% to 10%.

Figure 204: Machala Canton Economic Profile



Source: *Census INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Machala Canton*
Date: *April 25, 2017*

According to INEC and the data resulting from the 2010 Census, there are 11,215 economic establishments in Machala. On the other hand, 2,988 million USD was generated by sales. There are 41,633 employees at the Machala canton, according to the same 2010 Census. As of fixed assets, 24 MILLION USD were invested.

The main economic activities performed at the canton are the following: Production activities, trade activities, and services.

❖ BRANCHES OF ACTIVITY OF THE POPULATION IN MACHALA

The population in Machala is inclined to 21 activities, which are deemed as the most important ones. Of these, three stand out as having the highest percentage:

- 27,192 inhabitants of Machala, which corresponds to 25% of the population, work in retail and wholesale trade.
- The second most important sector is agriculture, livestock, forestry, and fishing: 14,244 inhabitants (13%) work in those activities.
- The manufacturing industry accounts for 7% of the population, amounting to 7,670 inhabitants dedicated to this activity.
- The construction industry also employs 7% of the population, meaning that 7,593 inhabitants work in those activities.
- 7% is the percentage of undeclared works. 6% of the population works in transportation and warehousing activities.
- The Teaching category, which is the one that follows in importance, employs a percentage of 5% of the population, which translates to 5,312 economically active inhabitants.
- It is also important to mention the Public Administration category, which gives employment to 5% of the inhabitants, amounts to 5,215 inhabitants. Regarding accommodation and food service activities, they provide employment for 5% of the inhabitants, representing 5,089 inhabitants.
- Public administration and defense, considered as a branch of activity, comprises 5% of the population of Machala; that is, 5,215 inhabitants are work in the aforementioned branch.
- The number of new workers reached 4,868 inhabitants, which represents a percentage of 4%.
- The remaining percentage of the population ranges from 0% to 3%.

Table 200: Branches of activity of the population of the Machala canton

BRANCH OF ACTIVITY	NUMBER
Agriculture, livestock, forestry, and fishing	14,244
Mining and quarrying	639.00
Manufacturing industries	7,670
Supply of electricity, gas, steam, and air conditioning	473.00
Water distribution, sewerage, and waste management	487.00
Construction	7,593.00
Retail and wholesale trade	27,192
Transportation and warehousing	6,579
Accommodation and food service activities	5,089
Information and communication	1,301
Financial and insurance activities	362
Real Estate activities	129
Professional, scientific, and technical activities	1,615

BRANCH OF ACTIVITY	NUMBER
Administrative and support services activities	2,384
Public administration and defense	5,215
Teaching	5,312
Human health care activities	2,768
Arts, entertainment, and recreation	640
Other service activities	2,962
Household activities as employers	3,557
Activities of extraterritorial organizations and bodies	5
Undeclared workers	7,150
New workers	4,868
TOTAL	**108,234**

Source: *INEC (Instituto Nacional de Estadística y Censo [National Institute of Statistics and Census]) Census, 2010*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Machala canton*
Date: *April 25, 2017*

SOCIOECONOMIC ACTIVITIES OF PUERTO BOLÍVAR

Puerto Bolivar is the main urban parish of the Machala canton, where one of the most important export ports in the country is located. It is estimated that approximately 85% of Ecuador's total banana production is marketed through the seaport of Puerto Bolívar However, other production and export activities are also developed around Puerto Bolivar, such as cocoa, coffee, shrimp, tropical fruits, timber, seafood, and minerals, making Machala a center of supply and trade for gold mining.

ECONOMIC PRODUCTIVE SYSTEM OF THE SANTA ROSA CANTON

In Santa Rosa canton, both men and women tend to work, as shown in the table below:

Table 201: Occupation of the Santa Rosa canton's population

OCCUPATION CATEGORY	TOTAL
Employee or worker of the State, Government, Municipality Provincial council, parish councils	3,754
Private employee or worker	4,485
Laborer or day laborer	6,006
Employer	630
Partner	293
Self-employed worker	6,929
Unpaid worker	419
Domestic worker	1,063

OCCUPATION CATEGORY	TOTAL
Unknown	1,676
TOTAL	**27,710**

Source: *INEC Census, 2010*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

7,565 of the men of Santa Rosa canton work in the agricultural sector. Then, 2,554 men work in wholesale and retail trade. Later comes the construction sector. On the other hand, 1,979 women are engaged in wholesale and retail trade, and 1522 women work in the teaching sector.

In relative terms: considering the branch of activity with the highest percentage of the population, agriculture, livestock, forestry, and fishing activities come first, employing 29.84% of the inhabitants. This is followed by wholesale and retail trade, with 15.73% of the population. Then comes education with 7.91%, manufacturing industries with 5.60%, construction with 5.85%, transportation and storage with 4.04%, public administration and defense 3.65%, household activities as employees 3.20%.
Mining and quarrying give employment to 1.73% of the population, administrative and support activities to 1.54% of the inhabitants, human health care activities to1.39%, scientific and technical activities to 0.74%, and arts and recreation to 0.29% of the population.

JAMBELÍ PARRISH

The Jambelí Parrish is a source of income for its inhabitants.
Of the 234 families that live in the parish, 134 families (57% of the population) are dedicated to fishing and collecting shells. This is due to the fact that these families dedicate their time to collecting shells (abundance) and the rest of the time to fishing; 71 families (31% of the population) are dedicated entirely to fishing; 12 families (5% of the population) collect crabs, and 17 families (7% of the population) no longer carry out any economic activity; in addition, some families conduct other additional or complementary activities apart from their daily activities in order to improve their income and render temporary services.

- **Artisanal fishing**
  Artisanal fishing is carried out in the estuaries and channels of the parish archipelago, in which each community has its fishing area. Hence, the type of fish collected varies between communities. However, the common ones are: *Sano*, snook, sea bass, millet, hogfish, *chaparra*, catfish, black drum fish, *carita, cachema, curel, mascapalo, rayado,* batoids, *sierra,* guitarfish, monkfish, common sole (guardaboyo), and in April and May, the sea shrimp.

- **Shell collection**
  The type of collected shells are: black pustulose ark, pustulose ark (Anadara grandis), *la bajera*, shell, clam, whiteshell, mussel, oyster, churo snail, lama shell.

- **Crab harvesting**
  This activity is similar to shell collecting, the type of crabs collected are: red crab (Ucides occidentalis) and blue crab.

- **Other activities**
  Agriculture is one of the activities that they develop. Some families conduct them in the winter to take advantage of the rainy season, in which they grow watermelon. After finishing their fishing activities, some families dedicate themselves to the collection of tamarind and plum in the high season. Another important but underdeveloped activity in which some families work is that of community tourism. In addition, some inhabitants are temporarily employed as day laborers in shrimp farms. Furthermore, several families have small stores of basic necessities. All these activities are complementary and/or economic alternatives for the family's livelihood.

- **Agricultural Production:**
  The Jambelí Parish has 25427.36 ha, 57% of which are used for agricultural production. From the preceding table, we can see that there is a high concentration of productive activity in the parish, which is dedicated exclusively to shrimp farming, a product that is exported almost in its entirety.
  In the parish, the main species of cultivated shrimp is Litopenneus Vannamey. In Jambelí, the crop is semi-intensive, with an average production rate per hectare of 2200 kg, which approximates 6345.63 tons.
  The main destination of shrimp production is the United States, where approximately 50% of the country's shrimp production is exported, followed by European Union countries (Italy 15%, Spain 14%, France 5%, and the United Kingdom 4%).

- **Hydrobiological production (estimated)**
  The data provided by the fishermen indicate that in the Jambelí parish, about 11,320 quintals of fish are produced (captured) per year; about 1,371,800 units of shells are produced (collected) per year; about 3,660 crabs are produced (collected) per year.

  The annual production of fish, shellfish, and crab by sector (islands) is detailed below:
  - In Costa Rica Island: approximately 3024 quintals of fish are produced (collected) per year, and approximately 756,000 shells are produced (collected) per year.
  - In Las Casitas Island: approximately 2,400 quintals of fish are produced (collected) per year; approximately 288,000 shells are produced (collected) per year
  - In Las Huacas Island: approximately 1936 quintals of fish are produced (collected) per year; approximately 18,3800 shells are produced (collected) per year; 26880 crabs are produced (collected) per year.

- The Bellavista island produces (catches) about 1,800 quintals of fish per year; and produces (collects) approximately 108,000 shells per year.
- In Pongalillo Island: about 2160 quintals of fish are produced (collected) per year; approximately 36,000 shells are produced (collected) per year; 10080 crabs are produced (collected) per year.

The products obtained by the inhabitants of the parish of Jambelí are commercialized in the ports of: Puerto Hualtaco in Huaquillas; Puerto Jelí in Santa Rosa and Puerto Bolívar in Machala. These ports are where the main traders (intermediaries) can be found. They manipulate the prices, keeping most of the product's profits since the prices they handle are very low, and many times the fishermen end up losing money in several transactions.

Another of the economic activities that are developed on the island and that has become an important source of income for the inhabitants of the area is ecotourism, since, in addition to the beautiful places of recreation and leisure that exist in the area, the visitor can find around the beach, dining rooms, cabins, hotels, which make it possible to enjoy a comfortable and pleasant stay.

PRODUCTIVE ECONOMIC SYSTEM OF ISLA PUNA

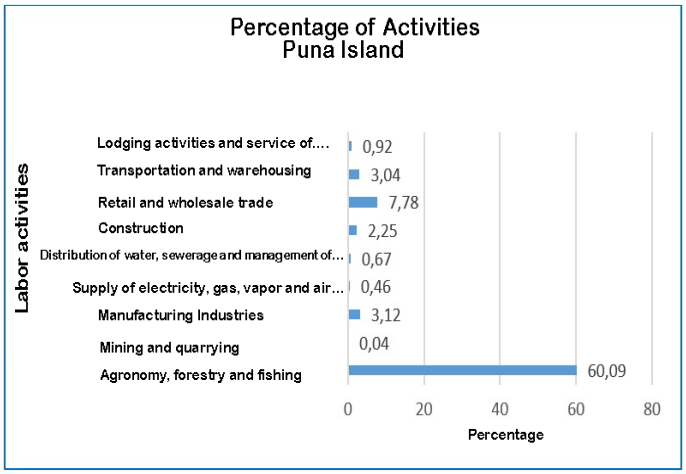
Table 202: Percentage of activities Isla Puna

PERCENTAGE OF BRANCH OF ACTIVITY ISLA PUNA		
Branch of activity (First level)	**Cases**	**Percentage**
Agronomy, forestry, and fishing	1,444	60.09
Mining and quarrying	1	0.04
Manufacturing industries	75	3.12
Supply of electricity, gas, steam, and air conditioning	11	0.46
Water distribution, sewerage, and waste management	16	0.67
Construction	54	2.25
Retail and wholesale trade	187	7.78
Transportation and warehousing	73	3.04
Accommodation and food service activities	22	0.92
Information and communication	3	0.12
Financial and insurance activities	2	0.08
Real Estate activities	1	0.04
Professional, scientific, and technical activities	10	0.42
Administrative and support services activities	15	0.62
Public administration and defense	31	1.29
Teaching	73	3.04
Human health care activities	13	0.54
Arts, entertainment, and recreation	4	0.17

PERCENTAGE OF BRANCH OF ACTIVITY ISLA PUNA		
Branch of activity (First level)	**Cases**	**Percentage**
Other service activities	28	1.17
Household activities as employers	66	2.75
Undeclared workers	174	7.24
New workers	100	4.16
Total	**2,403**	**100.00**

Source: *INEC Census, 2010*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Isla Puna*
Date: *April 25, 2017*

Illustration 205: Labor activities Isla Puna



Source: *INEC Census, 2010*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Province of El Oro*
Date: *April 25, 2017*

According to INEC's 2010 Census, 60% of the total population of Puna Island's main branch of activity is agriculture, forestry, and fishing.

6.3.5.- CHARACTERISTICS OF THE HOUSING UNITS

❖ INFRASTRUCTURE AND ACCESS TO BASIC SERVICES

In 2010, there were 159,016 housing units in the province, of which 97% had electricity, 56% had drinking water, 86% had garbage collection and 64% had sewerage services.

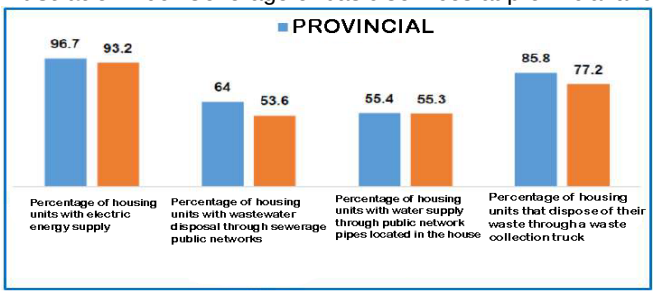
Table 203: Coverage of Basic Services in the province of El Oro

Unidad Territorial	Availability of water (%)	Availability of sewerage services (%)	Availability of electricity	Solid waste
El Oro	55.5	64.0	96.7	85.8
National	55.3	53.6	93.2	77.2

Source: *Sistema de Indicadores Sociales del Ecuador [System of Social Indicators of Ecuador], SIISE*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

The coverage of basic services in the province of El Oro is above the national average, as shown in the following graphic:

Illustration 206: Coverage of basic services at provincial and national level



Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

❖ COVERAGE OF BASIC SERVICES BY TERRITORIAL UNITS

Table 204: Basic Services Coverage by canton and area

Cantons	Total of housing units	Drinking water		Sewerage services		Electricity		Waste collection	
		#	%	#	%	#	%	#	%
MACHALA	6416	37612	58.6	47790	74.4	62712	97.7	58895	91.79
Urban	3841	734	19.1	884	23	372	96.8	2443	63.6
Rural	60319	36878	61.1	46906	77.7	58992	97.8	56452	93.59
SANTA ROSA	18385	1187	64.5	12444	67.6	17556	95.4	14908	81.09
Urban	5304	1975	37.2	1561	29.4	4796	90.4	2936	55.35
Rural	13081	9895	75.6	10883	83.1	1276	97.5	11972	91.52
TOTAL OF THE PROVINCE	**159016**	**88234**	**55.4**	**101845**	**64**	**153843**	**96.7**	**136343**	**85.74**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

PIPED WATER FROM PUBLIC WATER SUPPLY NETWORK

Table 205: Piped water from public network cantons

Province Canton	Percentage	Number of Housing Units	Total of Housing Units
EL ORO	79.4%	126,407	159,016
MACHALA	81.0%	52.01	64.16
Urban	84.0%	50,708	60,319
Rural	33.8%	1,302	3,841
SANTA ROSA	88.2%	16,216	18,385
Urban	97.7	12,782	13,081
Rural	64.7	3,434	5,304

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

WATER PIPED BY PUBLIC WATER SUPPLY NETWORK INSIDE THE HOUSING UNIT

Table 206: Water piped by public water supply network inside the housing unit Cantons

Province Canton	Percentage	Number of Housing Units	Total of Housing Units
EL ORO	55.4	88,234	159,016
MACHALA	58.6	37,612	64.16
Urban	61.1	36,878	60,319
Rural	19.1	734	3,841
SANTA ROSA	64.5	11.87	18,385
Urban	75.6	9,895	13,084

Rural	37.2	1.975	5.304

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

SEWERAGE NETWORK

Table 207: Coverage of Sewerage Network by canton

Province Canton	Percentage	Number of Housing Units	Total of Housing Units
EL ORO	64.0	101,845	159,016
MACHALA	74.4	47,790	64,160
Urban	77.7	46,906	60,319
Rural	23.0	884	3,841
SANTA ROSA	67.6	12,444	18,385
Urban	83.1	10,883	13,081
Rural	29.4	1,561	5,304

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

❖ POPULATION'S ACCESS TO HOUSING

According to data from the Instituto Nacional de Estadística y Censos (INEC) obtained from the results of the 2010 Population and Housing Census in Ecuador, the total number of housing units in the province of El Oro is 159,016 homes (163,290 households), of which 36,345 are located in rural areas and 122,671 in urban areas. There are many unrecoverable housing units concerning the quantitative housing deficit: 27% of the housing units are located in rural areas (9,806 units), and 15.5% of those are located in urban areas (18,881 units) are unusable. 37.6% of the housing units in El Oro present a quantitative housing deficit, which means that there are currently 59,846 housing units that, due to their unsatisfactory quality, can be improved through repairs, changes in materials, surface extensions, or connection to basic services.

Table 208: Tenure of housing in the province of El Oro

TENURE OF HOUSING	HOUSING UNITS	%
Own and fully-paid house	72,956	44.7
Rented house	36,169	22.2
Lent or donated house (not paid)	25,102	15.4

TENURE OF HOUSING	HOUSING UNITS	%
Own (given, donated inherited)	15,636	9.6
Own house but in the process of its payment	9,502	5.8
By services	3,567	2.2
Antichresis	358	0.2
TOTAL	163,290	100%

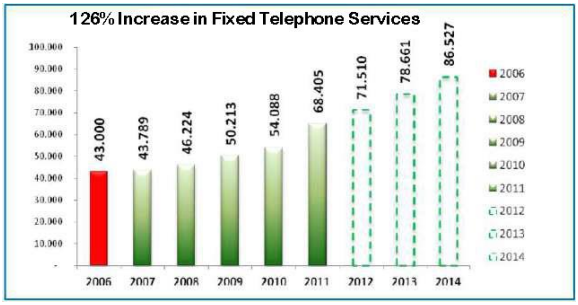
Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

In relation to basic services, the results of the 2010 Census show that the percentage of availability of garbage disposal, sewage system, and electricity service is higher than the national average. However, exclusive sanitary facilities and conventional telephone service have values below the country's average. It should be noted that the use of firewood or charcoal for cooking is very low (1.59%) compared to the national average (6.80%).
Another important datum that defines housing characteristics is what is used in households for cooking.
Basic housing services, including telephone services, have increased with respect to the 2001 Census. The largest percentage increase is in the service of garbage disposal with a collection vehicle.

❖ ACCESS TO TELECOMMUNICATIONS SERVICES

In 2010, according to the Instituto Nacional de Estadística y Censos (INEC), 36,120 housing units had telephone service or 22.7% of occupied houses with people living in them.
As per data from the Corporación Nacional de Telecomunicaciones (CNT) [Telecommunications Corporation], El Oro Agency, at the beginning of 2007, only 43,000 users had fixed telephone service in the province of El Oro. With the development of the National Connectivity Plan in El Oro's province, the infrastructure has increased by 126%. By the end of 2011, 68, 405 began using fixed telephone services.

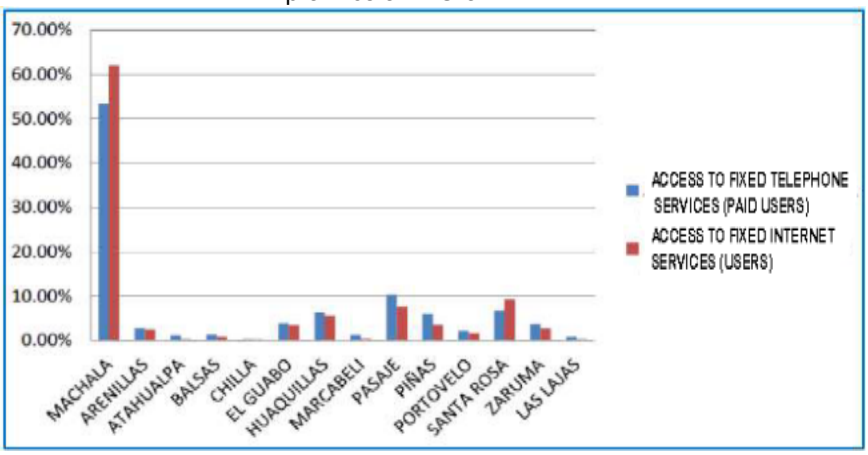
Illustration 207: Fixed telephone services of the Province of El Oro



Source: *2011 Corporate Governance Report. Agencia Regional Siete [Seventh Regional Agency] of CNT*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Province of El Oro* ***Date:***
April 25, 2017

CNT has provided broadband internet service starting with speeds of 128Kbps. But now, the speeds reach 15 Mbps This directly benefits the student and the productive sector of the province. Up to the end of 2011, 17,114 broadband Internet ports have been marketed.

Illustration 208: Access to Telephone and Internet services in the province of El Oro



Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

According to the data obtained from the 2010 Census, we can determine that there is greater telephone and internet coverage in the Machala canton, followed by Pasaje and Santa Rosa. The cantons that have less coverage are Chilla and Las Lajas due to the central office's distance.

INFO CENTER

The Info centers are community spaces for participation and development, which guarantee inclusive access to Information and Communication Technologies for rural and marginal urban parishes in Ecuador.
The proposal consists o introducing citizens to ICT knowledge in order to reduce the digital gap and illiteracy, motivating them to use technology to their advantage, thus improving their quality of life and promoting the productive development of their community, providing access to online products and services, both at a local and international level.

Table 209: Access to telecommunications services in the province of El Oro

PROVINCE	COVERAGE
Fixed telephone services	37.12%
Mobile telephone services	92.72%
Access to internet	33.71%

Source: *Development plan province of El Oro*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

HOUSING UNITS IN THE MACHALA CANTON

According to the 2010 Population and Housing Census conducted by the INEC, there are 75,479 housing units in Machala. Of these, 72.9% are houses or villas. This is considered to be the highest percentage.
9.9% are apartments, and 7.92% are rooms in tenement houses. 4.10% are ranches, and 1.09%, sheds.
The remaining 4.09% is divided with percentages lower than 1% between dwellings considered as collective housing units, nursing homes or orphanages, shacks, hotels, boarding houses, shelters, etc. This can be seen in the following table:

Table 210: Kind of housing units of Machala canton

KIND OF HOUSING UNIT	CASES	%
House/Villa	54,867	72.69
Department at a house or building	7,541	9.99
Room at a tenement house	5,975	7.92
Prefabricated house	253	0.00
Ranch	3096	4.10
Shed	824	1.09
Shack	108	0.14
Other particular housing	460	0.61
Hotel, boarding or residential house or hostel	20	0.03
Military barracks or police/firemen station	4	0.01
Social rehabilitation center/Prison	3	0.00
Shelter and protection center for children, women, and indigent people.	2	0.00
Hospital, clinic, etc.	11	0.01

KIND OF HOUSING UNIT	CASES	%
Convent or religious institution	7	0.01
Nursing home or orphanage	1	0.00
Other collective housing units	24	0.03
Homeless	6	0.01
Total	**75,479**	**100,00**

Source: *INEC Census* ***Prepared by:*** *Ecosfera Cia. Ltda.* ***Location:*** *Province of El Oro* ***Date:*** *April 25, 2017*

❖ OCCUPANCY CONDITIONS OF HOUSING UNITS IN THE MACHALA CANTON

Of the 71,401 dwellings considered by INEC during the 2010 Census, 85.09% are occupied by persons living in them, and 4.4% are occupied by individuals not living in them. 7.65% of the housing units are unoccupied, and 2.86% are under construction.

Table 211: Occupancy Condition of the housing units in the Machala canton

Occupancy condition of the housing units	CASES	%
Occupied with individuals living in the housing units	64,016	85.09
Occupied with individuals not living in the housing units	3,317	4.40
Unoccupied	5,765	7.65
Under construction	2,159	2.86
Total	**75,401**	**100.00**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ MAIN ACCESS ROAD TO THE HOUSING UNITS IN THE MACHALA CANTON

As for the main access to the housing units in Machala, according to INEC in its 2010 census, out of 75,401 homes, 53.80% have a paved or concrete street or road. 23.42% ballasted street or road. A percentage of 20.33% have cobblestone access roads. The remaining 2.45% of housing units have trails, small paths known as Chaquiñán, river, sea, or lake as an access channel.

Table 212: Main access road to the housing units in the Machala canton

MAIN ACCESS ROAD HOUSING	CASES	%
Paved or concrete street or road	40,566	53.80

MAIN ACCESS ROAD TO THE HOUSING	CASES	%
Cobblestone street or road	15,328	20.33
Soil or ballasted street or road	17,661	23.42
Trail, path, chaquiñán	1,639	2.17
River/sea/lake	36	0.05
Other	171	0.23
Total	**75,401**	**100%**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ BASIC HOUSING SERVICES IN THE MACHALA CANTON

According to the 2010 INEC census, basic public services include electricity, water, sanitary facilities and waste disposal.
In Machala, the percentage of housing units with basic public services amounts to 67%.

❖ AVAILABILITY OF WATER IN THE HOUSING UNITS OF THE MACHALA CANTON

The Machala canton has drinking water services, which cover about 85% of the population. In the urban area, the coverage of this service is 71%, while in the rural area, it of 29%.
Catchments are taken from the Casacay River and deep wells. The construction of a new drinking water treatment plant is currently in process. This is being carried out with a loan from the Danish government.

Table 213: Main sources of water in the Machala canton

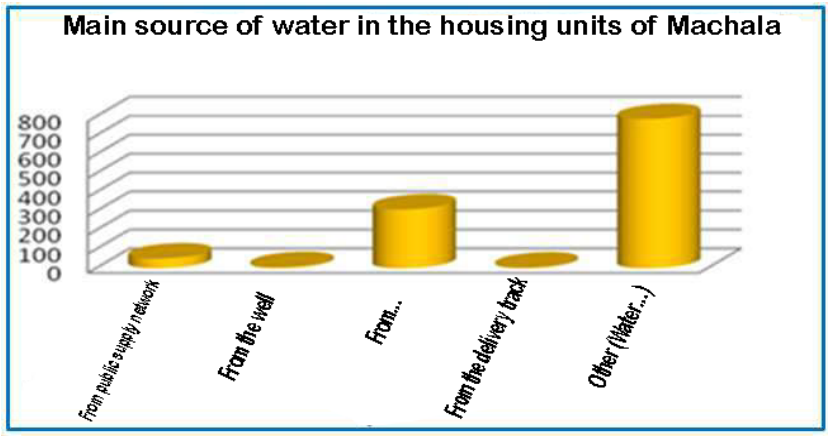
Main sources of water in the Machala canton Main sources of water	CASES	%
Water from the public supply network	52.01	81.06
Water from the well	6,631	10.34
Water from the river, stream, irrigation ditch, or canals	311	0.48
From the water delivery truck	4.42	6.89
Other (rainwater)	788	1.23
Total	**64.16**	**100.00**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: Machala canton
Date: *April 25, 2017*

In Machala, 81.06% of the housing units receive water service from the public water supply network. 10.34% receive water from a well, while 6.89% of the homes in Machala receive water from a delivery truck.

1.23% receives it from other sources (rainwater), and the remaining 0.48% receives it from rivers, streams, irrigation ditches, or canals.

Illustration 209: Source of water in the Machala canton



Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

Piped Water Connection

64.17% of the households in Machala obtain water through pipes inside the housing unit.
23.06% of the housing units obtain water from pipes located outside the house but inside the building.
3.20% of the housing units receive water through pipes located outside the building or plot.
And 9.57% of the households do not receive water through pipes but by other means.

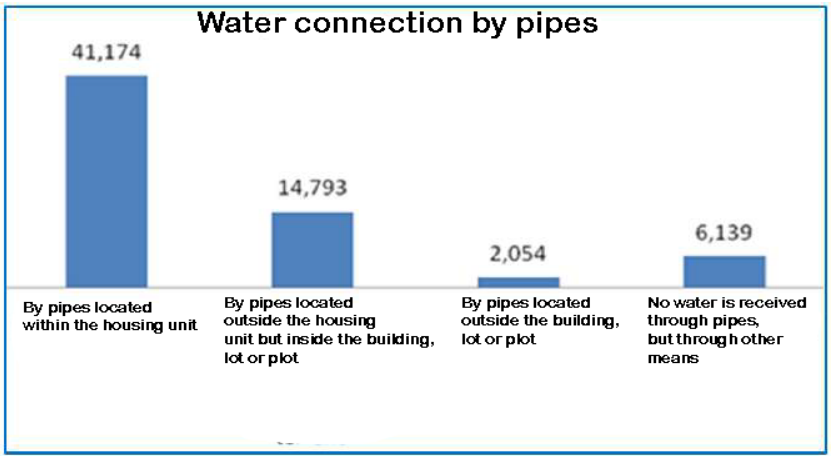
Table 214: Piped water connection in the Machala canton

Piped water connection	CASES	%
Through pipes in the housing unit	41,174	64.17
Through pipes located outside the housing unit But inside the building or plot.	14,793	23.06
Through pipes located outside the building or plot	2,054	3.20
No water is received through pipes but through other means	6,139	9.57
Total	**64.16**	**100.00**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

The Data shown in the table shows that 83.8% of the house in the Machala Canton have water service from the public supply network.

Illustration 210: Water Pipeline Connection in the Machala canton



Source: *INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ WATER DISPOSAL IN THE HOUSING UNITS OF THE MACHALA CANTON

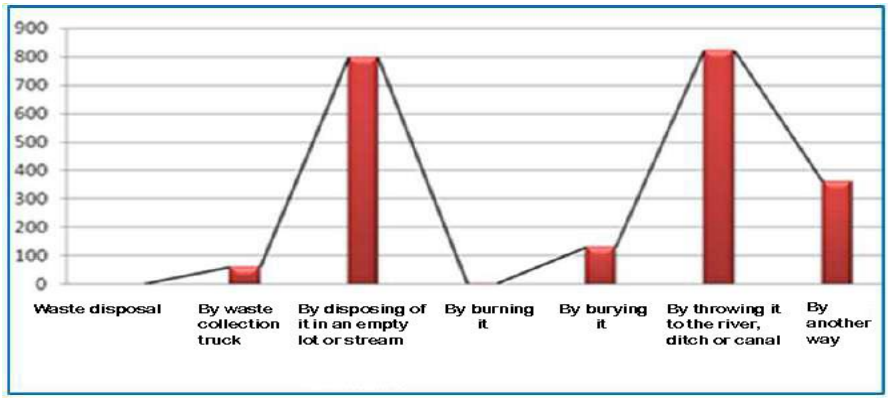
100% of the housing units registered in the province of El Oro, according to the 2010 INEC Census, 91.79% of them dispose of their garbage using the garbage truck. 4.92% of the households burn garbage, and 1.24% throw it in vacant lots. Finally, the remaining 2.01% dispose of garbage in other ways.

Table 215: Waste disposal in the Machala canton

DISPOSAL OF WASTE	CASES	%	
By garbage truck	58,895	91.79	
By disposing of it in a vacant lot Or gully	798	1.24	
By burning it	3,154	4.92	
By burying it	131	0.20	
By throwing it to the river, ditch or canal	822	1.28	
By another way	360	0.56	
Total	**64.16**	**100.00**	

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

Illustration 211: Disposal of waste in the Machala canton



Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ TENURE OR OWNERSHIP OF HOUSING UNITS IN THE MACHALA CANTON

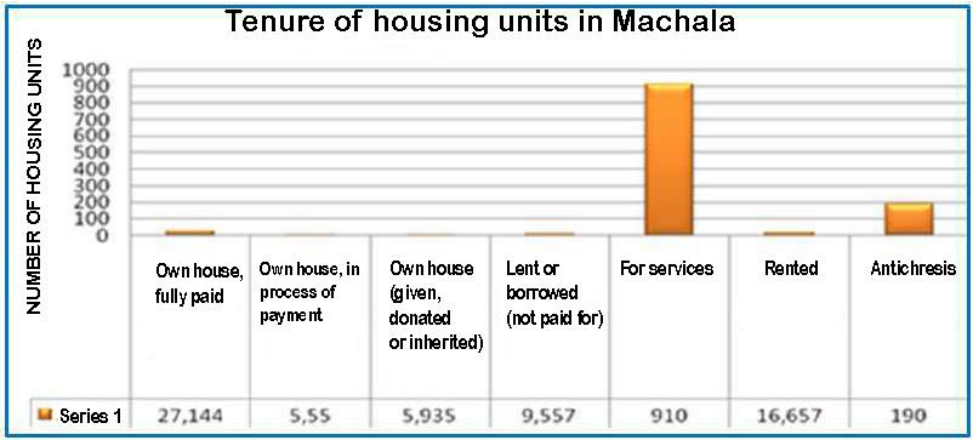
In Machala canton, 41.16% of households own their homes and have paid for them in full. Housing units that are owned but currently being paid for an amount to 8.42%. Lent or borrowed housing corresponds to 14.49%.
9% of those units were given, donated, or inherited. Rented housing units have an important percentage of 25.29%. The remaining 1.09% of the units correspond to housing for services and antichresis.

Table 216: Ownership of the Housing Unit in the Machala canton

TENURE OR OWNERSHIP OF THE HOUSING	CASES	%
Own and fully paid house	27,144	41.16
Own house but in process of its payment	555	8.42
Own house (given, donated or inherited)	5,935	9.00
Lent or borrowed house (not paid for)	9,557	14.49
By services	910	1.38
Rented house	16,657	25.26
Antichresis	190	0.29
Total	**65,943**	**100.00**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

Illustration 212: Tenure of housing units in the Machala canton



Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ CONSTRUCTION MATERIALS FOR HOUSING UNITES IN THE MACHALA CANTON

In Machala, the predominant material used for roofing is zinc. The houses with this kind of roof amount to 53.79%.
The next material in terms of percentage is concrete (slab or cement), with 25.74%.
And a percentage of 19.04% of the housing roof is for supply purposes. Tile is the predominant material in 1.15% of the housing units in Machala.
The percentage [sic] of the housing units' roofs are made of palm, straw, leaves, or other various materials.

Table 217: Roof materials of the housing units in the Machala canton

ROOF MATERIALS	CASES	%
Concrete (slab, cement)	16,517	25.74
Asbestos (eternit, eurilit)	12,216	19.04
Zinc	34,512	53.79
Tile	739	1.15
palm, straw or leaf	48	0.07
Other materials	128	0.20
TOTAL	**64,160**	**100%**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

Materials of the exterior walls

Regarding the exterior walls of the housing units in Machala, 62.20% are predominantly built with brick and blocks.
18.82% are of concrete, and 4.68% are of uncoated cane, while 4.46% are made of coated cane. 2.43% of the roofs are made with wood, and the remaining 0.24% is composed of other materials.

Table 218: Materials of the exterior walls from the housing units in the Machala canton

MATERIALS OF THE EXTERIOR WALLS	CASES	%
Concrete	12,077	18.82
Bricks or blocks	44,398	69.20
Rammed earth or *tapia*	113	0.18
Wood	156	2.43
Coated cane or bahareque	286	4.46
Uncoated cane	3	4.68
Other materials	152	0.24
TOTAL	**64,160**	**100%**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

Floor material

In the Machala canton, the predominant material used for the housing units floor is brick or cement, with a percentage of 46.17%.
In the second place, with 37.81%, comes ceramic, tile, vinyl, or marble. 11.01% of the floors of Machala's housing units are made of untreated boards. Only 1.08% of the housing units have hardwood, parquet, board, or suspended floors.
The remaining 3.93% is made up of soil and other materials.

Table 219: Material of exterior walls from houses in the Machala canton

MATERIALS OF EXTERIOR WALLS	CASES	%
Hardwood, parquet, board, or suspended floors	692	1.08
Untreated boards	7,062	11.01
Ceramic, tile, vinyl, or marble	24,256	37.81
Brick or cement	29,625	46.17
Cane	169	0.26
Soil	1,989	3.10
Other materials	370	0.58
TOTAL	**64,160**	**100%**

Source: *INEC Census, 2010*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Machala canton*
Date: *April 25, 2017*

❖ MAIN FUEL OR ENERGY POWER USED FOR COOKING IN THE HOUSING UNITS OF THE MACHALA CANTON

In Machala, 96.34% of households use GAS as cooking fuel. 0.34% of the households use firewood and charcoal. 0.23% of the units use electricity.
2.95% of households do NOT cook. 0.01% cooks with power from organic or other residues.

Table 220: Main Fuel used for cooking in the Machala canton

MAIN FUEL OR ENERGY POWER USED FOR COOKING	CASES	%
Gas (tank or cylinder)	63,532	96.34
Centralized gas supply	83	0.13
Electricity	151	0.23
Firewood, charcoal	224	0.34
Plant and/or animal waste	1	0.00
Other sources (for example, gasoline, kerosene or diesel etc.)	6	0.01
Does not cook	1,946	2.95
Total	**65,943**	**100.00**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ AVAILABILITY OF CONVENTIONAL TELEPHONE SERVICE IN THE MACHALA CANTON

In Machala, 28.73% of the population has a conventional telephone in their houses. 71.27% of the households does not have this service.

Table 221: Availability of Conventional Telephone in the Machala canton

AVAILABILITY OF CONVENTIONAL TELEPHONE	CASES	%
Yes	18,943	28.73
No	47	71.27
Total	65,943	100.00

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ AVAILABILITY OF MOBILE PHONE IN THE MACHALA CANTON

According to INEC data, 84.20% of Machala households have a mobile phone, and 15.80% of the population does not have one.

Table 222: Availability of mobile phone in the Machala canton

Availability of mobile phone	CASES	%
Yes	55,523	84.20
No	10.42	15.80
Total	65,943	100.00

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ AVAILABILITY OF COMPUTERS IN THE MACHALA CANTON

According to data from the INEC obtained from the 2010 census, 70.92% of households in Machala canton have a cell phone while 29.08% do not have one.

Table 223: Availability of computers in the Machala canton

Ownership of a computer	CASES	%
Yes	19,177	29.08
No	46,766	70.92
Total	65,943	100.00

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ AVAILABILITY OF INTERNET IN THE MACHALA CANTON

16.73% of households DOES HAVE INTERNET. And 83.27% of the housing units does not have this service.

Table 224: Availability of internet in the Machala canton

Availability of Internet	CASES	%
Yes	11,035	16.73
No	54,908	83.27
Total	65,943	100.00

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ HOUSING UNITS IN THE SANTA ROSA CANTON

In the Santa Rosa canton, the kinds of housing units are detailed in the following table:

Table 225: Kind of housing units of the Santa Rosa canton

KINDS OF HOUSING UNITS	CASES	PERCENTAGE %
House/villa	16,343	73.53
Department at a house or building	1,916	8.62
Room(s) at a tenement house	1,497	6.74
Prefabricated house	772	3.47
Ranch	1,044	4.70
Shed	413	1.86
Shack	86	0.39
Other particular housing	135	0.61
Hotel, boarding, or residential house or hostel	4	0.02
Military Barracks or firemen/policeman station	6	0.03
Rehabilitation center/prison	1	0.00
Hospital, clinic, etc.	1	0.00
Convent or religious institution	1	0.00
Nursing home or orphanage	1	0.00
Another collective housing	5	0.02
TOTAL	**22,225**	**100%**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

Considering the type of housing units that exist in the rural parish of Jambelí, 75% are houses/villas; 10% are ranches; 7% are prefabricated houses; 4% are shed; and the rest are of the following types: rooms and tenement houses; shacks; and other private housing.

❖ TENURE OF HOUSING UNITS IN SANTA ROSA

Regarding the tenure of housing units in the Santa Rosa canton, the following results were obtained:

Table 226: Tenure of housing units in the Santa Rosa canton

TENURE OR OWNERSHIP OF HOUSING Units	CANTON CASES	CASES JAMBELÍ PARRISH
Own and fully-paid house	6339	169
Own house but in the process of payment	744	6
Own (given, donated or inherited)	1238	33

TENURE OR OWNERSHIP OF HOUSING UNITS	CANTON CASES	PARROQUIA JAMBELI CASES
Lent or donated house (not paid)	2290	113
By services	148	162
Rented house	3707	25
Antichresis	21	6

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

In Jambelí parish, 33% of the total number of existing housing units are fully paid houses, 32% are service housing units, and 22% are loaned or rented houses (without payment). The remaining percentage is divided between homes that are being paid for, donated or inherited, rent or and antichresis. This amounts to 14% of the total number of homes.

❖ WATER SUPPLY IN THE SANTA ROSA CANTON

In the Santa Rosa canton, most of the human settlements receive water from the public water supply network; 95% of the urban population (cantonal head) and 64.34% of the rural population have this service.
In the rural parishes, the problem is that those who have water from the public network do not receive it on a regular basis, and when this situation arises the population is forced to use wells. It should be considered that the water extracted through this means is not of good quality.

Table 227: Sources of water in the housing units of the Santa Rosa canton

SOURCES OF WATER	CANTON CASES	CASES JAMBELI CASES
From the public water supply network	13,493	193
From the well	90	193
From a stream, Irrigation or river, ditch canal,	358	13
From a delivery truck	56	7
Other (rainwater)	156	89

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

The pipes located in certain sectors are very old and clogged, causing the water system to collapse.

The following table shows the type of connection from the water that is used for consumption

Table 228: Type of connection from water that is used for consumption in the Santa Rosa canton

CONNECTION OF THE WATER FOR CONSUMPTION	CANTON CASES	JAMBELI PARRISH CASES
From pipelines located inside the housing unit	10,426	133
From pipes located inside the building, lot or plot	2,961	147
From pipes located outside the building, lot or plot	369	9
Does not receive water from pipes but from other means	397	206

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

In the Jambelí parish, water is supplied by the Colembas water system located in the Arenillas canton. This system has its catchment from an irrigation canal of the Tawín dam. Water is taken to the treatment plant located in Puerto Pitaya, which is located in the Arenillas canton.
A distribution network was built in 2009 for the sites and communities located in the Jambelí archipelago from this treatment plant. The main network reaches the community of Casitas. It is divided into two sub-systems; the first one supplies Pongalillo, Las Huacas, and Jambelí. The second distribution network goes to the community of Costa Rica.
Although the communities located in the Jambelí parish already have drinking water from the Colembas system, in some cases, they still have drilled wells.
However, the community of Jambelí keeps this water system in operation as an alternative system because the Colembas water system still has some deficiencies, especially in the pumping station. For this reason, the community does not have water 24 hours a day.

❖ SEWERAGE SYSTEMS IN THE SANTA ROSA CANTON

In the canton's parish capital, 78.23% of the homes have sewerage service; the remaining percentage of the urban population, which is minimal, is connected to wells.

The opposite occurs with the rural parishes, where only 32.39% of the households have sewerage services, and 67.60% of the households that do not have sewerage services dispose of their wastewater either in wells, directly into the environment or in latrines. The inhabitants are aware that these forms of disposal pollute the surrounding environment, but it is the only solution that they have because they do not have a sewerage network nor an adequate wastewater collection system.

Table 229: Assessment of wastewater from the Santa Rosa canton

WASTEWATER DISCHARGE	CANTON CASES	JAMBELI PARRISH CASES
Connected to the public network	11,073	9
Connected to the septic tank	1,242	246
Connected to the cesspool	436	65
With direct discharge to the sea, river, lake or stream	482	27
Latrine	115	18
No disposal system	805	130

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

❖ WASTE DISPOSAL IN THE SANTA ROSA CANTON

The waste collection service provided by the municipality passes through most of the canton's human settlements; the waste collection truck collects garbage from 87.84% of the population of the canton's capital and 58.51% of the population of the rural parishes. Waste burning is the second option in the rural zone, and 29.23% of the population carries out this activity.

Table 230: Waste disposal of the Santa Rosa canton

WASTE DISPOSAL	CANTON CASES	JAMBELI PARRISH CASES
By waste collection truck	12,432	46
By throwing waste to an empty lot or stream	239	22
By burning waste	1,282	258
By burying waste	53	51
By throwing waste into the river, ditch, or canal	88	7
By disposing of the waste in another way	59	111

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

❖ CONSTRUCTION MATERIAL FOR HOUSING UNITS IN THE SANTA ROSA CANTON

The predominant material used for roofs in the urban area is concrete (slab); the quality is good because the material is long-lasting and does not require maintenance over time. In rural areas, zinc is the most commonly used roofing material because it is easy to install and convenient due to its low cost. This material's problems are heat accumulation and corrugated sheets that are not thermo-acoustic and therefore do not provide comfort to the home users. Also, they allow insects to enter through the cracks, have a short life span,

and if they are not well installed, they pose problems such as leaks or wind uplift.
Both in the cantonal capital and in the canton's rural parishes, most of the houses are built with bricks or blocks; these houses are of good quality, although there are humidity problems due to the climate. They are a durable material that does not require frequent maintenance. In rural areas, wood is the second most used material in housing construction (walls).

Brick or cement are the materials used in 55.5% of the canton's homes; the following percentage corresponds to floor covering with ceramic, tile, vinyl, or marble, amounting to 22.8% the total number of housing units.

❖ TELEPHONE AND INTERNET NETWORK IN THE SANTA ROSA CANTON

There are two types of telephone connectivity: conventional telephone and mobile telephone connection. In the canton, 14.29% of the total inhabitants have conventional telephone service, and 78.20% have mobile telephone service. At present, there are greater facilities for accessing mobile telephone service.

Thanks to technology, human beings are connected to the whole world through the internet, which is a way to access updated information, make inquiries, conduct business, etc. In the Santa Rosa canton, 11.69% of the inhabitants have this service.

There are four communication towers in the Jambelí parish: Orlando Ontaneda, OTECEL S.A., Destacamento MILITAR Naval Bellavista, Destacamento Militar Playana. They are located in the western part of the parish, in the communities of Costa Rica and Bellavista. 2% of the households in the rural parish of Jambelí have conventional or fixed telephone services, and 98% do not. This is explained by the massive use of mobile telephones, which has, to some extent. Replaced access to and use of conventional telephones.
Mobile phones are general resources, 79% of the population has mobile phones, and 21% does not use this benefit; however, it is a resource of massive use in the population with an age limit and that is allowed in the homes families of the parishes.

❖ AVAILABILITY OF COMPUTERS IN THE SANTA ROSA CANTON

In a global assessment, access to information and communication technologies is limited at the cantonal level. If the canton is segmented by urban and rural areas, the latter has 29% access to a computer as compared to the urban area, where 71% have access to a computer, which conceived as one of the tools that facilitate the inter-learning processes. Only 21% of people who have access to equipment. This represents a gap of 79%, which in absolute terms would mean a lack of 14,830 computers per household.

In Jambelí, only 2% of the families living on the rural parish islands have a computer, and 98% do not have a computer.

❖ AVAILABILITY OF INTERNET IN THE SANTA ROSA CANTON

In the canton, 88% of the households do not have Internet access while 22% do. This is clear evidence of virtual illiteracy and illiteracy in information and communication technologies. In rural areas, 71% of the housing units do not have access to the internet.

In the Jambelí parish, there is a critical digital gap in terms of internet access and availability. Only 1% of households have access to this service, while 99% do not. The latter percentage has established limited access to computer equipment, the internet, and training in the use of information and communication technologies.

❖ HOUSING IN THE PUNA ISLAND

Regarding the types of housing units on Puna Island, houses or villas represent 69% of the units, apartments in houses or buildings, 1%, rooms in the tenement, 2%, prefabricated houses, 10%, ranches, 10%, shacks, 4%, and others, 2%.
The electricity sources in the island are as follows: 66% from an electricity company network, 2% solar panel, 19% generator, and 12% of the housing units do not have electricity.
Regarding the source of drinking water, 37% drinks as it is received, 26% boils the water, 12% mixes it with chlorine, 1% filters it. 24% of households buy purified water.

6.3.6.- ELECTRICAL ENERGY

The electric service in the province is provided by CNEL Regional El Oro. Since 1966, when it installed a thermal plant in Machala, it gradually increased its generation capacity and expanded its service network.
Insufficient equipment and defective maintenance have conspired against adequate electric service throughout the province. Incorporating the provincial grid into the national interconnected system in 1987 helped relieve the chronic deficiency.

Access to electricity is one of the elements that influence housing quality and, therefore, people's quality of life. According to INEC data, in 2010, 153,843 homes had public electricity services.

Electricity is supplied to the different communities of the Jambelí Archipelago by CNEL Regional El Oro through distribution networks.

In the case of CNEL Regional El Oro, as a company that sponsors provincial and regional development, its main function is to satisfy its market requirements, which are directly related to the demand for power and energy. According to the Electricity Sector Regime Law, power and energy must be delivered in optimal quality, continuity, and whenever required.

❖ PUBLIC LIGHTING

The Public Lighting system covers the entire concession area and includes everything related to the lightning of streets, avenues, squares, parks, and multipurpose courts.
As of December 2011, there are 62,787 luminaires, classified by type of light source, i.e., differentiating whether they are mercury vapor or high-pressure sodium vapor as classified by their unit power.

❖ POWER GENERATION

There is electric power generation through the exploitation of gas from the gulf located in Bajo Alto.
Power generation depends on the interconnected system. However, the province has hydraulic resources that can help sustain hydroelectric energy consumption, since the thermal power plants' cost is very high, representing higher user tariffs.

The former INECEL gathered information on the province's generation capacity through small hydroelectric power plants.

- Power generation plant on the Luis river located in Portovelo (15 Mw).
- Power generation plant at Minas La Unión (320 MW).
- Tahuin dam hydroelectric power plant (1.5 MW).

The Autonomous Provincial Government of El Oro, requested the concession of the water bodies in the sectors where energy can be generated to benefit the province when this resource is exploited and is looking for partners to generate hydroelectric energy. Also, regarding wind energy, information is being collected on the sectors that could generate this energy type.

❖ ENERGY SERVICE COVERAGE IN THE MACHALA CANTON

Energy service coverage in the housing units, according to INEC's 2010 census, includes the use of energy-saving and conventional light bulbs and the availability of a light meter.

Table 231: Electricity supply in the Machala canton

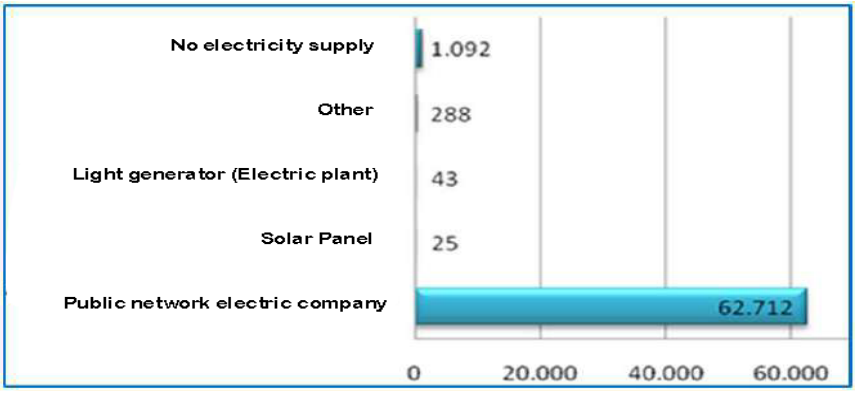
ELECTRIC LIGHT SUPPLY	CASES	%
Public utility network	62,712	97.74
Solar Panel	25	0.04
Light generator (Electric plant)	43	0.07
Other sources	288	0.45
No electricity supply	1,092	1.70
Total	**64.16**	**100.00**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

97.74% of the housing units in Machala receive electricity through the public utility network, while 1.70% of the homes do not have this service, which amounts to 1,092 homes in the canton.

7.7% receives electricity from an electric generator and 0.04% from solar panels. And 0.45% of the houses receive electricity in Machala by other means.

Illustration 213: Energy sources in the housing units of the Machala canton



Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ ENERGY SERVICE COVERAGE IN THE SANTA ROSA CANTON

95.49% of Santa Rosa's urban and rural homes have electricity services. This service is provided by the Corporación Nacional de Electricidad de El Oro [El Oro National Electricity Corporation].

Table 232: Electric power supply in the Santa Rosa canton

PARRISH	Public Network	Solar Panel	Light Generator	Other	No power supply
Santa Rosa	13753	4	9	62	325
Bellavista	714	1	0	2	36
Jambelí	271	9	86	6	123
La Avanzada	490	1	1	1	32
San Antonio	498	0	0	6	29
Torata	493	1	1	1	15
Victoria	780	0	2	2	18
Bellamaria	557	0	0	5	5

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

Electricity service in the Jambeli parish is available in all the communities; all five islands have this service permanently. Few families still do not have electricity in their homes.

6.3.7.- MIGRATORY MOVEMENTS

One of the demographic phenomena that have most affected Ecuador in general, and the province of El Oro in particular, is emigration. For many years, part of El Oro's population has emigrated, mainly due to other countries for economic and labor reasons.

During the last 10 years, the migration balance of El Oro Province has been negative. Specifically, in the five years of 2001-2005, El Oro's migration balance was -3.74‰, while in Ecuador, the rate was positive (0.28‰). The following five-year period (2006-2010) shows a significant decrease in the migratory balance, both in the province and in Ecuador.

Let's take as a reference the data from the 2010 Population and Housing Census. We can observe that the emigrant population in the 1990-2010 period in El Oro's province amounts to 13,529.
There is clear evidence that emigration has declined markedly in El Oro Province in recent years. As can be seen, in 2002, the number of people who emigrated from the province of El Oro Province amounted to 2,880, while in 2010, only 570 people left from El Oro.

This trend shows an important change that could be very significant for the province of El Oro. The fact that the population is staying in the territory is an indicative factor of its own development and a factor thereof. It is therefore important to consider this phenomenon. It is very important to analyze and study it in depth since it responds to multiple variables and factors that must be considered in everything related to provincial development planning.

❖ MIGRATION IN THE MACHALA CANTON

According to INEC data from the 2010 census, 51% of the 100% of migrants are men and 49%, women.

Table 233: Migrants by gender from the Machala canton

PARISH	CASES	%
Men	3,336	51.0
Women	3,205	49.0
TOTAL	**6,541**	**100%**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

According to the country's year of departure, considering the decade from 2001 to 2010, the largest number of individuals has migrated during 2002, amounting to 1,349 people, which corresponds to 20.62%.
The year in which the fewest people left the country during this period was precisely 2010, with 316 cases, which corresponds to a percentage of 4.83%.

Table 234: Year of departure of the migrants from the Machala canton

DEPARTURE DATE	CASES	%
2001	1,187	18.15
2002	1,349	20.62
2003	782	11.96
2004	408	6.24
2005	420	6.42
2006	370	5.66
2007	420	6.42
2008	471	7.20
2009	277	4.23
2010	316	4.83
2011	541	8.27
TOTAL	**6,541**	**100%**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*

According to INEC data from the 2010 census, the main reason for migration is for work purposes, amounting to 4,482 cases and a percentage of 68.52%.
1,206 individuals have traveled due to family ties, amounting to a percentage of 18,44%.
557 individuals have traveled for studying purposes, which represents a total of 8.52%.
296 individuals have traveled, representing 4.53% of the total number of migrants.

Table 235: Main reason for travel of migrants from the Machala canton

MAIN REASON FOR TRAVEL	CASES	%
Work	4,482	68.52
Studying	557	8.52
Family ties	1,206	18.44
Other	296	4.53
TOTAL	**6,541**	**100%**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Machala canton*
Date: *April 25, 2017*

❖ MIGRATION IN THE SANTA ROSA CANTON

The Santa Rosa canton's mobility ranks third as a canton with the highest level of migration between men and women, with 1804 cases in the parish.
In the Santa Rosa Canton, after analyzing the gender of migrants, women tend to migrate more in the canton (52%), while men migrate less (48%).
Migrant groups by territorial area: 83% of the men and women in the urban area tend to migrate from the canton, while in the rural sector, 17% of the men and women migrate.

Migrants who have moved abroad came from the urban area (83%) and, to a lesser extent, from the rural sector (17%). This perhaps shows that opportunities, livelihood strategies, and social inequality are more marked in the urban sector than in the rural sector.

The migrants of the Santa Rosa canton tend to have the highest number of migration cases within the 15-39-age range, amounting to 75% of the individuals. The reason for this is the demand for young unskilled labor abroad.

It can be estimated that the years in which the male and female inhabitants of the Santa Rosa canton left the country were 2001 and 2002. There were 378 and 390 cases, respectively. These figures decreased in the following years, although there was an increase in the number of departures in 2007 and 2008, which then decreased until 2010.

The main reason for the migration of the men and women from the Santa Rosa canton were for work purposes (1,340 cases), followed by family ties (290 cases), studying (121 cases), and other reasons (52 cases).
74% has migrated for work reasons, followed by family ties, amounting to 16%.

Table 236: Main reason for migration in the Santa Rosa canton

MIGRATION REASONS	CASES		TOTAL
	Men	Woman	
Work	710	630	1340
Studying	61	60	121
Family ties	139	151	290
Other	29	24	53
TOTAL	**939**	**865**	**1804**

Source: *Censo INEC, 2010*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa canton*
Date: *April 25, 2017*

Most of the population born in the parish lives in it; approximately 1,549 people remain in the Jambelí parish and subsist, in many cases, thanks to the fishing activities conducted in the area. A small number of people have decided to move to other parts of the country (165 people) and abroad (4 people) to obtain better job opportunities and higher salaries.

6.3.8.- ROAD NETWORKS AND TRANSPORTATION

ROAD NETWORK

In El Oro's province, there are 400.94 kilometers of State Road Network and 2652.58 kilometers of Provincial Road Network, of which 1145.01 kilometers correspond to Strategic Axes and 1507.57 kilometers to local roads without considering the bridle paths.

❖ STATE ROAD NETWORK

The State Road Network is made up of a set of primary and secondary roads that receive the highest vehicle traffic and intercommunicate the provincial capitals, canton capitals, international border ports with or without customs, and large and medium-sized centers of economic activity. They are administered by the Ministerio de Transporte y Obras Públicas [Ministry of Transportation and Public Works].

▪ PRIMARY ROADS

Primary roads, or arterial roads, comprise routes that connect border crossings, ports, and provincial capitals, forming a strategic network. Their traffic comes from secondary roads (collector roads), and they must have high mobility, controlled accessibility, and adequate geometric standards.

A primary road is considered a trunk road if it runs north-south, and transversal if it runs east-west. A total of 225.83 km of primary roads cross the province, defined as:

- E25 Coastal Trunk Road.
- E50 South Transversal.

- **SECONDARY ROADS**

Secondary roads, or collector roads, include routes whose function is to collect traffic from a rural or urban area to carry it to the primary roads; the following secondary roads pass through the province for a total of 175.11 Km:

- E59 Cumbe - Y de Corralitos.
- E583 Puerto Bolívar - Y del Cambio.
- E584: Pasaje - Y del Enano.
- E585: Y de Pasaje - Piñas - Y de Zaracay.

❖ PROVINCIAL ROAD NETWORK

Provincial Road Network of El Oro is the set of roads administered by the provincial government; according to the Road Plan 2014-2025, this network is composed of tertiary roads divided according to their importance into four strategic axes and local roads.

The tertiary roads connect parish centers and production areas with the roads of the National Road Network and local roads, with reduced traffic.

Table 237: Provincial Road Network

PROVINCIAL ROAD NETWORK	TOTAL IN KM
Main provincial strategic axis	488.90
Secondary provincial strategic axis	375.32
Main cantonal strategic axis	209.74
Secondary cantonal strategic axis	71,05
Local Roads	1507,57
PROVINCIAL ROAD NETWORK	**2.652,58**

Source: *Development Plan for the Province of El Oro*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

The 18% (488.90 km) belongs to the main provincial strategic axis, 14% (375.32 km) to the secondary provincial axis, 8% (209.74 km) to the main cantonal axis, 3% (71.05 km) to the secondary cantonal axis and, 57% (1507.57 km) to the local roads.

Road Network Condition

In the province, 80% of the state roads are in good condition, and only 20% are in poor condition. Regarding the current condition of the provincial roads, according to the road report of the Secretariat of Public Works as of December 2014, only 6% of the total roads are in particularly good condition, 16% are in good condition, while 68% of the total roads are in bad and very bad condition.

Table 238: Road Condition in el Oro province

PROVINCIAL ROAD NETWORK	Very Good	Good	Regular	Bad	Very Bad	TOTAL IN KM
Main provincial strategic axis	57,40	166,59	125,36	69,95	69,90	488,90
Secondary provincial strategic axis	66,80	91,16	119,46	79,20	18,70	375,32
Main cantonal strategic axis	21,35	44,09	12,18	121,98	10,14	209,74
Secondary cantonal strategic axis	3,76	10,92	22,90	26,87	6,60	71,05
Local Roads	5,04	101,40	189,62	1.033,35	178,16	1.507,57
PROVINCIAL ROAD NETWORK	**154,35**	**414,16**	**469,52**	**1.33,35**	**283,20**	**2.652,58**
PERCENTAGE %	**6%**	**16%**	**18%**	**50%**	**11%**	**100%**

Source: *Development Plan for the Province of El Oro*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

The most relevant causes determined in the Provincial Road Plan 2014-2025 that cause 1614.55 km of roads to be in bad and very bad condition are as follows:

- Insufficient financial and operational resources for the rehabilitation, periodic maintenance, and routine maintenance of the roads.
- Indiscriminate use of the roads without the existence of maintenance according to the use and the lack of the service's consequent payment to be able to give self-sustainability to the process.
- Lack of support from the private sector (Industries, Exporters, Transporters... etc.) in managing the province's road problem.

Also, the strong winter seasons cause constant landslides due to the slopes' instability in the upper part of the province.

In the "Type of Road Surface" table, we see that of the total number of kilometers 2652.58 (excluding mule tracks), 19% of the roads are asphalt; only 0.1% are paved; 43% are ballasted, and 38% are dirt (natural soil); in other words, 81% are ballasted and dirt.

Table 239: Types of Road Surfaces in the Province of El Oro

PROVINCIAL ROAD NETWORK	Asphalted		Cobblestone	Ballasted	Earth (natural soil)	TOTAL KM
	DTSB	Asphaltic Roadbed				
Main provincial strategic axis	161,25	18,0		240,11	69,54	488,90
Secondary provincial strategic axis	69,56	97,75		162,01	46,00	375,32
Main cantonal strategic axis	13,12	33,85	1,46	107,69	53,62	209,74
Secondary cantonal strategic axis	14,20	14,68		42,17		71,05
Local Roads	40,19	45,62		593,20	829,56	1.507,57
PROVINCIAL ROAD NETWORK	**298,32**	**209,90**	**1,46**	**1.145,18**	**997,72**	**2.652,58**
PERCENTAGE %	**19%**		**0,1%**	**43%**	**38%**	**100%**

Source: *Development Plan for the Province of El Oro*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Cantón Machala*
Date: *April 25, 2017*

TRANSPORTATION NETWORKS

The transportation sector has grown and has the following characteristics:

- The main transportation system is terrestrial. There are 18 cooperatives with 644 buses and vans for interprovincial and intercantonal transportation. Heavy transport is provided by 7 cooperatives, which have 110 trucks, and light cargo transport is provided by 12 cooperatives that have 236 vans and light trucks; there are also 23 cab cooperatives, which have 608 units.
- **Air transportation** has its main base at the new Santa Rosa Regional Airport, located in the city of Santa Rosa (via Jumón), built during 2008 and 2010 by the Army Corps of Engineers. It is a civilian airport, with the national operation, with international projection, and is administered by the General Directorate of Civil Aviation (DGAC).
- **Maritime transportation** is mainly from Puerto Bolívar, located in the northwest of the province, in the jurisdiction of the urban parish of Puerto Bolívar in the Machala canton. It is located south of the Gulf of Guayaquil, at the Santa Rosa channel entrance, protected by the Jambelí Archipelago. At a national level, Puerto Bolivar is the second most important port in the country due to the volume of cargo it handles since 80% of the national banana production is exported through it. It is a terminal that can handle all types of vessels and cargo: banana ships, refrigerated pallets and containers, dry containers, vehicles, machinery, coils, and other cargo.

ROAD AND TRANSPORTATION NETWORKS OF JAMBELI PARISH

The main means of transportation to reach the islands or neighboring cities is through the estuaries and canals of the Jambelí Archipelago.
Therefore, for example, Costa Rica and Bellavista's inhabitants usually travel through the channels to Puerto Hualtaco, while the rest of the population travels by sea to Puerto Bolívar.

In the Jambelí Parish islands, there are no well-determined streets, and there is space to build adequate planning.
In the head of the parish and the rest of the islands of Jambelí, the streets are made of dirt.

6.3.9.- TERRITORIAL AND SOCIAL ORGANIZATIONS

The local stakeholders identified in the province of El Oro, concerning land use planning, i.e., those who have a direct capacity to influence the land management process, are included in the following categories:

- Central State Institutions.
- Decentralized Autonomous Governments.
- Economic Actors.
- Social Actors.
- Higher Education Actors.
- Central State Institutions.

GOVERNMENTAL INSTITUTIONS

Table 240: Governmental Organizations of the Province of El Oro

CENTRAL GOVERNMENT ACTORS	COMPETENCE	RELATED SUBSYSTEM
Governorship	Provincial Executive Representative	Political - Administrative
Senplades	Coordination of Provincial, Cantonal, and Parish Planning	Political - Administrative
MIDUVI Provincial Directorate	Territorial planning (only for provinces)	Physical - Spatial - Political - Administrative
Ministry of Public Works Provincial Directorate	Road Infrastructure Works	Physical - Spatial
Ministry of Agriculture, Livestock, Aquaculture and Fisheries Provincial Directorate	Productive development programs	Economic Productive
Ministry of Environment Provincial Directorate	Environmental Management	Territorial Ecological

CENTRAL GOVERNMENT ACTORS	COMPETENCE	RELATED SUBSYSTEM
Ministry of Mines and Petroleum Provincial Directorate	Mining Control and Development	Economic Productive
Ministry of Economic and Social Inclusion Provincial Directorate	Social development, employment	Economic Productive
SENAMI Provincial Coordination	Rights and integration of migrants	Socio-Cultural Economic Productive
National Secretariat of Risk Management	Risk Prevention	Territorial Ecological
Binational Plan SENPLADES Undersecretary of Loja	Economic Development	Economic Productive
National Irrigation Institute (MAGAP – INAR) Provincial Directorate	Administrative and legal management of irrigation water	Territorial Ecological
National Port System Port Authority of Puerto Bolivar	Economic Development	Economic Productive

Source: *Development and Land Management Plan of the Province of El Oro*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

In the province, there have been some dynamics of integration between the municipal and provincial levels of government, around territorial development proposals in the Jubones Basin, which comprises a territory of 436,170 hectares, which includes 3 provinces: Azuay, with the cantons of Nabón, Girón, San Fernando, Santa Isabel, Oña and Pucará; El Oro, with the cantons of Machala, El Guabo, Pasaje Chilla, and Zaruma, and the province of Loja with the canton of Zaraguro.

Based on this territorial element, municipalities and provincial councils have been integrated. The Jubones River commonwealth is made up of 12 municipalities, 2 provincial governments, and about 45 parish councils, with a population of 241,552 inhabitants, most of which are in the lower middle basin, corresponding to the cantons of Machala, El Guabo, Pasaje Chilla and Pucará.

Another integration process occurs at the binational level between the border municipalities of southern Ecuador and northern Peru, within the Binational Development Plan framework for the Border Region, based on the peace agreements. It is oriented to the execution of binational development projects in the border area.

The municipalities of the province have an institutional space that allows the articulation of the 14 cantonal governments of the province in the Association of Municipalities of Ecuador - AME EL ORO; likewise, the Council of Rural Parochial Governments of El Oro - CONAGOPARE, which brings together the 49 Rural Parochial Boards of the province, is also constituted.

At the regional level, El Oro and Azuay's provinces are working on the construction of an austro-southern commonwealth.

SOCIAL AND ECONOMIC SECTOR

The economic sectors are all the sectors that develop productive activities and that are under some organizational form. Their union logic revolves around the defense and improvement of the conditions that favor the development of their activities; their relationship with land use planning is direct to the extent that these activities have an impact both on the territorial ecology (relationship with ecosystems, use of resources and energy and environmental impact) and on the economic production (generation of employment and wealth; political pressure) and physical space (productive infrastructures, etc.

Among the economic actors identified in the province, the following are the most important ones:

Table 241: Civil Society Organizations of the Province of El Oro

CIVIL SOCIETY ORGANIZATIONS
Federation of Suburban Neighborhoods of Machala (east, west and north)
Farmers' Federation FEPROCO
National Unit of Peasant Organizations
College of Architects of El Oro
College of Civil Engineers of El Oro
College of Lawyers
College of Economists
College of Biologists
College of Sociologists
College of Agricultural Engineers
Women's Movement (Piñas, Santa Rosa, El Guabo, Arenillas, Marcabeli)
Black Women's Movement of El Oro
Women of the popular sectors
Provincial Association of Savings and Loan Associations
XXI Foundation
Women Leaders Forum
Hummingbird Movement
Chimera Foundation
ESPOIR Foundation

Source: *Development and Land Management Plan of the Province of El Oro*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

Table 242: Economic Actors in the province of El Oro

ECONOMIC ACTORS
Association of Chambers of Production of the province
Machala Chamber of Commerce
Chamber of Tourism of El Oro
Chamber of Agriculture
Machala Agricultural Center
Chamber of Small Industry
Chamber of Construction
Chamber of Industries of El Oro
Chamber of Mining
Chamber of Small Mining
Chamber of Microenterprises
Chamber of Artisans
Chamber of Shrimp Producers
Maritime Chamber of Puerto Bolivar
Provincial Cattlemen's Association
Cantonal Agricultural Centers (Arenillas, El Guabo, Pasaje, Santa Rosa, Las Lajas, Piñas, Zaruma, Atahualpa, Balsas, Marcabeli)
Santa Rosa Cattlemen's Association
Banana Growers Association
Cocoa Growers Association
Shrimp Farmers Association
Concheros Association
Fishermen's Association
Beneficiation Plants Association
Muluncay Miners Association
Atahualpa Sugarcane Growers Association

Source: *Development and Land Management Plan of the Province of El Oro*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Province of El Oro*
Date: *April 25, 2017*

The Jambeli parish has several grassroots organizations made up of fishermen, shellfishermen, and artisanal crabbers who live on the islands. These organizations represent the main social force that contributes to the local development of each island community.

The parish organizations are:

- Association of Fishermen, Artisan and Related" Costa Rica
- Association of Fishermen, Artisanal Fishermen and related "9 de Octubre".
- Community Development Center CEDECO
- Association of shellfish, crustaceans, and related artisanal fishermen "Las Huacas".
- Association of fishermen and annex "Bellavista".
- Association "Divino Niño".

In addition, the representation of the state is manifested in the members of the Parish Council, which is located in the community of Isla Costa Rica.

For the territory of the parish, there is the intervention of several public and private institutions; among the most representative are the Port Captaincy, Provincial Autonomous Government of El Oro, Municipality of Santa Rosa, Technical University of Machala, C- CONDEM, UOPPAO, Ministry of Environment, Arcoíris Ecological Foundation, Ministry of Tourism, Ministry of Economic and Social Inclusion, among others.

6.3.10.- CUSTOMS AND TRADITIONS

Within the customs of religious faith and paganism, there is one in which a certain Christian image was worshipped, such as the commemoration of the Virgin of Mercy, who is our patroness and protector, all these customs ended with a celebration or "party", the same that was tinged with prolonged and lively dances.
Another activity of singular distraction was that of saying goodbye to family and friends when the coasting ships left from Puerto de Bolívar, the coasting ships: Olmedo, Bolívar, Jambelí, etc. to Santa Rosa or Guayaquil, before the completion of the Oro-Guayas highway. The Machaleño inhabitant always liked seafood, which was available in abundance, even in the surroundings of the town, because especially in Aguajes, the sea reached to where today we find the 9 de Octubre school and the airport. A great variety of seafood was offered by the fishermen who traveled through the center of Machala, hanging from a stick over their shoulders.

Among the main festive events in the city of Machala are the following:

- Patronal Festival: In honor of the Virgen de la Merced, celebrated on September 24 of each year, the election of the World Banana Queen is held during these festivities, with the participation of candidates from several banana producing and exporting countries. During this month, the Chamber of Industries Fairs, the Banana Fair, expo-sciences, and artistic presentations take place.
- Cantonization festivals: That is celebrated on June 25 of each year, in which cultural and social events, literary contests, painting and handicraft exhibitions, civic-military parades, and popular dances with artistic presentations are held.
- The month of the Arts: This event is national, proposed by the Casa de la Cultura Ecuatoriana, and takes place during August; the El Oro Nucleus of the Casa de la Cultura organizes a series of artistic-cultural events, pictorial exhibitions, etc., including free nautical trips in Puerto Bolivar.
- Battle of the chariots: In homage to the liberal movement that took place in Machala, on May 9, 1895, where the leader General Manuel Serrano stood out, supporting General Eloy Alfaro Delgado.
- Foundation of Puerto Bolivar: On December 18 of each year, since 1883, the anniversary of this important seaport, named after the liberator of America, is celebrated.

6.3.11.- TOURIST ATTRACTIONS

The main existing tourist attractions within the project area are:

- **Puerto Bolívar**
  Named after the liberator Simón Bolívar, it connects the province of El Oro with other ports in the world, since 85% of the national banana production is exported through it. In Puerto Bolivar, you can enjoy the sea breeze, the scenery, the beautiful sunsets, and the delicious seafood dishes, especially the world's best-known Ceviches. On the other hand, Puerto Bolivar is the starting point to visit Jambelí Island, Love Island, and Santa Clara or Dead Man's Island.

- **Old cabotage pier at Puerto Bolivar**
  It was inaugurated on May 9, 1902; being its constructor, the engineer Gastón Thoret, from this site, departed the coasting ships that transported passengers and cargo to and from the city of Guayaquil and Santa Rosa (Puerto Pital, originally). Several ships offered this service, among which we mention: Olmedo, Jambelí, Bolívar, Colón, Dayse Edith, Quito, etc. Until 1973 when the Oro-Guayas highway was completed. It was currently remodeled, becoming an interesting place where a marine museum belonging to the Casa de la Cultura and an elegant restaurant called El Viejo Muelle (The Old Pier) operates.

- **Jambelí Island**
  Machala is the starting point to this cozy island, located 35 minutes by boat from Puerto Bolivar. It should be noted that this island does not belong to this canton; however, it is from Puerto Bolivar in Machala, where you take the boats to go to the archipelago; the tour becomes an exciting adventure, watching the attractive landscape, the variety of birds and mangroves in the area. Jambelí is the largest open sea beach of the archipelago and also the most populated; it has several restaurants, lodging, recreation, and water sports. You can also visit the Geo-Mer marine museum. The shrimp industry is located towards the eastern part of the island, bordered by the Santa Rosa estuary, which restricts the expansion of the tourist and residential zone. Currently, the mangrove area has diminished, as these areas have been indiscriminately exploited with the beginning of shrimp production.
  As part of the tourism activities undertaken in the parish, especially in the community of Isla Costa Rica, an establishment has been set up in recent years to provide lodging for visitors to the area.
  In Costa Rica, Bellavista, and Las Huacas, facilities have also been set up to offer drinks and food to locals and visitors alike, especially on holidays and other special events.

- **Isla del Amor**
  Located five minutes by boat from Puerto Bolivar, visiting it is a great experience for nature lovers and ideal for an ornithologist since it is home to a variety of bird

species, hence its name; birds nest and reproduce on this island.

- **Santa Clara Island**

  Located 90 minutes from Puerto Bolivar, it was a temple of ancient indigenous cultures, where remains of an Inca shrine were found. It is also known as the Dead Man's Island because it appears as the figure of a man lying down with a dead man's appearance from a certain distance. Santa Clara has similar characteristics to those of the Galapagos Islands, such as the volcanic structure and the fauna, since it is the habitat of birds, sea lions, iguanas, blue-footed boobies, frigate birds, etc. And during the months from July to September, the sighting of humpback whales is one of the most awaited attractions by foreign tourists.

- **City of Machala**

  Although new to the canton of Machala, Tourist activity has had a considerable increase in the last six years, which is demonstrated by the increase of tourist establishments in the city and the province in general.

  Machala has 183 tourist establishments (qualified by the Ministry of Tourism) and with Tourist Operating License.

  The hotel plant has 60 lodging establishments, with an average of 3,180 beds.

7.- PROJECT DESCRIPTION

7.1.- INTRODUCTION

Puerto Bolivar's privileged location in the Santa Rosa Channel, sheltered by the island of Jambelí, offers natural port protection and makes it a safe place for ships' berthing and operation.

Likewise, the Santa Rosa channel, 200 meters wide and marked with lighted buoys, serves as access to the port and anchorage area. (*Source: Private Initiative for the Modernization of Puerto Bolivar, 2015).*

The Santa Rosa channel waters are calm and offer favorable navigational conditions, which facilitates vessel maneuvering. (*Source: Private Initiative for the Modernization of Puerto Bolivar, 2015).*

Within the development process of Puerto Bolivar, YILPORTECU S.A. intends that in approximately 7 years, seventh-generation vessels such as MSC OSCAR, with a cargo of 15,000 to 19,000 Twenty Equivalent Unit (20 feet containers) and a length of 400 meters, will enter this port.

7.2.- EXISTING INFRASTRUCTURE AT PORT TERMINAL

The space available to the Puerto Bolívar Port Terminal is 419,943 m^2. It is completely enclosed by the port fence and is occupied by administrative and institutional buildings, financial entities, internal circulation roads, parking lots, storage yards, and warehouses.

The Port Terminal has a reserve of port space that allows for future expansion of the port's area to carry out its operations.

DOCKING WORKS

Currently, as berthing facilities at the Port Terminal, there is a breakwater pier (Pier 1 and 2) and a Marginal Pier (Pier 3, 4, and 5). These allow simultaneous berthing of up to 5 cargo vessels, which can be general cargo, container, or bulk carriers.

BREAKWATER PIER

The breakwater pier houses piers 1 and 2, it is 130 meters long, 30 meters wide, and has a depth of 12.5 meters for the simultaneous berthing of two vessels, one on each side.

Photo 45: Area of Piers 1 and 2

PIERS 1 AND 2

Source: *Photograph taken by MAVIC Drone* ***Prepared by:*** *Ecosfera Cia. Ltda.* ***Location:*** *Puerto Bolívar – Machala, El Oro* ***Date:*** *April 28, 2017*
      
Source: *Photographs taken by the Consulting Team* ***Prepared by:*** *Ecosfera Cia. Ltda.* ***Location:*** *Puerto Bolívar – Machala, El Oro* ***Date:*** *April 28, 2017*

MARGINAL PIER

It is made of piles and reinforced concrete slab; it is 660 meters long, 15 meters wide, and has a draft of 12.5 meters. It allows the berthing of 3 vessels simultaneously. This pier houses Piers 3, 4, and 5.

Photo 46: Piers 3, 4 and 5

PIERS 3, 4 & 5

Source: *Photograph taken with MAVIC Drone (7 km transmission range, flight speed 64km/h, flight speed 64km/h*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *April 28, 2017*

Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *March 29, 2017*

Photo 47: Pier 3

PIER 3

PIER 4

PIER 5


Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *March 29, 20177*

7.3.- TECHNICAL CHARACTERISTICS OF THE PROJECT

The Maritime Terminal of Puerto Bolivar is located on the east bank of the Estero Santa Rosa, Canton Machala, Province of El Oro.

It began operating in 1962 with piers 1 and 2, built by the Board of Reconstruction of El Oro, the main objective was to provide the southern coastal region of the country an immediate way for the export of bananas due to the growing demand for this product in the foreign market, to the point of making Ecuador the first producer worldwide and bananas in the second product of foreign exchange generation for the country after oil.

The depth at the piers was 10 meters, referred to as the low tides of Sicily. Since the beginning of its operations, the docks have been dredged periodically through contracts with the General Directorate of Maritime Interests and executed by the Dredging Service of the Navy.

The dredged sediments have been deposited in reserve and low-level areas within the Port Precinct, thus allowing the ground levels to be raised and later incorporated as streets, yards, and warehouses.
The following table shows a summary of the dredging carried out by the Navy Dredging Service (SERDRA).

Table 243: Summary of dredging of Puerto Bolivar's piers

DREDGE	PERIOD	VOLUME (m^3)	DEPOSIT
Pastaza 1.600 HP	Jul- Oct. 1992	263.000	APPB reserve areas
Río Santiago 3.800HP	Jan.-Feb. 1996	182.000	APPB reserve areas
Pastaza 1.600 HP	Nov. 98-Feb. 1999	157.500	APPB reserve areas
Pastaza 1.600 HP	Sep-Dec. 2000	121.000	APPB reserve areas
Río Santiago 3.800 HP	Feb.-Jul. 2004	172.415	Shrimp farms Eng. Barrezueta
Zamora 3.800 HP	Sep. 2008-May 2009	284.262,9	APPB reserve areas

Source: *APPB Data, 2016*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *May 20, 2017*

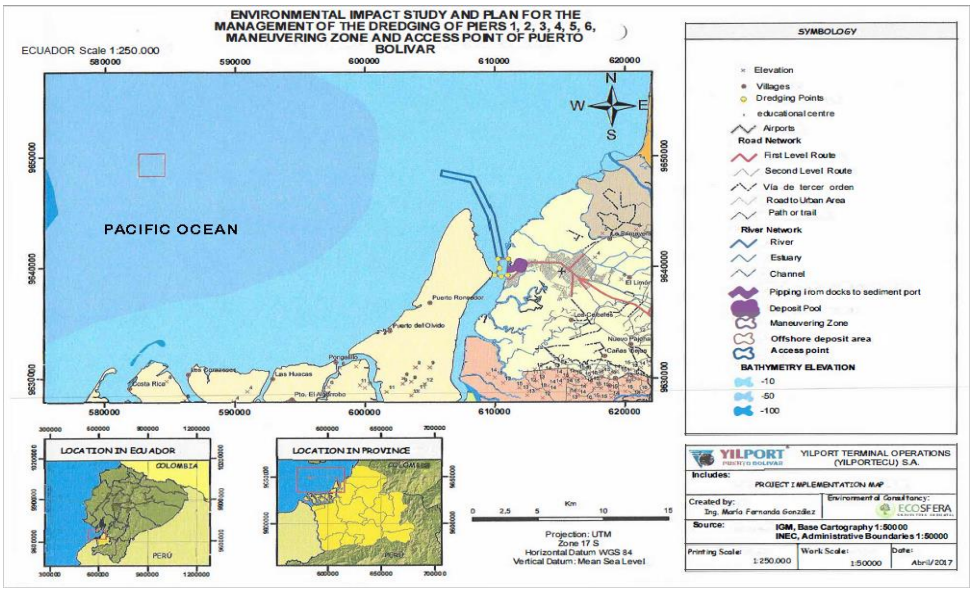
7.3.1.- PROJECT AREA

The dredging project includes two stages, as follows:

- **Dredging of piers 1, 2, 3, 4, 5, and 6:** 9 hectares.

- **Dredging of Maneuver Zone and Access Canal** to the port; on 473.57 hectares.
  The area located at the Santa Rosa estuary belongs to the navigation axis line to access the Sea Terminal of Puerto Bolivar.
  The works shall be done 4 kilometers before the off-shore buoy until the maneuver and dockage area limit, approximately 9,000 m long, in a 400-meter width, i.e., 400 hectares, as stated by the following figure.

Figure 214: Project areas



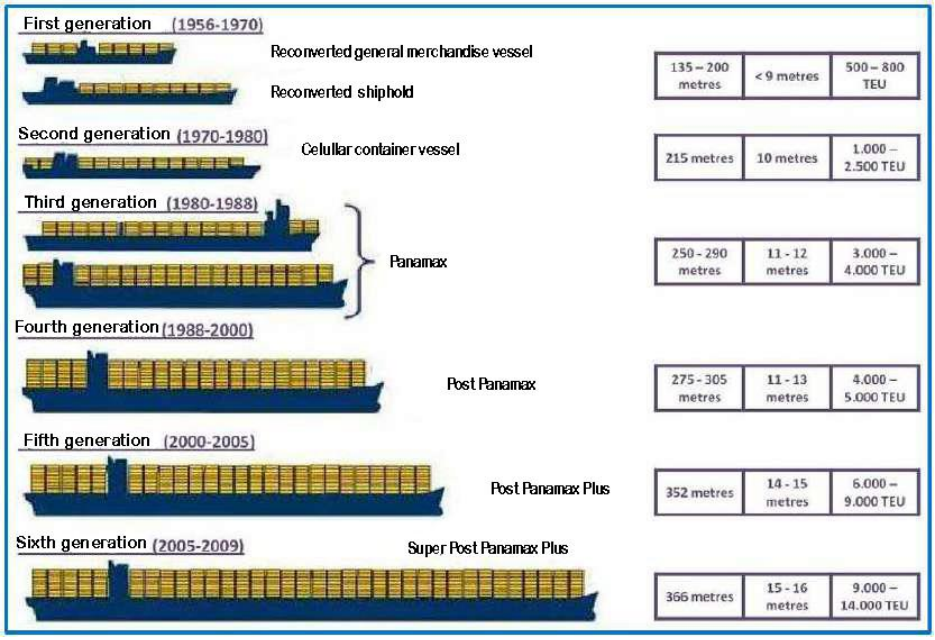
Source: *www.geoportaligm.gob.ec, IGM, INEC*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *April 20th, 2017*

7.3.2.- VESSELS THAT MAY ENTER THE PORT TERMINAL OF PUERTO BOLIVAR

For the dredging design, criteria that would allow the arrival of container vessels were taken into account, such as the following:

- Sub Panamax between 2,000 and 2,999 TEU
- Panamax between 3,000 and 5,000 TEU
- Post-Panamax, more than 5,000 TEU
- New Panamax more than 12,500 TEU
- Apart from those that currently enter the port

Figure 215: Types of vessels allowed for entry



Source: *APPB Data, 2016*
Prepared by: *Bolivar Port Authority*
Location: *Bolivar Port - Machala, El Oro*

7.3.3.- AREAS TO BE DREDGED AND DREDGING VOLUME

7.3.3.1.- DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6

The area to be dredged includes Piers 1, 2, 3, 3, 4, 5 and, additionally, the area adjacent to the future Pier 6.

Photo 48: Areas to be dredged of piers 1, 2, 3, 4 and 5

AREAS TO BE DREDGED FROM PIERS


Source: *EMPRIDREYD EL ORO EP*

Source: *Photograph taken with Drone MAVIC (7 km transmission range, flight speed 64km/h*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *April 28, 2017*

Photo 49: Dredging Area of Pier 6

DREDGING AREA PIER 6

Source: *EMPRIDREYD EL ORO EP*

Photo taken from Drone on 28/04/2017

Source: *Photograph taken with Drone MAVIC (7 km transmission range, flight speed 64km/h*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *April 28, 2017*

❖ **DREDGING VOLUME OF THE PIERS**

For the piers' dredging project, taking as reference the bathymetric study conducted by the company CONSULSUA Cia. Ltda. in March 2017, an increase is determined concerning the volumes obtained with the bathymetry of 2014; this percentage is applied to the volumes calculated for all the existing piers.

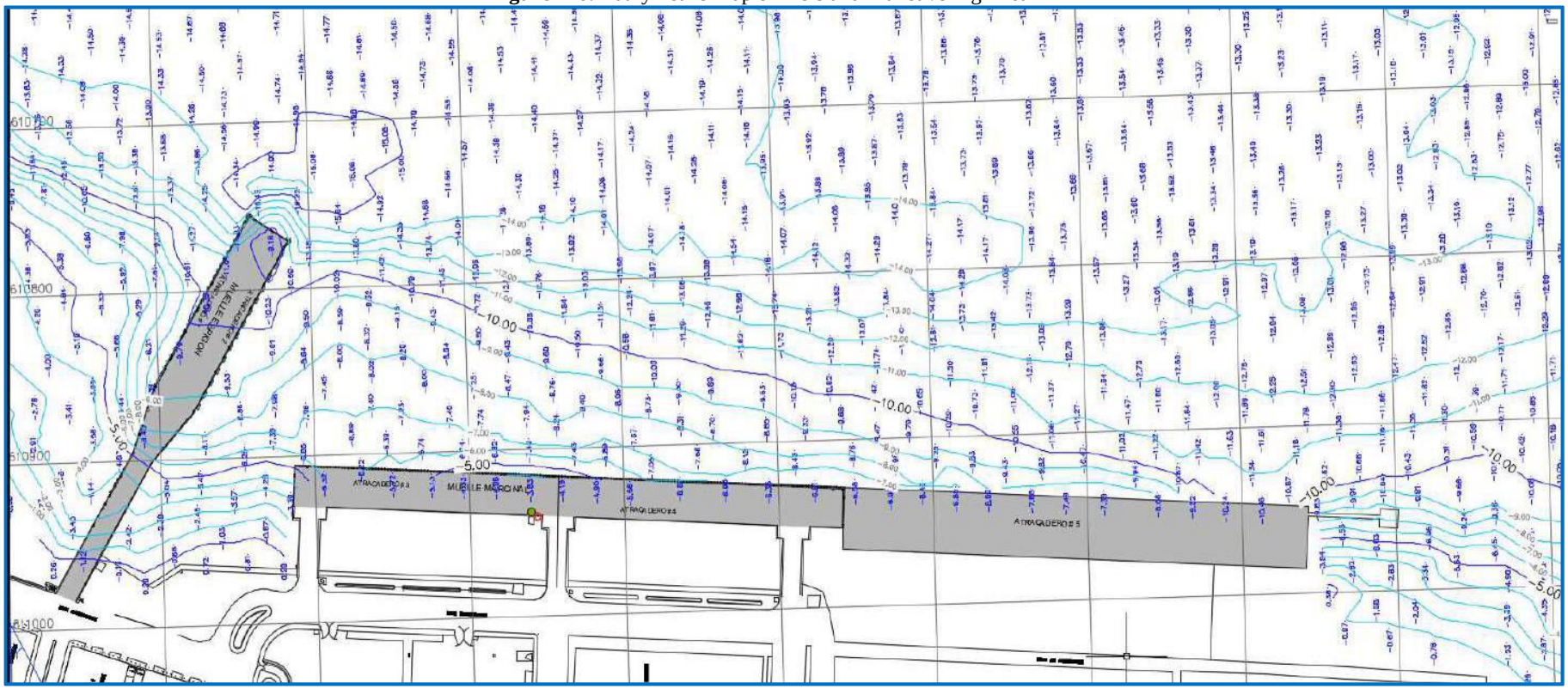
For the case of Pier #6 and its area to be dredged, bathymetry was performed between March 3 and 5, 2017, because bathymetric information of the area was not available, a total volume of 575,384.84 cubic meters was estimated, as shown in the table below:

Table 244: Areas to Dredge of the Piers 1, 2, 3, 4, 5 & 6

PIER	DIMENSIONS	DEPTH	VOLUME TO BE DREDGE
#1	160 x 100 m	-12,50 m	58.598,56 m^3
#2	160 x 50 m	-12,50 m	22.526,22 m^3
#3	180 x 100 m	-12,50 m	73.075,41 m^3
#4	180 x 100 m	-12,50 m	45.628,87 m^3
#5	300 x 100 m	-14,50 m	124.308,33 m^3
#6	500 x 100 m	-16,50 m	251.247,45 m^3
TOTAL VOLUME TO BE DREDGED			**575.384,84 m^3**

Source: *EMPRIDREYD EL ORO EP*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *April 28, 2017*

Figure 216: Bathymetric Map of Piers and Maneuvering Area



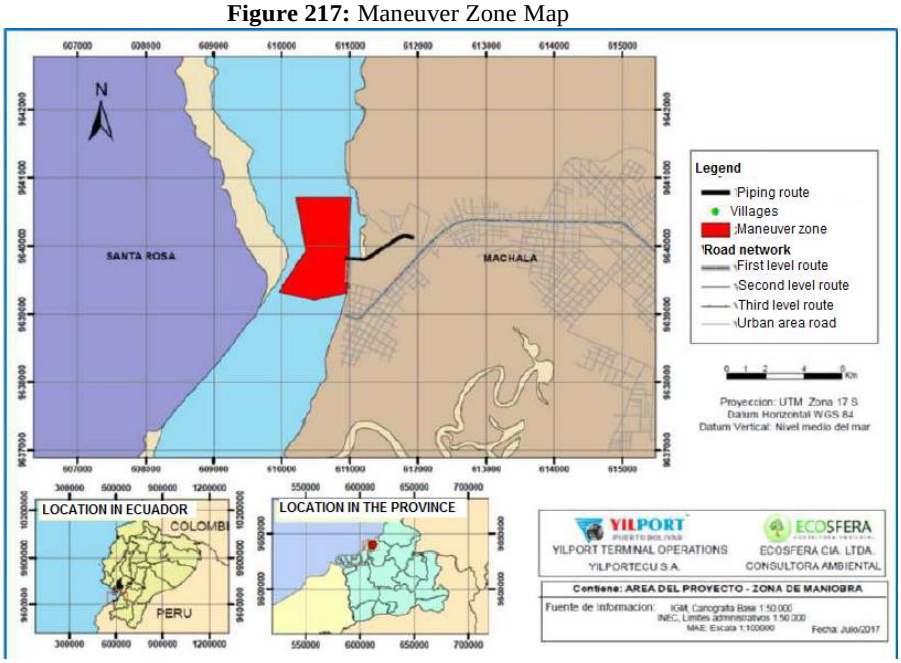
Source: *Bathymetric Study of the Maneuvering and Docking Zone of the Puerto Bolivar Maritime Terminal.*
Prepared by: *Consulsua Cia. Ltda.*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *March 21, 2017*

7.3.3.2.- DREDGING MANEUVER ZONE AND ACCESS CANAL

The Maneuver Zone and Access Canal to Puerto Bolivar are located in the Santa Rosa estuary and belong to the Pier zone and the navigation axis line to access the Sea Terminal of Puerto Bolivar. Each of these zones to be developed in two stages:

The **MANEUVER ZONE** will have a surface of 94.7 hectares; in the first dredging phase, projected to remove 2 million cubic meters, achieving a dimension of -14.5 m MLWS regarding the lowest tidal and 200-meter width at the bottom of the sea.
In the second stage, the year 2003, 1 million cubic meters shall be removed, achieving a dimension of -16.5 m, but with a 270-meter width in the sea's bottom.

Figure 217: Maneuver Zone Map



Source: *www.geoportaligm.gob.ec. IGM,INEC*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, Santa Rosa - El Oro*
Date: *April 15, 2017*

Fotography 50: Maneuver Zone Dredging Area

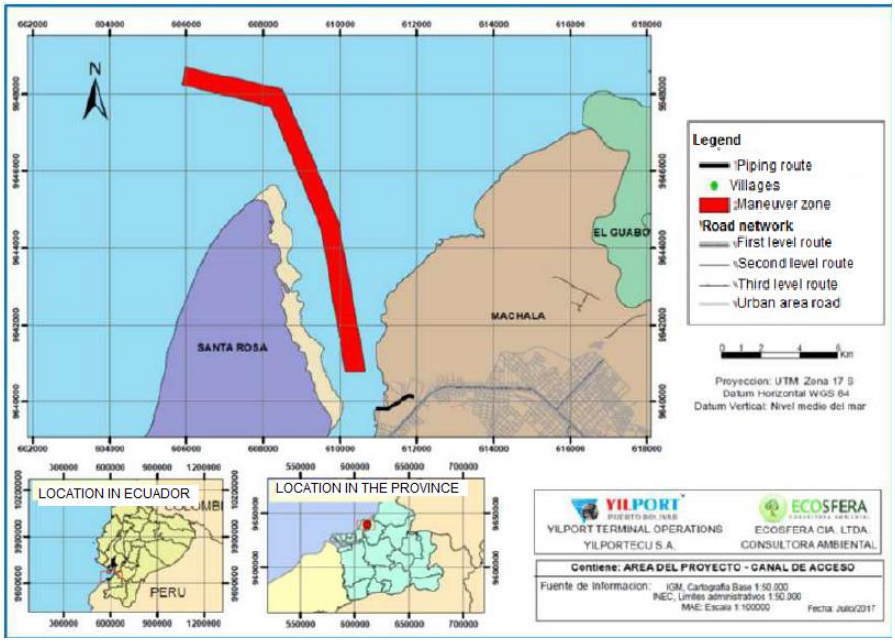
MANEUVER ZONE DREDGING AREA

Source: *Photo taken with Drone MAVIC (7 km transmission range, flight speed 64 km/h)*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, El Oro*
Date: *April 28, 2017*

The ACCESS CANAL shall have a surface equivalent to 400 hectares; in the first dredging stage, it will remove 5 million cubic meters of sediments, achieving a dimension of -14.5 m MLWS regarding the Sicigia tidal level and 200-meter width at the bottom of the sea.
The second stage in year 2023 shall remove 2 million cubic meters with a dimension of -16.5 m MLWS and a 270-meter width at the bottom of the sea.

The second stage of the maneuver zone and the access canal shall be executed approximately 6 years after the start of YILPORTECY S. A. operations.

Figure 218: Access Canal Zone Map



Source: *www.geoportaligm.gob.ec. IGM, INEC*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, Santa Rosa - El Oro*
Date: *July 15, 2017*

Figure 51: Access Canal Dredging Area

ACCESS CANAL DREDGING AREA

Source: *www.geoportaligm.gob.ec. IGM, INEC Photo taken with Drone MAVIC (7 km transmission range,flight speed 64 km/h)*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, El Oro*
Date: *April 28, 2017*

7.3.3.- DREDGING SEDIMENT DEPOSIT AREA

PIER DREDGING SEDIMENT DEPOSIT AREA

For the Dredging material deposit (sediments) of the areas attached to the piers, the same area used for the dredging between in years 2012 and 2013 has been considered.
The site is located at the old estates of ISSFA.

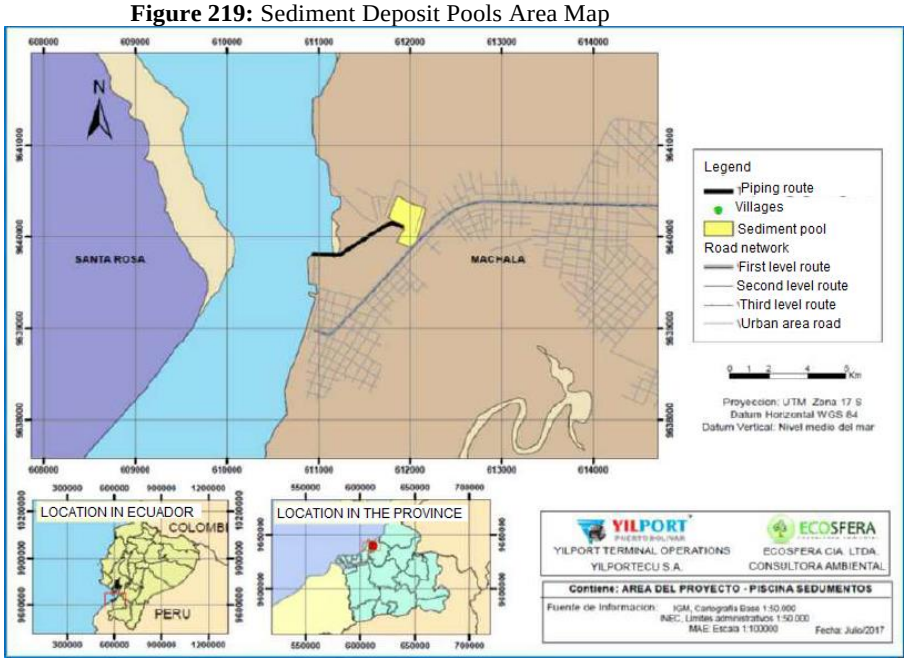
There are three pools of around 12.9 hectares in total, which have the previous dredging material, so these will be emptied, and the walls shall be conditioned to take the new dredged material. Also, it has been considered to construct walls for the fourth pool of around 2.8 hectares, together with the existing pools.

It shall be guaranteed a proper height of the 3.2-m walls in all existing pools and the new pool to be built for such purpose.

By the end of 2015, a land survey in the dredging deposit pools was performed to obtain the necessary information to estimate the volume of the material to dig and empty.

In addition to these volumes, it has been considered a stony material volume to stabilize the accesses to allow the entry and exit of machinery and dump trucks inside the pools to perform the digging and emptying works.

Figure 219: Sediment Deposit Pools Area Map



Source: *www.geoportaligm.gob.ec. IGM,INEC*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, Santa Rosa - El Oro*
Date: *July 15, 2017*

Photograph 52: Sediment Deposit Pools

SEDIMENT DEPOSIT POOLS

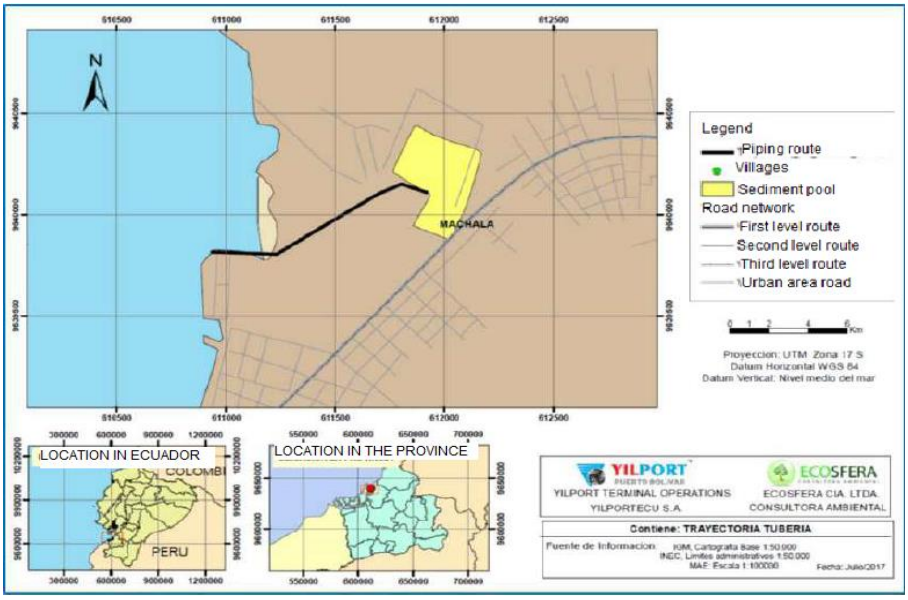
Source: *Photo taken with Drone MAVIC (7 km transmission range, flight speed 64 km/h)*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, El Oro*
Date: *April 28, 2017*

SEDIMENT DEPOSIT POOLS

Source: *Photo taken by the consulting team*
Prepared by: *Ecosfera Cia. Ltda.*
Location: *Puerto Bolivar - Machala, El Oro*
Date: *March 29, 2017*

The image below shows where the piping will be installed:

Figure 220: Sediment Pool Piping Route Map



Source: *www.geoportaligm.gob.ec. IGM,INEC*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, Santa Rosa - El Oro*
Date: *July 15, 2017*

Figure 53: Sediment Dredging Piping

SEDIMENT DREDGING PIPING ROUTE

Source: *Photo taken with Drone MAVIC (7 km transmission range, flight speed 64 km/h)*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, El Oro*
Date: *April 28, 2017*

SEDIMENT DEPOSIT AREA, ACCESS CANAL, AND MANEUVER ZONE

The site proposed as a sediment deposit area taken from the Maneuver Zone and the Access Canal of Puerto Bolivar is located offshore.

It has a survey area of 2 km by 2 km, with survey lines of 5 km, having a total of 5 lines plus three verification lines. It is located 12.75 miles away from the offshore buoy (25 km). This zone shows depths of over -30 m MLWS, achieving up to -40 m MLWS; likewise, the predominant currents in this site are directed towards the Northeast, so the sediments travel that way.

The London Convention states that dredging material may be placed at the sea. The purpose of this Convention is to promote the effective control of all contamination sources of the sea and the adoption of possible measures to avoid sea contamination due to waste and other materials disposal.

The disposal site coordinates are detailed below:

Table 245: Offshore Sediment Deposit Area Coordinates

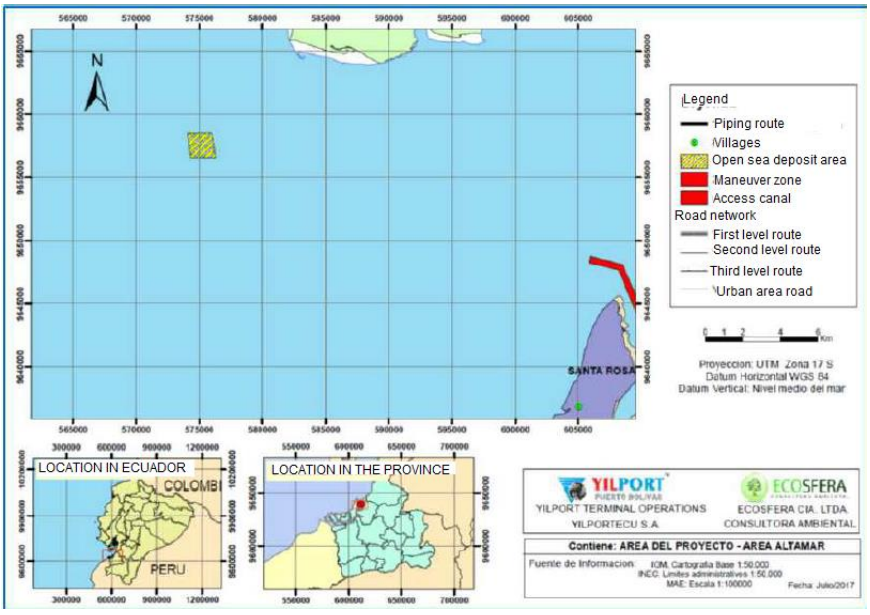
POINT	X	Y
P 1	583544	9649248
P 2	583880	9651278
P 3	585837	9651184
P 4	585560	9649187

Source: *Own preparation*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa, El Oro*
Date: *April 15, 2017*

Figure 221: Satellite Image of Offshore Sediment Deposit Area Coordinates

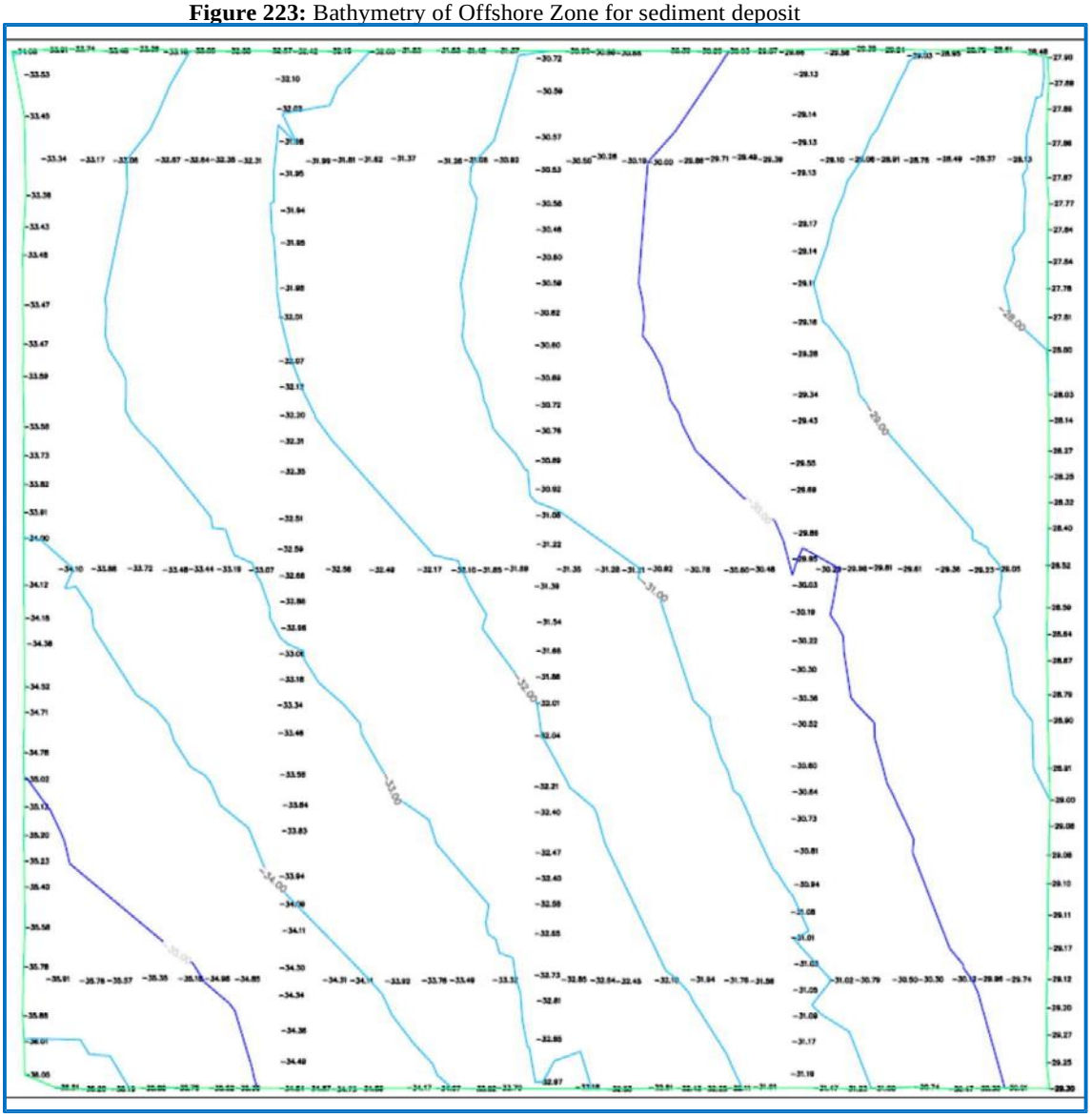
Source: *www.googleearth.com*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa, El Oro*
Date: *April 15, 2017*

Figure 222: Offshore Sediment Area Location Map



Source: *www.geoportaligm.gob.ec, IGM, INEC*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolivar - Machala, El Oro*
Date: *July 15, 2017*

Figure 223: Bathymetry of Offshore Zone for sediment deposit



Source: *Bathymetric Study of Offshore Zone*
Prepared by: *Consulsua Cia. Ltda.*
Location: *Puerto Bolivar - Machala, El Oro*
Date: *May 2017*

According to the bathymetry study performed at the deposit area, we have depths from elevation -27 m to elevation -36 m.

7.3.4.- DREDGING METHODOLOGY

METHODOLOGY FOR DREDGING OF PIERS AND SEDIMENT DISPOSAL

To dredge the maritime areas adjacent to Piers 1, 2, 3, 4, 5, and 6, the land pipeline will be installed following the sidewalk on the right side of the road that leads to the beginning of Pier 5, and then it will be installed along the edge of the piers until it reaches the beginning of Pier 3, being able to dredge from that point Piers 3, 2 and 1.

Pier 3 is estimated to take approximately 30 days, Pier 2 approximately 17 days, and Pier 1 approximately 30 days.

Subsequently, we will proceed to cut the pipe and place the downspout between Pier 4 and 5; the work of cutting the pipe will be done in approximately 5 days, and will continue with the dredging of Pier 4, which would be completed in about 30 days, finally, Pier 5 which would take 50 days, with a working time of 162 days.

An IHC Beaver dredge will be used to dredge these areas.

DREDGING METHODOLOGY MANEUVERING AREA AND ACCESS CHANNEL AND DISPOSAL OF SEDIMENT

Once the TSHD dredge fills its respective hoppers with the sediments extracted from the Maneuvering Zone and Access Channel, the dredging system is raised and then navigates to the sediment disposal point indicated in the previous table (GPS use), once the dredge is located at the point, the unloading gates located at the bottom of the dredge are opened.

The dredge will have two suction and dredge piles both sailing until the hopper is full, then the dredge will sail to the sediment tank for discharge and then start a new cycle. This will be repeated until the dredging is completed.

It is estimated to perform 4 cycles per day, considering that the dredging time until the hopper is filled is 90 minutes, and 90 minutes of navigation to the deposit site.

The following images show the process of sediment deposition.

Figure 224: Dredging Methodology

DREDGING METHODOLOGY

Source: *https://www.youtube.com/watch?v=aj6v4hEgq8U#action=share*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *July 15, 2017*

Sediment Dispersion Model

Based on the analyses described in previous sections, modeling of sediment behavior in the Altamar Sediment Disposal Zone was carried out.

For the modeling of sediment dispersion, both horizontal and vertical displacement of particles by tidal action influencing each depth level is considered, stratifying three levels from 0 - 9 m (surface layer), from 9 - 18 m (middle layer), and 18 - 27 m (bottom layer).

According to the sediment dispersion modeling and its results, it is concluded that the area required for the sedimentation of fine materials under extreme and conservative tidal conditions will not interfere with the activities related to the use of water resources that are carried out on the banks near the area of the deposit site, such as shrimp farms, since the sediments will move a distance of 1.48 km from the deposit site when the tide is in a state of flow at the surface level. 48 km from the deposition site, when the tide is in a state of flow at the surface level, at the medium depth level the fine sediment will move at a distance of 1.46 km and finally at the bottom level, due to its characteristics, the fine sediment will move around 1.84 km, which is related to the results obtained in the field, referring to the current measurements. Similar behavior is evidenced when performing the modeling in the backflow tide state, presenting an approximate displacement of fine sediments of about 6.02 km from the deposit site.

7.4.- ACCESS ROADS

Puerto Bolivar has a transportation network made up of well-developed road infrastructure, with multiple improvement and expansion works that constitute a good transportation road network for the handling of production:

- Guayaquil - Machala road axis (Route E40 and Route E25, distance 97 km, 1h17)
- Tumbes - Machala road axis (Route E25 and Route E50, distance 185 km, 3h)
- Cuenca - Machala road axis (Route E59 and E50, distance 168 km, time 3h17)
- Loja - Machala road axis (Route E35, E50, and E25, distance 233 km, time 4h20)
- Quito - Machala highway axis (Route E25 and E87, distance 521 km, time 9h)
- The Puerto Bolívar - Machala - Pasaje - Girón - Cuenca - Paute - Amaluza - Méndez - Puerto Morona road
- The Puerto Bolívar – Machala – Santa Rosa - Balsas - Chaguarpamba – Loja – Zamora – Yantzatza - El Pangui - Gral. Leonidas Plaza and Méndez road

Second-Order highways connect it with Zamora (300 km) and with Macas (440 km). Its geographical and commercial hinterland encompasses the southern Ecuadorian sector, efficiently serving the provinces of El Oro, Azuay, Loja, Cañar, Zamora, the closest sector to the provinces of Guayas and Morona Santiago, and northern Peru.

Locally, Puerto Bolívar is a 10-minute drive from the city of Machala. The current system that links the city of Machala and its port with neighboring areas, production centers, neighboring provinces, and the rest of the country is a network in good working order.

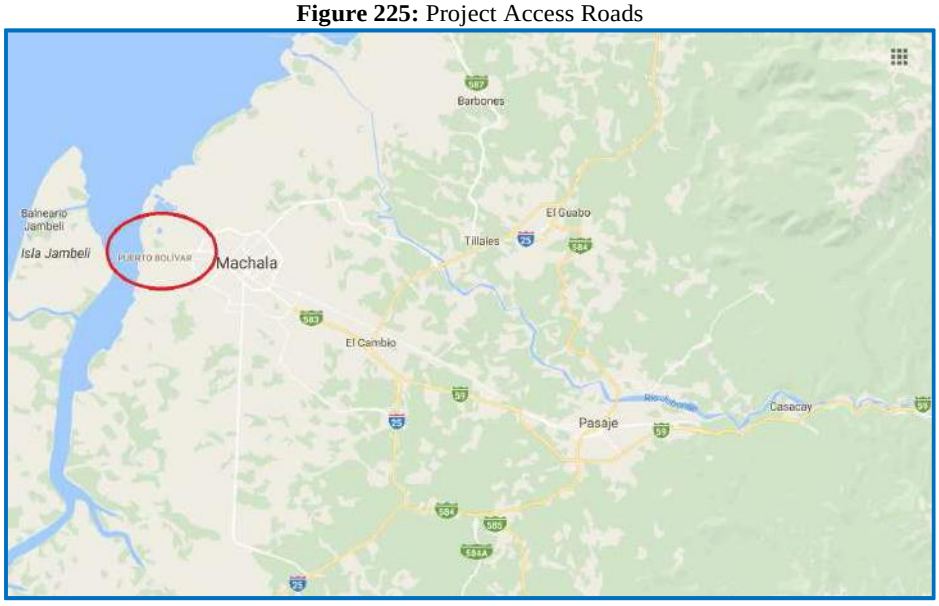
The main access road to the port, Avenida Bolivar Madero Vargas, with two lanes in each direction, the new road to La Primavera, the road to Pajonal, and the road to El Limon, all paved, cross the urban center of Machala.
These, together with the North and South ring roads, constitute a circulation network that has so far guaranteed communication with the port.

However, there are congested sections, especially the section corresponding to the junction of the northern perimeter road with the congestion, especially in the section corresponding to the junction of the northern perimeter road with Avenida Bolívar Madero Vargas up to the entrance to the port facilities. This avenue was initially conceived as a development corridor linking Machala with the parish of Puerto Bolivar and not as a freight corridor. It is foreseeable that these problems will worsen as traffic flows increase due to the growth of exports and imports and the development of new urban centers.

In 2001, the Port Authority of Puerto Bolivar already considered it necessary to build a road system that would efficiently contribute to the smooth flow of goods to and from the port *(DIPLAN–ASTEC Association, 2001).*

There is currently a project for the construction of northern access to Puerto Bolivar *(APPB, 2012).*

Figure 225: Project Access Roads



Source: *Google Maps*
Prepared by: *Google*
Date: *April 15, 2017*

7.5.- PROJECT LIFE CYCLE

The dredging project for Piers 1, 2, 3, 4, 5, and 6, maneuvering area and access channel of Puerto Bolivar has a life cycle of approximately 15 months.

The dredging activities and execution times for each area are detailed as follows:

Table 246: Life Cycle of Project

ACTIVITY	START DATE	EXECUTION TIME	PLACE OF DEPOSIT
Dredging Piers #1 – #4	Two days after issuance of Environmental License	5 Months	Sedimentation Ponds
Pier #5	10 days after issuance of Environmental License	5 Months	Sedimentation Ponds
Dredging Pier #6	2018	5 Months	Altamar
Dredging Maneuvering Area First Phase	2018	2 Months	Altamar
Dredging of access channel First Phase	2018	6 Months	Altamar
Dredging Maneuvering Area Second Phase	2023	5 Months	Altamar
Dredging of access channel Second Phase	2023	6 Months	Altamar

***** *During June to October, no dredging works will be carried out because this is a period of transit and reproduction of humpback whales (Megaptera novaeangliae)*

Source: *Own preparation*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Date: *July of 2017*

The new dredging of these areas is planned for 2023 as a maintenance measure for the project.

7.6.- MANPOWER REQUIRED

7.6.1.- DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6

For the dredging of Piers 1, 2, 3, 4, 5, and 6 of Puerto Bolívar, the dredging work will be carried out by Empresa Pública de Riego, Drenaje y Dragados (EMPRIDREYD EL ORO EP), and the personnel required is detailed in the following table:

Table 247: Manpower detail

NUMBER	POSITION	CANDIDATE
1	Dredge Supervisor	1
2	Dredge Operator	3
3	Assistant Operator	3
4	Dredge Operator	3
5	Assistant Engineer	3
6	Towing Helmsman	3
7	Towing Machinist	3
8	Seaman	3
9	Shore Maneuverer	6
TOTAL		**28**

Source: *Own preparation*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *April 2, 2017*

7.6.2.- DREDGING OF MANEUVERING AREA AND ACCESS CHANNEL

For the Dredging of the Maneuver Area and Access Channel, which will use a different type of dredge, the personnel required are detailed in the table below:

Table 248: Manpower detail

NUMBER	POSITION	CANDIDATE
1	Captain	1
2	Deck Officer	3
3	Helmsman	3
4	Boatswain's Mate	1
5	Chief Engineer	1
6	Engineer Officer	3
7	Machinist	3
8	Mechanic	1
9	Seaman	2

NUMBER	POSITION	CANDIDATE
10	Electrician	1
11	Port Machinist	1
12	Starboard Machinist	1
13	Dredge Officer	1
14	Cook	1
TOTAL		**23**

Source: *Own preparation*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *April 2, 2017*

The work system contemplates covering approximately 20 hours per day, for which rotating shifts will be used with the participation of technical and operational personnel.

7.7.- DESCRIPTION OF ACTIVITIES

Below is a summary table of the stages to be developed for dredging activities:

7.7.1.- ACTIVITIES TO BE CARRIED OUT BEFORE DREDGING

The activities to be carried out before dredging are as follows:

❖ CONSTRUCTION OF CAMP AND WAREHOUSES

For the construction of a camp, warehouse, or fuel storage site, a strategic location must be defined before starting the project. Avoid causing inconvenience to the population in the area of influence and the normal development of the port area's activities.

Under no circumstances will the location of the camp and warehouses interfere with vehicular or pedestrian traffic, nor will they generate visual disturbances or interference with neighboring buildings.

The camp must have minimum facilities that contribute to the comfort of the project workers.

❖ MOBILIZATION OF DREDGING EQUIPMENT

This action will be carried out according to the type of dredge and its specific requirements. The dredge to be used for Piers 1, 2, 3, 4, 5, and 6 is located close to the project area, and a local company will carry out the dredging work in this area;

while the dredge to be used for the Maneuvering Area and Access Channel will reach the project area by navigation. The dredge that will be used for the Maneuvering Area and Access Channel will reach the project area by navigation.
Mobilization of dredge pipes and accessories by land and river to the dredging site in the area of Puerto Bolivar.

The TSHD or similar during the arrival at Puerto Bolivar must present the work plan for dredging, industrial safety plan, contingency plan, ship maintenance plan, and environmental management plan.

- **INSTALLATION OF DREDGING EQUIPMENT**

The installation of machinery and equipment will be carried out, following the specifications of the specialist technician who will indicate the site where the dredging process will begin, according to the studies carried out.

- **FUELING OF DREDGING EQUIPMENT**

The fuel supply of machinery on land will be carried out at the corresponding authorized service stations. In the particular case of equipment and machinery located on the water, as in the case of dredges, a dock with the corresponding permits will be used to carry out the fuel supply maneuver.
For this action, a tugboat will be used. Once the dredging equipment is anchored to the dock, all the necessary measures will be implemented for the contingency in case of a fuel spill. These activities will be in charge of the companies that provide the fuel supply service.

- **MOBILIZATION AND INSTALLATION OF PIPING**

The piping will be installed following the corresponding instructions.

- **LANDFILL SITE PREPARATION**

The project contemplates rehabilitating a deposit site for the dredged materials, which have been previously selected through studies carried out by.

- **HYDRAULIC TEST**

Before the start of the dredging of Piers 1, 2, 3, 4, 5, and 6, hydraulic tests will be carried out on the pipelines to verify their correct operation and prevent spills or leaks.

7.7.2.- ACTIVITIES DURING DREDGING

The activities to be carried out during the dredging and hydraulic backfilling process are as follows:

- **DREDGING IN STAGES FOLLOWING THE DESIGN IN STUDY**

  The dredging processes will be carried out following the technical specifications determined in the previous studies.

  To successfully perform this operation, it is necessary to reach the maximum design elevation.

- **HYDRAULIC BACKFILLS**

  They will be carried out based on the maximum filling level, about the lowest level of the syzygy low water level.

- **MAINTENANCE OF MACHINERY, EQUIPMENT, AND PIPING**

  Maintenance performed on all equipment (dredges, pump banks, piping, couplings, etc.) will follow the manufacturer's recommendations, guaranteeing the correct operation of the equipment and reducing the contribution of contaminants to the environment as much as possible.

  Maintenance of mobile equipment must be performed at authorized sites that have the respective control equipment and final disposal of the waste generated.

  Pipeline maintenance will be planned according to the dredges' operation; dredge stoppages must be as short as possible.

- **BATHYMETRIES CONTROL**

  To verify compliance with the level to be reached with the dredging actions, bathymetries will be carried out at the sites that have already been dredged; if the results show that the level estimated in the engineering study has not been reached, the dredging process must continue.

- **FUEL SUPPLY**

  The dredge will be supplied with fuel, assisted by vessels designed for this activity.

  This operation will be carried out directly to the dredge at the worksite. The fuel supplier must have a contingency plan for the supply of hydrocarbons.

  Lubricating oils will be changed every 500 hours of work, both for the main machines and the generators or according to the constructor's maintenance stipulated.

  Used oil generated due to general dredge maintenance will be stored in airtight metal containers and subsequently disposed of.

❖ **TRANSPORT OF DREDGED SEDIMENT TO DEPOSITION SITES**

The dredged materials will be transported through pipelines with an inside diameter in accordance with the dredges. An energy dissipater will be used for unloading the dredged material at the deposit sites to prevent the unloading from affecting the infrastructures located around the unloading site.

7.7.3.- ACTIVITIES TO BE CARRIED OUT AFTER DREDGING

Once the dredging activities are completed, all equipment used must be dismantled and mobilized so that the project area is not affected nor the area of influence. The demobilization process will be carried out following the manufacturer's recommendations.

If it is convenient in the affected areas, hydraulic fillings or coatings will be made in the affected areas.

Also, the pipelines' demobilization will be carried out following the instructions of the studies carried out by the companies in charge.

7.8.- MACHINERY AND EQUIPMENT

The type of dredge, machinery, and equipment will be used according to the project phases.

7.8.1.- DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6

For the dredging of Piers 1, 2, 3, 4, 5, and 6, the following will be used:

- IHC BEAVER 6518C suction dredge with head, 650 mm discharge suction cutter.
- IHC BEAVER multipurpose barge with rectangular hull plus accessories and spare parts.
- 2000 m of 650 mm land pipeline.
- 500 m of 650 mm floating pipeline.
- 2 support boats with a 75hp outboard engine.

STATIONARY SUCTION DREDGE WITH CUTTER HEAD (CSD).

The main characteristics of this dredge are as follows:

- IHC BEAVER 6518C suction dredge with head, 650 mm suction discharge cutter.

- IHC BEAVER multipurpose barge with rectangular hull plus accessories and spare parts.
- 2000 m of 650 mm land piping.
- 2000 m of 650 mm floating pipeline.
- 2 support boats with a 75hp outboard engine.
- Overall length 47.20 m
- Beam 12.44 m
- Depth 2.97 m
- Average draft 2.05 m
- Maximum dredging depth 18,0 m
- Suction pipe diameter 650mm
- Total installed power 3800 HP

The cutter dredge consists of a pontoon or boat that houses the centrifugal pumps to produce the suction of the water-sediment mixture and a frame-like structure called a ladder that is lowered to the bottom and supports a shaft with a cutter that rotates in a direction normal to the axis of the suction pipe. This cutter is responsible for the disintegration of the material, which at the same time is transported by the water current generated by the suction. The dredge works in a stationary way, moving to one side and the other as the cut is made.

The dredge is held in position by pylons. Pipes transport the dredged material to the surface, and from there, it is piped to the discharge site. The project will use the "Provincia de El Oro" dredge owned by the Empresa Pública de Riego, Drenaje y Dragados (EMPRIDREYD EL ORO EP) of the Provincial Government of El Oro.

Figure 226: Schematic of Beaver 6518C Dredge

Source: *www.ihcholland.com*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Date: *July 15, 2017*

Photo 54: Dredge Beaver 6518C of EMPRIDREYD EP

DREDGE BEAVER


Source: *Photograph taken by Consulting Team*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *July 15, 2017*

7.8.2.- MANEUVERING AREA AND ACCESS CHANNEL DREDGING

A Trailing suction hopper dredger (TSHD) will be used for the dredging of Pier #6, Maneuvering Area, and Access Channel.

A TSHD is a self-propelled vessel that loads dredged material into its hopper. The dredging process of a TSHD consists of a loading cycle (dredging), transport (sailing), and the unloading stage.

Trailing suction hopper dredgers (TSHD), for its acronym in English, are classified as hydraulic dredgers, including dredging equipment that uses centrifugal pumps, at least for the process of transporting the dredged material, either taking it out of the water or transporting it horizontally to another site.

TSHDs are used in a wide variety of marine construction and maintenance projects, such as maintenance dredging in harbors and access channels, removing sediments to reach the required depth. They are mainly used to dredge loose materials such as sand, clay, or gravel.

Typically, a TSHD is equipped with one or two suction pipes to which suction heads are connected. Suction heads are often compared to huge vacuum cleaners.

The main parts of this type of dredge are:

- Standard installation on a vessel, e.g., engines, crew cabins, navigation bridge, among others.
- The dredging head is connected to the lower end of the suction pipe. These dredge heads loosen and suction the sediments to be dredged

using teeth and/or pressurized water. Different types of heads can be installed, depending on the ground conditions.

- The submersible dredge pumps. It pumps the slurry from the seabed into the hopper and, if required, from the hopper to land.
- The suction pipe and the pipeline on deck through which the slurry is transported.
- The hopper. This is the hold of the ship. A mixture of dredged material and water is pumped into the hopper, and most of the water is evacuated through the overflow system. The dredged material remains in the hopper during transport until it is discharged.
- The suction pipes are lowered to the bottom of the water, and the heads "crawl" over the seabed, sucking material as the vessel slowly moves forward, i.e., trawls. The suction pipes and suction heads can be positioned according to the dredging operation's needs so that they can be transported to the dredger.

The main characteristics are:

- Hopper capacity: 11,300 m³
- Deadweight: 18,620 ton
- Length: 142.5 m
- Sleeve: 27.5 m
- Loaded draft 9.1 m
- Maximum dredging depth: 38 / 57.5 / 77 m
- Diameter of suction pipe: 1,200 mm
- Pump power (drag): 3,400 kW
- Pump power (discharge): 7,500 kW
- Propulsion power: 2 x 5,750 kW
- Total diesel power installed: 13,110 kW
- Speed: 15.3 kn
- Lodging. 34
- Construction: 2003

Figure 227: Dredging mechanics Dredge TSHD

Source: *iadc-dredging.com*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar – Machala, El Oro*
Date: *July 15, 2017*

The vessel's mobilization does not represent an obstacle to the transit of other vessels in the navigation channel because it has its propulsion and autonomy.

Its dredging operation is carried out with the following systems:

- Winches, cables, and pulleys
- Hydraulic jacks
- Pumping (electric motor and pump)
- Suction (head and injectors)
- Pressurized water
- Hopper gates

7.9.- SCHEDULE OF DREDGING ACTIVITIES

Table 249: Schedule of Dredging Activities

ACTIVITY	START	EXECUTION TIME	PLACE OF DEPOSIT	RESPONSIBLE	MEANS OF VERIFICATION
Dredging Piers #1 – #4	Two days after issuance of Environmental License	5 Months	Sedimentation Ponds	EMPRIDREYD EL ORO EP	Notification of commencement of activities Dredging operation report
Pier #5	10 days after issuance of Environmental License	5 Months	Sedimentation Ponds	EMPRIDREYD EL ORO EP	Dredging operation report
Dredging Pier #6	2018	5 Months	Sedimentation Ponds	EMPRIDREYD EL ORO EP	Dredging operation report
Dredging Maneuvering Area First Phase	2018	2 Months	Altamar	DRAGA TSHD (designated contractor)	Dredging operation report
Dredging of Access Channel First Phase	2018	6 Months	Altamar	DRAGA TSHD (designated contractor)	Dredging operation report
Dredging Maneuvering Area Second Phase	2023	5 Months	Altamar	DRAGA TSHD (designated contractor)	Dredging operation report
Dredging of Access Channel Second Phase	2023	6 Months	Altamar	DRAGA TSHD (designated contractor)	Dredging operation report

*****_During June to October no dredging works will be carried out because this is the period of transit and reproduction of humpback whales (Megaptera novaeangliae)_

Table 250: TSHD Dredge Operation Plan

DREDGE OPERATION PLAN								
DREDGING SITE	**DREDGING TYPE**	**HOPPER FILLING TIME (MINUTES)**	**NAVIGATION TIME TO DISPOSITION ZONE (ALTAMAR) (MINUTES)**	**SEDIMENT DISPOSAL TIME (MINUTES)**	**CYCLES /DAY (10.000 m^3)***	**VOLUME /DAY (m^3)**	**TOTAL TIME**	**TOTAL SEDIMENT VOLUME (m^3)**
Maneuvering Area	TSHD	90	90	40	4	40.000	2 months	2'000.000
Access Channel	TSHD	90	90	40	4	40.000	6 months	5'000.000
TOTAL DREDGING VOLUME								**7'000.000,00**

*10.000 m^3 = 1 cycle

8.- ALTERNATIVES ANALYSIS

In Ecuador, 80% of foreign trade is carried out by sea, so the port and shipping sector is considered strategic for the development of the country's economy.

Puerto Bolivar represents a great access door for foreign trade, playing a fundamental role in the country's competitiveness; that is why its growth and development are a priority.

Within its operation, the Port Terminal of Puerto Bolivar seeks better-operating conditions within its competitive dynamics; these conditions are subject to maintain its port infrastructure operational, improving its nautical conditions, and tending to have greater capacity.

According to the Bathymetric Study carried out in March 2017 by CONSULSUA Cia. Ltda. For the project, it has been determined that the project is feasible Besides, it is essential to maintain and improve the berthing capacity of the piers (depth); not only for technical aspects but also for contractual aspects of concession.

8.1.- ALTERNATIVES DESCRIPTION

For the Alternatives Analysis, considering the experience and knowledge of dredging activities, three alternatives are proposed.

The description of these alternatives responds to the fulfillment of the project objectives: ***"Dredging of Piers 1, 2, 3, 4, 5 and 6, Maneuvering Area and Access Channel of Puerto Bolivar".***

The alternative to be selected will consider the technical, environmental, and economic aspects of the project.

- **ALTERNATIVE 1:**

  According to the studies carried out, 575,384.84 cubic meters will be extracted from the Pier Area (Piers 1, 2, 3, 4, 5, and 6).

  - Pier #1 = 58.598,56 m^3
  - Pier #2 = 22.526,22 m^3
  - Pier #3 = 73.075,41 m^3
  - Pier #4 = 45.628,87 m^3
  - Pier #5 = 124.308,33 m^3
  - Pier #6 = 251.247,45 m^3

  The proposed idea is to dispose of the material extracted from the dredging (sediments) in an area annexed to the Port Terminal piers of Puerto Bolivar. On the same site, the dredging material of 2012 and 2013 was disposed of, located in the former ISSFA premises.

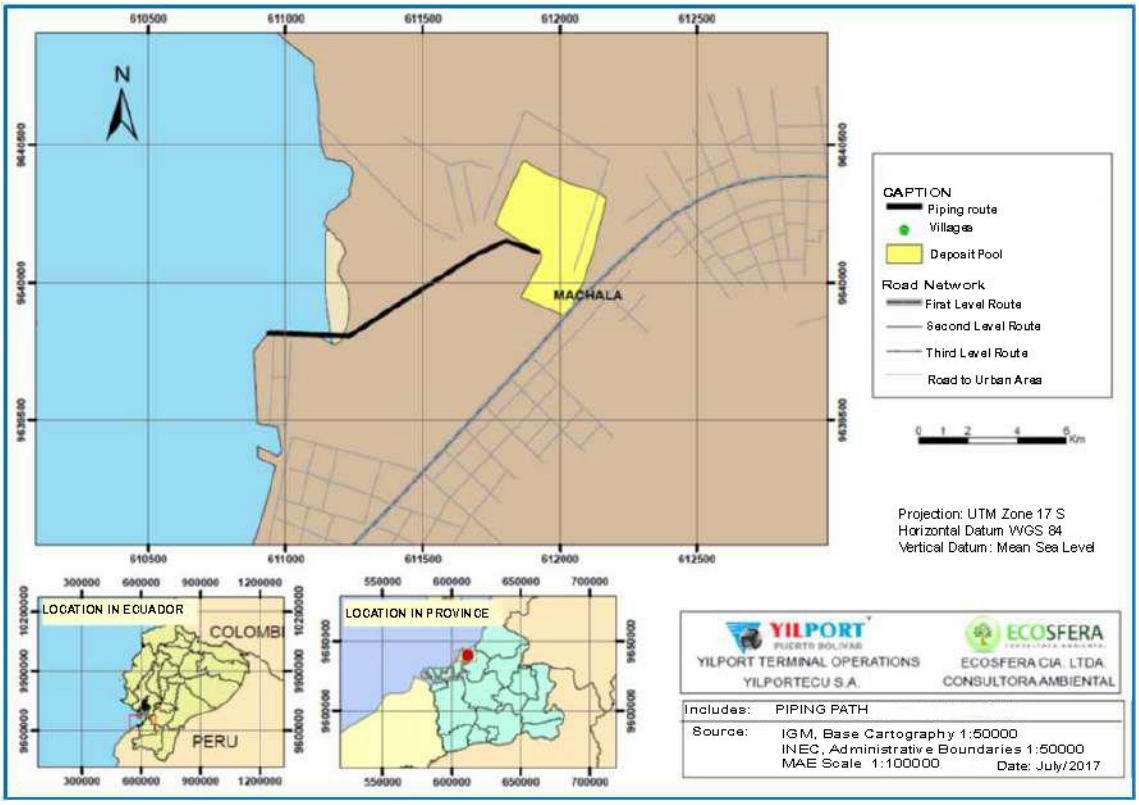
In this area, there are currently three pools of around 12.9 hectares, where walls and a fourth pool shall be constructed. The pool capacity is 375,000 m^3, when the pool capacity is insufficient, the material shall be removed and delivered for earth filling works.

Since this area is near the dredging area, a land piping may be installed following the right side of the route towards the start of Pier 5, and afterward it shall be installed along the water front of the piers until reaching Pier 3. From this point on, dredging of Pier 3, 2, and 1 may be performed in an easier way.

Then, the piping shall be cut and the drainpipe shall be installed between Pier 4 and 5. The piping cut work shall be done within 5 days, and it shall continue with the dredging of Pier 4 within 30 days. Finally, Pier 5 within 50 days. The total work period shall be a period of 162 days.

The figure below and the photo of the stated area details the information above:

Figure 228: Alternative 1



Source: *www.geoportaligm.gob.ec, IGM, INEC*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Bolivar Port - Machala, El Oro*
Date: *July 15, 2017*

Photography 55: Pier Dredging Sediment Disposal Site and Pipeline Route - Alternative 1

PIPELINE ROUTE FOR SEDIMENTS DREDGING

Source: *Photography was taken with Drone MAVIC (7 km transmission range, flight speed 64km/h)*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Bolivar Port – Machala, El Oro*
Date: *April 28, 2017*

It is important to emphasize that the pipeline will not block any area or cause any type of disturbance, and it will not affect the dredge's maneuvers.
The proximity of the area to the project will reduce dredging time, thus reducing dredge operation costs and the costs of the personnel involved in the project.
While the dredged material of the maneuver zone and access channel, which are approximately 7'000.000 m^3, will be disposed of in an area located offshore, according to the company's bathymetric study carried out CONSULSUA Cia. Ltda. is the recommended area.
This area has a surface of 4 km^2, is located 13.75 miles from the sea buoy (25 km), has depths that exceed -30 m MLWS and can reach -40m MLWS; the predominant currents at this site are directed to the Northeast, causing the sediments to be directed in this direction. It is located 18 km from Santa Clara Island and 13 km from Puna Island.

❖ ALTERNATIVE 2:

Due to the large number of sediments that are planned to be extracted from the pier dredging, maneuvering area, and Bolivar Port access channel, the total dredging of 7'575,384.84 m^3 has been considered to be disposed of in the offshore area located 13.75 nautical miles from the buoy. This is proposed as the second alternative.
However, it is important to consider that, when moving the total amount of sediments extracted to this area, the higher costs of the specialized dredge will have to be covered,

and the project's operating and technical costs will increase.
From the operational point of view, the transfer of the material will affect port traffic and maritime safety in the area.

Illustration 229: Satellite image for piers dredging sediment disposal - Alternative 2

Source: *Google Earth*
Prepared by: *Ecosfera Cia. Ltda., 2017*
Location: *Santa Rosa Canton - El Oro*
Date: *July 15, 2017*

❖ ALTERNATIVE 3:

This alternative implies not carrying out the project, which will have a negative economic impact on the province and the country, in addition to the fact that sedimentation will continue to increase, decreasing the piers' operational capacity.
From the legal point of view, the concession granted to YILPORT will not be complied with.

8.2.- ALTERNATIVES ANALYSIS

After analysis and evaluation of the proposed alternatives; it is concluded that the most feasible alternative for the project from the economic, environmental, technical, and operational point of view is Alternative 1, which involves the disposal of sediments in the area adjacent to the piers with the installation of a land pipeline and offshore area.
This alternative has less environmental impact and will reduce project execution time and operating costs.

9.- DETERMINATION OF INFLUENCE AREAS

The methodology for determining the influence area is based on the area characterization in its different components (baseline), and the project location, for which the criteria to be considered are related to the geographical scope, duration, and environment, which are translated into spatial, administrative, and ecological limits.

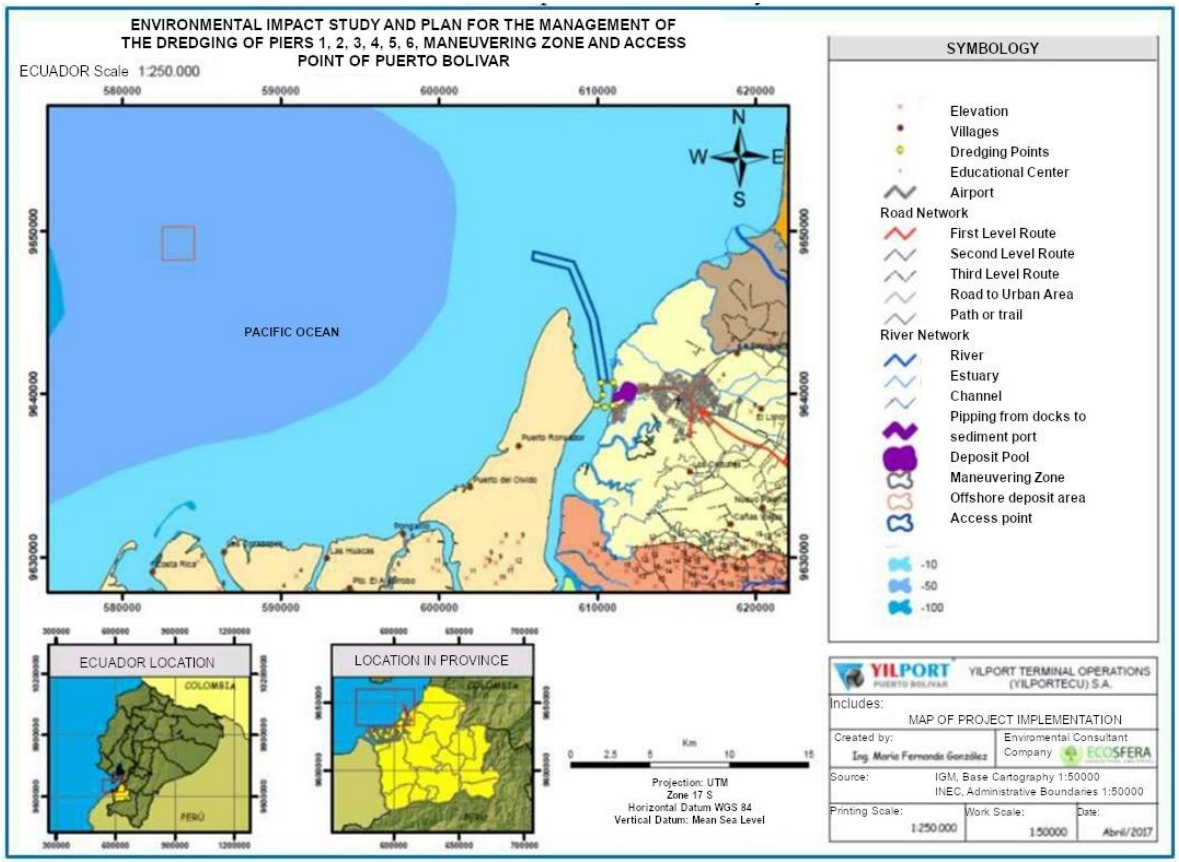
The influence area is defined as the entire project's entire surface where the operational dredging activities are carried out.

The influence area is the spatial zone or area in which the possible socio-environmental impacts, positive or negative, resulting from developing a new project or activity are manifested.

The project's environmental impacts are of significant range, which would affect the environment in medium proportion; The significant impacts to the environment are hazardous waste management, hydrocarbon management, and occupational health and safety; These impacts may affect the sensitive areas of the dredging area.

On the other hand, considering the project physical dimension, the impacts may transcend from the local to the regional level, considering environmental and climatic factors such as rainfall, wind, temperature, and relative humidity, which influence the dispersion of contaminating substances that may be produced.

Figure 230: Project Implementation Map



Source: *www.geoportaligm.gob.ec, Instituto Geográfico Militar* ***Created by:*** *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 6 of 2017*

9.1.- DIRECT INFLUENCE AREA

Based on the above criteria, the direct influence area of the project is defined by different components, so it can be pointed out that it has different extensions depending on the component to which they refer.
By influence area, we refer to the adjacent spaces where both the social and environmental components may be significantly or non-significantly affected by each of the activities that will be carried out during the stages of the project.
Based on the above criteria, the direct influence area of the project is defined by different components, so it can be pointed out that it has different extensions depending on the component to which they refer.

According to the project areas, a direct influence area of 485 hectares is considered.

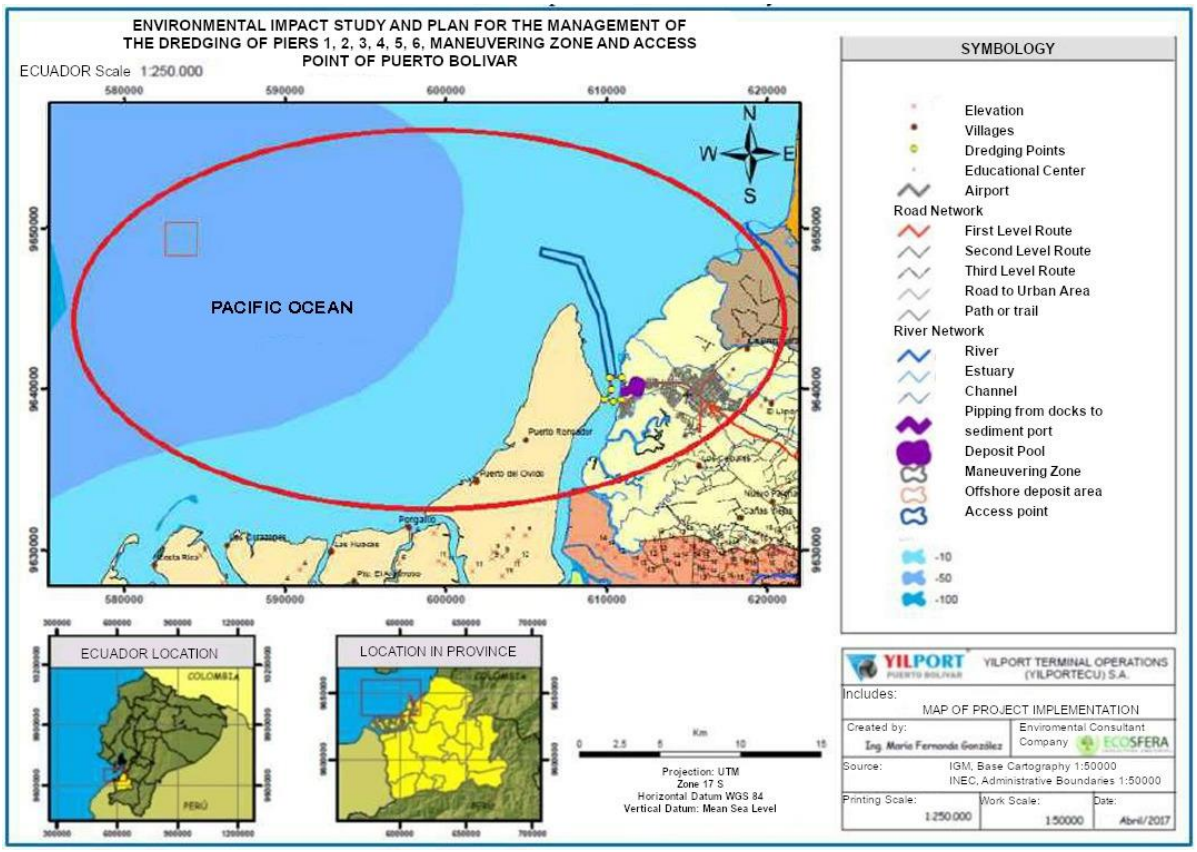
Table 251: Determination of a Direct Influence Area

COMPONENT	DIRECT INFLUENCE AREA
ABIOTIC	There are three general criteria under which the area of direct physical influence was determined, these are: **1. Regarding the land. –** The DIA is considered as the surface where the different infrastructures needed for the operation of the project are installed, being piers 1, 2, 3, 4, 5, and 6, the maneuvering area, and the access channel of Bolivar Port. **2. Regarding the noise. –** The use of machinery and equipment could influence the surrounding environment since sound pressure levels can be picked up by a receiver at approximately 1,000 m of vectorial distance according to project progress, so the direct influence area is considered 1,000 meters radius. **3. Regarding the water. -** Santa Rosa Marsh is the main area where the project will be developed.
BIOTIC	The development of the project activities does not involve vegetation clearing activities; However, within the direct influence area of the project there are several species of mangroves, which could cause the displacement of birds and terrestrial species due to the use of machinery. Influence area of the biotic component is considered as 1,000 m around the project according to its progress.
SOCIOECONOMIC	In social terms, the social influence area is not limited to the exact place where the project is located, but it extends to the sites of interaction of services demanded by the project activities, for example, the requirement of labor and supplies. In the case of dredging, the project involves the cantons of Machala and Santa Rosa in the province of El Oro and the parishes of Jambeli and Puerto Bolivar.

COMPONENT	AREA OF DIRECT INFLUENCE
	Concerning the social area, it's necessary to highlight that the project area is where the port facilities of Puerto Bolivar are located. Also, Puerto Bolivar, which the Jambeli Archipelago protects, is within the Direct Influence Area of the project and is the second port of Ecuador found at only 4.5 nautical miles from the sea buoy to its piers and is protected by the Jambeli Archipelago. Its strategic position allows it to be only 13 miles from the international traffic route, near the Panama Canal that connects it with the rest of the world.

Source: *Authors' own creation*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: May *5 of 2017*

Figure 231: Direct influence Area of the Project



Source: *www.geoportaligm.gob.ec, Instituto geográfico Militar, INEC*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 6 of 2017*

Photography 56: Project Direct Influence Areas Piers 1 and 2

INFLUENCE AREA - PIERS 1 AND 2










Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda.* ***Date:*** *April 10, 2017*

Photography 57: Project Direct Influence Areas Pier 3

INFLUENCE AREA – PIER 3





Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 10, 2017*

Photography 58: Project Direct Influence Areas Pier 4

INFLUENCE AREA – PIER 4


INFLUENCE AREA – PIER 4

Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 10, 2017*

Photography 59: Project Direct Influence Areas Pier 5

INFLUENCE AREA – PIER 5

INFLUENCE AREA – PIER 5	
	
	
	

Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 10, 2017*

Photography 60: Piers 1, 2, 3, 4, 5 and 6

PIERS 1, 2, 3, 4 AND 5

Source: *Photography taken with Drone MAVIC (7km transmission range, Flight speed 64km/h)*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 28, 2017*

Photography 61: Direct Influence Areas - Sediments Disposal Pools:

INFLUENCE AREA
SEDIMENTS DISPOSAL POOLS

INFLUENCE AREA
SEDIMENTS DISPOSAL POOLS

Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 10, 2017*

Photography 62: Pool area where sediments will be deposited

POOL AREA WHERE SEDIMENTS WILL BE DEPOSITED

Source: *Photography taken with Drone MAVIC (7km transmission range, Flight speed 64 km/h)*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 28, 2017*

Photography 63: Direct Influence Areas Neighborhoods of Bolivar Port

INFLUENCE AREA – NEIGHBORHOODS OF BOLIVAR PORT

Neighborhood Virgen del Cisne

INFLUENCE AREA
NEIGHBORHOODS OF BOLIVAR PORT

Neighborhood Virgen del Cisne

BACKFILL MATERIAL TO VIRGEN DEL CISNE SETTLEMENT

NEIGHBORHOOD LA UNION

Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 10, 2017*

Photography 64: Direct Influence Areas - Neighborhoods of Bolivar Port

INFLUENCE AREA
NEIGHBORHOODS OF BOLIVAR PORT

Source: *Photography taken with Drone MAVIC (7km transmission range, Flight speed 64 km/h)*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 28, 2017*

Photography 65: Direct Influence Areas – Santa Rosa Marsh

INFLUENCE AREA
SANTA ROSA MARSH

INFLUENCE AREA
SANTA ROSA MARSH










INFLUENCE AREA
SANTA ROSA MARSH

Source: *Photographs taken by the Consulting Team*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 10, 2017*

Photography 66: Direct Influence Areas – Santa Rosa Marsh

Photography 67: Direct Influence Areas – Santa Rosa Marsh

Source: *Photography taken with Drone MAVIC (7km transmission range, Flight speed 64 km/h)*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 28, 2017*

Photography 68: Direct Influence Areas – Santa Rosa Marsh

INFLUENCE AREA
SANTA ROSA MARSH

Source: *Photography taken with Drone MAVIC (7km transmission range, Flight speed 64 km/h)*
Prepared by: *Ecosfera Cía. Ltda.*
Date: *April 28, 2017*

9.2.- INDIRECT INFLUENCE AREA (IIA)

The Indirect Influence Area is the area that surrounds the direct influence area where indirect impacts are generated. It is defined as the area that may be impacted by the development of project activities with less impact (positive or negative).

Given the degree of intervention in the assessment area, the main component by which it is feasible to define the IIA is the socioeconomic component, given that its effects may be felt outside the DIA, mainly because of labor hiring from the sector during the development of the project.

The Indirect Influence Area corresponds to the political-administrative limits of Puerto Bolivar parish, Jambeli parish, Machala canton and Santa Rosa canton.

Table 252: Determination of an Indirect Influence Area

COMPONENT	INDIRECT INFLUENCE AREA
ABIOTIC	The IIA extends 2,000 m around the area of direct influence determined in the DIA. **1. Regarding soil. -**The city of Machala, and part of the territory of El Oro province, mainly the cantons of Machala and Santa Rosa, are considered IIAs. **2. Regarding noise:** The use of machinery and equipment could influence the surrounding environment; However, there will be no effect on the area of indirect influence. **3. Regarding water:** The area of indirect influence is defined as the area where the sediments will be deposited offshore, located at 13.75 miles from Bolivar Port.
BIOTIC	Considering the mobility of species, the IIA is extended to 2,000 m around the direct influence area for this component. Mainly mangrove species will be considered, as well as species that could be found in the sediment disposal area offshore.
SOCIOECONOMIC	It is related to the political-administrative division, in this case, according to the location of the project, it corresponds to the Jambeli parish, Puerto Bolivar parish, Machala canton and Santa Rosa canton. In addition, the province of El Oro will be considered since the economic aspect of the project involves the productive activities of the entire province. The main influence area of Puerto Bolivar is determined by the points of origin and destination of the cargo handled through the port and mobilized by the land transportation network. The geographical location of the Port determines the southern region of the country as the natural influence zone, including the provinces of Azuay, Cañar, Loja, Zamora Chinchipe, Morona Santiago and El Oro, both for export and import products. In addition, the north of Peru is considered, especially the Tumbes region.

Source: *Own elaboration.*
Prepared by: *Ecosfera Cía. Ltda.*
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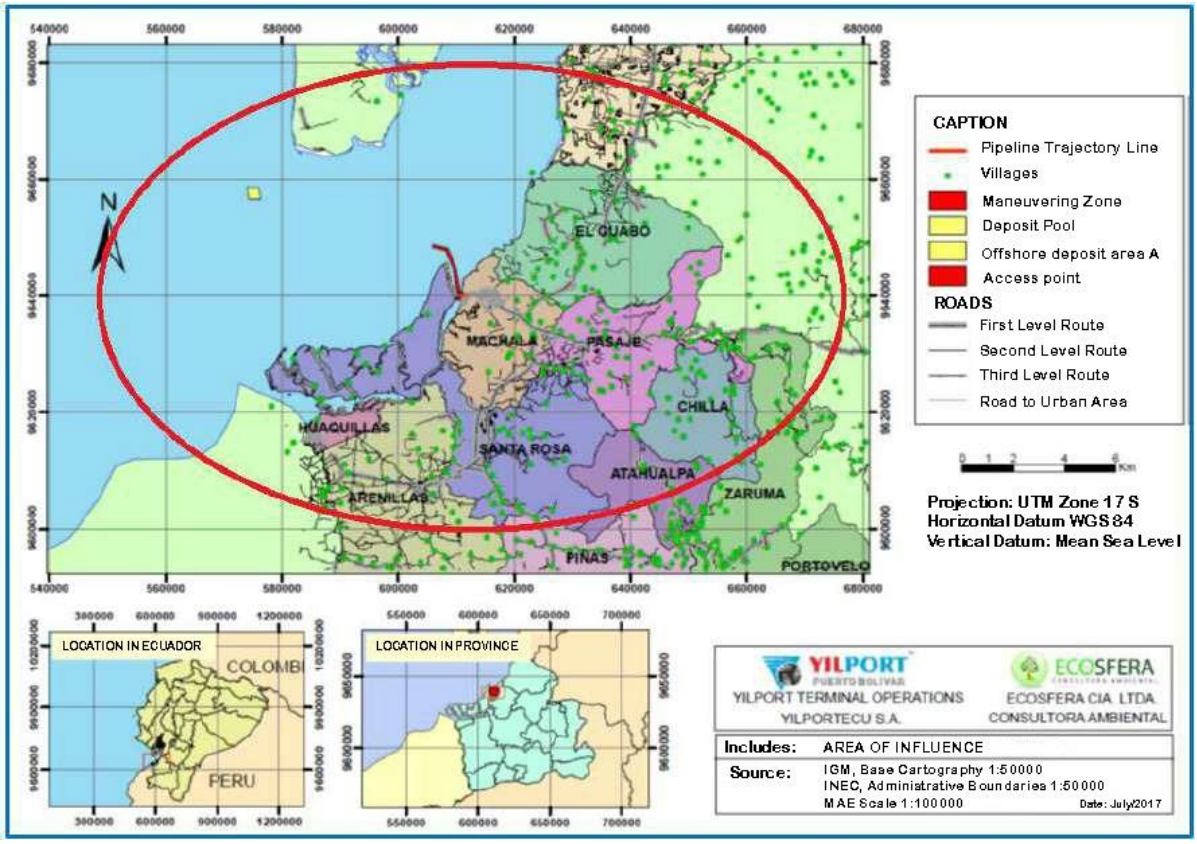
Date: *May 5, 2017*

Figure 232: Area of Indirect Influence



Source: *www.geoportaligm.gob.ec, Instituto geográfico Militar, INEC*
Created by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: July *10 of 2017*

9.3.- SENSITIVE AREAS

The definition of environmentally sensitive areas has been made considering the degree of vulnerability of environmental components in relation to the Dredging activities of Piers 1, 2, 3, 4, 5, and 6, Maneuver Zone, and Access Channel of Puerto Bolivar. The vulnerability is a function of the characteristics of the environmental parameter at risk, its possibility and magnitude of impact of project activities. The environmental susceptibility is described for those sensitive components during the project development. To determine the sensitivity in the project, the vulnerability degree of a particular area was established, which entails impacts, effects, or risks of said area in relation to the project activities.

The greater or lesser sensitivity will depend on the conditions of the area where the project will develop. To determine the sensitivity, the Biotic, forest and socio-economic environments will be taken into account.

Environmental and social sensitivity is defined as the potential for affectation (transformation or change) that a determined area can suffer or generate as a result of the alteration of

its physical, biotic, and socioeconomic processes that characterize it, due to the intervention of an activity or Project.

The objectives of the sensitivity analysis are:

- Identify areas by the sensitivity level
- Provide useful information for decision making
- Serve as a tool for the determination of intensity in the evaluation of environmental impacts.

Environmental sensitivity involves defining a rating scale to indicate the degree of vulnerability of the environment in relation to the disturbance-generating agent (the Project).
The classes in question and the assigned valuations are focused on the variables considered most relevant to the Project.

To provide a qualitative assessment, three categories of sensitivity have been defined and are presented in the following table:

Table 253: Sensitivity category criteria

CATEGORY	
High	**ALTERED COMPONENTS** Criteria are highlighted where the intervention processes significantly modify the original conditions and where complex mitigating measures are necessary.
Medium	**SEMI-ALTERED COMPONENTS** Where there is a fragile ecological or social balance, at the time of project implementation, its recovery and control require applying measures that involve some complexity.
Low	**UNALTERED COMPONENTS** It recognizes those criteria whose original conditions tolerate without complications the Project's actions, where the recovery could occur naturally, can occur with the application of some relatively simple measure.

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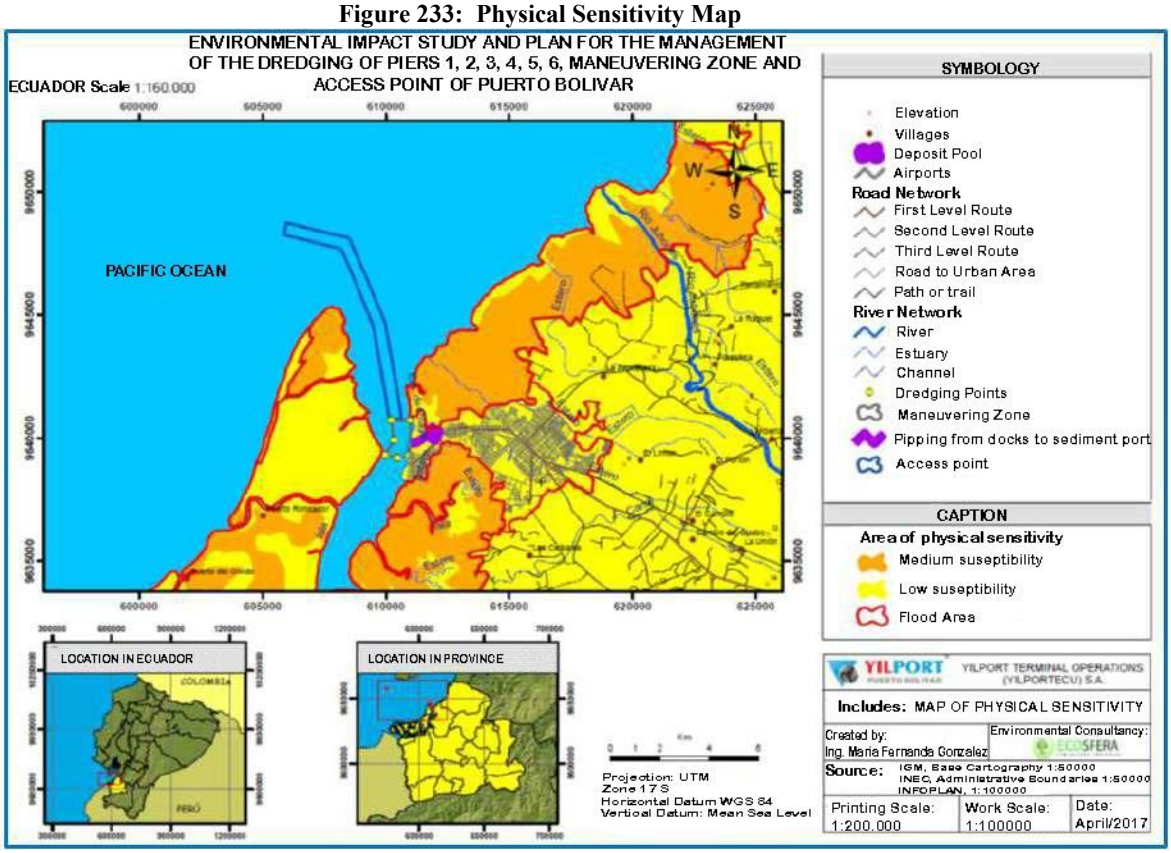
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 2, 2017*

PHYSICAL COMPONENT SENSITIVITY

The sensitivity analysis has been carried out in the environmental areas where this concept applies, including hydrogeology, geomorphology, soils, air quality, and hydrology.
The degree of sensitivity in the Physical Component is classified as Medium, mainly because the project area has a high risk of flooding and the Project will be developed in a water body; However, as for other factors such as geological, geomorphological, and soils, there are no sensitive areas.

Figure 233: Physical Sensitivity Map



Source: *www.geoportaligm.gob.ec, Instituto geográfico Militar, INEC*
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Date: *April 7 of 2017*

BIOTIC SENSITIVITY

The study area where the project is located is a High Biotic Sensitivity zone; It corresponds to a coastal marine ecosystem area, mainly with the presence of the Santa Rosa Estuary, mangrove species, and small remnants of secondary forest.

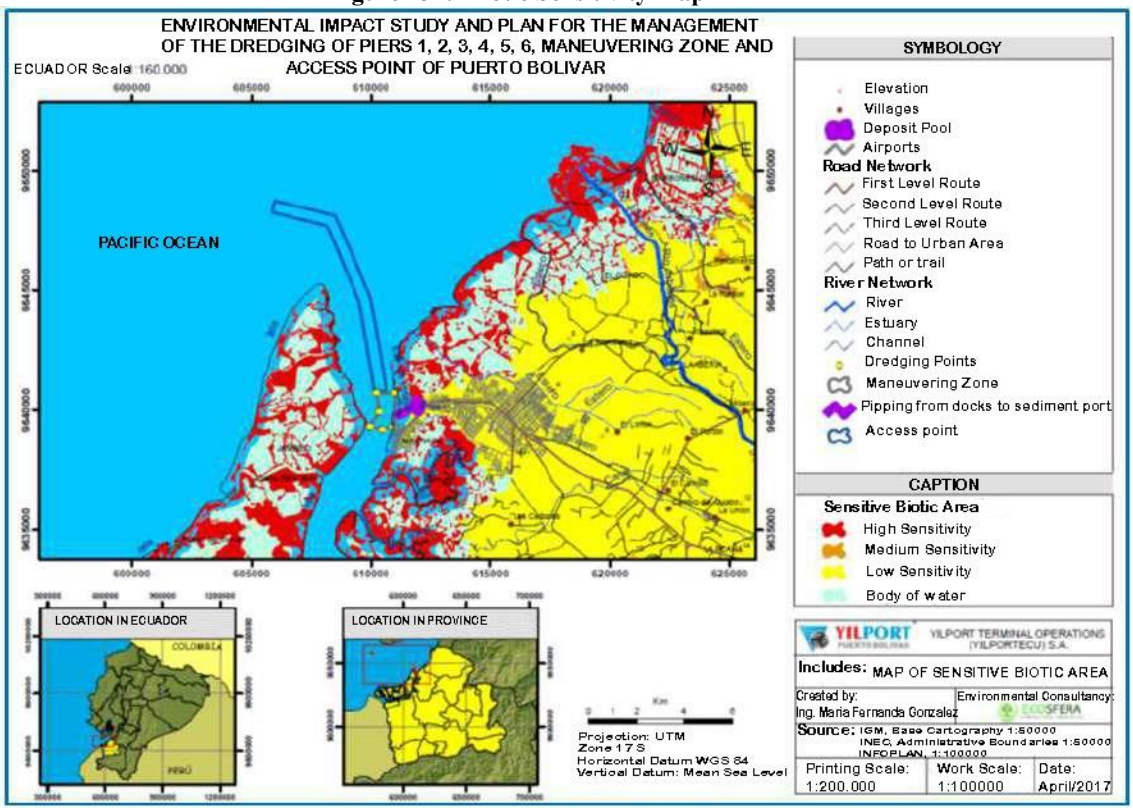
The study area's flora sensitivity is Medium; due to the almost total transformation of the vegetation cover, mainly influenced by anthropic activity, geographical and environmental factors. Also, the implementation of the project will not affect any species of flora.

The ecosystem near the area where the project is taking place determines the lack of abundance, diversity of rare or endangered species, and congregation sites; thus, it has been determined that there is a fauna sensitivity of Medium nature.

Additionally, to obtain the project Intersection Certificate with the National System of Protected Areas (SNAP), State Forestry Heritage (PFE), Forestry and Vegetation Protection (BVP), relevant documentation for the project "DREDGING OF PIERS 1, 2, 3, 4, 5 and 6, MANEUVER ZONE AND ACCESS CHANNEL OF PUERTO BOLIVAR" was presented and submitted through the platform of the Ministry of the Environment's Single Environmental Information System, located in (El ORO) province from where it was determined that the project **DOES NOT INTERSECT** with the

National System of Protected Areas (SNAP), State Forestry Heritage (PFE), Forestry and Vegetation Protection (BVP).

Figure 234: Biotic Sensitivity Map



Source: *www.geoportaligm.gob.ec, Instituto geográfico Militar, INEC*
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Date: *April 7 of 2017*

SOCIOECONOMIC SENSITIVITY

Taking into account that the levels of sensitivity are defined according to the possible weakening of various factors that make up a social structure, which can be caused by the intervention of human groups external to it; sensitivity criteria ratings of culture, economy, health, education, and landscape were carried out.

The culture criterion acquires a low sensitivity due to the small number of personnel that will work in the project's development, but it's determined as average sensitivity, given that the population is less than 1000 m from the project.

The criterion of economy acquires a high sensitivity positively, given that the project will dynamize the economic aspects increasing the foreign investment, increasing the exports of Puerto Bolivar, generating employment and underemployment, developing additional services, among others.

The health criterion acquires a low sensitivity since the health conditions of staff and the community are not affected by the project activities to a considerable extent.

The education criterion has a low sensitivity, since there are educational centers nearby, but for no reason are they affected by the development of the project. The landscape criterion has a medium sensitivity because the intervention (dredging) will be carried out in an area considered a tourist attraction; however, the project will not cause a major visual impact with the application of mitigation measures.

Tabla 254: Sensitivity Analysis of Environmental Components

COMPONENT	CRITERION	TYPE OF SENSITIVITY
PHYSICAL	Geological aspects	Low
	Geomorphological changes	Low
	Water bodies	Medium
	Flood risk	Medium
BIOTIC	Flora - Vegetable coverage	Medium
	Fauna - Abundance, diversity of species	High
SOCIO-ECONOMIC	Population	Medium
	Culture	Low
	Economy	High
	Health	Low
	Education	Low
	Landscape - Change in structure	Medium

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Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 2, 2017*

Once the corresponding evaluation has been carried out, we could say that in the influence area of the project, the only sensitive area that could be affected would be the Santa Rosa Marsh and its surroundings where the project will be executed, with a medium level in the physical component, high in the biotic component and medium in the social part, the latter being a positive sensitivity.
The project does not affect the nearby population with damage to housing, community infrastructure, water sources, or other population activities.

10.- IDENTIFICATION, EVALUATION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

Due to the project's characteristics and components: ''Dredging of Piers 1, 2, 3, 3, 4, 5 and 6, Maneuvering Zone and Access Channel of Bolivar Port'', it is necessary to carry out an Environmental Impact Assessment and Identification.

10.1.- IDENTIFICATION OF ENVIRONMENTAL IMPACTS

For the identification and classification of significant and non-significant environmental impacts to be produced during the dredging project, a combined methodology has been used:

VERIFICATION MATRIX

The Verification Matrix contains vertically the elements of the environment that could be affected by the dredging activity, and horizontally it will contain a list of the environmental and engineering aspects that could be relevant during the execution of the project, both in the Operation (dredging) and Retirement (demobilization) phases.

DIGITAL CARTOGRAPHY

Showing the physical space of the construction site, as well as adjacent structures and natural features.

PANEL OF EXPERTS

Formed by the Consulting Company's multidisciplinary team that will carry out the valuation of the Environmental Impacts.

10.1.1.- VERIFICATION MATRIX

For the preparation of this Environmental Impact Study, the ad-hoc methodology has been used, which consists of Checklists that relate the activities associated with the dredging and the potential or existing environmental impacts, respectively.

During the identification of environmental impacts, simplified criteria will be applied according to the following environmental evaluation parameters:

Table 255: Environmental Assessment Parameters

PARAMETERS	VALUES
Character (Cha)	▪ Positive (+) ▪ Negative (-)
Intensity (In)	▪ Low (1) ▪ Medium (2) ▪ High (3)
Extension (Ex)	▪ Punctual (1) ▪ Local (2) ▪ Regional (3)
Reversibility (Re)	▪ Reversible (1) ▪ Irreversible (3)
Mitigability (Mi)	▪ Mitigable (1) ▪ Non-Mitigable (3)
Previsibility (Pr)	▪ Foreseeable (1) ▪ Non-Foreseable (3)

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Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 2, 2017*

IMPACT IDENTIFICATION MATRIX

Table 256: Impact Identification Matrix

ENVIRONMENTAL COMPONENTS		INSTALLATION PHASE		OPERATION PHASE					RETIREMENT PHASE
		Machinery on piers	Machinery maneuvering area and access channel	Dredging in piers		Dredging in maneuvering area and channel		Sediment disposal in the offshore area	Removal of machinery and facilities
				Cargo	Transport	Cargo	Transport		
PHYSICAL ENVIRONMENT	**WATER**								
	Water quality	X	X	X		X	X	X	X
	Air circulation	X	X	X		X	X		
	AIR								
	Air quality	X	X	X	X	X	X	X	X
	Noise	X	X	X	X	X	X	X	X
	SOILS								
	Sediments			X		X			
BIOTIC ENVIRONMENT	**FLORA**								
	Mangroves								
	FAUNA								
	Fish		X		X			X	
	Birds		X		X				
	Phytoplankton and Zooplankton		X		X			X	
	Betonic and planktonic community		X		X			X	
	Marine mammals				X			X	
SOCIAL ENVIRONMENT	Port traffic		X	X	X	X	X		X
	Maritime safety	X	X	X	X	X	X	X	X

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Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 2, 2017*

10.2.- ENVIRONMENTAL IMPACT ASSESSMENT MATRIX

Table 257: Environmental Impact Assessment Matrix

ENVIRONMENTAL COMPONENTS			EVALUATION
PHYSICAL ENVIRONMENT	WATER	Water quality	-7
		Water circulation	+5
	AIR	Air quality	-5
		Noise	-5
	SOILS	Sediments	-5
BIOTIC ENVIRONMENT	FLORA	Mangroves	0
	FAUNA	Fish	-9
		Birds	-9
		Phytoplankton and Zooplankton	-9
		Betonic and planktonic community	-9
		Marine mammals	-9
SOCIAL ENVIRONMENT	SOCIAL	Port traffic	+13
		Maritime safety	+13

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Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 2, 2017*

10.3.- RESULTS ANALYSIS

The following is a brief description of the environmental impacts identified for each of the environmental components assessed:

10.3.1.- PHYSICAL COMPONENT

❖ WATER COMPONENT

The Santa Rosa Marsh, located in the project area, was identified within this component, considering aspects of water quality and water circulation.

- Water quality: During dredging, it is expected that sediments deposited at the bottom of Santa Rosa Marsh will be lifted and dispersed when deposited in the offshore area. According to the analyses carried out, these sediments have silt-clay characteristics, which causes the water to become cloudy, increasing suspended solids.

  This impact was assessed as negative, medium intensity, local extent, reversible, mitigable, and preventable, obtaining a value of -7.
- Regarding Water circulation, as indicated in the project description, dredging will be done in Santa Rosa Marsh. This action will improve water circulation, preventing in some way the loss of sediment circulation speed. Given these conditions, the impact has been rated as positive, low intensity, punctual extension, reversible in the short term, mitigable, and preventable; the value obtained is +5.

❖ AIR COMPONENT

It has been determined that the activities that could cause impacts on the air component are mainly emissions from the engines of the dredges and dump trucks, vehicles, and other equipment to be used in the project. In this case, air quality and environmental noise have been analyzed.

- The ambient air quality will be temporarily affected by the combustion gases produced by the dredge engines.

  This impact is identified as negative, low intensity, punctual, reversible, mitigable, and preventable, with a value of -5.
- Regarding noise, as in the previous case, the dredge engines' work will cause an increase in ambient noise. This impact has been identified as negative, although of low intensity, punctual extension, reversible, mitigable, and preventable; The evaluation value obtained is - 5.

❖ SOIL COMPONENT

The dredging project will affect the soil resource in terms of sediment extraction, which is the dredging objective.

- Sediment Deposit will be carried out in areas determined according to bathymetry and ease of transport studies (sedimentation ponds and offshore area); However, this action will cause negative environmental impacts of low intensity, punctual extension, reversible, mitigable, and preventable. The value obtained with the valuation used was -5.

10.3.2.- BIOTIC COMPONENT

❖ FLORA

Regarding the impact on the flora, the project will be developed in an area where the main species is the Mangrove.

- Mangrove area: The mangrove area will not be affected by the project because no clearing will be done, and the extracted sediments will be deposited in other areas already delimited.

❖ FAUNA

Being a project to be executed in a coastal area, Puerto Bolivar Port Terminal, there could be some impact on marine fauna and avifauna in the area.
Identifying the following species that could be impacted.

- Fish, according to investigations of the previous dredging works in the area, there is no record of fish being affected. According to the study of currents and granulometry, there will be no impact on fish in this area in the offshore deposit area.
  This impact has been classified as negative, of low intensity, reversible in the short term, not mitigable or foreseeable; the value obtained is -9.
- Avifauna, the removal of sediments with the dredge operation may cause a migration effect of these species. On the other hand, some may come closer to look for fish that leave because of the dredged material.
  According to previous dredging works, no effects on birds have been recorded as with the previous point. The value obtained for the possible impact is -9, which is a negative impact of low intensity, reversible in the short term, not mitigable or foreseeable.
- About the benthic fauna Phytoplankton and Zooplankton, according to the analysis carried out at the bottom of Santa Rosa Marsh and in the deposit area offshore, these organisms are important; However, there is no certainty that the development of the project will have a significant impact.
  This impact has been classified as negative, low intensity, reversible in the short term, not mitigable or foreseeable, obtaining a value of -9 in the valuation carried out.
- Within the Environmental Impact Study, a study of Characterization and Identification of Benthic and Planktonic Community Species was conducted, in which it was determined that the sediment discharge process will temporarily decrease the planktonic community, but this effect will be of short duration, since the

The planktonic community in the open sea (offshore zone) is constantly renewed.
The benthic community in the area where the dredged material will be deposited was determined as a sector of intermediate diversity, whose disturbances would not be drastic but moderate. To determine impacts, it is necessary to consider that the benthic community in soft bottoms is resilient to sediment deposition, being in short periods and considering that water mixing is constant due to the currents' dynamics.
At this point, the impact has been rated as negative, low intensity, reversible in the short term, not mitigable or foreseeable, obtaining a value of -9 in the impact assessment.

- As for marine mammals, no species were recorded in the study; however, since they are important species, the impact has been classified as negative, low intensity, reversible in the short term, not mitigable or foreseeable, obtaining a value of -9.

10.3.3.- SOCIO-ECONOMIC COMPONENT

The socio-economic component is expected to affect mainly the area where the project is located and its direct area of influence, which is the Port Terminal of Puerto Bolivar, by analyzing the following factors:

- Port Traffic, In Puerto Bolivar, the transit of merchant vessels has increased significantly in recent years, with larger and larger vessels requiring greater dock depth.
  With the implementation of the dredging of the Piers, Maneuvering Zone, and Access Channel project, there will be a positive, high intensity, regional extension, reversible, not mitigable, not foreseeable impact. This significant impact in the valuation obtained a value of +13.
- The Maritime Safety aspect has been considered due to its importance, since with the development of the project, there will be a transit of vessels of greater draft, which could cause accidents if the dredging works are not carried out because there are no piers with sufficient depth. This project will positively impact high-intensity, regional extension, reversible, not mitigable, not foreseeable. In the valuation carried out, it obtained a value of 13.

Within the socio-economic component, we can also highlight the environmental impact on shrimp farming, which will be minimal, considering that this productive activity has been adjusted and adapted to different dredging activities in previous years and has even been subjected to more serious contaminating events.
In addition, according to information provided by experts, the shrimp ponds will not be affected by sediment removal due to dredging.

With these results, we can conclude that most of the project's environmental impacts will be low intensity, local in extent, reversible in the short term, mitigable, and somewhat predictable.

11.- RISK ANALYSIS

With the purpose of analyzing the possible threats to which the development of the project ***"Dredging of Piers 1, 2, 3, 4, 5 and 6, Maneuvering Zone and Access Channel"*** is exposed, as well as the threats it may generate, the following risk analysis is carried out, to take actions for the prevention of contingencies.

The current increase in the frequency and destructive force of different events, whether geological or hydrometeorological, at the planetary level, has led to a growing interest in understanding these phenomena, not only by academics but also by politicians and society.

The possibilities of technological and health disasters also condition the need to improve the political, social, economic, and environmental approach to risk management and the need for these studies for the different cantons and provinces, especially for the coastal and mountainous areas, which are subject to various hazards, including landslides due to slope instability in mountainous areas, flooding due to heavy rains and the overflowing of rivers that cross the coastal plains and the penetrations of the sea.

Studies related to the analysis of hazards, vulnerability, and risks become instruments for risk management and decision-making by government bodies at different levels in disaster prevention and make it possible to develop an effective action model that places greater emphasis on preventive and mitigation aspects.

It is a matter of responding to phenomena and anticipating them by identifying hazards and their risks, the way to manage them, i.e., to transform and modify them to reduce the conditions of vulnerability that ultimately cause the main damage.

These studies require an interinstitutional and multidisciplinary system and multiple coordination at territorial, sectoral, environmental, social, etc. levels to ensure the identification, measurement, quantification, analysis, and understanding of risk.

The concepts of the topics to be analyzed in this Chapter are detailed below:

- **THREATS:** Of natural or anthropic origin. Natural hazards consist of the generation of phenomena such as floods, landslides, mass movements, and earthquakes. Simultaneously, the threats of anthropogenic or human origin include actions such as spills, labor accidents, terrorism, strikes, and inadequate practices, among others.
- **VULNERABILITY:** It is the resistance offered by the structure of a project, a building, or any work to the action of a threat.

RISK: Results from interrelating the critical values of a hazard and the corresponding vulnerability of the element subject to that hazard.

Risk = Threats * Vulnerability

11.1.- PROJECT RISKS TO THE ENVIRONMENT (ENDOGENOUS)

The project ***"Dredging of Piers 1, 2, 3, 4, 4, 5 and 6, Maneuvering Zone and Access Channel"*** may cause risks to the environment.

For Risk Determination and Analysis, a modification of the methodology proposed by William T. Fine for Risk Analysis has been used.

This methodology is based on evaluating three criteria, consequence (C), exposure (E), and probability (P), and multiplying the scores obtained for each of them; In this way, the degree of danger (GP) of risk is obtained.

To evaluate the consequence, the results that the studied risk materialization would generate must be analyzed. In this case, the evaluation parameters are modified to adapt to the project, establishing the distance reached by the negative impact as a factor for assessing the consequence. The table used for the assessment of this parameter is presented below:

Table 258: Degree of severity of consequences

DEGREES OF SEVERITY OF CONSEQUENCES	VALUE
Impact on the entire water system	100
Impact on the bodies of water that make up the canal	50
Impact on the entire length of the canal	25
Impact on the water body 1 km from the dredging area.	15
Impact on the water body 500 m from the dredging area.	5
The specific impact on the dredging area	1

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Date: *April 2, 2017*

For exposure, the frequency of occurrence of a situation capable of triggering an accident in the analyzed activity is assessed.

For this purpose, the following table is used to establish the possible scores:

Table 259: Risk exposure factor

EXPOSURE FACTOR	VALUE
Continuously (many times a day)	10
Frequently (once a day)	6
Occasionally	3
Irregularly (once a month)	2
Rarely (has been known to occur)	1
Remotely possible (not known to have occurred)	0,5

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Date: *April 2, 2017*

To evaluate the probability of accident occurrence, the time that can lead to an accident is considered, and the possibility of it ending in an accident is studied. For this purpose, the following evaluation table is used:

Table 260: Probability of accident occurrence

PROBABILITY OF ACCIDENT OCCURRENCE	VALUE
It is the most possible and expected outcome if the risk situation arises	10
It is entirely possible, it would not be strange at all 50% possible	6
It would be a rare consequence or coincidence	3
It would be a remotely possible coincidence; It has been known to occur	1
Extremely remote but conceivable, has not happened for years	0,5
Practically impossible (possibility in 1'000,000)	0,1

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Finally, the value obtained for the Degree of Danger (DD), based on the multiplication of consequence, exposure, and probability, is compared with William Fine's index value table to obtain a qualitative assessment of the risks analyzed.

$$DD = C * E * P$$

Where:
DD: Degree of Danger
C: Consequences
E: Exposition
P: Probability

Table 261: Probability of accident occurrence

VALUE INDEXES OF WILLIAM FINE	INTERPRETATION
0 < GP < 18	LOW
18 < GP ≤ 85	MEDIUM
85 < GP ≤ 200	HIGH
GP ≤ 200	CRITICAL

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The detected risks of the project to the environment for the analyzed activity are as follows:

Table 262: Endogenous Project Risks

RISKS	MEASURES TO BE ADOPTED
Fuel Spills	▪ Purchase of anti-spill kit ▪ Spill control procedures
Explosions Dredge explosion	▪ Control of electrical installations ▪ Control of fuel and product storage tanks and containers
Fires	▪ Control of electrical installations

RISKS	MEASURES TO BE ADOPTED
	▪ Control of fuel and chemical storage tanks and containers ▪ Review of fire extinguishers and firefighting equipment
Mechanical failures	▪ Continuous maintenance ▪ Personnel training
Operational failures	▪ Personnel training ▪ Use of Personal Protective Equipment ▪ Written work procedures
Dumping of dredged material into the body of water due to dredge mismanagement	▪ Determination of specific sites for disposal of dredged sediments ▪ Application of Contingency Plan
Pipe sinking, dredge accessories and operational equipment	▪ Application of Contingency Plan ▪ Periodic inspection of piping, fittings, and equipment

Prepared by: *Ecosfera Cía. Ltda.*
Location: *Puerto Bolívar – Machala, Santa Rosa – El Oro*
Date: *April 2, 2017*

ENDOGENOUS RISK ANALYSIS

Table 263: Results of the project analysis towards the environment

RISK	DEGREE OF HAZARD				
	(C)	(E)	(P)	Valuation index	Interpretation
Fuel Spills	50	2	3	300	Critical
Explosions and Dredge explosion	15	0,5	0,5	3,75	Low
Fires	1	1	1	1	Low
Mechanical failures	1	1	3	3	Low
Operational failures	1	1	3	3	Low

RISK	DEGREE OF HAZARD				
	(C)	(E)	(P)	Valuation index	Interpretation
Dumping of dredged material into the water body due to poor dredge handling	50	2	1	100	High
Sinking of pipelines, dredge and operational equipment operational	1	1	1	1	Low

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Date: *April 2, 2017*

In the event of a fuel spill due to marine currents, the contaminant's dispersion could affect the water bodies that make up the Santa Rosa Marsh.

11.2.- ENVIRONMENTAL RISKS TO THE PROJECT (EXOGENOUS)

The highest risk situations involve a combination of hydrological, geological, biological, and chemical events.

Considering that a large part of the lower Jubones River Basin is susceptible to flooding, severe rainfall events could cause the estuary to overflow and temporarily interrupt access routes to the sanitary sewer system.
This situation must be controlled by keeping the estuary channel clean and having alternate access routes to the sanitary sewer system.

The probability of historical seismicity is an especially important factor, considering that Ecuador is located within the Pacific Ring of Fire and subject to the South American and Nazca tectonic plates' movements. Since the 1960s, the level of seismic risk in the project's influence area is considered low; however, it is advisable to maintain prevention systems that may affect the dredging project's normal operation.

Considering the great extension of the territory, diversity of its topography, different zones and climates, etc., it is subject to be exposed to a series of risks, among which we note:

Table 264: Natural Risk Intensity

RISK	INTENSITY
Tremor	Medium
Overflow	High
Flooding from heavy rains	High
Hillside slides	Low
Sea Penetration	Medium

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Date: **April 2, 2017**

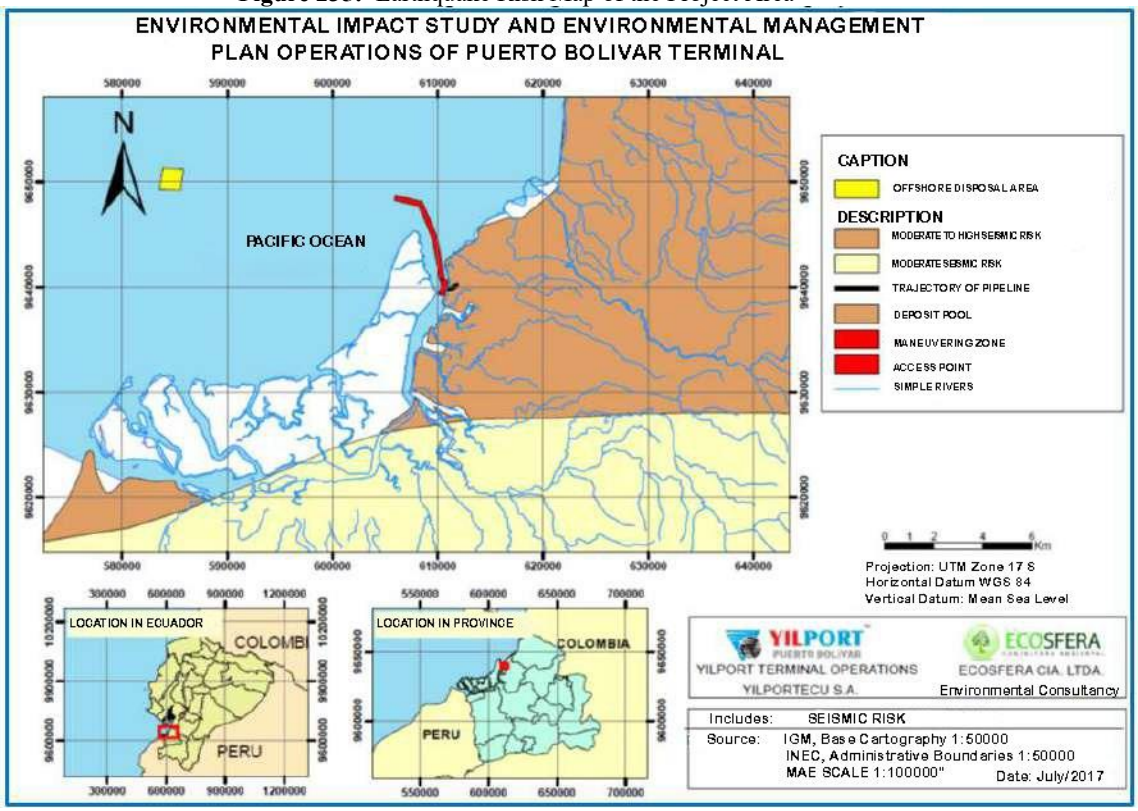
11.2.1.- SEISMIC RISKS

The evaluation of historical seismicity is of utmost importance as it constitutes a parameter used in the study of seismic hazard. Regarding seismic risk, Ecuador is located on the so-called "Pacific Ring of Fire", which is an active sector of movements of the Teutonic plates of Nazca and South America.
Historically, since 1541, about 80 seismic movements have been reported in the country, of intensity greater than grade 6 on the Mercalli scale, produced due to the presence of the active fault lines system, Dolores-Guayaquil Megashear.

Most of the energy released during the last century corresponds to an earthquake that occurred on December 12, 1953, whose epicenter was in the Gulf of Guayaquil and had a magnitude of 7.8 on the Richter scale. For this reason, the region is considered a seismically vulnerable zone, since a large amount of energy accumulated in the active faults can be released in a single earthquake.
For these reasons of past earthquakes and the high tendency of their future generation (according to the above), civil facilities must be built with anti-seismic construction standards.

According to data from the Secretariat of Risks in El Oro's province, earthquakes of slight magnitude are registered, and especially in the north of the province, specifically in Machala, this kind of events have not taken place.
The province of El Oro, including Machala and Puerto Bolivar, is in zone III, which corresponds to Medium seismic risk.

Figure 235: Earthquake Risk Map of the Project Area



Source: *www.geoportaligm.com, Instituto Geografico Militar, INEC*
Prepared by*: Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar - Machala, Santa Rosa - El Oro*
Date: *April 2 of 2017*

According to the Earthquake Map of the project area, Machala city is specifically located in a Moderate to High Seismic Risk zone. In contrast, the Jambeli parish area presents a Moderate Seismic Risk.

11.2.2. - TSUNAMI RISK

The threat of a Tsunami on the Ecuadorian coasts is permanent and real due to the subduction zone's presence and the complex system of faults, which has given rise to large earthquakes both at the continental and submarine levels. Earthquakes with location or epicenter on the continental shelf are the most threatening to Ecuador, as they may produce local tsunamis and affect the nearest coasts.

HISTORIC TSUNAMIS WITH EFFECTS ON THE ECUADORIAN ORIAN COASTS

Local tsunamis for the Ecuadorian coasts and with important information found in the literature (source: Espinoza, 1992; CERECIS Catalog) are detailed below:

1) On December 31, 1906, Tsunami generated 138 km from west of Tortuga, Esmeraldas province; seismic magnitude was Ms 8.8 on the Richter scale.
2) Tsunami of October 2, 1933, generated in front of Santa Elena Peninsula, province of Santa Elena, the seismic magnitude was 6.9 on the Richter scale
3) Tsunami of December 12, 1953, generated in front of the coast of Tumbes (bordering Ecuador-Peru), the seismic magnitude was over 8.6, waves were not destructive since they showed oscillations of approximately 20 cm
4) Tsunami of January 19, 1958, generated in the region bordering Ecuador-Colombia, the seismic magnitude calculated for this event was Ms 7.8 on the Richter scale
5) Tsunami of December 12, 1979, generated by an earthquake whose magnitude was Ms 7.9 on the Richter scale, offshore, north of the coastal borders of the San Lorenzo region, an area bordering Ecuador-Colombia.

Characterization of the Tsunamigenic hazard in El Oro province

The Machala region is prone to flooding since its neighborhoods and towns are located in the vicinity of marshes which make up the Jambelí Archipelago. In the surrounding areas of Puerto Bolívar there are stilt houses whose distance between the ground and sea level reaches 80 cm; likewise, Machala has been expanding just so that neighborhoods and residential districts are now a few meters away from the sea.

The estimated wave height could reach 2 m, and wave time of arrival could be calculated at around 75 minutes or more, this sector is sheltered by the Jambelí Archipelago, although the region with the highest exposure is Puerto Bolívar seaport.

11.2.3.- FLOOD RISK

Areas prone to flooding by overflowing of river currents are found at the lower areas of plains where, as a result of the heavy rains originating from the eastern mountain regions, river sedimentation and significant alterations to the natural drainage due to the construction of irrigation canals and the presence of river tanks, et al., waters overflow from their basins in these lower lands with scarce slopes causing frequent and catastrophic floods.

Another contributing factor is the presence of severe hydrometeorological phenomena, such as ENSO events (El Niño-Southern Oscillation) which affect the area every few years, as was the case with El Niño-related events during the years 1981-82 and 1997, thereby increasing the risk of flooding. These floods, combined with extreme rainfall in plains, can cause significant damages to the agriculture and human settlements present in these regions.

The aftermath of 1982-1983 El Niño event (from February to April 1982) and later that of 1997-1998 (from September 1997 to May 1998) caused huge damages at El Oro province's cantons. The worst damages were related to the loss of agricultural crops

and shrimp farms because of land flooding and the consequences of access roads, health facilities and schools, and water pollution.
The impact of excessive rainfall is particularly critical during El Niño seasons, but even average annual rainy seasons are causing devastating effects on the different communities of the cantons within El Oro province in Ecuador. Most disasters caused by floods have had their worst effects in rural areas, where there was a loss of crops due to land flooding and water pollution.
The total area affected directly or indirectly by this cause in the region is 74,525 ha (data obtained from Río Cañar flood control assessment).

As far as risk is concerned, within the urban area, there are houses settled in low regions facing the natural threat of flooding and houses within the city center, which are found at levels below the roadway.
Serious damages are caused when most of the district's main city urban area is flooded due to the presence of tributaries such as rivers and marshes crossing or surrounding it that overflow during heavy and severe rainfall.

RURAL AREA

At the rural level, floods are the greatest hazard to human settlements given the large number of water bodies present in the canton, which grow considerably in volume and flow rate during harsh winters or El Niño seasons, and the fact that most houses in the area settle beside those.

It is worth noting that the entire Machala canton territory lies within the flood zones in the coast of Ecuador marked on national risk maps.

FLOOD ZONES

Ecuador has regions where flood zones are concentrated. During the last 12 years, floods occurred most frequently in coastal provinces.

Between 20 to 40 flooding events were recorded in El Oro province. A large portion of the surface of cantons Machala and Santa Rosa, about 50%, is prone to suffer from floods, as is indicated in the flood risk map, which shows that the cities of Machala and Puerto Bolívar are flood-prone areas.

Figure 236: Flood Risk Map

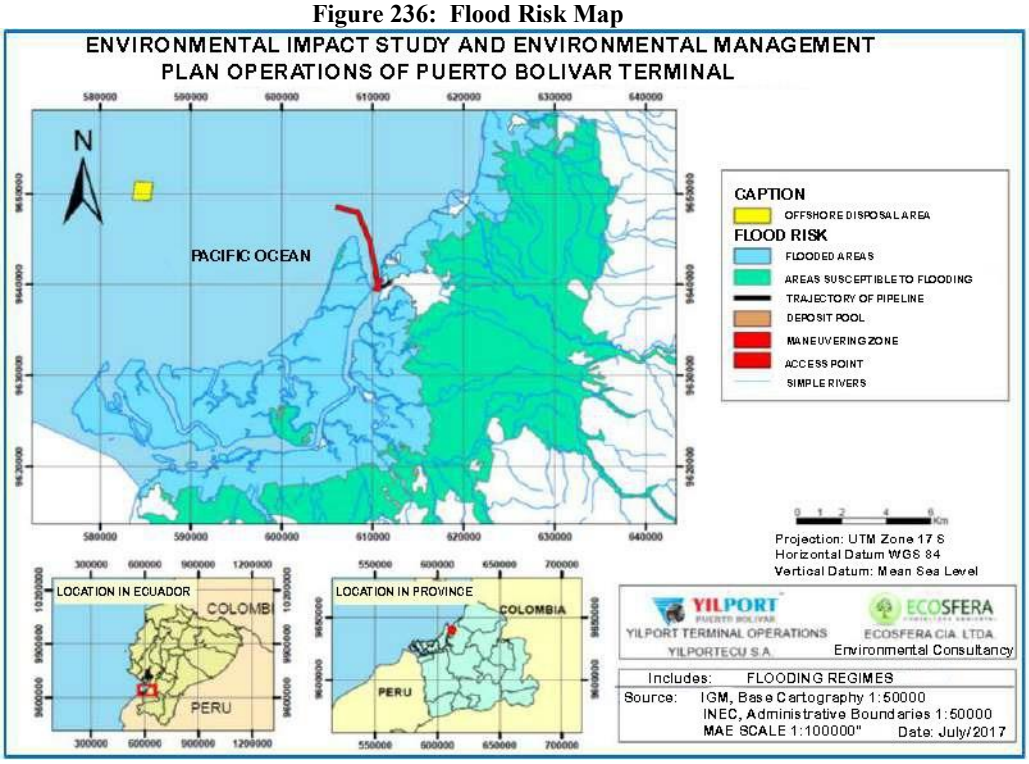
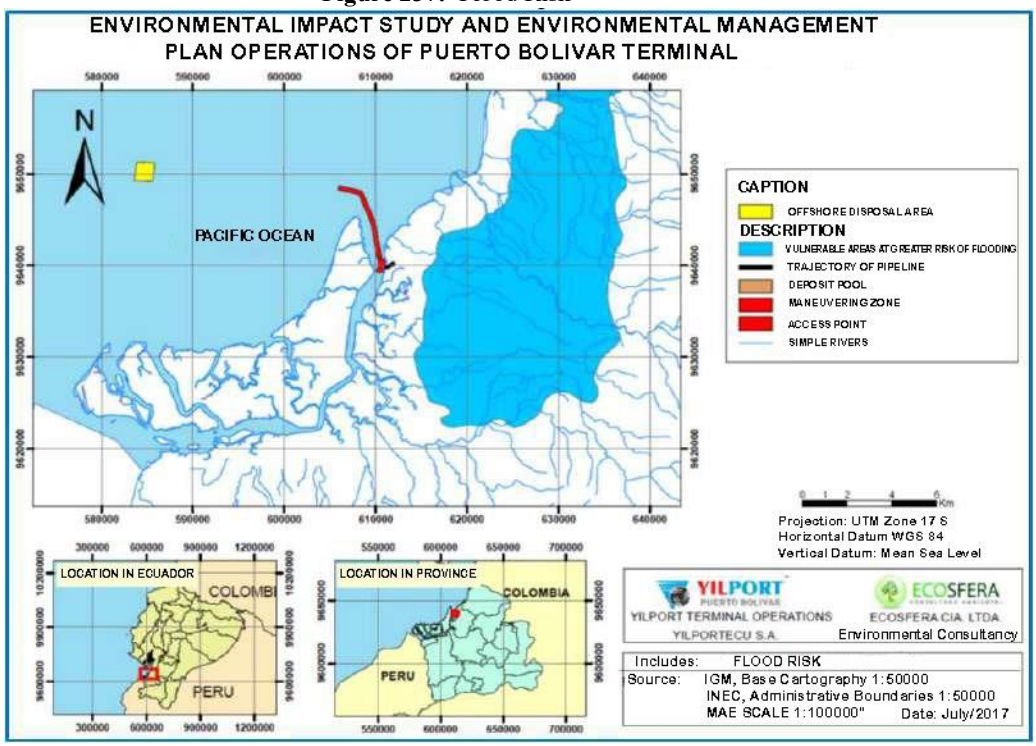


Figure 237: Flood Risk



Source: *www.geoportaligm.com, Instituto Geografico Militar, INEC*
Created by*: Ecosfera Cia. Ltda., 2017*
Location: *Puerto Bolívar - Machala, Santa Rosa - El Oro*
Date: *April 2 of 2017*

Specifically, the main natural threat against this project is flood risk since, as previously stated, El Niño event takes place and there is no drainage of the drainage basins to the project areas.

With regards to the Jambelí parish, most of the territory is prone to flooding due to its topography, with high and medium prone levels at the parish.

The exogenous risk assessment carried out in accordance with the previously explained methodology is described in the table below:

EXOGENOUS RISK ASEESSMENT

Table 265: Results of the environmental analysis related to the project

ENVIRONMENTAL FACTOR					
RISK	HAZARD LEVEL				
	(C)	(E)	(P)	Assessment index	Interpretation
Earthquake	100	1	0.5	50	Medium
Overflowing	50	3	1	150	High
Floods	15	3	0	450	Critical
Landslides	1	0.5	1	0.5	Low
Seawater intrusion	5	1	1	5	Low

***Prepared by**: Ecosfera Cía. Ltda. 2017*

11.3.- PROJECT RISK ANALYSIS AND ASSESSMENT

The risk assessment will be carried out using a simplified method which can account for existing risks and rationally organize them hierarchically in order of priority; below is the analysis and assessment for the project: ***"Dredging of piers 1, 2, 3, 4, 5 and 6, maneuvering area and access canal to Puerto Bolívar".***

11.3.1.- PREVENTIVE MANAGEMENT

Identifying the factors that entail risk and assessing them to judge their importance is necessary in order to establish appropriate preventive management and determine the required measures for preventing such risks.

Identifying the risks is essential, both for the people exposed to them and those who must act to eliminate them.

Therefore, identifying the risks and assessing them is a technical work in which many aspects must be contemplated; moreover, there are various ways of assessing risks.

Below are the organized criteria that will be contemplated in this risk assessment:

- Safety conditions
- Environmental conditions (in relation to the worker or occupational hygiene)
- Workload
- Workload management

Preventive management on safety is designed to develop preventive work on health and safety based on the following criteria:

- Avoiding risks
- Assessing the risks that cannot be avoided
- Dealing with the risks at their origin.
- Adapting the work to the person, specifically concerning how they conceive of their job position and what equipment, work approach, and production methodology to employ.
- Considering technical developments.
- Substituting what is dangerous for what poses low or no risk
- Planning prevention by seeking a coherent combination of technique, work organization, work conditions, social relations and environmental factors.

11.3.2.- RISK IDENTIFICATION

Risk identification has been carried out based on the project description, and observational data has been gathered by analyzing various activities, aided by an INSHTE[9] checklist.

[9] Spanish National Institute of Occupational Health and Safety (Instituto Nacional de Seguridad e Higiene del Trabajo España by its Spanish acronym)

Risk diagnosis involves studies for identifying conditions, risks, assessment of incidents produced, and their risk reduction alternatives.

Based on this assessment and the noise, gas, suspended particulate matter, effluents and waste factors, among others, recommendations were given in line with different standards such as health, environment and safety. The urgency of implementation and solution thereof will depend upon the magnitude and probability of the detected risk.

The following checklists have been implemented:

- Workplaces
- Machinery
- Hand tools
- Object handling
- Electrical wiring
- Fire and explosions
- Chemical substances
- Ventilation and air conditioning
- Noise
- Lightning
- Physical load

Through these, instances of non-conformity and non-compliance have been detected and assessed based on the applicable Ecuadorian legislation, specifically, the Regulation for Occupational Safety and Hygiene, the Regulation for Occupational Safety and Health, et al.

Table 266: Project risk identification

ASPECTS	FACTORS	OPERATING CAMPS AND FACILITIES	PIERS 1, 2, 3, 4, 5 AND 6	MANEUVERING AREA	ACCESS CANAL	SEDIMENTATION BASIN	OFFSHORE SEDIMENT DISPOSAL SITE	SEDIMENT-TRANSPORTING	LAND AND SEA ACCESS PATHS	DREDGES
Safety conditions	1.- Work places	G	G	G	G	G	G	G	G	G
	2.- Machinery	G	G	G	N/A	N/A	N/A	N/A	N/A	G
	3.- Hand tools	G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	G
	4.- Object handling	G	G	G	G	G	N/A	G	G	G
	5.- Electrical wiring	G	G	N/A	N/A	G	N/A	N/A	G	G
	6.- Fires and explosions (prevention)	G	G	G	N/A	G	N/A	N/A	D	G
	7.- Chemical substances	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	G
Environ. conditions	8.- Chemical contaminants	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	G
	9.- Ventilation and air conditioning	G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	G
	10.- Noise	G	G	G	G	G	N/A	N/A	G	G
Workload	11.- Physical load	G	G	G	G	G	G	G	G	G
Workload management	12.- Organizational factors	G	G	G	G	G	N/A	N/A	N/A	G

VD=Very Deficient **D= Deficient** **G = Good**

11.3.3.- RISK ANALYSIS – RISK LEVELS

For Risk Level Analysis, it is necessary to identify how the hazard analysis and risk assessment are executed. Activities associated with the process must be identified, as well as the associated jobs and associated teams.

The development of the activities to be carried out in the project: "Dredging of Piers 1, 2,3, 4, 5 and 6, Maneuvering Zone and Access Channel of Puerto Bolívar", imply inherent and associated risks with the tasks, processes, machinery, tools, materials that have a potential loss if not duly performed or used.
The safety of the people involved in the project, the facilities, infrastructure, and equipment that interact directly in the project, are essential.

Hence being important to perform a risk analysis as evidenced in the activities to be carried out in the Dredging process

Figure 238: Risk Levels

LEVELS OF RISK		CONSEQUENCE		
		Slightly harmful	Harmful	Extremely Harmful
PROBABILITY	Low	Trivial	Tolerable	Moderate
	Medium	Tolerable	Moderate	Important
	High	Moderate	Important	Intolerable

Made by: *Ecosphere Cia. Ltda., 2017*

Table 267: Project Risk Assessment

RISK ASSESSMENT												
"DREDGING OF PIERS 1, 2, 3, 4, 5 AND 6, MANEUVERING AREA AND ACCESS CHANNEL OF PUERTO BOLIVAR"												
TYPE OF RISK	IDENTIFIED IRISK	PROBABILITY			CONSEQUENCE			RISK				
		Low	Medium	High	Slightly harmful	Harmful	Extremely harmful	Trivial	Tolerable	Moderate	Important	Intolerable
Natural	Flooding			X		X					X	
	Drought	X			X			X				
	Erosion	X			X			X				
	Earthquakes or seisms		X				X				X	
	Landslides	X				X			X			
Mechanical	Entrapment by or between objects		X				X				X	
	Entrapment by overturning machines or Vehicles		X				X				X	
	Vehicular run overs or hits	X				X			X			
	Crashes against stationary objects		X			X				X		
	Crashes againstmobile objects		X				X				X	
	Direct & indirect electrical contact	X				X			X			
	Hits/cuts by objects or tools		X			X				X		
Physical	Falling objects		X			X				X		
	Different level Falls		X				X				X	

RISK ASSESSMENT												
"DREDGING OF MUELLES 1, 2, 3, 4, 5 AND 6, MANEUVERING AREA AND ACCESS CHANNEL PUERTO BOLÍVAR"												
TYPE OF RISK	**IDENTIFIED RISK**	**Probability**			**Consequence**			**Risk**				
		Low	**Medium**	**High**	**Slightly harmful**	**Harmful**	**Extremely damaging**	**Trivial**	**Tolerable**	**Moderate**	**Important**	**Intolerable**
	Same Level falls		X							X		
	Explosion at extreme ambient temperatures		X			X				X		
	Overexertion		X			X				X		
	Noise and Vibrations			X		X					X	
	Fires		X				X				X	
Chemical	Exposure to harmful or toxic substances	X				X			X			
Biological	Accidents caused by living beings	X			X			X				
Ergonomic	Position and Displacement		X			X				X		
	Cargo Handling		X				X				X	
Psychosocial	Relations and Communications			X		X					X	
	Working Time			X		X					X	

Symbology		
L: LOW	**SH:** SLIGHTLY HARMFUL	**T:** TRIVIAL
M: MEDIUM	**H:** HARMFUL	**TO:** TOLERABLE
H: HIGH	**EH:** EXTREMELY HARMFUL	**MO:** MODERATE
		I: IMPORTANT
		IN: INTOLERABLE

***Elaborada por**: Ecosfera Cia. Ltda., 2017*

Having the risk assessment been conducted, the most significant risks for the project *"Dredging of piers 1, 2, 3, 4, 5 and 6, maneuvering area and access canal to Puerto Bolívar"* have been identified, namely:

- Floods
- Earthquakes
- Entrapment by or between objects
- Entrapment by the overturning of machinery or vehicles
- Crashes against moving or still objects
- Fall of people at the same or different levels
- Noise and vibration
- Risk of fire
- Load handling
- Relations and communication
- Working time

Controls and actions must be implemented while developing the dredging project activities in order to ensure that the safety, health, and welfare of its human and material resources are kept while guaranteeing the protection of residents and the surrounding environment.

12.- ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (PMA) contemplates the implementation of selective corrective measures for preventing and mitigating the environmental impacts the project "Dredging of piers 1, 2, 3, 4, 5 and 6, maneuvering area and access canal to Puerto Bolívar" may cause.

Section 3 of Ministerial Resolution No. 061 on the Amendment of Book VI of the Unified Text on Subsidiary Legislation stipulates that the Environmental Management Plan is the document that sets forth, in detail and in chronological order, the actions that need to be taken to prevent, control, correct and compensate for possible adverse environmental impacts or to emphasize the beneficial impacts resulting from the development of a proposed action. The Environmental Management Plan generally consists of several sub-plans, depending on the activity or project's characteristics.

12.1.- GOALS

- To ensure that the activities carried out throughout the project comply with the environmental legislation in force.
- To prevent, mitigate, control, and monitor the environmental impacts identified in the project.
- To provide an environmental management tool so that the people involved in the project perform activities that prove beneficial to the environment.

12.2.- RESPONSIBILITY FOR IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

YILPORTECU S.A. is responsible for the fulfillment of the Environmental Management Plan.
It should be pointed out that this document unavoidably applies to personnel working at different stages of the project. Therefore the necessary resources must be provided, and the execution of the proposed activities in the Environmental Management Plan within the agreed-upon dates must be ensured.

12.3.- STRUCTURE OF THE ENVIRONMENTAL MANAGEMENT PLAN

A proposal for the development of this PMA is to devise plans focused on carrying out specific actions aimed at mitigating the project's adverse effects on environmental factors. The Environmental Management Plan contemplates the following basic plans outlined in TULSMA and in Ministerial Resolution No. 061:

- Impact prevention and mitigation plan
- Waste management plan
- Environmental communication, training, and education plan
- Community relations plan
- Contingency plan
- Occupational safety and health plan
- Monitoring and tracking plan
- Area abandonment and handover plan

Each program covers the following parameters:

- Code
- Measure name
- Goals
- Implementation site
- Responsible party
- Environmental aspect
- Identified impact
- Proposed measures
- Indicator
- Verification means
- Term (months)

12.3. 1.- IMPACT PREVENTION AND MITIGATION PLAN

It contains measures focused on detecting or avoiding the occurrence of the most severe impacts and mitigating or reducing the consequences that some project activities might have on the environment.

PREVENTION AND MITIGATION PLAN NOISE, VIBRATION AND GAS EMISSION CONTROL PROGRAM					
GOAL: To mitigate, prevent and control possible air quality alterations by noise generation and gas emission. **IMPLEMENTATION SITE:** PIERS 1, 2, 3, 4, 5, 6, MANEUVERING AREA AND ACCESS CANAL TO PUERTO BOLÍVAR **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PPM-01**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
AIR	Noise generation, vibrations, and gas emissions as a result of operating the dredge during the dredging procedure Health and safety effects on workers and residents	To conduct preventive and corrective maintenance of equipment and machinery to keep in proper operating conditions. Workers must wear PPE (hearing protection) to mitigate the noise generated by the dredge. Boat traffic (vessels) will be restricted during dredging operations, and only the necessary equipment will be manned to reduce sources of noise.	Number of pieces of equipment and machinery that have undergone maintenance/ number of pieces of equipment and machinery used*100 = 100%	▪ Machinery and equipment record sheet ▪ Photographic record	Monthly

PREVENTION AND MITIGATION PLAN MITIGATION PROGRAM FOR IMPACTS ON MARSH WATER QUALITY					
GOAL: To mitigate environmental impacts in order to keep water quality in Estero Santa Rosa **IMPLEMENTATION SITE:** PIERS 1, 2, 3, 4, 5 AND 6, MANEUVERING AREA AND ACCESS CANAL TO PUERTO BOLIVAR **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PPM-02**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
SOCIAL WATER	Water quality pollution in Estero Santa Rosa Social conflicts	Dredging operations must not be carried out during periods of strong winds, waves, and strong currents in order to reduce sediment suspension. A specific area must be defined for placing excess material from dredging operations, in addition to installing containment berms to prevent sediments from flowing into the marsh. Fuels, lubricants, and chemical products will be stored in safe containers and kept in containment trays to avoid leaks on vessels that can reach the marsh's surface. A leak control kit must be at hand	Number of leaks produced/number of controlled leaks*100 = 100%	▪ Leak record ▪ Photographic record	Monthly

PREVENTION AND MITIGATION PLAN PREVENTIVE MEASURES PROGRAM FOR OPERATING DREDGES					
GOAL: To verify that dredges meet environmental and safety standards during dredging operations, endeavor for which they were contracted **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PPM-03**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
BIOTIC ASPECTS AIR WATER SOCIAL SOCIO-ECONOMIC	Corroborate that the dredges comply with the environmental legislation in force	Dredges to be used in the project shall meet all required safety and environmental measures. The following actions must be taken: ▪ Perform verification procedures on dredge features regularly. ▪ Examine storage conditions of bilge water tanks and state of the control system for gas emissions into the atmosphere ▪ A record must be kept for weekly hours worked and volume of extracted sediments. ▪ Optimal performance of contingency plans and control systems shall be verified ▪ Confirm that pipe couplings are completely sealed and in good order to avoid leaks ▪ Verify that there are no cracks in the perimeter walls ▪ All technical and working personnel must wear clothing and protection equipment suitable to their area of work.	Number of proposed measures/ number of adopted measures *100 = ≥90%	▪ Compliance checklist ▪ Photographs	Monthly

		▪ Regularly examine equipment and basic tools for dealing with emergencies ▪ Users of the access canal to Estero Santa Rosa (dredging area) must be informed of the activity schedule in order to avoid conflicts.			

PREVENTION AND MITIGATION PLAN PIPELINE PLANIMETRY PROGRAM					
GOAL: To establish the land pipeline routing towards the sediment disposal site **IMPLEMENTATION SITE:** LAND PIPELINE LOCATION UP TO THE SEDIMENT DISPOSAL SITE **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PPM-04**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
SOCIAL SOIL	Health and safety effects on workers and residents Avoid vehicle accidents Social conflicts	Carry out the planimetry of land pipelines that will be placed as far as the sediment disposal site, where vehicle passage sites are made out.	Pipeline planimetry 100% implemented	▪ Planimetry report on land pipeline ▪ Photographic record	Monthly

PREVENTION AND MITIGATION PLAN PREVENTION AND SAFETY PROGRAM FOR TSHD DREDGE					
GOAL: To establish basic prevention and safety guidelines for the TSHD dredge arriving from overseas **IMPLEMENTATION SITE:** TSHD DREDGE **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PPM-05**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
AIR WATER SOIL SOCIAL	Noise generation, vibrations, and gas emissions Solid waste generation Water quality pollution in Estero Santa Rosa Health and safety effects on workers and residents	When the dredge arrives from overseas, the following will be required: • Dredging work plan • Industrial safety plan • Contingency plan • Vessel maintenance plan.	Number of delivered documents/ number of requested documents*100 = 100%	▪ Dredging work plan ▪ Industrial safety plan • Contingency plan ▪ Vessel maintenance plan.	Monthly

PREVENTION AND MITIGATION PLAN VISUAL IMPACT PREVENTION PROGRAM					
GOAL: To mitigate the visual impact that the sediment disposal site has on the area of influence **IMPLEMENTATION SITE:** SEDIMENT DISPOSAL SITE **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PPM-06**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
LANDSCAPE	Visual impact	Install a physical barrier in the sediment disposal site perimeter adjacent to the walled enclosure of former ISSFA plots of land facing Ave. Bolívar Madero Vargas	Physical barrier 100% implemented	• Photographic record	Monthly

PREVENTION AND MITIGATION PLAN
OFFSHORE SEDIMENT DISPOSAL SITE PROGRAM

GOAL: To mitigate environmental impacts associated with sediment disposal at an offshore location
IMPLEMENTATION SITE: SEDIMENT DISPOSAL SITE (OFFSHORE)
RESPONSIBLE PARTY: YILPORTECU S.A.

PPM-07

ENVIRON. ASPECT	IDENTIFIED IMPACT	PROPOSED MEASURES	INDICATORS	VERIFICATION MEANS	Frequency
BIOTIC ASPECTS WATER AIR SOIL SOCIO-ECONOMIC	Effects on water quality Effects on air quality Noise generation Effects on marine sediments Effects on flora and fauna Effects on benthic and planktonic communities Effects on phytoplankton and zooplankton Effects on marine mammals	The offshore sediment disposal site must be controlled, and the following measures must be taken: • Sediment discharge will be performed via the dredge lower gates so as to take advantage of its 6-meter draft, which will allow a fast and direct discharge of the material. • The dredge must be examined to assess its mechanical condition, and it must be verified that excess flue gases are not being emitted • Disposal shall not be performed at offshore locations from June to October due to humpback whale (*Megaptera novaeangliae*) transit during said months as part of their reproductive cycle. • Waste discharge is forbidden, as is any hydrocarbon effluent resulting from washing tanks, bilge water, and generally any other action capable of causing pollution	Discharges performed/ Submitted discharge reports*100 = 100% Dredge maintenance = 100% Sediment disposal schedule completed = 100% Number of proposed measures/ number of adopted measures *100 = ≥90%	▪ Sediment discharge daily report ▪ Offshore sediment disposal schedule ▪ Checklist of proper operating conditions of the dredge ▪ Photographic record ▪ Detailed coordinates of material disposal sites ▪ Volume record of disposing of material	Monthly

		• A leak control kit must be at hand • Dredges must have a record of weekly hours worked on sediment disposal • Discharges must be uniform at different areas within the disposal site. A high-tech monitoring and directing system (GPS device, other) is required to transmit real-time dredge locations, thus avoiding the formation of a bump at the bottom that could change currents. • Mark the offshore sediment disposal site • Keep a record of the volume disposed of at the offshore site • The monitoring programs laid down for offshore locations, water quality, sediments, benthic and planktonic flora, and fauna, mammals, and ichthyology must be complied with as described in the monitoring and tracking plan on this Environmental Management Plan. **<u>Contingency program for</u> <u>animal rescue</u>** It is important to devise a contingency plan in case marine animals inadvertently get injured or suffer an accident with the dredge during dredging works or at the disposal site.	Volume of disposed of sediment/ volume of extracted sediment*100 = 100% Monitoring procedures performed/ scheduled monitoring procedures *100 = 100%		

		The rescue procedure will be as follows: - Warn all dredge crew members - Reduce speed or stop dredge traffic - Georeference the location of the (injured) marine animal - Get in contact with the Ministry of Environment (072934596)- the Natural Heritage Department and the Ecuadorian Emergency Services 911 - Move the animal from the sea surface to the dredge deck by employing all necessary pieces of equipment without causing it physical harm. - Do not touch the marine animal. An injured animal is in a condition of stress; therefore, it could bite if someone tries to touch it or transmit a disease. - No crew member (with the exception of the suitable ones) must approach, since being surrounded by many people will increase the animal's tension, which may endanger its health even further. - Try to gather the following information: the species; the number of injured individuals; if it is offspring, young or adult; if it is wounded or bleeds or is entangled with something, etc. - Immediately move it to the ground and coordinate with local		

		authorities on its corresponding reception and care.			

12.3.2.- WASTE MANAGEMENT PLAN, PMD

The waste management plan lays down the guidelines for the proper management of any waste produced during the realization of the project.

WASTE MANAGEMENT PLAN MANAGEMENT PROGRAM FOR DREDGING WASTE AND SEDIMENTS					
GOAL: To carry out the appropriate management of dredging waste and sediments **IMPLEMENTATION SITE:** PIERS 1, 2, 3, 4, 5, 6, MANEUVERING AREA AND ACCESS CANAL TO PUERTO BOLÍVAR **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PMD-01**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
SOIL WATER LANDSCAPE SOCIAL	Solid waste generation Landscape transformation Social conflicts	Proper identification and disposal of solid waste produced by the project must be carried out. Dredging waste shall be disposed of as follows: • Waste products from the dredging of piers 1, 2, 3, 4, 5, and 6 shall be disposed of at the sediment disposal site near the Naval school in a plot of land devoted for such endeavor. • Dredging sediments in the maneuvering area and access canal to Puerto Bolívar shall be disposed of at an offshore location Sediment disposal and re-deposit processes will be carried out in accordance with the project activities in Chapter 7 of this assessment.	% of extracted sediments/ % of sediments scheduled to be extracted *100 = 100%	▪ Photographic record ▪ Record of extracted sediments ▪ Record of sediment disposal at specific sites	Monthly

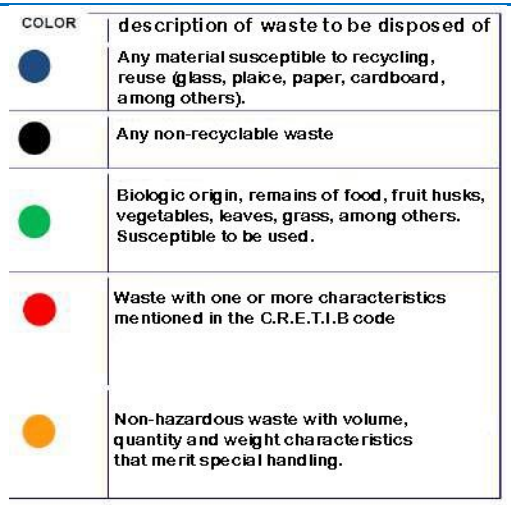
		Management of common waste produced by workers' activities will require classification as provided in regulation INEN NTE INEN 2841: 2014-03. Sorting out procedures at the waste source must be carried out using containers that ease identification so that they are later sorted out and finally disposed of. Sorting out procedures guarantee the quality of reusable waste and ease its classification, and for this reason, its containers must be clearly distinguishable. Collection procedures must be safely performed while trying to avoid waste leaks as much as possible. They must not cause the classification work previously carried out to be lost, for which waste products must be packed in a way that prevents contact between these and the environment and collection personnel. Collection containers at the waste generation source may be reusable or disposable and must be placed in the agreed-upon collection sites. Infrastructure at the collection and storage sites must be appropriately marked and shall be taken into	Number of installed containers/ number of required containers *100 = ≥90%	▪ Container purchase record ▪ Record of generated solid waste	

consideration for its internal evacuation and transportsystems.

Once the waste is separated in its respective containers, it must be stored according to their real feasibility of use and compatibility, facilitating their collection and transportation.

The colored containers must comply with their labeling in a visible place, according to the color code, as described below:

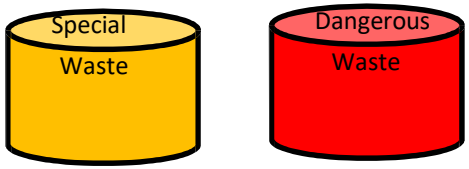
TYPE OF WASTE	COLOR CONTAINER	
Recyclable	Blue	
Non recyclable non hazardous	Black	
Organic	Green	
Hazardous	Red	
Specials	Orange	

		 Common waste will be collected by the municipal collector of the city of Machalaand then transferred to the city's sanitary landfill.			

WASTE MANAGEMENT PLAN
HAZARDOUS AND SPECIAL WASTE MANAGEMENT PROGRAM

OBJECTIVE: Establish specific procedures for the handling, transfer, storage and final disposal of the Hazardous waste generated in the work of the project
PLACE OF APPLICATION: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR
RESPONSIBLE: YILPORTECU S.A.

PMD-02

ENVIRONMENTAL APPEARANCE	IDENTIFIED IMPACT	PROPOSED MEASURES	INDICATORS	VERIFICATION MEASURE	FREQUENCY
SOIL WATER SOCIAL	Generation of hazardous waste and contamination of soil and water	Solid waste from inputs used in the machinery, such as: rags impregnated with oil and used fuel, plastic containers and oil filters, will be temporarily accumulated in containers according to the color code described above..  These will be transferred to a temporary storage area for hazardous waste, complying with INEN NTE 2266 transport, storage and handling of hazardous materials standards. A monthly log must be kept regarding generation of hazardous and special waste; all waste characteristics as volume, origin and final disposition will be included.	Amount of waste generated / Amount of waste managed *100 = 100% Registration as a generator of hazardous waste obtained = 1	• Photographic record • Monthly log on the generation of Hazardous Waste • Delivery of manifests • Certificates of final disposal. • Hazardous waste generator records	Monthly

		All hazardous liquid waste generated must be collected in properly labeled hermetic containers and taken to the temporary hazardous waste storage area for subsequent delivery to a qualified manager. The certificates delivered by the managers must be kept in a specific file that will be prepared and implemented for this type of waste. In addition, the Hazardous Waste Generator Registry must be obtained from the National Environmental Authority, as established in the Ministerial Agreement 026, 061 and 142.			

WASTE MANAGEMENT PLAN
LIQUID WASTE MANAGEMENT PROGRAM

OBJECTIVES:
- Avoid contamination of bodies of water
- Correctly manage drainage water generated in the sediment deposit area.

PLACE OF APPLICATION: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR

RESPONSIBLE: YILPORTECU S.A.

PMD-03

ENVIRONMENTAL APPEARANCE	IDENTIFIED IMPACT	PROPOSED MEASURES	INDICATORS	VERIFICATION MEASURE	FREQUENCY
WATER	Waste contamination	In the discharge zone (Sediments reservoirs), located near the Naval High School; dredging product of docks 1, 2, 3, 4, 5 and 6 will be deposited in an empty land, an adequate water drainage system must be established here. In addition, the drainage system must also be ready for winter, so rainwater is properly managed.	100% water drainage in sediment deposit area	Compliance report on the application of this measure, issued by Auditing	Monthly

12.3.3.- COMMUNICATION AND TRAINING PLAN, PCC

This plan consist in the increasing of knowledge level and raising awareness among workers regarding matters of industrial safety, occupational health and environment, which are enclosed in this Environmental Management Plan, in such a way as to raise awareness among staff to achieve a safe work and balanced environment.

COMMUNICATION AND TRAINING PLAN TRAINING PROGRAM					
OBJECTIVES: • Apply educational actions on industrial safety and occupational health issues, this will allow developing activities for the project in a safe and responsible manner in compliance with the applicable regulations. • Encourage workers and stakeholders involved, an environmental awareness that turns into protection and conservation of natural resources through responsible action in the work carried out in the project. • Adequately implement the Environmental Management Plan**.** **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PCC-01**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOCIAL	Unawareness of knowledge of the measures of the Environmental Management Plan (PMA) and of occupational health and safety regulations. Occupational risks due to lack of safety equipment, accidents and	**INTRODUCTORY TALK** They will be dictated to new workers starting job, to operators of machinery and technical equipment that is integrated into the project. The introductory talk will last no more than 30 minutes, topics that will be taught are described in the following table:	Number of workers trained / number of workers hired * 100 = ≥90%	• Photographic records • Records of attendance at talks and training • Training record	Quarterly

	contingencies during the activities of the project. Impact on the Health and Safety of workers.	<table><tr><th>TOPIC</th><th>OBSERVATIONS</th></tr><tr><td>Current and applicable Legislation to project activities</td><td>Emphasize the importance of compliance with approved PMA by the Ministry of the Environment</td></tr><tr><td>Importance of the use of personal protective equipment</td><td>According to perform activity; use of appropriate footwear, gloves, hearing protection, mask, etc.</td></tr><tr><td>Waste management</td><td>Dangerous and not dangerous</td></tr><tr><td>Emergency response</td><td>Socialization of emergency plan (procedures to follow in case of emergency)</td></tr><tr><td>Signaling</td><td>Preventive, informative, warning and evacuation</td></tr><tr><td>Good environmental practices</td><td>Environment protection</td></tr></table> **QUARTERLY TALKS** They will be addressed to all personnel involved in project activities. Talks will not last more than 60 minutes using didactic material (videos, diagrams, brochures). The main topics to be taught will be:			

TOPIC	OBSERVATIONS
Safe working conditions	Use of EPP collective protection etc.
Proper use of tools	Hhand and power
Waste management	Hazardous and non hazardous final disposal
Fire control	Extinguishers use and control
First aid	Wounds, burns, fractures etc.
Evacuation	Procedures to follow
Procedures in the event of accidental spillage of contaminants	Combustible
Current legislation applicable to project activities	Emphasize importance of compliance with the PMA, approved by the Ministry of environment
Response to labor and natural emergencies	Socialization of the emergency plan (produces to follow in case of emergency)
Signaling	Informative, preventive, warning and evacuation
Incidents and accidents	Difference, how to report procedures

On every talk and training, records will be made, will include topics covered, trainer data, date and number of training hours, and signature of participants, for which it is proposed to use the record format:

ENVIRONMENTAL TRAINING PLAN FOR THE PROJECT DOCKYARD DREDGING 1, 2, 3, 4, 5 AND 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR		
DATE:		
RESPONSIBLE:		
TOPIC:		
DURATION:		
NAME	ID NUMBER	SIGNATURE

12.3.4.-COMMUNITY RELATIONS PLAN (PRC)

It establishes the measures that must be applied to link the neighboring communities to the project in order to maintain good relations and avoid possible social conflicts. It includes broadcasting measures, communication and information strategies, as well as an environmental education program aimed at members of the community in the area of influence.

COMMUNITY RELATIONS PLAN COMMUNITY RELATIONS PROGRAM					
OBJECTIVES: - Build positive relationships with the communities, social organizations and local governments that are in the direct area of influence of the project, which facilitate the fulfillment of the activities foreseen in the project " DOCKYARD DREDGING 1, 2, 3, 4, 5 AND 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR, - Preferably and if the case permits it, generate sources of employment throughout the execution of the project, for the communities immersed in the project area. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PRC-01**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOCIAL	Harmony alteration of project Social conflicts	The person in charge of the YILPORTECU S.A., will handle "Community Relations" of the project, in which meetings will be held with main project stakeholders: - Local authorities - Social organizations and communities in the areas of project influence. Approaches should be made with the main authorities of the sector in order to inform residents concerns and establish communication links between the project - community - authorities.	N ° of meetings held / N ° of meetings planned per year	• Records of attendance at meetings • Photographic record • Meeting minutes	Quarterly

COMMUNITY RELATIONS PLAN SOCIAL PARTICIPATION PROGRAM					
OBJECTIVES: Inform the surrounding population of direct influence about project activities of YILPORTECU S.A. company **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PRC-02**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOCIAL	Lack of information to the community surrounding the project Social conflicts	The Consultora Ambiental ECOSFERA CIA. LTDA and the company YILPORTECU S.A., will coordinate with the Ministry of the Environment, proper dissemination mechanisms and informative talks to social actors involved and the neighboring community about the project, in accordance with the provisions of Executive Decree 1040 and Ministerial Agreement 103. In the public hearing to exhibit the project, in addition to the Environmental Impact Study, all activities to be performed and benefits of the project, will be shown.	Social completed participation process = 1	• Records of attendance at the Public Hearing • Photographic Records • PPS report approved by the MAE	Monthly

COMMUNITY RELATIONS PLAN FILLING MATERIAL DONATION PROGRAM					
OBJECTIVES: • Contribute to environmental sanitation and construction using the material (sediment) provided and extracted from dredging works • Generate an alternative positive effect **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PRC-03**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOCIAL	Social conflicts	The company YILPORTECU S.A. within its Environmental Management Plan undertakes to respond any request for donation of material (sediments extracted from dredging), to fill in urban and rural areas of the province, as well as irregular neighborhoods where required. Companies, educational units, communities and people who require this collaboration may direct their request to be process together with delivery plot, at the offices of YILPORTECU S.A. This material due to its characteristics and physical composition is suitable as filling material.	Requests received / requests handled * 100 = 100%	• Material donation requests • Material delivery records	According to submitted requests Three months (3)

12.3.5.- CONTINGENCY PLAN (PDC)

It is an emergency response plan; an organization, response procedures, definition of minimum equipment and definition of those responsible, are required in order to face possible claims and accidents that may occur in the project area.

CONTINGENCY PLAN EMERGENCY AND CONTINGENCY RESPONSE PROGRAM					
OBJECTIVES: • Prevent the occurrence of unplanned but foreseeable events, and define immediate response actions to control such events in a timely and effective manner. • Establish emergency prevention measures, in order to protect people's lives, affected natural resources, and their own and third-party assets. • Define the procedures to be followed in the event of emergencies in such a way as to minimize the adverse effects derived from them. • Promote in all staff, the development of skills and capacities to prevent and face emergency situations **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PDC-01**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
BIOTIC SOCIAL ECONOMIC	Risk of Vehicular accidents Risk of Occupational Accidents	Impact on Health and Safety of the company YILPORTECU S.A. must establish a security mechanism in response to any emergency that may arise during project activities. This mechanism must establish responsibilities to respond immediately to possible events (natural disasters, work accidents, etc.) that may occur.	Contingency Plan prepared = 1 100% effective response to emergencies	• Plan of Contingency • Reports and notifications of workplace accidents • Record of accidents and incidents	Quarterly

	Effects on workers' health and Safety of the population in the area of influence Fire Hazard Oil spills and other dangerous substances	A responsible person must be designated at work front as well as the one in charge of applying the **CONTINGENCY PLAN**. Who will be in charge of directing the actions in the event of an emergency. This in turn may designate responsibilities to other workers. The workforce must know the following instructions to follow in case of emergency: • Notify the person in charge of contingencies and emergencies. • Person in charge must determine the degree and type of emergency: fire, accident (communicate alert or alarm). • Report the emergency to ECU 911. • Keep bystanders away, if necessary using a human cord. • Prohibit the entry of people to site where the event took place, signage or barriers such as danger tapes, cones, etc., will be placed • Make staff aware of fire risk locations, falls, etc., placing informative or preventive signs necessary to avoid work accidents.	Number of Emergency documents presented / Number of emergency documents requested * 100 = ≥90%	• Photographic record	

		• Familiarize staff with security information, spotting the ECU 911-phone number. Personnel should be trained in first aid issues. It is necessary to keep an updated registry of Aid institutions with addresses and telephone numbers (Red Cross, Fire Brigade, National Police, Emergencies, Risk Management, Hospitals and Clinics). Workforce personnel should be trained in first aid issues. It will also be the responsibility of the company industrial safety manager, to develop the following plans: • Fuel maneuvering plan • Fire plan • Man overboard plan • Abandonment plan for the ship • Fuel spill control plan • Collision and boarding plan • Analysis of plan operability • Risk management plan.			

CONTINGENCY FUEL PLAN MANAGEMENT PROGRAM					
OBJECTIVES: Prevent, mitigate and control emergency situations caused by potential oil spills. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PDC-02**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
WATER SOIL	Fuel Spills Impact on water and soil resources Risk of accidents Impact on the health and safety of workers and the population	Condition of dredgers, couplings and hoses should be checked to verify that their engines do not spill oil, it is also necessary to verify that the emergency equipment is complete and fully operational.	Number of spills controlled / number of spills produced *100 = 100%	• Monthly registration of coupling and hoses maintenance • Report spill control • Photographic record • Spill control kit purchase record	Monthly

12.3.6.- OCCUPATIONAL HEALTH AND SAFETY PLAN (PSO)

Setting all activities aimed at avoiding and preventing work accidents and effects on workers' health.

OCCUPATIONAL HEALTH AND SAFETY PLAN INDUSTRIAL SAFETY PROGRAM					
OBJECTIVE: Have a technical legal instrument in the field of Industrial Safety and Occupational Health, in accordance with established current regulations. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PSO-01**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOCIAL	Accident Risk Impact on the Safety and Health of the workers Risk of damage to machinery and facilities	YILPORTECU S.A. company, must carry up all Internal Regulations for Safety and Health at Work aligned with those established in the Ministry of Labor, complying with Executive Decree 2393 and other legal bodies that govern Ecuador. Health and Safety policies will be applied in all activities, following standards free of risks and accidents. In any event, these must be communicated for evaluation and subsequent adoption of mechanisms to minimize them in the future. To achieve objectives and policies referred above, the plan contains the following basic components: • Statement of corporate policy and management commitment to health, safety and environmental programs.	Internal Health and Safety Regulations = 1	• Internal Regulations of Health and Safety in the job approved by Work Ministry	Quarterly

		• Training and security program • Communication procedures • Investigation and reporting procedures for incidents and accidents. **<u>HEALTH AND SAFETY POLICY</u>** Company's Health and Safety policy applies to all its operations and projects. In order for the institution to achieve its objective of protecting health and safety of workers, policy standards will be disclosed to all employees and dependent workers and will be the stand for the Health and security program. Policy establishes institution's desire to achieve an accident-free workplace by complying with all regulatory requirements, communicating potential hazards to its employees and other interested parties, and providing appropriate training and equipment. This policy also defines the expectations of the institution regarding to its employees and contractors, holding them responsible for protecting the health and safety of themselves and their colleagues.	Number of workers who know about the policy / number of workers hired *100 = 100%	• Policy health records and workers socialized security	

		SAFETY TRAINING YILPORTECU S.A., will ensure a global safety Training Program for all workers including the following main aspects: • Environmental safety policies and standards of the institution. • Responsibilities of workers regarding clothing of work. • Specific job hazards • Safety precautions • Job responsibilities • Regulatory requirements • Policies of normative observance of the institution. **SAFETY MEETINGS** The person in charge of Industrial Safety will prepare a regular series of safety meetings to verify compliance with environmental and operational safety procedures. Attendance will be taken at these meetings. **INCIDENT AND ACCIDENT REPORTS** Industrial Safety Officer will report safety incidents and accidents and must complete an accident report as soon as possible.	Number of workers who received safety training / number of workers hired *100 = 100% Safety meetings held / Safety meetings scheduled *100 = ≥90%	• Safety training records • Minutes of safety meetings	

		The industrial safety officer must create a reporting system for the following: - Occupational injuries or illnesses - Wounds that can be treated in site (medical aid) - Loss of property (fire, explosion, spills, vehicular accidents). **<u>REPORTING AND INVESTIGATION OF INCIDENTS AND ACCIDENTS</u>** Workers will immediately notify the Industrial Safety Technician about safety incidents and in turn, Technician must create a reporting system for the following: - Fatalities. - Occupational injuries or illnesses. - Wounds that can be treated in site (medical aid). - Loss or damage to property (fire, explosion, spills, vehicle accidents). - All incidents	Number of accidents reported / number of accidents produced *100 = 100%	• Reports and Investigation of incidents and accidents at work	

OCCUPATIONAL HEALTH AND SAFETY PLAN OCCUPATIONAL HEALTH PROGRAM					
OBJECTIVES: Guarantee personnel health working in the YIPORTECU S.A. project, through the Surveillance Workers' Health plan. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PSS-02**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOCIAL	Impact on the Health and Safety of the workers	Measures to be performed in terms of workers´ health will be the following:: **MEDICAL EXAMS** A file should be kept with the medical records of the workers with their respective pre-occupational exams, at start. Such files will be confidential doctor-patient character **FIRST AID KIT** Records of the inspection of the first aid kits must be installed and maintained, in the project's operational area. Replacement of medications if necessary must be done accordingly. Status and availability of first aid kit implements.	Number of Clinical Histories carried out / Total number of workers *100 =100% Number of first aid kits installed / number of first aid kits required *100 = 100%	• Workers' Medical records • First aid kit inspection records • Photographic records	Quarterly

OCCUPATIONAL HEALTH AND SAFETY PLAN
PERSONAL PROTECTIVE EQUIPMENT SUPPLY PROGRAM

OBJECTIVES:

- Avoid possible occupational accidents and illnesses to personnel during activities
- Avoid, prevent and / or reduce incidence of occupational diseases and accidents during the operation phase of the project.
- Implement the use of Personal Protective Equipment (PPE) during all activities, thus protecting workers
- Protect the physical safety of workers through the establishment of mandatory application procedures
- Comply with the applicable guidelines stipulated in the Workers' Health and Safety Regulations

PLACE OF APPLICATION: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR
RESPONSIBLE: PROMOTER

PSS-03

ENVIRONMENTAL APPEARANCE	IDENTIFIED IMPACT	PROPOSED MEASURES	INDICATORS	VERIFICATION MEASURE	FREQUENCY
SOCIAL	Occupational risks due to lack of safety equipment Impact on the Health and Safety of workers	Workforce must have safety equipment. The following measures should be considered when requiring new PPE or to restore damaged PPE: **General disposition** YILPORT ECU S.A must require workers to use PPE within the project activities. The use of means of personal protection will be mandatory. Without prejudice to its effectiveness, the PPE will allow, as far as possible, work performance without unnecessary inconvenience for the person who executes activities related to work and without diminishing their operation.	Number of workers wearing PPE / number of contracted workers	• Invoices certifying the purchase of PPE • Photographic record of workers using the PPE • Minutes of delivery reception of PPE	Quarterly

		Employer will be obliged to: - Provide its workers with the means of compulsory used to protect them from professional risks inherent in the work they perform. - Provide its workers with the accessories necessary for the correct conservation of personal protection means. - Timely renew means of personal protection, or their components, according to their respective characteristics and needs. - Instruct their workers on the correct use and conservation of personal protection means, submitting to precise training and making them aware of their applications and limitations. - Determine the places and jobs in which the use of some means of personal protection is mandatory. - Enforce the use and maintenance of PPE and monitor their efficient use and care. The worker is obliged to: - Use personal protection means in their work, according to their work needs. - Make correct use of them, not introducing any type of reform or modification.			

		- Communicate to SSO -Technician deficiencies observed in the state or operation of the means of protection, the lack of them or suggestions for their functional improvement. In all maintenance work where there is a risk of falling objects or blows, it is necessary to wear an impact helmet for protection. Personal protective equipment will consist of the following items: • Workwear • Reflective vests • Helmets • Steel toe boots • Gloves • Masks • Safety glasses • Auditive protectors • Safety harness - work at heights Moreover, other PPE that the Security technician determines necessary.			

OCCUPATIONAL HEALTH AND SAFETY PLAN
SIGNALING PROGRAM

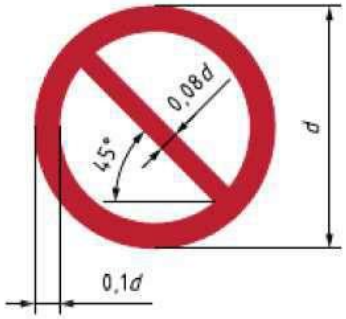
OBJECTIVES:

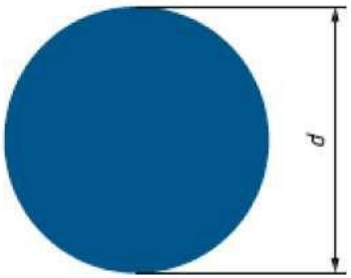
- Define and execute a program for the implementation of signaling and demarcation of areas, in order to delimit and identify risk spaces or areas, aimed at reducing possible occurrence of work accidents, as well as in the offshore storage area.
- Prevent the occurrence of accidents and work incidents due to possible flaws in the signaling scheme
- Maintain in perfect condition the signage, warnings and indications of work areas, evacuation routes, and risk areas.

PSS-04

PLACE OF APPLICATION: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR
RESPONSIBLE: YILPORTECU S.A.

ENVIRONMENTAL APPEARANCE	IDENTIFIED IMPACT	PROPOSED MEASURES	INDICATORS	VERIFICATION MEASURE	FREQUENCY
SOCIAL	Risks of Occupational Accidents Risks to the physical integrity of workers and the population Impact on the Health and Safety of workers and population	In the project, both preventive and warning signage must be implemented. Restrictive in the intervention areas. The design of the signage (colors, symbols, measurements, etc.) must be carried out in accordance with the INEN ISO - 3864-1: 2013 Standard. **DESIGN FOR SAFETY SIGNS** The safety colors, contrasting colors and geometric figures, should only be used in the following combinations to obtain the five types of safety signs: **• PROHIBITION SIGNS** The center line of the slash must pass through the central point of prohibition	Number of signals installed / number of signals scheduled to install	• Photographic record • Signage purchase invoices	Monthly

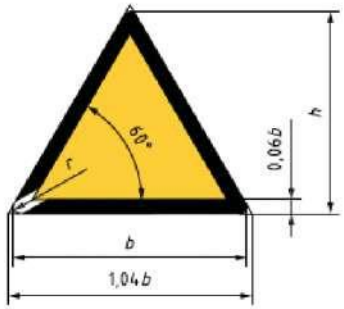
		Signal and must cover the graphic sign.  The colors of the sign should be: **Background color**: white **Circular band and slash**: red **Graphic symbol**: black **• SIGNS OF MANDATORY ACTION** They must meet the design requirements shown in the following figure:			



The colors of the sign should be:
Background color: blue
Graphic symbol: white
The security color blue should be covering at least 50% of the sign area.

CAUTION SIGNS

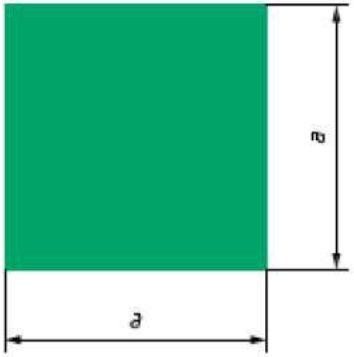
If b = 70 mm, then r = 2 mm. The colors of the sign shall be:



Background color: yellow
Triangle band: black

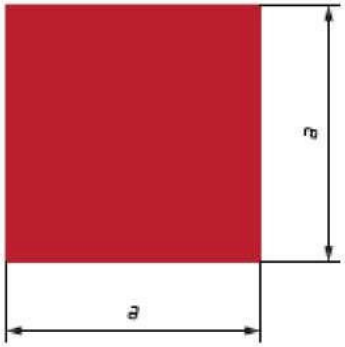
Graphic symbol: black
The yellow color should cover at least 50% of the sign area.

• SIGNS OF SAFE CONDITION
The colors of the sign should be:



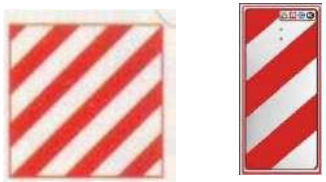
Background color: green
Graphic symbol: white
The safety green color should cover at least 50% of the sign area

• FIRE EQUIPMENT SIGNS
The colors of the sign should be:

		 **Background color**: red **Graphic symbol:** white The safety red color should cover at least 50% of the sign area. According to the requirements in the mining area, the following signs: The minimum signals to install in the project will be the following: **PROHIBITION SIGNS** The following are some signs that must be implemented in the work area: - NO SMOKING - FORBIDDEN NOT AUTHORIZED PEOPLE - NO PARKING - NON-POTABLE WATER			

		- LITTERING IS STRICTLY FORBIDDEN **CAUTION SIGNALS** - DANGER MEN WORKING - DANGER HEAVY VEHICLE DEPARTURE - DANGER WORK FRONT **MANDATORY ACTION SIGNALS** - MANDATORY USE OF PERSONAL PROTECTIVE EQUIPMENT **SAFE CONDITION SIGNALS** - MEETING POINT - EMERGENCY EXITS - FIRST AID KIT - RESCUE TELEPHONES - EXTINGUISHER Preventive signage should be implemented in areas of the project operation. When sediments are deposited in the high seas, the respective signage will also be installed. In the offshore area, a signaling buoy will be placed.			

OCCUPATIONAL HEALTH AND SAFETY PLAN EXTINGUISHING AGENTS INSTALLATION PROGRAM					
OBJECTIVE: Have an extinguishing agent as a first-hand mechanism for extinguishing a fire **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PSS-05**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOCIAL	Risks of Occupational Accidents Risks to the physical integrity of workers and population Impact on the Health and Safety of workers and population Risk of damage to machinery and infrastructure.	Within the project areas, extinguishing agents must be installed according to the characteristics of the areas and the recommendations of the security technician. Fire extinguishers must be installed in easily accessible and clearly identifiable places, free from any obstacles, and they must always be in maximum operating condition. Technician in charge of Occupational Health and Safety of the company YILPORECU S.A. must check and recharge the fire extinguishers. An inspection sheet must be made, and must include extinguisher number, location, type of extinguishing agent, date of last recharge, responsible and state in which the extinguisher is located. In addition, the personnel must be trained in the handling and use of fire extinguishers as well as they will be kept informed of the	Number of fire extinguishers installed / Number of fire extinguishers scheduled to install Number of fire extinguishers recharged / Number of fire extinguishers installed	• Invoices for the purchase of fire extinguishers • Photographic record • Invoices for recharging fire extinguishers • Fire extinguisher inspection sheets	Monthly

		measures to be followed to prevent fires occurrences. Signaling must be placed in the area where the extinguishers are located, as follows:  SQUARE - On the wall, above the equipment high enough to be seen over surrounding obstacles and from a distance.  STRIP 0.05 m wide on the floor, around the equipment, leaving 0.20 m free on each side and 0.50 m free in front		

12.3.7.- MONITORING AND FOLLOW UP PLAN (PMS)

This plan constitutes a technical document where the necessary actions are established to carry out a periodic evaluation of the environmental variables and their parameters to be monitored, in compliance with the current environmental legislation of Ecuador, with the purpose of reducing the socio-environmental impacts associated with the project.

<table>
<tr><th colspan="6">MONITORING AND FOLLOW UP PLAN
AIR QUALITY CONTROL PROGRAM</th></tr>
<tr><td colspan="5">OBJECTIVE: Ambient air quality parameters monitoring in order to identify possible negative impacts from emissions to the atmosphere and by high levels of sound pressure.
PLACE OF APPLICATION: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR
RESPONSIBLE: YILPORTECU S.A.</td><td>PMS-01</td></tr>
<tr><th>ENVIRONMENTAL APPEARANCE</th><th>IDENTIFIED IMPACT</th><th>PROPOSED MEASURES</th><th>INDICATORS</th><th>VERIFICATION MEASURE</th><th>FREQUENCY</th></tr>
<tr><td>AIR QUALITY</td><td>Air quality impact</td><td><u>AIR QUALITY MONITORING</u>
Quarterly monitoring of ambient air quality and noise levels in the area of operation should be done in order to determine if negative impacts have been generated to the environment.
Monitoring points are detailed below:
<table><tr><th>POINT</th><th>PLACE</th><th>COORDINATES (UTM-Datum WGS 84)</th></tr><tr><td>1</td><td>Pier APPB</td><td>X: 610951
Y:9639819</td></tr></table></td><td>Number of monitoring carried out / number of monitoring scheduled *100 = 100%</td><td>• Monitoring schedule
• Air Quality Monitoring Report
• Noise Monitoring Report
• Photographic records</td><td>Quarterly</td></tr>
</table>

Monitoring should be performed using the proper calibrated equipment, and following the established methodology in Annex 4 of Book VI of Unified Text of Secondary Legislation, Ministry of the Environment issued by Ministerial Agreement 097 - A.

NOISE MONITORING

Noise monitoring must be carried out by an Accredited Laboratory before the Ecuadorian Accreditation Service - SAE at the following points::

POINT	PLACE	COORDINATES (UTM- WGS 81)
1	Pier # 1	X: 610941 Y:9639369
2	Administrative area APPB	X:611136 Y: 9639401
3	Pier #5	X: 611014 Y: 9640135
4	Cabotage Pier Puerto Bolivar	X: 610892 Y:9639050

When measuring, the following should be taken into account:

- Identification of the source, name or company name, responsible and address.
- Location of the source
- Approximate location of the points of measurement
- Type of measurement performed
- Description of the measuring equipment used.

		- Technical personnel names who are performing measurement. - Date and time measurement was performed. - Observations detected. - Applicable corrections. - Noise emission level value. Monitoring must be carried out with calibrated equipment and following the established methodology in Annex 5 of Book VI, Unified Text of Secondary Legislation, Ministry of the Environment issued by Ministerial Agreement 097 - A. **Registration and analysis** A registration system should be established for all monitoring performed. In addition to evaluating results obtained and establishing new control measures, in case results do not comply with permissible limits established by current environmental regulations.			

MONITORING AND FOLLOW-UP PLAN WATER RESOURCE ENVIRONMENTAL QUALITY CONTROL PROGRAM					
OBJECTIVE: Monitor the water quality parameters, in order to identify possible negative impacts **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PMS-02**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
WATER QUALITY	Impact on water and sediment quality	**<u>WATER QUALITY MONITORING</u>** Monthly monitoring of control points established in the environmental baseline will be carried out; those will be compared with permissible limits of Chart 2. Admissible Quality Criteria for the preservation of aquatic and wild life in fresh, marine and estuaries waters of Annex 1 of Book VI; Unified Text of Secondary Legislation, Ministry of the Environment, issued by Ministerial Agreement 097 - A. Monitoring will be carried out according to the dredging works location that are being carried out at that time; otherwise, they will not be performed. Monitoring points are located in Santa Rosa estuary at different points described below:	Number of monitoring carried out / number of monitoring scheduled *100 = 100%	• Water Quality Report • Monitoring schedule • Sampling chains of custody • Photographic records	Monthly

POINT	PLACE	COORDINATES (UTM-WGS 84)
1	In front of the Port (Prof. 0.60 m)	X:610680 Y:9639902
2	Naval Academy Front '(Prof. 0.60 m)	X: 610682 Y: 9640521
3	Island of Love (Prof. ,0.60 m)	X:610505 Y: 9641879
4	Spa entrance	X: 611365 Y:964541S
5	El Coco (Prof. 0.60 m)	X: 608302 Y:9646721
6	Punta el Faro (Prof.0.60 in)	X: 609094 Y: 9642541

Monitoring parameters:

The parameters to monitor are the following:

- Arsenic
- Cadmium
- Total chromium
- Copper
- Iron
- Mercury
- Fecal Coliforms
- Surfactants-Detergents
- Oils and fats
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Total Petroleum Hydrocarbons
- Dissolved Oxygen in situ
- Ammonia
- Total Suspended Solids.
- Organophosphate pesticides
- Organochlorine pesticides

		• Organonitrogen Pesticides • Carbamates All water quality analyzes will be performed in laboratories SAE accredited. **<u>Sampling</u>** Taking water samples will be simple and timely. A sampling record sheet should be completed including the following information: - Responsible - Date, time and place. - Number of samples taken - Sample preservation method employee - Name of laboratory analyzing samples and name of the person in charge or in charge of the analysis and delivery of results - Name and signature of the person responsible for its transportation - Notes or observations - Date and signature of the samples received in laboratory. In addition, the use of suitable containers for taking samples will be verified. Samples can be collected in hermetic closure plastic containers for most parameters, however, quantification of COD (Chemical Oxygen Demand) and TPH (Total Hydrocarbons), requires the use of dark glass containers.			

		Registration and analysis A registration system should be established for all monitoring performed. Applying evaluations of results obtained and establishing new control measures, in the event such results do not comply with the permissible limits established by current environmental regulations. Sampling will be carried out on a monthly basis as long as the company operates the project. **Frequency** When dredging operations are in progress, monitoring will be performed on a monthly basis. Whereas when dredging operations are not carried out, monitoring will be quarterly.			

MONITORING AND FOLLOW-UP PLAN
SOIL ENVIRONMENTAL QUALITY CONTROL PROGRAM IN SEDIMENTS

OBJECTIVES:

• Monitor the quality of sediment, in order to identify possible negative impacts to the soil.

PLACE OF APPLICATION: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR

RESPONSIBLE: YILPORTECU S.A.

PMS-03

ENVIRONMENTAL APPEARANCE	IDENTIFIED IMPACT	PROPOSED MEASURES	INDICATORS	VERIFICATION MEASURE	FREQUENCY
SOIL SEDIMENTS	Impact on the quality of Soils and Sediments	**Monitoring Points:** Sediment monitoring will be carried out according to information gathering to establish project baseline. Sediment monitoring points are detailed below:	Number of monitoring carried out / number of monitoring scheduled *100 = 100%	• Sediment Analysis Report • Sampling chains of custody • Photographic records	Monthly

POINT	PLACE	COORDINATES (UTM WGS 84)
1	In front of the Port (Sediment 2 m>	6106S0 9639902
2	Naval Academy Front (Sediment 4 m)	610682 9640521
3	Love Island (Sediment 6 m)	610505 9641879
4	El Coco Spa Entrance (Sediment 2.5 m)	611365 9645418
5	P5 • Punta el Faro (Sediment 7 m)	608302 9646721
6	Jambeli Entrance (Sediment 8 m).	609094 9642541
7	Lochs of sediments	611860 9640136

Monitored parameters will be completed in accordance with the international standards provisions, such as the American standard, because Ecuador does not have regulations for this type of analysis.

The parameters to be monitored are the following:

		- Arsenic - Chromium - Cadmium - Copper - Iron - Mercury - Lead - Total Petroleum Hydrocarbons - Hydrogen potential - Organochlorine pesticides - Organophosphate pesticides - Organonitrogen Pesticides - Carbamates **Sampling**: YilportEcu or the consulting company to be hire, ill be responsible for coordinating sediment onitoring, and must have experience in taking amples, as well as follows protocols of accredited aboratory performing sample analysis. Analyzes must be carried out by an Accredited aboratory at Ecuadorian Service of Ecuador ccreditation. Results obtained from sediment analysis laboratory ill be compared with the Canadian regulations: Canadian Environmental Quality Guidelines **Frequency** When dredging operations are in progress, monitoring will be carried out on a monthly basis. Whereas when dredging operations are not carried out, monitoring will be quarterly.			

MONITORING AND FOLLOW-UP PLAN SHRIMP MORTALITY BIOASSAYS PROGRAM					
OBJECTIVES: • Determine the degree of toxicity of the suspended sediments from the simulated dredging of the Access channel in shrimp post larvae. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PMS-04**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
SOIL SEDIMENTS	Impact on the quality of Soils and Sediments	Across bioassays, the mortality of Litopenaeus vannamei shrimp post-larvae, produced by exposure of suspended sediments in concentrations of 10%, 50% and 100%, under conditions of laboratory with dredging simulation. **<u>Monitoring Points</u>:** Sediment monitoring will be carried out according to information gathering to establish project baseline. Sediment monitoring points are detailed below:	Number of monitoring carried out / number of monitoring scheduled *100 = 100%	• Analysis report • Photographic records	Monthly

POINT	PLACE	COORDINATES (UTM WGS 84)
1	In front of the Port (Sediment 2 m)	6106S0 9639902
2	Naval Academy Front (Sediment 4 m)	610682 9640521
3	Love Island (Sediment 6 m)	610505 9641879
4	El Coco Spa Entrance (Sediment 2.5 m)	611365 9645418
5	P5 • Punta el Faro (Sediment 7 m)	608302 9646721
6	Jambeli Entrance (Sediment 8 m).	609094 9642541

MONITORING AND FOLLOW-UP PLAN SATELLITE MONITORING PROGRAM OF THE OFFSHORE SEDIMENT DEPOSIT					
OBJECTIVE: Verify the final destination of dredged product deposited in authorized sites. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PMS-05**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
Water and Soil quality	Disposal of sediments from offshore dredging	Dredging product from maneuvering zone and Access Channel to Puerto Bolívar, will be taken to an offshore zone; vessels must have a satellite tracking system in order to monitor site of substrate arrangement.	100% of extracted material (sediments) deposited in a delimited area	• Compliance report of application of this measure, issued by the oversight • Ship / dredger route report	Monthly

MONITORING AND FOLLOW-UP PLAN PHYTOPLANKTON AND ZOOPLANKTON SPECIES MONITORING PROGRAM					
OBJECTIVE S: Determine conditions of phytoplankton and zooplankton in the project marine area of influence. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PMS-06**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
WATER	Affection of bioaquatic species Temporary removal of bioaquatic species during operations in the mouth area and phytoplankton and zooplankton amounts will be reduced temporarily, given the dynamics of the project.	Carry out control of phytoplankton and zooplankton amounts in the area of marine influence by taking samples. Periodic evaluation of this resource will be performed, preferably on quarterly bases. Measurements records will be kept and compared *vs* values obtained from project environmental baseline.	Number of monitoring carried out / number of monitoring scheduled *100 = 100%	• Monitoring Reports	Bimonthly

MONITORING AND FOLLOW-UP PLAN BIOAQUATIC SPECIES MONITORING PROGRAM					
OBJECTIVE S: Determine phytoplankton and zooplankton conditions in the marine area of influence of the project. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PMS-07**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
WATER	Affection of bioaquatic species Temporary removal of bioaquatic species during operations in the mouth area and phytoplankton and zooplankton amounts will be reduced temporarily, given the dynamics of the project.	Carry out bi-monthly monitoring of molluscs and crustaceans, in mangrove custody areas located within the project's area of influence: - Artisanal Fishing Production Cooperative - Vikings of the Sea - Estero Porteno Artisan Women Association - Community Organization of Tourist Services La Playita.	Number of monitoring carried out / number of monitoring scheduled *100 = 100%	• Monitoring Reports	Bimonthly

MONITORING AND FOLLOW-UP PLAN FLORA AND FAUNA MONITORING PROGRAM					
OBJECTIVE S: Determine planktonic and benthic flora and fauna conditions. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PMS-08**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
BIOTICS	Flora and fauna affectation	Planktonic and benthic Flora and Fauna monitoring will be carried out, reports of sightings of marine mammals and ichthyofauna in the high seas deposit area, including a monitoring point at the limit of the Santa Clara Island Marine Reserve.	Number of monitoring carried out / number of monitoring scheduled *100 = 100%	• Monitoring Reports	Bimonthly

MONITORING SCHEDULE

FREQUENCY	MONITORING AREA
Monthly	Study monitoring points approved (water and sediment)
Bimonthly	Bio-aquatic species (molluscs, crustaceans)
Bimonthly	Planktonic and benthic Flora and Fauna, sightings of marine mammals and ichthyofauna in the deposit area on the high seas reports, including a monitoring point at the edge of the Isla Santa Clara Marine Reserve

MONITORING AND FOLLOW-UP PLAN ENVIRONMENTAL CONTROL AND MONITORING PROGRAM					
OBJECTIVE S: Monitor compliance with the Environmental Management Plan through the inspection of the activities carried out in the project. **PLACE OF APPLICATION**: PIERS 1, 2, 3, 4, 5, 6, MANEUVERING ZONE AND ACCESS CHANNEL OF PUERTO BOLÍVAR **RESPONSIBLE:** YILPORTECU S.A.					**PMS-09**
ENVIRONMENTAL APPEARANCE	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEASURE**	**FREQUENCY**
MONITORING AND FOLLOW-UP OF ENVIRONMENTAL COMPONENTS (AIR, NOISE, SOIL, WATER) SOCIAL	Affecting the quality of air, water and soil Risk of accidents Impact on the Health and Safety of workers Solid waste generation Generation of atmospheric emissions Damage to machinery and equipment Social conflicts	**Environmental Supervision and Enforcement for actions fulfillment of the Environmental Management Plan** It constitutes a system of evaluation, follow-up and monitoring of measures and environmental programs contemplated in the PMA, in order to provide feedback and optimize environmental control and management processes. A monitoring matrix will be applied to monitor the occurrence, remediation and control of environmental impacts as well as the execution of proposed measures. This plan will allow obtaining records that facilitate correcting and optimizing measures implemented efficiency for identified impacts involved, as well as allowing control in the application of environmental measures and programs. YIPORTECU S.A. company, must contemplate hiring of a qualified consulting company and inspector of the Environmental Management Plan, which will be in charge	Measures completed / PMA measures *100 = 100%	• Monthly reports on compliance with PMA measures • Contract with the auditing company	Monthly

		of monitoring and control of environmental measures applied by the executing company.			

12.3 8.- AREA ABANDONMENT AND HANDOVER PLAN, PAE

The Abandonment Plan defines preventive measures for the gradual and organized abandonment of the area and progressive recovery until reaching the initial conditions of the project area.

AREA ABANDONMENT AND HANDOVER PLAN AREA CLOSURE, ABANDONMENT AND HANDOVER PROGRAM					
GOALS: To define future reconditioning and restoration measures aimed at reducing health and environmental risks. **IMPLEMENTATION SITE:** PIERS 1, 2, 3, 4, 5 AND 6, MANEUVERING AREA AND ACCESS CANAL TO PUERTO BOLIVAR **RESPONSIBLE PARTY:** YILPORTECU S.A.					**PAE-01**
ENVIRON. ASPECT	**IDENTIFIED IMPACT**	**PROPOSED MEASURES**	**INDICATORS**	**VERIFICATION MEANS**	**Frequency**
Protection of the environmental components (flora, fauna, soil, air, water)	Effects on flora, fauna, productive areas, soil, water, and socio-economic factors Soil pollution	Once dredging and project operation works have been completed, machinery, equipment and solid waste removal as well as pier cleaning will undergo verification procedures. Verification procedures will be conducted to confirm that the material was properly disposed of in the sediment disposal site (sedimentation basin). In addition, facility removal endeavors must consider implementing an inventory system for metallic structures and equipment. Once dredging endeavors have been completed, an environmental report will be issued on the realization of dredging operations at PIERS 1, 2, 3, 4, 5 AND 6, MANEUVERING AREA AND ACCESS CANAL TO PUERTO BOLÍVAR	100% Abandonment Plan fulfillment	▪ Abandonment Plan report ▪ Photographic record	Upon project completion

		In brief, the Abandonment Plan must contemplate two initial stages: 1. The first stage will be associated with the conclusion of all usage activities and will involve the following actions: – Dismantling of machinery, facilities and structures – Debris removal – Waste treatment based on their classification During dismantling, measures must be adopted to prevent noise and dust generation/propagation, and resulting liquid and solid waste must be properly disposed of; accident prevention steps must also be followed. 2. The next step entails the recovery of disturbed sites and includes the following activities: – Soil leveling and reconstruction – Area adaptation so that it can serve a new purpose before abandonment activities take place, a schedule must be prepared stating the activities that need to be implemented in the Abandonment Plan and			

		coordination with relevant authorities must be kept for the appropriate realization of the intended activities. **PREPARATION STAGES FOR THE CLOSURE AND ABANDONMENT PLAN** ▪ **Environmental inspection** The environmental inspection must identity: – Signs of soil pollution by solid waste; – Infrastructure conditions; – Use of soil and topography – Demolition and dismantling requirements, in addition to conducting an environmental sensitivity assessment and identifying polluting sources.			

13.- SCHEDULE OF VALUES FOR THE ENVIRONMENTAL MANAGEMENT PLAN

Table 268: Schedule of values for the Environmental Management Plan

SCHEDULE OF VALUES FOR THE ENVIRONMENTAL MANAGEMENT PLAN													
PLANS	**COMPLETION TERM**												**COST ESTIMATE**
	Mo. 1	**Mo. 2**	**Mo. 3**	**Mo. 4**	**Mo. 5**	**Mo. 6**	**Mo. 7**	**Mo. 8**	**Mo. 9**	**Mo. 10**	**Mo. 11**	**Mo. 12**	
MITIGATION AND PREVETION PLAN													
1. NOISE, VIBRATION AND GAS EMISSION CONTROL PROGRAM													**$4,800**
2. MITIGATION PROGRAM FOR IMPACTS ON MARSH WATER QUALITY													**$1,200**
3. PREVENTION AND MITIGATION PROGRAM													**$100**
4. PIPELINE PLANIMETRY PROGRAM													**$500**
5. DREDGE PREVENTION AND SAFETY PROGRAM													**$30**

SCHEDULE OF VALUES FOR THE ENVIRONMENTAL MANAGEMENT PLAN													
PLANS	**COMPLETION TERM**												**COST ESTIMATE**
	Mo. 1	**Mo. 2**	**Mo. 3**	**Mo. 4**	**Mo. 5**	**Mo. 6**	**Mo. 7**	**Mo. 8**	**Mo. 9**	**Mo. 10**	**Mo. 11**	**Mo. 12**	
6. VISUAL IMPACT PREVENTION PROGRAM													**$1,500**
7. OFFSHORE DISPOSAL SITE PROGRAM													**$1,000**
WASTE MANAGEMENT PLAN													
1. COMMON WASTE MANAGEMENT PROGRAM													**$200**
2. HAZARDOUS WASTE MANAGEMENT PROGRAM													**$2,000**
3. LIQUID WASTE MANAGEMENT PROGRAM													**$2,000**
ENVIRONMENTAL COMMUNICATION AND EDUCATION PLAN													
1. ENVIRONMENTAL COMMUNICATION, TRAINING AND EDUCATION PROGRAM													**$2,000**

SCHEDULE OF VALUES FOR THE ENVIRONMENTAL MANAGEMENT PLAN													
PLANS	**COMPLETION TERM**												**COST ESTIMATE**
	Mo. 1	**Mo. 2**	**Mo. 3**	**Mo. 4**	**Mo. 5**	**Mo. 6**	**Mo. 7**	**Mo. 8**	**Mo. 9**	**Mo. 10**	**Mo. 11**	**Mo. 12**	
COMMUNITY RELATIONS PLAN													
1. COMMUNITY RELATIONS PROGRAM													**$2,000**
2. SOCIAL INVOLVEMENT PROGRAM													**$1,500**
3. BACKFILL MATERIAL DONATION PROGRAM													**$1,000**
CONTINGENCY PLAN													
1. EMERGENCY AND CONTINGENCY RESPONSE PROGRAM RESPONSE PROGRAM													**$9,000**
2. FUEL HANDLING PROGRAM													**$1,000**
OCCUPATIONAL SAFETY AND HEALTH PLAN													
1. INDUSTRIAL SAFETY PROGRAM													**$7,000**

SCHEDULE OF VALUES FOR THE ENVIRONMENTAL MANAGEMENT PLAN													
PLANS	**COMPLETION TERM**												**COST ESTIMATE**
	Mo. 1	**Mo. 2**	**Mo. 3**	**Mo. 4**	**Mo. 5**	**Mo. 6**	**Mo. 7**	**Mo. 8**	**Mo. 9**	**Mo. 10**	**Mo. 11**	**Mo. 12**	
2. OCCUPATIONAL HEALTH PROGRAM													**$3,500**
3. PERSONAL PROTECTION EQUIPMENT PROVISION PROGRAM													**$3,500**
4. SAFETY SIGNS IMPLEMENTATION PROGRAM													**$2,000**
5. EXTINGUISHING AGENTS INSTALLATION PROGRAM													**$1,000**
MONITORING AND TRACKING PLAN													
1. AIR QUALITY CONTROL PROGRAM													**$3,000**
2. AMBIENT WATER QUALITY CONTROL PROGRAM													**$40,000**
3. SOIL QUALITY CONTROL PROGRAM AND													**36,000**

SCHEDULE OF VALUES FOR THE ENVIRONMENTAL MANAGEMENT PLAN													
PLANS	**COMPLETION TERM**												**COST ESTIMATE**
	Mo. 1	**Mo. 2**	**Mo. 3**	**Mo. 4**	**Mo. 5**	**Mo. 6**	**Mo. 7**	**Mo. 8**	**Mo. 9**	**Mo. 10**	**Mo. 11**	**Mo. 12**	
BIOESSAYS FOR DETERMINING SHIMP MORTALITY RATE													
4. SATELLITE MONITORING PROGRAM FOR THE OFFSHORE SEDIMENT DISPOSAL SITE													**$500**
5. MONITORING PROGRAM FOR PHYTOPLANKTON AND ZOOPLANKTON BIOAQUATIC SPECIES													**8,000**
6. MONITORING PROGRAM FOR BIOAQUATIC SPECIES (MOLLUSCA, CRUSTACEANS) IN MANGROVE SAFEKEEPING AREAS													**12,000**
7. MONITORING PROGRAM FOR PLANKTONIC													**20,000**

SCHEDULE OF VALUES FOR THE ENVIRONMENTAL MANAGEMENT PLAN													
PLANS	**COMPLETION TERM**												**COST ESTIMATE**
	Mo. 1	**Mo. 2**	**Mo. 3**	**Mo. 4**	**Mo. 5**	**Mo. 6**	**Mo. 7**	**Mo. 8**	**Mo. 9**	**Mo. 10**	**Mo. 11**	**Mo. 12**	
AND BENTHIC FLORA AND FAUNA, MARINE MAMMALS AND FISH SPOTTING AT OFFSHORE SEDIMENT DISPOSAL SITE													
8. ENVIRONMENTAL OVERSIGHT AND TRACKING PROGRAM													**48,000**
AREA ABANDONMENT AND HANDOVER PLAN													
1. CLOSURE AND ABANDONMENT PROGRAM													**$500**
TOTAL							**Two hundred thirteen** [*sic*] **thousand eight hundred and thirty**						**214830**

Prepared by: *Ecosfera Cía. Ltda. 2017*

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  - Anexo 1: Norma de Calidad Ambiental y de descarga de Efluentes Recurso Agua
  - Anexo 2: Norma de Calidad Ambiental del Recurso Suelo y Criterios de remediación para suelos contaminados
  - Anexo 3: Norma de Emisiones al Aire desde Fuentes fijas
  - Anexo 5: Niveles máximos de Emisión de Ruido y Metodología de Medición para fuentes fijas y fuentes móviles, y Niveles máximos de Emisión de vibraciones y Metodología de Medición

15.- ANNEXES

- **ANNEX 1:** Company's RUC (Tax I.D.), identification card and corporate name
- **ANNEX 2:** Company award
- **ANNEX 3:** Intersection certificate
- **ANNEX 4:** Terms of reference
- **ANNEX 5:** Thematic map
- **ANNEX 6:** Water Quality analysis reports
- **ANNEX 7:** Sediment analysis reports
- **ANNEX 8:** Ambient air quality report
- **ANNEX 9:** Noise monitoring report
- **ANNEX 10:** Report on determining median lethal concentration on shrimp larvae
- **ANNEX 11:** Bathymetric survey at piers, maneuvering area and offshore location
- **ANNEX 12:** Ecological research of the marine quadrant where the sediment disposal site of the access canal and maneuvering area of Puerto Bolívar are located.
- **ANNEX 13:** Oceanographic research and sediment disposal at the disposal site for the dredging of the access canal to Puerto Bolívar port terminal
- **ANNEX 14:** Glossary of terms

I, Miguel Angel Pantoja Shimanskii, certify that the present document consisting of 691 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 695 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.

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ENVIRONMENTAL IMPACT STUDY
DREDGING OF PIERS 1, 2, 3, 4, 5, and 6,
THE MANEUVERING AREA, AND THE ACCESS CANAL
TO PUERTO BOLIVAR

YILPORT®
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

ANNEX 1

RUC

INTERNAL REVENUE SERVICE (SRI IN SPANISH)

TAXPAYER IDENTIFICATION NUMBER
CORPORATIONS

TAXPAYER IDENTIFICATION NUMBER (RUC IN SPANISH):	**0992982047001**
BUSINESS NAME:	**YILPORT TERMINAL OPERATIONS YILPORTECU S.A.**
TRADE NAME:	YILPORT TERMINAL OPERATIONS
TYPE OF TAXPAYER:	SPECIAL
LEGAL REPRESENTATIVE:	Carlos Alberte CRUZ HERNÁNDEZ
ACCOUNTANT:	Gladys Victoria REDROBAN ANDRADE

DATE OF COMMENCEMENT OF ACTIVITIES:	July 29, 2016
DATE OF INCORPORATION:	June 30, 2016
FILING DATE:	July 29, 2016
UPDATE DATE:	September 8, 2017

MAIN ECONOMIC ACTIVITY:

Exploitation activities of terminal facilities such as ports

DOMICILE FOR TAX PURPOSES:

Province: EL ORO Canton: MACHALA Parish: PUERTO BOLÍVAR Citadel: PUERTO BOLÍVAR Street: AV. BOLÍVAR MADERO VARGAS Number: W/N Building: P. BOLÍVAR PORT AUTHORITY Location reference: INSIDE THE PUERTO BOLÍVAR PORT AUTHORITY Cellphone: 0987734139 E-mail: rafael.sapina@yilport.com.tr

SPECIAL ADDRESS:

TAX OBLIGATIONS:

- ANNNEX ON SHAREHOLDERS, PARTICIPANTS, PARTNERS, MEMBERS OF THE BOARD OF DIRECTORS AND ADMINISTRATORS
- ANNEX ON DIVIDENDS, PROFITS OR BENEFITS (ADI IN SPANISH)
- DEPENDENCY RELATIONSHIP ANNEX
- SIMPLIFIED TRANSACTIONAL ANNEX
- CORPORATION INCOME TAX RETURN

- WITHHOLDING TAX RETURN AT SOURCE
- MONTHLY VAT STATEMENT

Are taxpayers' rights: Treatment and confidentiality rights. Assistance or collaboration rights. Economic rights. Information rights. Procedural rights; for further information visit www.sri.gob.ec.

Individuals which capital stock, annual income or annual costs and expenses exceed the limits established in the Regulations for the Implementation of the Law on Internal Tax Regime are obliged to have accounting books, becoming withholding agents, they cannot enter the Simplified Regime (RISE) and their VAT statements shall be filed on a monthly basis.

Remember that your VAT statements may be filed on a semester basis provided that you are not obliged to have accounting books, transfer goods or provide services only with 0% rate of VAT and/or your sales with a rate different than 0% are subject to 100% withholding of VAT.

 # OF REGISTERED ESTABLISHMENTS: From 001 to 001 **OPEN:** 1
JURISDICTION: \ZONA 7\ EL ORO **CLOSED:** 0

Taxpayer's signature

Internal Revenue Service
(illegible signature) / Seal

I declare that the information contained herein is true and accurate; therefore, I bear the legal responsibility arising therefrom (Article 9, Tax Code, Article 9 of the Law on the Taxpayer Identification Number (RUC) and Article 9 of the Regulations for the Implementation of the Law on the Taxpayer Identification Number (RUC))

User: JFGN010607 **Date of issue:** GUAYAQUIL/AV. FRANCISCO **Date and time:** 2017/09/08 16:48:13

INTERNAL REVENUE SERVICE (SRI IN SPANISH)

TAXPAYER IDENTIFICATION NUMBER
CORPORATIONS

TAXPAYER IDENTIFICATION NUMBER (RUC IN SPANISH): **0992982047001**

BUSINESS NAME: **YILPORT TERMINAL OPERATIONS YILPORTECU S.A.**

REGISTERED ESTABLISHMENTS:

ESTABLISHMENT NUMBER: 001 **STATUS** OPEN PARENT OFFICE

DATE OF COMMENCEMENT OF ACTIVITIES: July 29, 2016

ECONOMIC ACTIVITIES:

Exploitation activities of terminal facilities such as ports

ESTABLISHMENT ADDRESS:

Province: EL ORO Canton: MACHALA Parish: PUERTO BOLÍVAR Citadel: PUERTO BOLÍVAR Street: AV. BOLÍVAR MADERO VARGAS Number: W/N Reference: INSIDE THE PUERTO BOLÍVAR PORT AUTHORITY Building: P. BOLIVAR PORT AUTHORITY Cellphone: 0995083333 E-mail: rafael.sapina@yilport.com.tr

Taxpayer's signature

Internal Revenue Service
(illegible signature) / Seal

I declare that the information contained herein is true and accurate; therefore, I bear the legal responsibility arising therefrom (Article 9, Tax Code, Article 9 of the Law on the Taxpayer Identification Number (RUC) and Article 9 of the Regulations for the Implementation of the Law on the Taxpayer Identification Number (RUC))

User: JFGN010607 **Date of issue:** GUAYAQUIL/AV. FRANCISCO **Date and time:** 2017/09/08 16:48:13

ENVIRONMENTAL IMPACT STUDY
DREDGING OF PIERS 1, 2, 3, 4, 5, and 6,
THE MANEUVERING AREA, AND THE ACCESS CANAL
OF PUERTO BOLÍVAR

ANNEX 2

Contract Awarding

ADMINISTRATIVE RESOLUTION No. 31- 2016

VICTOR VICENTE GUZMÁN BARBOTO, GENERAL MANAGER OF THE PUERTO BOLÍVAR PORT AUTHORITY

WHEREAS:

Article 66, Paragraph 25 of the Constitution of the Republic of Ecuador sets forth the right of the people to access to quality public and private goods, with efficiency, effectiveness, and proper treatment, as well as to receive adequate and truthful information about their content and characteristics;

Article 154 of the Constitution of the Republic of Ecuador states as follows: *"In addition to the powers established by law and that befall upon them, State Ministers must: 1.Govern the public policies under their area of jurisdiction and issue the necessary agreements and administrative resolutions for their administration...;"*

Article 227 of the Constitution of the Republic of Ecuador states that the Public Administration constitutes a service to the community that is governed, among others, by the principles of effectiveness, efficiency, hierarchy, decentralization, and coordination;

Article 314 of the Constitution of the Republic of Ecuador determines that the State shall be responsible for the provision of public drinking water and irrigation services, sanitation, electrical power, telecommunications, roads, port and airport infrastructures, as well as others determined by law;

Subsection two of the aforementioned article indicates that the State shall guarantee that public services and the provision thereof adhere to the principles of obligation, generality, uniformity, efficiency, responsibility, universality, accessibility, regularity, continuity, and quality. The State shall order public service prices and rates to be fair, and
shall determine the control and regulation thereof;

Subsection two of Article 316 of the Constitution of the Republic of Ecuador provides that the State may exceptionally delegate the exercise of activities in strategic sectors and public services to the private initiative and to the popular and solidarity economy in the cases established by law;

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Article 100 of the Organic Code of Production, Commerce, and Investment establishes the exceptionality set forth in the recital above, in accordance with the following text *"When necessary and appropriate, to satisfy the public, collective, or general interest, in the absence of technical or economic capacity or when the demand for the service cannot be covered by public or mixed companies, the State or its institutions may exceptionally, and duly decreed by the President of the Republic,* delegate the management of the strategic sectors and the provision of public electricity services, roads, port, airport, or railway infrastructures, and others to the private initiative or the popular and solidarity economy;"

Executive Decree No. 810, published in Official Record No. 494 of July 19, 2011, issued the Regulation for the Enforcement of the Exceptional Regime for the Delegation of Public Transport Services, which establishes the procedure to be followed so that the State, through its institutions and within the scope of its powers, can delegate the power to provide and comprehensively manage the public services in the transport sector, including others provided by road infrastructures, to private companies or the popular and solidarity economy;

Article two of the aforementioned Regulation indicates that the delegation of the power to provide and comprehensively manage public transport services is applicable, exceptionally and previously declared by the President of the Republic, when the highest authority of the delegating entity, through a justified resolution, based on specialized technical studies, demonstrates the opportunity, convenience, and technical-economic viability of such process, in accordance with Article 100 of the Organic Code of Production, Commerce, and Investment, in the following cases: *"1. When the need or convenience to satisfy the public, collective, or general interest via the modernization and development of infrastructure for the benefit and the integral management of transport and logistics services is justifiably proven;*"

The process of delegation of the Puerto Bolívar port public service is subject to the regime applicable to public-private associations, contained mainly in the Organic Code of Production, Commerce, and Investment, and Executive Decree No.) 582, published in RO. 453 of March 6, 2015;

On March 9, 2015, THE PUERTO BOLÍVAR PORT AUTHORITY received a private initiative proposal from YILPORT HOLDING NV, under the provisions of Article 6 of the Regulation for the Public-Private Collaboration Regime, contained in Decree No. 582, published in Official Record 453 of March 6, 2015;

On March 24, 2015, by means of notification No.-APPB-GG-0129, the General Management of the Puerto Bolívar Port Authority notifies YJLPORT HOLDING NV that the Private Initiative proposal "PUERTO BOLIVAR MODERNIZATION PROJECT" is of public interest for the Ecuadorian State;

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In the report of April 29, the corresponding units of the PUERTO BOLÍVAR AUTHORITY analyzed the private initiative proposal and determined the technical, economic, and legal viability of the proposal presented by YILPORT HOLDING NV, in compliance with the provisions of Articles 8, 9, and 10 of the Regulation of Public-Private Collaboration;

The President of the Republic, by Executive Decree No. 674 of May 12, exceptionally authorized the delegation of the public port service management of Puerto Bolívar to the private initiative, through a contractual modality defined by the granting entity, in accordance with Article 100 of Organic Code of Production, Commerce, and Investment;

By means of Official Letter APPB - GG-0257 of June 5, 2015, the General Management appointed the Technical Commission in charge to move forward with the public tender procedure;

Eng. Mariuxi Gálvez Vivar, President of the Technical Commission, as part of the preparatory stage, and as indicated in the respective notification of June 9, 2015, forwards the Specifications of the **PUBLIC TENDER FOR THE DESIGN, FINANCING, EQUIPMENT, EXECUTION OF ADDITIONAL WORKS, OPERATION AND MAINTENANCE OF THE PUERTO BOLÍVAR PORT TERMINAL** to the General Management
for their respective approval;

By means of **ADMINISTRATIVE RESOLUTION No. 66-2015** of **June 9, 2015**, this Management reached the following decision:

"... Article 1.- Authorize the start of the International Public Tender process for the DESIGN, FINANCING, EQUIPMENT, EXECUTION OF ADDITIONAL WORKS, OPERATION and MAINTENANCE OF THE PUERTO BOLÍVAR PORT TERMINAL, in accordance with the provisions of Article 100 of the Organic Code of Production, Commerce, and Investment, and Executive Decree No. 810 published in Official Record No. 494 of July 19, 2011.

Article 2.- Approve the specifications and the reference budget of (USD 611,220,000.00) SIX HUNDRED ELEVEN MILLION TWO HUNDRED TWENTY THOUSAND US DOLLARS AND 00/100, as well as a term of delegation of (37) years as of the signing of the contract.

Article 3.- Instruct the Technical Commission Secretariat to publish this Resolution, the specifications, the call for tender, as well as the documents generated in this procurement process in the official portal created for the publication of this process.

Article 4.- Inform the Undersecretary of Ports and Maritime and River Transport of the specifications and this Resolution for the corresponding registration thereof;"

The call for tender was published on APPB's (Puerto Bolívar Port Terminal) official web page on June 9, 2015, summoning national or foreign legal entities, associations, or consortia formed by them, legally capable to enter into contracts, to participate in Public Tender No. 001-2015-APP-APPB to choose the best bid for the **"DESIGN, FINANCING, EXECUTION OF ADDITIONAL WORKS, EQUIPMENT, OPERATION AND MAINTENANCE OF THE PUERTO BOLÍVAR PORT TERMINAL,"** in accordance with the administrative, technical, economic, and contractual terms approved by APPB's General Manager through Resolution No. 66-2015 of June 9, 2015;

On October 2, 2015, at 16h40, in APPB's meeting room, the only offer for the aforementioned call for tender is received from Dr. Vianna Maino, attorney-in-fact of **YILPORT HOLDING NV**; this submission took place within the term established in Amending Circular No. 5 of September 16, 2015;

On October 2, 2015, at 17h00, in a public hearing during the **BIDDER QUALIFICATION PHASE,** the Opening of Envelopes takes place, containing 1 Original envelope: Part A and B, and 3 Envelopes with copies of the original consisting of parts A and B; and that, after the time established in the bidding documents schedule for this tender, the Technical Selection Commission, upon verifying the checklist of the eligibility requirements presented, and with a favorable qualification of the submitted bid, hereby enables the Bidder to move on to the next phase.

On October 13, 2015, at 10h00 during the **TECHNICAL EVALUATION PHASE**, in a public hearing in APPB's meeting room, the opening of the Technical Bid Envelope takes place, containing 1 Original Envelope, 6 Envelopes with copies of the original, and 1 box containing Lay Out Drawings; and that, after the time established in the bidding documents schedule for this tender, the Technical Selection Commission, upon verifying the check list of the technical requirements presented, and with a favorable qualification of the submitted bid, hereby enables the bid to be subsequently reviewed by the Subcommittee;

The Technical Subcommittee, consisting of port equipment, infrastructure, and maintenance operations experts, presents Annex 14 corresponding to the Qualification of the Technical Proposal, with a rating of 100/100; however, the subcommittee adds a series of comments, recommendations, and conclusions to this qualification, which must to be considered by the Technical Commission at the time of entering the Negotiation and Award Phase.

On November 24, 2015, at 10h00 during the **ECONOMIC EVALUATION PHASE**, in a public hearing in APPB's meeting room, the opening of the Economic Bid Envelope takes place, containing 1 Original envelope; and that, after time established in the bidding documents schedule for this tender, and given that there is only one bidder, there was no need for tabulations or comparative tables to determine whether the minimum requirements are met, the Technical Commission hereby enables the bidder to move on to the next phase;

After the bid presented by YILPORT HOLDING NV for the **"DESIGN, FINANCING, EXECUTION OF ADDITIONAL WORKS, EQUIPMENT, OPERATION, AND MAINTENANCE OF THE PUERTO BOLÍVAR PORT TERMINAL"** has passed each of the phases

set forth in the specifications of the tender in question, the Technical Selection Commission summons the Bidder to the final phase of Negotiation and Award;

The Memorandum of Understanding of February 04, 2016, entered into between the Minister of Transport and Public Works - Eng. Walter Solis; the General Manager of the Puerto Bolívar Port Authority - Dr. Vicente Guzman, and the President of Yilport Holding NV - Robert Yildirim, established the purpose of taking the corresponding actions under the framework of the Ecuadorian Legislation to carry out the final phase of the design, financing, equipment, execution of additional works, operation and maintenance of the Puerto Bolívar port terminal, based on the background indicated in said document, and in accordance with the applicable legal regime.

That the Technical Selection Commission of the **PUBLIC CALL FOR TENDER FOR THE "DESIGN, FINANCING, EXECUTION OF ADDITIONAL WORKS, EQUIPMENT, OPERATION, AND MAINTENANCE OF THE PUERO BOLÍVAR PORT TERMINAL,"** in accordance with the criteria and considerations contemplated in the Technical Specifications, whose results and details are included in the **FINAL EVALUATION REPORT** of November 30, 2015, and once the **NEGOTIATION PHASE** has concluded, where the observations of the technical review have been acquitted or ratified, including the relevant aspects of the proposed improvements; and in accordance with Paragraph e) of Clause 18 "Negotiation and Award," and with unanimous criteria in the **NEGOTIATION AND AWARD REPORT** of February 22, which recommends the Manager of the Puerto Bolívar Port Authority to issue the Award Resolution of the public tender to the YILPORT HOLDTNG NV;

- In exercising the powers granted by the Constitution of the Republic of Ecuador, the Organic Code of Production, Commerce, and Investment, The Law on the National Administrative Port Regime Art. 12 and 13 Paragraph a), and Executive Decree No. 674, of May 12, 2015:

HEREBY RESOLVES:

Article 1.- To award the **PUBLIC TENDER FOR THE "DESIGN, FINANCING, EXECUTION OF ADDITIONAL WORKS, EQUIPMENT, OPERATION, AND MAINTENANCE OF THE PUERTO BOLÍVAR PORT TERMINAL"** to YILPORT HOLDING NV, in the amount of **SEVEN HUNDRED FIFTY MILLION DOLLARS (USD 750'000,000.00),** financed partly by the foreign investor, with a term of execution of 50 years as of the signing of the contract.

Article 2.- The General Management, with support from the corresponding Departments and Units, if necessary, shall prepare the minutes including the conditions established in the bidding specifications for said purpose and the subject matters agreed in the corresponding negotiation.

Article 3.- The General Management, together with the legal representative of the Ecuadorian company to be set up by **YILPORT HOLDING NV**, in compliance with the bidding specifications, shall sign the contract within the deadlines established in the specifications.

Article 4.- The current bid bond shall remain under the custody of the entity until the signing of the contract, for which the Treasurer of the entity, who is the custodian thereof, shall proceed to return it upon receiving the notification of the duly legalized contract.

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Article 5.- The award resolution shall be notified to the private bidder at the email address indicated for said purpose: **vianna.maino@gmail.com;** and it shall also be published on the webpage of the Puerto Bolívar Port Authority, in the official site of the tender under this Resolution;

DULY NOTIFY.-

Issued and signed in the Office of the Manager General of the Puerto Bolívar Port Authority on February 24, 2016.

Space for signature

DR. VÍCTOR VICENTE GUZMÁN BARBOTO
GENERAL MANAGER

I HEREBY CERTIFY that this Resolution was issued and signed by DR. VÍCTOR VICENTE GUZMÁN BARBOTÓ, General Manager of the Puerto Bolívar Port Authority, on February 24, 2016.

Space for signature

MGS. ELAINE RAMÓN MONTENEGRO
SECRETARY GENERAL

ENVIRONMENTAL IMPACT STUDY
DREDGING OF PIERS 1, 2, 3, 4, 5, and 6,
THE MANEUVERING AREA, AND THE ACCESS CANAL
TO PUERTO BOLIVAR

YILPORT PUERTO BOLIVAR

ECOSFERA CONSULTORA AMBIENTAL

ANNEX 3

Certificate of Intersection

MAE-SUIA-RA-DPAEO-2017-207553
MACHALA, Thursday, April 20, 2017

Dear Proponent
SAPIÑA GARCÍA RAFAEL BERNARDO
GENERAL MANAGER
YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.
Hand delivered

CERTIFICATE OF INTERSECTION WITH THE NATIONAL SYSTEM OF PROTECTED AREAS (SNAP), THE STATE FOREST HERITAGE (PFE), AND PROTECTION FORESTS AND VEGETACTION (BVP), FOR THE FOLLOWING PROJECT:

DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANEUVERING AREA, AND THE ACCESS CANAL TO PUERTO BOLÍVAR LOCATED IN THE PROVINCE OF (EL ORO)

1.- BACKGROUND INFORMATION

With the purpose of obtaining the Certificate of Intersection with the National System of Protected Areas (SNAP), the State Forest Heritage (PFE), and Protection Forests and Vegetation (BVP), YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A., in its capacity as proponent of the project, work, or activity, hereby requests this State Agency to issue the Certificate of Intersection for the following project: DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANEUVERING AREA, AND THE ACCESS CANAL TO PUERTO BOLÍVAR LOCATED IN THE PROVINCE OF (EL ORO).

2.- ANALYSIS OF THE DOCUMENTATION PRESENTED

The Proponent submits the information of the project, work, or activity in UTM coordinates using in the DATUM reference system: WGS-84 Area 17 South, which is automatically overridden by the Single Environmental Information System (SUIA) with the official geographic coverage of the National System of Protected Areas (SNAP), the State Forest Heritage (PFE), and Protection Forests and Vegetation (BVP) of the Ministry of the Environment.

Based on the automatic analysis of the information using the SUIA System, it has been determined that the project, work, or activity related to the DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANEUVERING AREA, AND THE ACCESS CANAL TO PUERTO BOLIVAR, located in the Province of (EL ORO), **DOES NOT INTERSECT** with the National Area of Protected Areas (SNAP), the State Forest Heritage (PFE), and Protection Forests and Vegetation (BVP).

3.- AUTOMATIC CERTIFICATE OF INTERSECTION

Ministerial Agreement No. 389 of December 8, 2014 establishes that the National Director for the Prevention of Environmental Pollution shall sign all National Certificates of Intersection.

4.- CATALOGUE OF PROJECTS, WORKS, OR ACTIVITIES:

Based on the information sent by YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A., in its capacity as Proponent of the project, work, or activity, and in accordance with the Catalogue of Project, Works, or Activities issued by means of Ministerial Agreement No. 061 of May 04, 2015, published in Official Registration No. 316 of Monday, May 04, 2015, the following has been determined:

41.01.15 THE CONSTRUCTION AND/OR OPERATION OF THE CONSTRUCTION WORK FOR THE DREDGING OF RIVER AND/OR SEA SOURCES corresponds to: **ENVIRONMENTAL PERMIT.**

5.- PROJECT CODE: MAE-RA-2017-297974

The process of Environmental Regularization for your project must continue at the PROVINCIAL DIRECTORATE OF EL ORO, located in the Territorial Jurisdiction of the Province

Sincerely,

ENVIRONMENTAL ENGINEER VIELKA CRISTINA ALTUNA ALVAREZ
NATIONAL DIRECTOR FOR THE PREVENTION OF ENVIRONMENTAL POLLUTION, ALTERNATE

I, SAPIÑA GARCIA RAFAEL BERNARDO, holder of identity card PAC333385, hereby declare under oath that the information entered corresponds to reality and I understand the responsibility entailed in providing or concealing false or erroneous information, in accordacen with the provisions of Articl2 255 of the Organic Integral Criminal Code, which states as follows: Falsehood or concealment of environmental information.- Any person that issues or provides false information or conceals relevant information for the issuance and granting of environmental permits, environmental impact studies, audits, and environmental diagnoses, or permits or licenses for forest use that lead the environmental authority to commit an error, shall be punished with a custodial sentence of one to three years.

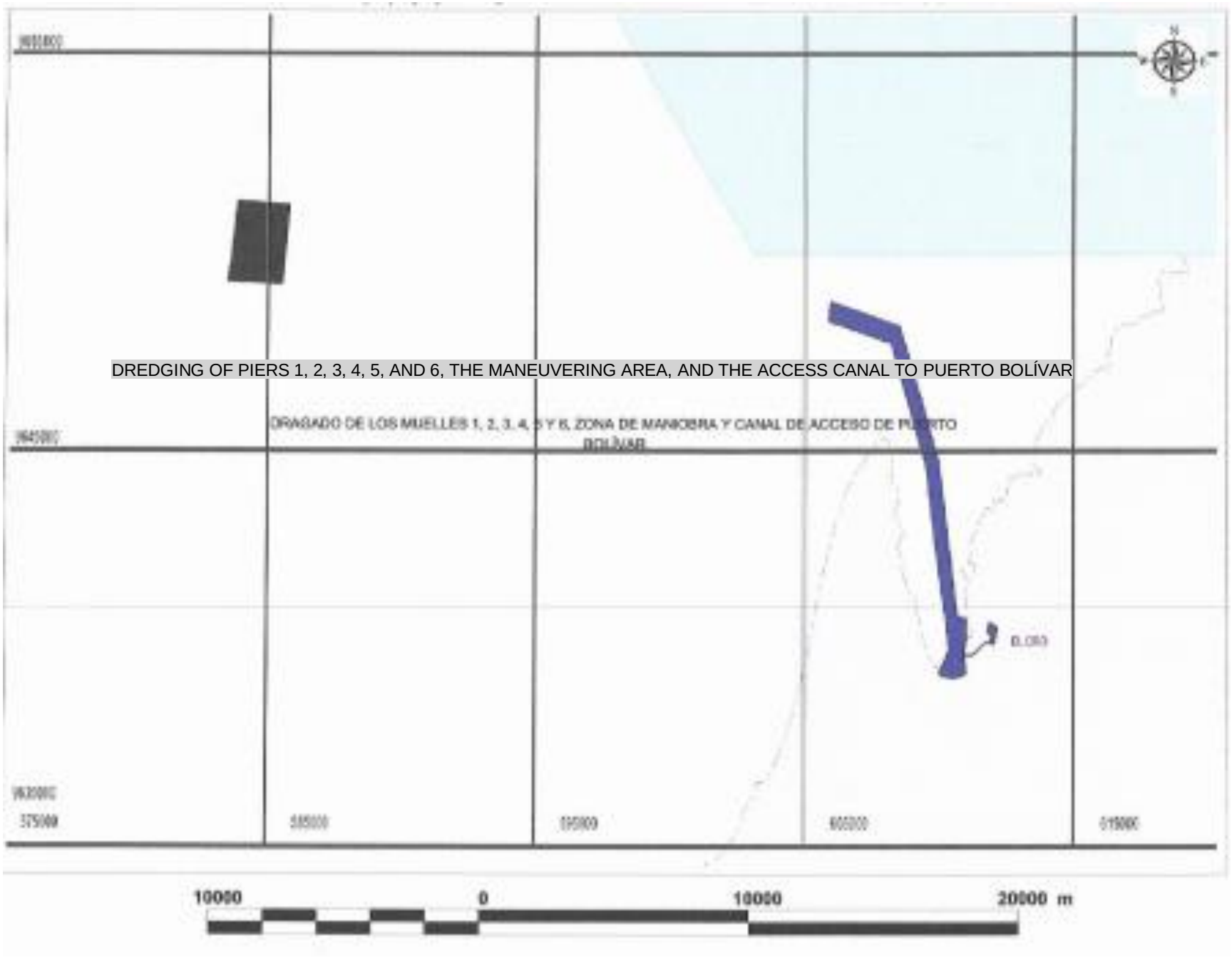
Ministerio del Ambiente

Sincerely,
SAPIÑA GARCÍA RAFAEL BERNARDO
PAC333385

Calle Madrid 1159 y Andalucía
Quito – Ecuador
Postal Code: 170109
Telephone: (593 2) 3987-600
www.ambiente.gob.ec

ENVIRONMENTAL IMPACT ASSESSMENT
CERTIFICATE OF INTERSECTION

DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANEUVERING AREA, AND THE ACCESS CANAL TO PUERTO BOLÍVAR



LOCATION SKETCH

THEMATIC LEGEND

- Protection forests
- Intangible areas
- Parque Nacional
- Parque Nacional
- Refugio de Vida Silvestre
- Reserva Biológica
- Reserva Ecológica
- Reserva Geobotánica
- Reserva Marina
- Reserva de Producción de Fauna
- Área Nacional de Recreación

SNAP

- Yasuni Buffer Zone State
- Forest Heritage Quebradas
- Vivas Decentralized
- Autonomous Subsystem
- Ramsar area
- Ramsar point
- DREDGING OF PIERS 1, 2, 3
- DREDGING OF PIERS 1, 2, 3

DATUM:
Universal Transverse Mercator Projection
WGS-84 Area 17 South

SCALE:
1:125000

NATIONAL DIRECTORATE FOR THE PREVENTION OF ENVIRONMENTAL POLLUTION

ANALYSIS OF THE INFORMATION

The project:
Does not intersect with Protection Forests.
Is not within Intangible areas.
Does not intersect with SNAP.
Is not within the Yasuní Buffer Zone.
Does not intersect with the State Forest Heritage.
Does not intersect with the Decentralized Autonomous Subsystem.
Does not intersect with Quebradas Vivas.
Does not intersect with the Ramsar area.
Does not intersect with the Ramsar point.

INFORMATION SUBJECT TO FIELD VERIFICATI

SOURCE OF CARTOGRAPHIC INFORMATION

BASE CARTOGRAPHY	Topographic Maps Geographic Institute Military I.G.M. Scale 1:50,000
THEMATIC CARTOGRAPHY	National System of Protected Areas, Protection Forests and State Forest Heritage. MINISTRY OF THE ENVIRONMENT

Generated by: S.U.I.A.

Date prepared: Thu, April 20, 2019

ENVIRONMENTAL IMPACT STUDY
DREDGING OF PIERS 1, 2, 3, 4, 5, and 6,
THE MANEUVERING AREA, AND THE ACCESS CANAL
OF PUERTO BOLÍVAR

ANNEX 4

Terms of Reference

MINISTRY OF THE ENVIRONMENT

UNDERSECRETARY OF ENVIRONMENTAL QUALITY (SCA)

STANDARD TERMS OF REFERENCE FOR ENVIRONMENTAL IMPACT ASSESSMENT: OTHER SECTORS

w

MINISTRY OF THE ENVIRONMENT

STANDARD TERMS OF REFERENCE FOR ENVIRONMENTAL IMPACT ASSESSMENT – OTHER SECTORS

OVERVIEW

Terms of Reference (TOR) are preliminary documents that determine the content, scope, focus, methods and techniques to apply in preparing environmental studies. Terms of reference for completing the environmental study will be available online at Single Environmental Information System (Sistema Único de Información Ambiental – SUIA) for promoters of the project, work or activity; the Competent Environmental Authority will focus the studies based on the activity being regularized.

The process of regularizing activities is effectuated at the level of definitive studies, i.e., viability and/or relevant permits that may be required in advance by the Sector Authority (e.g. Ministry of Electricity and Renewable Energy/ARCONEL[1], SENAGUA)[2].

The following TOR defined apply to **environmental studies** of projects, works or activities:

- Agricultural
- Construction
- Industries
- Services

The proponent shall continue the environmental regularization process for the Environmental License as provided under current environmental law.

Sections that must be included in the Environmental Impact Assessment (EIA) generally are:

- Executive Summary
- Datasheet
- Acronyms and Abbreviations
- Introduction
- Legal and Institutional Framework
- Definition of Study Areas
- Environmental Analysis - Baseline
- Project, Work or Activity Description
- Alternatives Analysis
- Determination of the Area of Influence
- Forest Inventory
- Impact Identification and Assessment
- Risk Analysis
- Environmental Management Plan (EMP)
- EMP Estimated Timeline
- Appendixes
  Glossary of Terms Reference
  Bibliography

Generally, the environmental impact assessment (EIA) must identify and address:

- Applicable environmental regulations, standards and requirements provided at international, national, regional and/or local levels, including those designed to meet resource management objectives and/or the land use plans that may be in effect and in the surroundings of the jurisdiction(s) where the project is expected to be developed that could have a potential impact.

[1] TN: Electricity Regulation and Control Agency (Agencia de Regulación y Control de Electricidad – ARCONEL)
[2] TN: National Water Department of the Republic of Ecuador (Secretaría Nacional del Agua de la República del Ecuador – SENAGUA Ecuador)

- Failing such legislation, a set of reference points must be identified that can be used in the analysis and the basis for their selection.

- Concerns of the public and stakeholders relating to the impacts in and around the project and alternatives for stakeholders within the scope of the potential impact.

- Project promoters must document the specific steps taken to commit to the public and other stakeholders so that they acquire the commitment as soon as possible prior to preparing the Environmental Impact Assessment (EIA).

- Include in the public involved: local governments, people living and working in project surroundings, those whose interests in the resources may be affected, e.g., indigenous peoples and those safeguarding protected areas, agricultural land and water resources.

- All plans related to the proposed activity, for example, restoration and rehabilitation plans, closure plans, mitigation plans and others within the general environmental management plan.

- All project phases, from technical viability studies to preparing the terrain for closure operations as well as plans to expand the capacity of current or adjacent sites.

- Alternative approaches to comply with the purpose and need for the proposed project during the construction phase, including search for an alternative site, site configuration, design, construction to identify, avoid, reduce or mitigate negative impacts or to improve positive environmental or socioeconomic impacts.

- The Environmental Impact Assessment (EIA) must evaluate the impacts of a range of representative and technically viable and reasonable alternatives (at least 2) as well as the project proposal. Project alternatives must include a “No Action” alternative indicating what would happen in the absence of the proposed project, in addition to the range of alternatives indicated above.

- Cleaner production practices and best practices must be considered as an alternative.

- Direct, indirect and cumulative impacts and assessments

- Uncertainty and how it is addressed through the monitoring and contingency plans that may be necessary to reduce the risk of future adverse effects.

- Specific commitments, including the person responsible for each, what will be done, when and how they will be monitored, reported and audited to confirm that commitments are met.

General Objectives

- Comply with the provisions of applicable Environmental Regulations.
- Prepare the Environmental Impact Assessment and Environmental Management Plan described in currently effective environmental legislation and other laws applicable to the project.

Specific Objectives

- Establish methodologies to determine current socio-environmental conditions of the place where the project will be carried out.
- Develop the environmental analysis of the project, work or activity study area.
- Incorporate methodological criteria to characterize the Biotic Component.
- Include the Biotic Component design methodology with technical and literature support to be used in gathering the information (qualitative and quantitative inventories), sampling points, location, size, number and sampling effort, etc.
- Identify possible socio-environmental impacts on environmental components that could arise because of project development.
- Determine the areas of direct and indirect influence as well as sensitive areas that could be affected by possible environmental impacts of the project, work or activity proposed.
- Perform the alternatives analysis of new infrastructure to be emplaced.

- Identify risks for both environment-to-project and project-to-environment (endogenous and exogenous).
- Formulate an Environmental Management Plan for the project in order to avoid, minimize or compensate possible environmental impacts identified in the project.

DEVELOPMENT OF THE TERMS OF REFERENCE

The Environmental Impact Assessment will include the following points that must be completed by an accredited, certified and registered environmental consultant as provided in legislation.

- Executive Summary
- Datasheet
- Acronyms and Abbreviations
- Introducción
- Legal and Institutional Framework
- Definition of the study area
- Baseline Environmental Analysis
- Project, Work or Activity Description
- Alternatives Analysis
- Determining the Area of Influence
- Forest Inventory
- Impact Identification and Assessment
- Risk Analysis
- Environmental Management Plan (EMP)
- EMP Estimated Timeline
- Appendixes
  Glossary of Terms
  Reference Bibliography

EXECUTIVE SUMMARY

The Executive Summary is a synthesis or summary that favors broad understanding of the results obtained in the study and that contains the most relevant, easily used information for reviewers of works, projects or activities as well as critical problems, description of negative and positive impacts, principal environmental management measures and strategies, and sources of information used.

The content of the Executive Summary must be entered into the specific text field of the Single Environmental Information System (SUIA in Spanish) with no more than 2000 characters (approximately 2 pages).

1. DATASHEET

Information from the datasheet will take the data entered during project registration, so it is suggested that the activity promoter pay attention to the validity and truthfulness of the information entered so that the process continues problem-free during the ensuing steps of the regularization process.

The updated list of environmental consultants certified by the Ministry of the Environment will be displayed to confirm the environmental consultant in the SUIA system, and the consultant responsible for the project will be selected.

Complete the fields established in the system corresponding to the consultant team that participated in preparing the study. Also, upload into the system the team participating with the firm responsible.

Based on the following table, provide the list of the team that participated in preparing the study:

Names and Surnames	Professional Training	Component of the study participated in (physical, biotic, socioeconomic and cultural, etc.)

2. ACRONYMS AND ABBREVIATIONS

All acronyms and abbreviations in the study must be clearly defined and described in this section. This will avoid the reader having to look up words and acronyms or abbreviations in the text. It shall be a document attachment of no more than 2 pages.

3. INTRODUCTION

This section shall explain the conceptual framework of the study as well as a description of the overall content and its different sections, the methodology used to collect primary and secondary information, sampling procedure and its relationship with environmental studies performed for previous phases, if any.

A maximum of 2500 characters of text (approximately 1 page) may be included in the SUIA field.

4. INSTITUTIONAL AND LEGAL FRAMEWORK

The applicable legal framework will be automatically displayed in the SUIA system depending on the project, work or activity, which must be accepted by the proponent in its respective terms and conditions.

Notwithstanding indications on developing the study, the project shall take into account works or activities to be performed, the particular environment and characteristics, and the measures to be adopted, which will involve analysis of applicable environmental legislation, standards and requirements established at international, national, regional, and/or local levels as well as those designed to meet the resource management objectives, among others.

5. DEFINITION OF THE STUDY AREA

The study area includes the area set out in the intersection certificate wherein the project, work or activity will be emplaced; however, it must be understood that the information analysis and collection shall include specific activities to be emplaced, administrative political units and hydrographic systems.

Thus, the project promoter must be meticulous with the geographic coordinates entered and the geographic scope for collecting baseline information so that the process may continue without problems in ensuing steps of the regularization process and later monitoring and control as well as the possible inclusion of complementary activities, as provided in Article 19 of Book VI of the Unified Text of Secondary Legislation from the Ministry of the Environment, which was issued under Ministerial Resolution No. 061 published in Official Register No. 316 dated May 04, 2015 and/or applicable legislation.

The SUIA system field allows a maximum 4000 characters (approximately 1 page) where the analysis of elements for collecting baseline information is considered; i.e. the area of the intersection certificate versus the project activities and infrastructure to be emplaced, administrative political units and hydrographic systems.

6. ENVIRONMENTAL ANALYSIS – STUDY AREA BASELINE

The environmental characterization must include the description of the physical, biotic, and socioeconomic and cultural media under minimum methodological criteria that are described in this document.

Each component's determination will depend on the type of project, work or activity. If any do not apply, the grounds for not characterizing any of them will be justified technically in a well-reasoned manner.

The promoter of the activity will attach the characterization of the study and the analysis of the study area to the system and enter the monitoring information on the different components collected in the field into the SUIA system (primary information).

The study document attached to the system must include references and literature sources of secondary information used in the analysis and diagnosis carried out and the literature citations and references for the methodologies employed in collecting primary information.

The system will digitize only (primary) information collected in the field. If the project, based on its characteristics, does not merit collection of primary information, there must be technical justification for the component(s).

6.1 PHYSICAL ENVIRONMENT

Characterization of the physical environment must include the following:

- **Methodology:** The methodology employed in collecting primary and secondary information must be described along with the technical criteria for selecting the number and location of sampling sites and number of samples; physiochemical parameters to be analyzed (on- and off-site); detailed methodology for collecting, transporting and preserving samples; accredited laboratories that perform the sample analysis; equipment and personnel necessary to survey the physical aspect; analytic and instrument techniques used by the laboratory. The methodology shall take into account the terms of the standards attached to Book VI of the Unified Text of Secondary Legislation of the Ministry of the Environment and where appropriate, the standards issued by the Ecuadoran Standardization Service.
- Environmental components that must be characterized include: Geology and Geomorphology, Soil, Climate and Weather, Air Quality, Noise, Hydrology, Flora, Fauna, Social Environment, and Cultural Heritage.

Following is a proposed analysis:

Environment	Scope	Observations
PHYSICAL	**Water Resource** * Overall hydrography * Surface and subterranean hydrology * General status and current hydrographic handling (hydroelectric projects) * Water bodies: width, depth, speed, flow * Multi-annual and seasonal average, maximum, minimum flows (hydroelectric projects and those using the resource) * Water quality * Estimate of ecological flow (hydroelectric projects or those using the resource) * Flood pattern * Main uses of water that will be affected	All details established by the regulations of the competent sector authority will be taken into account. Tidal power generation projects will take monitoring of interest in regard to the ocean resource into account as provided in the applicable technical standard. For ex post studies, discharge monitoring must be added to the above-indicated details as well as results of compliance with maximum allowable limits set out in applicable law and regulation.
	Climate • Climate classification • Climate parameters of interest: precipitation, temperature, heliophany, wind speed and direction, evapotranspiration, others.	Isolinear and other maps may be included to illustrate the spatial distribution of principal climate parameters.

Environment	Scope	Observations
	Soil Resource • Geology • Geomorphology • Soil stability (Geotechnics) • Sources of material (Quarries) • Current land use, potential land use • Areas that are under some special territorial zoning regime	All details established by the regulations of the competent sector authority will be taken into account.
	Air Resource • Quality (general estimate) • Noise • Non-ionizing radiation (in case of high voltage power lines)	For ex post studies, gas emission monitoring must be added to the above-indicated details as well as results of compliance with maximum allowable limits set out in applicable law and regulation

Results: The results must be shown using graphics, tables, maps, etc., analyzing the results of sampling for each physical component and comparing laboratory analysis results and analysis of the maximum allowable limits established under applicable environmental regulations for water, air and soil quality.

- **Conclusions:** Individual conclusions on their physical environment must be presented.
- **Appendixes:** All appendixes must be presented which show all the above-mentioned and all that may be necessary to establish the baseline, for example: sampling point location maps, laboratory analysis, certificates accrediting the parameters and laboratories engaged for sample analysis, climate yearbooks used, maps of results (slopes, geomorphology, watershed, etc.), maps of areas of influence, maps of sensitive areas, chains of sample custody, etc.
- In addition, literature citations must be included with their sources in the bibliography chapter.

Notwithstanding preparation of the study document, the following fields will be completed in the SUIA system:

Project Study Area characterization and analysis

- Precipitation
- Temperature
- Humidity
- Wind speed and Evapotranspiration

The minimum, average, maximum and source must be indicated for each one using no more than 250 characters.

Water Bodies

- Category (Lentic or Lotic)
- Name
- Sample location: Coordinates (UTM, WGS 84): At least 2 points
- Width
- Depth
- Speed
- Flow
- Use

Physical Mechanical Soil Characteristics

- Code
- Sample location: Coordinates (UTM, WGS 84)

- Relative Humidity
- Liquid limit
- Plastic limit
- Plasticity index
- Clay
- Silt
- Sand
- Gravel
- Specific gravity

Chemical characteristics of the soil

- Sample location: Coordinates (UTM, WGS 84)
- Consideration of land use
- Parameters according to applicable environmental regulations and characteristics of the activity
- Accredited Laboratory

Waste identification

- Hazardous and/or special waste
- Solid waste

Water Quality

- Name of water body
- Sample location: Coordinates (UTM, WGS 84)
- Consideration of water use
- Parameters according to applicable environmental regulations and characteristics of the activity
- Accredited laboratory

Note: For ex post studies, also consider discharge monitoring and allowable limits.

Air Quality

- Sample code
- Sample location: Coordinates (UTM, WGS 84)
- Parameters according to applicable environmental regulations
- Accredited laboratory

Note: For ex post studies, also consider emission monitoring and allowable limits according to the regulations.

Sound pressure level

- Sample code
- Sample location: Coordinates (UTM, WGS 84)
- Parameters according to applicable environmental regulations
- Accredited laboratory

Non-ionizing Radiation (In the case of High Voltage Transmission Lines)

- Sample code
- Sample location: Coordinates (UTM, WGS 84)
- Description of sampling site
- Parameters and allowable limits according to environmental regulations

6.2 BIOTIC ENVIRONMENT

The following will be considered in characterizing the biotic environment, including flora and fauna.

Environment	Scope	Observations
BIOTIC	**Flora** • Ecosystem characteristics and representativeness • Existing vegetation formations • Flora and fauna location, extent and abundance • Endangered species **Fauna** • Zoogeographic floors • Fauna location, extent and abundance **Land Fauna** • Mastofauna (mammals) • Avifauna (birds) • Herpetofauna (reptiles and amphibians) • Entomofauna (insects) • Endangered species under the IUCN list and Ecuador's Red Book	Illustrate ecosystem and vegetation formations with corresponding thematic maps The information referring to ecosystems and vegetation coverage will automatically be generated based on the coordinates of the intersection certificate. Field samples will be required for the land flora and fauna description, especially if important and protected, endangered or endemic species are identified. Ecological aspects of each component of the biotic environment must be included. Sampling techniques such as trapping, direct visual observation and local interviews, among others will be used for the inventory.
	Hydrobiological Resources • Aquatic biology (ichthyofauna, aquatic macro-invertebrates)	Field samples are required, especially if important and protected endangered or endemic species are identified. Ecological aspects of each component of the biotic environment must be included. Sampling techniques such as trapping, direct visual observation and local interviews, among others, will be used for the inventory. Emphasis for hydroelectric or tidal power station projects and those that apply.
	Biodiversity and Endemism • In affected areas pertaining to: Intangible Zones, National Protected Area System (SNAP in Spanish), Protective Forest and Vegetation	

Environment	Scope	Observations
	and Fragile Ecosystems (paramos, wetlands and mangroves)	

In characterizing the biotic environment, attention must be paid to previous requirements and permits: Research Permit to collect and take samples for biotic studies; Permit to move wild specimens, and sample deposit certificate granted by Holding Centers authorized by the Ministry of the Environment, etc.

The information of this component will be attached in the SUIA system. In addition, the forms established in the system will be downloaded; an analysis of the scope of the research permit obtained will be described in the text field. Finally the deposit certificate for the samples will be attached, which may not exceed 15 MB.

Flora

Methodology: The methodology used must be described in detail, including the literature review (secondary information) and field visits (primary information). For the latter, qualitative and quantitative inventories will be taken. The following must be included for both samplings: sampling method (e.g. transect, parcel, other) and technical justification for the choice, sampling date, sampling site, sampling point, UTM WGS84 Zone 17S coordinates (for transects, the starting and ending coordinate must be included, and 4 coordinates for parcels), altitude, description of the area, and sampling effort. The latter point is important since it indicates the number of people and hours dedicated to collecting the information.

The following indices and parameters and their respective analyses must be included for quantitative sampling: basal area (AB), biomass (V=LxAB), relative density (DnR), relative dominance (DmR), importance value indices (IVI), richness and abundance analysis, Shannon-Wiener diversity index, Simpson diversity index, Chao index, flora species abundance curve, floristic structure and composition, and dominant floristic groups.

Results: Characterization of flora must contain a classification of vegetation units according to the proposal of the Ministry of the Environment (MAE in Spanish) ecosystem map and the 1999 Sierra classification, determining species habit (herbaceous, shrub, arboreal, etc.); vertical vegetation stratification (emergent, canopy, sub-canopy or understory) indicating percentages; vegetation coverage of the sampling unit determining horizontal stratification (very sparse, sparse, very clear, clear, slightly dense, dense, very dense) and coverage percentage.

The quantitative sampling results must include the determination of species richness, abundance, diversity and similarity, for which diversity indices such as Shannon-Wiener, Simpson, similarity indices and other parametric and non-parametric methods shall be employed.

The qualitative sampling results must contain the information for family, scientific name, common name, habit, origin, type of vegetation and type of sampling. Floristic composition will be determined using this sampling type (number of species, numbers of families and dominant families).

In regard to ecological aspects, the species conservation status (CITES, IUCN and Red Books), indicator, sensitive, endemic species; sensitive species, rare species; species of economic interest; endangered species, threatened species; floristic structure of important sites; floristic sensitivity and identification of sensitive zones must be indicated. The description of the resource use must be included, which could be medicinal, commercial, food or other.

Conclusions: Conclusions and recommendations must be included.

Appendixes: Maps must be attached with all the information that has been collected.

Fauna

Methodology: The methodology must be well detailed with technical and literature support. It must include sampling date, sampling site, sampling point, UTM WGS84 Zone 17S coordinates, altitude, description of the area and sampling effort. In addition, the sampling method chosen and its technical justification must be indicated. Indicate the family, scientific name, common name, number of individuals, number of species, percentage and diversity value.

Results: The richness and abundance parameters must be determined as well as statistical indices (diversity, similarity, etc.). Incorporate graphic representation for each parameter analyzed in the quantitative inventories of the Fauna Component. Include the discussion of the results obtained from analyzing the quantitative parameters of the Fauna Component, contrasting with existing literature information.

Include ecological aspects that were determined based on the quantitative sampling, species conservation status (CITES, IUCN and Red Books), bioindicator species, endemic species, sensitive species, rare species, species of economic interest and endangered or threatened species. Also include the use of the resource.

Conclusions: Include conclusions and recommendations.

Appendixes: Attach location maps for samples of all biotic components using a representative scale.

The SUIA system clarifies the areas of research applied and considered in the biotic environment characterization document – fauna based on the characteristics of the project and the study area (e.g. Mastofauna, ornithofauna, herpetofauna, entomofauna, ichthyofauna, etc.). Observations and actions of the case will be included.

In case collecting information for one or more of these research areas does not apply, it must be justified in the system text fields.

Enter the species in a threatened category (CITES) in the text field considering the following: frequency, scientific name, common name, uses and actions of the case.

Generally, the following will be considered for the Baseline in Protected Areas:

a) Collection of primary information based on sampling or direct observation and based on secondary information only as a complement.
b) Sampling site and route coordinates
c) Flora and fauna inventories:
Mastofauna: aquatic and marine mammals as required
Birds
Amphibians
Reptiles
Entomofauna: Coleoptera and Lepidoptera
Aquatic macroinvertebrates
Ecological aspects and biostatistical analyses
Sensitive species
Conservation status {CITES, Red Books, IUCN)
Bioindicator species of the ecosystem conservation status
Endemic species
Migratory species
Richness
Importance value indicator
Alpha and beta diversity

6.3 SOCIOECONOMIC AND CULTURAL ENVIRONMENT

Social Component Methodology:

The Environmental Impact Assessment or its equivalent shall describe the methodological process of collecting information for the social component. It shall include backup for the research tools used: datasheets, forms, registration techniques, methodological approach strategies, etc. Include the description of the research team and the respective technical justification.

Characterization of Socioeconomic and Cultural Aspects

The baseline characterization will be on the areas of influence, so the description of the social context must differentiate from the general Area of Indirect Influence (AII) to the specific Area of Direct Influence (AID).

For the socioeconomic–cultural description of the Area of Indirect Influence, secondary information will be used, especially the latest census data, Territorial Zoning Plans of administrative–political

units that are part of the AII and relevant documentary information collected during the field research process which includes documents provided by the proponent.

The socioeconomic–cultural description of the Area of Direct Influence will be based on primary information that will be generated during the field research process.

Thus, investigation techniques to apply shall be:

- Process of analyzing the contents of secondary information referring particularly to the Area of Indirect Influence
- Quantitative information techniques if necessary
- Qualitative research techniques that can generate significant information on the socioeconomic use of the Area of Direct Influence. The following will apply for this purpose:

    - Participant observation of the local scene
    - Semi-structured interviews with relevant social actors
    - Semi-structured interviews wtih instutional and organizational actors
    - Group discussions wiht consultant team specialists and project promoter
    - Surveys of relevant social actors

Records of participant observation, semi-structured interviews, surveys of relevant actors and any other technique applied will be incorporated into the EIA-EMP as Appendixes.

The list of qualified, relevant informants from the areas of influence that were interviewed based on the following matrix shall be included:

LIST OF QUALIFIED INFORMANTS				
DATE	**INTERVIEWEE NAME**	**POSITION**	**INSTITUTION / COMMUNITY ORGANIZATION**	**POLITICAL ADMINISTRATIVE JURISDICTION, ETC.**

The following aspects shall be considered for description of the Social Areas of Direct and Indirect Influence:

Demographic Profile: Composition of the population by age and sex, population growth rate, density, migration characteristics of the economically active population (EAP)

Food and Nutrition: food supply, nutritional problems, water and other natural resource use and access

Health: factors that have an effect on birth rate; infant, general and maternal mortality; morbidity; existing health services; traditional medicine practices

Education: literacy condition, level of instruction, school buildings, teachers and students in the last school year

Housing: number, types, predominant material

Stratification: (socioeconomic groups), organization (types of association, forms of relationship, leadership), and social participation as well as characterization of values and customs; status of legalization of properties and communities (communities, associations, etc.)

Physical Infrastructure: existing roads, community infrastructure, basic services (water, sewer), education, health, environmental sanitation

Productive Activities: Land holding and use, local production, jobs, productive projects and community development

Archeology: studies of archeological remains and conservation that are incorporated in the EIA shall be performed according to the National Cultural Heritage Institute (INPC in Spanish) as

provided by law. A certificate from the INPC shall be submitted to support the non-existence of archeological remains, if that is the case.

Transportation: access to and type of transportation in the project, work or activity area.

Socio-institutional field: This chapter focuses on describing and explaining the makeup of the existing socio-institutional field, its structure and operation. It shall include the description and analysis of the perception and posture of Representative Political Organizations, and possible conflicts that could arise due to personal or political positions about the presence of the promoter and development of the project.

The use made by communities in the project AID of water, soil, forests, flora and fauna, etc., shall be described in detail.

Perceptual Environment

Analysis shall be completed of:

Tourism: places of interest because of their landscape value, natural resources and the cultural and historic value.

In addition, the following table indicates points related to analysis of the perceptional environment that may be included:

Environment	Scope	Observations
Perceptual	Landscape and tourism • Areas with landscape value • Areas with tourist attractions • Areas with recreational value	Include a brief description

A maximum 5 MB file on the social component of the study shall be attached in the SUIA system.

6.4 IDENTIFICATION OF CONTAMINATED SITES OR SOURCES OF CONTAMINATION

Contaminated sites or sources of contamination shall be identified for ex post projects, works or activities and others that apply, and entered into the SUIA as shown in the following table:

Affected Area	UTM DATUM WGS 84 Coordinates		Sources of Contamination
Water, air and soil, biotic component and social component	**Enter Coordinates**		Select from the system
	X	**Y**	

This shall be attached to the system together with the study Appendix documents and corresponding thematic map(s).

Having identified environmental liabilities, after the regularization process, they shall be assessed and remediated in coordination with the relevant Environmental Authority and pursuant to the methodologies established by the Ministry of the Environment.

7. PROJECT, WORK OR ACTIVITY DESCRIPTION

This section shall contain information about: the work force required, access roads, project life cycle, techniques used, activities to be developed, raw materials, processes, machinery and equipment, required inputs, water catchment from bodies of water or a groundwater source as the case may be, emissions and discharges generated by the project during each of its construction, operation and closure or abandonment phases, and anything relating to the proposed project, work or activity.

Possible expansions or new infrastructure and/or activities anticipated for consideration in the regularization process of ex post projects, works or activities must be identified and included, as the case may be.

The technical document with the detailed project, work or activity description must be uploaded to the SUIA system and may be based on the aspects detailed below.

Technical Characteristics of the Project: Techniques that will be used for different phases of project construction, operation and closure must be indicated in order to determine possible impact on the environment. Parameters to be indicated include power, voltage, length, flow, types of turbines, etc. depending on the project, work or activity.

Access Roads: Routes or roads that will be used to access the Project area shall be indicated, including principal, secondary, unimproved, etc. roads. They shall be drawn on a map to an appropriate scale.

Project Life Cycle: The useful life of the project must be indicated for the different phases of project construction, operation and closure.

Required Work Force: The number of people who will work on the project must be indicated in this section along with their positions and/or specialties and the activity they will perform.

Activities: Indicate the activities included in the project, considering the construction, operation and closure phases, such as earth movement, maintenance activities.

Facilities: Indicate the facilities at the project during each phase (construction, operation or closure) and attach a map on a scale of 1:1,000 with the location of the facilities. It should also indicate the facility location, area, size, description and diagrams of the facility, plates or tables to support it: dump sites, camps, explosive storage magazines, mechanical workshops, warehouses, laboratory, etc. like the example shown in the following table.

Facilities	Description
Camps	Specify the characteristics and details for each case.
Warehouses	
Roads	
Fuel storage	
Temporary waste storage sites	
Power generation	
Other (specify)	

Machinery: Include machinery, equipment or tools required by the project for each phase and each step of project construction, operation and closure.

Indicate machinery or equipment the project will use and describe it as in the example shown in the following table.

Machinery or Equipment	Description
Backhoes / vehicles	Indicate the number, characteristics and details of interest
Compressors	
Pneumatic drills (jackhammers)	
Ovens	
Boilers	
Electric generator	
Water pumps	
Other (specify	

Material and inputs: Indicate the materials and inputs required by the project for each phase, indicating amounts and/or volumes required such as water, fuel, electricity, explosives, etc., and describe following the example of the following table.

Material and Inputs	Description
Dielectric oil for transformers	Indicate amount, characteristics and pertinent details.
Cleaning detergents	
Grease	
Cement for construction	
Explosives	
Fuel	
Water	
Other (specify)	

Liquid Discharges: Indicate possible liquid discharges of the project, like sewer water or process water (camps/industrial, etc.). Describe the treatment system for sewer water, which may be described similarly to the example shown in the following table.

Type of Liquid Discharge	Amount Generated (l/day or l/s)	Type of Treatment	Final Disposal Method
Sewer water			
Process water			

Waste: Indicate the waste generated by the project during the phases and each of the construction, operation and closure stages of the project. Indicate the type of waste generated, amount and final disposal site and whether it is domestic waste, non-hazardous and hazardous waste, proceeding as provided in Book VI of the Unified Text of Secondary Legislation of the Ministry of the Environment (issued with Ministry Agreement No. 061 published in Official Register No. 316 dated May 04, 2015) and technical standards attached to this book and applicable environmental regulations.

Attach the project description document in the SUIA system and enter the prioritized information in the system: phase, activity and infrastructure with geographic location in UTM datum WGS 84 coordinates and a brief description.

Enter the chemical substances to be used based on the search criterion established in the system catalog. If it is not available, specify and enter the name of the substance.

Enter the timeline for the project phases, dates anticipated for start and completion and actions. In addition, enter the information on materials, inputs, equipment and tools to be used and their quantities.

8. ALTERNATIVES ANALYSIS

The study must assess impacts of a range of representative alternatives that are technically viable and reasonable based upon which at least 2 alternatives shall be described, not including the alternative of “no project” which can be assessed as a “no action” alternative, indicating what would happen in the absence of the proposed project in addition to the range of alternatives already indicated.

Alternatives analysis is not required for ex post projects, works or activities except in the case of expansions, new activities and infrastructure.

At least two alternatives and parameters assessed must be considered in Protected Areas, which can determine the option of least environmental impact.

The following analysis must be considered in Protective Forests and/or State Forest Heritage.

- Vegetation coverage or land use

- Floristic composition and structure
- Floristic resource use

Attach the analysis document in the SUIA system (in appendixes if the system does consider the fields in this chapter). Enter the information from the alternatives analysis considering the technical aspects, ecological and socioeconomic systems for alternative project (activities and/or infrastructure) locations as comparative criteria. The table below provides an example document.

TECHNIQUE	ECOLOGICAL	SOCIOECONOMIC AND CULTURAL
Construction processes	Hydrographic and hydrologic characteristics	Land holding
Infrastructure safety	Bodies of water (surface / underground)	Population directly affected
Costs	Water use	Productive activities directly affected
	Geological, geomorphological and geotechnic characteristics	Levels of social conflict
	Land use	Compatibility with territorial zoning plans
	Volume of soil removed	Interference with historic, cultural and archeological heritage
	Area and type of vegetation to be removed (primary / secondary forest)	Infrastructure of basic services (sanitation, electric power, water supply)
	Fragile and/or protected ecosystems	Sensitive elements (schools, health centers, community infrastructure)
	Biodiversity (flora / fauna)	
	Endangered species	

Based on the comparative criteria considered for each alternative, provide a brief description of the characteristics of that alternative and define it considering first the option of least environmental impact.

9. DETERMINATION OF AREAS OF INFLUENCE AND SENSITIVE AREAS

The boundaries of the area of influence that will involve the project, work or activity management and will be constructed based at least on the following considerations and inputs:

- Analysis of the baseline of the reference area of the project, work or activity
- Project description and scope of activities
- Positive and/or negative impact identification and assessment
- Environmental Management Plan activities

9.1. AREA OF DIRECT INFLUENCE (AID)

Implement methodologies with their respective technical justification in defining the AID, which enable delimitation of the area where the socio-environmental impacts will be apparent during the work.

Both biotic and abiotic components involved must be assessed, incorporating the methodological criteria, directives and guidelines for the social component established in applicable environmental legislation issued by the Ministry of the Environment wherein the Area of Direct Social Influence (AISD) is defined.

As a proposal it is suggested that the following components be considered, notwithstanding other criteria of the person who prepared the expert analysis may consider appropriate, which may be applied flexibly and proportionally, adapting their forecasts to each concrete work, activity or project.

Environmental Component	AREA OF DIRECT INFLUENCE (AID)
Physical Component	
Geology and Geomorphology	In accordance with the methodology to be used by the environmental consultant to define the AID
Soil Quality	In accordance with the methodology to be used by the environmental consultant to define the AID
Air Quality	Areas that could be directly affected by combustion gas emissions, particulate and sedimentable material or others arising from the project, work or activity may be considered as criteria of this component in the methodology to be used by the environmental consultant to define the AID
Noise and Vibrations	Direct and sensitive receptors of noise and vibration emissions arising from the project, work or activity may be considered as criteria of this component in the methodology to be used by the environmental consultant to define the AID
Hydrology and Water Quality	The basin / sub-basin / micro-basin or hydrographic unit, body (bodies) of water present, flow, self-purification, consumption and non-consumption use of the water and sensitive receptors downstream, among others, may be considered as criteria of this component in the methodology to be used by the environmental consultant to define the AID
Biotic Component	
Flora and Vegetation	Natural boundaries of vegetation, protected areas, protective forests and vegetation, physiographic aspects of the terrain like streambeds, high ridge lines, plains, slopes and slope exposure, etc. may be considered as criteria of this component in the methodology to be used by the environmental consultant to define the AID
Fauna	Natural vegetation boundaries, protected areas, physiographic aspects of terrain like streambeds, high ridge lines, plains, slopes and slope exposure, etc. may be considered as faunistic criteria in the methodology to be used by the environmental consultant to define the AID
Social Component	
Levels of Social Integration	The Area of Social Direct Influence methodology must be carried out as provided in the directives and guidelines for the social component established by the Ministry of the Environment where the Area of Social Direct Influence (AISD) is defined. **Area of Social Direct Influence:** the social space arising from direct interactions of one or several elements of the project or activity with one or several elements of social context where the project will be emplaced. The direct project – social environment relationship exists on at least two levels of social integration: individual units (farms, dwellings and their corresponding owners) and first and second order social organizations (communities, enclosures, neighborhoods and organizational associations).

Environmental Component	AREA OF DIRECT INFLUENCE (AID)
	The individual elements of the AISD are identified by focusing indemnification actions while communities, neighborhoods, and first and second order organizations that make up the AISD are identified by establishing compensation actions.

9.2. AREA OF INDIRECT INFLUENCE (MANAGEMENT AREA)

Once the area of direct influence is defined and delimited, the spatial area must be established where the promoter will generate positive and/or negative impacts on socio-environmental comportments brought about by their activity, based on the baseline analysis, scope of activities, project, work or activity impacts identified and Environmental Management Plan activities.

The management area that includes the area of direct influence and the boundary of the area of indirect influence may be adjusted with updates to the Environmental Management Plan that are made and based on the provisions of current environmental legislation in force.

Both biotic and abiotic components involved must be assessed in defining the boundary of the area of indirect influence, incorporating methodology criteria, directives and guidelines for the social component set out in applicable environmental regulations issued by the Ministry of the Environment for that purpose.

As a proposal, notwithstanding other criteria that the consultant preparing the expert analysis may consider appropriate, it is suggested that the following components be considered, which may be applied flexibly and proportionally, adapting the provisions to each concrete work, activity or project.

Environmental Component	AREA OF INDIRECT INFLUENCE (AII)
Physical component	
Geology and Geomorphology	In accordance with the methodology to be used by the environmental consultant to define the AII and criteria to establish the spatial area wherein the promoter will manage this component; based on the baseline analysis, scope of activities, impacts identified for the project, work or activity and activities of the Environmental Management Plan
Soil Quality	In accordance with the methodology to be used by the environmental consultant to define the AII and criteria to establish the spatial area wherein the promoter will manage this component; based on the baseline analysis, scope of activities, impacts identified for the project, work or activity and activities of the Environmental Management Plan
Air Quality	In accordance with the methodology to be used by the environmental consultant to define the AII and criteria to establish the spatial area wherein the promoter will manage this component; based on the baseline analysis, scope of activities, impacts identified for the project, work or activity and activities of the Environmental Management Plan
Noise and Vibrations	In accordance with the methodology to be used by the environmental consultant to define the AII and criteria to establish the spatial area wherein the promoter will manage this component; based on the baseline analysis, scope of activities, impacts identified for the project, work or activity and activities of the Environmental Management Plan
Hydrology and Water Quality	In accordance with the methodology to be used by the environmental consultant to define the AII and criteria to establish the spatial area wherein the promoter will manage this component; based on the baseline analysis, scope of activities, impacts identified for the project, work or activity and activities of the Environmental Management Plan

Environmental Component	AREA OF INDIRECT INFLUENCE (AII)
Biotic Component	
Flora and Vegetation	In accordance with the methodology to be used by the environmental consultant to define the AII and criteria to establish the spatial area wherein the promoter will manage this component; based on the baseline analysis, scope of activities, impacts identified for the project, work or activity and activities of the Environmental Management Plan
Fauna	In accordance with the methodology to be used by the environmental consultant to define the AII and criteria to establish the spatial area wherein the promoter will manage this component; based on the baseline analysis, scope of activities, impacts identified for the project, work or activity and activities of the Environmental Management Plan
Social Component	
Levels of Social Integration	Methodology for the Area of Indirect Social Influence must be completed in accordance with the directives and guidelines for the social component established in applicable environmental regulations issued by the Ministry of the Environment wherein the Area of Social Direct Influence (AISD) is defined. **Area of Social Indirect Influence**: social-institutional space resulting from the project relationship with territorial-political units where the project is developed: parish, canton and/or province. The reason for the relationship is the role of the project and/or activity in local territorial zoning. Although based on the political-administrative location of the project, other territorial units may exist that are relevant to project social-environmental management, such as the Indigenous Territorial Districts, Protected Areas, Municipal Commonwealths.

Pay particular attention to the following in Protected Areas to determine Areas of Influence:

- Hydrographic watersheds
- Representative vegetation units
- Risk zones
- Threatened species and CITES, CMS species

9.3. DEFINITION OF SENSITIVE AREAS

Appropriate methodologies will be used that can determine socially sensitive areas considering that social sensitivity is the reaction-response capacity of an element of the AID without loss of identity when faced with the disturbances caused by the project.

Sensitive elements of the environment, such as housing, community infrastructure, water sources for community use and the like must be considered. Once the sensitivity of the elements of the AID is determined, the corresponding table and map shall be generated.

Assess whether the use of forestry, marine, etc. natural resources found in the project area are the main economic and/or nutritional income for the population.

Pay particular attention to the following in Protected Areas to determine Sensitive Areas:

- Fragile ecosystems considered in the CRE
- Georeference the sensitive areas identified, such as:
  - Nesting areas
  - Mangrove ecosystem
  - Roosting sites
  - Wetlands
  - RAMSAR sites
  - Salt licks
  - Foraging areas

- Breeding grounds
- Aquatic or marine mammal sighting areas
- Migratory species routes

- In addition, consider that the system may be fed more technical information.

Add the document for determination of areas of influence and sensitive areas to the system, and literature citations and references for the methodologies employed must be included.

In addition, results of the distances defined for the areas of direct and indirect influence shall be entered into the SUIA system by component (physical, biotic, etc.) along with the description of results as well as requirements for information on the social component established in the system in regard to communities, population centers or other jurisdictions in relation to the infrastructure and/or activities that the project would affect.

10. FORESTRY INVENTORY AND ECONOMIC ASSESSMENT OF GOODS AND SERVICES

An Inventory of Forestry Resources must be completed as well as the piedmont calculations if native vegetation coverage was removed, as provided in Ministry Agreements No. 076 published in Official Register No. 766 dated August 14, 2012, and 134 published in Official Register No. 812 dated October 18, 2012.

It would generally consider the following:

a) General project data
b) Coordinates of sampling sites and the area of emplacement
c) Description of study area

METHODOLOGY:

e) Field phase: collection of primary information based on sampling or direct observations and based on secondary information only as a complement,
f) Office phase: data analysis
g) Results: average volume per hectare
h) Sensitive species: Conservation status (CITES, Red Books, UICN) Endemic species

RICHNESS

i) Importance value indicator
j) Tables of records, statistical tables (diameters, indexes)

Conclusions: total volume to be removed

That is, with development of the following information:

DATASHEET

- Project name:
- Administrative Political Location
- Intersection: Indicate if there is an intersection with the National *SYSTEM OF PROTECTED AREAS, Protective FORESTS* and *VEGETATION, STATE FOREST HERITAGE*, Cuyabeno Intangible Zone, Imuya, *CORE* of Yasuni National Park and Buffer Zone of Yasuni National Park Core
- Area the project will intervene in
- Forestry professional responsible for preparing the Forest Inventory

DEVELOPMENT

- WGS 84 System Coordinates of the areas required by the Project shall be included.

Description of Study Area

- Description of ecosystems in the study area
- Land use and coverage (% of land use according to the area affected)
- Land holding

Field Phase

- Materials and methods (detail indicators, equations, literature, photographic records and other backup documentation that is used to collect the information on the forestry inventory)
- Sampling percentage of the forestry inventory in the area affected by the project shall represent at least (n=1%) if the project is implemented in areas with primary and secondary native forest. In the case of areas with human intervention where primarily relict trees and pioneer vegetation is evident, a forest census must be completed. Justify the percentage.

DATA ANALYSIS

Tables of results
- Species diversity (DnR, DmR, IVI, Shannon Wiener, and Simpson indexes, Sorensen similarity index)
- Tables of calculations of BHD, AB, Height, total and commercial volume (If there are no growth tables by species, use 0.7 for latifoliate species and 0.5 for conifers)
- Define endemic, rare, and important species and conservation status of species recorded in the field according to the Red Book.
- Species of economic importance

Results del Forest Inventory
- Basal Area per hectare (≥ 10 cm BHD)
- Average volume per hectare per site sampled
- Average volume of wood foot per hectare and extrapolation for the total area of intervention

Statistical charts
- Diametric distribution (curve of diameters)

Forest fee payments must be based on Art. 1 of Ministry Agreement 041 ($3 dollars per cubic meter of standing timber or at the piedmont).

CONCLUSIONS

RECOMMENDATIONS

APPENDIXES

- Maps (areas to be affected)
- Map of forest inventory sampling
- Map of land use and vegetation coverage

11. IDENTIFICATION, EVALUATION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

11.1 EX ANTE PROJECTS, WORKS OR ACTIVITIES

Significant positive and negative environmental impacts that could be caused by the different phases of the project, work or activity, construction, operation-maintenance and closure or abandonment, etc. must be identified, characterized, predicted and assessed

Environmental impacts must be identified, predicted and assessed taking into account the environmental variables and elements affected by the following environmental components:

- Physical environment
- Biotic environment
- Socioeconomic and cultural environment

Analysis of environmental impacts shall cover the following phases:

a. Environmental Impact identification:

Begin with the analysis of the effects that the works and activities forecast during different phases of the project, work or activity (construction, operation-maintenance, closure or abandonment, etc.) could have on the environment.

Therefore, cause-effect matrixes may be used along with checklists or other methods that facilitate basic identification and characterization of the potential environmental impacts during each phase and key activities of the project cycle.

b. Prediction and quantification of environmental impacts:

Carry out in order to predict the size, intensity, extent, duration or other characteristics that could arise, considering the nature of the environmental impacts.

Impact factors (causes of the impacts from the project) and environmental impacts (alteration of the environment due to impact factors) shall be forecast and quantified.

Methods based on cause-effect matrixes, supported by cartographic models or geographic information systems, social research, surveys, panels of experts, etc. may be used, as necessary, according to the significance and nature of impacts and the availability of economic, technology and material resources. A basic recommendation is to select the method that allows adequate results to be obtained for making decisions, using the least amount of resources.

c. Impact assessment and determination of significance:

Carry these out in order to assess environmental impacts, comparing the assessment of their characteristics with the criteria that determine the significance of the environmental impacts.

Significance criteria of the impacts may be the following, among others:

- Compliance with current environmental policy, legislation and regulations in effect
- Compliance with allowable limits of emissions and dumping
- Compliance with established environmental quality limits
- Causing alterations in environmental components and variables that are irreversible, permanent or of long duration
- Causing impacts on singular environmental sites or values that society has decided to protect

Significant impacts shall be subject to mitigation measures in order to bring them to allowable levels and compensation measures in order to build an environment similar to what was affected at another site.

d. Summary of significant impacts of the project:

Significant impacts of the project shall be presented in an impact matrix wherein the basic occurrence and characteristics of the impact (size and intensity), among others, shall be visualized depending on the matrix used, all based on the activity that could generate it and alteration of the component and environmental variable.

e. Establishing the impact hierarchy

Once the impacts are identified and quantified, they must be ranked in a hierarchy in order to determine their significance, maintaining agreement with the information to be entered into the SUIA system.

Results analysis / conclusions and recommendations:

The results shall be analyzed detailing positive vs. negative impacts and taking into account the ranges that will be considered for the measures to be included in the Environmental Management Plan.

The conclusions and recommendations shall be included for the project activities and significant environmental impacts.

The document identifying, assessing and valuing impacts shall be attached to the system and must include literature citations and references for the methodologies used. In addition, enter conclusions in the text field using no more than 3000 characters.

Generally, the following must be addressed in the Environmental Impact Identification and Assessment in Protected Areas for the analysis to be performed on them:

Flora:

- Vegetation coverage or land use
- Floristic composition and structure
- Wildlife habitat for critical, endangered or vulnerable species
- Conservation areas and fragile and sensitive ecosystems
- Floristic resource use
- Other

Fauna

- Faunistic structure and composition
- Wildlife habitat for critical, endangered or vulnerable species
- Areas of ecological interest: feeding grounds, salt licks, watering holes, nesting sites, temporary resting sites and the like
- Introduction of exotic species and/or wild species migration
- Risk of affecting breeding periods of species identified within one of the conservation criteria
- Habitat fragmentation
- Hydrobiological water quality
- Risk of bioaccumulation in living organisms and/or proliferation of disease vectors
- Other

The following fields must be entered in the SUIA system, without prejudice to preparation of the study document:

Activity Stage / Phase
Component
Environmental aspects
Impacts identified
Results

11.2 EX POST PROJECTS, WORKS OR ACTIVITIES

In addition to environmental impact identification and assessment, in the case of ex post projects compliance with applicable environmental regulations must be analyzed and verified, considering the results of conformity and non-conformity as a priority, as well as what is observed as shown below:

Non-conformity (Finding)	Article and letter (of the law)	Minor non-conformity	Major non-conformity	Evidence Observed	Verification measures	Appendixes

12. RISK ANALYSIS

A brief description of possible risks that could arise from project activities shall be included in the Contingency Plan and the Environmental Management Plan (EMP).

The project – environment associated risks and environment – project associated risks shall be described,

Use the most appropriate methodology in the risk analysis depending on the type of risk, and include the corresponding literature citation and reference.

12.1 RISKS OF THE PROJECT TO THE ENVIRONMENT (ENDOGENOUS)

Among this type of risk and according to the location and characteristics of the project, work or activity, the following may be considered endogenous risks, among others:

- Spills
- Explosions
- Fires
- Mechanical failures (equipment)
- Operational failures (operator)

Methodologies applicable to this type of risk shall be used, a simplified method of which is provided as a guideline to quantify existing risks and rank their priority. The principles governing this assessment include:

- Severity of potential losses (light, moderate, serious, catastrophic, etc.)
- Frequency with which losses have or may be produced (very low, low, medium, high, etc.)
- Probability that a loss will occur (literature reference, historic records of accidents, etc.)

As a reference to categorize Risk, use of the following formula may be considered as a reference: **R=Severity x Frequency**; and the results may be presented in a series of ranges with their respective quantification.

Quantification of these risks must agree with the activities described the respective chapter of the study.

12.2 RISKS OF THE ENVIRONMENT TO THE PROJECT (EXOGENOUS)

The following, among others, may be considered exogenous risks and according to the project, work or activity location and characteristics:

Geological risks	Earthquakes
	Tremors
	Land slides
	Settling
	Soil erosion
Atmospheric risks	Flooding
	Hurricanes
	Droughts
	Storms
Biological risks	Plagues
	Epidemics
Social Risk	Sabotage
	Terrorism

Methodologies applicable to this type of risks shall be utilized where historic information may be used to determine the frequency with which the different environmental risks occur. As a guideline for assessment, the matrix prepared by Fundación Natura 1996 is presented where the probability assessment versus consequences is represented as follows:

- **Social**:

R= V*S
R= Risk
V = Vulnerability
S = Sensitivity

PROBABILITY SCORE: 0 = absence, 1 = Did not occur over the last 5 years, 2 = Did not occur over the last 2.5 years, 3 = Occurred in the last year.

PROBABILITY VULNERABILITY INDEX	0	1	2	3
For example: Strikes				

LEVEL OF RISK: high = > 0.5, medium 0.25 - 0.49, low= 0 - 0.24

All risks will be added by community and activity and score depending on the value obtained.

COMMUNITY	ACTIVITY	SENSITIVITY INDEX	VULNERABILITY INDEX					RISK	LEVEL OF RISK
			Example of Strike				Vulnerability index		
		0.9	Include classification based on probability				Add partial vulnerability indices	R = vulnerability index x sensitivity index	

Sensitivity index: Coefficient 0.9 corresponds to the most likely.

- **Biological –** Threats or risks must be assessed from the point of view of the Biotic Component related to project development and include a Biological Risk Matrix synthesizing the Type of Risk / Activities / Risk Score.

The risk analysis in the Protected Area shall consider the project's impact on the ecosystem.

As for the overall study, the risk analysis for protected areas must pay attention to the following:

Flora:
- Vegetation coverage or land use
- Floristic composition and structure
- Wildlife habitat for critical, endangered or vulnerable species
- Conservation areas and fragile and sensitive ecosystems
- Faunistic resource use
- Other

Fauna
- Faunistic structure and composition
- Wildlife habitat for critical, endangered or vulnerable species
- Areas of ecological interest: feeding grounds, salt licks, watering holes, nesting sites, temporary roosting sites and the like
- Introduction of exotic species and/or migratory wild species
- Risk of impact on breeding periods of species identified in one of the conservation criteria
- Habitat fragmentation
- Hydrobiological water quality
- Risk of bioaccumulation in living organisms and/or proliferation of disease vectors
- Other

Notwithstanding the previously indicated analysis that may be required, in Protective Forests and/or State forest heritage, the analysis of the project impact on the following must be considered as a priority:

- Vegetation coverage or land use
- Floristic composition and structure
- Floristic resource use

The risk analysis document shall be attached to the system and must include literature citations and references on the methodologies used.

Information on the results of the risks shall also be entered into the system: type (endogenous and exogenous), sub-type (geological, etc.), results and actions of the case.

13. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

13.1. EX ANTE PROJECTS, WORKS OR ACTIVITIES

Once the possible environmental impacts derived from the process of a work, project, economic or productive activity have been identified, analyzed and quantified, an Environmental Management Plan must be prepared, which shall consider at least the following aspects:

Analyze the possible actions to take for those activities that involve an undesirable impact as determined in the qualitative impact assessment.

Identify institutional responsibilities for addressing needs that are not the direct responsibility of the company and design coordination mechanisms.

Describe the processes, technologies, design, operation and others that were considered to reduce negative environmental impacts when necessary.

Description of positive impacts in order to maintain and reinforce them during the phases of the project, work or activity; the impacts mentioned shall be included in the different programs and sub-programs of the Environmental Management Plan.

Include a deadline for environmental control and information update: environmental studies and plans must be reviewed periodically. Both control strategies and updating must be dynamic.

Based on these considerations, the environmental impact assessment will propose at least the plans listed below with their respective programs, responsibilities, budgets, timelines, performance appraisals and management plan.

a) IMPACT PREVENTION AND MITIGATION PLAN

This corresponds to the actions tending to minimize negative environmental impacts during the different phases of project operations.

If there is an intersection with a Protected Area and/or Protective Forest/State forest heritage, this sub-plan shall include the following among the other aspects included in the study:

Flora and wildlife rescue Program and implementation of forest nurseries
Establish canopy bridges
Avoid unnecessarily clearing large, sensitive and threatened tree species
Establish wildlife passageways
Avoid the presence of exotic species
Avoid extracting wild flora and fauna
Avoid rerouting natural water flows
Bury power lines

b) WASTE MANAGEMENT PLAN

This includes concrete measures and strategies to be applied in projects, works or activities to prevent, treat, recycle / reuse and dispose of different hazardous and non-hazardous waste in compliance with the guidelines established in Book VI of the Unified Text of Secondary Legislation of the Ministry of the Environment, issued by Ministry Agreement 061 published in Official Register No. 316 dated May 04, 2015, and applicable technical environmental standards issued for that purpose by the Ministry of the Environment.

This plan shall include, depending on the specifics of the case, a hazardous waste management program and the actions to take in compliance with applicable environmental legislation (Book V! TUSMA, Ministerial Resolution No. 026 published in Official Register No. 334 dated May 12, 2008 "Procedures for registration of hazardous waste generators, hazardous waste management prior to environmental license being issued and for transport of hazardous materials" and Ministerial Resolution No. 142 published in Official Register No. 856 dated December 21, 2012 "National list of hazardous chemical substances, hazardous and special waste ").

c) ENVIRONMENTAL COMMUNICATION, TRAINING AND EDUCATION PLAN

Includes a training program on EMP elements and application for all company personnel in accordance with the duties they perform.

In the case of intersection with a Protected Area and/or Protective Forest / State forest heritage, this sub-plan shall include the following among the other aspects included in the study.

Protected Area: The training program must be oriented to social actors in the project area of influence and must be aligned with the communication, education and participation program of the annual operational management plan of the protected area and protective forest management plan (if any).
Protective Forest: The training program must be oriented to social actors of the project area of influence and must be aligned with the comprehensive management of the protective forest and vegetation with which it intersects.

d) COMMUNITY RELATIONS PLAN

This is a program of activities to be developed with the community (or communities) directly involved, the authority and the promoter of the project, work or activity.

It shall include measures to disseminate the study, principal information and communication strategies, eventual plans for indemnification, compensation projects and mitigation of socio-environmental impacts as well as a participatory environmental education program with the community. These agreements must allow a reduction in negative effects and optimization of positive actions.

It consists of a series of specific programs and activities to be developed with the communities and social actors of the areas of influence in order to reduce, mitigate and compensate any that the project may generate on the socioeconomic and cultural component, which will include:

Information and Communication Program: Includes ESIA dissemination measures, mechanisms of information on the activities to carry out, progress of the project and compliance with the agreements and other EMP measures.
Compensation and Indemnification Program: Based on the impact assessment performed, guidelines will be established to apply compensation measures in the communities located in the area of direct influence of the project, which are related to negative impacts generated and environmental goods and services that may be affected as well as compensation mechanisms and procedures for owners of properties to be taken over.
Local Work Force Hiring Program: The policies and procedures to use in engaging staff from the project Areas of Influence will be described.
Environmental Education Program: Directed at the communities and other social actors of the area of influence of the project, work or activity.
Mitigation measures and protection for sensitive elements located in the project area of influence and other mitigation measures for specific impacts on the socio-economic component that are identified in the environmental assessment shall be described.

Actions considered in the Community Relations Plan shall be specified technically: objectives, activities, resources, execution timelines, team responsible, monitoring methods, verification methods.

e) CONTINGENCY PLAN

Includes details of the actions as well as equipment, material and personnel lists and quantities to address eventual accidents and emergencies in the infrastructure or input handling during different phases of the project, work or activity operations based on the risk analysis. The definition and assignment of responsibilities shall be included for execution of its different phases (flow chart and organization chart), operational cooperation strategies and an annual training and drill program.

If the contingency does not contain the event, a comprehensive restoration plan must automatically be established that addresses remediation of the site affected, compensation and indemnification.

If it intersects with a Protected Area, this sub-plan shall include the following among the aspects involved:

Flora and wildlife rescue program and implementation of forest nurseries.

f) OCCUPATIONAL HEALTH AND SAFETY PLAN

This plan includes the standards established by the company internally to preserve employee health and safety, including strategies for its dissemination and all actions aimed at compliance with applicable laws.

g) AFFECTED AREA REHABILITATION PLAN

An analysis must be performed to determine a restoration and rehabilitation plan based on the socio-environmental impacts and/or effects of the project, work or activity.

If there is an intersection with a Protected Area, this sub-plan shall include the following among the other aspects included in the study:
Establish nurseries
Determine native species to replant or reforest
Manage natural regeneration
Determine areas to be replanted and/or re-forested

If there is an intersection with a Protective Forest/State forest heritage, this sub-plan must include the following among the other aspects included in the study:
Determine native species to replant or reforest
Manage natural regeneration
Determine areas to be replanted and/or re-forested

h) ABANDONMENT PLAN AND DELIVERY OF THE AREA

This includes designing activities to be completed upon conclusion of the operation, how to proceed with abandonment and delivery of the area of the project, work or activity.

i) MONITORING AND CONTROL PLAN

The Environmental Impact Assessment (ESIA) shall define systems for monitoring, assessment, environmental monitoring, public health monitoring of the area of influence, and community relations, which tend to properly control impacts identified in the ESIA and compliance with the Environmental Management Plan (EMP) as well as corrective activities proposed therein.

Community Monitoring shall be applied considering the particular characteristics of the activity to be developed. It may include community training activities on monitoring, accompaniment and results reporting mechanisms.

The sub-plan shall include, among other aspects included in the study, the following if there is an intersection with a Protected Area and/or Protective Forest/State forest heritage:

The Monitoring and Control Plan must be aligned with the Research and Monitoring Program of the annual operational management plan of the protected area or Protective Forest as the case may be.

The EMP sub-plans may be uploaded to the SUIA system as an Excel file. At least the following system requirements must be considered when entering information:

For EMP sub-plans, except the Contingency Plan and the Monitoring Plan:

Environmental Aspect	Impact Identified	Proposed Measure	Indicators	Verification Method	In-Charge	Frequency	Period	Actions
						Number of times the proposed measure repeats in a determined period	Daily, weekly, monthly, quarterly, semi-annually, annually	

For the Contingency Plan

Risk	Environmental Component	Proposed Measure	Indicators	Verification Method	In-Charge	Frequency	Period	Actions
						Number of times the proposed measure repeats in a determined period	Daily, weekly, monthly, quarterly, semi-annually, annually	

Consider the following for the Monitoring Plan

ENVIRONMENTAL COMPONENT (as applies)	PARAMETERS TO MONITOR	Coordinates (X Y) (required for Ex Post, but not Ex Ante)		SAMPLING FREQUENCY	REPORTING FREQUENCY
		X	Y		
Groundwater	Per the regulation			Number of times repeated per the proposed measure over a determined period	Monthly, quarterly, semi-annually, annually
Surface Water					
Marine Water					
Discharges					
Sewer and Gray Water					
Air Quality					
Noise					
Vibrations					
Non-ionizing Radiation					
Soil Quality					
Sediment					
Flora					
Fauna					
Social					
Other					

13.2 EX POST PROJECTS, WORKS OR ACTIVITIES

Ex Post projects, works or activities must prepare, in addition to the Environmental Management Plan, an action plan that enables correction of Non-Conformities (NC) encountered which will incorporate principally the following:

Non-conformity	Proposed Measures	Verification Methods	In-Charge	Term (Months)	
				Start Date	End Date
				dd/mm/yyyy	dd/mm/yyyy

14. PRICED TIMELINE OF THE ENVIRONMENTAL MANAGEMENT PLAN

A timeline must be provided with all costs associated with execution of the sub-plans and corresponding programs and that are part of the Environmental Management Plan.

A priced timeline of the management plan must be generated by phases, construction, and operation.

Information corresponding to the EMP activity or measure shall be entered into the SUIA system for each sub-plan, setting out the months included in the timeline and considering the frequency of the measure, as well as its budget.

Priced Timeline of the Environmental Management Plan							
	Month 1	Month 2	Month 3	Month 4	Month 5	Month X…	Budget
Mitigation and Impact Prevention Plan							
Scheduled Activities **(for each measure indicated in the sub-plans both proposed and other additional ones)**							
Waste Management Plan							
Scheduled Activities							
Communication and Training Plan							
Scheduled Activities							
Community Relations Plan							
Scheduled Activities							
Contingency Plan							
Scheduled Activities							
Monitoring and Control Plan							
Scheduled Activities							
Area Rehabilitation and Closure Plan							
Scheduled Activities							
TOTAL		WRITTEN OUT					$US

15. APPENDIXES

- Include the Glossary of Terms: It must contain the main definitions being used in the study.
- Include Literature References: Considering all the information generated in the study. It must be properly cited using the corresponding standard and duly linked to the part of the document being cited.
- This section shall also include all supporting documents for the information contained and backup documentation for the study (e.g. Research permit for collecting and taking samples for biotic studies; permit to move wild specimens; certificate of samples received issued by the Holding Centers that are authorized by the Ministry of the Environment; documentation or permits issued by INPC for archeological studies; results of soil, air, water, etc. analysis performed by certified laboratories according to the studies and analyses carried out for the project, work or activity; other backup documentation as required by environmental law and regulation).
- Basic and thematic map information in a digital format using the ArcGis Geographic Information System (Versions from 9.* to 10.2 *.mxd), including the respective database using UTM coordinates and the WGS84 ellipsoid reference system; the working scale for the basic information shall be 1:50000, 1:25000 or greater (IGM Topographic Sheets) and the printed scale shall depend on the size of the project, i.e., the minimum mappable unit (UMC in Spanish) which is the size of the minimum area that should appear on a thematic map for correct visualization:
  - Thematic information must provide detail on the source(s) of information with their respective official source, scale and year of the competent authority. It is recommended that updated information be used and National Geo-Information Council (Consejo Nacional de Geo Información – CONAGE) guidelines are followed in presenting marginal cartographic information.

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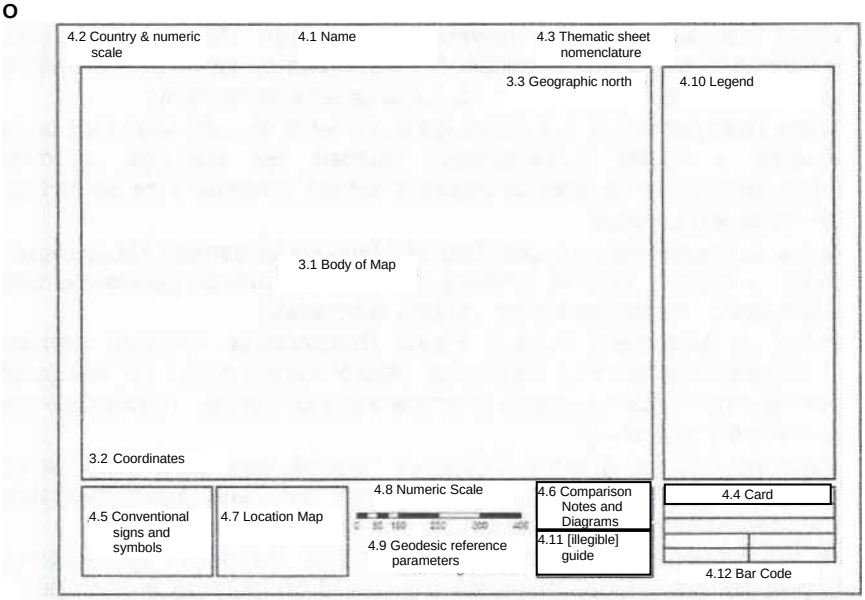

- All maps shall include the study area according to the provisions in current environmental legislation in force.
- Basic and Thematic Maps based on characteristics of the project, work, or activity and the like, may include the following:
- Political-Administrative Location Map: Must show territorial division at the level of the province, canton, parish and section depending on the size of the project.
- Base Map: Must show bodies of water (double rivers, single rivers, irrigation canals, streams, lakes), roads (first, second and third order), population centers, contour lines, heights, points

of interest (schools, health centers, housing, churches, recreation centers, cemeteries, bridges, airports, helipads, haciendas, hills, and the like).

- Project Implementation Map: This map shows infrastructure or emplacement of other existing works according to the project area and its different phases as well as including the polygon of the intersection certificate.
- Protected Area Map: This map contains the National System of Protected Areas, Protective Forests and Vegetation, State forest heritage, Intangible Zones, Buffer Zone and others of great interest.
- Geological Map: Lithology formation and geological period.
- Geomorphological Map: Macro and meso relief; also include the DEM, the digital elevation model.
- Physiography and soil Map: Physical mechanical characteristics of the soil, taxonomy, (order, suborder).
- Soil Sampling Map: This map must contain coverage of the taxonomy, georeferenced sampling points, the table of contents of which shows the laboratory analysis results.
- Water Sampling Map: This map must contain the water sampling codes, sampling type, sampling location using UTM coordinates, site description, on-site laboratory results of the sampling, etc.
- Noise Sampling Map: This map must contain noise sampling codes, location of sampling location using UTM coordinates, site description, sampling type, sampling results (decibels).
- Climate Map: include (isohyets, isotherms): Include weather stations and climate types. The isohyets and isotherm maps should include units of measure and symbology of the competent agent.
- Hydrogeological Map: This map contains the division based on units of measure and representative scale, which can be basins, sub-basins or micro-basins. In the table of attributes, it should contain water catchment points
- Hydrographic Basin Map
- Physical Sampling Map (Water, Soil, Noise and Air Quality): must contain georeferenced points with the respective field and laboratory results.
- Flora and Fauna Sampling Map (Mastofauna, Avifauna, Herpetofauna, Ichthyofauna, Land Invertebrates, Macroinvertebrates): This map must contain the georeferenced points, transects or parcels with their respective field and laboratory results.
- Land Use and Vegetation Coverage Map: This map must contain vegetation coverage showing the first level legend of the Intergovernmental Climate Change Panel (Panel Intergubernamental de Cambio Climático – IPCC) of the MAE.
- Community, Ethnicity, Federations Maps: Boundaries of the communities must be supported from an official source; social information surveys will be accepted for ethnicities.
- Owner Map: backed up by official sources of the Parish and/or Canton Independent Governments, etc.
- Maps of Areas of (Physical, Biotic, Social) Direct Influence and Management Area: This map must also contain the reference or study area, and the management area is similar to the area of indirect influence.
- Maps of Areas of (Physical, Biotic, Social) Sensitivity: based on the analysis performed, this map must indicate the degree of sensitivity of each component.
- Monitoring Point Map (Liquid Discharges and Atmospheric Emissions)
- Project Alternatives Map prepared based on the project alternatives analysis chapter.
- Map showing Control Points in case of spill: Include in the table of attributes control point identification or code, location based on UTM coordinates, response times, contingency material.
- Exogenous Risk Map (Environment on the Project must include variables like seismology, slopes, flooding, etc.) based on the risk analysis chapter.
- Endogenous Risk Map (Project on the Environment, such as spills, explosion, etc.) and the respective ranks (high, medium or low) based on the risk analysis chapter.
- Satellite and/or vertical aerial photography in color: Satellite information shall include the technical characteristics like type of satellite, number of bands, spatial and spectral resolution, cloudiness percent, RGB combination, year taken, reference system (georeferencing).
- The satellite image must be no older than five years from the current date, taking into account that the image must be high resolution (5m per pixel) and cloudiness no greater than 15%

(take into account that the study area should not be cloudy); moreover, Aster or Landsat panchromatic images will be accepted at 15 m resolution.

- Submit metadata of all cartographic information, both basic and thematic, based on the Ecuadoran Metadata Profile (PEM in Spanish) under ISO 19115:2003 and ISO 19115-2:2009 Standards with their respective XML files. This information may be located at the following link: http://sni.gob.ec/documentos-geograficos
- Other maps: merited by the project and its characteristics.

SOCIAL PARTICIPATION PROCESS

This process shall be conducted according to the provisions of Articles 44, 45 and 46 of Book VI of the Secondary Unified Environmental Law Text of the Ministry of the Environment issued by Ministry Agreement 061 published in Official Register No. 316 dated May 04, 2015, and applicable environmental manuals and standards issued for that purpose by the Ministry of the Environment. The purpose of this process is to inform the population potentially affected by the project and make them aware of the Impact Study and Environmental Management Plan in order to determine and incorporate their comments, opinions and observations, which shall be described in detail in the Social Participation Report.

A table shall be included which will specifically explain the observations and comments collected during the social participation process; components of the Environmental Study will be indicated that accommodate and respond to the matters proposed or the justification for not including them based on the criteria of technical and economic viability set out in D.E. 1040.

OBSERVATIONS MADE BY THE COMMUNITY		
Questions – remarks made by actors	Responses developed during the process	Describe the inclusion in the EIA or justification for not including it/them

ESTUDIO DE IMPACTO AMBIENTAL
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ANEXO 5

Mapas Temáticos

ESTUDIO DE IMPACTO AMBIENTAL
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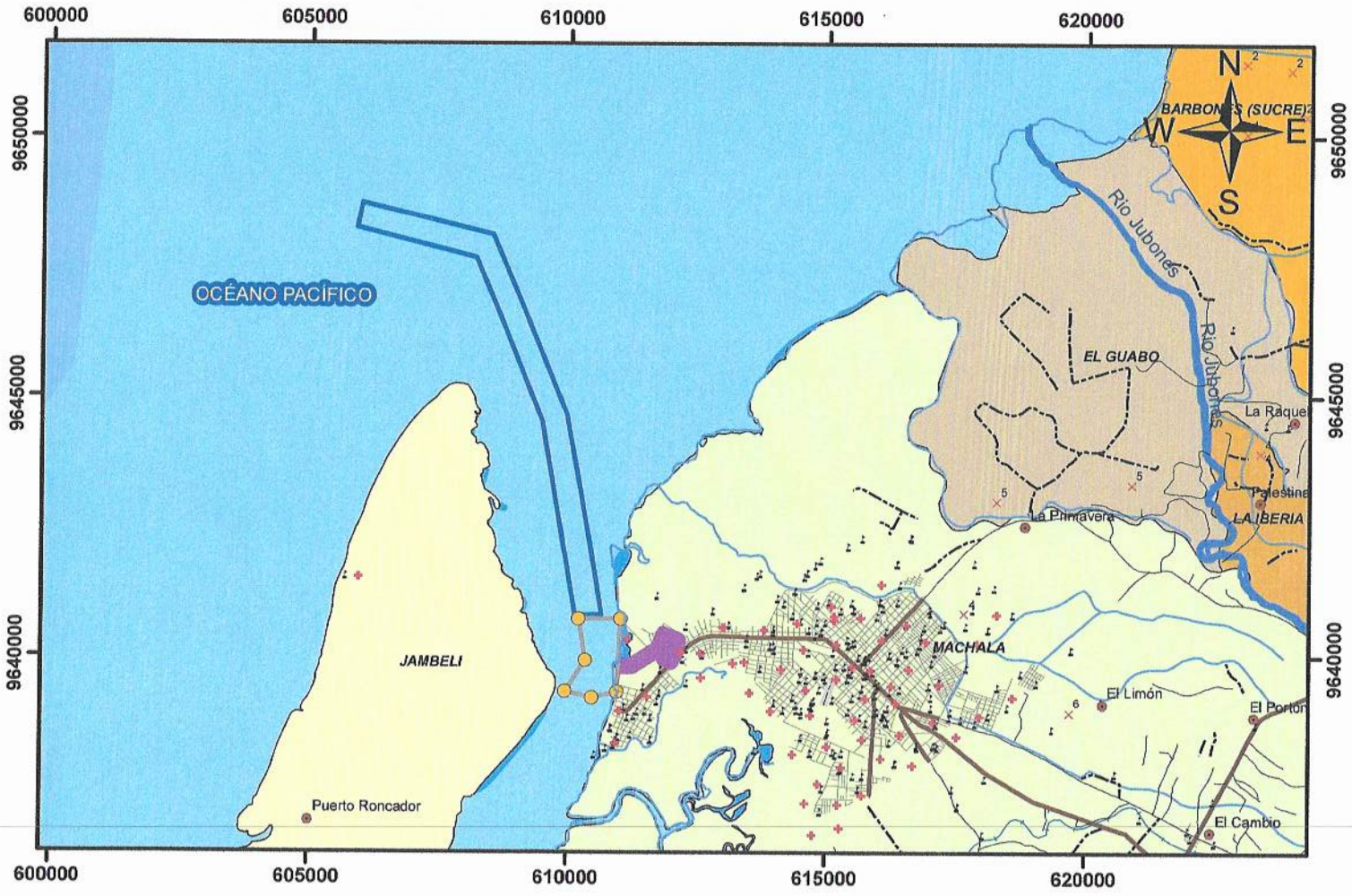
Mapa Base

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:130.678



Km
0 1 2 4 6

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Centro de salud
- Centro educativo
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Puntos de dragado
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

BATIMETRÍA ELEVACIÓN

- -10
- -50

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA BASE	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA
Fuente de información: IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000	
Escala de impresión: 1:130.678	Escala de trabajo: 1:50000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
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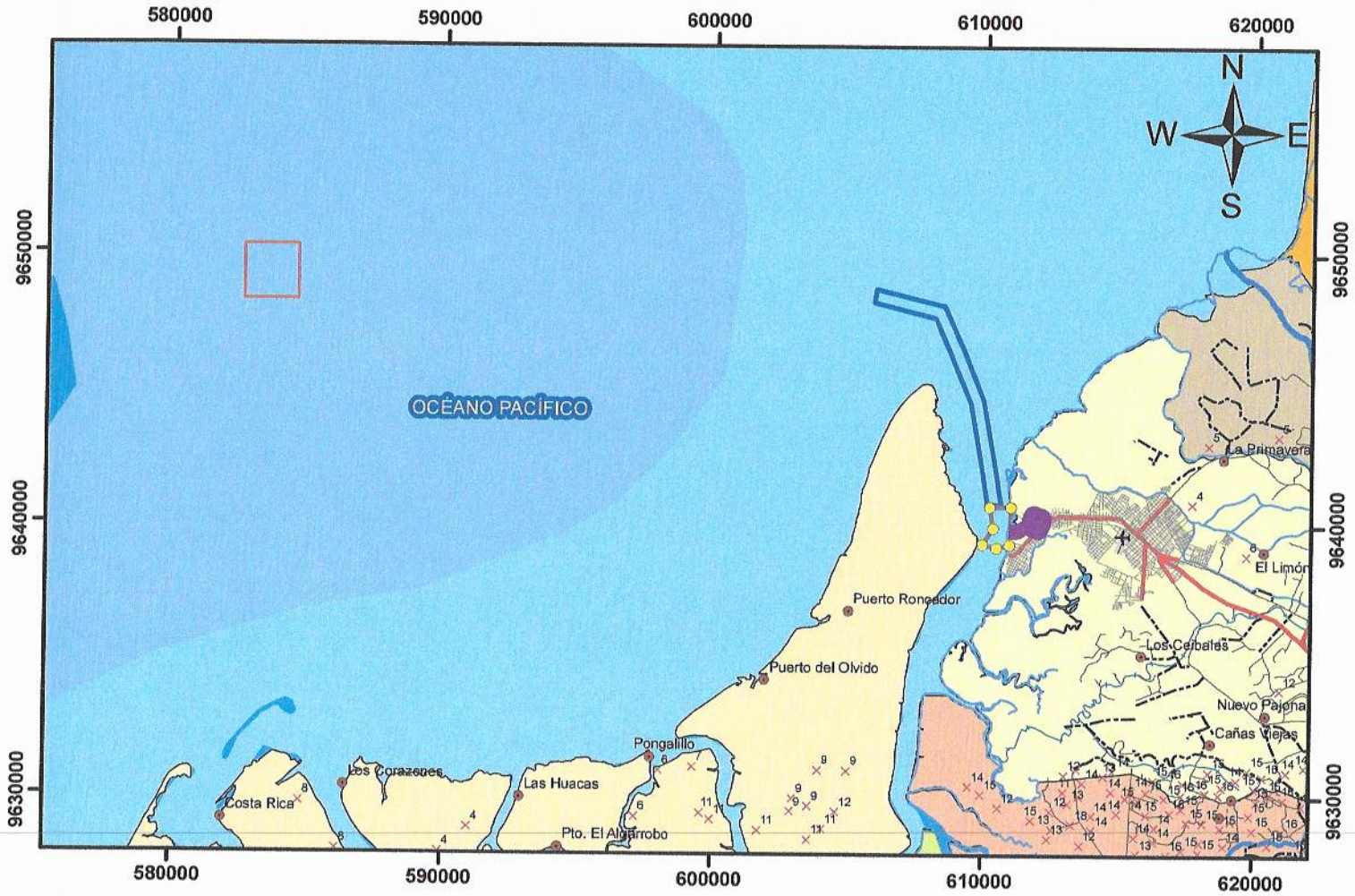
Mapa Implantación del Proyecto

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4,5,6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:250.000



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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Centro educativo
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Área de depósito en altamar
- Canal de acceso

BATIMETRÍA ELEVACIÓN

- -10
- -50
- -100

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Contiene: MAPA DE IMPLANTACIÓN DEL PROYECTO

Elaborado por:	Consultora Ambiental:
Ing. María Fernanda González	ECOSFERA CONSULTORA AMBIENTAL

Fuente de información: IGM, Cartografía Base 1:50000
INEC, Límites administrativos 1: 50000

Escala de impresión:	Escala de trabajo:	Fecha:
1:250.000	1:50000	Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
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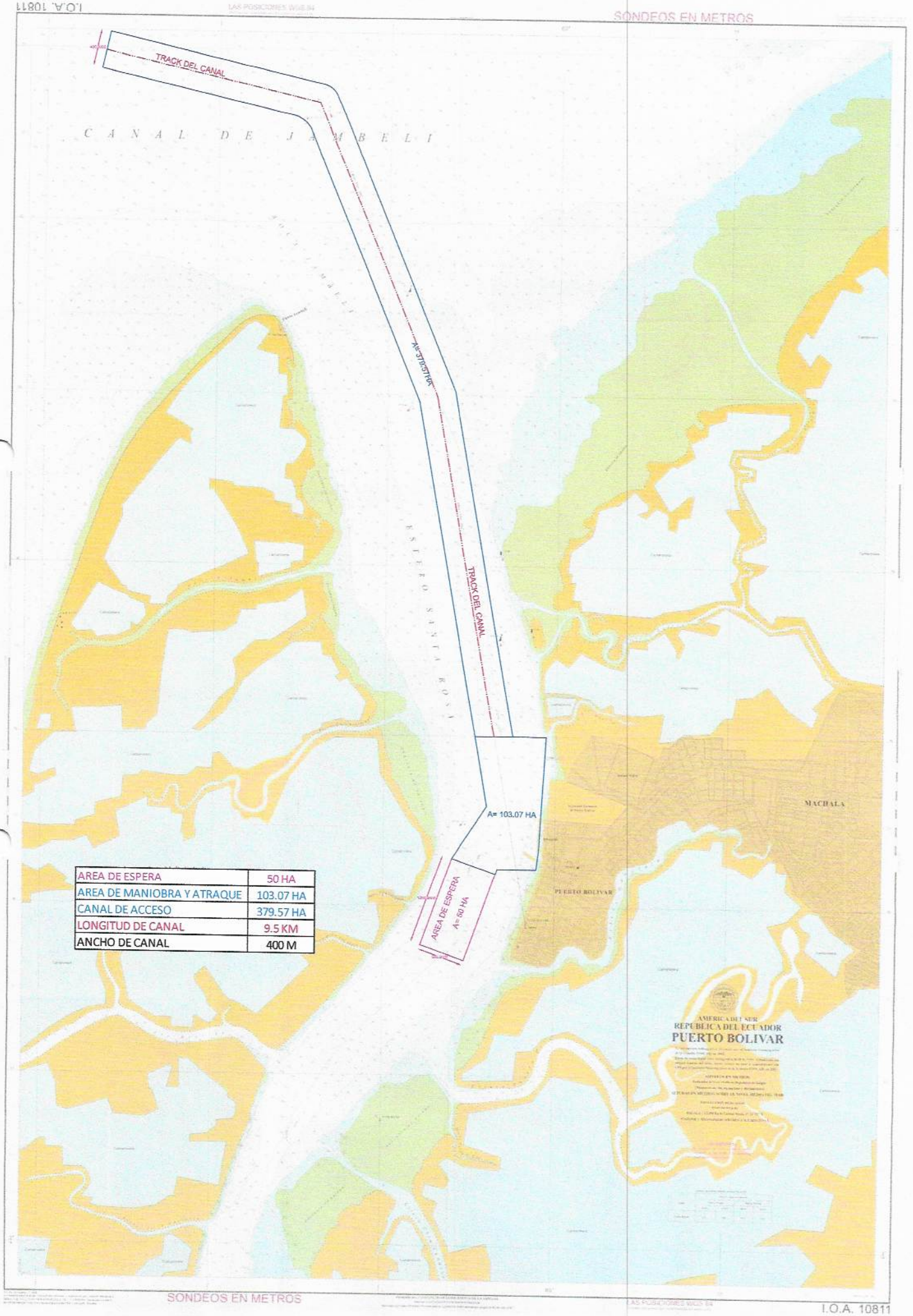
Mapa de Batimetría

SONDEOS EN METROS



AREA DE ESPERA	50 HA
AREA DE MANIOBRA Y ATRAQUE	103.07 HA
CANAL DE ACCESO	379.57 HA
LONGITUD DE CANAL	9.5 KM
ANCHO DE CANAL	400 M

SONDEOS EN METROS

LAS POSICIONES WGS 84

I.O.A. 10811

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Mapa Geología

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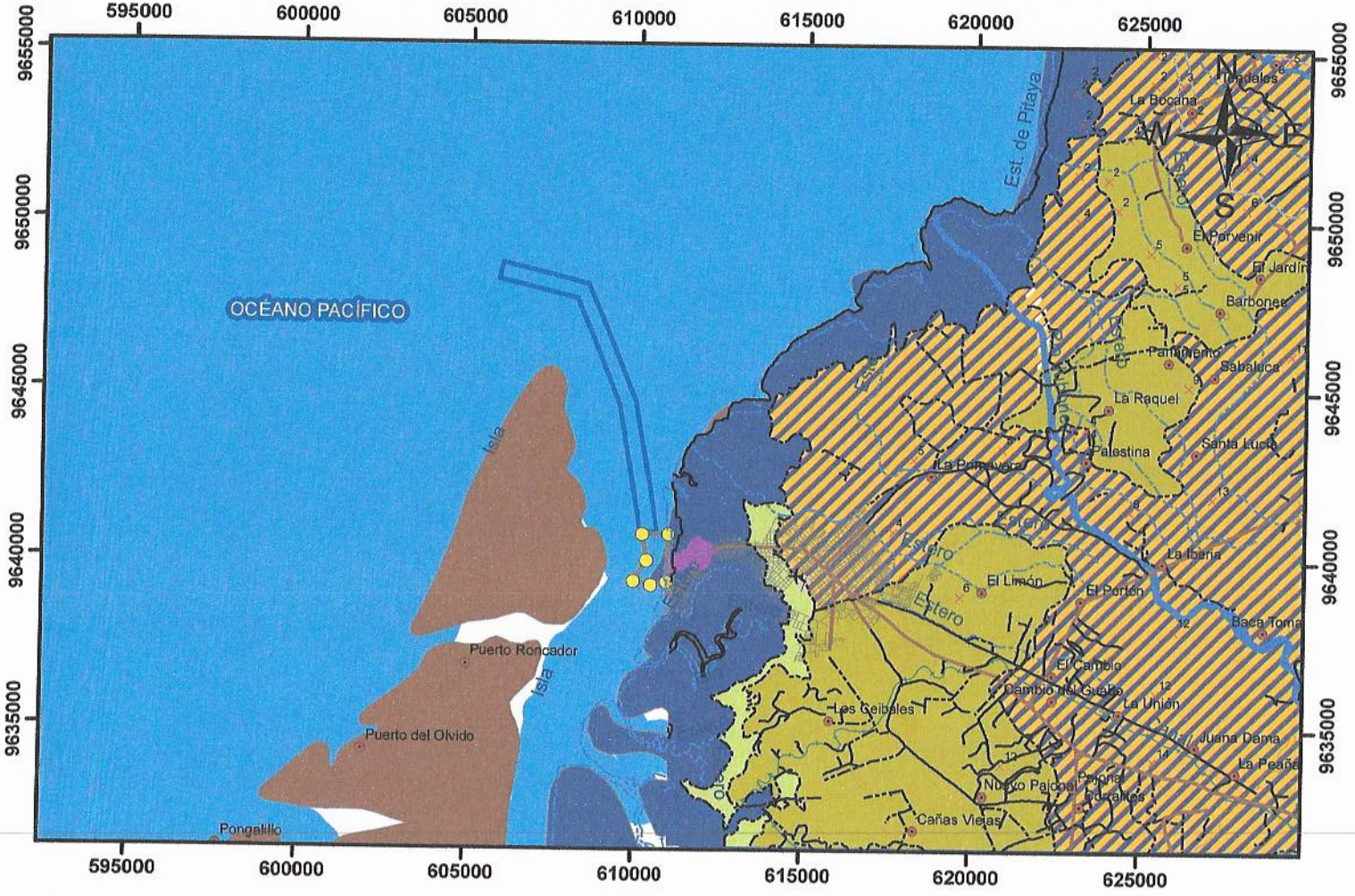
ECUADOR Escala 1:200.000



Km
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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

- Contaco
- Contacto inferido

Litología

- FORMACIÓN PUNÁ
- (manglares) depósito aluvia,l de estero (salitral)
- cuaternario indiferenciado
- depóosito aluvial
- Arcillas marinas de estuario

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA DE GEOLOGÍA
Elaborado por: Ing. María Fernanda González	**Consultora Ambiental:** ECOSFERA CONSULTORES AMBIENTALES
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 Carta geológica MACHALA, 1:100000
Escala de impresión: 1:200.000	**Escala de trabajo:** 1:100000 — **Fecha:** Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
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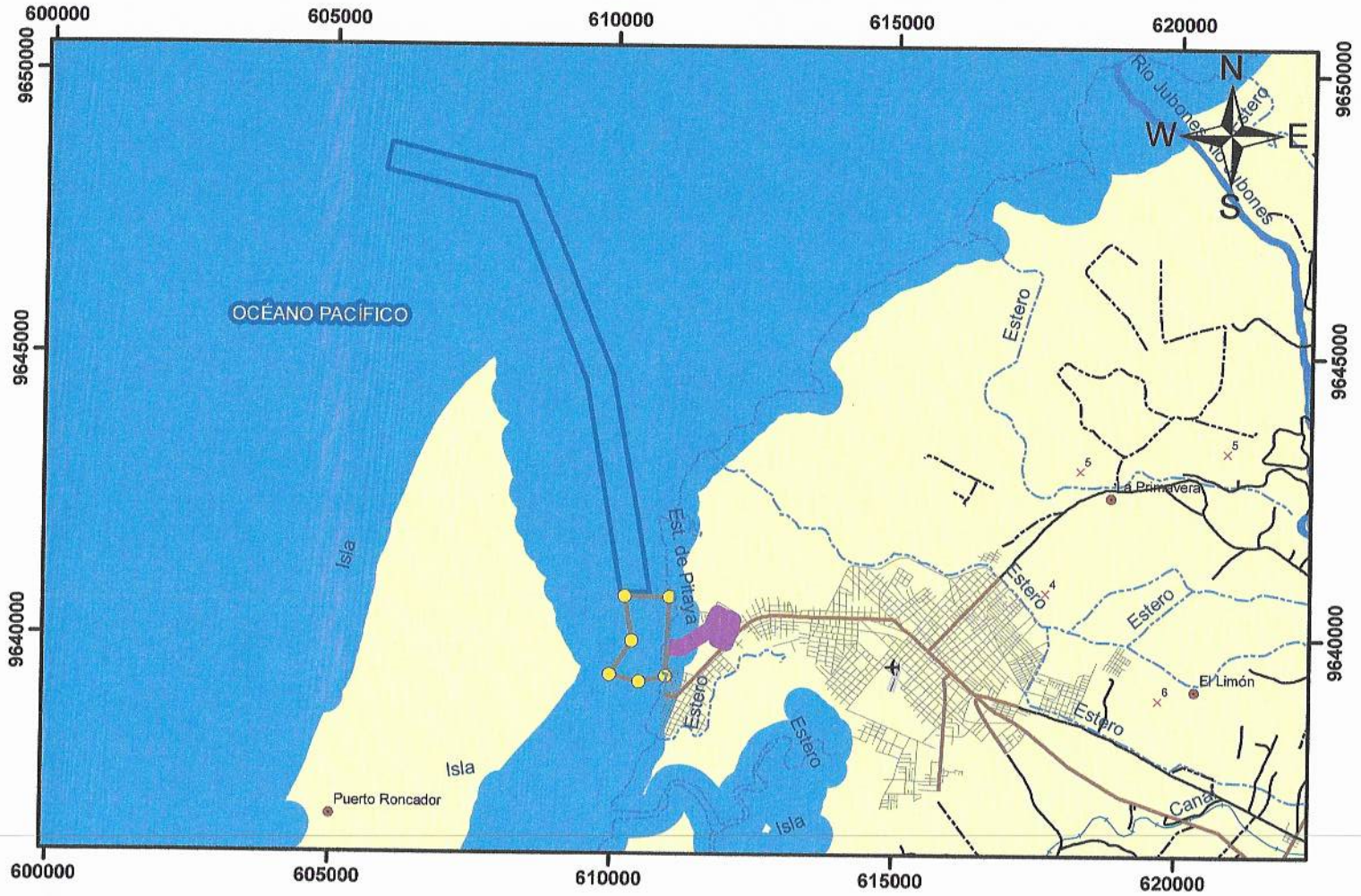
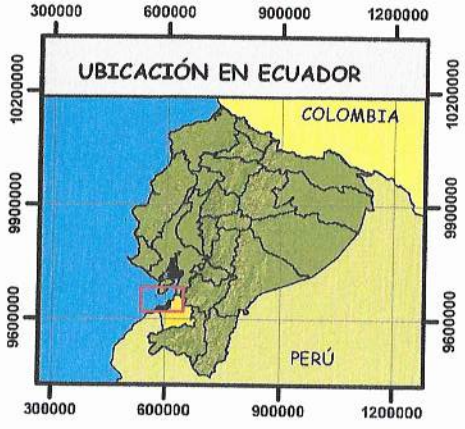
Mapa Geomorfología Mesorelieve

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:120.000





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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

MESORELIEVE

- LLANURA LITORAL

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE GEOMORFOLOGÍA - MESORELIEVE	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAE, Escala 1:100000
Escala de impresión: 1:120.000	Escala de trabajo: 1:100000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
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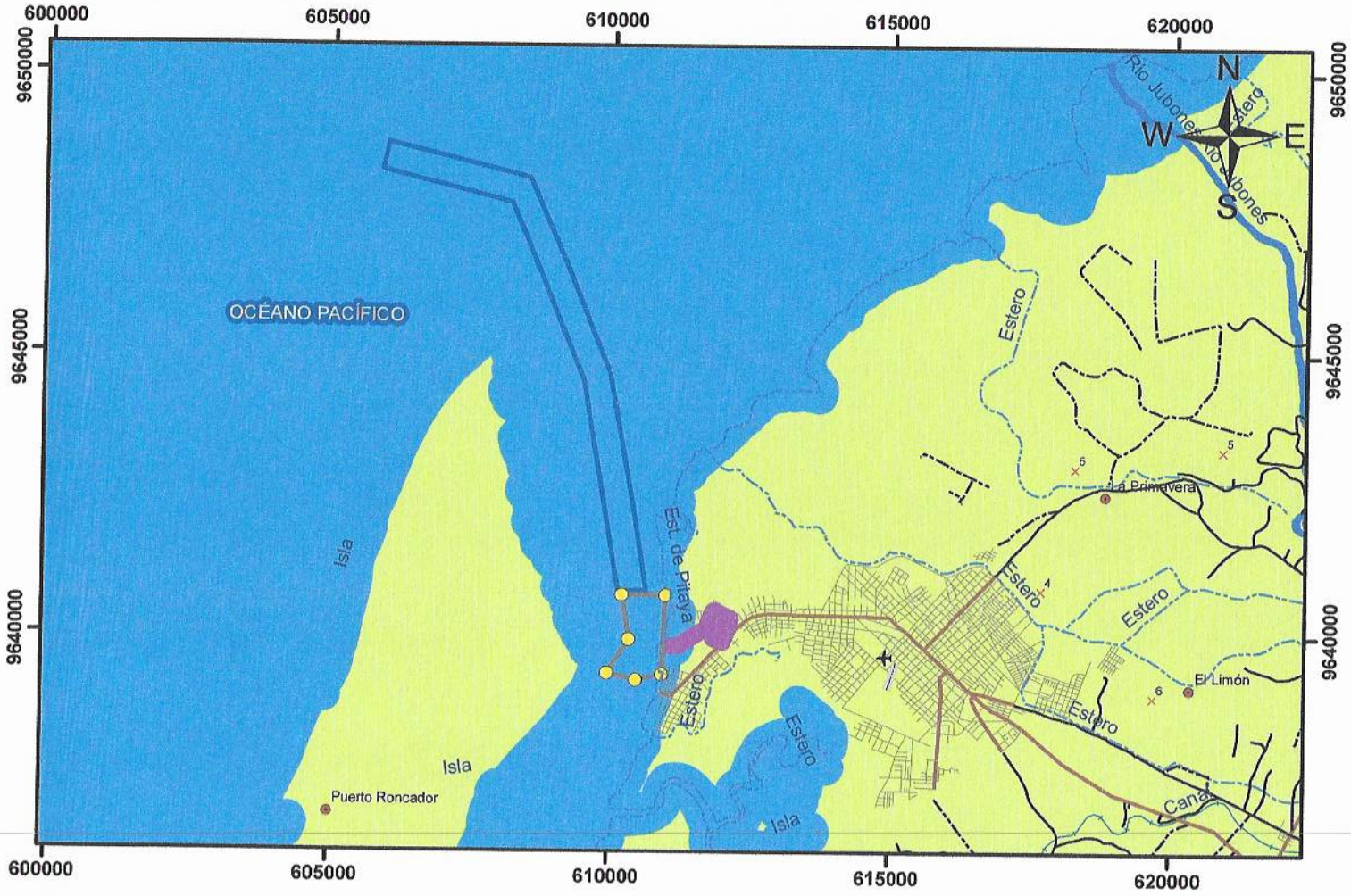
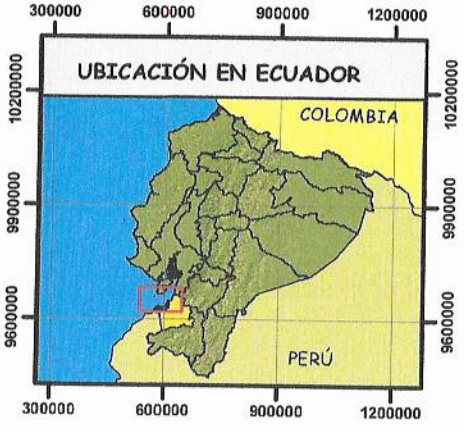
Mapa Geomorfología Macrorelieve

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:120.000





Km
0 1 2 4 6

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

MACRORELIEVE

- LLANURA

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE GEOMORFOLOGÍA - MACRORELIEVE	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAE 1:100000
Escala de impresión: 1:120.000	Escala de trabajo: 1:100000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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PUERTO BOLIVAR

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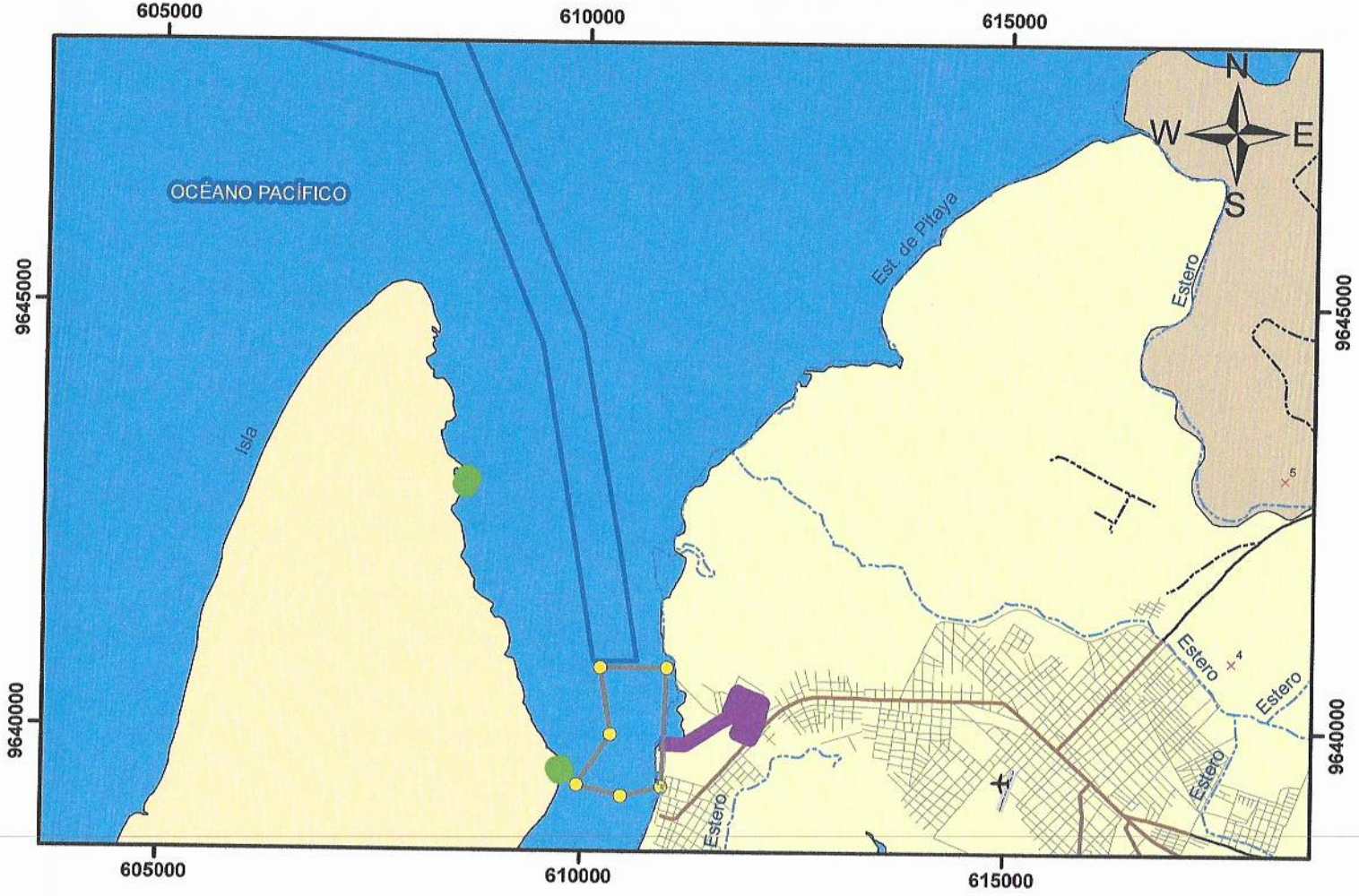
CONSULTORA AMBIENTAL

Mapa Inventario Forestal

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:80.000



Km
0 0,5 1 2 3

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

- Parcelas de inventario forestal

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA DE UBICACIÓN DE LAS PARCELAS DE INVENTARIO FORESTAL
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORES AMBIENTALES
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000
Escala de impresión: 1:80.000	Escala de trabajo: 1:50000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
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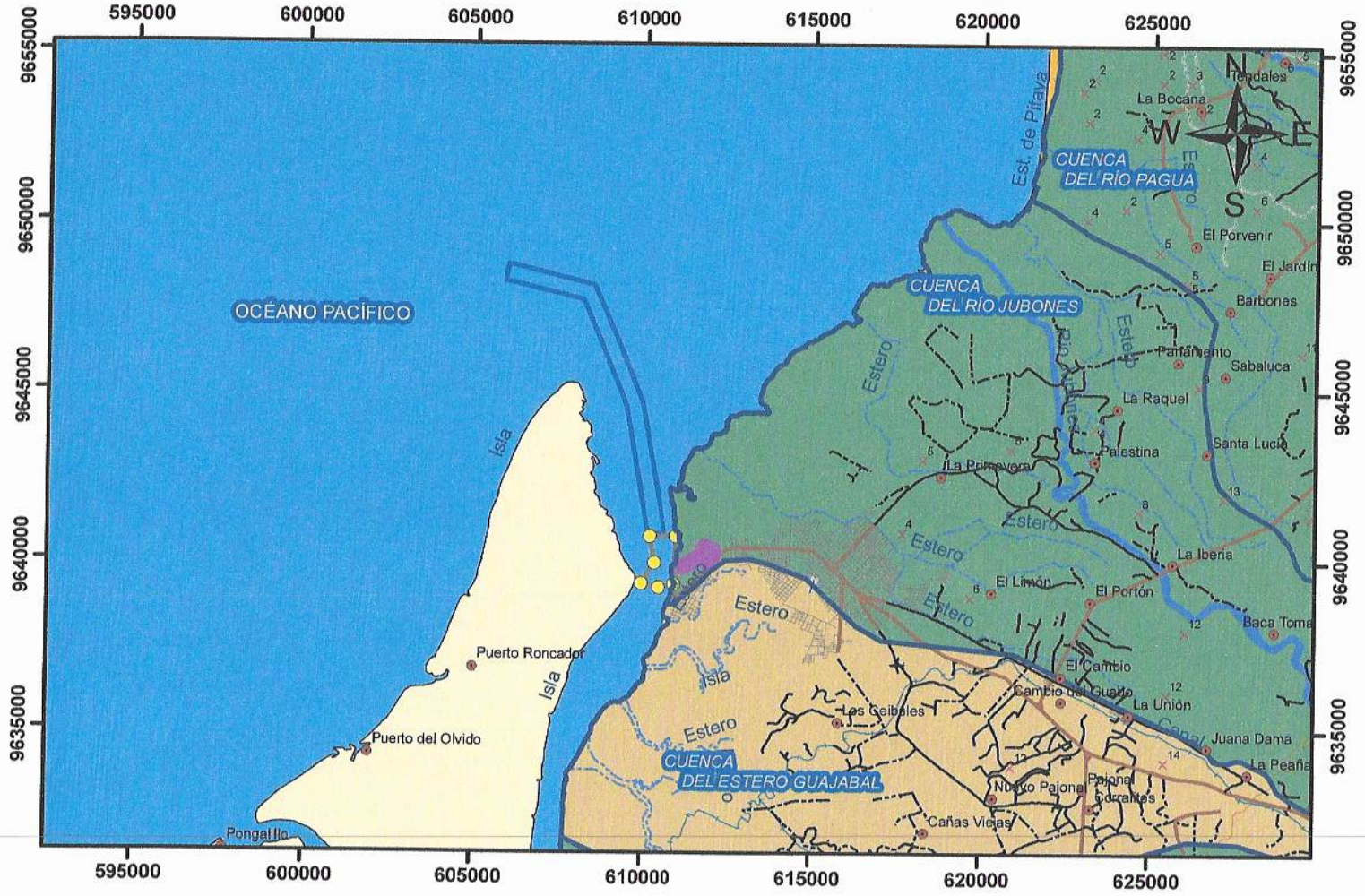
Mapa Hidrogeológico

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:200.000



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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Puntos de dragado
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

- Límite de Cuenca Hidrográfica

MICROCUENCAS

- Drenajes Menores
- Estero Guajabal

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA HIDROGEOLÓGICO
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 INFOPLAN, 1:100000
Escala de impresión: 1:200.000	Escala de trabajo: 1:100000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
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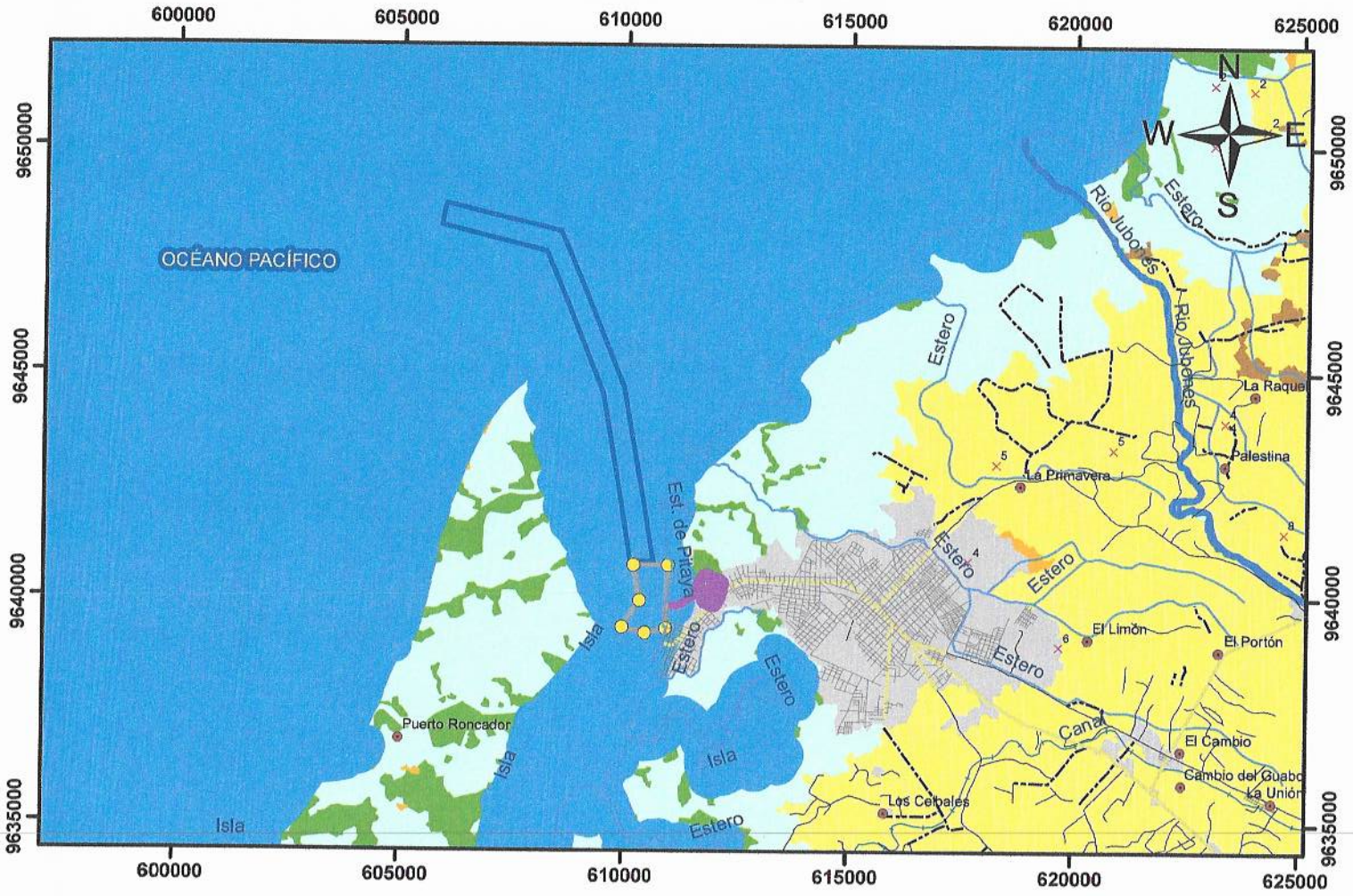
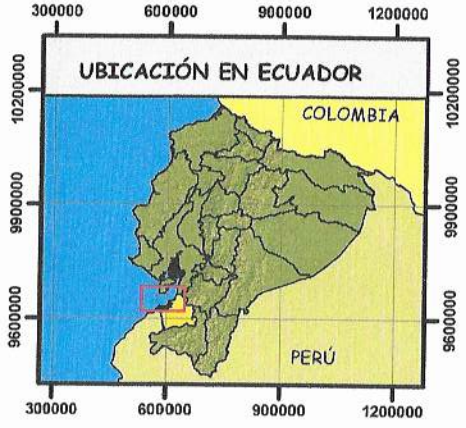
Mapa de Cobertura Vegetal

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4,5,6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:150.000





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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Sendero o vereda
- Vía en área urbana

Red hídrica

- Río
- Estero
- Canal
- Zona de maniobras
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Canal de acceso

LEYENDA

Cobertura Vegetal

- BOSQUE
- VEGETACION ARBUSTIVA Y HERBACEA
- TIERRA AGROPECUARIA
- OTRAS TIERRAS
- CUERPO DE AGUA
- ZONA ANTROPICA

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE COBERTURA VEGETAL	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAE, 1:100000
Escala de impresión: 1:150.000	Escala de trabajo: 1:100000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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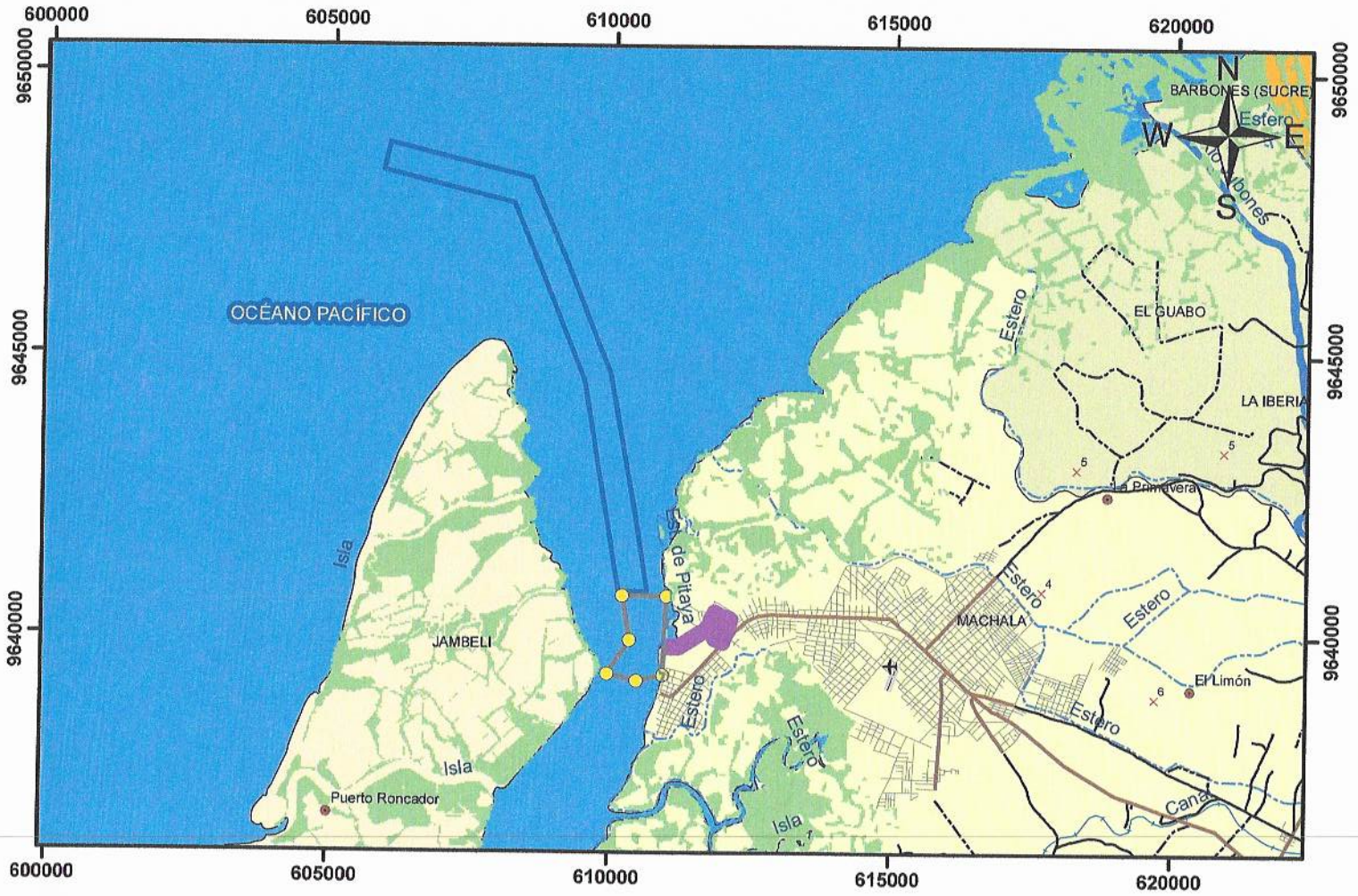
Mapa de Patrimonio Nacional de Áreas Naturales

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:120.000



Km
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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

MANGLARES

YILPORT PUERTO BOLIVAR

YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE PATRIMONIO NACIONAL DE ÁREAS NATURALES

Elaborado por: Ing. María Fernanda González	**Consultora Ambiental:** ECOSFERA CONSULTORÍA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAE, Escala 1:100000

Escala de impresión:	Escala de trabajo:	Fecha:
1:120.000	1:100000	Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
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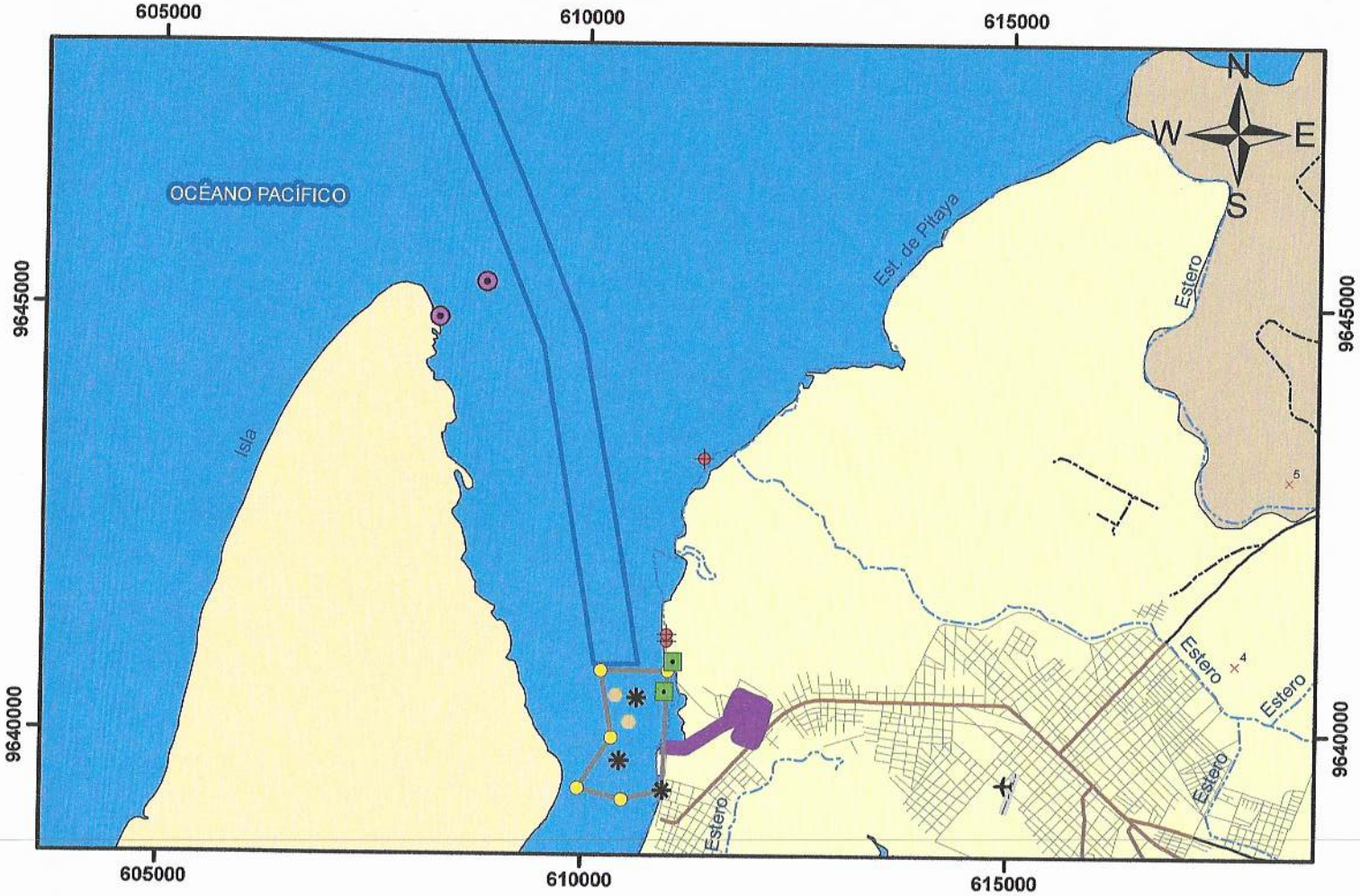
Mapa Monitoreo Biótico

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:80.000



SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

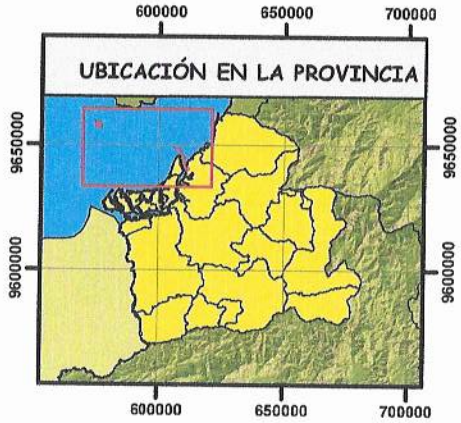
- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

- Avistamiento de aves
- Monitoreo entomofauna
- Monitoreo Ictiologico
- Monitoreo herpetofauna
- Monitoreo de flora



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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE MONITOREO BIÓTICO	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORÍA AMBIENTAL
Fuente de información: IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000	
Escala de impresión: 1:80.000	Escala de trabajo: 1:50000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
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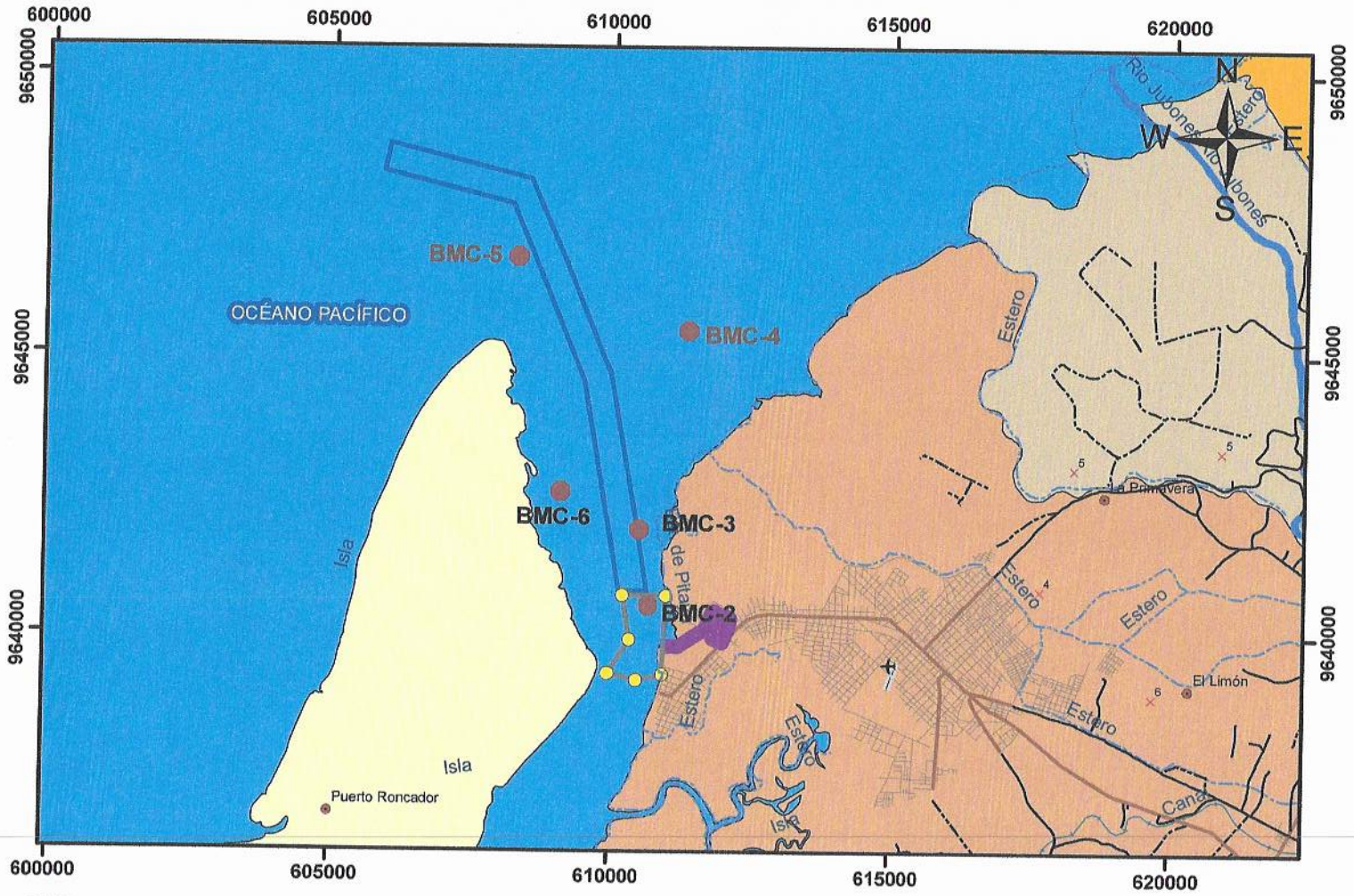
Mapa Puntos de Bioensayos

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:120.000



SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

Puntos para bioensayos de mortalidad de camarón

Km
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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA DE PUNTOS PARA BIOENSAYOS DE MORTALIDAD DE CAMARÓN
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000
Escala de impresión: 1:120.000	Escala de trabajo: 1:50000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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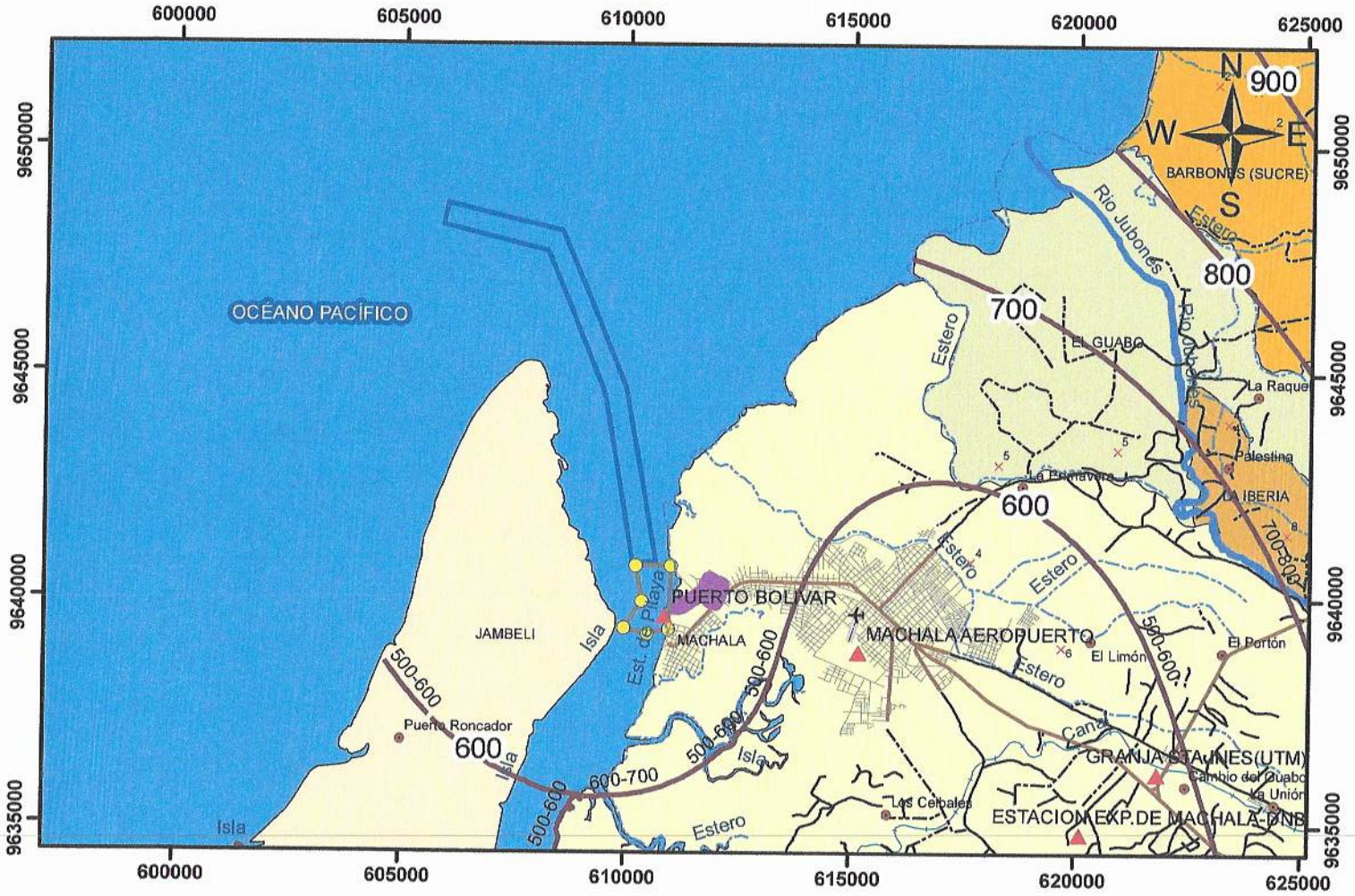
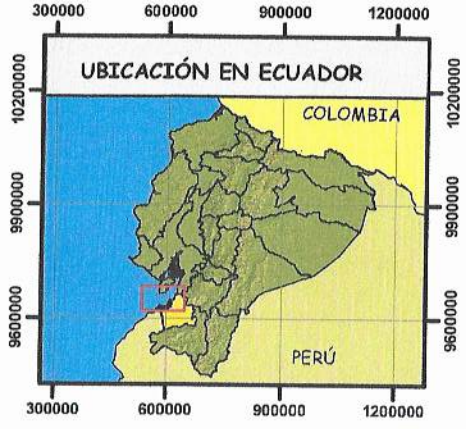
Mapa Isoyetas

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:150.000





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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Curvas de nivel
- Piscina de sedimentos
- Tubería desde muelles a puerto de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

- Estaciones metereológicas
- Isoyetas (mm/anuales)

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA DE ISOYETAS
Elaborado por: Ing. María Fernanda González	**Consultora Ambiental:** ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAGAP, INAMHI
Escala de impresión: 1:150.000	**Escala de trabajo:** 1:100000 — **Fecha:** Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
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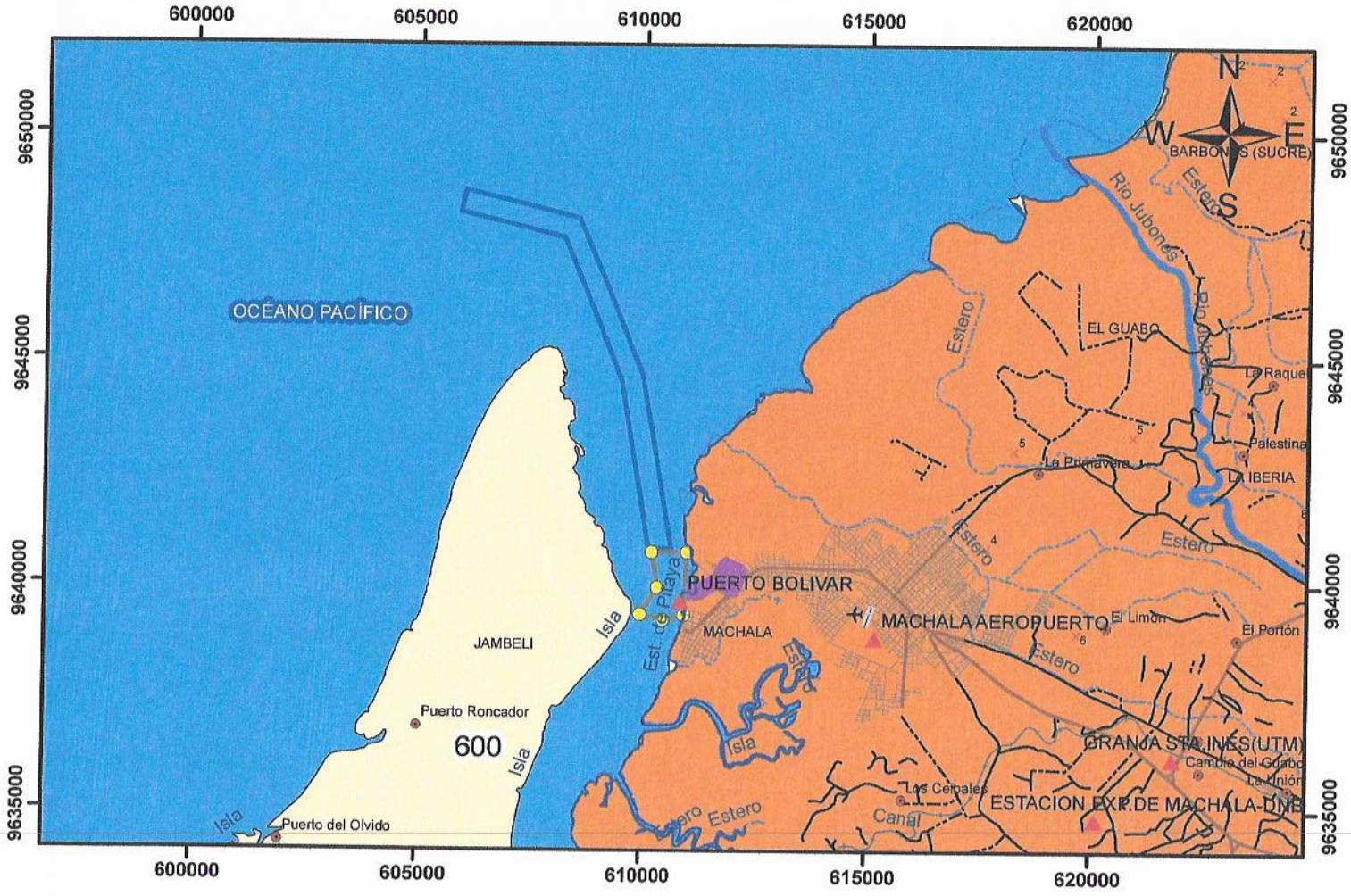
Mapa Isotermas

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:150.000



Km
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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Curvas de nivel
- Puntos de dragado
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

- Estaciones metereológicas

Zonas de temperatura (°C)

- 25-26 °C

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA DE ISOTERMAS
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORÍA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAGAP, INAMHI
Escala de impresión: 1:150.000	Escala de trabajo: 1:100000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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PUERTO BOLIVAR

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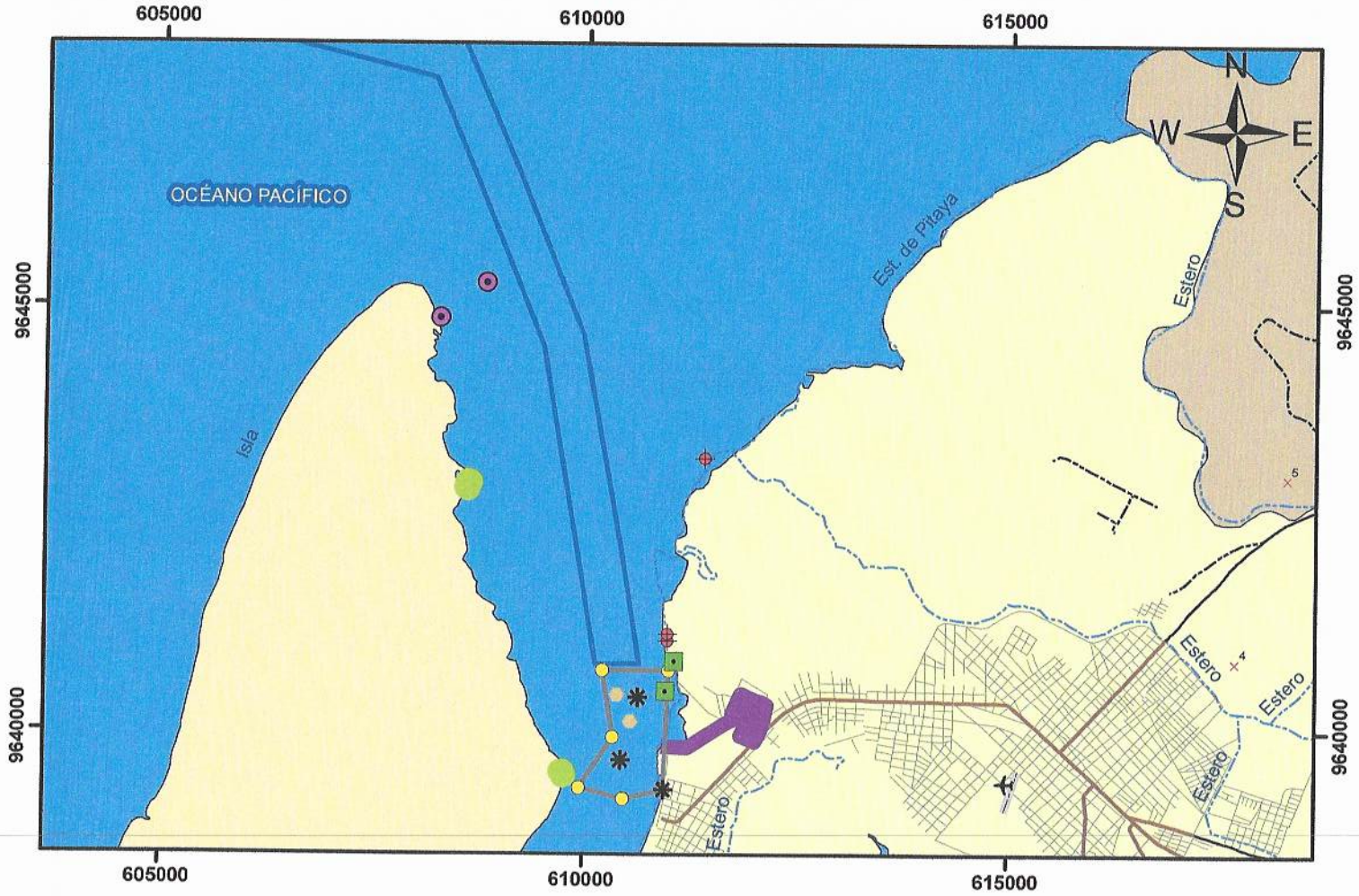
Mapa
Monitoreo Biótico

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:80.000



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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Zona de maniobras
- Piscina de sedimentos
- Canal de acceso

LEYENDA

- Avistamiento de aves
- Monitoreo entomofauna
- Monitoreo Ictiologico
- Monitoreo herpetofauna
- Monitoreo de flora
- Parcelas de inventario forestal

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA DE MONITOREO BIÓTICO
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORES AMBIENTALES
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000
Escala de impresión: 1:80.000	Escala de trabajo: 1:50000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
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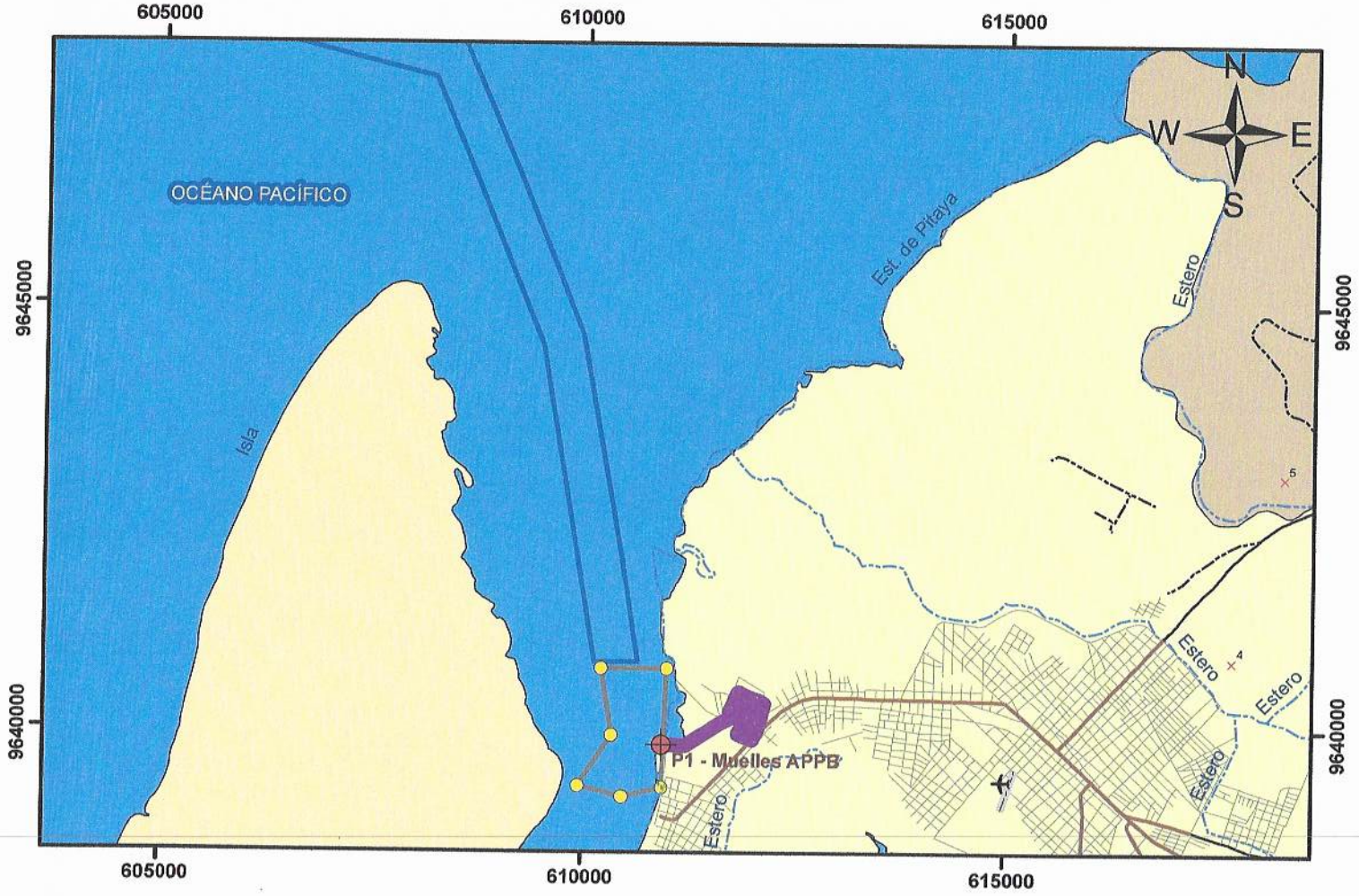
Mapa
Monitoreo Gases

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:80.000



SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

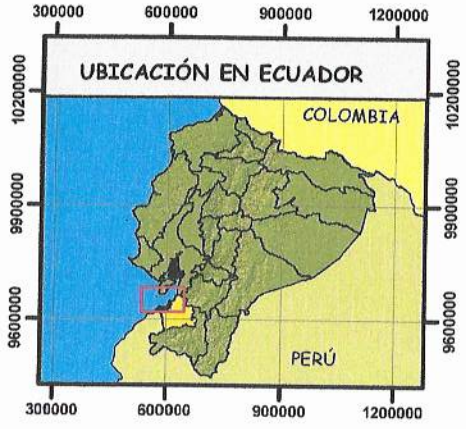
- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

Punto de monitoreo de gas ambiente



Km
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Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE MONITOREO DE GAS AMBIENTE	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información: IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000	
Escala de impresión: 1:80.000	Escala de trabajo: 1:50000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

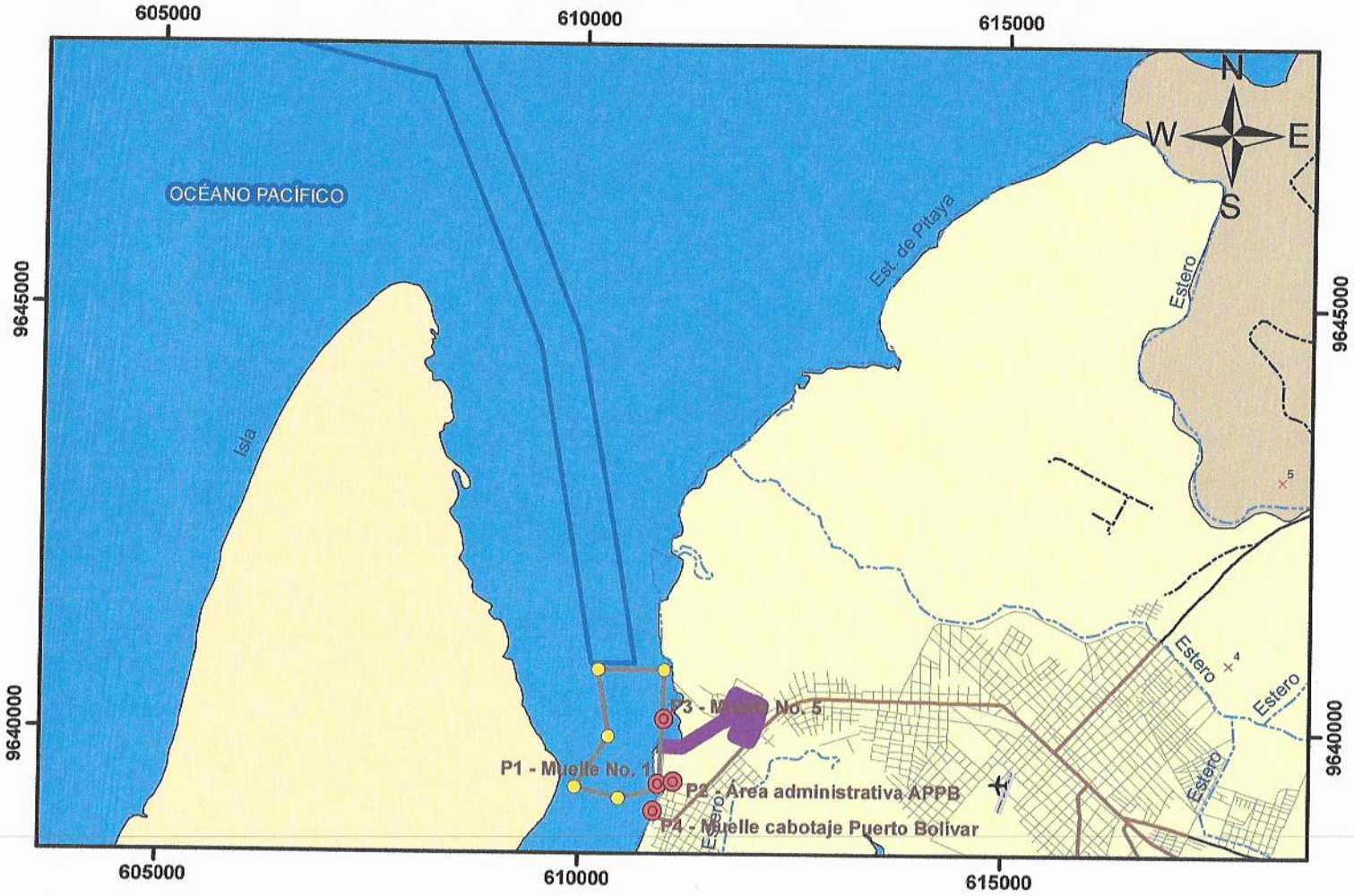
YILPORT
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

Mapa Monitoreo de Ruido

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:80.000



Km
0 0,5 1 2 3

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

- Puntos de monitoreo de ruido ambiente

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE MONITOREO DE RUIDO AMBIENTE	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información: IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000	
Escala de impresión: 1:80.000	Escala de trabajo: 1:50000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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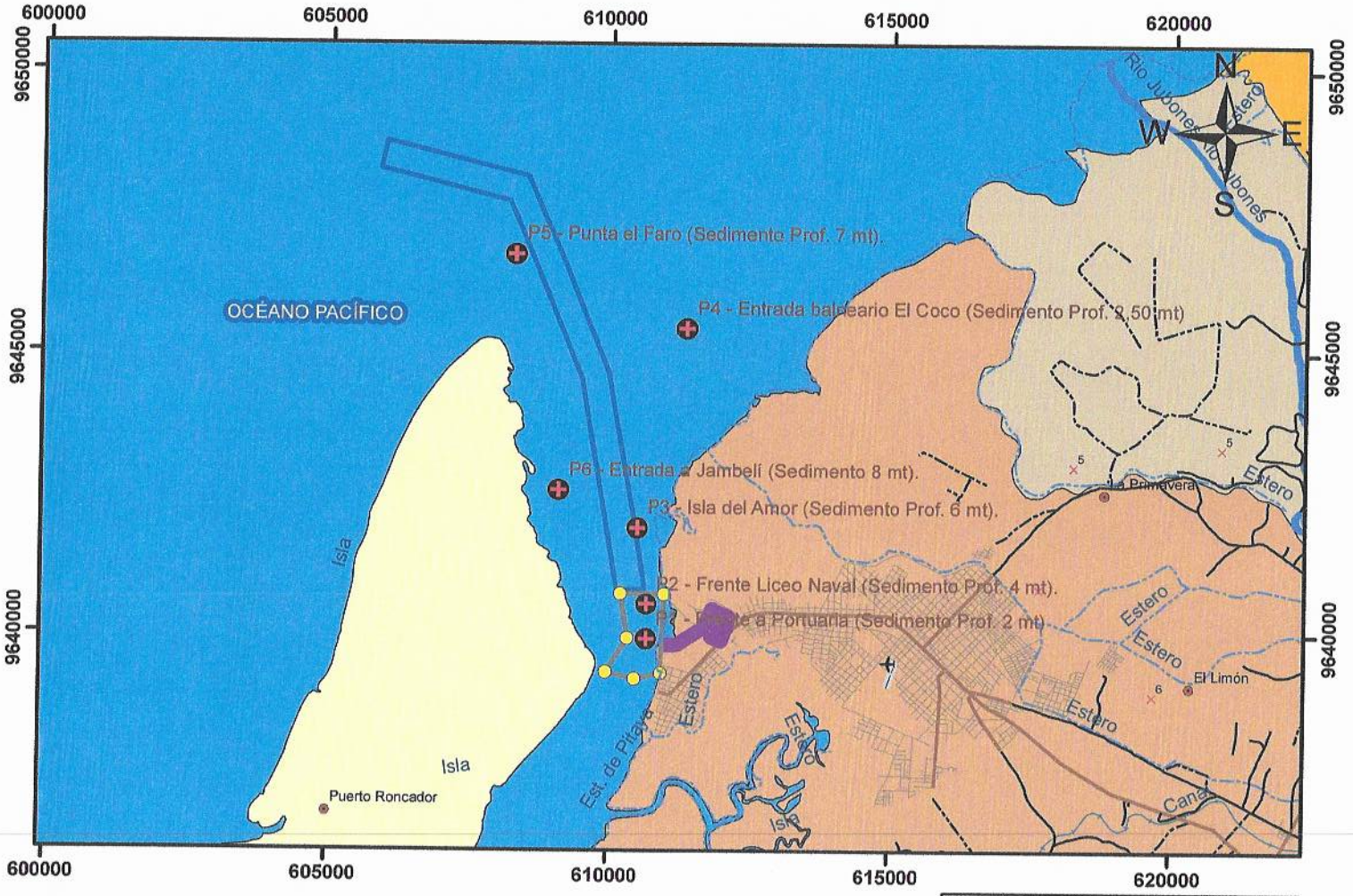
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

Mapa Muestreo de Agua

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:120.000



SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

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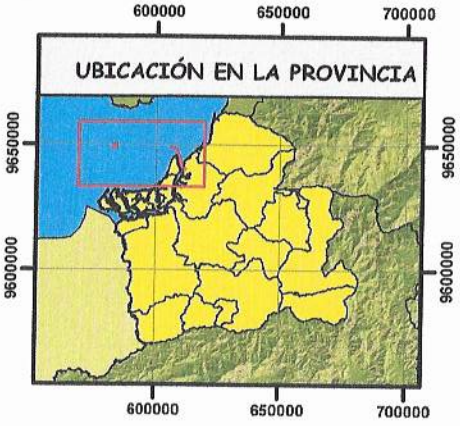
- Río
- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

Puntos de monitoreo de agua



Km
0 1 2 4 6

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

RESULTADOS DE LABORATORIO

	P1	P2	P3	P4	P5	P6
Arsénico						
Cadmio						
Cromo						
Cobre						
Hierro						
Mercurio						
Coliformes totales						
Tensoactivos						
Aceites y grasas						
DBO						
DQO						
HTP						
Oxigeno disuelto						
Amoniaco						
SST						

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE MUESTREO DE AGUA

Elaborado por:	Consultora Ambiental:	
Ing. María Fernanda González	ECOSFERA CONSULTORÍA AMBIENTAL	
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000	
Escala de impresión: 1:120.000	**Escala de trabajo:** 1:50000	**Fecha:** Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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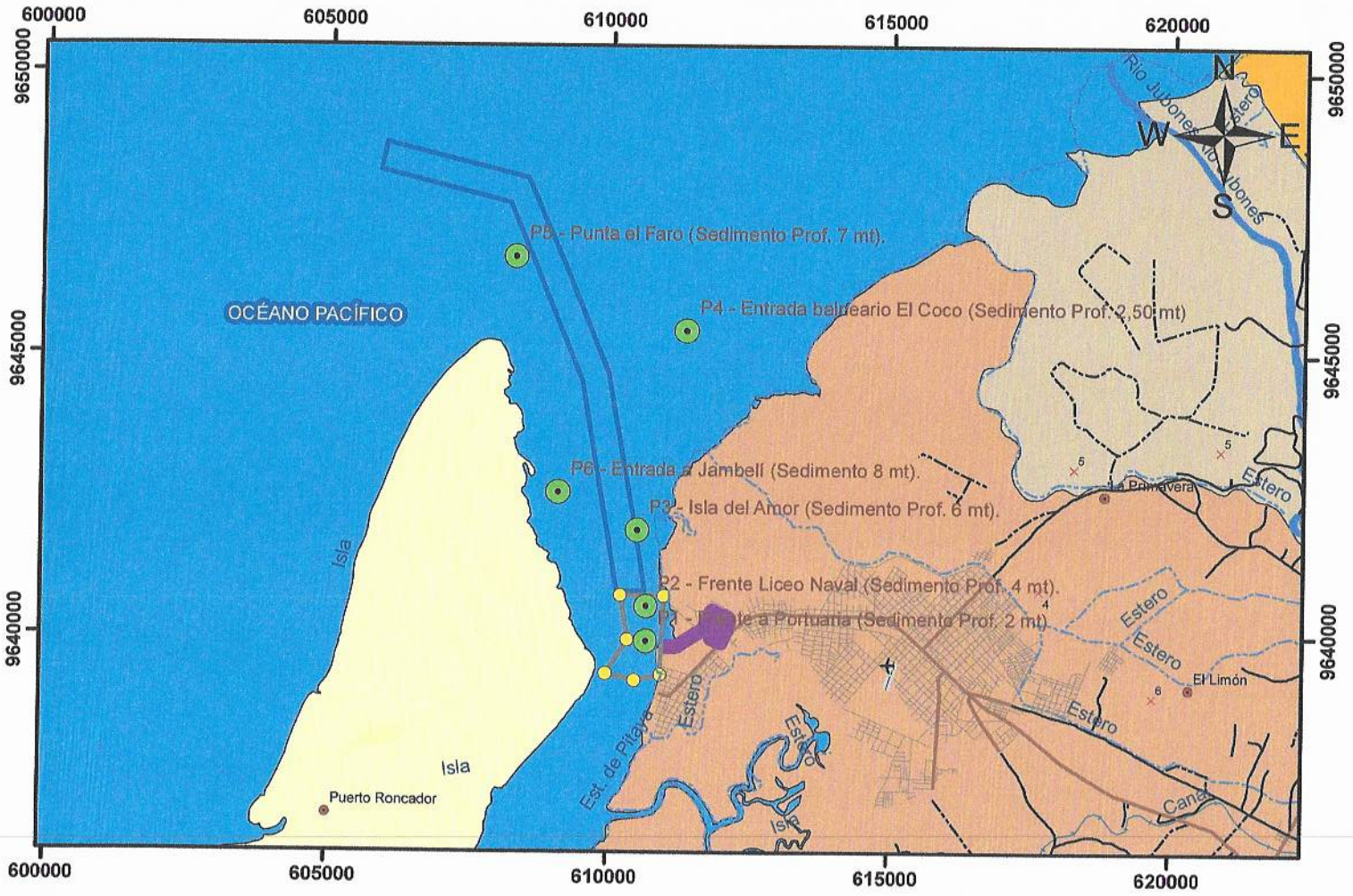
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

Mapa Muestreo de Sedimentos

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:120.000



Km
0 1 2 4 6

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

RESULTADOS DE LABORATORIO	P1	P2	P3	P4	P5	P6
Arsénico						
Cromo						
Cadmio						
Cobre						
Hierro						
Mercurio						
Plomo						
HTP						
pH						

SIMBOLOGÍA

- Cotas
- Poblados
- Puntos de dragado
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
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- Sendero o vereda

Red hídrica

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- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

Puntos de monitoreo de sedimentos

YILPORT PUERTO BOLIVAR

YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE MONITOREO DE SEDIMENTOS

Elaborado por: Ing. María Fernanda González	**Consultora Ambiental:** ECOSFERA CONSULTORA AMBIENTAL
Fuente de información: IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000	
Escala de impresión: 1:120.000	**Escala de trabajo:** 1:50000
Fecha: Abril/2017	

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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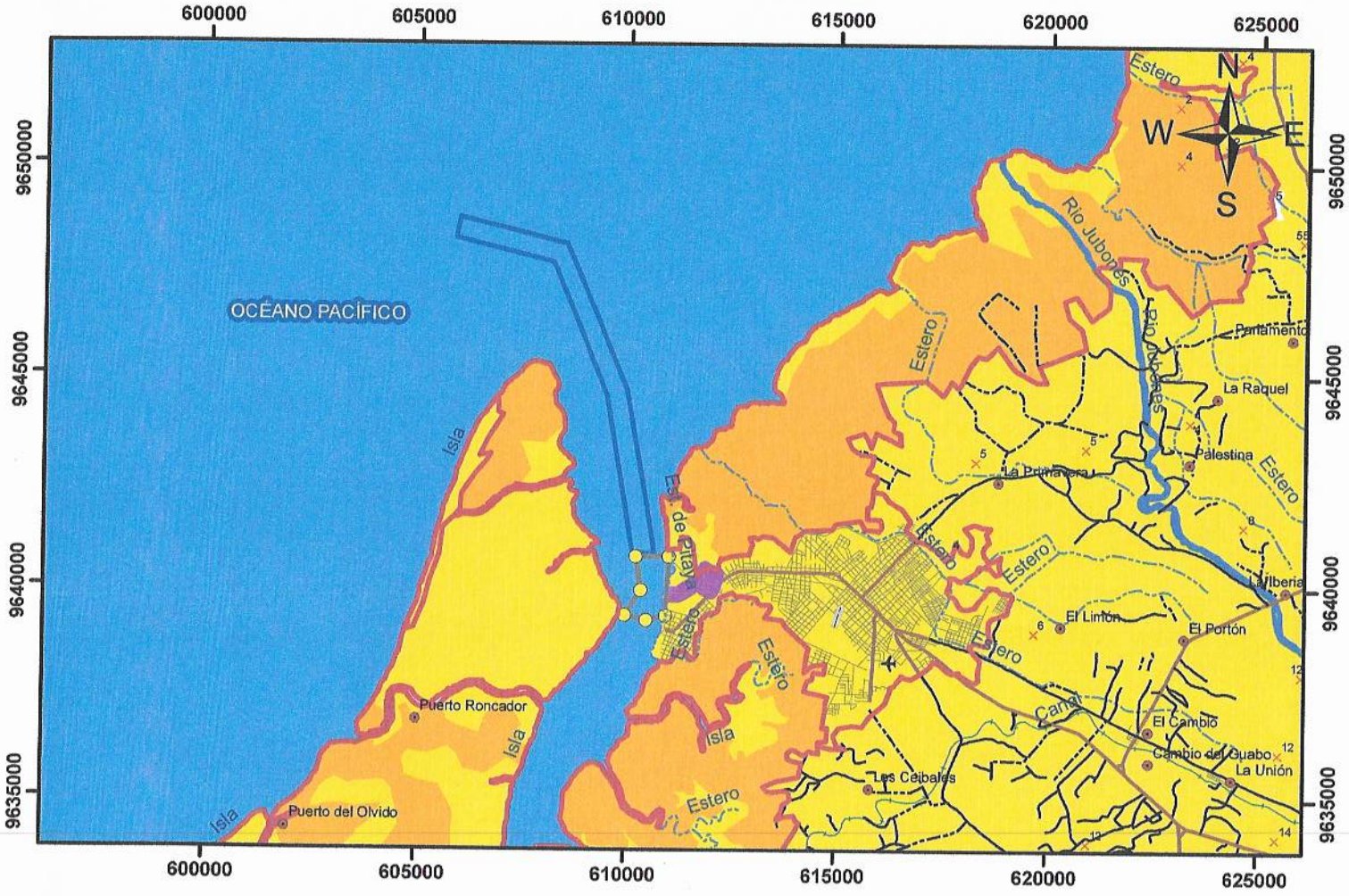
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

Mapa
Sensibilidad Física

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:160.000



Km
0 1 2 4 6

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Piscina de sedimentos
- Aeropuerto

Red vial

- Vía de primer orden
- Vía de segundo orden
- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Puntos de dragado
- Zona de maniobras
- Tubería desde muelles a puerto de sedimentos
- Canal de acceso

LEYENDA

Áreas de sensibilidad física

- Mediana susceptilidad
- Baja susceptibilidad
- Área de inundación

YILPORT PUERTO BOLIVAR

YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE SENSIBILIDAD FÍSICA		
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORÍA AMBIENTAL	
Fuente de información: IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 INFLOPLAN, 1:100000		
Escala de impresión: 1:160.000	Escala de trabajo: 1:100000	Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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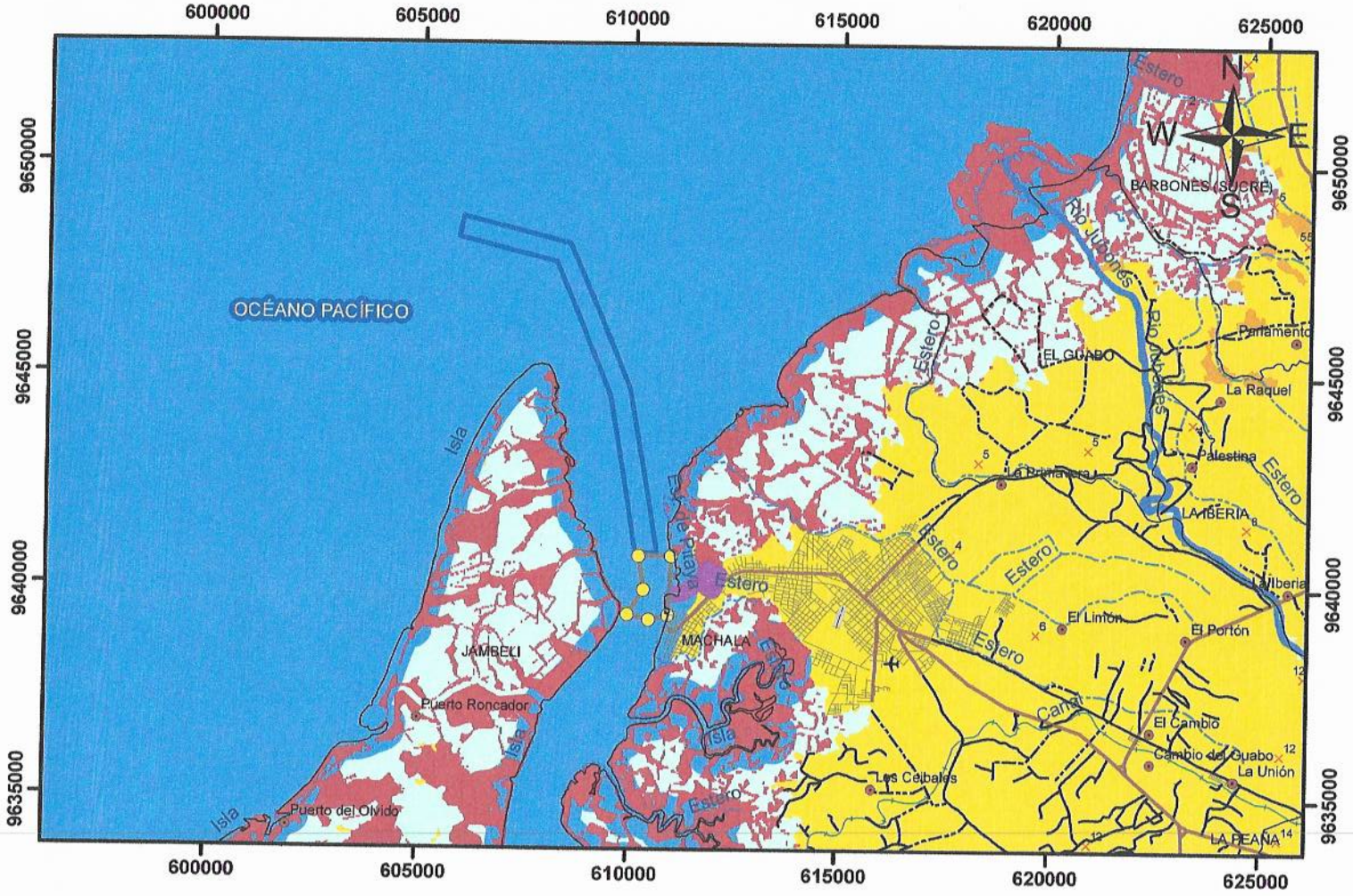
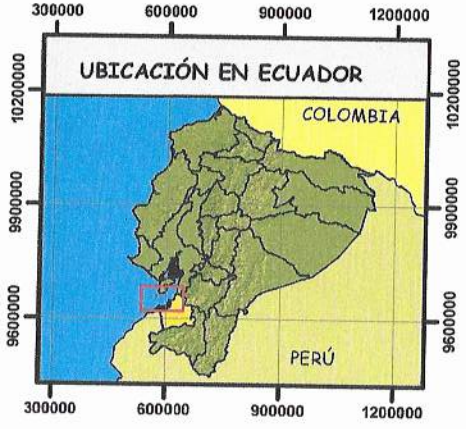
Mapa Sensibilidad Biótica

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:160.000





Km
0 1 2 4 6

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

SIMBOLOGÍA

- Cotas
- Poblados
- Piscina de sedimentos
- Aeropuerto

Red vial

- Vía de primer orden
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- Vía de tercer orden
- Vía en área urbana
- Sendero o vereda

Red hídrica

- Río
- Estero
- Canal
- Puntos de dragado
- Zona de maniobras
- Tubería desde muelles a puerto de sedimentos
- Canal de acceso

LEYENDA

Áreas de sensibilidad biótica

- Alta sensibilidad
- Mediana sensibilidad
- Baja sensibilidad
- Cuerpo de agua

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene:	MAPA DE SENSIBILIDAD BIÓTICA
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAE, 1:100000
Escala de impresión: 1:160.000	Escala de trabajo: 1:100000 — Fecha: Abril/2017

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

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PUERTO BOLIVAR

ECOSFERA
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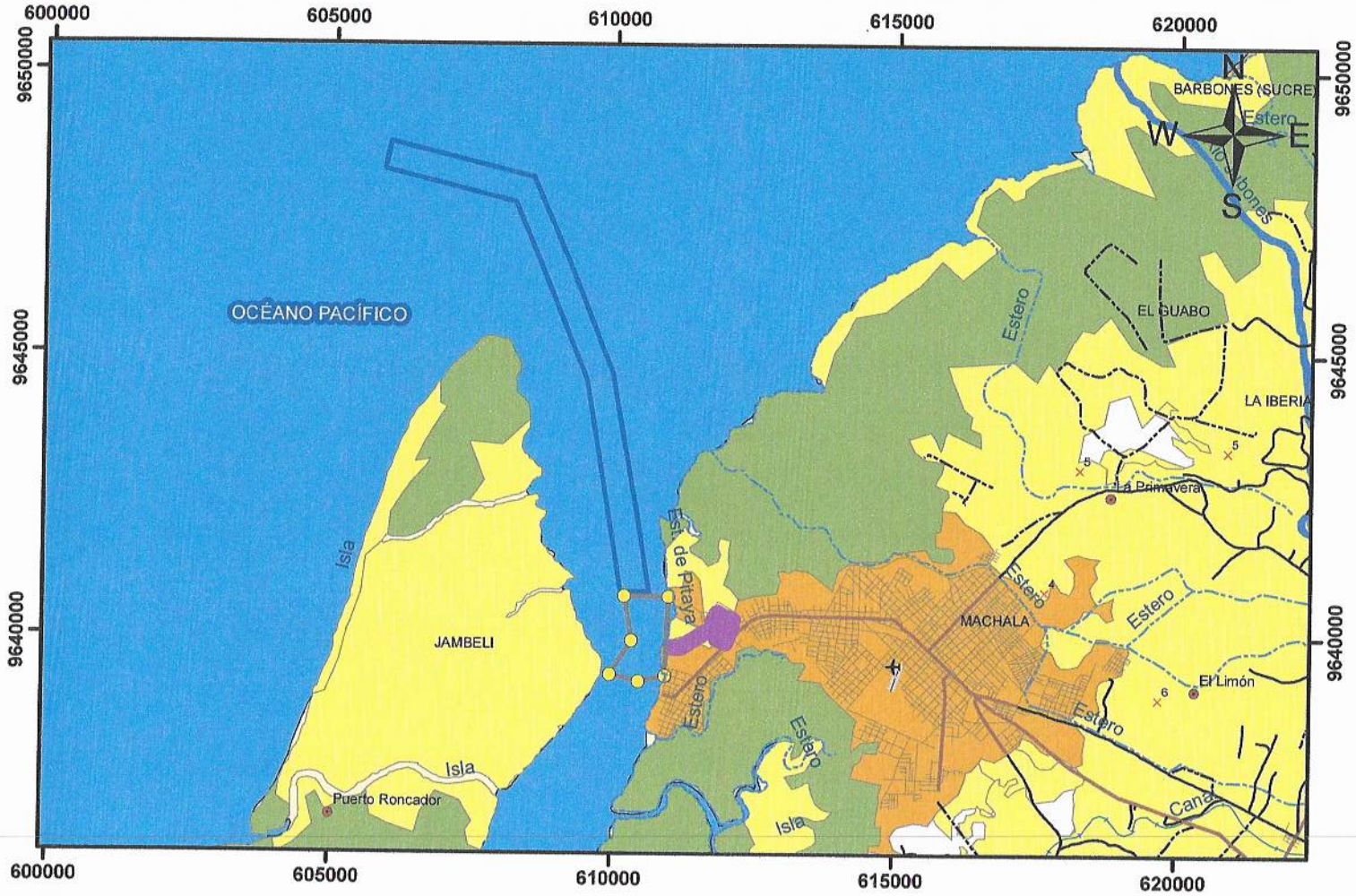
Mapa de Suelos

ESTUDIO DE IMPACTO AMBIENTAL Y PLAN DE MANEJO DRAGADO DE MUELLES 1,2,3,4, 5, 6, ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

ECUADOR Escala 1:120.000



Km
0 1 2 4 6

Proyección: UTM
Zona 17 S
Datum Horizontal WGS 84
Datum Vertical: Nivel medio del mar

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Red hídrica

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- Estero
- Canal
- Tubería desde muelles a puerto de sedimentos
- Piscina de sedimentos
- Zona de maniobras
- Canal de acceso

LEYENDA

ORDEN DEL SUELO

- BASEOc
- BASEU
- ENTISOL
- INCEPTISOL

YILPORT PUERTO BOLIVAR — YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A.

Contiene: MAPA DE TAXONOMÍA DEL SUELO	
Elaborado por: Ing. María Fernanda González	Consultora Ambiental: ECOSFERA CONSULTORA AMBIENTAL
Fuente de información:	IGM, Cartografía Base 1:50000 INEC, Límites administrativos 1: 50000 MAGAP, 1:100000
Escala de impresión: 1:120.000	Escala de trabajo: 1:100000 — Fecha: Abril/2017

ENVIRONMENTAL IMPACT ASSESSMENT
PIER DREDGING 1, 2, 3, 4, 5 AND 6,
MOTION AREA AND ACCESS CHANNEL OF
PUERTO BOLÍVAR

[Logo of YILPORT – PUERTO BOLIVAR]

[Logo of ECOSFERA – ENVIRONMENTAL CONSULTING]

ANNEX 6

Water Quality Analysis

[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-1	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 11:35 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P1 – In front of Port Authority (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0610680 9639902

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED/PHYSICAL COMPONENTS					
Total solids suspended	106	14	mg/l	PEE-GQM-FQ-06	03/30/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
INORGANIC NON-METALS					
Ammonia	0.060	0.012	mg/l	PEE-GQM-FQ-31	03/31/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
METALS					
Arsenic (3)	< 0.0031	---	mg/l	PEE-GQM-FQ-33	04/04/17 AUT
Cadmium (3)	< 0.0004	---	mg/l	PEE-GQM-FQ-33	04/04/17 AUT
Total chromium (3)	< 0.0024	---	mg/l	PEE-GQM-FQ-33	04/04/17 ER
Copper (3)	< 0.0037	---	mg/l	PEE-GQM-FQ-33	04/04/17 ER
Iron (3)	< 0.0047	---	mg/l	PEE-GQM-FQ-33	04/04/17 AUT
Mercury (1)	< 0.00500	---	mg/l	ICP-OES	04/04/17 AUT

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody
2: Non-accredited Outsourced Parameters
3: Accredited parameters whose results are outside the scope of accreditation
4: Outsourced parameters accredited by the outsourced laboratory, assessed competence - Chap. 5 MC; see scope at www.acreditacion.gob.ec

Parque Industrial California 2 Bloque D-41 Km. 11 1/2 vía a Daule
Telephones 2-103390 (2) / 2-103825 (35) / 05398-286653
www.grupoquimicomarcos.com
Guayaquil - Ecuador

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 11:35 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
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Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0610680 9639902

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED ORGANIC COMP. Surfactants-Detergents (3)	0.027	0.008	mg/l	PEE-GQM-FQ-21	03/30/17 JV
Oils and fats (3)	<0.44	---	mg/l	PEE-GQM-FQ-03	04/03/17 NS
Biochemical oxygen demand (3)	9.12	0.44	mgO2/l	PEE-GQM-FQ-05	03/30/17 LS
Chemical oxygen demand	18.00	3.47	mgO2/l	PEE-GQM-FQ-04	04/03/17 LS
Total petroleum hydrocarbons (3)	<0. 04	---	mg/l	PEE-GQM-FQ-07	04/04/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
MICROBIOLOGY Fecal coliforms (1)	2	----	NMP/100ml	9222 D	03/29/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
SAMPLING DATA Dissolved oxygen in situ	5.17	0.50	mgO2/l	PEE-GQM-FQ-65	03/29/17 LB

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. The chain of custody is secured by PGO905
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[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

Parque Industrial California 2 Bloque D-41 Km. 11 1/2 vía a Daule
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ECOSFERA CIA LTDA
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Attention: Harry Veintimilla
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Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 11:35	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
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Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0610680 9639902	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody.

The results of this test report are only applicable to the tested samples.
This test report should not be reproduced other than in its entirety, with the written permission of G.Q.M.
The samples will be retained for 7 days from the date of delivery of results.

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 11:35	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P1 – In front of Port Authority (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0610680 9639902	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. The chain of custody is secured by PGO905.

[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

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This test report should not be reproduced other than in its entirety, with the written permission of G.Q.M.
The samples will be retained for 7 days from the date of delivery of results.

[Logo of GRUPO QUIMICO MARCOS]

SAMPLING REPORT

65755-1
SAMPLING ORDER
5312
Sample 1 of 13

DATE: 03/29/2014
CLIENT: ECOSFERA CIA LTDA
SAMPLING PLACE: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
SAMPLE IDENT.: Water – Point 1 (DEFINE) – *In front of the Port Authority*
COMPARATIVE TABLE:

TYPE OF SAMPLING: Simple MATRIZ: NATURAL WATERS COORDINATES:*17M 0610680 – 9639902*

IN SITU SAMPLING DATA

#	TIME	PARAMETERS							OTHERS	ORGANOLEPTIC CHAR.		ENVIRONMENTAL COND.			COMMENTS
		Ph	TºC	ELECTRICAL CONDUCTIVITY	TDS	RESIDUAL CHLORINE	OD mg/l	OD % SAT		ODOR	APPEARANCE	1º ENV.	HUM.	CLIM. COND.	
2	**11:30**	**7.71**	**29.4**				**5.17**	**63.3**			**TB**			**CD.**	**060 M**
AVERAGE										GENERAL COMMENTS:					
QUALITY CONTROL	DUPL.														

NOMENCLATURES: ODOR: QU: Chemical, CL: Chlorinated, DL: Dulos, FR: Fruity, SF: Sulfur, AGR: Sour / APPEARANCE: TB: Turbia, SL: Solid, IN: Colorless / CLIMATE CONDITIONS: GR: Garúa, NB : Fog, LV: Rain, NL: Cloudy, GZ: Hail, CD: Clear sky, VT: Winds, SUN: Sunny / Q: Flow / DO: Dissolved oxygen,% SAT: Saturation percentage / QUALITY CONTROL: EQ: Equipment, VEH: Vehicles, ENV: Containers

Q. HISTORIC	--------	Q PER GQM	---------	TIDE STATUS	----------	RECEIVING MEDIUM	----

QUALITY CONTROL	----------

PG-0905-06

FLOW DETERMINATION				DRAFT, DIAGRAMS, CALCULATIONS	OM: 5312 Sample 1 of 13:
RECIPIENT VOL.					**EQUIPMENT VERIFICATION**
#	TIME	Q: (Vol/t (Seg))x3.6	ALIC= Q= $\frac{Vcomp}{\sum Q_2}$		DETAIL / MEASUREMENT
					pH EI -
					ELECT. COND. EI -
					RESID. CHLORINE EI -
					DISSOLVED OXI.
					ALTITUDE / SALINITY
					COLD CHAIN/TºC TESTIMONY
					DETAILS / TºC / TIME
					EXIT POINT **9.0** **13:00**
					GQM ARRIVAL **14.2** **16:30**

NOMENCLATURES: Q: Flow, VOL: Volume, t: Time / ALI: Aliquot, QI: Instantaneous flow rate recorded when the point sample was taken, Vcomp: Total volume of the composite sample
=> QI: Sum of the instantaneous flows registered in each sub-sample.

CUSTODY CHAIN						RESPONSIBILITY SIGNATURES	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		CLIENT	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		SAMPLER GQM	TIS - MCH
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			

IMPORTANT: ACCORDING TO TUSLMA TOMO V., BOOK VI OF THE ENVIRONMENTAL QUALITY OF ART. 72-80, THE REGULATOR IS RESPONSIBLE FOR THE DESIGNATION OF THE SAMPLE POINTS, GQM IS EXEMPTED FROM LIABILITY OF ANY INFLUENCE THAT THE SAMPLES MAY HAVE BY FACTORS KNOWN OR NOT BY THE REGULATOR, WHICH COULD AFFECT THE SUITABILITY OF THE SAMPLES. THE PARAMETERS ESTABLISHED IN THE WORK ORDER, QUOTATION, OR SAMPLE ORDER.

REVIEWED BY:

[Logo of GRUPO QUIMICO MARCOS]

SAMPLES RECEPTION

ORDER NO.	**65755**	DATE OF ARRIVAL: 03/17/29 16:46

CLIENT:	ECOSFERA ECOSFERA CIA LTDA
ADDRESS:	Avenida Bolivar y Colon – Machala
ATTENTION TO:	Harry Veintimilla
INVOICE TO:	ECOSFERA ECOSFERA CIA LTDA
ADDRESS:	Avenida Bolivar y Colon – Machala
ATTENTION TO	Harry Veintimilla

DELIVERY OF RESULTS: 05/17/10 PRIORITY: A NO. OF SAMPLES: 13

DATE AND TIME OF SAMPLING: 03/17/29 11:35 MATRIX: NATURAL WATERS

PLACE OF SAMPLING: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar

IDENTIFICATION: P1 In front of the Port Authority

COMPARATIVE TABLE:

GEOGRAPHIC COORDINATES: 17M0610680 9639902 SAMPLED BY: GRUPO QUIMICO MARCOS

TYPE OF SAMPLING: Simple SAMPLE DURATION:

TECHNICAL STANDARD: INEN 2169/2176:2013-PG/GCM/09

LAB. NO.	PAR. CODE	PARAMETER	METHOD
65755-1	As-icp	Arsenic	PEE-GQM-FQ-33
65755-1	Cd-icp	Cadmium	PEE-GQM-FQ-33
65755-1	Cr-icp	Total Chromium	PEE-GQM-FQ-33
65755-1	Cu-icp	Copper	PEE-GQM-FQ-33
65755-1	DigGQM	Samples Digestion - Waters	
65755-1	Fe-icp	Iron	PEE-GQM-FQ-33
65755-1	Hg-1	Mercury	ICP-OES
65755-1	MB03	Fecal Coliforms	9222 D
65755-1	OP07	Surfactants-Detergent	PEE-GQM-FQ-21
65755-1	PO02	Oils and fats	PEE-GQM-FQ-03
65755-1	PO07	Biochemical Oxygen Demand	PEE-GQM-FQ-05
65755-1	PO09	Chemical Oxygen Demand	PEE-GQM-FQ-04
65755-1	PO15	Total Petroleum Hydrocarbons	PEE-GQM-FQ-07
65755-1	PO51	Dissolved Oxygen in situ	PEE-GQM-FQ-65
65755-1	PQ05	Ammonia	PEE-GQM-FQ-31
65755-1	PS02	Total Suspended Solids	PEE-GQM-FQ-06

Delivery of samples to GQM LB	Entry of samples to Autolab MCH	Entry of Lab. Samples	Receipt of Lab. Samples
Order revised by:	Date of Revision:	Service Order in:	Certificate of Sampling in:

[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-2	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 11:19 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P2 – In front of Liceo Naval (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0610682 9640521

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED/PHYSICAL COMPONENTS					
Total solids suspended	87	11	mg/l	PEE-GQM-FQ-06	03/30/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
INORGANIC NON-METALS					
Ammonia	< 0.036	---	mg/l	PEE-GQM-FQ-31	03/31/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
METALS					
Arsenic (3)	< 0.0031	---	mg/l	PEE-GQM-FQ-33	04/04/17 AUT
Cadmium (3)	< 0.0004	---	mg/l	PEE-GQM-FQ-33	04/04/17 AUT
Total chromium (3)	< 0.0024	---	mg/l	PEE-GQM-FQ-33	04/04/17 ER
Copper (3)	< 0.0037	---	mg/l	PEE-GQM-FQ-33	04/04/17 ER
Iron (3)	< 0.0047	---	mg/l	PEE-GQM-FQ-33	04/04/17 AUT
Mercury (1)	< 0.00500	---	mg/l	ICP-OES	04/04/17 ER

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody
2: Non-accredited Outsourced Parameters
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Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 11:19 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P2 – In front of Liceo Naval (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0610682 9640521

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED ORGANIC COMP.					
Surfactants-Detergents (3)	0.045	0.013	mg/l	PEE-GQM-FQ-21	03/30/17 JV
Oils and fats (3)	<0.44	---	mg/l	PEE-GQM-FQ-03	04/03/17 NS
Biochemical oxygen demand (3)	19.00	0.91	mgO2/l	PEE-GQM-FQ-05	03/30/17 LS
Chemical oxygen demand	36.00	6.93	mgO2/l	PEE-GQM-FQ-04	04/03/17 LS
Total petroleum hydrocarbons (3)	<0.04	---	mg/l	PEE-GQM-FQ-07	04/04/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
MICROBIOLOGY					
Fecal coliforms (1)	2	----	NMP/100ml	9222 D	03/29/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
SAMPLING DATA					
Dissolved oxygen in situ	4.65	0.45	mgO2/l	PEE-GQM-FQ-65	03/29/17 LB

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

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[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

Parque Industrial California 2 Bloque D-41 Km. 11 1/2 vía a Daule
Telephones 2-103390 (2) / 2-103825 (35) / 05398-286653
www.grupoquimicomarcos.com
Guayaquil - Ecuador

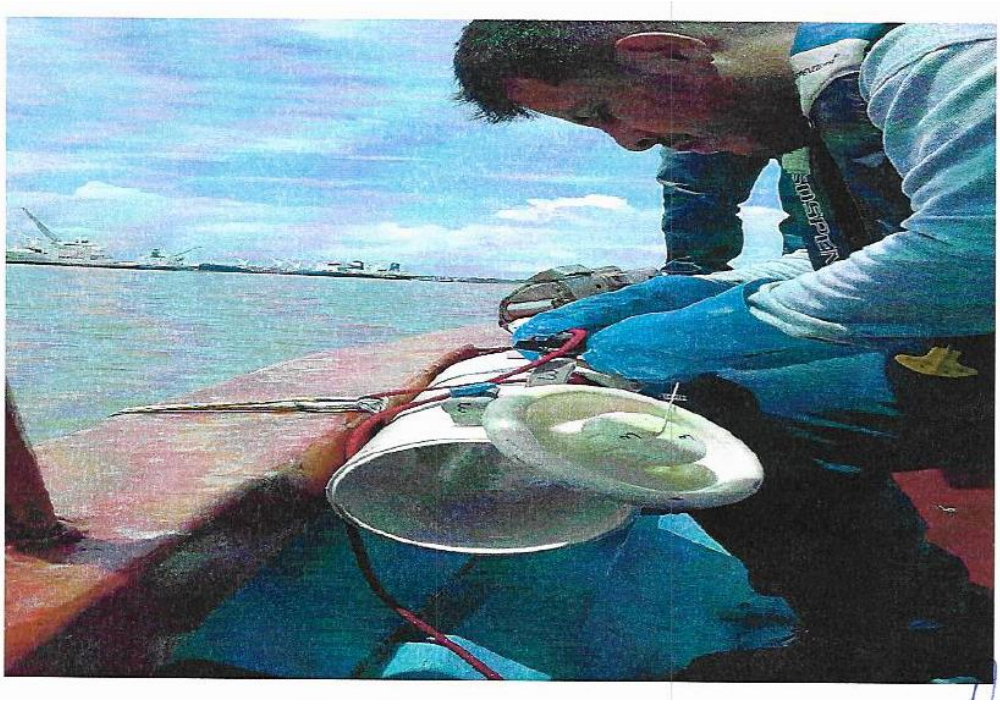
ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 11:35	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P2 – In front of Liceo Naval (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0610682 9640521	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY



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The samples will be retained for 7 days from the date of delivery of results.

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 11:19	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P2 – In front of Liceo Naval (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0610682 9640521	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. The chain of custody is secured by PGO905.

[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

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[Logo of GRUPO QUIMICO MARCOS]

SAMPLING REPORT

65755-2
SAMPLING ORDER
5312
Sample 2 of 13

DATE: 03/29/2014
CLIENT: ECOSFERA CIA LTDA
SAMPLING PLACE: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
SAMPLE IDENT.: Water – Point 2 (DEFINE) – *Liceo Naval*
COMPARATIVE TABLE:

TYPE OF SAMPLING: Simple MATRIZ: NATURAL WATERS COORDINATES:*17M 0610682 – 9640521*

IN SITU SAMPLING DATA

#	TIME	PARAMETERS							OTHERS	ORGANOLEPTIC CHAR.		ENVIRONMENTAL COND.			COMMENTS
		Ph	TºC	ELECTRICAL CONDUCTIVITY	TDS	RESIDUAL CHLORINE	OD mg/l	OD % SAT		ODOR	APPEARANCE	1º ENV.	HUM.	CLIM. COND.	
2	**11:19**	**7.54**	**29.1**				**4.65**	**59.2**		**YES**	**TB**			**CD.**	**-------**
AVERAGE										GENERAL COMMENTS:					
QUALITY CONTROL	DUPL.														

NOMENCLATURES: ODOR: QU: Chemical, CL: Chlorinated, DL: Dulos, FR: Fruity, SF: Sulfur, AGR: Sour / APPEARANCE: TB: Turbia, SL: Solid, IN: Colorless / CLIMATE CONDITIONS: GR: Garúa, NB : Fog, LV: Rain, NL: Cloudy, GZ: Hail, CD: Clear sky, VT: Winds, SUN: Sunny / Q: Flow / DO: Dissolved oxygen,% SAT: Saturation percentage / QUALITY CONTROL: EQ: Equipment, VEH: Vehicles, ENV: Containers

Q. HISTORIC	--------	Q PER GQM	---------	TIDE STATUS	----------	RECEIVING MEDIUM	----

QUALITY CONTROL	----------

FLOW DETERMINATION				DRAFT, DIAGRAMS, CALCULATIONS	OM: 5312 Sample 1 of 13:
RECIPIENT VOL.					**EQUIPMENT VERIFICATION**
#	TIME	Q: (Vol/t (Seg))x3.6	ALIC= Q= $\frac{Vcomp}{\sum Q_2}$		DETAIL / MEASUREMENT
					pH - EI -
					ELECT. COND. - EI -
					RESID. CHLORINE - EI -
					DISSOLVED OXI. - EI -
					ALTITUDE / SALINITY
					COLD CHAIN/TºC TESTIMONY
					DETAILS / TºC / TIME
					EXIT POINT **9.0** **13:00**
					GQM ARRIVAL **14.2** **16:30**

NOMENCLATURES: Q: Flow, VOL: Volume, t: Time / ALI: Aliquot, QI: Instantaneous flow rate recorded when the point sample was taken, Vcomp: Total volume of the composite sample
=> QI: Sum of the instantaneous flows registered in each sub-sample.

CUSTODY CHAIN						RESPONSIBILITY SIGNATURES	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		CLIENT	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		SAMPLER GQM	TIS - MCH
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			

IMPORTANT: ACCORDING TO TUSLMA TOMO V., BOOK VI OF THE ENVIRONMENTAL QUALITY OF ART. 72-80, THE REGULATOR IS RESPONSIBLE FOR THE DESIGNATION OF THE SAMPLE POINTS, GQM IS EXEMPTED FROM LIABILITY OF ANY INFLUENCE THAT THE SAMPLES MAY HAVE BY FACTORS KNOWN OR NOT BY THE REGULATOR, WHICH COULD AFFECT THE SUITABILITY OF THE SAMPLES. THE PARAMETERS ESTABLISHED IN THE WORK ORDER, QUOTATION, OR SAMPLE ORDER.

REVIEWED BY:

[Logo of GRUPO QUIMICO MARCOS]

SAMPLES RECEPTION

ORDER NO.	**65755**	DATE OF ARRIVAL: 03/17/29 16:46

DATE AND TIME OF SAMPLING: 03/07/29 11:19 MATRIX: NATURAL WATERS

PLACE OF SAMPLING: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar

IDENTIFICATION: P2 In front of Liceo Naval (0.60 m deep)

COMPARATIVE TABLE:

GEOGRAPHIC COORDINATES: 17M0610682 9640521 SAMPLED BY: GRUPO QUIMICO MARCOS

TYPE OF SAMPLING: Simple SAMPLE DURATION:

TECHNICAL STANDARD: INEN 2169/2176:2013-PG/GCM/09

LAB. NO.	PAR. CODE	PARAMETER	METHOD
65755-1	As-icp	Arsenic	PEE-GQM-FQ-33
65755-1	Cd-icp	Cadmium	PEE-GQM-FQ-33
65755-1	Cr-icp	Total Chromium	PEE-GQM-FQ-33
65755-1	Cu-icp	Copper	PEE-GQM-FQ-33
65755-1	DigGQM	Samples Digestion – Waters	
65755-1	Fe-icp	Iron	PEE-GQM-FQ-33
65755-1	Hg-1	Mercury	ICP-OES
65755-1	MB03	Fecal Coliforms	9222 D
65755-1	OP07	Surfactants-Detergent	PEE-GQM-FQ-21
65755-1	PO02	Oils and fats	PEE-GQM-FQ-03
65755-1	PO07	Biochemical Oxygen Demand	PEE-GQM-FQ-05
65755-1	PO09	Chemical Oxygen Demand	PEE-GQM-FQ-04
65755-1	PO15	Total Petroleum Hydrocarbons	PEE-GQM-FQ-07
65755-1	PO51	Dissolved Oxygen in situ	PEE-GQM-FQ-65
65755-1	PQ05	Ammonia	PEE-GQM-FQ-31
65755-1	PS02	Total Suspended Solids	PEE-GQM-FQ-06

[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-3	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 11:59 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P3 – Isla del Amor (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0610505 9641879

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED/PHYSICAL COMPONENTS					
Total solids suspended	66	8	mg/l	PEE-GQM-FQ-06	03/30/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
INORGANIC NON-METALS					
Ammonia	< 0.036	---	mg/l	PEE-GQM-FQ-31	03/31/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
METALS					
Arsenic (3)	< 0.0031	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Cadmium (3)	< 0.0004	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Total chromium (3)	< 0.0024	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Copper (3)	< 0.0037	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Iron (3)	< 0.0047	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Mercury (1)	< 0.00500	---	mg/l	ICP-OES	04/07/17 ER

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody
2: Non-accredited Outsourced Parameters
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Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 10:59 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P3 – Isla del Amor (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0610505 9641879

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED ORGANIC COMP.					
Surfactants-Detergents (3)	0.016	---	mg/l	PEE-GQM-FQ-21	03/30/17 JV
Oils and fats (3)	<0.44	---	mg/l	PEE-GQM-FQ-03	04/03/17 NS
Biochemical oxygen demand (3)	18.00	0.86	mgO2/l	PEE-GQM-FQ-05	03/30/17 LS
Chemical oxygen demand	34.00	6.55	mgO2/l	PEE-GQM-FQ-04	04/03/17 LS
Total petroleum hydrocarbons (3)	<0.04	---	mg/l	PEE-GQM-FQ-07	04/04/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
MICROBIOLOGY					
Fecal coliforms (1)	1	----	NMP/100ml	9222 D	03/29/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
SAMPLING DATA					
Dissolved oxygen in situ	5.93	0.58	mgO2/l	PEE-GQM-FQ-65	03/29/17 LB

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

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[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

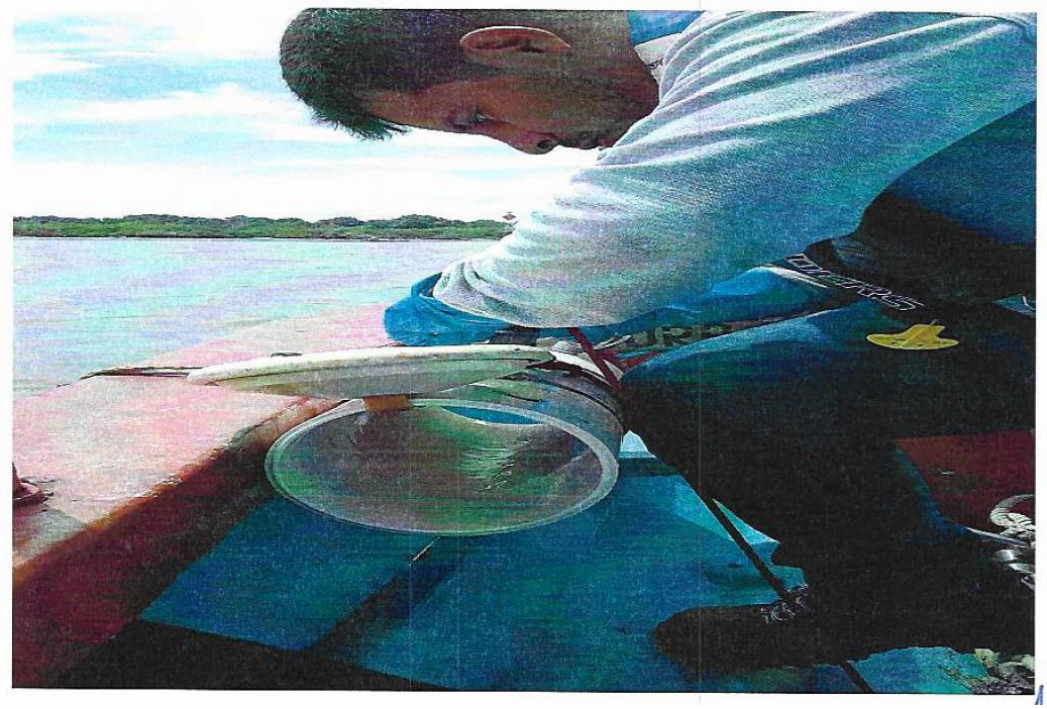
ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 10:59	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P3 – Isla del Amor (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0610505 9641879	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY



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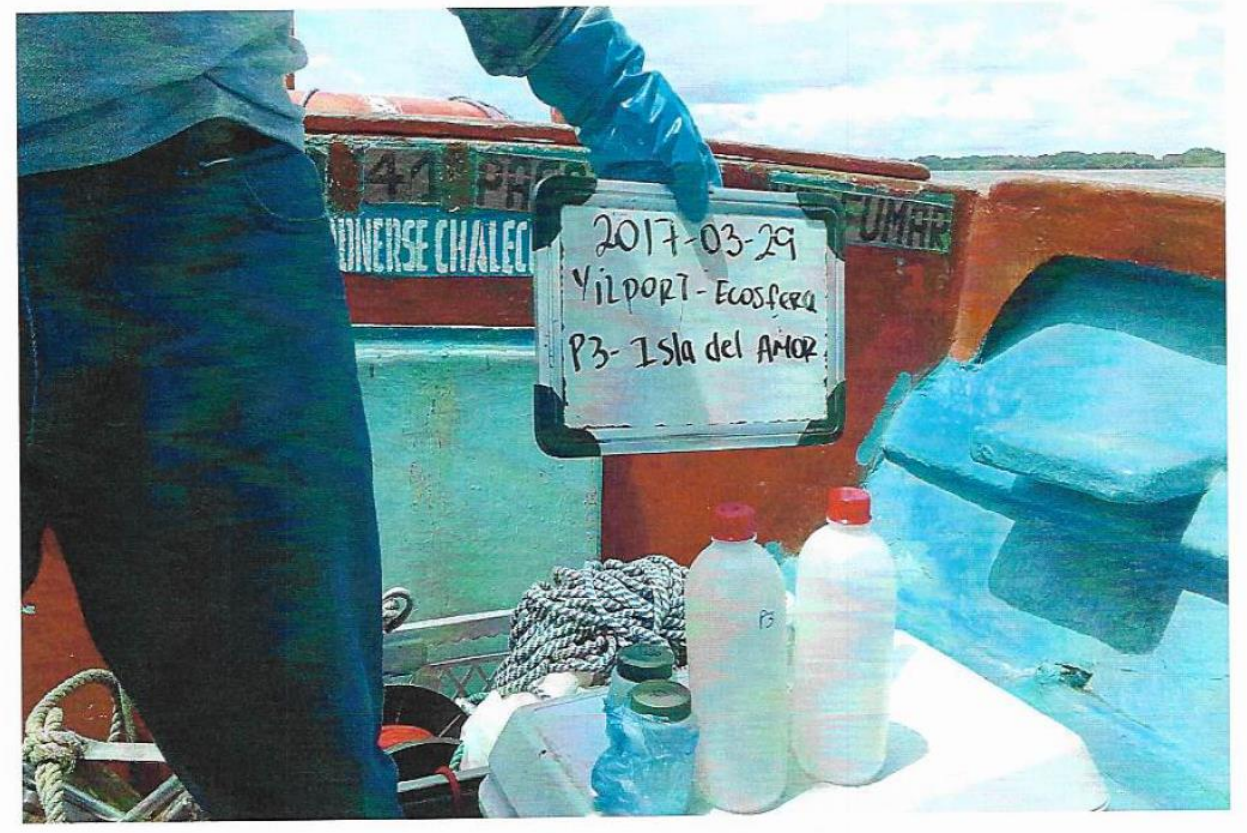
The samples will be retained for 7 days from the date of delivery of results.

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 10:59	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P3 – Isla del Amor (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0610505 9641879	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY



1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody.

[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

Parque Industrial California 2 Bloque D-41 Km. 11 1/2 vía a Daule
Telephones 2-103390 (2) / 2-103825 (35) / 05398-286653
www.grupoquimicomarcos.com
Guayaquil - Ecuador

[Logo of GRUPO QUIMICO MARCOS]

SAMPLING REPORT

65755-3
SAMPLING ORDER
5312
Sample 3 of 13

DATE: 03/29/2014
CLIENT: ECOSFERA CIA LTDA
SAMPLING PLACE: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
SAMPLE IDENT.: Water – Point 3 (DEFINE) – *Isla del Amor*
COMPARATIVE TABLE:

TYPE OF SAMPLING: Simple MATRIZ: NATURAL WATERS COORDINATES:*17M 0610505 – 9641879*

IN SITU SAMPLING DATA

#	TIME	PARAMETERS							OTHERS	ORGANOLEPTIC CHAR.		ENVIRONMENTAL COND.			COMMENTS
		Ph	TºC	ELECTRICAL CONDUCTIVITY	TDS	RESIDUAL CHLORINE	OD mg/l	OD % SAT		ODOR	APPEARANCE	1º ENV.	HUM.	CLIM. COND.	
3	**10:59**	**7.60**	**28.9**				**5.93**	**74.2**			**TB**			**CD.**	**0.60 m**
AVERAGE										GENERAL COMMENTS:					
QUALITY CONTROL	DUPL.														

NOMENCLATURES: ODOR: QU: Chemical, CL: Chlorinated, DL: Dulos, FR: Fruity, SF: Sulfur, AGR: Sour / APPEARANCE: TB: Turbia, SL: Solid, IN: Colorless / CLIMATE CONDITIONS: GR: Garúa, NB : Fog, LV: Rain, NL: Cloudy, GZ: Hail, CD: Clear sky, VT: Winds, SUN: Sunny / Q: Flow / DO: Dissolved oxygen,% SAT: Saturation percentage / QUALITY CONTROL: EQ: Equipment, VEH: Vehicles, ENV: Containers

Q. HISTORIC	--------	Q PER GQM	---------	TIDE STATUS	----------	RECEIVING MEDIUM	----

QUALITY CONTROL	----------

PG-0905-06

FLOW DETERMINATION				DRAFT, DIAGRAMS, CALCULATIONS	OM: 5312 Sample 1 of 13:
RECIPIENT VOL.					**EQUIPMENT VERIFICATION**
#	TIME	Q: (Vol/t (Seg))x3.6	ALIC= Q= $\frac{Vcomp}{\sum Q_2}$		DETAIL / MEASUREMENT
					pH - EI -
					ELECT. COND. - EI -
					RESID. CHLORINE - EI -
					DISSOLVED OXI. - EI -
					ALTITUDE / SALINITY
					COLD CHAIN/TºC TESTIMONY
					DETAILS / TºC / TIME
					EXIT POINT **9.0** **13:00**
					GQM ARRIVAL **14.2** **16:30**

NOMENCLATURES: Q: Flow, VOL: Volume, t: Time / ALI: Aliquot, QI: Instantaneous flow rate recorded when the point sample was taken, Vcomp: Total volume of the composite sample
=> QI: Sum of the instantaneous flows registered in each sub-sample.

CUSTODY CHAIN						RESPONSIBILITY SIGNATURES	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		CLIENT	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		SAMPLER GQM	TIS - MCH
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			

IMPORTANT: ACCORDING TO TUSLMA TOMO V., BOOK VI OF THE ENVIRONMENTAL QUALITY OF ART. 72-80, THE REGULATOR IS RESPONSIBLE FOR THE DESIGNATION OF THE SAMPLE POINTS, GQM IS EXEMPTED FROM LIABILITY OF ANY INFLUENCE THAT THE SAMPLES MAY HAVE BY FACTORS KNOWN OR NOT BY THE REGULATOR, WHICH COULD AFFECT THE SUITABILITY OF THE SAMPLES. THE PARAMETERS ESTABLISHED IN THE WORK ORDER, QUOTATION, OR SAMPLE ORDER.

REVIEWED BY:

[Logo of GRUPO QUIMICO MARCOS]

SAMPLES RECEPTION

ORDER NO.	**65755**	DATE OF ARRIVAL: 03/17/29 16:46

DATE AND TIME OF SAMPLING: 03/07/29 10:59 MATRIX: NATURAL WATERS

PLACE OF SAMPLING: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar

IDENTIFICATION: P3 Isla del Amor (0.60 m deep)

COMPARATIVE TABLE:

GEOGRAPHIC COORDINATES: 17M0610505 9641879 SAMPLED BY: GRUPO QUIMICO MARCOS

TYPE OF SAMPLING: Simple SAMPLE DURATION:

TECHNICAL STANDARD: INEN 2169/2176:2013-PG/GCM/09

LAB. NO.	PAR. CODE	PARAMETER	METHOD
65755-1	As-icp	Arsenic	PEE-GQM-FQ-33
65755-1	Cd-icp	Cadmium	PEE-GQM-FQ-33
65755-1	Cr-icp	Total Chromium	PEE-GQM-FQ-33
65755-1	Cu-icp	Copper	PEE-GQM-FQ-33
65755-1	DigGQM	Samples Digestion – Waters	
65755-1	Fe-icp	Iron	PEE-GQM-FQ-33
65755-1	Hg-1	Mercury	ICP-OES
65755-1	MB03	Fecal Coliforms	9222 D
65755-1	OP07	Surfactants-Detergent	PEE-GQM-FQ-21
65755-1	PO02	Oils and fats	PEE-GQM-FQ-03
65755-1	PO07	Biochemical Oxygen Demand	PEE-GQM-FQ-05
65755-1	PO09	Chemical Oxygen Demand	PEE-GQM-FQ-04
65755-1	PO15	Total Petroleum Hydrocarbons	PEE-GQM-FQ-07
65755-1	PO51	Dissolved Oxygen in situ	PEE-GQM-FQ-65
65755-1	PQ05	Ammonia	PEE-GQM-FQ-31
65755-1	PS02	Total Suspended Solids	PEE-GQM-FQ-06

[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-4	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 10:31 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P4 – Entry to El Coco resort (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0611365 9645418

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED/PHYSICAL COMPONENTS					
Total solids suspended	93	12	mg/l	PEE-GQM-FQ-06	03/30/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
INORGANIC NON-METALS					
Ammonia	< 0.036	---	mg/l	PEE-GQM-FQ-31	03/31/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
METALS					
Arsenic (3)	< 0.0031	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Cadmium (3)	< 0.0004	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Total chromium (3)	< 0.0024	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Copper (3)	< 0.0037	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Iron (3)	< 0.0047	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Mercury (1)	< 0.00500	---	mg/l	ICP-OES	04/07/17 ER

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody
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3: Accredited parameters whose results are outside the scope of accreditation
4: Outsourced parameters accredited by the outsourced laboratory, assessed competence - Chap. 5 MC; see scope at www.acreditacion.gob.ec

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 10:31 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P4 – Entry to El Coco resort (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0611365 9645418

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED ORGANIC COMP.					
Surfactants-Detergents (3)	0.016	---	mg/l	PEE-GQM-FQ-21	03/30/17 JV
Oils and fats (3)	<0.44	---	mg/l	PEE-GQM-FQ-03	04/03/17 NS
Biochemical oxygen demand (3)	20.00	0.96	mgO2/l	PEE-GQM-FQ-05	03/30/17 LS
Chemical oxygen demand	40.20	7.74	mgO2/l	PEE-GQM-FQ-04	04/03/17 LS
Total petroleum hydrocarbons (3)	<0.04	---	mg/l	PEE-GQM-FQ-07	04/04/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
MICROBIOLOGY					
Fecal coliforms (1)	2	----	NMP/100ml	9222 D	03/29/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
SAMPLING DATA					
Dissolved oxygen in situ	6.32	0.61	mgO2/l	PEE-GQM-FQ-65	03/29/17 LB

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

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[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

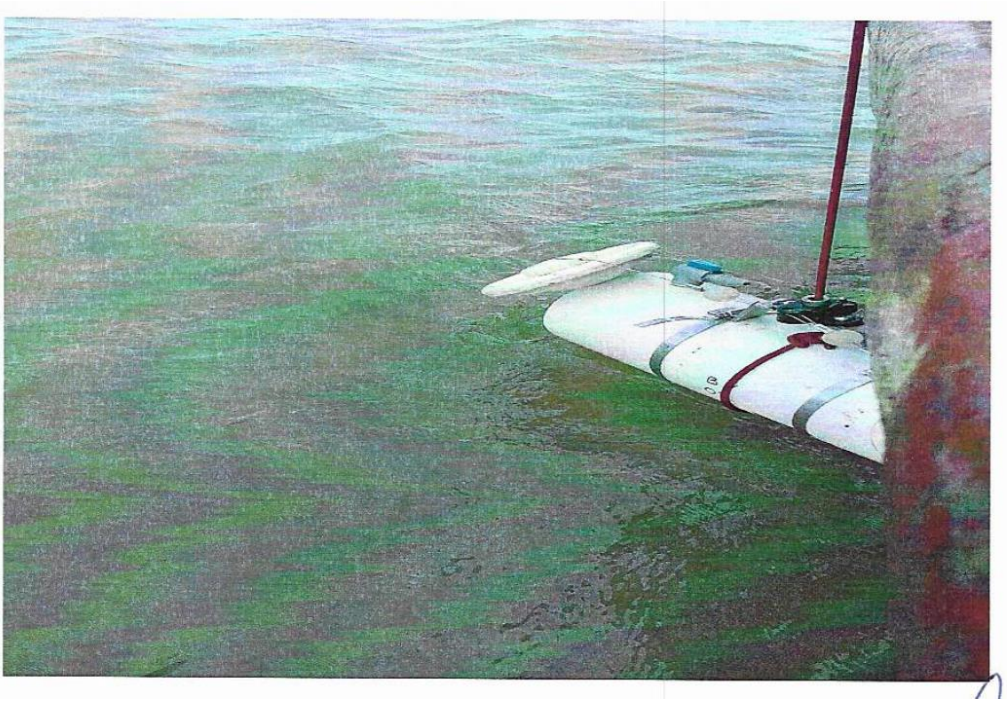
ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 10:31	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P4 – Entry to El Coco resort (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0611365 9645418	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY



1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody.

The results of this test report are only applicable to the tested samples.
This test report should not be reproduced other than in its entirety, with the written permission of G.Q.M.
The samples will be retained for 7 days from the date of delivery of results.

[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-4	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 10:31	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P4 – Entry to El Coco resort (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0611365 9645418	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody.

[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

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Parque Industrial California 2 Bloque D-41 Km. 11 1/2 vía a Daule
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www.grupoquimicomarcos.com
Guayaquil - Ecuador

[Logo of GRUPO QUIMICO MARCOS]

SAMPLING REPORT

65755-4
SAMPLING ORDER
5312
Sample 4 of 13

DATE: 03/29/2014
CLIENT: ECOSFERA CIA LTDA
SAMPLING PLACE: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
SAMPLE IDENT.: Water – Point 4 (DEFINE) – *Entry to El Coco resort*
COMPARATIVE TABLE:

TYPE OF SAMPLING: Simple MATRIZ: NATURAL WATERS COORDINATES:*17M 0611365 – 9645418*

IN SITU SAMPLING DATA

#	TIME	PARAMETERS							OTHERS	ORGANOLEPTIC CHAR.		ENVIRONMENTAL COND.			COMMENTS
		Ph	TºC	ELECTRICAL CONDUCTIVITY	TDS	RESIDUAL CHLORINE	OD mg/l	OD % SAT		ODOR	APPEARANCE	1º ENV.	HUM.	CLIM. COND.	
4	**10:31**	**7.90**	**28.9**				**6.32**	**80.7**			**TB**			**CD.**	**0.60 m**
AVERAGE										GENERAL COMMENTS:					
QUALITY CONTROL	DUPL.									*Duplicate of sample. Ag and TPH White*					

NOMENCLATURES: ODOR: QU: Chemical, CL: Chlorinated, DL: Dulos, FR: Fruity, SF: Sulfur, AGR: Sour / APPEARANCE: TB: Turbia, SL: Solid, IN: Colorless / CLIMATE CONDITIONS: GR: Garúa, NB : Fog, LV: Rain, NL: Cloudy, GZ: Hail, CD: Clear sky, VT: Winds, SUN: Sunny / Q: Flow / DO: Dissolved oxygen,% SAT: Saturation percentage / QUALITY CONTROL: EQ: Equipment, VEH: Vehicles, ENV: Containers

Q. HISTORIC	--------	Q PER GQM	---------	TIDE STATUS	----------	RECEIVING MEDIUM	----

QUALITY CONTROL	----------

FLOW DETERMINATION				DRAFT, DIAGRAMS, CALCULATIONS	OM: 5312 Sample 1 of 13:
RECIPIENT VOL.					**EQUIPMENT VERIFICATION**
#	TIME	Q: (Vol/t (Seg))x3.6	ALIC= Q= $\frac{Vcomp}{\sum Q_2}$		DETAIL / MEASUREMENT
					pH EI -
					ELECT. COND. EI -
					RESID. CHLORINE EI -
					DISSOLVED OXI. EI -
					ALTITUDE / SALINITY
					COLD CHAIN/TºC TESTIMONY
					DETAILS / TºC / TIME
					EXIT POINT **9.0** **13:00**
					GQM ARRIVAL **14.2** **16:30**

NOMENCLATURES: Q: Flow, VOL: Volume, t: Time / ALI: Aliquot, QI: Instantaneous flow rate recorded when the point sample was taken, Vcomp: Total volume of the composite sample
=> QI: Sum of the instantaneous flows registered in each sub-sample.

CUSTODY CHAIN						RESPONSIBILITY SIGNATURES	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		CLIENT	[signature]
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		SAMPLER GQM	T13 - MCH
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			

IMPORTANT: ACCORDING TO TUSLMA TOMO V., BOOK VI OF THE ENVIRONMENTAL QUALITY OF ART. 72-80, THE REGULATOR IS RESPONSIBLE FOR THE DESIGNATION OF THE SAMPLE POINTS, GQM IS EXEMPTED FROM LIABILITY OF ANY INFLUENCE THAT THE SAMPLES MAY HAVE BY FACTORS KNOWN OR NOT BY THE REGULATOR, WHICH COULD AFFECT THE SUITABILITY OF THE SAMPLES. THE PARAMETERS ESTABLISHED IN THE WORK ORDER, QUOTATION, OR SAMPLE ORDER.

REVIEWED BY:

[Logo of GRUPO QUIMICO MARCOS]

SAMPLES RECEPTION

ORDER NO.	**65755**	DATE OF ARRIVAL: 03/17/29 16:46

DATE AND TIME OF SAMPLING: 03/07/29 10:31 MATRIX: NATURAL WATERS

PLACE OF SAMPLING: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
IDENTIFICATION: P4 Entry to El Coco resort (0.60 m deep)
COMPARATIVE TABLE:

GEOGRAPHIC COORDINATES: 17M0611365 9645418 SAMPLED BY: GRUPO QUIMICO MARCOS
TYPE OF SAMPLING: Simple SAMPLE DURATION:
TECHNICAL STANDARD: INEN 2169/2176:2013-PG/GCM/09

LAB. NO.	PAR. CODE	PARAMETER	METHOD
65755-1	As-icp	Arsenic	PEE-GQM-FQ-33
65755-1	Cd-icp	Cadmium	PEE-GQM-FQ-33
65755-1	Cr-icp	Total Chromium	PEE-GQM-FQ-33
65755-1	Cu-icp	Copper	PEE-GQM-FQ-33
65755-1	DigGQM	Samples Digestion – Waters	
65755-1	Fe-icp	Iron	PEE-GQM-FQ-33
65755-1	Hg-1	Mercury	ICP-OES
65755-1	MB03	Fecal Coliforms	9222 D
65755-1	OP07	Surfactants-Detergent	PEE-GQM-FQ-21
65755-1	PO02	Oils and fats	PEE-GQM-FQ-03
65755-1	PO07	Biochemical Oxygen Demand	PEE-GQM-FQ-05
65755-1	PO09	Chemical Oxygen Demand	PEE-GQM-FQ-04
65755-1	PO15	Total Petroleum Hydrocarbons	PEE-GQM-FQ-07
65755-1	PO51	Dissolved Oxygen in situ	PEE-GQM-FQ-65
65755-1	PQ05	Ammonia	PEE-GQM-FQ-31
65755-1	PS02	Total Suspended Solids	PEE-GQM-FQ-06

[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-5	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 09:03 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P5 – Punta El Faro (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0608302 9646721

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED/PHYSICAL COMPONENTS					
Total solids suspended	182	23	mg/l	PEE-GQM-FQ-06	03/30/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
INORGANIC NON-METALS					
Ammonia	< 0.036	---	mg/l	PEE-GQM-FQ-31	03/31/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
METALS					
Arsenic (3)	< 0.0031	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Cadmium (3)	< 0.0004	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Total chromium (3)	< 0.0024	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Copper (3)	< 0.0037	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Iron (3)	< 0.0047	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Mercury (1)	< 0.00500	---	mg/l	ICP-OES	04/07/17 ER

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. The chain of custody is secured by PGO905
2: Non-accredited Outsourced Parameters
3: Accredited parameters whose results are outside the scope of accreditation
4: Outsourced parameters accredited by the outsourced laboratory, assessed competence - Chap. 5 MC; see scope at www.acreditacion.gob.ec

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 09:03 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P5 – Punta El Faro (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0608302 9646721

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED ORGANIC COMP.					
Surfactants-Detergents (3)	0.016	---	mg/l	PEE-GQM-FQ-21	03/30/17 JV
Oils and fats (3)	<0.44	---	mg/l	PEE-GQM-FQ-03	04/03/17 NS
Biochemical oxygen demand (3)	17.00	0.82	mgO2/l	PEE-GQM-FQ-05	03/30/17 LS
Chemical oxygen demand	32.00	6.16	mgO2/l	PEE-GQM-FQ-04	04/03/17 LS
Total petroleum hydrocarbons (3)	<0.04	---	mg/l	PEE-GQM-FQ-07	04/04/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
MICROBIOLOGY					
Fecal coliforms (1)	5	----	NMP/100ml	9222 D	03/29/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
SAMPLING DATA					
Dissolved oxygen in situ	6.64	0.65	mgO2/l	PEE-GQM-FQ-65	03/29/17 LB

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

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3: Accredited parameters whose results are outside the scope of accreditation
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[signature]
FERNANDO MARCOS V.
Technical Director

[signature]
LAURA YANQUI M.
Quality Coordinator

ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 09:03	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P5 – Punta El Faro (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0608302 9646721	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody.

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The samples will be retained for 7 days from the date of delivery of results.

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 09:03	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P5 – Punta El Faro (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0608302 9646721	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY

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[signature]
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[Logo of GRUPO QUIMICO MARCOS]

SAMPLING REPORT

65755-5
SAMPLING ORDER
5312
Sample 5 of 13

DATE: 03/29/2014
CLIENT: ECOSFERA CIA LTDA
SAMPLING PLACE: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
SAMPLE IDENT.: Water – Point 5 (DEFINE) – *Punta El Faro*
COMPARATIVE TABLE:

TYPE OF SAMPLING: Simple MATRIZ: NATURAL WATERS COORDINATES:*17M 060832 – 96446721*

IN SITU SAMPLING DATA

#	TIME	PARAMETERS							OTHERS	ORGANOLEPTIC CHAR.		ENVIRONMENTAL COND.			COMMENTS
		Ph	TºC	ELECTRICAL CONDUCTIVITY	TDS	RESIDUAL CHLORINE	OD mg/l	OD % SAT		ODOR	APPEARANCE	1º ENV.	HUM.	CLIM. COND.	
5	**9:03**	**7.80**	**28.5**				**6.64**	**83.2%**			**TB**			**NB, GR**	**9.06 m**
AVERAGE										GENERAL COMMENTS:					
QUALITY CONTROL	DUPL. **7.87**						**6.63**	**83.7%**							

NOMENCLATURES: ODOR: QU: Chemical, CL: Chlorinated, DL: Dulos, FR: Fruity, SF: Sulfur, AGR: Sour / APPEARANCE: TB: Turbia, SL: Solid, IN: Colorless / CLIMATE CONDITIONS: GR: Garúa, NB: Fog, LV: Rain, NL: Cloudy, GZ: Hail, CD: Clear sky, VT: Winds, SUN: Sunny / Q: Flow / DO: Dissolved oxygen,% SAT: Saturation percentage / QUALITY CONTROL: EQ: Equipment, VEH: Vehicles, ENV: Containers

Q. HISTORIC	--------	Q PER GQM	---------	TIDE STATUS	----------	RECEIVING MEDIUM	----

QUALITY CONTROL	----------

PG-0905-06

FLOW DETERMINATION				DRAFT, DIAGRAMS, CALCULATIONS	OM: 5312 Sample 1 of 13:
RECIPIENT VOL.					**EQUIPMENT VERIFICATION**
#	TIME	Q: (Vol/t (Seg))x3.6	ALIC= Q= $\frac{Vcomp}{\sum Q_2}$		DETAIL / MEASUREMENT
					pH: EI - **372** — **10.01**
					ELECT. COND.: EI -
					RESID. CHLORINE: EI -
					DISSOLVED OXI.: EI -**359**
					ALTITUDE **1 FT** / SALINITY **0 PPT** — **105.2%**
					COLD CHAIN/TºC TESTIMONY
					DETAILS / TºC / TIME
					EXIT POINT — **9.0** — **13:00**
					GQM ARRIVAL — **14.2** — **16:30**

NOMENCLATURES: Q: Flow, VOL: Volume, t: Time / ALI: Aliquot, QI: Instantaneous flow rate recorded when the point sample was taken, Vcomp: Total volume of the composite sample
=> QI: Sum of the instantaneous flows registered in each sub-sample.

CUSTODY CHAIN						RESPONSIBILITY SIGNATURES	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		CLIENT	[signature]
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		SAMPLER GQM	T13 - MCH
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			

IMPORTANT: ACCORDING TO TUSLMA TOMO V., BOOK VI OF THE ENVIRONMENTAL QUALITY OF ART. 72-80, THE REGULATOR IS RESPONSIBLE FOR THE DESIGNATION OF THE SAMPLE POINTS, GQM IS EXEMPTED FROM LIABILITY OF ANY INFLUENCE THAT THE SAMPLES MAY HAVE BY FACTORS KNOWN OR NOT BY THE REGULATOR, WHICH COULD AFFECT THE SUITABILITY OF THE SAMPLES. THE PARAMETERS ESTABLISHED IN THE WORK ORDER, QUOTATION, OR SAMPLE ORDER.

REVIEWED BY:

[Logo of GRUPO QUIMICO MARCOS]

SAMPLES RECEPTION

ORDER NO.	**65755**	DATE OF ARRIVAL: 03/17/29 16:46

DATE AND TIME OF SAMPLING: 03/07/29 09:03 MATRIX: NATURAL WATERS

PLACE OF SAMPLING: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
IDENTIFICATION: P5 Punta El Faro (0.60 m deep)
COMPARATIVE TABLE:

GEOGRAPHIC COORDINATES: 17M0608302 9646721 SAMPLED BY: GRUPO QUIMICO MARCOS
TYPE OF SAMPLING: Simple SAMPLE DURATION:
TECHNICAL STANDARD: INEN 2169/2176:2013-PG/GCM/09

LAB. NO.	PAR. CODE	PARAMETER	METHOD
65755-1	As-icp	Arsenic	PEE-GQM-FQ-33
65755-1	Cd-icp	Cadmium	PEE-GQM-FQ-33
65755-1	Cr-icp	Total Chromium	PEE-GQM-FQ-33
65755-1	Cu-icp	Copper	PEE-GQM-FQ-33
65755-1	DigGQM	Samples Digestion – Waters	
65755-1	Fe-icp	Iron	PEE-GQM-FQ-33
65755-1	Hg-1	Mercury	ICP-OES
65755-1	MB03	Fecal Coliforms	9222 D
65755-1	OP07	Surfactants-Detergent	PEE-GQM-FQ-21
65755-1	PO02	Oils and fats	PEE-GQM-FQ-03
65755-1	PO07	Biochemical Oxygen Demand	PEE-GQM-FQ-05
65755-1	PO09	Chemical Oxygen Demand	PEE-GQM-FQ-04
65755-1	PO15	Total Petroleum Hydrocarbons	PEE-GQM-FQ-07
65755-1	PO51	Dissolved Oxygen in situ	PEE-GQM-FQ-65
65755-1	PQ05	Ammonia	PEE-GQM-FQ-31
65755-1	PS02	Total Suspended Solids	PEE-GQM-FQ-06

[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-6	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

ECOSFERA CIA LTDA
Legal Representative: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon – Machala
Machala, Tel. 0992909970
Attention: Harry Veintimilla
Type of Industry

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 09:37 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P6 – Entry to Jambelí (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0609094 9642541

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED/PHYSICAL COMPONENTS					
Total solids suspended	177	23	mg/l	PEE-GQM-FQ-06	03/30/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
INORGANIC NON-METALS					
Ammonia	< 0.036	---	mg/l	PEE-GQM-FQ-31	03/31/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
METALS					
Arsenic (3)	< 0.0031	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Cadmium (3)	< 0.0004	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Total chromium (3)	< 0.0024	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Copper (3)	< 0.0037	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Iron (3)	< 0.0047	---	mg/l	PEE-GQM-FQ-33	04/07/17 ER
Mercury (1)	< 0.00500	---	mg/l	ICP-OES	04/07/17 ER

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

1: Sampling parameters/activity, not included in the scope of ISO 17025 accreditation by the SAE. PGO905 secures the chain of custody
2: Non-accredited Outsourced Parameters
3: Accredited parameters whose results are outside the scope of accreditation
4: Outsourced parameters accredited by the outsourced laboratory, assessed competence - Chap. 5 MC; see scope at www.acreditacion.gob.ec

Guayaquil, APRIL 21, 2017

Date, time, and place of testing: 03/29/17 09:37 Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception: 03/29/17 16:46
Sample point and identification: P6 – Entry to Jambelí (0.60 m deep)
Sample technical standard (1): INEN 2169/2176:2013-PG/GQM/09
Sample matrix: NATURAL WATERS
Sampled by: GRUPO QUÍMICO MARCOS C. LTDA.
Sampler: LB-MCH
Type of sampling: Simple
Geographic Coordinates: 17M0609094 9642541

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
ADDED ORGANIC COMP.					
Surfactants-Detergents (3)	0.016	---	mg/l	PEE-GQM-FQ-21	03/30/17 JV
Oils and fats (3)	<0.44	---	mg/l	PEE-GQM-FQ-03	04/03/17 NS
Biochemical oxygen demand (3)	23.00	1.10	mgO2/l	PEE-GQM-FQ-05	03/30/17 LS
Chemical oxygen demand	44.00	8.47	mgO2/l	PEE-GQM-FQ-04	04/03/17 LS
Total petroleum hydrocarbons (3)	<0.04	---	mg/l	PEE-GQM-FQ-07	04/04/17 NS

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
MICROBIOLOGY					
Fecal coliforms (1)	8	----	NMP/100ml	9222 D	03/29/17 AOH

Parameter	Result	U K=2	Unit	Analytical Method	Analyzed
SAMPLING DATA					
Dissolved oxygen in situ	5.95	0.58	mgO2/l	PEE-GQM-FQ-65	03/29/17 LB

-----	Non-applicable	N.E.	Not carried out	Analytical method: Standard Methods 2012, 22nd edition
< LD	Lower than detectable limit	L.M.P.	Maximum permissible level	
U	Uncertainty	P.E.E.	GQM specific testing procedure	

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Machala, Tel. 0992909970
Attention: Harry Veintimilla
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Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 09:37	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P6 – Entry to Jambelí (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0609094 9642541	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

PHOTOGRAPHIC MEMORY

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[Logo of GRUPO QUIMICO MARCOS]	*TEST REPORT* No. 65755-6	**TEST LABORATORY ACCREDITED BY THE SAE WITH ACCREDITATION NO. OAE DE 2C 05-001**

Guayaquil, APRIL 21, 2017

Date, time, and place of testing:	03/29/17 09:37	Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
Date and time of reception:	03/29/17 16:46	
Sample point and identification:	P6 – Entry to Jambelí (0.60 m deep)	
Sample technical standard (1):	INEN 2169/2176:2013-PG/GQM/09	
Sample matrix:	NATURAL WATERS	
Sampled by:	GRUPO QUÍMICO MARCOS C. LTDA.	
Sampler:	LB-MCH	
Type of sampling:	Simple	
Geographic Coordinates:	17M0609094 9642541	

GRUPO QUIMICO MARCOS Cia. Ltda.
ABSENCE OF THIS SEAL VOIDS THE ORIGIN OF RESULTS REPORT
MC2201-11

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Parque Industrial California 2 Bloque D-41 Km. 11 1/2 vía a Daule
Telephones 2-103390 (2) / 2-103825 (35) / 05398-286653
www.grupoquimicomarcos.com
Guayaquil - Ecuador

[Logo of GRUPO QUIMICO MARCOS]

SAMPLING REPORT

65755-6
SAMPLING ORDER
5312
Sample 6 of 13

DATE: 03/29/2014
CLIENT: ECOSFERA CIA LTDA
SAMPLING PLACE: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
SAMPLE IDENT.: Water – Point 6 (DEFINE) – *Entry to Jambelí*
COMPARATIVE TABLE:

TYPE OF SAMPLING: Simple MATRIZ: NATURAL WATERS COORDINATES:*17M 0609094 – 9642541*

IN SITU SAMPLING DATA

#	TIME	PARAMETERS							OTHERS	ORGANOLEPTIC CHAR.		ENVIRONMENTAL COND.			COMMENTS
		Ph	TºC	ELECTRICAL CONDUCTIVITY	TDS	RESIDUAL CHLORINE	OD mg/l	OD % SAT		ODOR	APPEARANCE	1º ENV.	HUM.	CLIM. COND.	
6	**9:37**	**7.67**	**28.2**				**5.95**	**74.6**			**TB**			**NB**	**9.60 m**
AVERAGE										GENERAL COMMENTS:					
QUALITY CONTROL	DUPL.														

NOMENCLATURES: ODOR: QU: Chemical, CL: Chlorinated, DL: Dulos, FR: Fruity, SF: Sulfur, AGR: Sour / APPEARANCE: TB: Turbia, SL: Solid, IN: Colorless / CLIMATE CONDITIONS: GR: Garúa, NB: Fog, LV: Rain, NL: Cloudy, GZ: Hail, CD: Clear sky, VT: Winds, SUN: Sunny / Q: Flow / DO: Dissolved oxygen,% SAT: Saturation percentage / QUALITY CONTROL: EQ: Equipment, VEH: Vehicles, ENV: Containers

Q. HISTORIC	--------	Q PER GQM	---------	TIDE STATUS	----------	RECEIVING MEDIUM	----

QUALITY CONTROL	----------

FLOW DETERMINATION				DRAFT, DIAGRAMS, CALCULATIONS	OM: 5312 Sample 1 of 13:
RECIPIENT VOL.					**EQUIPMENT VERIFICATION**
#	TIME	Q: (Vol/t (Seg))x3.6	ALIC= Q= $\frac{Vcomp}{\sum Q_2}$		DETAIL / MEASUREMENT
					pH EI -
					ELECT. COND. EI -
					RESID. CHLORINE EI -
					DISSOLVED OXI. EI -
					ALTITUDE / SALINITY
					COLD CHAIN/TºC TESTIMONY
					DETAILS / TºC / TIME
					EXIT POINT **9.0** **13:00**
					GQM ARRIVAL **14.2** **16:30**

NOMENCLATURES: Q: Flow, VOL: Volume, t: Time / ALI: Aliquot, QI: Instantaneous flow rate recorded when the point sample was taken, Vcomp: Total volume of the composite sample
=> QI: Sum of the instantaneous flows registered in each sub-sample.

CUSTODY CHAIN						RESPONSIBILITY SIGNATURES	
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		CLIENT	[signature]
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:		SAMPLER GQM	T13 - MCH
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			
DELIVERED/RECEIVED BY:		DATE/TIME:		COMMENTS:			

IMPORTANT: ACCORDING TO TUSLMA TOMO V., BOOK VI OF THE ENVIRONMENTAL QUALITY OF ART. 72-80, THE REGULATOR IS RESPONSIBLE FOR THE DESIGNATION OF THE SAMPLE POINTS, GQM IS EXEMPTED FROM LIABILITY OF ANY INFLUENCE THAT THE SAMPLES MAY HAVE BY FACTORS KNOWN OR NOT BY THE REGULATOR, WHICH COULD AFFECT THE SUITABILITY OF THE SAMPLES. THE PARAMETERS ESTABLISHED IN THE WORK ORDER, QUOTATION, OR SAMPLE ORDER.

REVIEWED BY:

[Logo of GRUPO QUIMICO MARCOS]

SAMPLES RECEPTION

ORDER NO.	**65755**	DATE OF ARRIVAL: 03/17/29 16:46

DATE AND TIME OF SAMPLING: 03/07/29 09:37 MATRIX: NATURAL WATERS

PLACE OF SAMPLING: Estero Santa Rosa, Machala, in front of the Port Authority of Puerto Bolivar
IDENTIFICATION: P6 Entry to Jambelí (0.60 m deep)
COMPARATIVE TABLE:

GEOGRAPHIC COORDINATES: 17M0609094 9642541 SAMPLED BY: GRUPO QUIMICO MARCOS
TYPE OF SAMPLING: Simple SAMPLE DURATION:
TECHNICAL STANDARD: INEN 2169/2176:2013-PG/GCM/09

LAB. NO.	PAR. CODE	PARAMETER	METHOD
65755-1	As-icp	Arsenic	PEE-GQM-FQ-33
65755-1	Cd-icp	Cadmium	PEE-GQM-FQ-33
65755-1	Cr-icp	Total Chromium	PEE-GQM-FQ-33
65755-1	Cu-icp	Copper	PEE-GQM-FQ-33
65755-1	DigGQM	Samples Digestion – Waters	
65755-1	Fe-icp	Iron	PEE-GQM-FQ-33
65755-1	Hg-1	Mercury	ICP-OES
65755-1	MB03	Fecal Coliforms	9222 D
65755-1	OP07	Surfactants-Detergent	PEE-GQM-FQ-21
65755-1	PO02	Oils and fats	PEE-GQM-FQ-03
65755-1	PO07	Biochemical Oxygen Demand	PEE-GQM-FQ-05
65755-1	PO09	Chemical Oxygen Demand	PEE-GQM-FQ-04
65755-1	PO15	Total Petroleum Hydrocarbons	PEE-GQM-FQ-07
65755-1	PO51	Dissolved Oxygen in situ	PEE-GQM-FQ-65
65755-1	PQ05	Ammonia	PEE-GQM-FQ-31
65755-1	PS02	Total Suspended Solids	PEE-GQM-FQ-06

I, Miguel Angel Pantoja Shimanskii, certify that the present document consisting of 103 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 103 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: 18TH OF MARCH, 2020
Número de calificación/ Qualification number: 1840315
Correo electrónico/email: m.pantoja@translatorsecuador.com
Tel: +593.998901132

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Verifique las credenciales ingresando la CC en el siguiente link:
https://appsj.funcionjudicial.gob.ec/perito-web/pages/peritos_nacional.jsf

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

YILPORT
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

ANEXO 7

Análisis de Sedimentos

Grupo Químico Marcos	*INFORME DE ENSAYOS* No. 65755-7	LABORATORIO DE ENSAYOS ACREDITADO POR EL SAE CON ACREDITACION No. OAE LE 2C 05-001

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:40	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P1 - Frente a Portuaria (Sedimento Prof. 2 mt)	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610680 9639902	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
INORGANICOS NO METALES:					
pH-s	7,90	0,79	---	PEE-GQM-FQ-53	30/03/17 SV

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
METALES:					
Arsenico (3)	< 0,6	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Cromo (4)	23	---	mg/kg	AA-PE-S011	05/04/17 S14
Cadmio (4)	1	---	mg/kg	AAA-PE-S011	05/04/17 S14
Cobre (4)	15	---	mg/kg	AAA-PE-S011	05/04/17 S14
Hierro (4)	> 500	---	mg/kg	AAA-PE-S011	05/04/17 S14
Mercurio (3)	< 0,26	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Plomo	10,3	3,4	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS ORGANICOS:					
Hidrocarburos Totales de Petroleo	1103	55	mg/Kg	PEE-GQM-FQ-56	04/04/17 NS

S14 = Resultado proporcionado por ANAVANLAB Código OAE LE C 13-006

-----	No. Aplica	N.E.	No Efectuado	Método Analítico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Límite Máximo Permisible	
U	Incertidumbre	P.E.E.	Procedimiento especifico de ensayo de GQM	

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905
2: Parámetros subcontratados no acreditados
3: Parámetros acreditados cuyos resultados están fuera del alcance de acreditación
4: Parámetros subcontratados acreditados por el laboratorio subcontratista, competencia evaluada - Cap. 5 MC; ver alcance en www.acreditacion.gob.ec

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Los resultados de este informe de ensayo solo son aplicables a las muestras analizadas.
Este informe de ensayo no deberá reproducirse más que en su totalidad, con autorización escrita de G.Q.M.
Las muestras serán retenidas por 7 dias a partir de la fecha de entrega de resultados.

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:40	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P1 - Frente a Portuaria (Sedimento Prof. 2 mt)	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610680 9639902	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

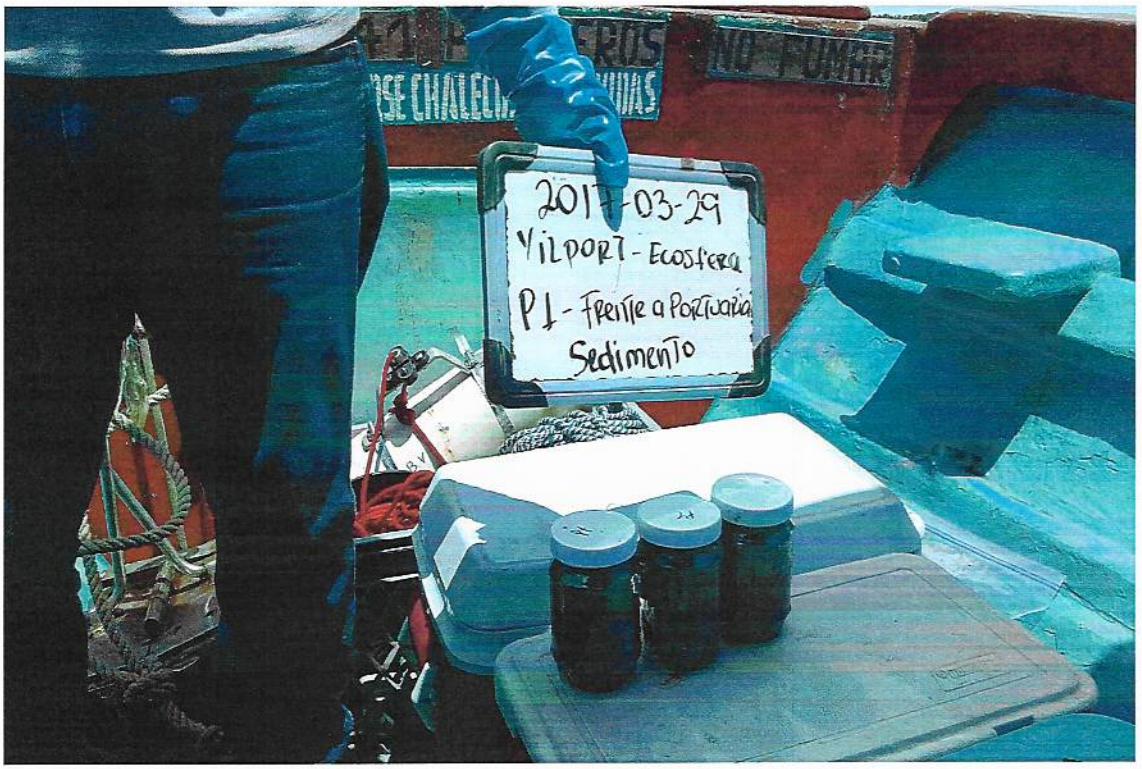
MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:40	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P1 - Frente a Portuaria (Sedimento Prof. 2 mt)	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610680 9639902	

MEMORIA FOTOGRAFICA



1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Grupo Químico Marcos

ACTA DE TOMA DE MUESTRAS

(S755-7

ORDEN DE MUESTREO: 5312

Muestra 7 de 13

FECHA 2017-03-29

CLIENTE ECOSFERA CIA LTDA

LUGAR DE MUESTREO Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar

IDENT. DE LA MUESTRA Sedimento - Punto 1 - (9 mts de profundidad, Definir profundidad y nombre del punto) – Frente a portuaria

TABLA COMPARATIVA

TIPO MUESTREO Simple

MATRIZ SEDIMENTOS

COORDENADAS 17M0610680 – 9639902

DATOS DEL MUESTREO IN SITU

#	HORA	PARAMETROS							OTROS	CARACT. ORGANOLÉPTICAS		CONDICIONES AMBIENTALES			OBSERVACIONES
		pH	T°C	CONDUCTIVIDAD ELÉCTRICA	TDS	CLORO RESIDUAL	OD mg/l	OD % SAT		OLOR	APARIENCIA	T° AMB.	HUMED.	COND. CLIMAT.	
7	11:40								—	SF	—	—		CD	2 mts
PROMEDIO															
CONTROL CALIDAD	DUPLIC									OBSERVACIONES GENERALES:					

NOMENCLATURAS: OLOR: QU = Químico, CL = Clorado, DL = Dulce, FR = Frutal, SF = Sulfuro, AGR = Agrio / APARIENCIA: TB = Turbia, SL = Sólidos, IN = Incolora / CONDICIONES CLIMATICAS: GR = Garúa, NB = Neblina, LV= Lluvia, NL = Nublado, GZ = Granizo, CD = Cielo Despejado, VT = Vientos, SOL = Soleado / Q = Caudal / OD = Oxígeno Disuelto, % SAT = Porcentaje de Saturación / CONTROL CALIDAD. EQ = Equipos, VEH = Vehiculos, ENV = Envases

Q. HISTORIC		Q. POR GQM		ESTADO DE MAREA	—	MEDIO RECEPTOR	

CONTROL CALIDAD	

DETERMINACIÓN DE CAUDAL

VOL. DEL RECIPIENTE:

#	TIEMPO	Q: (Vol / t (Seg)) x 3,6	ALIC = $Q_i * \frac{V_{comp}}{\Sigma Q_i}$
TOTAL			

CROQUIS, ESQUEMAS, CÁLCULOS

VERIFICACIÓN DE EQUIPOS

DETALLE		MEDICIÓN
pH	El -	
COND. ELECT.	El -	
CLORO RESIDUAL	El -	
OXI. DISUELTO	El -	
ALTITUD	SALINIDAD	

CADENA DE FRIO/TESTIGO DE T°C

DETALLE	T°C	HORA
SALIDA DE PUNTO	9,0	13:00
LLEGADA GQM	14,2	16:30

NOMENCLATURAS: Q = Caudal, Vol= Volumen, t = Tiempo / ALI = Alicuota, Qi = Caudal instantáneo registrado cuando la muestra puntual fue tomada, Vcomp = Volumen total de la muestra compuesta
Σ > Qi = Sumatoria de los caudales instantáneos registrados en cada sub – muestra

CADENA DE CUSTODIA

ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	

FIRMAS DE RESPONSABILIDAD

CLIENTE	
MUESTREADOR(ES) GQM	F/B – MCh

IMPORTANTE: SEGÚN TUSLMA TOMO V, LIBRO VI DE LA CALIDAD AMBIENTAL DEL ART. 72 - 80, EL REGULADO ES RESPONSABLE DE LA DESIGNACIÓN DE LOS PUNTOS DE MUESTREO. SE EXIME DE RESPONSABILIDAD A GQM DE CUALQUIER INFLUENCIA QUE PUDIESEN TENER LAS MUESTRAS POR FACTORES CONOCIDOS O NO POR EL REGULADO, QUE PUDIESEN AFECTAR LA IDONEIDAD DE LAS MUESTRAS. SE REALIZAN LOS PARÁMETROS ESTABLECIDOS EN LA ORDEN DE TRABAJO, COTIZACIÓN U ORDEN DE MUESTREO.

REVISADO POR: _____

Grupo Químico Marcos

RECEPCION DE MUESTRAS

NO. ORDEN: 65755 FECHA DE LLEGADA: 17/03/29 16:46

FECHA Y HORA DE MUESTREO: 17/03/29 11:40 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
IDENTIFICACION: P1 - Frente a Portuaria (Sedimento Prof. 2 mt)
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0610680 9639902 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-7	As-suelo	Arsenico	PEE-GQM-FQ-54
65755-7	CRS14	Cromo	AA-PE-S011
65755-7	Cd-s-S14	Cadmio	AAA-PE-S011
65755-7	Cu-s-S14	Cobre	AAA-PE-S011
65755-7	DIGGQMS	Digestión de muestras - Suelos-Sedimentos	
65755-7	FES14	Hierro	AAA-PE-S011
65755-7	Hg-s	Mercurio	PEE-GQM-FQ-54
65755-7	MU2	Servicio de muestreo puntual fuera GYE	
65755-7	Pb-s	Plomo	PEE-GQM-FQ-54
65755-7	TPH-s	Hidrocarburos Totales de Petroleo	PEE-GQM-FQ-56
65755-7	env-s-LS3	Servicio de envio Courier	---
65755-7	pH-suelo	pH-s	PEE-GQM-FQ-53

FECHA Y HORA DE MUESTREO: 17/03/29 11:25 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
IDENTIFICACION: P2 - Frente Liceo Naval (Sedimento Prof. 4 mt).
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0610682 9640521 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-8	As-suelo	Arsenico	PEE-GQM-FQ-54
65755-8	CRS14	Cromo	AA-PE-S011
65755-8	Cd-s-S14	Cadmio	AAA-PE-S011

Grupo Químico Marcos	*INFORME DE ENSAYOS* No. 65755-8	LABORATORIO DE ENSAYOS ACREDITADO POR EL SAE CON ACREDITACION No. OAE LE 2C 05-001

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo: 29/03/17 11:25 Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
Fecha y Hora de Recepción: 29/03/17 16:46
Punto e Identificación de la Muestra: P2 - Frente Liceo Naval (Sedimento Prof. 4 mt).
Norma Técnica de muestreo (1): PG-GQM-15 SUELOS
Matriz de la muestra: SEDIMENTOS
Muestreado por: GRUPO QUIMICO MARCOS C. LTDA
Muestreador: LB-MCH
Tipo de Muestreo: Simple
Coordenadas Geográficas: 17M0610682 9640521

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
INORGANICOS NO METALES:					
pH-s	8,14	0,81	---	PEE-GQM-FQ-53	30/03/17 SV

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
METALES:					
Arsenico	1,7	0,6	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Cromo (4)	17	---	mg/kg	AA-PE-S011	05/04/17 S14
Cadmio (4)	1	---	mg/kg	AAA-PE-S011	05/04/17 S14
Cobre (4)	9	---	mg/kg	AAA-PE-S011	05/04/17 S14
Hierro (4)	> 500	---	mg/kg	AAA-PE-S011	05/04/17 S14
Mercurio (3)	< 0,26	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Plomo	12,6	4,2	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS ORGANICOS:					
Hidrocarburos Totales de Petroleo	1131	57	mg/Kg	PEE-GQM-FQ-56	05/04/17 NS

S14 = Resultado proporcionado por ANAVANLAB Código OAE LE C 13-006

-----	No. Aplica	N.E.	No Efectuado	Método Analítico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Límite Máximo Permisible	
U	Incertidumbre	P.E.E.	Procedimiento especifico de ensayo de GQM	

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905
2: Parámetros subcontratados no acreditados
3: Parámetros acreditados cuyos resultados están fuera del alcance de acreditación
4: Parámetros subcontratados acreditados por el laboratorio subcontratista, competencia evaluada - Cap. 5 MC; ver alcance en www.acreditacion.gob.ec

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Los resultados de este informe de ensayo solo son aplicables a las muestras analizadas.
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Las muestras serán retenidas por 7 días a partir de la fecha de entrega de resultados.

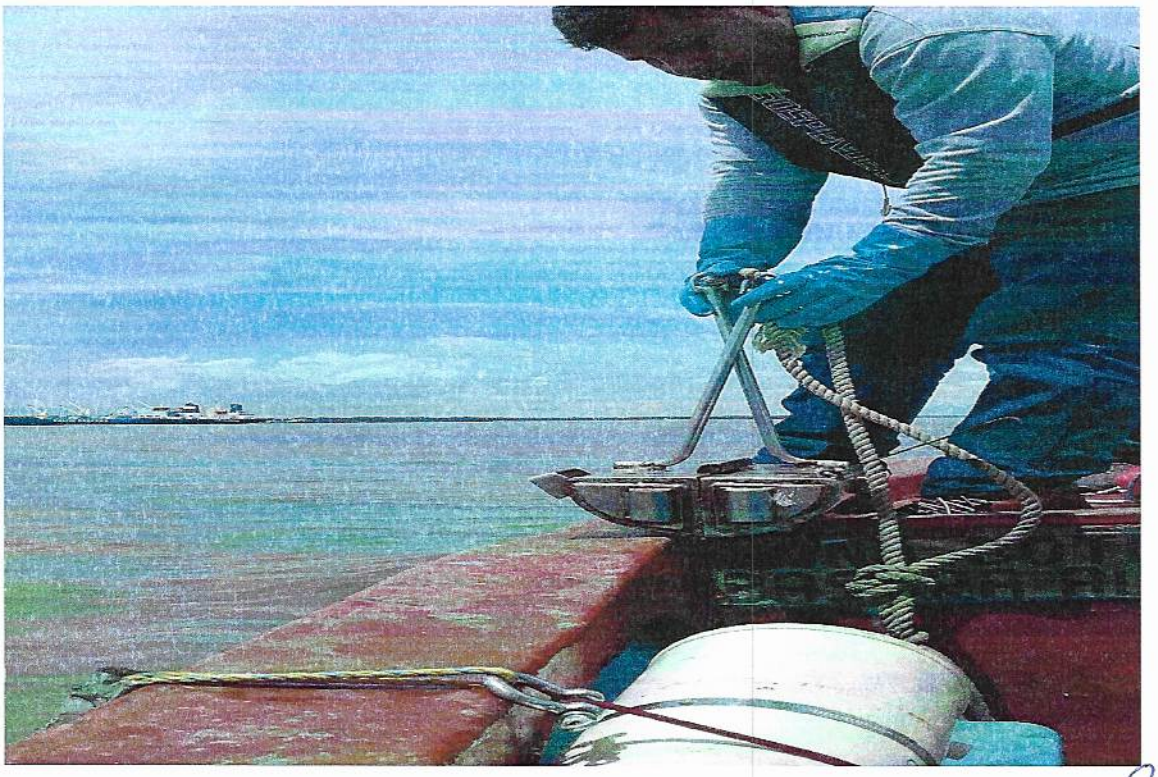
ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:25	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P2 - Frente Liceo Naval (Sedimento Prof. 4 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610682 9640521	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

MEMORIA FOTOGRAFICA



1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:25	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P2 - Frente Liceo Naval (Sedimento Prof. 4 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610682 9640521	

MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Los resultados de este informe de ensayo solo son aplicables a las muestras analizadas.
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Las muestras serán retenidas por 7 días a partir de la fecha de entrega de resultados.

Grupo Químico Marcos

ACTA DE TOMA DE MUESTRAS

65733-8

ORDEN DE MUESTREO: 5312

Muestra 8 de 13

FECHA 2017-03-29

CLIENTE ECOSFERA CIA LTDA

LUGAR DE MUESTREO Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar

IDENT. DE LA MUESTRA Sedimento - Punto 2 - (9 mts de profundidad, Definir profundidad y nombre del punto) – Liceo Naval

TABLA COMPARATIVA

TIPO MUESTREO Simple

MATRIZ SEDIMENTOS

COORDENADAS ~~0 0~~ 17M 0610082 - 9640521

DATOS DEL MUESTREO IN SITU

#	HORA	PARAMETROS							OTROS	CARACT. ORGANOLÉPTICAS		CONDICIONES AMBIENTALES			OBSERVACIONES
		pH	T°C	CONDUCTIVIDAD ELÉCTRICA	TDS	CLORO RESIDUAL	OD mg/l	OD % SAT		OLOR	APARIENCIA	T° AMB.	HUMED.	COND. CLIMAT.	
8	11:25													CD	9 mts.
PROMEDIO															
CONTROL CALIDAD	DUPLIC									OBSERVACIONES GENERALES:					

NOMENCLATURAS: OLOR: QU = Quimico, CL = Clorado, DL = Dulce, FR = Frutal, SF = Sulfuro, AGR = Agrio / APARIENCIA: TB = Turbia, SL = Sólidos, IN = Incolora / CONDICIONES CLIMATICAS: GR = Garúa NB = Neblina, LV= Lluvia, NL = Nublado, GZ = Granizo, CD = Cielo Despejado, VT = Vientos, SOL = Soleado / Q = Caudal / OD = Oxigeno Disuelto, % SAT = Porcentaje de Saturación / CONTROL CALIDAD: EQ = Equipos, VEH = Vehiculos, ENV = Envases

Q. HISTORIC		Q. POR GQM		ESTADO DE MAREA		MEDIO RECEPTOR	

CONTROL CALIDAD	

DETERMINACIÓN DE CAUDAL

VOL. DEL RECIPIENTE:

#	TIEMPO	Q: (Vol / t (Seg)) x 3,6	ALIC = $Q_i = \frac{V_{comp}}{\sum Q_i}$
TOTAL			

NOMENCLATURAS: Q = Caudal, Vol= Volumen, t = Tiempo / ALI = Alicuota, Qi = Caudal instantáneo registrado cuando la muestra puntual fue tomada, Vcomp = Volumen total de la muestra compuesta
= > Qi = Sumatoria de los caudales instantáneos registrados en cada sub – muestra

CROQUIS, ESQUEMAS, CÁLCULOS

VERIFICACIÓN DE EQUIPOS

DETALLE		MEDICIÓN
pH	EI -	
COND. ELECT.	EI -	
CLORO RESIDUAL	EI -	
OXI. DISUELTO	EI -	
ALTITUD	SALINIDAD	

CADENA DE FRIO/TESTIGO DE T°C

DETALLE	T°C	HORA
SALIDA DE PUNTO	9,0	10:00
LLEGADA GQM	14,2	16:30

CADENA DE CUSTODIA

ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	

FIRMAS DE RESPONSABILIDAD

CLIENTE	
MUESTREADOR(ES) GQM	J10 - MCh

IMPORTANTE: SEGÚN TUSLMA TOMO V, LIBRO VI DE LA CALIDAD AMBIENTAL DEL ART. 72 - 80, EL REGULADO ES RESPONSABLE DE LA DESIGNACIÓN DE LOS PUNTOS DE MUESTREO. SE EXIME DE RESPONSABILIDAD A GQM DE CUALQUIER INFLUENCIA QUE PUDIESEN TENER LAS MUESTRAS POR FACTORES CONOCIDOS O NO POR EL REGULADO, QUE PUDIESEN AFECTAR LA IDONEIDAD DE LAS MUESTRAS. SE REALIZAN LOS PARÁMETROS ESTABLECIDOS EN LA ORDEN DE TRABAJO, COTIZACIÓN U ORDEN DE MUESTREO.

REVISADO POR: _____

Grupo Químico Marcos

RECEPCION DE MUESTRAS

NO. ORDEN: 65755 FECHA DE LLEGADA: 17/03/29 16:46

FECHA Y HORA DE MUESTREO: 17/03/29 11:25 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
IDENTIFICACION: P2 - Frente Liceo Naval (Sedimento Prof. 4 mt).
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0610682 9640521 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-8	Cu-s-S14	Cobre	AAA-PE-S011
65755-8	DIGGQMS	Digestión de muestras - Suelos-Sedimentos	
65755-8	FES14	Hierro	AAA-PE-S011
65755-8	Hg-s	Mercurio	PEE-GQM-FQ-54
65755-8	Pb-s	Plomo	PEE-GQM-FQ-54
65755-8	TPH-s	Hidrocarburos Totales de Petroleo	PEE-GQM-FQ-56
65755-8	pH-suelo	pH-s	PEE-GQM-FQ-53

FECHA Y HORA DE MUESTREO: 17/03/29 11:07 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar
IDENTIFICACION: P3 - Isla del Amor (Sedimento Prof. 6 mt).
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0610505 9641879 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-9	As-suelo	Arsenico	PEE-GQM-FQ-54
65755-9	CRS14	Cromo	AA-PE-S011
65755-9	Cd-s-S14	Cadmio	AAA-PE-S011
65755-9	Cu-s-S14	Cobre	AAA-PE-S011
65755-9	DIGGQMS	Digestión de muestras - Suelos-Sedimentos	
65755-9	FES14	Hierro	AAA-PE-S011
65755-9	Hg-s	Mercurio	PEE-GQM-FQ-54
65755-9	Pb-s	Plomo	PEE-GQM-FQ-54

Grupo Químico Marcos

INFORME DE ENSAYOS
No. 65755-9

LABORATORIO DE ENSAYOS ACREDITADO POR EL SAE CON ACREDITACION No. OAE LE 2C 05-001

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:07	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P3 - Isla del Amor (Sedimento Prof. 6 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610505 9641879	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
INORGANICOS NO METALES:					
pH-s	8,15	0,82	---	PEE-GQM-FQ-53	30/03/17 SV

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
METALES:					
Arsenico (3)	< 0,6	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Cromo (4)	20	---	mg/kg	AA-PE-S011	05/04/17 S14
Cadmio (4)	2	---	mg/kg	AAA-PE-S011	05/04/17 S14
Cobre (4)	8	---	mg/kg	AAA-PE-S011	05/04/17 S14
Hierro (4)	> 500	---	mg/kg	AAA-PE-S011	05/04/17 S14
Mercurio (3)	< 0,26	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Plomo	11,3	3,7	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS ORGANICOS:					
Hidrocarburos Totales de Petroleo	1071	54	mg/Kg	PEE-GQM-FQ-56	05/04/17 NS

S14 = Resultado proporcionado por ANAVANLAB Código OAE LE C 13-006

-----	No. Aplica	N.E.	No Efectuado	Método Analítico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Límite Máximo Permisible	
U	Incertidumbre	P.E.E.	Procedimiento especifico de ensayo de GQM	

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905
2: Parámetros subcontratados no acreditados
3: Parámetros acreditados cuyos resultados están fuera del alcance de acreditación
4: Parámetros subcontratados acreditados por el laboratorio subcontratista, competencia evaluada - Cap. 5 MC; ver alcance en www.acreditacion.gob.ec

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:07	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P3 - Isla del Amor (Sedimento Prof. 6 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610505 9641879	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Grupo Químico Marcos	*INFORME DE ENSAYOS* No. 65755-9	LABORATORIO DE ENSAYOS ACREDITADO POR EL SAE CON ACREDITACION No. OAE LE 2C 05-001

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 11:07	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P3 - Isla del Amor (Sedimento Prof. 6 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0610505 9641879	

MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Grupo Químico Marcos

ACTA DE TOMA DE MUESTRAS

GS 755-9

ORDEN DE MUESTREO: 5312

Muestra 9 de 13

FECHA 2017-03-29

CLIENTE ECOSFERA CIA LTDA

LUGAR DE MUESTREO Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar

IDENT. DE LA MUESTRA Sedimento - Punto 3 - (9 mts de profundidad, Definir profundidad y nombre del punto) - Isla del amor

TABLA COMPARATIVA

TIPO MUESTREO Simple

MATRIZ SEDIMENTOS

COORDENADAS 17M 0610505 - 9641879

DATOS DEL MUESTREO IN SITU

#	HORA	PARAMETROS							OTROS	CARACT. ORGANOLÉPTICAS		CONDICIONES AMBIENTALES			OBSERVACIONES
		pH	T°C	CONDUCTIVIDAD ELÉCTRICA	TDS	CLORO RESIDUAL	OD mg/l	OD % SAT		OLOR	APARIENCIA	T° AMB.	HUMED.	COND. CLIMAT.	
09	11:07									—				CD.	6 mts.
PROMEDIO															
CONTROL CALIDAD	DUPLIC									OBSERVACIONES GENERALES:					

NOMENCLATURAS: OLOR: QU = Químico, CL = Clorado, DL = Dulce, FR = Frutal, SF = Sulfuro, AGR = Agrio / APARIENCIA: TB = Turbia, SL = Sólidos, IN = Incolora / CONDICIONES CLIMATICAS: GR = Garúa, NB = Neblina, LV= Lluvia, NL = Nublado, GZ = Granizo, CD = Cielo Despejado, VT = Vientos, SOL = Soleado / Q = Caudal / OD = Oxígeno Disuelto, % SAT = Porcentaje de Saturación / CONTROL CALIDAD: EQ = Equipos, VEH = Vehiculos, ENV = Envases

Q. HISTORIC		Q. POR GQM		ESTADO DE MAREA		MEDIO RECEPTOR	

CONTROL CALIDAD	

DETERMINACIÓN DE CAUDAL

VOL. DEL RECIPIENTE:

#	TIEMPO	Q: (Vol / t (Seg)) x 3,6	ALIC = $Q_i * \frac{V_{comp}}{\sum Q_i}$
TOTAL			

NOMENCLATURAS: Q = Caudal, Vol= Volumen, t = Tiempo / ALI = Alicuota, Qi = Caudal instantáneo registrado cuando la muestra puntual fue tomada, Vcomp = Volumen total de la muestra compuesta
= > Qi = Sumatoria de los caudales instantáneos registrados en cada sub – muestra

CROQUIS, ESQUEMAS, CÁLCULOS

VERIFICACIÓN DE EQUIPOS

DETALLE		MEDICIÓN
pH	El -	
COND. ELECT.	El -	
CLORO RESIDUAL	El -	
OXI. DISUELTO	El -	
ALTITUD	SALINIDAD	

CADENA DE FRIO/TESTIGO DE T°C

DETALLE	T°C	HORA
SALIDA DE PUNTO	9,00	13:00
LLEGADA GQM	14,2	16:30

CADENA DE CUSTODIA

ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	

FIRMAS DE RESPONSABILIDAD

CLIENTE	
MUESTREADOR(ES) GQM	AB - MCH

IMPORTANTE: SEGÚN TUSLMA TOMO V, LIBRO VI DE LA CALIDAD AMBIENTAL DEL ART. 72 - 80, EL REGULADO ES RESPONSABLE DE LA DESIGNACIÓN DE LOS PUNTOS DE MUESTREO. SE EXIME DE RESPONSABILIDAD A GQM DE CUALQUIER INFLUENCIA QUE PUDIESEN TENER LAS MUESTRAS POR FACTORES CONOCIDOS O NO POR EL REGULADO, QUE PUDIESEN AFECTAR LA IDONEIDAD DE LAS MUESTRAS. SE REALIZAN LOS PARÁMETROS ESTABLECIDOS EN LA ORDEN DE TRABAJO, COTIZACIÓN U ORDEN DE MUESTREO.

REVISADO POR: _____

RECEPCION DE MUESTRAS

NO. ORDEN: **65755** FECHA DE LLEGADA: 17/03/29 16:46

FECHA Y HORA DE MUESTREO: 17/03/29 11:07 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
IDENTIFICACION: P3 - Isla del Amor (Sedimento Prof. 6 mt).
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0610505 9641879 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-9	TPH-s	Hidrocarburos Totales de Petroleo	PEE-GQM-FQ-56
65755-9	pH-suelo	pH-s	PEE-GQM-FQ-53

FECHA Y HORA DE MUESTREO: 17/03/29 10:36 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
IDENTIFICACION: P4 - Entrada balneario El Coco (Sedimento Prof. 2,50 mt)
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0611365 9645418 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-10	As-suelo	Arsenico	PEE-GQM-FQ-54
65755-10	CRS14	Cromo	AA-PE-S011
65755-10	Cd-s-S14	Cadmio	AAA-PE-S011
65755-10	Cu-s-S14	Cobre	AAA-PE-S011
65755-10	DIGGQMS	Digestión de muestras - Suelos-Sedimentos	
65755-10	FES14	Hierro	AAA-PE-S011
65755-10	Hg-s	Mercurio	PEE-GQM-FQ-54
65755-10	Pb-s	Plomo	PEE-GQM-FQ-54
65755-10	TPH-s	Hidrocarburos Totales de Petroleo	PEE-GQM-FQ-56
65755-10	pH-suelo	pH-s	PEE-GQM-FQ-53

Grupo Químico Marcos	*INFORME DE ENSAYOS* No. 65755-10	LABORATORIO DE ENSAYOS ACREDITADO POR EL SAE CON ACREDITACION No. OAE LE 2C 05-001

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 10:36	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P4 - Entrada balneario El Coco (Sedimento Prof. 2,50 mt)	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0611365 9645418	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
INORGANICOS NO METALES:					
pH-s	7,99	0,80	---	PEE-GQM-FQ-53	30/03/17 SV

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
METALES:					
Arsenico	1,6	0,5	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Cromo (4)	15	---	mg/kg	AA-PE-S011	05/04/17 S14
Cadmio (4)	2	---	mg/kg	AAA-PE-S011	05/04/17 S14
Cobre (4)	9	---	mg/kg	AAA-PE-S011	05/04/17 S14
Hierro (4)	> 500	---	mg/kg	AAA-PE-S011	05/04/17 S14
Mercurio (3)	< 0,26	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Plomo	7,1	2,4	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS ORGANICOS:					
Hidrocarburos Totales de Petroleo	1256	63	mg/Kg	PEE-GQM-FQ-56	05/04/17 NS

S14 = Resultado proporcionado por ANAVANLAB Código OAE LE C 13-006

-----	No. Aplica	N.E.	No Efectuado	Método Analítico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Límite Máximo Permisible	
U	Incertidumbre	P.E.E.	Procedimiento especifico de ensayo de GQM	

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905
2: Parámetros subcontratados no acreditados
3: Parámetros acreditados cuyos resultados están fuera del alcance de acreditación
4: Parámetros subcontratados acreditados por el laboratorio subcontratista, competencia evaluada - Cap. 5 MC; ver alcance en www.acreditacion.gob.ec

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Los resultados de este informe de ensayo solo son aplicables a las muestras analizadas.
Este informe de ensayo no deberá reproducirse más que en su totalidad, con autorización escrita de G.Q.M.
Las muestras serán retenidas por 7 días a partir de la fecha de entrega de resultados.

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 10:36	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P4 - Entrada balneario El Coco (Sedimento Prof. 2,50 mt)	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0611365 9645418	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 10:36	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P4 - Entrada balneario El Coco (Sedimento Prof. 2,50 mt)	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0611365 9645418	

MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Grupo Químico Marcos

ACTA DE TOMA DE MUESTRAS

(8233-17

ORDEN DE MUESTREO: 5312

Muestra 10 de 13

FECHA 2017-03-29

CLIENTE ECOSFERA CIA LTDA

LUGAR DE MUESTREO Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar

IDENT. DE LA MUESTRA Sedimento - Punto 4 - (9 mts de profundidad, Definir profundidad y nombre del punto) – Entrada Balneario El coco

TABLA COMPARATIVA

TIPO MUESTREO Simple

MATRIZ SEDIMENTOS

COORDENADAS 00 17M0611365-9645418

DATOS DEL MUESTREO IN SITU

#	HORA	PARAMETROS							OTROS	CARACT. ORGANOLÉPTICAS		CONDICIONES AMBIENTALES			OBSERVACIONES
		pH	T°C	CONDUCTIVIDAD ELÉCTRICA	TDS	CLORO RESIDUAL	OD mg/l	OD % SAT		OLOR	APARIENCIA	T° AMB.	HUMED.	COND. CLIMAT.	
10	10:30													CD	25mt profundidad.
PROMEDIO															
CONTROL CALIDAD	DUPLIC									OBSERVACIONES GENERALES:					

NOMENCLATURAS: OLOR: QU = Químico, CL = Clorado, DL = Dulce, FR = Frutal, SF = Sulfuro, AGR = Agrio / APARIENCIA: TB = Turbia, SL = Sólidos, IN = Incolora / CONDICIONES CLIMATICAS: GR = Garúa, NB = Neblina, LV= Lluvia, NL = Nublado, GZ = Granizo, CD = Cielo Despejado, VT = Vientos, SOL = Soleado / Q = Caudal / OD = Oxigeno Disuelto, % SAT = Porcentaje de Saturación / CONTROL CALIDAD: EQ = Equipos, VEH = Vehiculos, ENV = Envases

Q. HISTORIC		Q. POR GQM		ESTADO DE MAREA		MEDIO RECEPTOR	

CONTROL CALIDAD	

DETERMINACIÓN DE CAUDAL

VOL. DEL RECIPIENTE:

#	TIEMPO	Q: (Vol / t (Seg)) x 3,6	ALIC = $Q_i * \frac{V_{comp}}{\Sigma Q_i}$
TOTAL			

CROQUIS, ESQUEMAS, CÁLCULOS

VERIFICACIÓN DE EQUIPOS

DETALLE		MEDICIÓN
pH	El -	
COND. ELECT.	El -	
CLORO RESIDUAL	El -	
OXI. DISUELTO	El -	
ALTITUD	SALINIDAD	

CADENA DE FRIO/TESTIGO DE T°C

DETALLE	T°C	HORA
SALIDA DE PUNTO	9,0	13:00
LLEGADA GQM	14,2	16:30

NOMENCLATURAS: Q = Caudal, Vol= Volumen, t = Tiempo / ALI = Alicuota, Qi = Caudal instantáneo registrado cuando la muestra puntual fue tomada, Vcomp = Volumen total de la muestra compuesta
=> Qi = Sumatoria de los caudales instantáneos registrados en cada sub – muestra

CADENA DE CUSTODIA

ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	

FIRMAS DE RESPONSABILIDAD

CLIENTE	
MUESTREADOR(ES) GQM	FIB- MCh

IMPORTANTE: SEGÚN TUSLMA TOMO V, LIBRO VI DE LA CALIDAD AMBIENTAL DEL ART. 72 - 80, EL REGULADO ES RESPONSABLE DE LA DESIGNACIÓN DE LOS PUNTOS DE MUESTREO. SE EXIME DE RESPONSABILIDAD A GQM DE CUALQUIER INFLUENCIA QUE PUDIESEN TENER LAS MUESTRAS POR FACTORES CONOCIDOS O NO POR EL REGULADO, QUE PUDIESEN AFECTAR LA IDONEIDAD DE LAS MUESTRAS. SE REALIZAN LOS PARÁMETROS ESTABLECIDOS EN LA ORDEN DE TRABAJO, COTIZACIÓN U ORDEN DE MUESTREO.

REVISADO POR: _____

Grupo Químico Marcos

ACTA DE TOMA DE MUESTRAS

65733-4

ORDEN DE MUESTREO: 5312

Muestra 11 de 13

FECHA 2017-03-29

CLIENTE ECOSFERA CIA LTDA

LUGAR DE MUESTREO Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar

IDENT. DE LA MUESTRA Sedimento - Punto 5 - (9 mts de profundidad, Definir profundidad y nombre del punto) - punta El faro (7 mts)

TABLA COMPARATIVA

TIPO MUESTREO Simple

MATRIZ SEDIMENTOS

COORDENADAS ~~DD~~ 17M 0608302 - 9646721

DATOS DEL MUESTREO IN SITU

#	HORA	PARAMETROS							OTROS	CARACT. ORGANOLÉPTICAS		CONDICIONES AMBIENTALES			OBSERVACIONES
		pH	T°C	CONDUCTIVIDAD ELÉCTRICA	TDS	CLORO RESIDUAL	OD mg/l	OD % SAT		OLOR	APARIENCIA	T° AMB.	HUMED.	COND. CLIMAT.	
11	9:16														
PROMEDIO															
CONTROL CALIDAD	DUPLIC									OBSERVACIONES GENERALES:					

NOMENCLATURAS: OLOR: QU = Químico, CL = Clorado, DL = Dulce, FR = Frutal, SF = Sulfuro, AGR = Agrio / APARIENCIA: TB = Turbia, SL = Sólidos, IN = Incolora / CONDICIONES CLIMATICAS: GR = Garúa, NB = Neblina, LV= Lluvia, NL = Nublado, GZ = Granizo, CD = Cielo Despejado, VT = Vientos, SOL = Soleado / Q = Caudal / OD = Oxigeno Disuelto, % SAT = Porcentaje de Saturación / CONTROL CALIDAD: EQ = Equipos, VEH = Vehiculos, ENV = Envases

Q. HISTORIC		Q. POR GQM		ESTADO DE MAREA		MEDIO RECEPTOR	

CONTROL CALIDAD	

DETERMINACIÓN DE CAUDAL

VOL. DEL RECIPIENTE:

#	TIEMPO	Q: (Vol / t (Seg)) x 3,6	ALIC = $Q_i * \frac{V_{comp}}{\sum Q_i}$
TOTAL			

CROQUIS, ESQUEMAS, CÁLCULOS

VERIFICACIÓN DE EQUIPOS

DETALLE		MEDICIÓN
pH	El -	
COND. ELECT.	El -	
CLORO RESIDUAL	El -	
OXI. DISUELTO	El -	
ALTITUD	SALINIDAD	

CADENA DE FRIO/TESTIGO DE T°C

DETALLE	T°C	HORA
SALIDA DE PUNTO	9,0	13:00
LLEGADA GQM	14,2	16:30

NOMENCLATURAS: Q = Caudal, Vol= Volumen, t = Tiempo / ALI = Alicuota, Qi = Caudal instantáneo registrado cuando la muestra puntual fue tomada, Vcomp = Volumen total de la muestra compuesta, $\sum$ > Qi = Sumatoria de los caudales instantáneos registrados en cada sub – muestra

CADENA DE CUSTODIA

ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	

FIRMAS DE RESPONSABILIDAD

CLIENTE	
MUESTREADOR(ES) GQM	

IMPORTANTE: SEGÚN TUSLMA TOMO V, LIBRO VI DE LA CALIDAD AMBIENTAL DEL ART. 72 - 80, EL REGULADO ES RESPONSABLE DE LA DESIGNACIÓN DE LOS PUNTOS DE MUESTREO. SE EXIME DE RESPONSABILIDAD A GQM DE CUALQUIER INFLUENCIA QUE PUDIESEN TENER LAS MUESTRAS POR FACTORES CONOCIDOS O NO POR EL REGULADO, QUE PUDIESEN AFECTAR LA IDONEIDAD DE LAS MUESTRAS. SE REALIZAN LOS PARÁMETROS ESTABLECIDOS EN LA ORDEN DE TRABAJO, COTIZACIÓN U ORDEN DE MUESTREO.

REVISADO POR: _____

Grupo Químico Marcos	*INFORME DE ENSAYOS* No. 65755-11	LABORATORIO DE ENSAYOS ACREDITADO POR EL SAE CON ACREDITACION No. OAE LE 2C 05-001

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 09:16	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P5 - Punta el Faro (Sedimento Prof. 7 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0608302 9646721	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
INORGANICOS NO METALES:					
pH-s	8,00	0,80	---	PEE-GQM-FQ-53	30/03/17 SV

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
METALES:					
Arsenico (3)	< 0,6	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Cromo (4)	19	---	mg/kg	AA-PE-S011	05/04/17 S14
Cadmio (4)	< 1,0	---	mg/kg	AAA-PE-S011	05/04/17 S14
Cobre (4)	11	---	mg/kg	AAA-PE-S011	05/04/17 S14
Hierro (4)	> 500	---	mg/kg	AAA-PE-S011	05/04/17 S14
Mercurio (3)	< 0,26	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Plomo	6,5	2,1	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS ORGANICOS:					
Hidrocarburos Totales de Petroleo	1090	55	mg/Kg	PEE-GQM-FQ-56	06/04/17 NS

S14 = Resultado proporcionado por ANAVANLAB Código OAE LE C 13-006

-----	No. Aplica	N.E.	No Efectuado	Método Analítico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Límite Máximo Permisible	
U	Incertidumbre	P.E.E.	Procedimiento especifico de ensayo de GQM	

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905
2: Parámetros subcontratados no acreditados
3: Parámetros acreditados cuyos resultados están fuera del alcance de acreditación
4: Parámetros subcontratados acreditados por el laboratorio subcontratista, competencia evaluada - Cap. 5 MC; ver alcance en www.acreditacion.gob.ec

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Los resultados de este informe de ensayo solo son aplicables a las muestras analizadas.
Este informe de ensayo no deberá reproducirse más que en su totalidad, con autorización escrita de G.Q.M.
Las muestras serán retenidas por 7 dias a partir de la fecha de entrega de resultados.

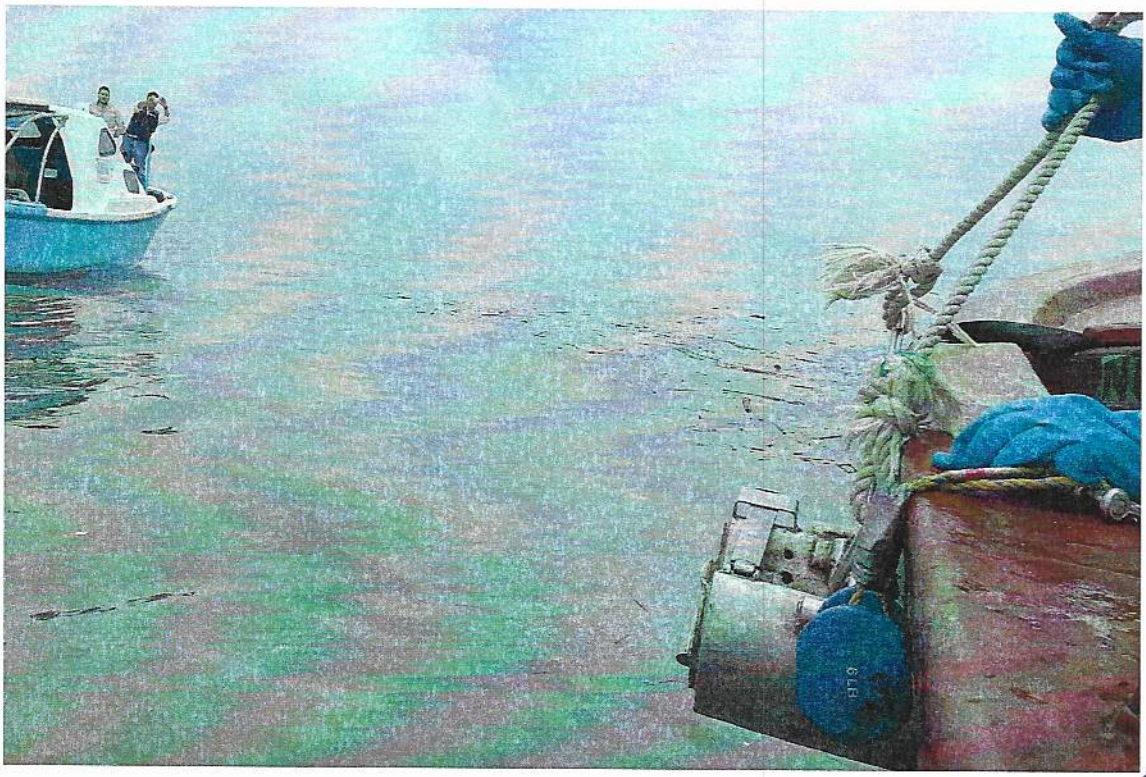
ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 09:16	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P5 - Punta el Faro (Sedimento Prof. 7 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0608302 9646721	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

MEMORIA FOTOGRAFICA



1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 09:16	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P5 - Punta el Faro (Sedimento Prof. 7 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0608302 9646721	

MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Q.F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Grupo Químico Marcos

RECEPCION DE MUESTRAS

NO. ORDEN: 65755 FECHA DE LLEGADA: 17/03/29 16:46

FECHA Y HORA DE MUESTREO: 17/03/29 09:16 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
IDENTIFICACION: P5 - Punta el Faro (Sedimento Prof. 7 mt).
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0608302 9646721 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-11	As-suelo	Arsenico	PEE-GQM-FQ-54
65755-11	CRS14	Cromo	AA-PE-S011
65755-11	Cd-s-S14	Cadmio	AAA-PE-S011
65755-11	Cu-s-S14	Cobre	AAA-PE-S011
65755-11	DIGGQMS	Digestión de muestras - Suelos-Sedimentos	
65755-11	FES14	Hierro	AAA-PE-S011
65755-11	Hg-s	Mercurio	PEE-GQM-FQ-54
65755-11	Pb-s	Plomo	PEE-GQM-FQ-54
65755-11	TPH-s	Hidrocarburos Totales de Petroleo	PEE-GQM-FQ-56
65755-11	pH-suelo	pH-s	PEE-GQM-FQ-53

FECHA Y HORA DE MUESTREO: 17/03/29 09:43 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
IDENTIFICACION: P6 - Entrada a Jambelí (Sedimento 8 mt).
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0609094 9642541 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-12	As-suelo	Arsenico	PEE-GQM-FQ-54
65755-12	CRS14	Cromo	AA-PE-S011
65755-12	Cd-s-S14	Cadmio	AAA-PE-S011
65755-12	Cu-s-S14	Cobre	AAA-PE-S011
65755-12	DIGGQMS	Digestión de muestras - Suelos-Sedimentos	

Grupo Químico Marcos

ACTA DE TOMA DE MUESTRAS

(3755-17

ORDEN DE MUESTREO: 5312

Muestra 12 de 13

FECHA 2017-03-24

CLIENTE ECOSFERA CIA LTDA.

LUGAR DE MUESTREO Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolivar

IDENT. DE LA MUESTRA Sedimento - Punto 6 - (9 mts de profundidad, Definir profundidad y nombre del punto) - Entrada a Jambelí.

TABLA COMPARATIVA

TIPO MUESTREO Simple

MATRIZ SEDIMENTOS

COORDENADAS 06 17M 0609094 - 9642541

DATOS DEL MUESTREO IN SITU

#	HORA	PARAMETROS							OTROS	CARACT. ORGANOLÉPTICAS		CONDICIONES AMBIENTALES			OBSERVACIONES
		pH	T°C	CONDUCTIVIDAD ELÉCTRICA	TDS	CLORO RESIDUAL	OD mg/l	OD % SAT		OLOR	APARIENCIA	T° AMB.	HUMED.	COND. CLIMAT.	
12	9:43									SF	—	—	—		8 mts.
PROMEDIO										OBSERVACIONES GENERALES:					
CONTROL CALIDAD	DUPLIC														

NOMENCLATURAS: OLOR: QU = Químico, CL = Clorado, DL = Dulce, FR = Frutal, SF = Sulfuro, AGR = Agrio / APARIENCIA: TB = Turbia, SL = Sólidos, IN = Incolora / CONDICIONES CLIMATICAS: GR = Garúa, NB = Neblina, LV= Lluvia, NL = Nublado, GZ = Granizo, CD = Cielo Despejado, VT = Vientos, SOL = Soleado / Q = Caudal / OD = Oxígeno Disuelto, % SAT = Porcentaje de Saturación / CONTROL CALIDAD: EQ = Equipos, VEH = Vehículos, ENV = Envases

Q. HISTORIC	—	Q. POR GQM	—	ESTADO DE MAREA	—	MEDIO RECEPTOR	—

CONTROL CALIDAD	

DETERMINACIÓN DE CAUDAL

VOL. DEL RECIPIENTE:

#	TIEMPO	Q: (Vol / t (Seg)) x 3,6	ALIC = $Q_i * \frac{V_{comp}}{\sum Q_i}$
TOTAL			

CROQUIS, ESQUEMAS, CÁLCULOS

VERIFICACIÓN DE EQUIPOS

DETALLE		MEDICIÓN
pH	El -	
COND. ELECT.	El -	
CLORO RESIDUAL	El -	
OXI. DISUELTO	El -	
ALTITUD	SALINIDAD	

CADENA DE FRIO/TESTIGO DE T°C

DETALLE	T°C	HORA
SALIDA DE PUNTO	9,0	13:00
LLEGADA GQM	14,2	16:30

NOMENCLATURAS: Q = Caudal, Vol= Volumen, t = Tiempo / ALI = Alicuota, Qi = Caudal instantáneo registrado cuando la muestra puntual fue tomada, Vcomp = Volumen total de la muestra compuesta
Σ > Qi = Sumatoria de los caudales instantáneos registrados en cada sub – muestra

CADENA DE CUSTODIA

ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	
ENTREGA/RECIBE POR:		FECHA/HORA:		OBSERVACIÓN:	

FIRMAS DE RESPONSABILIDAD

CLIENTE	
MUESTREADOR(ES) GQM	

IMPORTANTE: SEGÚN TUSLMA TOMO V, LIBRO VI DE LA CALIDAD AMBIENTAL DEL ART. 72 - 80, EL REGULADO ES RESPONSABLE DE LA DESIGNACIÓN DE LOS PUNTOS DE MUESTREO. SE EXIME DE RESPONSABILIDAD A GQM DE CUALQUIER INFLUENCIA QUE PUDIESEN TENER LAS MUESTRAS POR FACTORES CONOCIDOS O NO POR EL REGULADO, QUE PUDIESEN AFECTAR LA IDONEIDAD DE LAS MUESTRAS. SE REALIZAN LOS PARÁMETROS ESTABLECIDOS EN LA ORDEN DE TRABAJO, COTIZACIÓN U ORDEN DE MUESTREO.

REVISADO POR: _____

Grupo Químico Marcos	*INFORME DE ENSAYOS* No. 65755-12	LABORATORIO DE ENSAYOS ACREDITADO POR EL SAE CON ACREDITACION No. OAE LE 2C 05-001

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 09:43	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P6 - Entrada a Jambelí (Sedimento 8 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0609094 9642541	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
INORGANICOS NO METALES:					
pH-s	8,21	0,82	---	PEE-GQM-FQ-53	30/03/17 SV

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
METALES:					
Arsenico (3)	< 0,6	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Cromo (4)	17	---	mg/kg	AA-PE-S011	05/04/17 S14
Cadmio (4)	< 1,0	---	mg/kg	AAA-PE-S011	05/04/17 S14
Cobre (4)	10	---	mg/kg	AAA-PE-S011	05/04/17 S14
Hierro (4)	> 500	---	mg/kg	AAA-PE-S011	05/04/17 S14
Mercurio (3)	< 0,26	---	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT
Plomo	9,7	3,2	mg/Kg	PEE-GQM-FQ-54	31/03/17 AUT

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS ORGANICOS:					
Hidrocarburos Totales de Petroleo	1005	50	mg/Kg	PEE-GQM-FQ-56	06/04/17 NS

S14 = Resultado proporcionado por ANAVANLAB Código OAE LE C 13-006

-----	No. Aplica	N.E.	No Efectuado	Método Analítico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Límite Máximo Permisible	
U	Incertidumbre	P.E.E.	Procedimiento especifico de ensayo de GQM	

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905
2: Parámetros subcontratados no acreditados
3: Parámetros acreditados cuyos resultados están fuera del alcance de acreditación
4: Parámetros subcontratados acreditados por el laboratorio subcontratista, competencia evaluada - Cap. 5 MC; ver alcance en www.acreditacion.gob.ec

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Los resultados de este informe de ensayo solo son aplicables a las muestras analizadas.
Este informe de ensayo no deberá reproducirse más que en su totalidad, con autorización escrita de G.Q.M.
Las muestras serán retenidas por 7 días a partir de la fecha de entrega de resultados.

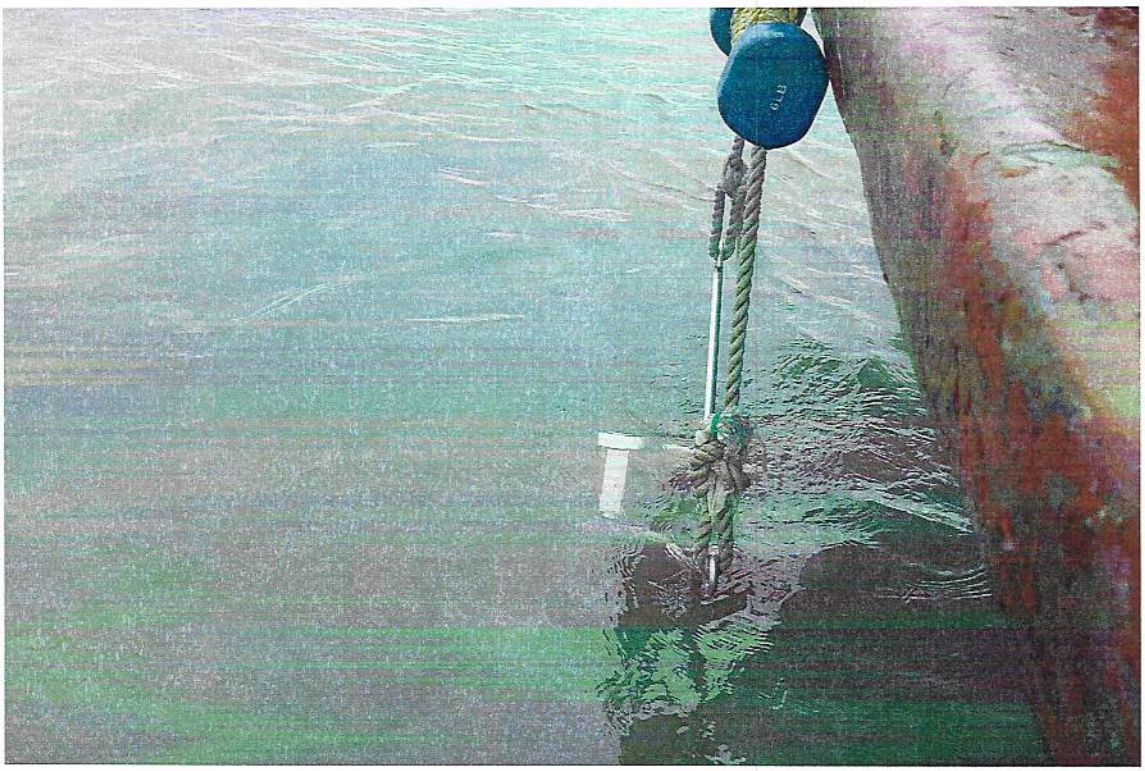
ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 09:43	Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
Fecha y Hora de Recepción:	29/03/17 16:46	
Punto e Identificación de la Muestra:	P6 - Entrada a Jambelí (Sedimento 8 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0609094 9642541	

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-11

MEMORIA FOTOGRAFICA



1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Guayaquil, 21 DE ABRIL DEL 2017

Fecha, Hora y lugar de Muestreo:	29/03/17 09:43	Estero Santa Rosa, ciudad de Machala frente a la Autoridad
Fecha y Hora de Recepción:	29/03/17 16:46	Portuaria de Puerto Bolívar
Punto e Identificación de la Muestra:	P6 - Entrada a Jambelí (Sedimento 8 mt).	
Norma Técnica de muestreo (1):	PG-GQM-15 SUELOS	
Matriz de la muestra:	SEDIMENTOS	
Muestreado por:	GRUPO QUIMICO MARCOS C. LTDA	
Muestreador:	LB-MCH	
Tipo de Muestreo:	Simple	
Coordenadas Geográficas:	17M0609094 9642541	

MEMORIA FOTOGRAFICA

1: Parámetros/Actividad de muestreo, no incluidos en el alcance de acreditación ISO 17025 por el SAE. La cadena de custodia se asegura mediante PG0905

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

RECEPCION DE MUESTRAS

NO. ORDEN: **65755** FECHA DE LLEGADA: 17/03/29 16:46

FECHA Y HORA DE MUESTREO: 17/03/29 09:43 MATRIZ: SEDIMENTOS
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
IDENTIFICACION: P6 - Entrada a Jambelí (Sedimento 8 mt).
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: 17M0609094 9642541 MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Simple DURACIÓN MUESTREO:
NORMA TECNICA: PG-GQM-15 SUELOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-12	FES14	Hierro	AAA-PE-S011
65755-12	Hg-s	Mercurio	PEE-GQM-FQ-54
65755-12	Pb-s	Plomo	PEE-GQM-FQ-54
65755-12	TPH-s	Hidrocarburos Totales de Petroleo	PEE-GQM-FQ-56
65755-12	pH-suelo	pH-s	PEE-GQM-FQ-53

FECHA Y HORA DE MUESTREO: 17/03/29 09:58 MATRIZ: AGUAS NATURALES
LUGAR MUESTREO: Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria de Puerto Bolívar
IDENTIFICACION: Arrastre biológico del P6 - Entrada a Jambelí (17M0609094 - 9642541) a P3 - Isla del Amor
TABLA COMPARATIVA:

COORDENADAS GEOGRAFICAS: MUESTREADO POR : GRUPO QUIMICO MARCOS
TIPO MUESTREO: Compuesto DURACIÓN MUESTREO: 09:58 A 10:03
NORMA TECNICA: PG-GQM-16 BIOLOGICOS

NO. LAB.	CLA. PAR.	PARAMETRO	METODO
65755-13	SU07	Fitoplancton	10200F
65755-13	SU08	Zooplancton	10200G

INFORME DE ANÁLISIS DE FITOPLANCTON Y ZOOPLANCTON

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala, Tel: 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 03 de mayo del 2017

Fecha y lugar de muestreo: 29/03/2017 Estero Santa Rosa, ciudad de Machala frente a la Autoridad Portuaria De Puerto Bolívar
Fecha y Hora de Recepción 29/03/2017 16:46
Tipo de muestra: AGUAS NATURALES
Muestreado por: GRUPO QUIMICO MARCOS C. LTDA
Muestreador: LB - MCH

1. INTRODUCCIÓN

Los ecosistemas marinos son complejos, y presentan jerarquías en su estructura de acuerdo al comportamiento del ambiente, es necesario estudiar las variaciones a pequeña escala ya que los trabajos a gran escala las ignoran (Mullin, 1993). Según Moncoiffé et al. (2000), considera que la alta frecuencia en la toma de muestras del plancton, en especial el fitoplancton, tiende a minimizar el error temporal asociado el cual está calculado en un 35% en toma de muestras mensuales en ecosistemas variables. Los eventos de surgencia han sido muy estudiados especialmente por Fortier and Gagné (1990) y D'Croz et al. (1991), entre otros. Sin embargo, las referencias existentes según algunos autores (Lasker, 1975; Dickey, 1990; Osborn et al., 1990; Kiorboe, 1993; Montecinos and Balbontín, 1993), se han basado principalmente en eventos hidrodinámicos, cambios de temperatura y densidad del agua.

Las especies planctónicas, que constituyen cada nivel trófico difieren con las áreas geográficas latitudinales, y entre unas especies a otras, lo que implica directamente en sus hábitat ecológico del ecosistemas oceánico, que puede ser medido por la diversidad, biomasa y composición de sus especies (Nibakken. 1993).

El fitoplancton es un conjunto de organismos acuáticos fotosintetizadores que viven dispersos y/o suspendidos en las columnas de agua, es considerado como las base de las redes tróficas y algunas de estas especies pueden ser heterótrofas por cortos periodos como son: dinoflagelados y eugleniodeos. El nombre proviene de los términos griegos, phyton, que significa "planta" y planktos, que representa "errante" (Oliva-Martínez et al., 2014). Estos organismos unicelulares contienen diferentes tipos de pigmentos (clorofilas), que son capaces de sintetizar y producir proteínas, ácidos grasos e hidratos de carbono con la finalidad de constituirse en la fuente principal de alimento de los consumidores primarios del medio acuático; estas especies de fitoplancton solo deben permanecer en la parte

eufótica, es decir, en la parte superior de las aguas con la finalidad de realizar reproducción, crecimiento y fotosíntesis (Corral et al., 2000).

El zooplancton está constituido por grupos de organismos unicelulares, estos son heterótrofos debido a que para su supervivencia dependen de la ingesta de otros organismos, bacterias o el mismo fitoplancton (Corral et al., 2000). El término proviene del griego zoo que significa "animal" y plancton "errante", es decir, llevado de un lugar a otro (Oliva-Martínez et al., 2014). De la misma manera que el fitoplancton, el desarrollo de estos organismos depende del medio en donde se encuentren. Para el desarrollo y crecimiento de zooplancton no solo se depende de la cantidad de alimento disponible si no de la calidad nutricional de las comunidades fitoplanctónicas (Conde-Porcuna et al., 2004). Según Mora, J. y R. Escribano (2013), los organismos son de pequeño tamaño y pertenecen a varios grupos taxonómicos, los mismos que se encuentran suspendidos en la columna de agua, y manifiesta que su distribución depende del movimiento de las corrientes. A partir del zooplancton se puede obtener un excelente criterio sobre el estado trófico de los sistemas acuáticos y de la misma manera deducir la estructura de las comunidades acuáticas (Conde-Porcuna et al., 2004).

2. ANTECEDENTES

Bonilla D. (1990), detalla la distribución temporal superficial del zooplancton en La estación fija de La Libertad determinando que las mayores concentraciones de la biomasa zooplanctónica los reporta en los meses de abril y mayo.

Ortega, D. & E. Elías (1995), reportan que frente a la Península de Santa Elena se presentó la mayor concentración de plancton durante noviembre de 1995, destacando los grupos más representativos Copépodos, Quetognatos y Eufáusidos.

3. METODOLOGÍA

a. METODO DE CAMPO

La obtención de muestras fue efectuada el día 29 de marzo del año 2017 a las 09:58 AM en la ciudad de Machala, en el Estero Santa Rosa frente a la Autoridad Portuaria de Puerto Bolívar, con ayuda de una canoa a motor; las coordenadas de cada punto fueron tomadas con ayuda de un GPS. Se analizaron dos puntos de muestreo consolidados en donde se realizaron arrastres superficiales para la obtención de una muestra de zooplancton y una muestra de fitoplancton El arrastre fue relizado a una velocidad de 2 nudos/h en un tiempo de 10 minutos.

La red de zooplancton tenía una abertura de boca de 0.30 m de diámetro y longitud de la malla de un metro con una abertura de poro de red de 300 µ. Las muestras fueron vaciadas en frascos de plástico de 500 ml y preservadas con alcohol al 70%. Para la captura de fitoplancton se utilizó una red con abertura

de boca de 0.30 m de diámetro y 1,00 m de largo con una abertura de ojo de malla de 60 µ, las muestras fueron vaciadas en frascos plásticos de 500 ml y preservadas con lugol.

b. METODO DE LABORATORIO

Las muestras antes de ser analizadas, estuvieron sometidas a refrigeración. Para las observaciones de las muestras de fitoplancton y zooplancton se utilizó un microscopio BOECO modelo BM120.
Los análisis de de fitoplancton se realizaron en base a la metodología de Semina (1978), donde nos dice que para calcular el número de cel/m^3 debemos utilizar la fórmula:

$$\frac{cel}{m^3} = \left(\frac{1}{Vol1}\right)\left(\frac{Vol2}{Vol3}\right)$$

Volumen 1= volumen de agua filtrado en la malla utilizada (60 µ)
Volumen 2= muestra concentrada en un vial plástico de 500 ml
Volumen 3= 2 gotas de muestra homogenizada (100 *ul*).

Para el análisis cualitativo se utilizaron los trabajos de Tapia, 2002; Actas Oceanográficas, 2002; Cajas et, al., 1998; Jiménez, 1983; Jiménez, 1983; Luzuriaga et, al., 1998; Zambrano, 1983.

Para la determinación de organismos/10m^2 del zooplancton se empleo la fórmula propuesta por la FAO, 1978; la cual nos dice que se divida el numero de organismos observados en la muestra para el volumen de agua filtrada y se lo multiplique por 10.

$$\frac{org}{10m^2} = \frac{\#\ de\ organismos\ x\ 10}{Volumen\ de\ agua\ \ filtrada}$$

La identificación taxonómica se la realizo con trabajos de Fernández, 2004; Pesantes, 1978; y Zambrano 1983.

Todos los resultados fueron expresados en abundancia relativa; para obtener la abundancia relativa de las muestras colectadas se aplicó la siguiente fórmula:

$$\%Ai = \frac{ni\,(100)}{N}$$

Donde:

%Ai: abundancia relativa
ni: número de individuos por especie

4. RESULTADOS

4.1. Análisis del Fitoplancton (Red de 60 µ)

4.1.1. Arrastre Superficial desde P6 – Entrada a Jambelí a P3 – Isla del Amor (Cód. 65755-13-1).

La especie con mayor abundancia encontrada en esta muestra fue *Skeletonema costatum* con 10.5 x 10^5 cel/m^3; a esta especie le siguieron *Biddulphia sinensis* con 4.7 x 10^4 cel/m^3; *Coscinodiscus concinnus* con 4.3 x 10^4 cel/m^3; *Biddulphia mobiliensis* con 2.19 x 10^4 cel/m^3; *Chaetoceros debilis* con 1.8 x 10^4 cel/m^3; *Coscinodiscus radiatus* con 1.6 x 10^4 cel/m^3; *Navicula sp.* con 1.46 x 10^4 cel/m^3. Con menos abundancia encontramos a *Chaetoceros sp.* con 8463 cel/m^3; *Ditylum brightwellii* con 457 cel/m^3; *Chaetoceros affinis* con 343 cel/m^3; y finalmente, *Dinophysis caudatas* y *Paralia sulcata* con 229 cel/m^3 cada una. (Gráfico 1).

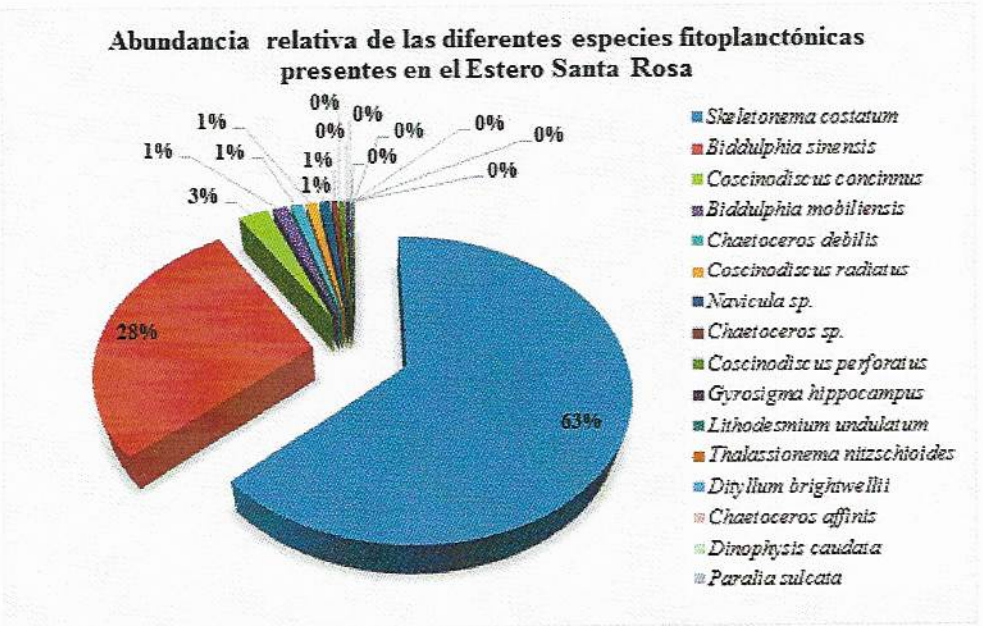


Gráfico 1. Abundancia relativa de las especies fitoplanctónicas presentes en el Estero Santa Rosa

4.2. Análisis del Zooplancton (Red de 60 µ)

Análisis de los grupos microzooplanctónicos capturados en el arrastre de fitoplancton.

4.2.1. Arrastre Superficial desde P6 – Entrada a Jambelí a P3 – Isla del Amor (Cód. 65755-13-1).

En esta muestra, la especie con mayor abundancia fueron los copépodos en estado de copepodito con 24.4 x 10^4 org/10m^2; en abundancia le siguieron los copépodos en estado de nauplio con 21.9 x 10^4 org/10m^2; *Tintinnopsis dadayi* con 7.3 x 10^4 org/10m^2; y por último, con menor abundancia está el tintínido *Tintinnopsis campanula* con 4575 x 10^4 org/10m^2. (Gráfico 4).

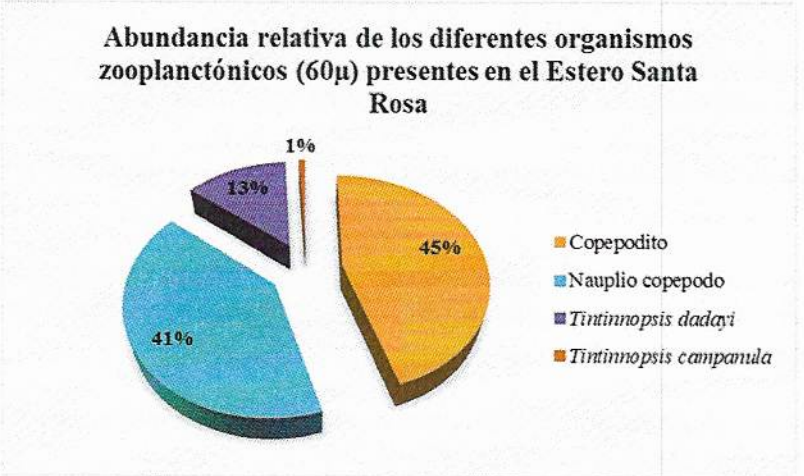


Gráfico 4. Abundancia relativa de los organismos microzooplanctónicos presentes en el Estero Santa Rosa

4.2. Análisis del Zooplancton (Red de 300 µ)

4.2.1. Arrastre Superficial. Desde P6 – Entrada a Jambelí a P3 – Isla del Amor (Cód. 65755-13-2).

En esta muestra solo se encontró a la especie *Acartia tonsa*, la cual presentó una baja abundancia de 343 org/10m^2. (Gráfico 3).

Gráfico 3. Abundancia relativa de los organismos zooplanctónicos presentes en el Estero Santa Rosa.

5. CONCLUSIONES

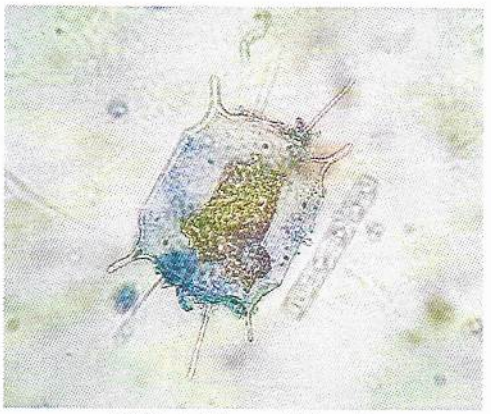
- Se encontraron 16 especies fitoplanctónicas, agrupadas en dos divisiones: Bacillariophyta (15 especies) y la división Dinophyta (1 especie).
- El total fitoplanctónico capturado fue de 16.6 x 10^5 cel/cm^3; en donde la especie más abundante fue Skeletonema costatum, la cual abarcó el 83% del total fitoplanctónico colectado.
- En el análisis microzooplanctónico (60µ) se encontraron los siguientes grupos: Copepoda y Ciliophora.
- El total microzooplanctónico colectado fue de 54.2 x 10^4 org/$10m^2$; en donde los copépodos en estado de copepodito alcanzaron la mayor abundancia, con un 45% del total microzooplanctónico colectado.
- En el análisis zooplanctónicos (300µ) solo se encontró una especie, la cuál fue el copépodo Acartia tonsa, con una abundancia de 343 org/$10m^2$.

Dra. Laura Yanqui
Coordinadora de Calidad

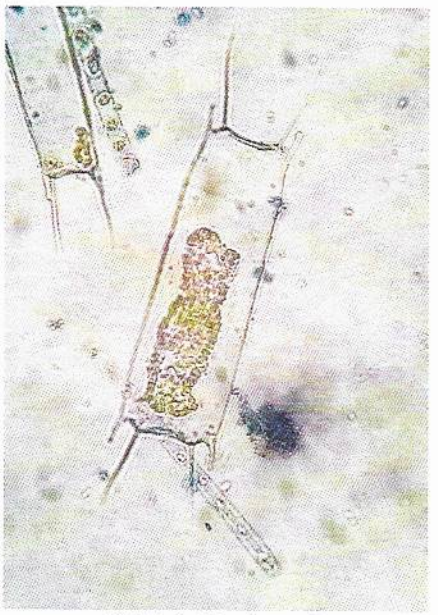
Dr. Fernando Marcos
Director Técnico

Blga. Sandra Armijos
Responsable del análisis

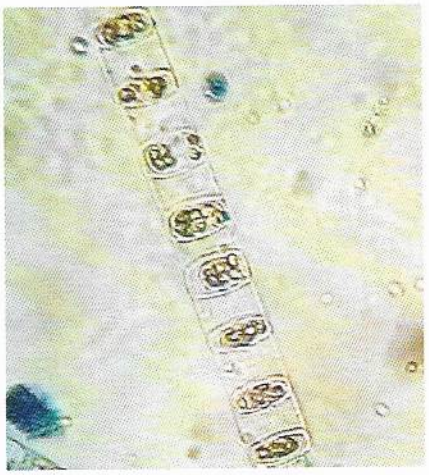
ANEXOS



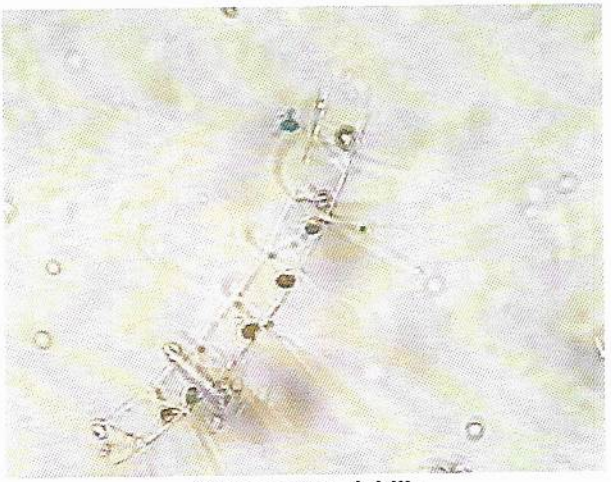
Biddulphia mobiliensis



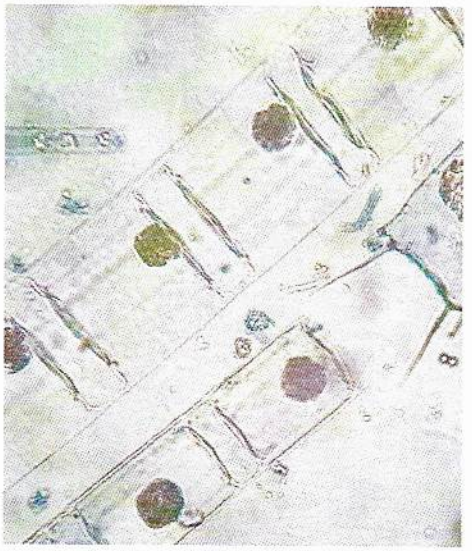
Biddulphia sinensis



Skeletonema costatum

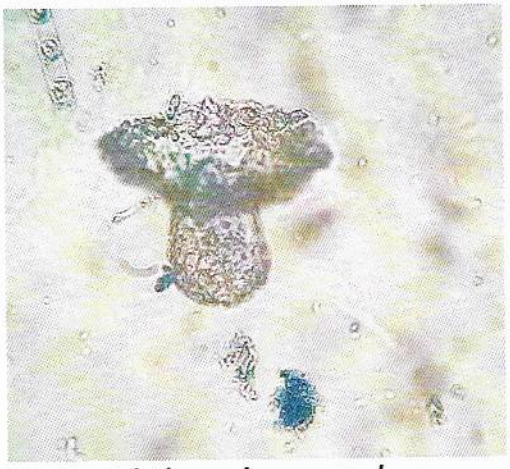


Chaetoceros debilis

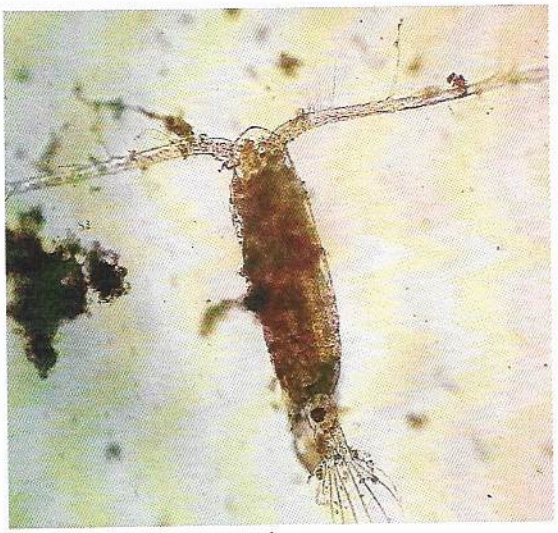


Lithodesmium undulatum

Nauplio copépodo



Tintinnopsis campanula



Acartia tonsa

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

YILPORT®
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

ANEXO 8

Análisis de Calidad de Aire Ambiente

INFORME DE ENSAYO N° M-ME-0260-002-17

MONITOREO DE CALIDAD DE AIRE AMBIENTE

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

IDENTIFICACIÓN DEL CLIENTE

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
Prov. El Oro; Machala, Av. Bolívar Madero Vargas S/N – Puerto Bolivar
Ing. Harry Veintimilla
0992909970

Guayaquil, 20 de abril de 2017

PRESENTACIÓN DEL MONITOREO

Coordenadas geográficas:	0610951 – 9639819	*Coord. Técnico:*	Ing. José Marcial
Orden de trabajo:	OT-0260-17	*Técnico:*	Gabriel Sellán
Norma técnica:	Acuerdo Ministerial 097-A	*Fecha inicial:*	20 de Abril de 2017
Procedimiento de muestreo:	PEE.EL.019	*Fecha final:*	20 de Abril de 2017

EQUIPOS UTILIZADOS

CÓDIGO	NOMBRE	MARCA	MODELO	SERIE	FECHA CAL.	CERTIFICADOS
EL.EA.071	BOMBA SUPELCO	MICRO AIR SAMPLER	NO ESPECÍFICA	NO ESPECÍFICA	09-05-16	http://www.elicrom.com/trazabilidad/
EL.PT.211	TERMOHIGRÓMETRO	ATM	HT9214	NO ESPECÍFICA	07-01-17	
EL.PT.567	ANEMÓMETRO	CONTROL COMPANY	3655	160252813	04-03-16	
EL.PT.547	BARÓMETRO	CONTROL COMPANY	1081	160253706	01-03-16	

CROQUIS DE PUNTOS:

Dirección: Cdla Guayaquil Mz. 21 Calle 1era Solar 10 Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

ELICROM	**INFORME DE ENSAYO N° M-ME-0260-002-17** **MONITOREO DE CALIDAD DE AIRE AMBIENTE** **DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR**

DESCRIPCIÓN DE LA FUENTE EVALUADA

NOMBRE:	*DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR*
ACTIVIDAD:	*ALMACENAMIENTO, CARGA Y DESCARGA DE CONTENEDORES*
RÉGIMEN DE FUNCIONAMIENTO:	*TURNOS: 3 (8 HORAS CADA TURNO)* *DÍAS POR MES: 30 DÍAS* *HORAS POR MES: 720 HORAS*

CONDICIONES AMBIENTALES

Las condiciones ambientales del sitio de monitoreo fueron:

Puntos	Lugar de Medición	Temperatura Media (°C)	Humedad Relativa (%HR)	Velocidad del Viento (m/s)	Presión Atmosférica (mmHg)
1	MUELLE # 5	31,6	69,3	1,5	753,6

RESULTADOS

MUELLE # 5 20 DE ABRIL DE 2017				
Parámetro	**Concentración Observada µg/m³**	**Concentración Corregida µg/m³**	**Máximo Permitido***	**Evaluación**
Monóxido de carbono	2024,22	2086,62	10000	CUMPLE
Dióxido de nitrógeno	10,96	11,29	200	CUMPLE
Dióxido de azufre	8,64	8,90	125	CUMPLE
Ozono	22,86	23,56	100	CUMPLE

*Norma de calidad del aire o nivel de inmisión, Acuerdo Ministerial N°097-A.

Este informe no podrá reproducirse excepto en su totalidad sin la aprobación escrita del laboratorio ELICROM MEDIO AMBIENTE. El presente informe se refiere solamente al sitio descrito en este informe en las condiciones ambientales descritas al momento del ensayo.

"SUPLEMENTO DEL INFORME / CERTIFICADO NÚMERO ME-0260-002-17"

AUTORIZADO POR:

.....

ING. SHIRLEY SÁENZ
COORDINADORA TÉCNICA M.A.

ANEXO:

1. ***CROMATOGRAFÍAS***
2. ***FOTOGRAFÍA***
3. ***CERTIFICADO DE CALIBRACIÓN***

Dirección: Cdla Guayaquil Mz. 21 Calle 1era Solar 10 Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

Clarity - Chromatography SW

ANALISIS DE CALIDAD DE AIRE

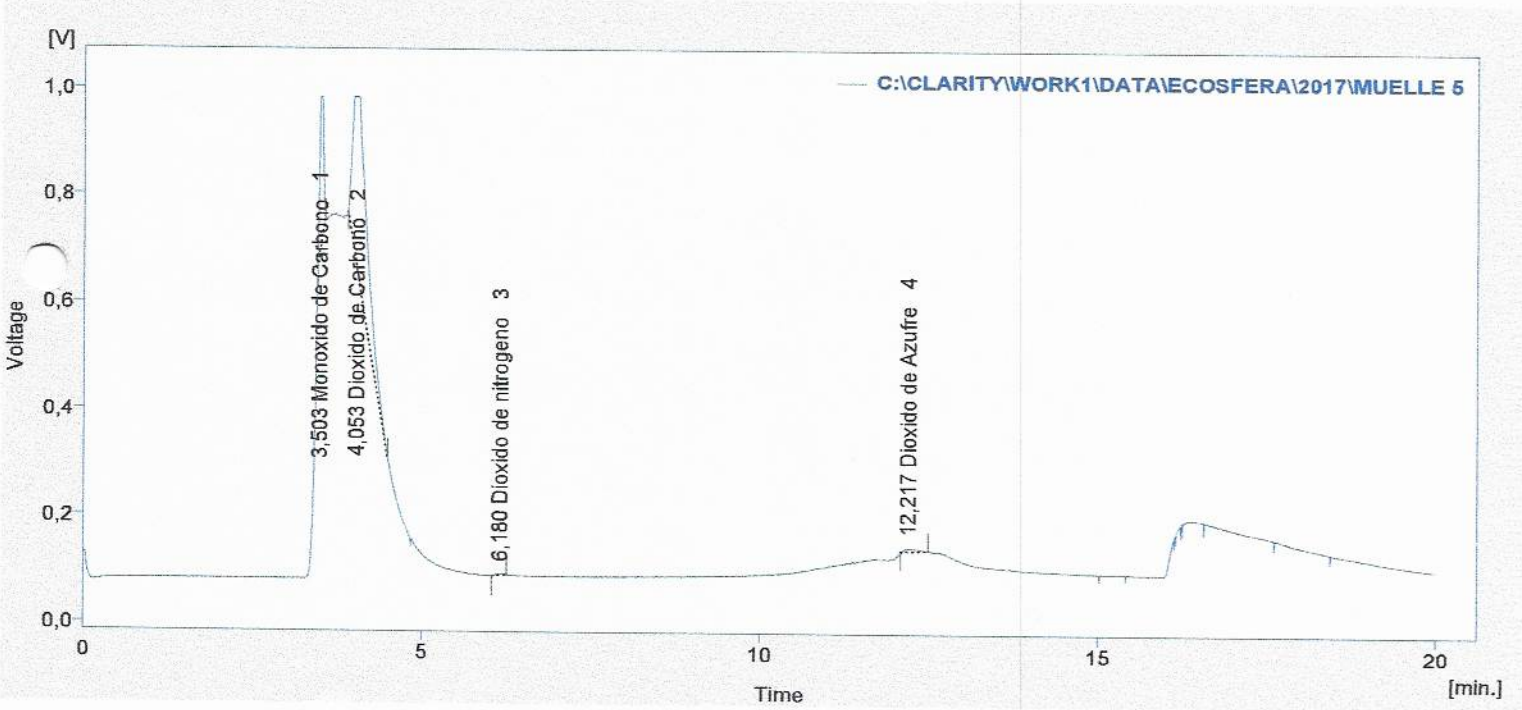
PERSONA DE CONTACTO: ING. HARRY VEINTIMILLA

Printed Version Info:

Printed Version	: Modified	Printed Date	: 24/04/2017 8:37:40
Report Style	: Chromatogram	By	: None
Calibration File	: GASES AMBIENTE		

Sample Info:

Sample ID	: ECOSFERA CIA. LTDA.	Amount [µg/m3]	: 1
Sample	: MUELLE 5	ISTD Amount	: 0
Inj. Volume [ml]	: 1	Dilution	: 1



Result Table (ESTD - C:\CLARITY\WORK1\DATA\ECOSFERA\2017\MUELLE 5)

	Reten. Time [min]	Response	RB	Amount [µg/m3]	Amount [%]	Peak Type	Compound Name
1	3,503	1039,102	A	2024,224	202422,4	Ordnr	Monoxido de Carbono
2	4,053	4828,756	A	N/A	N/A	Error	Dioxido de Carbono
3	6,180	22,183	A	10,968	1096,8	Ordnr	Dioxido de nitrogeno
4	12,217	91,246	A	8,644	864,4	Ordnr	Dioxido de Azufre
	Total			1,000	204383,7		

Clarity - Chromatography SW

ANALISIS DE OZONO

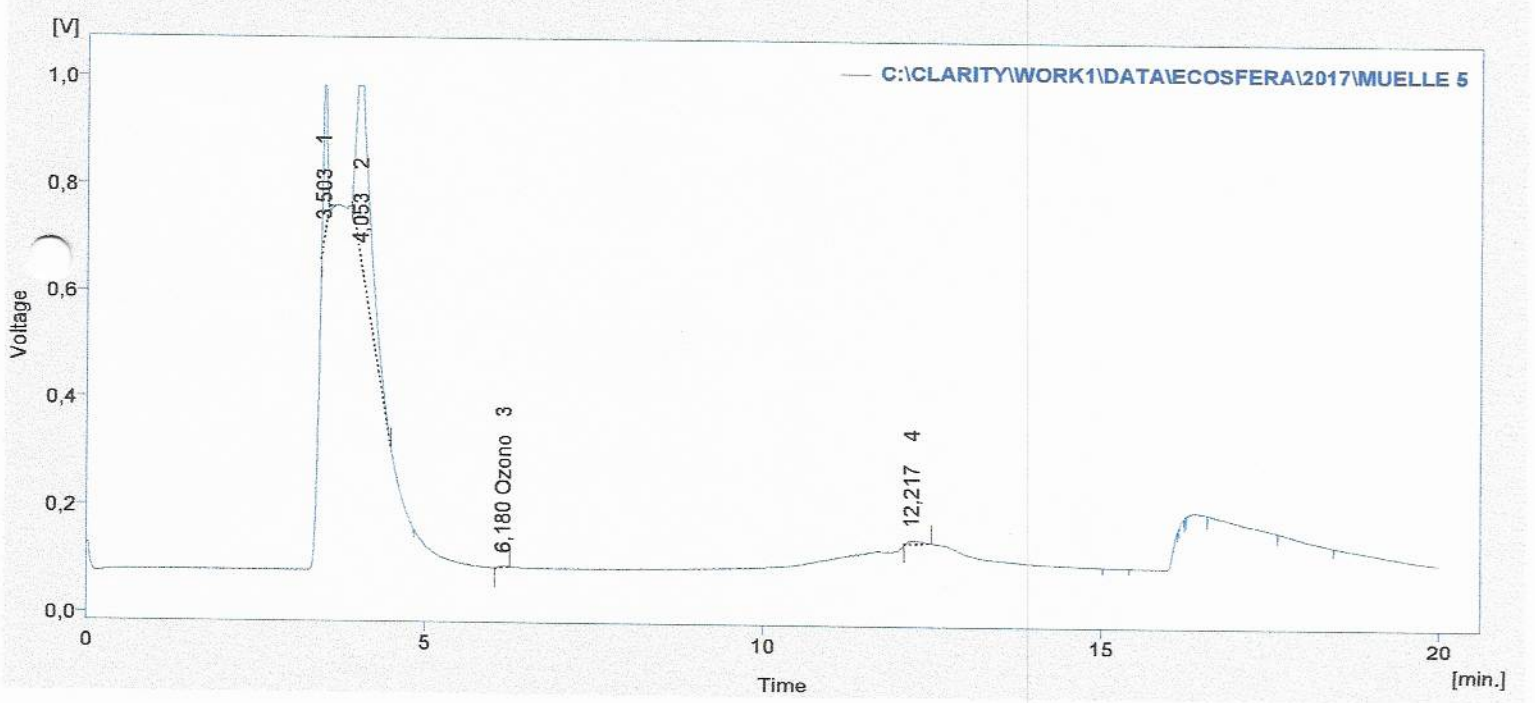
PERSONA DE CONTACTO: ING. HARRY VEINTIMILLA

Printed Version Info:

Printed Version	: 24/04/2017 8:15:32 Recent (Linked Calibration)	Printed Date	: 24/04/2017 8:37:11
Report Style	: Chromatogram	By	: None
Calibration File	: OZONO		

Sample Info:

Sample ID	: ECOSFERA CIA. LTDA.	Amount [ug/m3]	: 1
Sample	: MUELLE 5	ISTD Amount	: 0
Inj. Volume [ml]	: 1	Dilution	: 1



Result Table (ESTD - C:\CLARITY\WORK1\DATA\ECOSFERA\2017\MUELLE 5)

	Reten. Time [min]	Response	RB	Amount [ug/m3]	Amount [%]	Peak Type	Compound Name
3	6,180	22,183	A	22,868	2286,8	Ordnr	Ozono
	Total			1,000	2286,8		

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE CALIDAD DE AIRE AMBIENTE
ABRIL DE 2017

UBICACIÓN: MUELLE # 5

Fecha de monitoreo: 20 de abril de 2017

Equipo utilizado: Bomba Supelco

Realizado por:

Ing. José Marcial

Abril de 2017

Dirección: Cdla. Guayaquil Calle 1era Solar 10; Pbx: 2282007; Cel: 099337519, 097448710;
jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

SUPELCO

CHEMICAL STANDARDS GENERAL USE STANDARDS
Phone: (314) 286-7750. FAX: (314) 771-5757 email: supelco@sial.com

Certificate of Analysis

Certificate Number: 0721311

Certification Date: 2016-05-09
Certificate expiration: 2017-05
Lot. Number: M-CNP24879

Supelco certifies that this unit has been verified in terms of the standars maintained by this laboratory, using instruments that are traceable to the U.S. National Institute of Standars and Technology (NIST). Supporting documentation is on file and available for inspection upon request.
Some og these products are classified as hazardous under European Union (EU) legislation. The risk and safety (R and S) phrases assigned by the EU are listed in the index of EU.

DESCRIPTION	CAT No	CONCENTRATION
CO	EPA PROTOCOLS COMPLIANCE	500 µg/mL each component
NO		Bal nitrogen
SO2		

Store betwen 25 +/- 5°C
Maximum usable shelf life one year from date of manufacture

William J. Sacher
Director of Technical Services

Document: 35266.CERT15.BMP

CERTIFICADO DE CALIBRACIÓN

Ciudadela Guayaquil, calle 1era mz 21 solar 10
Guayaquil - Ecuador Pbx: 04-2282007 Fax: ext. 403
http://www.elicrom.com mail: ventas@elicrom.com

Servicio de Acreditación Ecuatoriano
Acreditación N° OAE LC C 10-009
LABORATORIO DE CALIBRACIÓN

CERTIFICADO No: CC-0254-004-17

IDENTIFICACIÓN DEL CLIENTE

EMPRESA:	ELICROM CIA. LTDA.
DIRECCIÓN:	CIUDADELA GUAYAQUIL, CALLE 1 ERA MZ 21 SOLAR 10
TELÉFONO:	2282007

IDENTIFICACIÓN DEL EQUIPO

EQUIPO:	TERMOHIGRÓMETRO	UNIDAD DE MEDIDA TEMPERATURA:	°C
MARCA:	ATM	RESOLUCIÓN TEMPERATURA:	0,1
MODELO/TIPO:	HT9214	RANGO TEMPERATURA:	(-10 a 50) °C
SERIE:	NO ESPECIFICA	UNIDAD DE MEDIDA HUMEDAD:	%HR
CÓDIGO DE CLIENTE:	EL.PT.211	RESOLUCIÓN HUMEDAD:	0,1
UBICACIÓN:	MEDIO AMBIENTE	RANGO HUMEDAD:	(20 a 99) %HR

EQUIPOS UTILIZADOS

CÓDIGO	NOMBRE	MARCA	MODELO	SERIE	FECHA CAL.	PROX. CAL
EL.PC.013	TERMOHIGROMETRO PATRON	VAISALA	MI70/HMP76B	H4510020/H4950006	06-feb.-15	06-feb.-17
EL.PT.039	CAMARA DE ESTABILIDAD	ELICROM	NO APLICA	NO APLICA	12-ago-16	12-ago-17
EL.PT.365	TERMOHIGROMETRO	CENTER	342	140103655	02-abr-16	02-abr-17

CALIBRACIÓN

MÉTODO:	COMPARACIÓN DIRECTA CON TERMOHIGRÓMETRO PATRÓN Y CÁMARA DE ESTABILIDAD
PROCEDIMIENTO:	PEC.EL.04
LUGAR DE CALIBRACIÓN:	LABORATORIO T.H. (ELICROM)
TEMPERATURA MEDIA (°C):	22,7
HUMEDAD MEDIA (%HR)	49,0

Descripción	Unidad	Patrón	Equipo	Corrección	Incertidumbre
Temperatura interna 1	°C	28,04	28,0	0,0	1,0
Humedad 1	%HR	24,82	28,3	-3,5	4,9
Humedad 2	%HR	45,32	46,4	-1,1	4,9
Humedad 3	%HR	75,40	70,6	4,8	4,9

OBSERVACIONES:

El cálculo de la incertidumbre expandida se realizó en base a la guía OAE G02 R01, multiplicando la incertidumbre típica por el factor de cobertura **k=2,00**, que para una distribución t (de Student) con **Veff** = ∞ (grados efectivos de libertad) corresponde a una probabilidad de cobertura de aproximadamente el 95,45%. La incertidumbre típica de medición se ha determinado conforme al documento EA-4/02. Este certificado no podrá reproducirse excepto en su totalidad sin la aprobación escrita del laboratorio Elicrom-Calibración. El presente certificado se refiere solamente al equipo arriba descrito al momento del ensayo.

CALIBRACIÓN REALIZADA POR: Sergio Rodríguez

FECHA CALIBRACIÓN: 2017-01-07 **FECHA PRÓXIMA:** 2017-07-07

AUTORIZADO POR:
Ing. Sabina Pineda
GERENTE TÉCNICO

RECIBIDO POR:
RESPONSABLE - CLIENTE

Calibration complies with ISO/IEC 17025 and ANSI/NCSL Z540-1

Cert. No.:3655-7473034

Traceable® Certificate of Calibration for Micro-Anemometer/Thermometer

Instrument Identification:

Model: 3655 S/N: 160252813 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Air Velocity Standard	1016965	11/21/16	201511211620
Digital Thermometer	90969500	10/01/16	4000-7091939

Certificate Information:

Technician: 177 Procedure: CAL-3655 Cal Date: 3/04/16 **Cal Due: 3/04/18**

Test Conditions: 22.1°C 42.0 %RH 1021 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
FPM		N.A.		0	0	Y	20	20	7	2.9:1
FPM		N.A.		1,029	990	Y	736	1,322	7	>4:1
FPM		N.A.		1,630	1,499	Y	1,337	1,923	7	>4:1
°C		N.A.		24.22	23.4	Y	22.2	26.2	0.06	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full without the written premission of Control Company.

Aaron Judice, Technical Manager

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2

Maintaining Accuracy:

In our opinion once calibrated your Micro-Anemometer/Thermometer should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Micro-Anemometer/Thermometers change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

Control Company 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Calibration
Certificate No. 1750.01

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Cert. No.: 1081-7473887

Traceable® Certificate of Calibration for Barometer with Clock

Instrument Identification:

Model: 1081 S/N: 160253706 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	9/21/16	1000380976
Non-Contact Frequency Counter	26.66887	5/15/16	1000374678

Certificate Information:

Technician: 57 Procedure: CAL-31 Cal Date: 3/01/16 Due Date: 3/01/18
Test Conditions: 24.3°C 43.0 %RH 1015 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
mb/hPa		N.A.		929.45	927	Y	923	935	0.70	>4:1
mb/hPa		N.A.		979.75	977	Y	974	986	0.70	>4:1
mb/hPa		N.A.		1,014.55	1,011	Y	1,009	1,021	0.70	>4:1
Sec/24hr		N.A.		0.000	0.700	Y	-8.640	8.640	0.13	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4.1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez, Quality Manager

Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Barometer with Clock should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Barometer with Clocks change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

ESTUDIO DE IMPACTO AMBIENTAL
DRAGADO DE MUELLES 1, 2, 3, 4, 5 Y 6,
ZONA DE MANIOBRA Y CANAL DE ACCESO DE
PUERTO BOLÍVAR

YILPORT®
PUERTO BOLIVAR

ECOSFERA
CONSULTORA AMBIENTAL

ANEXO 9

Análisis de Ruido Ambiente

INFORME DE ENSAYO N° M-ME-0260-001-17

MONITOREO DE RUIDO AMBIENTE EXTERNO

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR

IDENTIFICACIÓN DEL CLIENTE

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
Prov. El Oro; Machala, Av. Bolívar Madero Vargas S/N – Puerto Bolívar
Ing. Harry Veintimilla
0992909970

Guayaquil, 20 de abril de 2017

PRESENTACIÓN DEL MONITOREO

Uso de suelo:	Industrial (ID3)	*Metodología de muestreo:*	15 segundos
Coordenadas geográficas:	0610941 – 9639369	*Coord. de proyecto:*	Ing. José Marcial
Orden de trabajo:	OT-0260-17	*Técnico:*	Gabriel Sellán
Norma técnica de muestreo:	Acuerdo Ministerial 097-A	*Fecha inicial:*	20 de Abril de 2017
Procedimiento de muestreo:	PEE.EL.001	*Fecha final:*	20 de Abril de 2017

EQUIPOS UTILIZADOS

CÓDIGO	NOMBRE	MARCA	MODELO	SERIE	FECHA CAL.	CERTIFICADOS
EL.EM.022	SONÓMETRO	CENTER	390	150207044	12-05-16	http://www.elicrom.com/trazabilidad/
EL.PC.003	CALIBRADOR	SPER SCIENTIFIC	850016	081202542	06-06-16	
EL.PT.211	TERMOHIGRÓMETRO	ATM	HT9214	NO ESPECÍFICA	07-01-17	
EL.PT.567	ANEMÓMETRO	CONTROL COMPANY	3655	160252813	04-03-16	
EL.PT.547	BARÓMETRO	CONTROL COMPANY	1081	160253706	01-03-16	

CROQUIS DE PUNTOS:

Dirección: Cdla Guayaquil Mz. 21 Calle 1era Solar 10 Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

EVALUACIÓN DE FFR

NOMBRE:	*DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR*
ACTIVIDAD:	*ALMACENAMIENTO, CARGA Y DESCARGA DE CONTENEDORES*
PUNTOS CRÍTICOS DE AFECTACIÓN:	*RECEPTORES:* *VIVIENDAS CERCANAS* *PERSONAL ADMINISTRATIVO* *PERSONAL DEL PUERTO*
SUPERFICIES CERCANAS REFLECTORAS DE SONIDO:	*EMISOR: SIN LINDEROS FÍSICOS* *RECEPTOR: PAREDES DE HORMIGÓN*
PUNTOS DONDE LA FFR EMITE NPS MÁS ALTOS:	*PLAN DE MANEJO AMBIENTAL*
RÉGIMEN DE FUNCIONAMIENTO:	*TURNOS: 3 (8 HORAS CADA TURNO)* *DÍAS POR MES: 30 DÍAS* *HORAS POR MES: 720 HORAS*
DESCRIPCIÓN DE RUIDO RESIDUAL: *P1: TOMADO EN EL PASO DE VEHÍCULOS HACIA BODEGA* *P2: TOMADO DETRÁS DE ÁREAS ADMINISTRATIVAS* *P3: TOMADO EN LOTE BALDÍO CERCA DE ÁREA DE MANIOBRA MUELLE 5* *P4: TOMADO CERCA A JUNTA PARROQUIAL*	*FUENTES QUE CONTRIBUYEN:* *NO HUBO AFECTACIÓN DE RUIDO*
DESCRIPCIÓN DEL RUIDO ESPECÍFICO: *P1: SE TOMÓ EN EL PASO DE VEHÍCULOS PARA CARGA Y DESCARGA DE PRODUCTOS* *P2: SE TOMÓ JUNTO A ÁREAS ADMINISTRATIVAS* *P3: SE TOMÓ EN ÁREA DE MANIOBRAS Y PASO DE VEHÍCULOS* *P4: SE TOMÓ EN PASO DE VEHÍCULOS*	*FUENTES QUE CONTRIBUYEN:* *PASO VEHICULAR*

CONDICIONES AMBIENTALES

Las condiciones ambientales del sitio de monitoreo fueron:

Puntos	Lugar de Medición	Temperatura Media (°C)	Humedad Relativa (%HR)	Velocidad del Viento (m/s)	Presión Atmosférica (mmHg)
1	MUELLE 1	31,6	69,3	1,5	753,6
2	ÁREAS ADMINISTRATIVAS	31,9	67,9	1,3	753,6
3	MUELLE 5	32,1	66,5	1,1	753,6
4	MUELLE DE CABOTAJE	32,3	66,5	0,9	753,6

DESVIACIÓN AL MÉTODO

No se realizó ninguna desviación durante el procedimiento.

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GUAYAQUIL - ECUADOR

RESULTADOS

Puntos	Lugar de Medición	Ponderación	Coordenadas UTM		Ruido Total Leq, t [dB]	Lmax [dB]	Lmin [dB]	Ruido Residual Leq,r [dB]	Ruido especifico LKeq = le [dB]	Lkeq= Le+Kbf [dB]	Incertidumbre [dB]
1	MUELLE 1	A	0610941	9639369	65,2	69,8	62,7	50,9	65,0	68,0	± 5,0
		C	0610941	9639369	77,6	79,3	77,3	58,5	77,5		
2	ÁREAS ADMINISTRATIVAS	A	0611136	9639401	65,1	71,4	59,1	62,3	61,9	64,9	± 6,0
		C	0611136	9639401	78,5	81,9	77,0	75,0	76,0		
3	MUELLE 5	A	0611014	9640135	63,7	66,1	62,4	61,3	59,9	65,9	± 6,0
		C	0611014	9640135	81,8	87,1	79,6	78,5	79,1		
4	MUELLE DE CABOTAJE	A	0610892	9639050	58,0	63,1	55,0	51,3	57,0	60,0	± 5,0
		C	0610892	9639050	72,1	77,2	70,4	60,9	71,7		

Puntos	Fecha	Ponderación	Hora inicio	Hora final	Tiempo de medición	Total de muestras
1	20-04-17	A	15:15:26	15:17:26	00:02:00	5
	20-04-17	C	15:21:19	15:23:19	00:02:00	5
2	20-04-17	A	15:31:40	15:33:40	00:02:00	5
	20-04-17	C	15:34:00	15:36:00	00:02:00	5
3	20-04-17	A	15:57:31	15:59:31	00:02:00	5
	20-04-17	C	16:00:00	16:02:00	00:02:00	5
4	20-04-17	A	16:39:39	16:41:39	00:02:00	5
	20-04-17	C	16:42:10	16:44:10	00:02:00	5

En el anexo 5 Niveles máximos de emisión de ruido y metodología de medición para fuentes fijas y fuentes móviles y niveles máximos de vibración y metodología de medición en su anexo 5 indica: ***"La persona o empresa que realiza las mediciones no es quien determina si una FFR cumple o no con los niveles máximos de emisión de ruido, su función es solo determinar y reportar el valor LKeq. Sera la Autoridad ambiental competente quien determine si hay cumplimiento o no".***

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GUAYAQUIL - ECUADOR

"SUPLEMENTO DEL INFORME / CERTIFICADO NÚMERO ME-0260-001-17"

AUTORIZADO POR:

.....
ING. SHIRLEY SÁENZ
COORDINADORA TÉCNICA M.A.

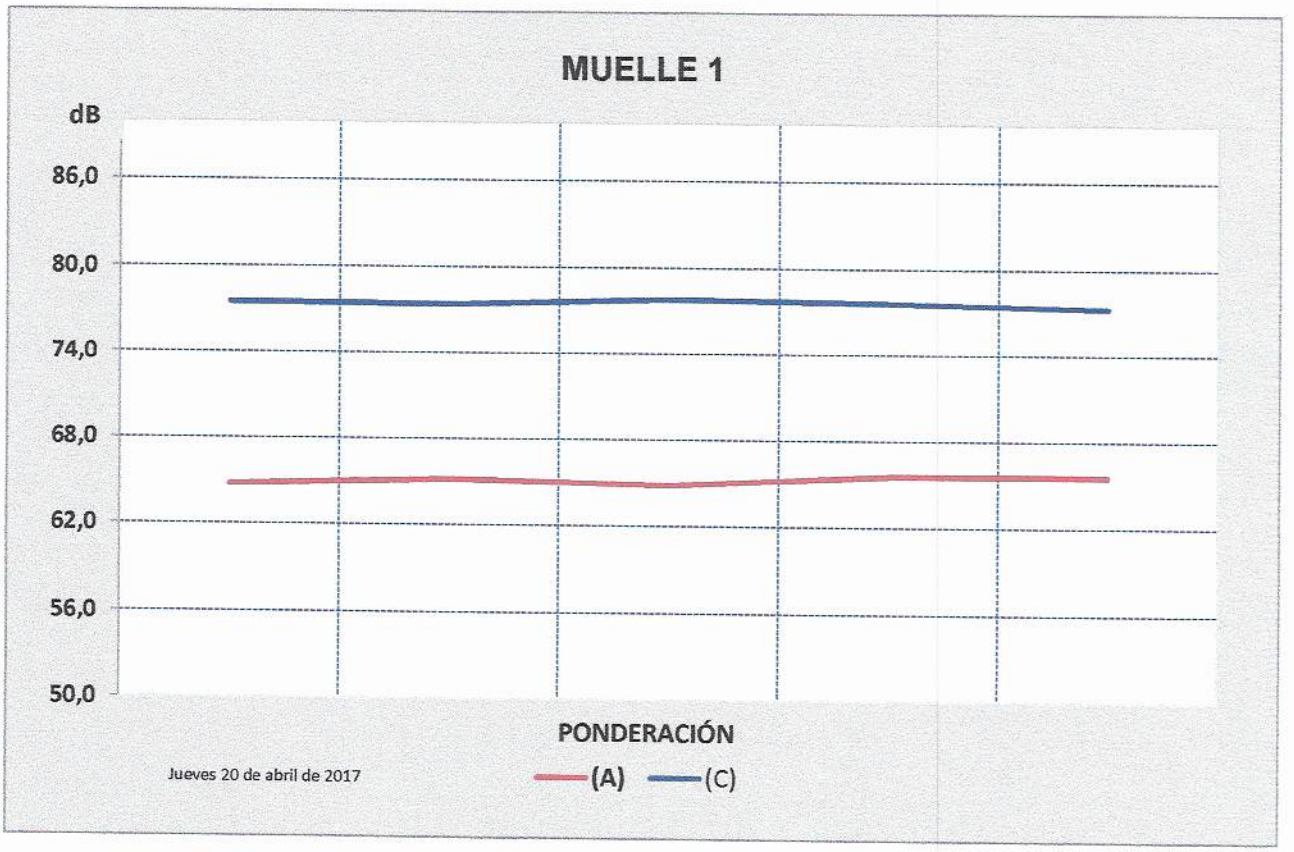
ANEXO:

1. ***DATOS DE EQUIPOS***
2. ***CERTIFICADOS DE CALIBRACIÓN***
3. ***EVIDENCIA FOTOGRÁFICA***

Dirección: Cdla Guayaquil Mz. 21 Calle 1era Solar 10 Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

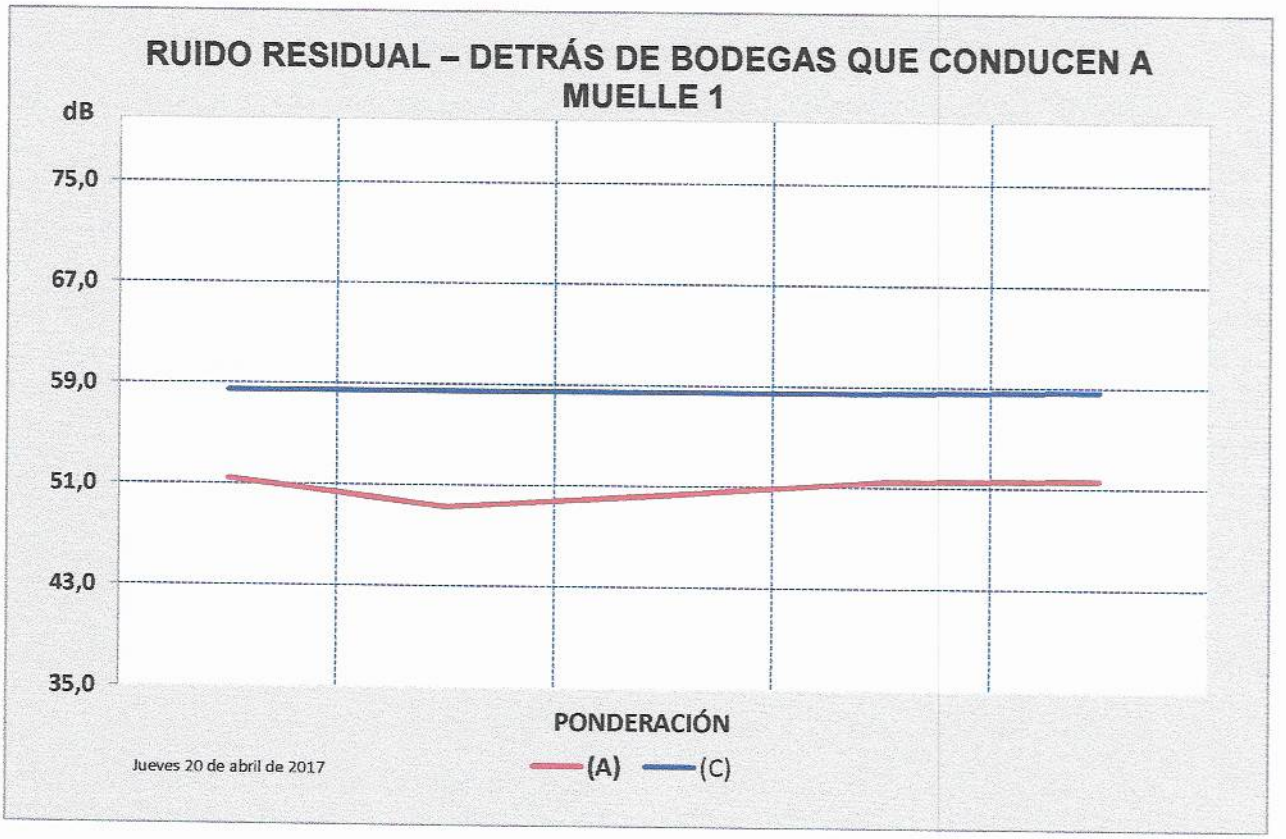
UBICACIÓN: MUELLE 1
COORDENADAS GEOGRÁFICAS: (0610941; 9639369)



Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

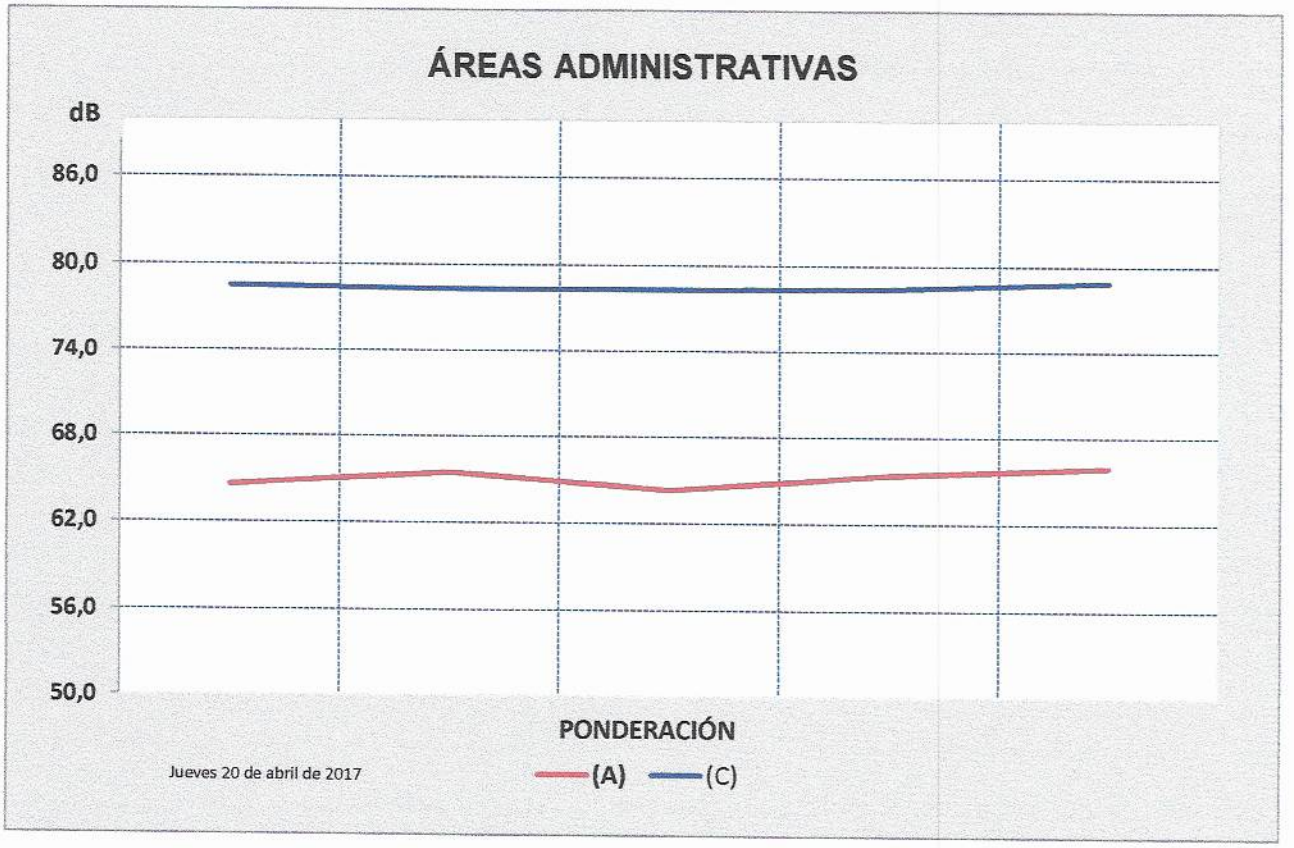
UBICACIÓN: RUIDO RESIDUAL – DETRÁS DE BODEGAS QUE CONDUCEN A MUELLE 1
COORDENADAS GEOGRÁFICAS: (0611088; 9639374)



Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

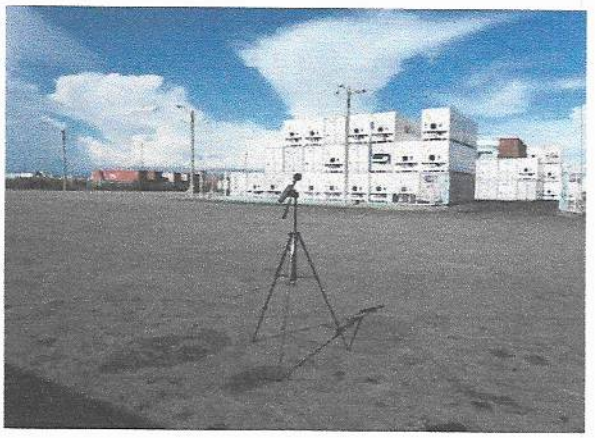
UBICACIÓN: ÁREAS ADMINISTRATIVAS
COORDENADAS GEOGRÁFICAS: (0611136; 9639401)

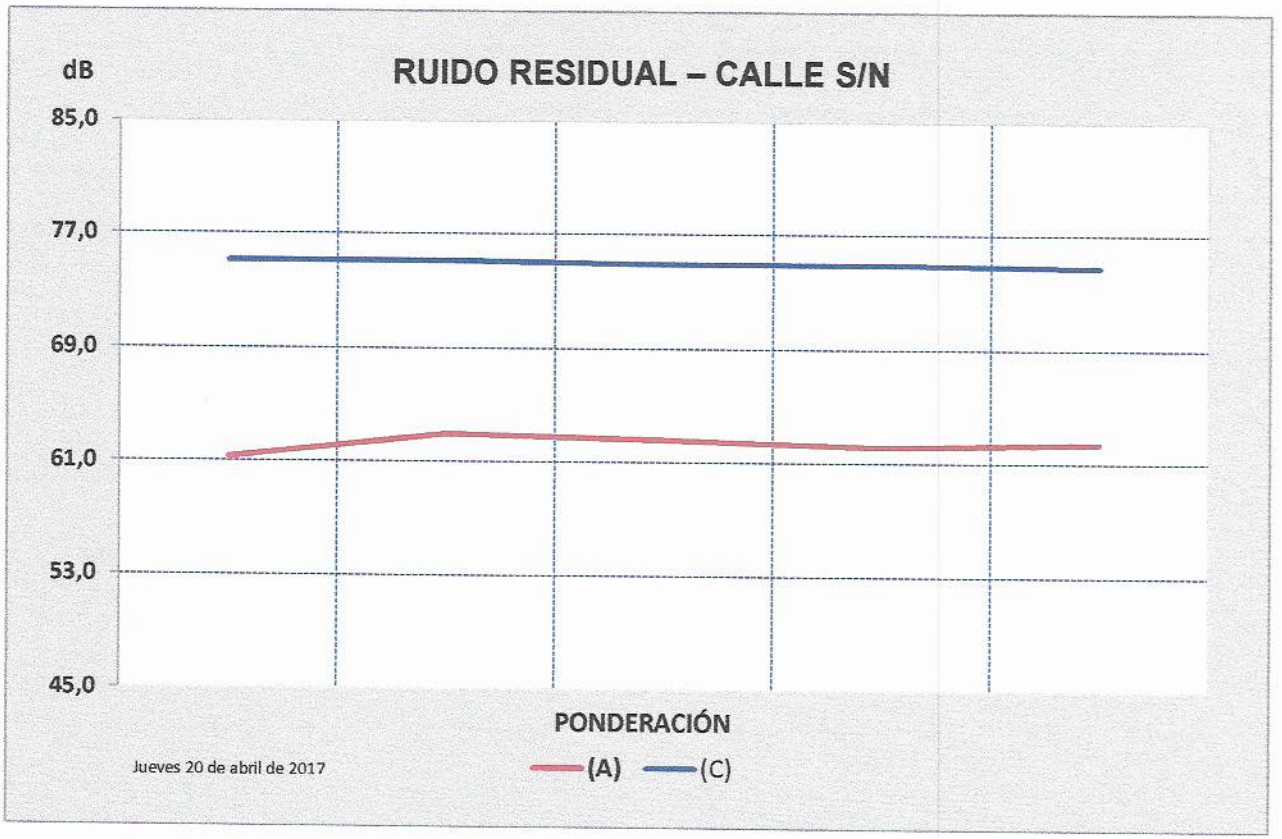


Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

UBICACIÓN: RUIDO RESIDUAL – CALLE S/N
COORDENADAS GEOGRÁFICAS: (0611161; 9639350)





Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
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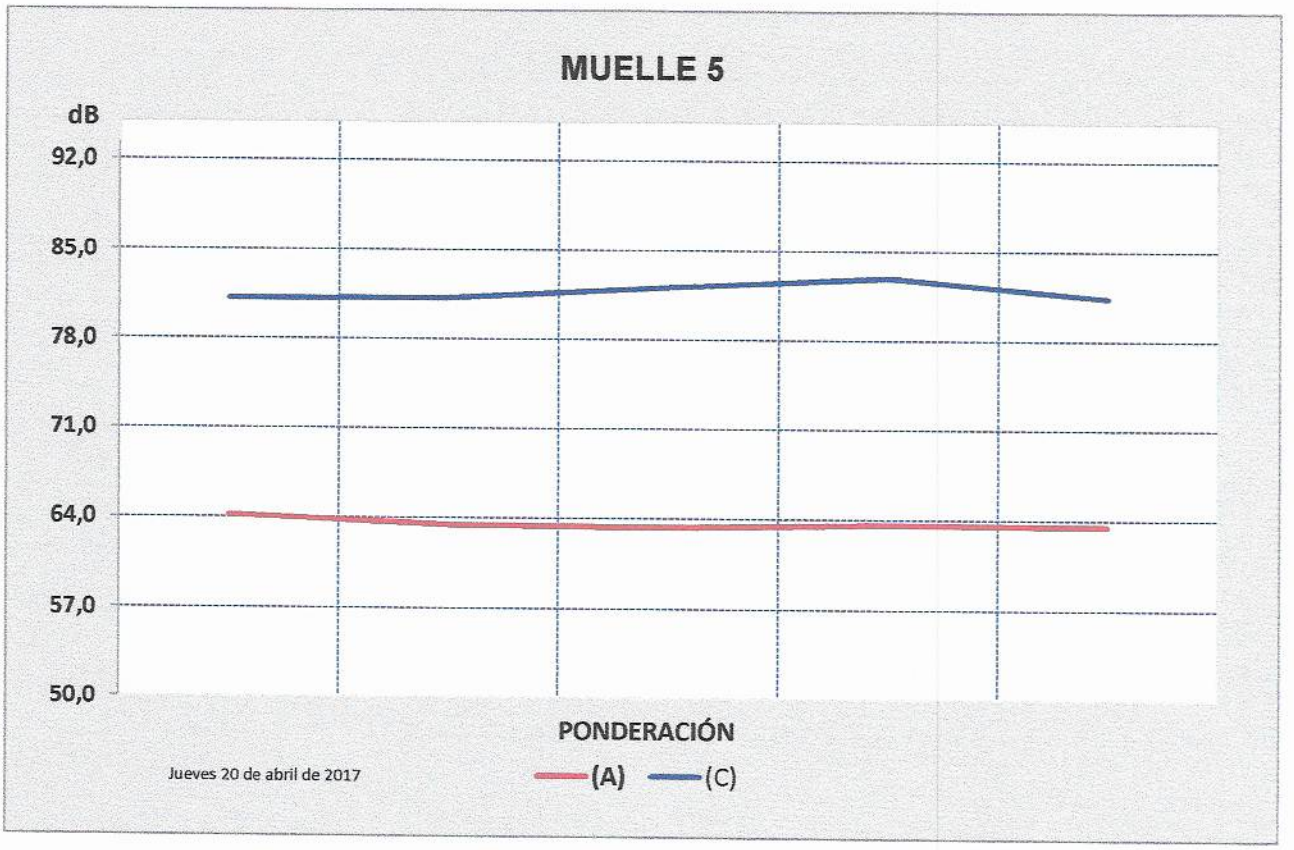
DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

UBICACIÓN: MUELLE 5
COORDENADAS GEOGRÁFICAS: (0611014; 0640135)



Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
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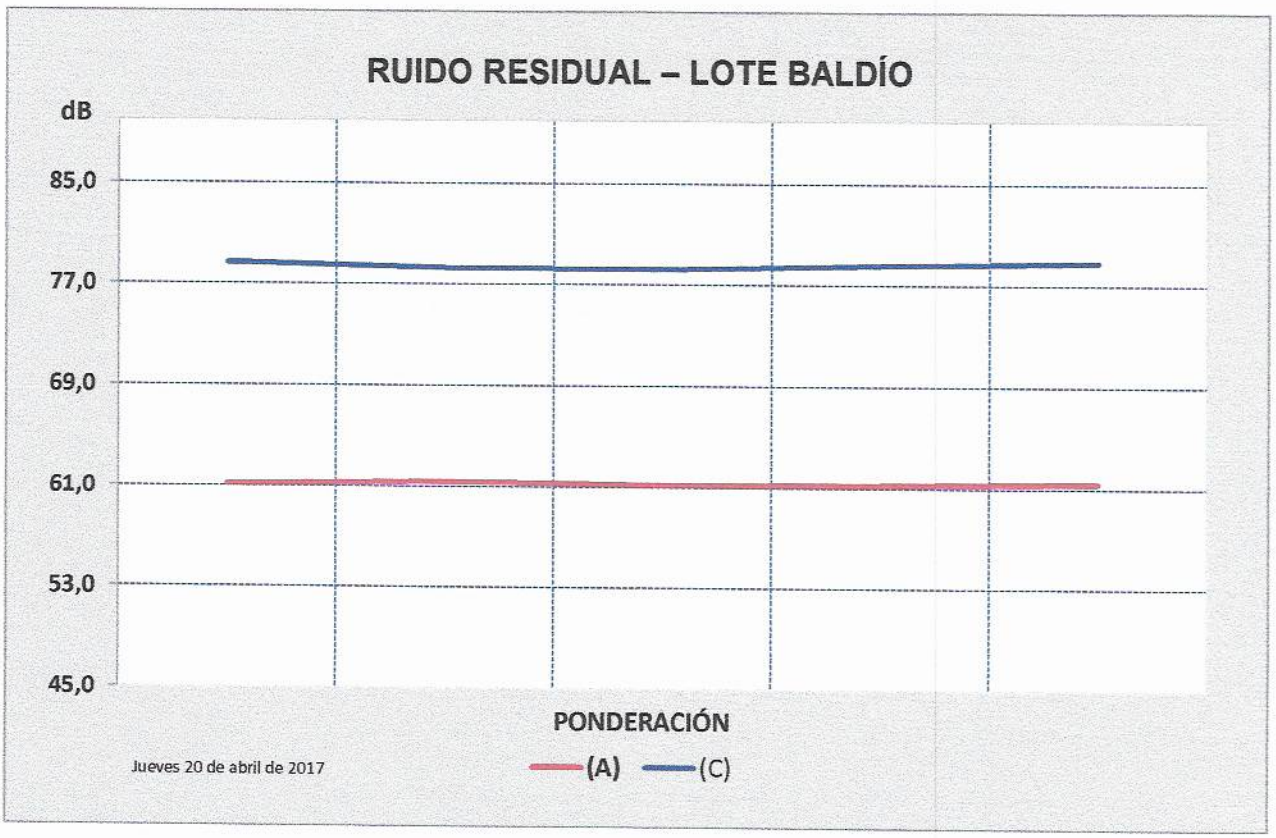
DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

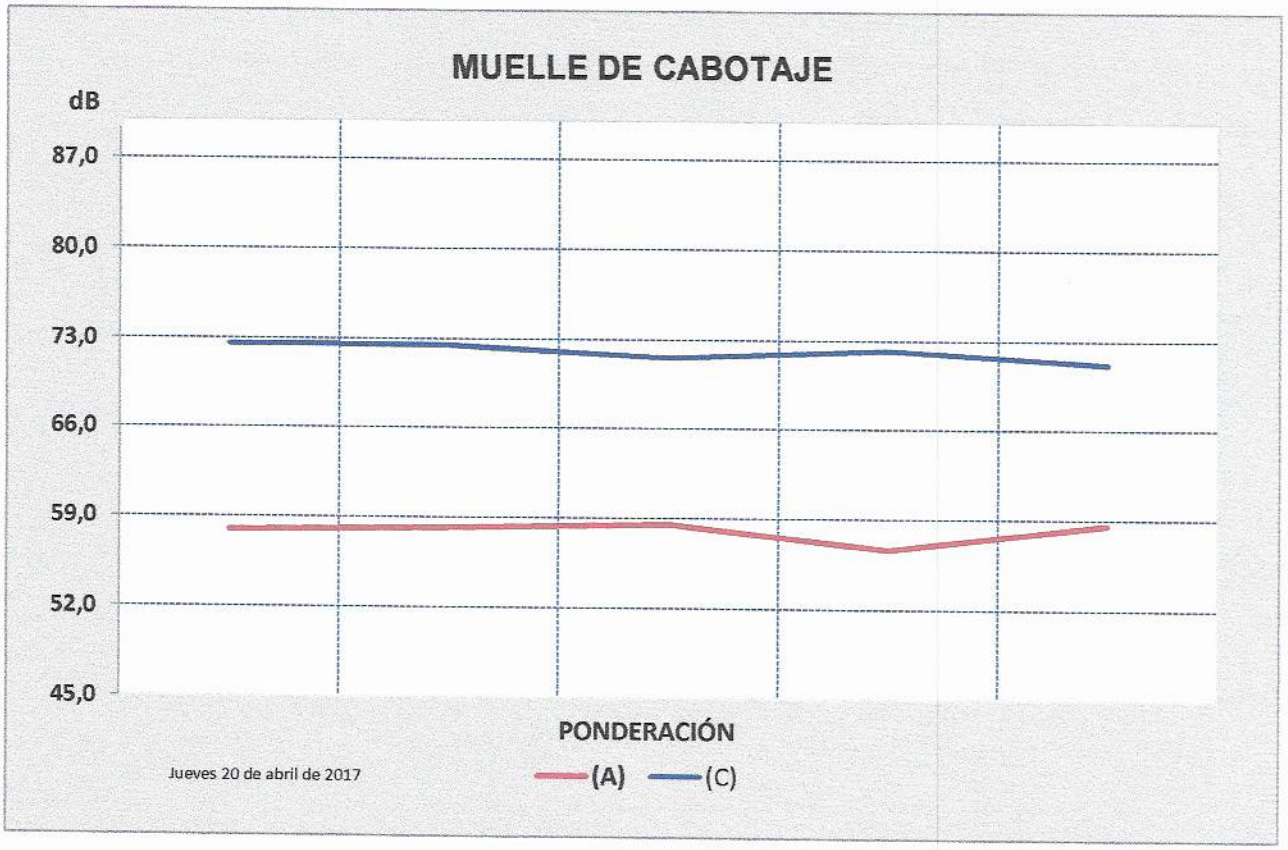
UBICACIÓN: RUIDO RESIDUAL – LOTE BALDÍO
COORDENADAS GEOGRÁFICAS: (0611068; 9640082)



Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

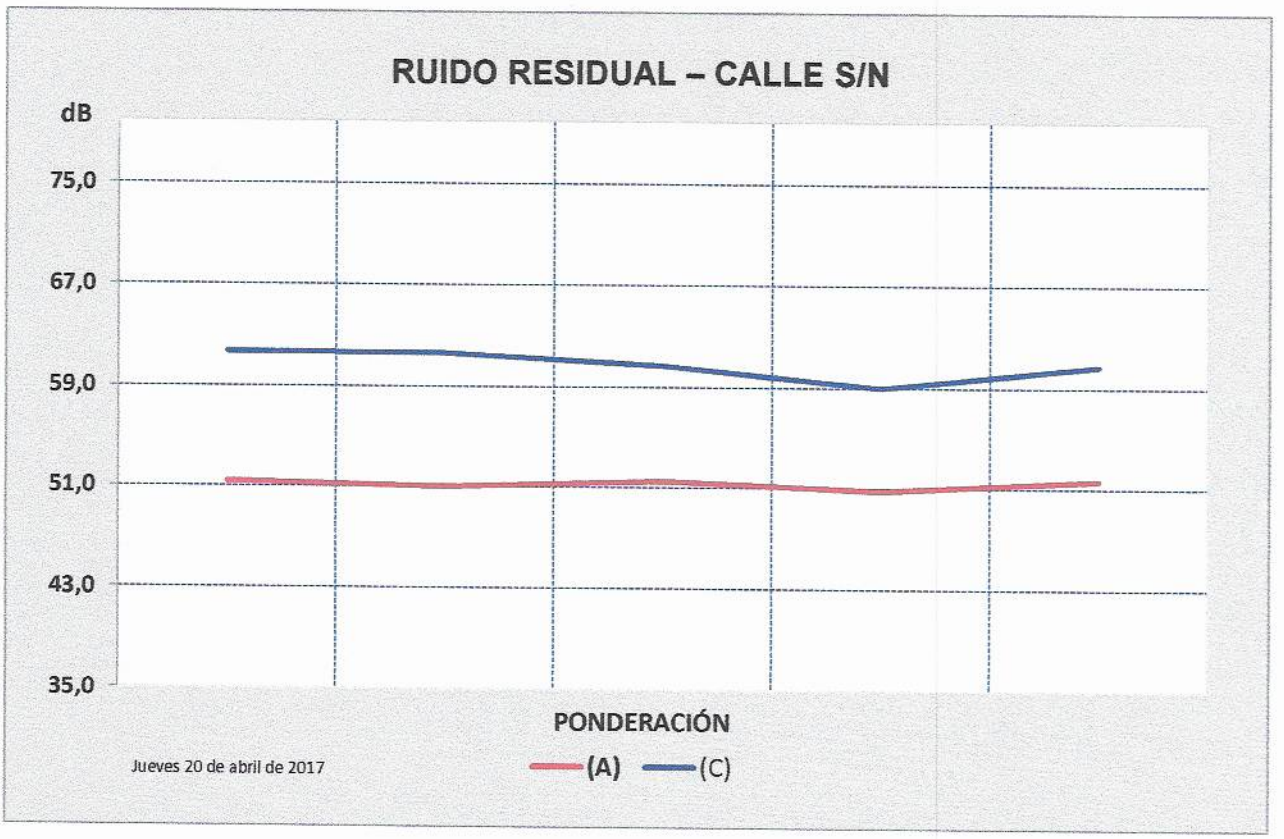
UBICACIÓN: MUELLE DE CABOTAJE
COORDENADAS GEOGRÁFICAS: (0610892; 9639050)



Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

DRAGADO DE MUELLES 1,2,3,4,5,6 ZONA DE MANIOBRA Y CANAL DE ACCESO DE PUERTO BOLÍVAR
MONITOREO DE RUIDO AMBIENTAL EXTERNO
ABRIL DE 2017

UBICACIÓN: RUIDO RESIDUAL – CALLE S/N
COORDENADAS GEOGRÁFICAS: (0610963; 9639060)



Dirección: Cdla. Guayaquil Mz. 21 Calle 1era Solar 10, Frente al Mall del Sol; Pbx: 2282007; Cel: 099337519, 099448710; jmarcial@elicrom.com
GUAYAQUIL - ECUADOR

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

SOUND LEVEL METER

Manufactured by:	CENTER
Model No:	390
Serial No:	150207044
Calibration Recall No:	26344

Submitted By:

Customer:	ELICROM CIA. LTDA.
Company:	Cdla Guayaquil, Mz. 21 Calle 1 era Slr.
Address:	10 Frente al Mall del Sol Ecuador GUAYAQUIL

The subject instrument was calibrated to the indicated specification using standards traceable to the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 390 CENT

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.

West Caldwell Calibration Laboratories' calibration control system meets the following requirements, ISO 10012-1 MIL STD 45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2008 and ISO 17025

Note: With this Certificate, Report of Calibration is included.

Approved by:

Calibration Date: 12-May-16

FC

Certificate No: 26344 - 4

Felix Christopher (QA Mgr.)

ISO/IEC 17025:2005

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

ACCREDITED

Calibration Lab. Cert. # 1533.01

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

2 PT. ACOUSTICAL CALIBRATOR

Manufactured by:	SPER SCIENTIFIC
Model No:	850016
Serial No:	081202542
Calibration Recall No:	26503

Submitted By:

Customer:	ELICROM CIA. LTDA.
Company:	Cdla. Guayaquil, Mz. 21 Calle 1ear Slr.
Address:	10 Frente al Mall del Sol
	Ecuador-Guayaquil

The subject instrument was calibrated to the indicated specification using standards traceable to the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 850016 SPER

Upon receipt for Calibration, the instrument was found to be:

Outside (X)

tolerance of the indicated specification. See attached Report of Calibration.

West Caldwell Calibration Laboratories' calibration control system meets the requirements, ISO 10012-1 MIL-STD-45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2008 and ISO 17025.

Note: With this Certificate, Report of Calibration is included.

Approved by:

FC

Calibration Date: 06-Jun-16

Certificate No: 26503 - 12

Felix Christopher (QA Mgr.)
ISO/IEC 17025:2005

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

ACCREDITED
Calibration Lab. Cert. # 1533.01

CERTIFICADO DE CALIBRACIÓN

Ciudadela Guayaquil, calle 1era mz 21 solar 10
Guayaquil - Ecuador Pbx: 04-2282007 Fax: ext. 403
http://www.elicrom.com mail: ventas@elicrom.com

Acreditación N° OAE LC C 10-009
LABORATORIO DE CALIBRACIÓN

CERTIFICADO No: CC-0254-004-17

IDENTIFICACIÓN DEL CLIENTE

EMPRESA:	ELICROM CIA. LTDA.
DIRECCIÓN:	CIUDADELA GUAYAQUIL, CALLE 1 ERA MZ 21 SOLAR 10
TELÉFONO:	2282007

IDENTIFICACIÓN DEL EQUIPO

EQUIPO:	TERMOHIGRÓMETRO	UNIDAD DE MEDIDA TEMPERATURA:	°C
MARCA:	ATM	RESOLUCIÓN TEMPERATURA:	0,1
MODELO/TIPO:	HT9214	RANGO TEMPERATURA:	(-10 a 50) °C
SERIE:	NO ESPECIFICA	UNIDAD DE MEDIDA HUMEDAD:	%HR
CÓDIGO DE CLIENTE:	EL.PT.211	RESOLUCIÓN HUMEDAD:	0,1
UBICACIÓN:	MEDIO AMBIENTE	RANGO HUMEDAD:	(20 a 99) %HR

EQUIPOS UTILIZADOS

CÓDIGO	NOMBRE	MARCA	MODELO	SERIE	FECHA CAL.	PROX. CAL
EL.PC.013	TERMOHIGROMETRO PATRON	VAISALA	MI70/HMP76B	H4510020/H4950006	06-feb.-15	06-feb.-17
EL.PT.039	CAMARA DE ESTABILIDAD	ELICROM	NO APLICA	NO APLICA	12-ago-16	12-ago-17
EL.PT.365	TERMOHIGROMETRO	CENTER	342	140103655	02-abr-16	02-abr-17

CALIBRACIÓN

MÉTODO:	COMPARACIÓN DIRECTA CON TERMOHIGRÓMETRO PATRÓN Y CÁMARA DE ESTABILIDAD
PROCEDIMIENTO:	PEC.EL.04
LUGAR DE CALIBRACIÓN:	LABORATORIO T.H. (ELICROM)
TEMPERATURA MEDIA (°C):	22,7
HUMEDAD MEDIA (%HR)	49,0

Descripción	Unidad	Patrón	Equipo	Corrección	Incertidumbre
Temperatura interna 1	°C	28,04	28,0	0,0	1,0
Humedad 1	%HR	24,82	28,3	-3,5	4,9
Humedad 2	%HR	45,32	46,4	-1,1	4,9
Humedad 3	%HR	75,40	70,6	4,8	4,9

OBSERVACIONES:

El cálculo de la incertidumbre expandida se realizó en base a la guía OAE G02 R01, multiplicando la incertidumbre típica por el factor de cobertura **k=2,00**, que para una distribución t (de Student) con **Veff =** ∞ (grados efectivos de libertad) corresponde a una probabilidad de cobertura de aproximadamente el 95,45%. La incertidumbre típica de medición se ha determinado conforme al documento EA-4/02. Este certificado no podrá reproducirse excepto en su totalidad sin la aprobación escrita del laboratorio Elicrom-Calibración. El presente certificado se refiere solamente al equipo arriba descrito al momento del ensayo.

CALIBRACIÓN REALIZADA POR: Sergio Rodríguez

FECHA CALIBRACIÓN: 2017-01-07 **FECHA PRÓXIMA:** 2017-07-07

AUTORIZADO POR:
Ing. Sabino Pineda
GERENTE TÉCNICO

RECIBIDO POR:
RESPONSABLE - CLIENTE

Calibration complies with ISO/IEC 17025 and ANSI/NCSL Z540-1

Cert. No.:3655-7473034

Traceable® Certificate of Calibration for Micro-Anemometer/Thermometer

Instrument Identification:

Model: 3655 S/N: 160252813 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Air Velocity Standard	1016965	11/21/16	201511211620
Digital Thermometer	90969500	10/01/16	4000-7091939

Certificate Information:

Technician: 177 Procedure: CAL-3655 Cal Date: 3/04/16 **Cal Due: 3/04/18**

Test Conditions: 22.1°C 42.0 %RH 1021 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
FPM		N.A.		0	0	Y	20	20	7	2.9:1
FPM		N.A.		1,029	990	Y	736	1,322	7	>4:1
FPM		N.A.		1,630	1,499	Y	1,337	1,923	7	>4:1
°C		N.A.		24.22	23.4	Y	22.2	26.2	0.06	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full without the written premission of Control Company.

Aaron Judice, Technical Manager

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2

Maintaining Accuracy:

In our opinion once calibrated your Micro-Anemometer/Thermometer should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Micro-Anemometer/Thermometers change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

Control Company 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Calibration complies with ISO/IEC 17025, ANSI/NCSL Z540-1, and 9001

Calibration Certificate No. 1750.01

Cert. No.: 1081-7473887

Traceable® Certificate of Calibration for Barometer with Clock

Instrument Identification:

Model: 1081 S/N: 160253706 Manufacturer: Control Company

Standards/Equipment:

Description	Serial Number	Due Date	NIST Traceable Reference
Digital Barometer	D4540001	9/21/16	1000380976
Non-Contact Frequency Counter	26.66887	5/15/16	1000374678

Certificate Information:

Technician: 57 Procedure: CAL-31 Cal Date: 3/01/16 Due Date: 3/01/18

Test Conditions: 24.3°C 43.0 %RH 1015 mBar

Calibration Data: (New Instrument)

Unit(s)	Nominal	As Found	In Tol	Nominal	As Left	In Tol	Min	Max	±U	TUR
mb/hPa		N.A.		929.45	927	Y	923	935	0.70	>4:1
mb/hPa		N.A.		979.75	977	Y	974	986	0.70	>4:1
mb/hPa		N.A.		1,014.55	1,011	Y	1,009	1,021	0.70	>4:1
Sec/24hr		N.A.		0.000	0.700	Y	-8.640	8.640	0.13	>4:1

This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.

A Test Uncertainty Ratio of at least 4:1 is maintained unless otherwise stated and is calculated using the expanded measurement uncertainty. Uncertainty evaluation includes the instrument under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor k=2 to approximate a 95% confidence level. In tolerance conditions are based on test results falling within specified limits with no reduction by the uncertainty of the measurement. The results contained herein relate only to the item calibrated. This certificate shall not be reproduced except in full, without written approval of Control Company.

Nominal=Standard's Reading; As Left=Instrument's Reading; In Tol=In Tolerance; Min/Max=Acceptance Range; ±U=Expanded Measurement Uncertainty; TUR=Test Uncertainty Ratio; Accuracy=±(Max-Min)/2; Min = As Left Nominal(Rounded) - Tolerance; Max = As Left Nominal(Rounded) + Tolerance; Date=MM/DD/YY

Nicol Rodriguez, Quality Manager

Aaron Judice, Technical Manager

Maintaining Accuracy:

In our opinion once calibrated your Barometer with Clock should maintain its accuracy. There is no exact way to determine how long calibration will be maintained. Barometer with Clocks change little, if any at all, but can be affected by aging, temperature, shock, and contamination.

Recalibration:

For factory calibration and re-certification traceable to National Institute of Standards and Technology contact Control Company.

CONTROL COMPANY 4455 Rex Road Friendswood, TX 77546 USA
Phone 281 482-1714 Fax 281 482-9448 service@control3.com www.control3.com

Control Company is an ISO 17025:2005 Calibration Laboratory Accredited by (A2LA) American Association for Laboratory Accreditation, Certificate No. 1750.01.
Control Company is ISO 9001:2008 Quality Certified by (DNV) Det Norske Veritas, Certificate No. CERT-01805-2006-AQ-HOU-RvA.
International Laboratory Accreditation Cooperation (ILAC) - Multilateral Recognition Arrangement (MRA).

EVIDENCIA FOTOGRÁFICA

Cabe mencionar que la fuente de ruido analizada se encuentra enmascarada por el ruido producido del paso de vehículos livianos y pesados que circulan constantemente cerca de la fuente evaluada.

ENVIRONMENTAL IMPACT STUDY
DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6,
THE MANEUVERING AREA, AND THE PUERTO
BOLIVAR ACCESS CANAL

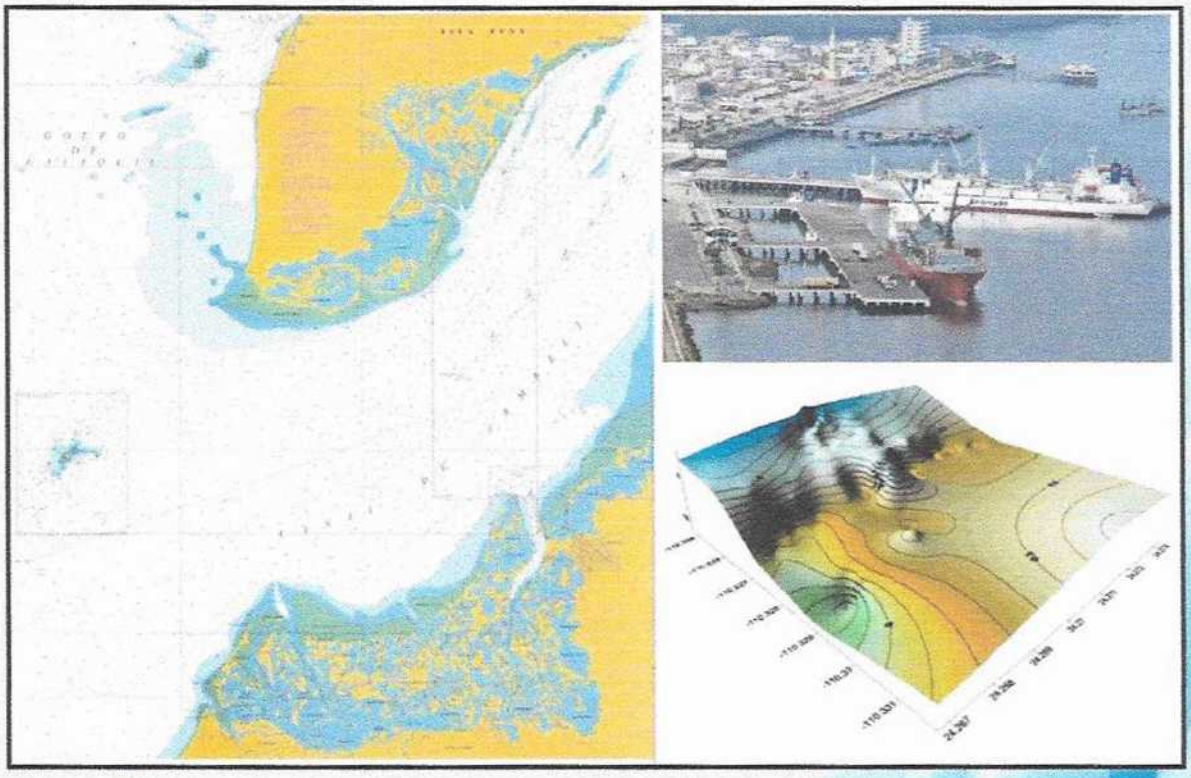
YILPORT PUERTO BOLIVAR

ECOSFERA CONSULTORA AMBIENTAL

ANNEX 11

Bathymetric Study in the Maneuvering and Docking Area of the Puerto Bolivar Terminal

BATHYMETRIC STUDY IN THE MANEUVERING AND DOCKING AREA OF THE PUERTO BOLÍVAR MARITIME TERMINAL



CARRIED OUT BY:

consulsua
CONSULTORA EN INGENIERÍA Y AMBIENTE

PREPARED FOR:

YILPORT
PUERTO BOLIVAR

Guayaquil, March 21, 2017

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I. INTRODUCTION

The operator of Puerto Bolívar, namely YILPORTECU S.A., requested CONSULSUA to carry out a bathymetric study in the Piers and Maneuvering Area of the port located in the sector of Puerto Bolivar, Canton of Machala in the province of El Oro, to determine the current depths in that area.

Bathymetry is the measurement of underwater reliefs or terrain in a seabed, waterway, lake space or reservoir. It serves the purpose of generating nautical mapping that describes the characteristics of such waterbed, assisting the verification of bottom conditions and technical dredging studies and ensuring the safety of vessels during navigation and maneuvering.

Figure No. I-1: Piers of the Puerto Bolívar Port Authority

Source: Google Earth.
Prepared by: CONSULSUA C. Ltda.

II. OBJECTIVES

2.1 GENERAL OBJECTIVE

Perform Monobeam bathymetry in the dock areas of the Puerto Bolivar Maritime Terminal in order to determine its current depths.

2.2 SPECIFIC OBJECTIVES

- Run a bathymetric survey using Monobeam Ecoprobe with probe lines every 5 meters and 2 check lines 50 meters
- Produce a scaled map that relates to the MLWS containing the corresponding banks
- Produce a scaled map, that relates to the MSL containing the corresponding banks
- Produce an MDT (Terrain Digital Model) with the data obtained from the survey.

III. STUDY AREA

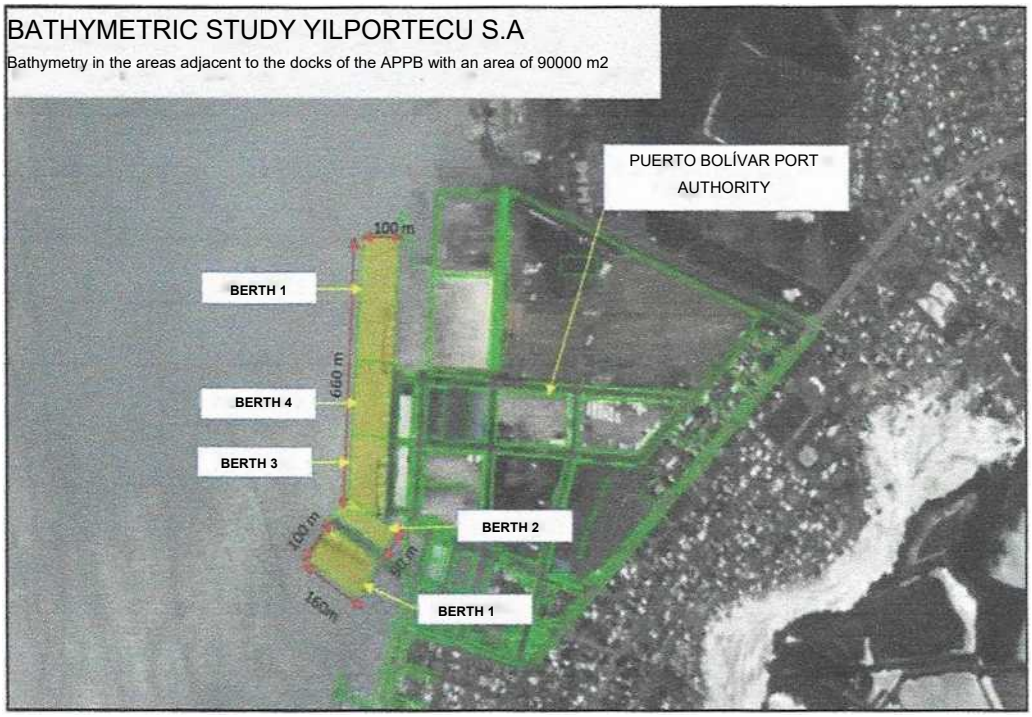
The study area is located in the Santa Rosa estuary and corresponds to the dock area of the Puerto Bolivar Terminal, including the pier type pier and the other berths. The total survey area consists of 90000 m^2 distributed as follows:

Table No. III-1: Study Area Dimensions

BERTH	LENGTH (m)	WIDTH (m)	AREA (m2)
1	160	100	16000
2	160	50	8000
3	180	100	18000
4	180	100	18000
5	300	100	30000
TOTAL			90000

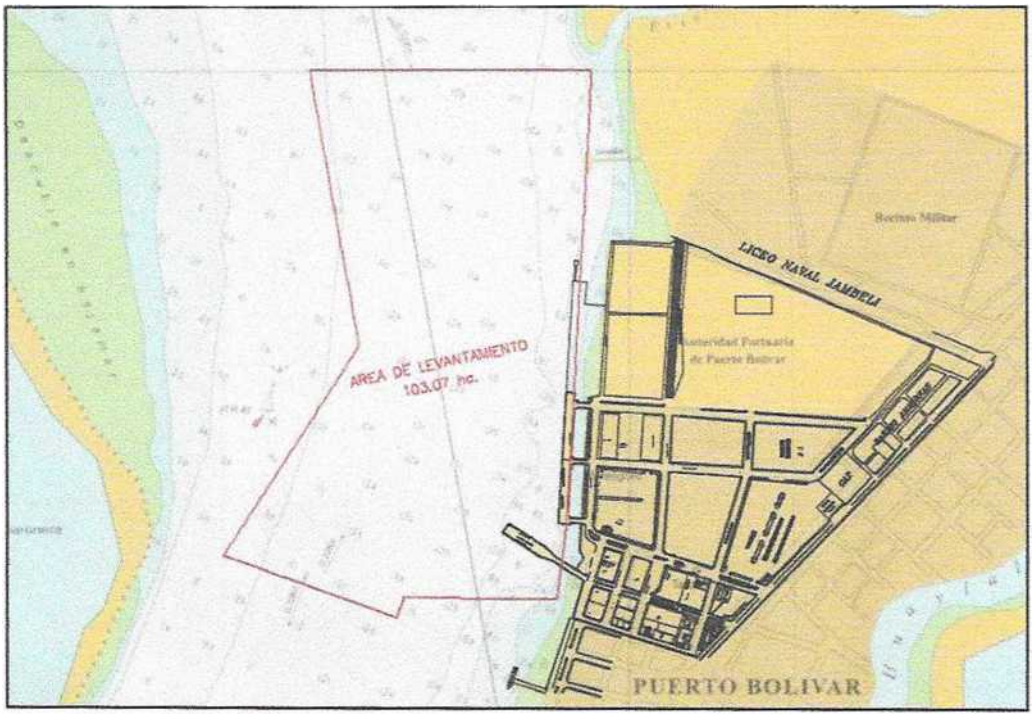
The following figures show the study area.

Figure No. III-1: Areas surveyed in the docking and maneuvering areas.



Source: Google Earth 2016
Prepared by: CONSULSUA C. Ltda.

Figure N ° III-2: Areas surveyed beyond the breakwater type pier



Source: IOA Letter 10811 Puerto Bolívar
Prepared by: CONSULSUA C. Ltda.

IV. BATHYMETRIC STUDY

4.1 BATHYMETRIC SURVEY

The bathymetric activities were carried out using high frequency, following the OHI - International Hydrographic Organization standards. For corrections to consider tidal effects, a tide gauge was installed on pier 3, near the booth of the old INOCAR tide gauge. Also, in order to verify the data, the height to the surface water was measured from the pier using NRS reduction.

The bathymetric survey was carried out over a total area of 103.7 ha. of which 9 ha. correspond to the area surveyed in the docking areas of both the pier type pier and the marginal pier, and where 94.07 ha., correspond to the maneuvering area.

Figure No. IV-1: Surveyed areas plus the breakwater type pier

Prepared by: CONSULSUA C. Ltda.

4.1.1 Description of personnel, equipment, and software

Technical Personnel

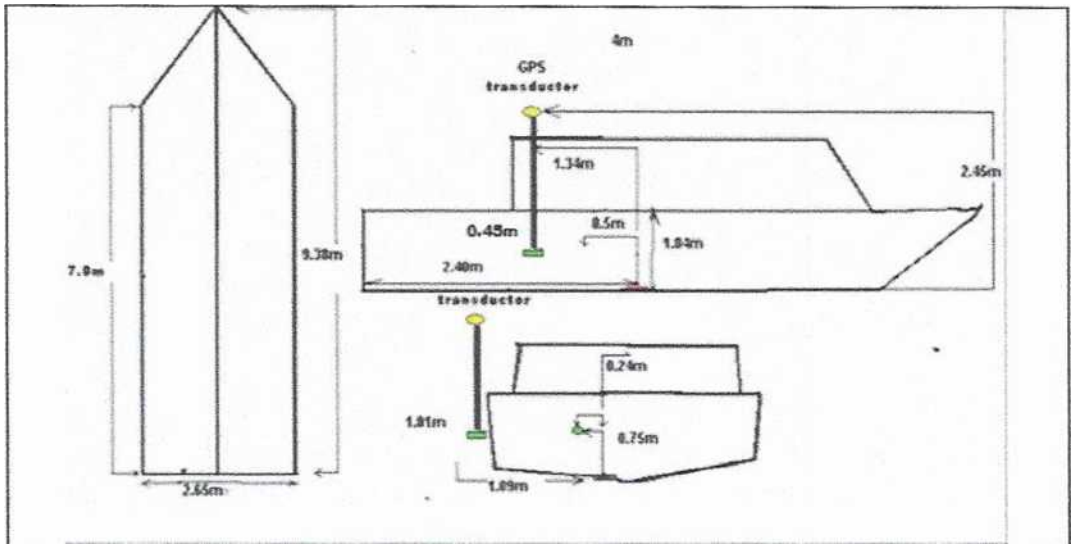
The following technical personnel was employed for the Bathymetric Survey in Puerto Bolivar:

- 01 Hydrographic Surveyor
- 01 Field Coordinator
- 03 Assistants

Vessel

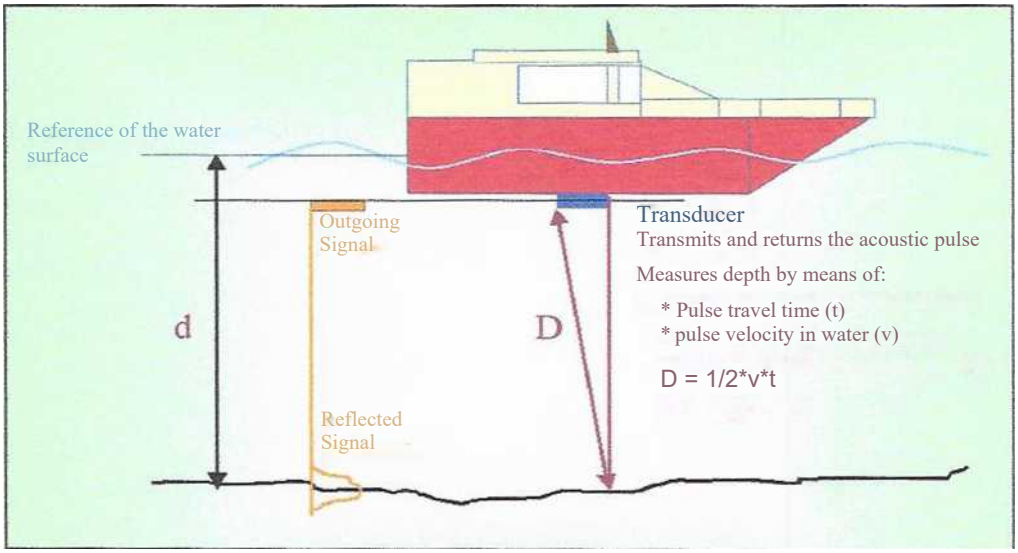
The bathymetric activities were carried out in a shallow draft boat, adapting the bathymetric equipment information collection and positioning means. The transducer's depth was 0.45m, in order to add to the depth obtained by the ecoprobe.

Figure No. IV-2: Position of the equipment aboard the science vessel.



Prepared by: CONSULSUA C. Ltda

Figure No. IV-3: MONOBEAM ECOPROBE Metering system



Prepared by: CONSULSUA C. Ltda.

Photograph No. IV-1: Hydrographic Boat for Bathymetric Survey.

Prepared by: CONSULSUA C. Ltda.

Positioning System

The Positioning System is provided by a differential GPS integrated with HYPACK 2014 navigation systems and an Ecoprobe. This equipment is installed in the ship cabin.

X and Y Positioning

The differential GPS provides greater accuracy to the system. This type of receiver, in addition to receiving and processing satellite information, simultaneously receives and processes other additional information from a land station nearby, recognized by the receiver, which allows greater precision in this type of activity.

Photograph No. IV-2: Differential-DGPS Positioning System

Prepared by: CONSULSUA C. Ltda.

Table No. IV-1: Technical Specifications of the DGPS HEMISPHERE

GNSS specifications		
Receiver Type:	Double Frequency, Multi GNSS RTK, Glonass and BeiDou	
Signals received:	GPS, Glonass, BeiDou,y Galiieo	
No. of Channels:	372	
GPS sensitivity:	-142 dBm	
SBAS Tracking:	3 parallel channels	
Position update:	10 Hz standard and 20 Hz optional (with subscribing)	
Horizontal Precision:		
	RMS (67%)	2DRMS (95%)
RTK (	10 mm + 1 ppm	20 mm + 2 ppm
High precision L-ban service ():		
	4 cm	8 cm
SBAS (WASS)(:):	0.3 m	0.6 m
Autonomous (without SA) (.):	1.2 m	2.5 m
Pitch/Roll accuracy:	1st using tilt sensor	
1PPS precision:	20 ns	
Cold start:	< 60 sec (without almanac or RTC)	
Warm start:	< 30 sec (without almanac or RTC)	
Hot start:	< 10 sec (without almanac or RTC) and position)	
Maximum Speed:	1.850 Km/Hr	
Maximum Altitude:	18.288 m	
L-Band sensor specifications		
Receiver Type:	Single Channel	

Channels:	1530 to 1560 MHz
Sensitivity:	-130 dBm
Channel spacing:	5.0 KHz
Satellite Selection:	Manual, or Automatic
Signal acquisition:	15 sec

Communications

Serial ports:	2 full duplex RS232. CAN
Interface level:	Atlas GNSS (Web Ul)
Baud rate:	4800-115200
Correction Protocols	
I/O:	Owner of Hemisphere GNSS, RTCM v2.3 (DGPS), RTCM v3 (RTK)
I/O data protocol:	NMEA 0183, NMEA 2000, Hemisphere Binary GNSS, Bluetooth 2.0 (Class 2) and Wi-Fi
Time Output:	1 PPS, CMOS, low active , folling edge synchronization, 10kO, lOpF
Event marking:	CMOS, low active, folling edge synchronization, 10kΩ, 10pF

Power

Input voltage:	7-32 VDC with inverse polarity operation
Energy consumption:	4.5 Nominal W (GPS, L1/L2, Glonass L1/L2, BeiDou B1/B2/B3 y \L Band)
Consumption:	0.38 Nominal A (GPS, L1/L2, Glonass Ll/ L2, BeiDou B1/B2/B3 y \L Band)
Energy insulation:	No
Reverse polarity protection:	Yes
Antenna voltages:	Internal antenna

Environmental

Operating Temperature:	-40 °C to + 70 °C
Storage Temperature:	-40 °C to + 85 °C 95% no
Humidity:	condensed
Shock and Vibrations:	Mechanical shock: EP 455 section 5.41.1 operational Vibration: EP 455 section 5.41.1 Random

EMC:	EC (ISO 14982 Emissions and Immunity) FCC Part 15. Sub-part B. CISPR 22
Housing	IP67
Mechanical	
Dimensions:	15.8 Long x 15.8 Width x 7.9 Height (Centimeters)
Weight:	<1.15 Kg
LED Status indications:	Energy, GNSS Hook, Bluetooth
Power/Data Connector:	12 pin male (metallic)
Antenna mount:	1-14 UNS-2A female adapter, 5/8"-ll UNC 2B Adapter, flat mount available

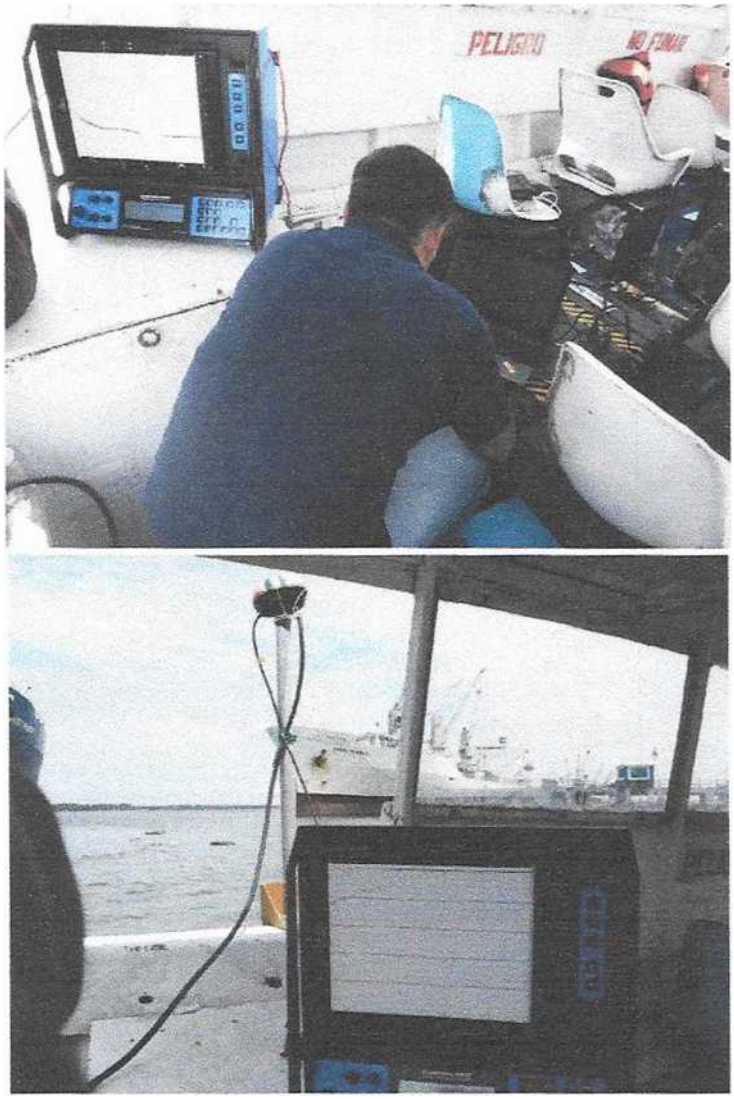
Prepared by: CONSULSUA C. Ltda

ODOM Ecoprobe model ECHOTRACK 3200 MKUI

The Echotrac MKIII used is a high-resolution portable surface water tool designed for marine hydrographic studies in coastal areas with depths under 750 m. It is used to measure the distance between the water surface and objects suspended in the water or at the bottom.

The Echotrac MKIII has a high-resolution option and both thermal paper logger or high-quality bright graph. It has two frequencies or channels, both high and low channels have frequency agility, allowing the operator to precisely adjust the transducer. It provides a feature to reduce noise near the surface caused by the transducer's bell which produces an increase in the strength of the return echo. The MKIII can operate in shallow and deep waters and has four serial ports and high-speed Ethernet functionality for maximum efficiency; it works in conjunction with the Transducer. The following Photographs display the equipment:

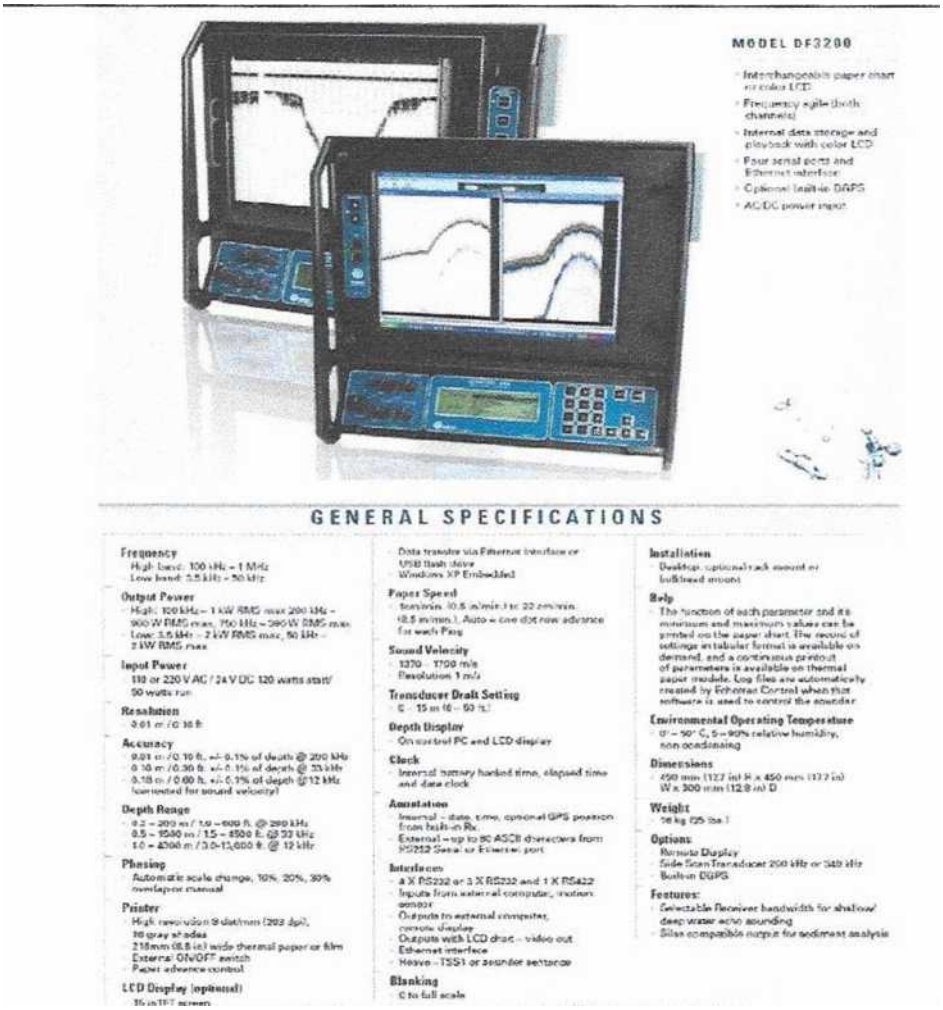
Photograph No. 1V-3: ECHOTRACK MKIII Ecoprobe



Prepared by: CONSULSUA C. Ltda.

Figure No. IV-4: Shows the technical specifications of the ECHOTRAC MKIII Ecoprobe used for the bathymetric surveying

Figure No. IV-4: Technical Specifications of the ECHOTRAC MKIII Ecoprobe used in the survey



Source: Odom 2016

Tide gauge

To correct for tidal variations, an RBR Solo tide gauge was used. It´s the same as the one installed at one end of pier 3 on the dates listed in Table No. IV-2, as follows:

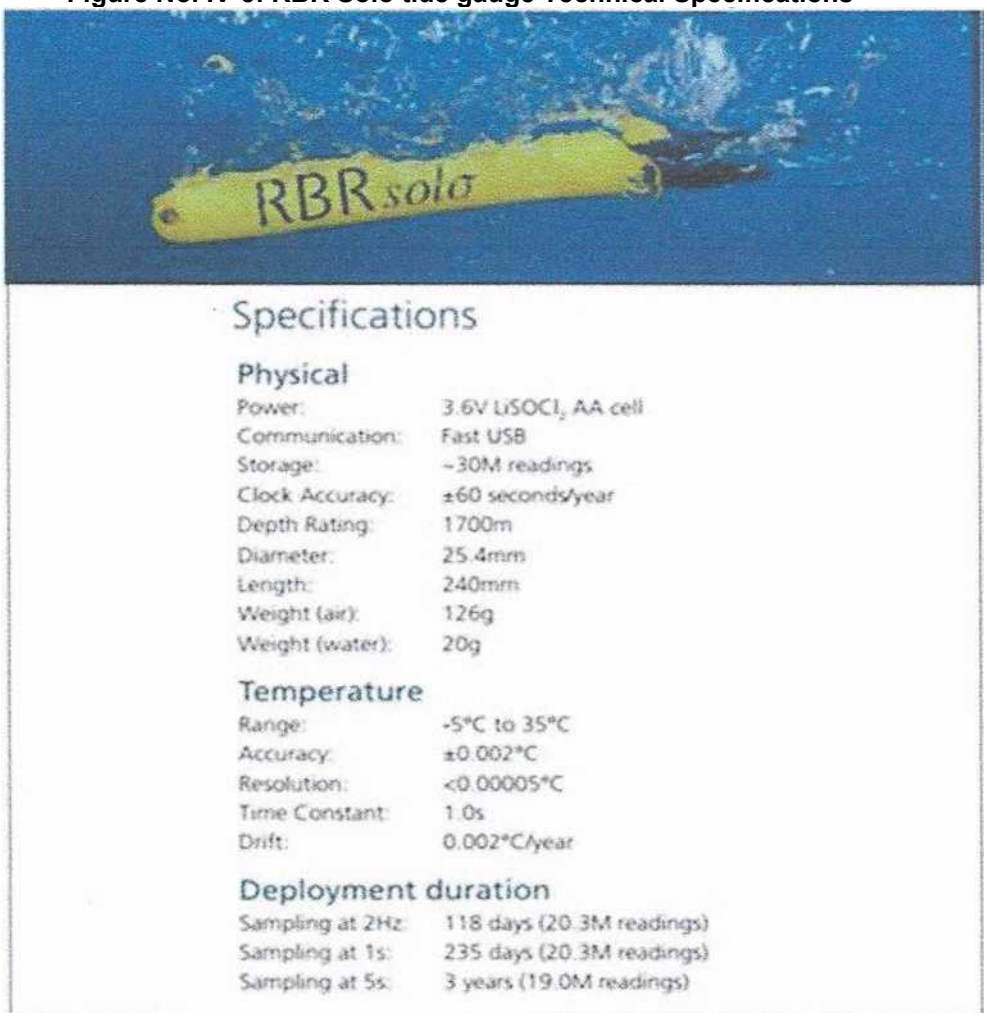
Table No. IV-2: Tide Gauge Installation Dates

Tide gauge type	Start Date	End Date
RBR Solo	03/02/2017	03/04/2017

Prepared by: CONSULSUA C. Ltda.

Figure No IV-5 shows the technical specifications of the tide gauge used:

Figure No. IV-5: RBR Solo tide gauge Technical Specifications



Source: RBR Solo

The tide gauge is shown below.

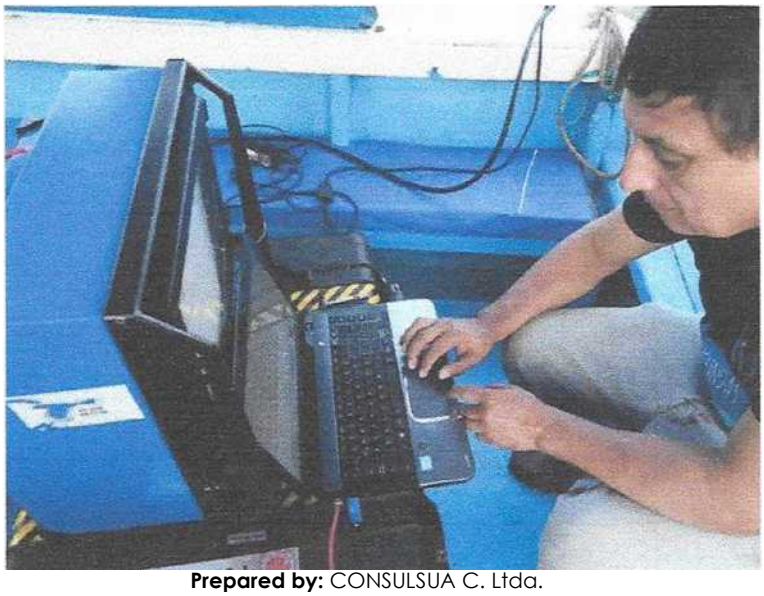
Photograph No. IV-4: Anchoring of the RBR Solo Tide gauge

Prepared by: CONSULSUA C. Ltda.

Processors

Computers with hard disk capacity that enable capturing and storing information (X, Y) from positioning equipment and depths (Z) obtained from the ecoprobe, with a compact disk unit to have a copy of the raw data generated on site.

Photograph No. IV-5: Survey information backup processors X, Y, Z



Prepared by: CONSULSUA C. Ltda.

4.1.2 Working methodology

To meet the study goals, field work, data processing, report and map generation activities took place. The methodology required adjusting the bathymetric equipment for gathering information, positioning, calibrating equipment and finally surveying the bathymetric information.

Field Activities

The Batimetric Survey used hydrographic equipment and software for gathering information and positioning to perform exploration, analysis, and compression of the obtained bathymetry; this allowed for the description of the waterbed where 4 days were spent executing field work.

Main lines were set up every 5 meters, perpendicular to the docks, and 2 check lines were placed 50 m apart to perform the bathymetric survey. Before peforming such Bathymetric Survey, all the equipment was calibrated, as per guidelines of the International Hydrographic Organization.

In the areas where the data detected generated uncertainty about the existence of obstacles, the survey was intensified. The latter to discard faulty data and to ascertain the existence (or not) of such data by physical inspection; tides were also monitored during the Bathymetric Survey.

Equipment Calibration.

DGPS calibration - Differential

The southern corner of Pier 3 was used as reference point, using normal GPS and satellite imagery available.

Ecoprobe

The calibration and depth verifications were carried out using a test plate, which provided a depth data point observed by using the ecoprobe.

Photograph No. IV-6: Calibration of bathymetric equipment

Prepared by: CONSULSUA C. Ltda.

Tide correction on probes

It is important to note that bathymetry refers MLWS - Mean Low Water Spring or NRS so reduction of tides will be done at this level and the data is given in 5-minute intervals. This data was processed to obtain "TDX" files required for tidal correction in the Hypack program. Water draft height was measured from the surface to the edge of the pier, making reference to Z (elevation).

Photograph No. IV-7: Height metering from the water surface to the edge of the pier

Elaboración: CONSULSUA C. Ltda.

This data was measured approximately every 10 minutes and proved useful for comparison with the tide gauge data. 8888The data obtained for the survey dates, Thursday 02 and Saturday 04 March 2017, was the following:

Table No. IV-3: Water Level Metering from March 02 to 05 2017

Thursday, March 2, 2017

Time	Height (m)
11:45:00	4.25
11:55:00	4.29
12:05:00	4.47
12:15:00	4.55
12:25:00	4.63
12:35:00	4.69
12:45:00	4.70
12:55:00	4.73
13:05:00	4.75
13:15:00	4.76
13:25:00	4.75
13:35:00	4.72
13:45:00	4.68
13:55:00	4.63
14:05:00	4.58
14:15:00	4.53

Time	Height (m)
14:25:00	4.46
14:35:00	4.37
14:45:00	4.32
14:55:00	4.23
15:05:00	4.14
15:15:00	4.05
15:25:00	3.97
15:35:00	3.86
15:45:00	3.73
15:55:00	3.62
16:05:00	3.51

Friday, March 3, 2017

Time	Height (m)
7:55:00	2.00
8:05:00	1.99
8:15:00	1.98
8:25:00	1.99
8:35:00	2.01
8:45:00	2.02
8:55:00	2.06
9:05:00	2.10
9:15:00	2.15
9:25:00	2.19
9:35:00	2.26
9:45:00	2.33
9:55:00	2.42
10:05:00	2.53
10:15:00	2.63
10:25:00	2.74
10:35:00	2.85
10:45:00	2.97
10:55:00	3.11
11:05:00	3.23
11:15:00	3.37
11:25:00	3.50
11:35:00	3.62
11:45:00	3.73

Time	Height (m)
11:55:00	3.85
12:05:00	3.96
12:15:00	4.06
12:25:00	4.17
12:35:00	4.25
12:45:00	4.31
12:55:00	4.37
13:05:00	4.43
13:15:00	4.50
13:25:00	4.55
13:35:00	4.57
13:45:00	4.59
13:55:00	4.61
14:05:00	4.61
14:15:00	4.59
14:25:00	4.55
14:35:00	4.50
14:45:00	4.47
14:55:00	4.42
15:05:00	4.35
15:15:00	4.29
15:25:00	4.20
15:35:00	4.14
15:45:00	4.07
15:55:00	3.99
16:05:00	3.90

Saturday, March 4, 2017

Time	Height (m)
7:13:00	2.68
7:23:00	2.40
7:33:00	2.35
7:43:00	2.29
7:53:00	2.24
8:03:00	2.20
8:13:00	2.16
8:23:00	2.14
8:33:00	2.12

Time	Height (m)
8:43:00	2.10
8:53:00	2.08
9:03:00	2.08
9:13:00	2.08
9:23:00	2.09
9:33:00	2.11
9:43:00	2.14
9:53:00	2.17
10:03:00	2.21
10:13:00	2.26
10:23:00	2.30
10:33:00	2.38
10:43:00	2.46
10:53:00	2.54
11:03:00	2.64
11:13:00	2.72
11:23:00	2.82
11:33:00	2.92
11:43:00	3.03
11:53:00	3.15
12:03:00	3.26
12:13:00	3.37
12:23:00	3.48
12:33:00	3.59
12:43:00	3.70
12:53:00	3.78
13:03:00	3.88
13:13:00	3.94
13:23:00	4.02
13:33:00	4.17

Sunday, March 5, 2017

Time	Height (m)
6:40:00	3.24
6:50:00	3.15
7:00:00	3.07
7:10:00	2.99
7:20:00	2.88

Time	Height (m)
7:30:00	2.81
7:40:00	2.73
7:50:00	2.66
8:00:00	2.58
8:10:00	2.53
8:20:00	2.46
8:30:00	2.40
8:40:00	2.36
8:50:00	2.31
9:00:00	2.26
9:10:00	2.23
9:20:00	2.22
9:30:00	2.19
9:40:00	2.17
9:50:00	2.16
10:00:00	2.16
10:10:00	2.16
10:20:00	2.17
10:30:00	2.19
10:40:00	2.21
10:50:00	2.23
11:00:00	2.27
11:10:00	2.31
11:20:00	2.36
11:30:00	2.41
11:40:00	2.47
11:50:00	2.55
12:00:00	2.63
12:10:00	2.72
12:20:00	2.81
12:30:00	2.90

Prepared by: CONSULSUA C. Ltda.

The data obtained for reduction is as follows:

Pier edge elevation: 3.21m

According to the 2017 INOCR Tide Table, the vertical distance between the NRS (Probe Reduction Level) or MLWS as per the case, to the Mean Sea Level (MSL -IGM Elevation) called Zo = 1.70 meters.

The tidal heights, as analyzed, for each hour are the following:

Table No. 1V-4: Tidal heights

Thursday, March 2, 2017

Time	Height (m)
11:45:00	0.66
11:55:00	0.62
12:05:00	0.44
12:15:00	0.36
12:25:00	0.28
12:35:00	0.22
12:45:00	0.21
12:55:00	0.18
13:05:00	0.16
13:15:00	0.15
13:25:00	0.16
13:35:00	0.19
13:45:00	0.23
13:55:00	0.28
14:05:00	0.33
14:15:00	0.38
14:25:00	0.45
14:35:00	0.54
14:45:00	0.59
14:55:00	0.68
15:05:00	0.77
15:15:00	0.86
15:25:00	0.94
15:35:00	1.05
15:45:00	1.18
15:55:00	1.29
16:05:00	1.4

Friday, March 3, 2017

Time	Height (m)
7:55:00	2.91
8:05:00	2.92
8:15:00	2.93
8:25:00	2.92
8:35:00	2.9
8:45:00	2.89
8:55:00	2.85
9:05:00	2.81
9:15:00	2.76
9:25:00	2.72
9:35:00	2.65
9:45:00	2.58
9:55:00	2.49
10:05:00	2.38
10:15:00	2.28
10:25:00	2.17
10:35:00	2.06
10:45:00	1.94
10:55:00	1.8
11:05:00	1.68
11:15:00	1.54
11:25:00	1.41
11:35:00	1.29
11:45:00	1.18
11:55:00	1.06
12:05:00	0.95
12:15:00	0.85
12:25:00	0.74
12:35:00	0.66
12:45:00	0.6
12:55:00	0.54
13:05:00	0.48
13:15:00	0.41
13:25:00	0.36
13:35:00	0.34
13:45:00	0.32

Time	Height (m)
13:55:00	0.3
14:05:00	0.3
14:15:00	0.32
14:25:00	0.36
14:35:00	0.41
14:45:00	0.44
14:55:00	0.49
15:05:00	0.56
15:15:00	0.62
15:25:00	0.71
15:35:00	0.77
15:45:00	0.84
15:55:00	0.92
16:05:00	1.01

Saturday, March 4, 2017

Time	Height (m)
7:13:00	2.23
7:23:00	2.51
7:33:00	2.56
7:43:00	2.62
7:53:00	2.67
8:03:00	2.71
8:13:00	2.75
8:23:00	2.77
8:33:00	2.79
8:43:00	2.81
8:53:00	2.83
9:03:00	2.83
9:13:00	2.83
9:23:00	2.82
9:33:00	2.8
9:43:00	2.77
9:53:00	2.74
10:03:00	2.7
10:13:00	2.65
10:23:00	2.61
10:33:00	2.53

Time	Height (m)
10:43:00	2.45
10:53:00	2.37
11:03:00	2.27
11:13:00	2.19
11:23:00	2.09
11:33:00	1.99
11:43:00	1.88
11:53:00	1.76
12:03:00	1.65
12:13:00	1.54
12:23:00	1.43
12:33:00	1.32
12:43:00	1.21
12:53:00	1.13
13:03:00	1.03
13:13:00	0.97
13:23:00	0.89
13:33:00	0.74

Sunday, March 5, 2017

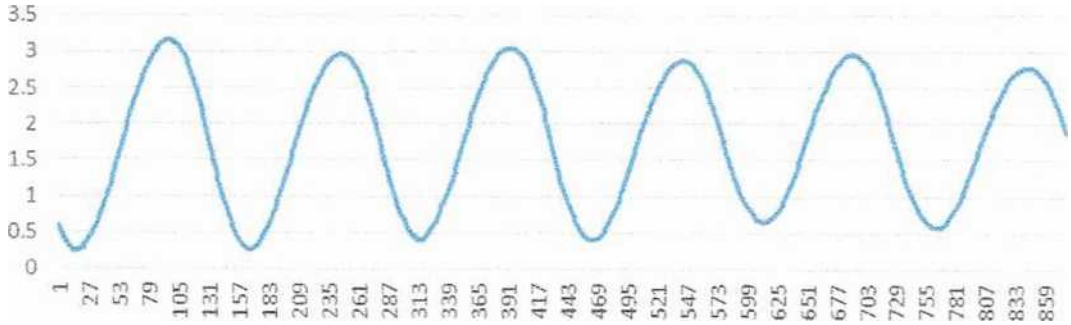
Time	Height (m)
6:40:00	1.67
6:50:00	1.76
7:00:00	1.84
7:10:00	1.92
7:20:00	2.03
7:30:00	2.1
7:40:00	2.18
7:50:00	2.25
8:00:00	2.33
8:10:00	2.38
8:20:00	2.45
8:30:00	2.51
8:40:00	2.55
8:50:00	2.6
9:00:00	2.65
9:10:00	2.68
9:20:00	2.69

Time	Height (m)
9:30:00	2.72
9:40:00	2.74
9:50:00	2.75
10:00:00	2.75
10:10:00	2.75
10:20:00	2.74
10:30:00	2.72
10:40:00	2.7
10:50:00	2.68
11:00:00	2.64
11:10:00	2.6
11:20:00	2.55
11:30:00	2.5
11:40:00	2.44
11:50:00	2.36
12:00:00	2.28
12:10:00	2.19
12:20:00	2.1
12:30:00	2.01

Prepared by: CONSULSUA C. Ltda.

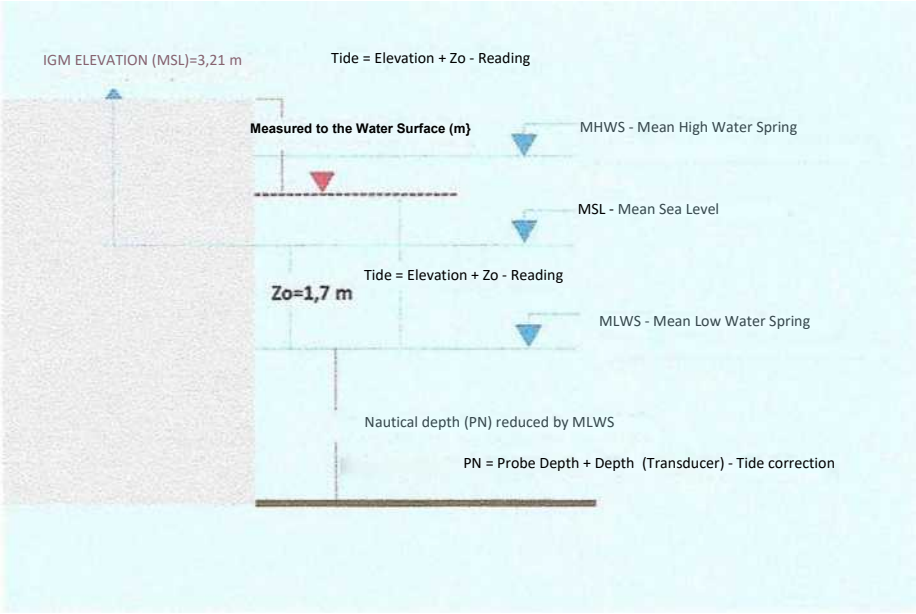
In addition, a tide gauge was installed on Pier 3. Located at the same metering site going down to the water surface from the pier, the equipment remained anchored from March 02, 2017 to March 05, 2017; below is the figure with the curve representing the raw draft data; this data was obtained every 5 minutes.

Figure No. IV-6: Draft



The reduction scheme is presented in Figure N ° IV-7.

Figure No IV-7: Data Reduction Scheme

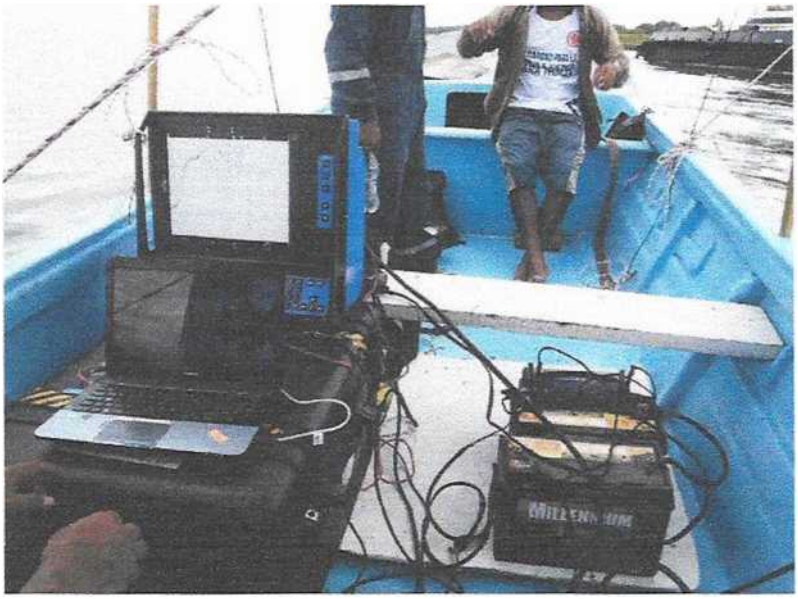


Prepared by: CONSULSUA C. Ltda.

Checking equipment connections on the ship

For correct operation during the Bathymetric Survey, the link between the GPS-Differential and the ecoprobe transducer is checked. This verification is effectively executed when the hydrographic software (Hypack) indicates a connection between these two devices, presenting the "X, Y" and "Z" coordinates as the corresponding outputs.

Photograph No. IV-8: Verifying the link between the devices



Prepared by: CONSULSUA C. Ltda.

Raw Data processing and verification thereof with the data obtained in the field.

Hypack software was used for information processing (Annex C-Field Book), obtaining the final product (maps) according to the following sequence:

Editing of information collected in the survey to make corrections; depth by tides and depth (0.45m).

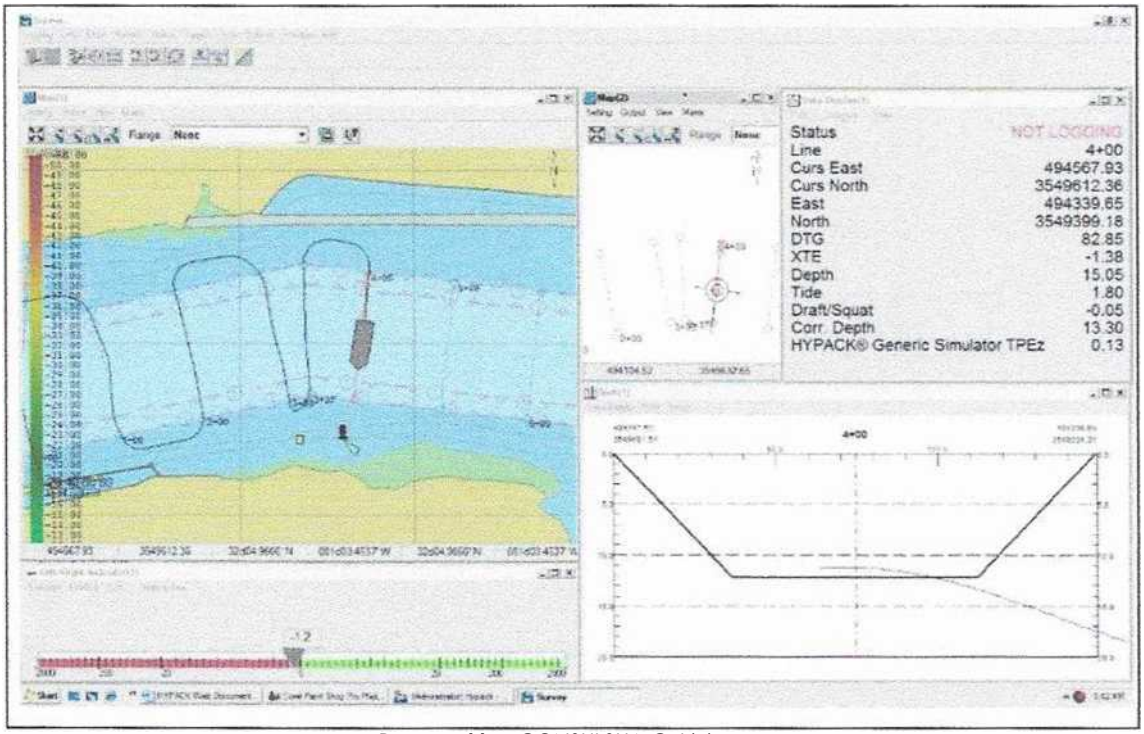
Process and product quality control, to eliminate doubtful raw data and obtain and print preliminary data.

Once the data has been obtained, the general maps are drawn up at a 1:2500 scale; for printing in analogue format and with the corresponding digital file. (see Annex F Maps).

Hypack Software

The Hypack 2015 software was used for the processing and integration of the data in real time. The unit of measure used was the meter; the verification of depths was carried out by sampling and corrections were also made by means of the transducer location, speed of sound in the water column.

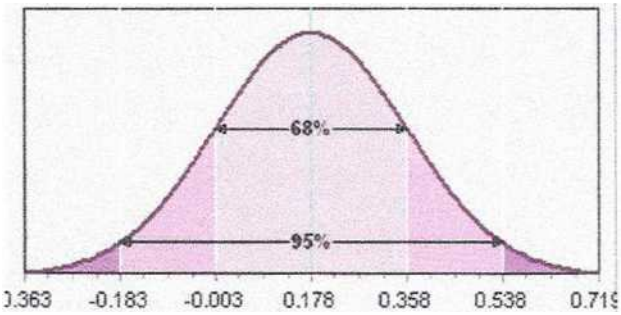
Figure No. IV-8: 2015 Hypack Software



Prepared by: CONSULSUA C. Ltda.

Below is the standard deviation graph for the total surveyed data, obtained using the HYPACK program

Figure No. IV-9: Standard deviation of the surveyed data.



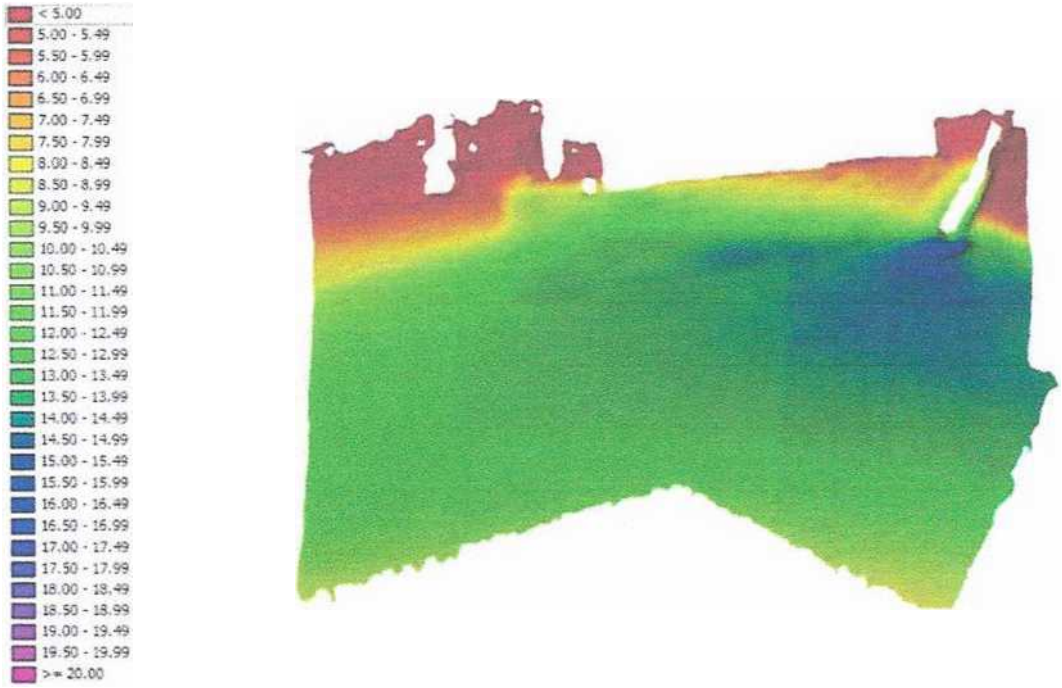
INFORMATION PROCESSING AND CARTOGRAPHIC EDITING

We used the Hypack software for information processing and integration, and the AUTOCAD CIVIL 3D 2014 software for cartographic editing, which allowed us to import and export files in DWG format to other file types, including 3D files. The drawing files contain: XYZ points, the scale, the UTM grid related to Datum WGS 84, and the North and East grid values.

For printing the maps and to cover the surveyed area, the sheet is adjusted to the INEN A1 format with the corresponding scales. Maps include a graphic scale, location graph and a general information label.

This program was also used to obtain a 3D view of the Bathymetry (see Annex D 3D Hypack images); below is one of the images obtained:

Figure No. IV-10: Hypack 3D View



Prepared by: CONSULSUA C. Ltda.

V. CONCLUSIONS

According to the data obtained in the survey, it was possible to conclude that the most relevant depths found were between berths 3, 4 and 5, with banks ranging from 7 m to 12.5 m. on average in the area near the pier, and gaining depth as we move away from them to an approximate distance of 350 m, where we observed banks up to 13 m for berth 5 and 14 m for berths 3 and 4.

VI. BIBLIOGRAPHY

- INTERNATIONAL HYDROGRAPHIC ORGANIZATION OHI Standards for Hydrographic Surveys (S-44). *5 ed.* International Hydrographic Bureau, 2008.

- Derrotero de las Costas Continentales e Insular del Ecuador, INOCAR 2005. (Sailing Directions for the Continental and Insular Coasts of Ecuador).

- Tabla de Mareas y Datos Astronómicos del Sol y de la Luna 2017, INOCAR 2017 (2017 Table of Tides and Sun-Moon Astronomical Data)

- Aproximación a Puerto Marítimo de Puerto Bolívar, Carta Náutica IOA 10811.(Approximation to the Puerto Bolivar Maritime Port, IOA 10811Nautical Charter)

VII. ANNEXES

ANNEX A: PHOTOGRAPHIC RECORDS

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PHOTOGRAPHIC RECORDS

- BATHYMETRY

ANNEX B: TIDE CHARTS (FOR REDUCTION)

Attached in digital format

ANNEX C: FIELD LOGBOOK

Attached in digital format

ANNEX D: 3D HYPACK IMAGES (DIGITAL)

The file is attached in digital form.

ANNEX E: EQUIPMENT TECHNICAL SPECIFICATIONS

ANNEX F: MAPS

GENERAL BATHYMETRY IMPLEMENTATION RELATED TO MLWS

GENERAL BATHYMETRY IMPLEMENTATION RELATED TO MSL

ANNEX G: ECHOGRAM

ENVIRONMENTAL IMPACT STUDY
DREDGING OF PIERS 1, 2, 3, 4, 5, and 6,
THE MANEUVERING AREA, AND THE ACCESS CANAL
OF PUERTO BOLÍVAR

ANNEX 12

Terms and Definitions

GLOSSARY OF TERMS AND DEFINITIONS

ADSORPTION: Adsorption is understood to be the fixation of a molecular or ionic species (adsorbate) on the surface of a solid substance (adsorbent). It is a complex surface phenomenon, in which physical-chemical molecular interaction forces are produced between the absorbate and the adsorbent.

AFFLUENT: It is the water, wastewater or other liquid that enters a receiving water body, reservoir, treatment plant or treatment process.

AIR: Also called "ambient air", any unconfined portion of the atmosphere, and is defined as a gaseous mixture whose normal composition is at least twenty percent (20%) oxygen, seventy-nine percent (79 %) nitrogen and one percent (1%) carbon dioxide, in addition to variable proportions of inert gases and water vapor, in volumetric ratio.

FRESH WATER: is one that does not contain significant amounts of salts. In general, values less than 0.5 UPD are considered (practical unit of salinity that represents the amount of grams of dissolved salts per kg of water)

MARINE WATER: it is the water of the seas and oceans. They are distinguished by their high salinity, also known as salt water. Marine waters correspond to territorial waters in the extension and terms established by international law, inland marine waters, those of lagoons and estuaries that are permanently communicated.

WASTE WATER: is water of varied composition from domestic, industrial, commercial agricultural, livestock or other use, whether public or private, and that for this reason has suffered degradation in its original quality.

INDUSTRIAL WASTE WATER: waste water generated in industrial operations or processes.

GROUND WATER: is all subsoil water, especially that found in the saturation zone.

DOMESTIC WASTE WATER: Mixture of: liquid household waste evacuated from residences, public, educational, commercial and industrial places.

SALT WATER: It is one that has a salinity equal to or greater than 30UPS (g / Kg) of salts.

SHIPPING AGENT: It is the natural or legal person that represents the shipowner in administrative, commercial and operational procedures, as well as in all procedures related to the arrival and stay of the ship, accepting on behalf of the shipowner, the rights and obligations that to this they correspond in said efforts.

STORAGE STORAGE: It means the permanence and custody inside the Terminals, patios, warehouses or any enclosure or facility, including special warehouses destined to refrigerated cargo or dangerous merchandise, cargo or containers with import, export or other cargo , subject to customs destination, including all the resources and activities necessary for the provision of such services.

STORAGE OF NON-CONTAINERED GENERAL CARGO IN WAREHOUSES: Such Storage of non-containerized cargo in warehouses shall be understood as such.

STORAGE OF NON-CONTAINERED GENERAL CARGO IN SPECIAL WAREHOUSES: Such storage of non- containerized cargo in special warehouses, intended for refrigerated cargo or dangerous merchandise.

STORAGE OF NON-CONTAINERED GENERAL CARGO IN PATIOS: It will be understood as such Storage of non-containerized cargo in patios.

CONTAINER STORAGE: It shall be understood as such Storage of container cargo.

PROTECTED NATURAL AREA: Geographically defined surface that has been designated by law or other legal norm dictated by the competent bodies of the Executive Function, whatever its management category, in order to meet the conservation objectives defined by law or regulation.

OWNER: It is the natural or legal person who, as a ship owner or not, exercises the navigation of a ship at his own risk and expense.

SENAE CUSTOMS AUTHORITY: It will mean the National Customs Service of Ecuador, which, for this purpose, will be the highest authority in customs matters in this country, or the entity that legally substitutes it in its functions.

CAPTAIN OF THE PORT (CAPTAIN OF THE PORT): It is the Maritime Authority, whose functions are determined in the Maritime Police code.

PORT AUTHORITY OF PUERTO BOLIVAR or APPB: It is the port entity of public law, legal entity, equity and own funds, owner of the port and the facilities concessioned and delivered in the concession. It is the grantor entity and will exercise control of the Concession.

NATIONAL PORT AUTHORITY: This is considered the General Directorate of the Merchant Marine and the Coast (DIGMER). In distinct, this body will also be referred to as APN.

GOVERNMENT AUTHORITY: Any body or authority that is part of the central or institutional public administration of the executive function shall be understood as such.

NATIONAL ENVIRONMENTAL AUTHORITY: Ministry of the Environment.

COMPETENT ENVIRONMENTAL AUTHORITY: They are competent to carry out the processes of prevention, control and monitoring of environmental pollution, firstly the Ministry of the Environment and by delegation, the autonomous decentralized provincial, metropolitan and / or municipal accredited governments.

AUTHORIZATION: It is the power that YPH has to subcontract the provision of special port services to port operators and authorize complementary service companies to perform such services within the port area, it should be noted that these companies must be previously registered with the Undersecretary of Ports Transportation Maritime and Fluvial (SPTMF) and be authorized BY APPB under the conditions established by this entity.

SHIP OR SHIP: Self-propelled boats or not, dedicated to the transport of cargo and people. All references in this manual to ship or vessels, ship or vessels, will include, without exception, its owner, owner, charterer and / or agent.

LINE VESSEL: It is one that sails under a determined and cyclical itinerary of stops operated by a Shipping Agency and that maintains a frequent regular service to or from the sea port, it is also considered under this name to a ship that the same Shipping Agency places it as a replacement for the holder to cover your itinerary for any justified reason.

CARGO SHIP PROJECT: Being to that vessel which must operate (loading, unloading, stowing, reestibar and / or trincar) , one or lumps defined as Project Cargo.

SOIL ENVIRONMENTAL QUALITY: Set of qualitative and / or quantitative characteristics that allow the soil to function within the limits of the ecosystem of which it forms part and with which it interacts, and that enables its use for a specific purpose on a broad scale of time

CHANNELS: Conduits used to transport water, for multiple purposes.

RESILIENCE CAPACITY: The ability of a system and its components to anticipate, absorb, adapt or recover from the effects of a negative impact or emergent damage (natural or anthropic), in a timely and efficient manner, carrying out the acts over time. evolutionary and regenerative that will reestablish ecological balance, wealth and biodiversity.

CHARACTERIZATION OF WASTEWATER: process aimed at comprehensive and statistically reliable knowledge of the characteristics of waste water (domestic and industrial) and integrated by taking samples, measuring flow and identifying the physical, chemical, biological and microbiological components.

SOIL CHARACTERIZATION: Determination of the physical , chemical and biological characteristics of the soil, which define its environmental quality.

CHARACTERIZATION ON A DRY BASE: it is the test carried out directly on the solid matrix of a soil or residue in order to determine its chemical composition.

LOADING: will mean taking the cargo or container from its storage place, transferring it and placing it on a means of land transport, including all the resources and activities necessary for the provision of said service.

GENERAL CARGO: it is one that is presented in solid state and that, being packed or unpacked, can be treated as unit d, whose shape, dimension and weight exceed 2 cubic meters or 2 tons (per unit) which allows a treatment as conventional cargo with the equipment and basic structure of the port.

NON-CONVENTIONAL GENERAL CARGO: it is one that is presented in solid state and that, being packed or unpacked, can be treated as a unit, whose shape, dimension and weight exceed 2 cubic meters or 2 tons (per unit) which does not allow a treatment as conventional cargo with the equipment and the basic structure of the port.

SOLID BULK CARGO: It is cargo not mobilized in bags, boxes or other kind of packaging, loaded without any brand or account, such as: grains, seeds, minerals and others.

LIQUID BULK CARGO: Consists of cargo that is transported in liquid state, without containers, in ship's tanks and elsewhere.

PROJECT CARGO: consists of all cargo whose individual weight exceeds 30 metric tons or with dimensions that exceed the measurements of a 20, 40 or 45 foot ISO container. Project Cargo is

also considered to be those goods that, due to their value or risk, imply the adoption of special methods and precautions for loading, unloading, handling and storage.

CONTAMINANT LOAD: Quantity of a contaminant provided in a discharge of waste water or present on a receiver body expressed in units of mass per unit and time.

MAXIMUM PERMISSIBLE LOAD: It is the load limit of a parameter that can be accepted in the discharge to a receiving body or to a system
. sewer.

CATALOG OF PROJECTS, WORKS OR ACTIVITIES: List and classification of existing projects, works or activities in the country, based on their particular characteristics and the magnitude of the negative impacts they cause to the environment.

FLOW ENVIRONMENTAL: Flow or environmental flows can be defined as the water system required to maintain the integrity, productive, services and benefits the ecosystems water, particularly when it is subject to regulation of the flow rate and high competition due to the existence of multiple uses .

INTERSECTION CERTIFICATE: The intersection certificate is a document generated from the UTJVI coordinates in which it is precisely indicated whether or not the proposed project, work or activity intersects with the National System of Protected Areas (SNAP), Forests and Protective Vegetation, State Forest Heritage, intangible zones and buffer zones.

CLIENTS: The natural or legal person is considered such that by effect of their activity and by provision of the laws and regulations in force, requires the provision or use of Basic Services and Special Services delegated to the Concessionaire by APPB, during the term of the Contract and in the terms provided in it.

COMBUSTION: Rapid oxidation, which consists of a combination of oxygen with those materials or substances capable of oxidizing, resulting in the generation of gases, particles, light and heat.

COMPENSATION FOR SOCIAL-ENVIRONMENTAL DAMAGE: To compensate in an equivalent and collective way, the environmental damages generated during the execution of a work, activity or project, that cause losses of environmental goods or services temporarily or permanently and that may affect related human activities to the presence and operation of said goods and services. The social investment actions carried out by the State and the social responsibility activities of a company should not be considered synonymous with this concept, which applies exclusively to those damages directly or indirectly related to environmental damage.

COMPENSATION: Regulatory process used to avoid violent spills, applicable to spills of industrial origin in which the waste is stored to level the daily discharge histogram and homogenize the quality of the waste.

CONCENTRATION OF A SUBSTANCE IN AIR: It is the relationship that exists between the weight or volume of a substance and the unit of volume of air in which it is contained.

REFERENCE CONDITIONS: Twenty-five degrees centigrade (25ºC) and seven hundred and sixty millimeters of pressure mercury (760 mm Hg).

SOIL CONSERVATION: Optimal use and management of the soil resource to maintain a set of characteristics that enable it to function within the limits of the ecosystem of which it is a part.

POLLUTION: The presence in the environment of one or more pollutants or the combination of them, in such concentrations and with such a residence time, that in these conditions they cause negative for human life, health and well-being of man, the flora, fauna, ecosystems or that produce in the habitat of living beings, air, water, soils, landscapes or natural resources in general, a significant deterioration.

WATER POLLUTION: any alteration of the physical , chemical or biological characteristics, in concentrations such that it is not suitable for the intended use, or that causes an adverse effect on the aquatic ecosystem, human beings or the environment in general.

AIR POLLUTION: The presence of substances in the atmosphere, resulting from human activities or natural processes, present in sufficient concentration, for a sufficient time and under circumstances such that they interfere with the comfort, health or well-being of human beings or the environment.

AIR POLLUTANT: Any substance or material emitted into the atmosphere, either by human activity or by natural processes, and that adversely affects man or the environment.

AIR CRITERIA POLLUTANTS: Any air pollutant for which, in this standard, a maximum permitted concentration value at ground level in ambient air is specified, and therefore affects the receptors, whether they are people, animals, vegetation or materials for different periods of time.

HAZARDOUS AIR POLLUTANT (unconventional): These are air pollutants that can pose a threat of adverse effects on human health or the environment.

SOIL POLLUTANT: Substance that, in any physical state or form, which, when incorporated or interacts in the soil, alters or modifies its natural composition and degrades its environmental quality.

CONTROLLED CONFINEMENT OR SECURITY CELL / FILLING : Engineering work carried out for the final disposal of hazardous waste, in order to guarantee its definitive and safe isolation.

WATER QUALITY CRITERION: numerical concentration or recommended descriptive statement on physical, chemical and biological parameters to maintain a certain beneficial use of water. The quality criteria for various uses of water are the basis for determining the quality objectives in the sections of a receiving body. This determination generally requires a modeling process of the receiving body where the most critical flow conditions of the receiving body, future loads of pollutants and the assimilation capacity of the water resource are considered.

CROSS DOCKING: Unloading merchandise from an incoming truck or vehicle to load it on a vehicle or truck to the dock.

RECEIVING BODY: River, basin, channel or body of water that is capable of directly or indirectly receiving the discharge of wastewater.

BODY OF WATER: It is any river, lake, lagoon, groundwater, channel, water reservoir, current, marine area, estuary.

WATER BODY: They are all surface and subterranean bodies of water such as streams, ditches, rivers, lakes, lagoons, wetlands, swamps, natural falls.

RECEIVING BODY: It is any body of water that is capable of directly or indirectly receiving the discharge of wastewater.

CHIMNEY: Duct that facilitates the transport and evacuation to the atmosphere of the combustion products generated in the fixed source.

ENVIRONMENTAL DAMAGE: It is the negative environmental impact on the environmental conditions present in a given space, caused by the development of projects, which lead to an imbalance in the functions of ecosystems and which alter the supply of services that such ecosystems provide to society .

DEGRADATION: Loss of environmental quality of the soil due to contamination by harmful substances, deterioration of the physical structure , modification of the chemical composition, alteration of biological processes or inappropriate use of the resource.

UNLOADING: this will be understood as taking the cargo or container from a means of land transport, moving it and placing it in its storage place, including all the resources and activities necessary for the presentation of said service.

POLLUTANT DISCHARGE: Action of dumping, depositing, or injecting water, substances or waste in a permanent, intermittent or fortuitous manner that degrades the environmental quality of the soil resource due to contamination.

LANDING: It will mean the transfer of cargo or container from the deck or warehouse of a ship to the docks, and will include all the resources and activities necessary for the provision of such service.

DESTROYING: This will be understood as the unmooring of the cargo or container inside the holds of a ship or on its deck, including all the resources and activities necessary for the presentation of such service.

DISPATCH: It will mean the issuance, verification, control and issuance of the documents that record the delivery of the cargo to the consignee or its representative, including its administration and management, the packaging control in the case of general cargo or the control of seals. and state of the container if it is containerized cargo, and all the resources and activities necessary for the presentation of such services.

UNSETTING: It will mean undoing or undoing the lashing of the cargo on board and will include all the resources and activities necessary for the provision of such service.

WASTEWATER DISCHARGE: Action of dumping wastewater into a sewer system or receiving body.

POINT DISCHARGE: any defined source from which pollutants are or may be discharged.

WASTE: They are the substances (solid, semi-solid, liquid, or gaseous), or composite materials resulting from a process of production, transformation, recycling, use or consumption, whose

elimination or final disposal proceeds in accordance with the provisions of environmental legislation national and international applicable.

HAZARDOUS WASTE: Solid, pasty, liquid or gaseous wastes resulting from a process of production, extr action, transformation, recycling, use or consumption and that contain any substance that has corrosive, reactive, toxic , flammable, biological-infectious and / or radioactive, which represent a risk to human health and the environment in accordance with the applicable legal provisions, and the provisions of this book.

SPECIAL WASTE ARE:
a) Those wastes, which, without being dangerous, by their nature, can impact the environment or health, due to the volume of generation and / or difficult degradation and for which a system of recovery, reuse and / or recycling in order to reduce the amount of waste generated, avoid its inadequate handling and disposal, as well as the oversaturation of municipal sanitary landfills.
b) Those whose content of substances having characteristics corrosive, reactive, toxic, flammable, biological -infecciosas and / or radioactive not exceed the limits of concentration set in environmental regulations that is issued for the purpose and for which it is necessary adequate environmental management and maintain periodic control and monitoring.
c) Those that are determined in the national list of special waste.

NON-HAZARDOUS WASTE: Set of solid materials of organic and inorganic origin (putrescible or not) that have no practical use for the activity that produces it, being from domestic, commercial, industrial and all kinds of activities that occur in a community , with the sole exception of human excreta. Depending on the activity in which they are produced, they are classified into agricultural (agricultural and livestock), forestry, mining, industrial and urban. With the exception of the miners, due to their characteristics of location, quantities, composition, etc., the others have many common aspects, from the point of view of recovery and recycling.

FROM THE CRADLE TO THE CRADLE (cradle to cradle): It involves, learning and imitating from nature the use in the flow of nutrients from your metabolism , in which the concept of waste does not even exist, it has "eco-effectiveness" as its principles. .

DISPOSAL: The last stage of waste management and / or waste solids, which are arranged in short and sanitary manner by isolation processes and confinement definitively waste and / or solid waste unusable or waste dangerous and special with previous treatment, in specially selected places and designed to avoid contamination , damage or risks to human health or the environment. Final disposal is carried out when technically all types of traffic have been ruled out, both within and outside Ecuadorian territory.

DECIBEL: dimensionless unit used to express the logarithm of the ratio between a measured quantity and a reference quantity . The decibel is used to describe sound pressure levels in this standard.

AERODYNAMIC DIAMETER: For a specific particle , it is the diameter of a sphere with unit density (density of water) that settles in still air at the same speed as the particle in question.

SULFUR DIOXIDE (SO2): Colorless and irritating gas formed mainly by the combustion of fossil fuels.

NITROGEN DIOXIDE (NO2): A highly toxic, reddish-brown gas that is formed due to the oxidation of atmospheric Nitrogen that is used in combustion processes in vehicles and factories .

DOLLAR OF THE UNITED STATES OF AMERICA: Means the official currency issued by the United States of America, legal tender and free circulation in the Republic of Ecuador.

ECOSYSTEM: Natural set of physical and biological components of an environment, interrelated and interdependent.

EMISSION: The discharge of gaseous substances, pure or with substances in suspension in the atmosphere. For the purposes of this standard, the emission refers to the discharge of substances from human activities.

EROSION: Disaggregation, detachment and dragging of solid particles from the earth's surface by action of water, wind, gravity, ice, due to natural or human-induced causes.

DISPOSAL OF HAZARDOUS AND / OR SPECIAL WASTE:
They cover both operations that result in the final disposal of hazardous and / or special waste, as well as those that result in recovery, recycling, regeneration and reuse.

CRITICAL AIR POLLUTION EPISODE : It is the presence of high concentrations of criteria pollutants in the air and for short periods of time, as a result of large-scale emissions conditions and / or unfavorable meteorological conditions that prevent the dispersion of previously emitted pollutants.

SHIPMENT: It will mean the transfer of the cargo or container from the Terminals to the interior of the warehouses or deck of the ship , including all the resources and activities necessary for the presentation of said service.

EMISSION: Release into the environment of substances, preparations, organisms or microorganisms during the execution of activities

WILD SPECIES: The species of flora and fauna that are indicated in the Forestry and Conservation of Natural Areas and Wildlife Law, other related regulations, as well as those protected by the CITES Convention and those contained in the Red Book of the World Union of nature. Invasive alien species, understood as those introduced deliberately or accidentally outside their range are excluded from this definition natural and they are a threat to habitats or native wild species.

WASTE / WASTE LABEL: It is any written or graphic expression printed or recorded directly on the container and packaging of a commercial presentation product that identifies it and that is in accordance with current or internationally recognized national standards.

ETA (Estimated Time of Arrival): Estimated time of arrival of the ship at sea buoy.

ETB (Estimated Time of berthing): Estimated time of arrival of the ship to the dock.

ENVIRONMENTAL STUDIES: They consist of a predictive estimate or a present identification of environmental damage or alterations, in order to establish preventive measures, mitigation activities and rehabilitation measures for environmental impacts produced by a probable or effective execution of a project. of any of the phases, which will constitute technical tools for the environmental regularization, control and monitoring of a work, project or activity that involves environmental risk.

NON-HAZARDOUS WASTE MANAGEMENT ASES: Corresponds to the set of technical and operational activities of the integral management of non-hazardous solid waste that includes: minimization in the generation, separation at the source, storage, collection, transportation, collection and / or transfer, exploitation or treatment and final disposal.

NOISE EMITTING SOURCE (RES): Any activity, operation or process that generates or may generate noise emissions to the environment, including noise from living beings.

FIXED SOURCE OF NOISE (FFR): For this standard, the fixed source of noise is considered to be a noise emitting source or a set of noise emitting sources located within the physical and legal limits of a
property located in a fixed or determined place. Examples of these sources are: mechanical metal, car washes, factories, bus terminals, discos, etc.

GESTOR WASTE AND / OR WASTES: natural or legal, public or private, which is registered pa r management in whole or in part of solid waste non - hazardous or special and hazardous waste without causing harm to human health or to the environment.

GENERATION OF RESIDUES AND / OR SOLID WASTE: Amount of residues and / or solid waste originated by a certain source in a certain interval of time. It is the first stage in the life cycle of waste and is closely related to the degree of awareness of citizens and the socio-economic characteristics of the population.

GENERATOR OF RESIDUES AND / OR SOLID WASTE: Any person, natural or legal, public or private, who, as a result of their activities, may create or generate waste and / or solid waste.

GUIDE TO GOOD ENVIRONMENTAL PRACTICES: Document in which the actions that natural or legal persons involved in an activity are presented in a summarized way, put into practice to prevent or minimize environmental impacts and that are not contemplated in current environmental regulations.

HABITAT: They are the different terrestrial or aquatic zones differentiated by their geographical, abiotic and biotic characteristics, relative in their extension and location to the organisms that occupy them to carry out and complete their cycles of birth, development and reproduction.

SAFETY DATA SHEET: It is the information on the safety and hygiene conditions necessary for the handling, transport, distribution, marketing and final disposal of hazardous and / or special chemicals and wastes.

SOIL SKYLINE: Layer of soil or soil material approximately parallel to the surface of the ground, which is the product of evolution and which differs from adjacent layers genetically related to it in physical, chemical and biological properties and characteristics.

ENVIRONMENTAL INCIDENT: It is any mishap or unexpected event, whether fortuitous or generated by negligence, after which a pollutant is released into the environment or an infrastructure becomes a source of direct or indirect pollution, which causes an alteration of natural conditions of the environment in a given time.

INCINERATION: It is a thermochemical process of oxidation of organic matter by means of oxygen which is in excess. Total combustion generates combustion failure residues producing harmful elements dioxins and furans. Sulfur and nitrogen oxides are also generated.

NON-COMPLIANCE: Faults in the execution of any obligation, be it of an administrative or technical nature. Administrative non-compliance will be understood as non-observance in the presentation of documents for the purposes of environmental evaluation, control and monitoring. Technical non-compliance will constitute non-execution of the activities established in the approved environmental studies and constant obligations in the environmental permits granted by the Competent Environmental Authority, and / or in the environmental technical standards, aimed at the prevention, control and monitoring of environmental pollution. .

ENVIRONMENTAL IMPACT: They are all the alterations, positive, negative, neutral, direct, indirect, generated by an economic activity, work, public or private project, which, due to cumulative or delayed effect, generate measurable and demonstrable changes on the environment, its components , their interactions and relationships and other characteristics intrinsic to the natural system.

ACCREDITED LABORATORY: legal, public or private person that performs physical, chemical, biochemical or microbiological analyzes on water samples, which is accredited by the Ecuadorian Accreditation Service of Ecuador.

ENVIRONMENTAL LICENSE: It is the environmental permit granted by the Competent Environmental Authority to a natural or legal person, for the execution of a project, work or activity. It establishes the obligation of compliance with the applicable environmental regulations by the regulated to prevent, mitigate or correct the undesirable effects that the project, work or authorized activity may cause in the environment.

LISTS OF RATES or RATE OF THE CONCESSION: The set of Rates that the Concessionaire will charge for the Services it provides in the Concession and that it will keep publicly known at all times. It will contain the Basic Rates and the Special Rates. The name is given to the moment in which a vessel during the docking maneuver at the dock designated for this purpose has secured the first mooring strip to said dock.

MAXIMUM PERMISSIBLE LIMITS: Limit values for soil contamination determined for each parameter.

BASELINE: Denotes the state of an altered system at a particular time, before a subsequent change. It is also defined as the conditions at the time of the investigation within an area that may be influenced by productive or human activities.

BOTTOM LINE (background): It denotes the prevailing environmental conditions, before any disturbance. That is, it means the conditions that would have prevailed in the absence of anthropogenic activities, only with the natural processes at work.

LEACHED: Liquids that seep through the waste, formed by water from rain or runoff. The leachate can also come from the humidity of the waste, by reaction or decomposition of the same and that carries dissolved or suspended waste and pollutants that are in the same waste.

HANDLING: It is the movement of goods within the port area without including the transport service.

PARTICULATE MATERIAL: It is made up of solid or liquid material in the form of particles, with the exception of non-combined water, present in the atmosphere. It is designated as PM10 to the particulate material whose aerodynamic diameter is less than 10 microns.

HAZARDOUS MATERIAL: It is any chemical product and the waste that is released from it, which due to its physical characteristics - chemical, corrosive, toxic, reactive, explosive, flammable, biological - infectious, represent a risk of affecting human health, resources natural resources and the environment or destruction of environmental goods and services or others, which requires controlling their use and limiting their exposure, in accordance with legal provisions.

MITIGATION MEASURE: That activity that, once identified and / or produced a negative impact or environmental damage, is intended to

lessen, weaken or lessen the negative impacts or environmental damage produced by an activity, work or project by controlling, containing or eliminating the factors that originate or intervene on them in any other way.

PREVENTIVE MEASURE: That which, once a negative impact or environmental damage to occur in the near future, as a result of a work, activity or project, is adopted in order to prevent, slow down or minimize its negative effects or their occurrence. .

BEST AVAILABLE TECHNOLOGY: That technology provided by technical or scientific progress that can be accessed under reasonable conditions, taking into account costs and benefits.

CLIMATE CHANGE MITIGATION: An anthropogenic intervention to reduce sources of greenhouse gas emissions and conserve and increase sinks of greenhouse gases.

MONITORING: It is the scheduled process of collecting samples, making measurements, and subsequently recording various characteristics of the environment, often in order to assess compliance with specific objectives.

MONITORING OF REFRIGERATED CONTAINERS: consists of monitoring the temperature of the refrigerated containers according to the customer's instructions.

CARBON MONOXIDE (CO): Colorless, odorless and toxic gas resulting from the incomplete combustion of fossil fuels.

DOCK: Any installation, wall, mooring, dock or docking and mooring facilities for ships or vessels and the spaces assigned therein for loading and unloading operations.

SAMPLE: Representative portions of a soil to define its environmental quality, taken according to a sampling plan.

COMPOSITE SAMPLE: Set of several representative subsamples of a soil area.

SINGLE SAMPLE: Material collected at a single sampling point.

POINT SAMPLE: individual sample taken at random (in relation to the time and / or place of a volume of water), it represents the quality of the water at the time and place in which it was taken.

SOUND PRESSURE LEVEL (LO SPL): Ten times the decimal logarithm of the square of the quotient of a given quadratic sound pressure and the reference acoustic pressure, which is obtained with a normalized frequency weighting and time weighting. For the purposes of this standard, the

weighting to be used will be A or C depending on the case and, constant of the SLOW or IMPULSIVE time depending on the case.

EQUIVALENT CONTINUOUS SOUND PRESSURE LEVEL (LEQ): Ten times the decimal logarithm of the square of the quotient of a mean square sound pressure during a given time interval and the reference acoustic pressure, which is obtained with a normalized frequency weighting .

BACKGROUND LEVEL: It expresses the prevailing environmental conditions before any disturbance caused by human activities, that is, only with the natural processes in operation.

EMISSION STANDARD: It is the value that indicates the maximum permissible discharge of the defined air pollutants, coming from a fixed or mobile source.

NORM (STANDARD) OF WATER QUALITY: document recognized in laws or regulations for the control of water pollution at the governmental level.

ENVIRONMENTAL STANDARDS: These are the standards whose objective is to ensure the protection of the environment, the preservation of nature and the conservation of the natural heritage and impose an obligation or requirement whose compliance must be met by the Control Subject for the purposes of prevention and control of environmental quality during the construction, operation and closure of a project or activity.

PORT OPERATIONS: These are activities related to the entry, stay and departure of ships and the movement of cargo to or from ships or within the terrestrial or aquatic spaces of the Yilport Holding port area.

PARAMETER, COMPONENT OR CHARACTERISTIC: physical , chemical, biological variable or property , combination of the above, element or substance that serves to characterize the quality of the water resource or the discharges.

SEDIMENTABLE PARTICLES: Particulate material, solid or liquid, generally larger than 10 microns; due to their weight, they tend to precipitate easily, which is why they can remain temporarily suspended in the ambient air.

ENVIRONMENTAL LIABILITIES: It is that environmental damage and / or negative environmental impact generated by a work, project or productive or economic activity, which has not been repaired or restored, or that which has been previously intervened, but inadequately or incompletely and which continues present in the environment, constituting a risk for any of its components. In general, the environmental liability is associated with a source of pollution and tends to increase over time.

ENVIRONMENTAL PERMIT: It is the Administrative Authorization issued by the competent Environmental Authority, which demonstrates compliance with the environmental regularization process of a project, work or activity and for this reason the promoter is legally and regulatory empowered to carry out its activity, but subject to compliance with the applicable Environmental Regulations, conditions approved in the environmental study and those established by the competent Environmental Authority.

PERSON: Shall mean any (i) natural person (ii) legal entity or association, including, without limitation, any company, company, partnership, "joint venture", voluntary association , bank "trust" or partnership (iii) government (including any body, or institution that is a political or administrative subdivision of it).

PORT: It is the set of works and facilities that are within the port area, its accesses and its area of influence that constitute a set of facilities on the coast or riverbank, and whose purpose is the reception, shelter, attention, operation and dispatch of ships and naval artifacts, as well as the reception, operation, storage, treatment; mobilization and dispatch of national and foreign goods that arrive there by land or sea.

SOIL PROFILE: Vertical section of the terrain that allows studying the soil as a whole from its surface to the underlying material.

ENVIRONMENTAL MANAGEMENT PLAN : Document that establishes in detail and in chronological order the actions that are required to be carried out to prevent, mitigate, control, correct and compensate the possible negative environmental impacts or accentuate the positive impacts caused in the development of a proposed action. In general, the Environmental Management Plan consists of several sub-plans, depending on the characteristics of the activity or project.

SAMPLING POINT: extraction site for taking water samples.

CRITICAL AFFECTION POINTS (PCA): Sites or places near a FFR, occupied by sensitive receptors (humans, fauna, etc.) that require conditions of tranquility and serenity.

RECEPTION: It will mean the expedition, verification, execution of the cargo tariff, control of the documents that record the collection of the cargo or container, including its administration and management, the control of the packaging in the case of general cargo and the preparation of the EQUIPMENT INTERCHANGE RECEIPT (EIR), control of seals and container status in the case of containerized cargo, and all the resources and activities necessary for the presentation of such services. As well as the issuance of the pertinent documentation that establishes the conditions of reception of the cargo or container.

PORT ENCLOSURE: Set of terrestrial and aquatic spaces, whose delimitation corresponds to the CNMMP, in which the infrastructures, facilities and facilities of the port are located, including the external areas determined for the docking and turning access maneuvers.

WASTE / RESIDUE COLLECTION: Action of collecting and / or collecting waste / residues to the equipment destined to transport it to storage facilities, disposal or final disposal sites.

NATURAL RESOURCES: It refers to the biotic (flora, fauna) or abiotic (water, air or soil) resource.

ENVIRONMENTAL REGISTRATION: It is the mandatory environmental permit granted by the Competent Environmental Authority, in which it is certified that the developer1 · has complied with the regularization process of its project, work or activity.

ENVIRONMENTAL REGULARIZATION: It is the process by which the promoter of a project, work or activity, presents to the Environmental Authority the systematized information that allows officializing the socio-environmental impacts that its project, work or activity generates, and seeks to define the actions of management of these impacts under the parameters established in the applicable environmental legislation.

SANITARY LANDFILL: It is an engineering technique for the adequate confinement of waste and / or solid waste; It consists of placing them in cells duly equipped for this and in an area of the

smallest possible size, without causing damage to the environment, especially due to contamination to bodies of water, soil, atmosphere and without causing annoyance or danger to public health and safety. It comprises the spreading, accommodation and compaction of wastes and / or residues, reducing their volume to the applicable minimum, and then covering them with a layer of earth or other inert material, at least daily and controlling the gases, leachates and the vector proliferation.

ENVIRONMENTAL REMEDIATION: Set of measures and actions that is applied in a determined area to reverse the environmental effects caused by pollution as a result of the development of activities, works or economic or productive projects. The biopiling the land-farming and laboratory processes are examples of methods of remediation.

RECYCLING: Process by which, after a selective separation and classification of solid waste, hazardous and special waste , they are used, transformed and returned to the materials their potential for reincorporation as energy or raw material for the manufacture of new products. Recycling can consist of several stages such as clean technology processes, industrial reconversion, separation, selective collection, collection, reuse, transformation and commercialization.

SOIL RESOURCE: continental and island lands suitable for agriculture, livestock, forestation of natural reserves, protected areas, human settlements, among others.

SAFETY LANDFILL: Engineering work designed, built and operated to confine hazardous waste to the ground. It consists of one or more cells for final disposal and a set of infrastructure elements for the reception and conditioning of waste, as well as for the control of entry and evaluation of its operation.

RESTORATION (Comprehensive): It is a right of nature by means of which, when it has been affected by a negative environmental impact or damage, it must be returned to the conditions determined by the environmental authority that ensure the reestablishment of balances, cycles and natural functions. It also implies the return to dignified conditions and quality of life of a person or group of people, community or town, affected by a negative environmental impact or damage.

REUSE: Action to take advantage of a waste, without previous treatment.

RISK: Function of the probability of occurrence of an event and the amount of damage it can cause

ENVIRONMENTAL RISK: It is the potential danger of affecting the environment, ecosystems, the population and / or their assets, derived from the probability of occurrence and severity of damage caused by accidents or extraordinary events associated with the implementation and execution of a project, work or activity.

MAIN ROLES OF THE TERRITORIAL LEVELS: The main roles of the territorial levels , in relation to the National Decentralized System of Environmental Management (SNDGA), are those provided for in the Environmental Management Law , in the Organic Code of Territorial Organization, Autonomy and Decentralization (COOTAD), and what is determined by the National System of Competences, in accordance with current regulations.

SPECIFIC NOISE: It is the noise generated and emitted by an FFR or an FMR. It is the one that is quantified and evaluated for the purposes of compliance with the maximum noise emission

levels established in this standard through the LKeq (Corrected Equivalent Continuous Sound Pressure Level).

RESIDUAL NOISE: It is the noise that exists in the environment where the measurement is carried out in the absence of the specific noise at the time of measurement.

TOTAL NOISE: It is that noise composed-0 by the specific noise and the residual noise .

IMPULSIVE NOISE: Noise characterized by short, large increases in sound pressure. The duration of an impulsive noise is generally less than 1s.

SYSTEM NATIONAL DECENTRALIZED OF MANAGEMENT ENVIRONMENTAL (SNDGA): It is the system that allows joint institutions of the State Environmental competition by the guidelines set by the Environmental Authority National as governing body, coordinating and regulating environmental management at national level; This system constitutes the mechanism for cross-sectoral coordination, integration and cooperation between the different areas of environmental management and natural resource management.

SINGLE ENVIRONMENTAL MANAGEMENT SYSTEM (SUMA): It is the set
of principles, norms, procedures and mechanisms oriented to the planning, programming, control, administration and execution of the environmental impact assessment, environmental risk assessment, environmental management plans, risk management plans, monitoring systems, contingency plans and mitigation, environmental audits and abandonment plans, within the environmental regularization, control and monitoring mechanisms, which must be applied by the National Environmental Authority and accredited bodies.

SERVICES: Set of activities assumed and provided by the Concessionaire by delegation of APG under the conditions established for this purpose in the contract. These correspond to Basic Services and Special Services.

SOIL: Surface layer of the earth's crust, located above the rocky substrate, made up of mineral particles, organic matter , water, air and living organisms, which fulfills both natural and use functions.

SUBJECT OF CONTROL: Any natural or legal person, public or private, national or foreign, or organization that on its own account or through third parties, carries out in the national territory and regularly or accidentally, an economic or professional activity that has the potential to affect the quality of natural resources as a result of their actions or omissions or that, by virtue of any title, controls said activity or
have a determining economic power over its technical performance. For its determination, what the state or municipal legislation provides for each activity on the holders of permits or authorizations, licenses or other administrative authorizations will be taken into account.

RESIDENTIAL LAND: Land, where the primary activity is the occupation of land for residential purposes and for recreational activities, wilderness areas are not considered within this definition , such is the case of national or provincial parks.

COMMERCIAL LAND: Land, where the primary activity is related to commercial and service operations, for example, shopping centers, and its occupation is not for residential or industrial purposes.

INDUSTRIAL LAND: Land where the main activity includes the elaboration, transformation or construction of various products.

CONTAMINATED SOIL: Anyone whose natural physical , chemical and biological characteristics have been altered due to anthropogenic activities and represents a risk to human health or the environment.

TERMINALS: TERMINALS OF CONTAINERS and MULTIPURPOSE or TCM: S ignificara the Concession Area, along with infrastructure, equipment and other assets identified in Paragraph four of the Project Investment and Management as Concession Area. For the purposes of the Contract, the Container and Multipurpose Terminals are considered an independent operating unit.

TEU: Shall mean the unit equivalent to a twenty (20) foot long container.

TCLP: (Toxicity Characteristic leaching procedure) Leaching extraction methodology in soil samples.

TEUS: It will mean the total number of containers, measured in TEU, object of the transfer of Cargo.

SOIL TEXTURE: The relative proportion by particle size of sand, silt and clay. The texture has to do with the ease with which the soil can be worked, the amount of water and air it retains and the speed with which the water penetrates the soil and passes through it.

TIME OF OCCUPATION: With respect to any ship, it will mean the period in which such ship remains in YPH, which begins at the moment in which such ship moorings its first spy when docking at YPH and ends when the ship releases its last spy to the YPH undocking moment.

MAXIMUM OCCUPATION TIME: It will mean, with respect to any vessel that receives Cargo Transfer services at YPH, the Maximum Occupancy Time with respect to such vessel, calculated in accordance with the formula established in the Indicators Verification Manual.

COMMERCIAL OPERATIONS START TIME: Time
The start of commercial operations will be computed from the moment the Ship already moored to the dock has all the necessary authorizations, including the authorization of the Captain of the ship and the Shipowner, directly or through their agents.

• DOCKING TIME: The undocking time will be computed from the end of the commercial operations of the ship including the necessary authorizations and available resources of the Terminal for the respective undocking, including the authorization of the Captain of the ship and the Shipowner, directly or through of its agents.

DELIVERY TIME OF GENERAL CARGO AND SOLID BULK CARGO TO VEHICLE: The undocking time will be computed from the date and time that the transport vehicle enters the reception and delivery area, complying with all the requirements of the Puerto Bolívar Port Terminal and the authorities involved and the date and time when the goods were received / delivered to / from the terminal of / to the vehicle.

CARGO REMOVAL ATTENTION TIME: The service time for cargo removal requests will mean the period of time elapsed between the first working moment available for the Delegated Manager

and from the confirmation of receipt by the Delegated Manager (by his system of management) and until the effective delivery to the transport element that picks it up.

TIME OF RECEPTION OF CONTAINERS: For these purposes, the Time of receipt of Containers will be computed as the period that elapses between the date and time that the container enters the transport vehicle to the reception and delivery area and the date and time in where the container is removed from the vehicle by means of the terminal.

CONTAINER DELIVERY TIME: For these purposes, the Container Delivery Time will mean the period that elapses between the date and time the transport vehicle is entered at the reception and delivery one, and the date and time the container is delivered on the vehicle by means of the terminal.

TIME OF ATTENTION OF CARGO WITHDRAWAL REQUEST (CONTAINER): The time of attention of requests for removal of the drop will mean the period of time elapsed between the first working moment available for the Delegated Manager and from the confirmation of receipt by the Manager Delegate (by its management system) and until the effective delivery to the transport element that withdraws it.

TON: It will mean one metric ton.

TONNAGE: It will mean the total weight in Tons, object of the Load Transfer. Tons of Record or Tonnage of one hundred cubic feet, of all the interior spaces of the ship, ship, naval artifact, including all the spaces below the tonnage deck and the permanently enclosed spaces on said deck.

TRANSSHIPMENT: This is considered the operation of disembarking and loading goods that arrive at the port and leave it by sea, without leaving the port area. It is considered the operation of direct transfer cargo from one ship to another.

CARGO TRANSFER or "Ship to gate": It will mean all the activities of Loading or Unloading; Trinca or Destrinca; Boarding or disembarking; Portage; Loading or unloading to means of land transportation; Reception and Dispatch, execution of the cargo tariff, control of seals and will include all the resources and activities necessary for the provision of said services; it being understood that in the case of storage, these services will include only the days free of fee collection, as stipulated for shipment (export) or for disembarkation (import). Understanding, furthermore, that in the case of containers that receive deconsolidation or consolidation (a) the dispatch included in this service will only be for the empty deconsolidation container and will not include the dispatch of the cargo contained and (b) that the reception included in This service will only be for the empty consolidation container and will not include the reception of the general cargo contained therein.

TRINCA ABOARD: Means ra securing cargo or container ship, and will include all necessary resources and activities according to international industry standards should be provided for the provision of such service.

INDUSTRIAL USE OF THE LAND: The one whose essential purpose is to serve for the development of industrial activities, excluding agricultural and livestock.

RESIDENTIAL USE OF THE LAND: One whose essential purpose is the construction of houses including green areas and spaces for recreation and leisure activities.

COMMERCIAL USE OF THE LAND: The one whose purpose is the development of activities related to commercial operations and services.

AGRICULTURAL USE OF THE LAND: Those that, without being urban or industrial, are used for the development of agricultural, forestry and livestock activities.

US EPA: United States Environmental Protection Agency.

BASELINE VALUES: Parameters or indicators that quantitatively or qualitatively represent the baseline conditions.

BOTTOM VALUES: Parameters or indicators that quantitatively or qualitatively represent the bottom line conditions.

CLIMATE VARIABILITY: Average state and other statistical data (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond specific meteorological phenomena. The variability may be due to natural internal processes within the climate system -internal variability-, or to variations that respond to anthropogenic actions - external variability.

DEPARTURE OF THE DOCK: It is the moment in which a ship during the undocking maneuver from the dock releases its last mooring strip.

TERMINAL CUT OFF: It is the date and time that the terminal stipulates for a ship, in which all its cargo for shipment must be physically inside, ready, documented and authorized for shipment. The Cut Off Terminal is different from the Cut Off established by shipping lines or services.

RESOLUTION MAE-DPAEO – 2017- 009

Eng. Reinaldo Daniel Sánchez Cevallos

Provincial Director of the Environment of El Oro

MINISTRY OF THE ENVIRONMENT

Whereas:

Article 14 of the Constitution of the Republic of Ecuador recognizes the right of the people to live in a healthy and ecologically balanced environment that guarantees sustainability and good living, sumak kawsay, and declares the preservation of the environment, the conservation of ecosystems, the prevention of environmental damage, and the recovery of degraded natural spaces to be of public interest;

Paragraph 27 of Article 66 of the Constitution of the Republic of Ecuador recognizes and guarantees people the right to live a healthy and ecologically balanced environment, free of contamination, and in harmony with nature;

Paragraph 4 of Article 276 of the Constitution of the Republic of Ecuador indicates that the development regime shall include, among others, the objective of recovering and preserving of nature, and maintaining a healthy and sustainable environment that guarantees people and communities equitable, permanent, and quality access to water, air, and soil, and to the benefits of subsoil resources and the natural heritage;

Article 19 of the Environmental Management Law states that public, private, or mixed works, and public or private investment projects that may cause environmental impacts must be qualified by decentralized control agencies, prior to their execution, in accordance with the Single Environmental Management System, whose guiding principle shall be precautionary;

Article 20 of the Environmental Management Law indicates that the environmental permit granted by the Ministry of the Environment must be obtained to start any activity involving environmental risk;

Article 28 of the Environmental Management Law establishes that every natural or legal person has the right to participate in environmental management through social participation mechanisms, which shall include consultations, public hearings, initiatives, proposals, or any other form of partnership between the public and private sectors;

Article 29 of the Environmental Management Law indicates that every natural or legal person has the right to be informed of any State institution activities that can produce environmental impacts;

Article 1 of Executive Decree No. 849, published in Official Record No. 522 of

August 29, 2011 states that the Minister of the Environment, given that it is an issue under his/her jurisdiction, shall issue the pertinent rules, by means of Ministerial Agreements, to replace the Unified Text of the Secondary Legislation of the Ministry of the Environment, published in special edition No. 2 of the Official Record of March 31, 2003;

Ministerial Agreement No. 134, published in the Supplement of Official Record No. 812 of October 18, 2012, issues the amendment to Ministerial Agreement No. 076, published in the Official Record of Second Supplement No. 766 of August 14, 2012, whereby the amendment to Article 96 of Book III and Article 17 of Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment is issued, which published by Executive Decree No. 3516 of Official Registry special edition No. 2 of March 31, 203; Ministerial Agreement No. 041, published in the Supplement of Official Record No. 164 of April 5, 2010, which adds the Forest Resources Inventory as a chapter of the Environmental Impact Study;

Article 14 of Ministerial Agreement No. 061 of April 7, 2015, published in the special edition of Official Record No. 316, which amends Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment, establishes that the projects, works, or activities included in the catalog issued by the National Environmental Authority shall be regularized through the SUIA (Single Environmental Information System), which shall automatically determine the type of environmental permit, which may be: Environmental Registration or Environmental Permit;

Article 25 of Ministerial Agreement No. 061 of April 7, 2015, published in the special edition of Official Record No. 316, which amends Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment, establishes that the Environmental Permit is granted by the competent Environmental Authority via the SUIA, which is mandatory for the projects, works, or activities considered to be of medium or high environmental impact and risk. The subject of control shall comply with the obligations arising from the granted environmental permit;

By means of Ministerial Agreement No. 268 of August 29, 2014, the responsibility of issuing and signing Environmental Permits is delegated to the Provincial Directors;

In accordance with Article 44 of Ministerial Agreement 061, published in the special edition of Official Record No. 316 Year II - N270, dated May 04, 2015, which reforms Book VI of the Unified Text of the Secondary Environmental Legislation of the Ministry of the Environment (TULAS), **Regarding social participation.-** It is governed by the principles of legitimacy and representativeness, and it is defined as an effort of State institutions, citizens, and the subject of control interested in carrying out a project, work or activity. The Competent Environmental Authority shall inform the population of the possible implementation of activities and/or projects, as well as the expected socio-environmental impacts and the relevance of the actions to be taken, in order to collect their opinions and observations, and incorporate the ones that are technically and economically feasible into the Environmental Studies. The social participation process is mandatory to obtain the environmental permit;

On April 19, 2017, the Legal Representative of YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A. registers the project "DREDGING OF PIERS 1, 2, 3, 4, 5, and 6, THE MANEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, in the Single Environmental Information System;

On April 19, 2017, the Legal Representative of YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A., enters the location coordinates in the Single Environmental Information System and requests the issuance of the Certificate of Intersection with the National System of Protected Areas (SNAP), Protection Forests and Vegetation (BVP), and the State Forest Heritage (PFE) for the Ex Ante Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar;

By Official Letter No. MAE-SUIA-RA-DPAEO-2017-207553 of Thursday, April 20, 2017, the National Directorate for the Prevention of Environmental Pollution of the Ministry of the Environment grants the Certificate of Intersection for the project: "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, indicating that said project DOES NOT INTERSECT with the National System of Protected Areas (SNAP), Protection Forests and Vegetation (BVP), and the State Forest Heritage (PFE), whose coordinates are as follows:

Set of coordinates 1 (Polygon)

Shape	X	Y
1	610956	9639311
2	610478	9639203
3	609957	9639327
4	610347	9639925
5	610216	9640713
6	609917	9642098
7	609498	9644527
8	608686	9646508
9	609189	9647676
10	605878	9648244
11	605974	9648726
12	608511	9648113

13	609175	9646587
14	609970	9644652
15	610433	9642109
16	610654	9640792
17	611014	9640712
18	610931	9639816
19	611233	9639806
20	611697	9640103
21	611804	9640152
22	611854	9640142
23	611923	9640297
24	611766	9640387
25	611866	9640633
26	612023	9640556
27	612171	9640506
28	612139	9640341
29	612088	9640197
30	612036	9640065
31	611852	9640125
32	611804	9640149
33	611699	9640100
34	611234	9639805
35	610931	9639814
36	610956	9639311

Set of coordinates 2 (Polygon)

Shape	**X**	**Y**
1	583533	9649248
2	583880	9651278
3	585837	9651184
4	585560	9649187
5	583544	9649248

The Legal Representative of YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A. downloads the Terms of Reference from the Single Environmental Information System on April 20, 2017 to prepare the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974;

The Legal Representative of YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A. enters the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, in the Single Environmental Information System on May 20, 2017 for the corresponding analysis, revision, and resolution;

The Coordination Minutes of the Social Participation Process of the Project: "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, was signed on May 24, 2017, in compliance with the social participation process, by following the indicated steps: Publication on the web pages, http://maeeloro.wordpress.com, http://www.yilport.com, and http://www.ecosferaconsultora.com; publication in Oral Press, Radio Gaviota 105.1 FM, on May 31, and June 01 and 02, 2017; publication in Written Press, Diario El Correo, on June 03, 04, 06, 2017; posting tender signboards from June 02 to 12, 2017 at the Puerto Bolívar Port Authority, the Puerto Bolívar Communal House, the Puerto Bolívar Health Center, the Puerto Bolívar Captaincy, and the Puerto Bolívar Cabotage Pier; hand-delivered invitations on June 02, 03, and 05, 2017; and Informational Meeting on June 07, 2017, starting at 11:20 am, at the Auditorium of the Puerto Bolívar Port Authority, with an attendance of 89 people;

By means of Memorandum No. MAE-UPNEO-DPAEO-20171-108-M of July 07, 2017, based on Technical Report No. 2017-077-OTZ, the Natural Heritage Unit of this Provincial Directorate of the Environment makes observations on the environmental baseline and biotic component of the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974;

By means of Official Letter No. MAE-DPAEO-001993-2017 of July 07, 2017, this State agency notified the observations made to the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar,

with Code No. MAE-RA-2017-297974, based on Statement No. 12503 issued by the Natural Heritage Unit, and Technical Report No. 006661-DPAEO-2017, requesting the legal representative to solve the observations made, as they DID NOT COMPLY with the provisions of current environmental regulations;

On September 18, 2017, the legal representative of the project enters the updates of the observations made to the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, in the Single Environmental Information System for analysis and review, in response to Official Letter No. MAE-DPAEO-001993-2017;

By means of Memorandum No. MAE-UPNEO-DPAEO-2017-1570-M of September 25, 2017, and Memorandum No. MAE.UPNEO-DPAEO-2017-1603-M of September 29, 2017, based on Technical Report No. 140-2017-OTZ, the Natural Heritage Unit of this Provincial Directorate of the Environment made observations on the environmental baseline and biotic component presented in the first scope of the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar;

By means of Memorandum No. MAE-UCAEO-DPAEO-2017-1041-M of October 26, 2017, the Environmental Quality Unit of this Provincial Directorate submits the consolidated report related to the preliminary review of the first scope of the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, recommending that it be sent to the Natural Heritage Unit to review and validate the observations regarding the biotic component, prior to issuing the official resolution;

By means of Memorandum No. MAE-UPNEO-DPAEO-2017-1792-M of October 26, 2017, the Natural Heritage Unit of this Provincial Directorate, informs that they have reviewed the consolidated report related to the preliminary review of the first scope of the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, issued by the Environmental Quality Unit by means of Memorandum No. MAE-UCAEO-DPAEO-2017-1041-M of October 26, 2017, indicating that the observations made in Technical Report No. 140-OTZ-2017, sent with Memorandum No. MAE.UPNEO-DPAEO- 2017-1603-M of September 29, 2017, have been included and considered;

By means of Official Letter No. MAE-DPAEO-002275-2017 of October 26, 2017, based of Resolution No. 12503 issued by the Natural Heritage Unit and

Technical Report No. 007598-DPAEO-2017 of October 26, 2017, the observations made to the first scope of the Ex Ante Environmental Impact Study of the Project: "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, have been notified to the Legal Representative, requesting him to solve the respective observations, as they DID NOT COMPLY with the provisions set forth in current environmental regulations;

On October 27, 2017, the Legal Representative of the project enters the second scope of the Ex Ante Environmental Impact Study of the Project: "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, in the Single Environmental Information System for analysis and review, in response to Official Letter No. MAE-DPAEO-002275-2017 of October 26, 2017;

By means of Memorandum No. MAE-UPNEO-DPAEO-2017-1899-M of November 13, 2017, based on Memorandum No. MAE-UPNEO-DPAEO-2017-1880-M and Technical Report No. 2017-169- OTZ of the Natural Heritage Unit of this Provincial Directorate, a FAVORABLE resolution is issued, after reviewing and validating the observations related to the baseline in its biotic component and the Ex Ante evaluation of environmental impacts of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, and determining the compliance therewith and recommending the continuation of the environmental regularization process;

By means of Official Letter No. MAE-DPAEO-000524-2017 of November 16, 2017, based on Technical Report No. 2017-169-OTZ of November 9, 2017, issued by the Natural Heritage Unit of the Provincial Directorate of the Environment of El Oro; and consolidated Technical Report No. 007857-DPAEO-2017 of November 16, 2017, prepared by the Environmental Quality Unit, the project in question is found to be IN COMPLIANCE with the technical and legal provisions set forth in the Applicable Environmental Regulations, reason for which this State agency issues a Favorable Resolution for the the Ex Ante Environmental Impact Study of the Project: "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974. In order to proceed with the issuance of the Environmental Permit, the following was requested:

1.- Performance bond or policy for the Environmental Management Plan, equivalent to 100% of the total cost thereof, with its respective support.
2.- Transfer into checking account No. 3001174975, subline: 370102 at BanEcuador for the payment of the environmental management and quality administrative services provided by this State agency, in accordance with Ministerial Agreement No. 083-B, published in Official Record No. 387 of November 4,

2015, with the values specified below:

(EX ANTE STUDIES)
0.001 of the total cost of the project (minimum USD 1000). The costs shall be based on the construction contract or sworn statement of the total amount to be invested in the project.

(EX POST STUDIES - Update to the Environmental Impact Study)
0.001 of the cost of the last operating year (Minimum 1000 USD). The costs shall be based on SRI form 101 Section 799 of the last fiscal year.

(Audit for licensing purposes)
0.001 of the cost of the last operating year (Minimum 1000 USD). The costs shall be based on SRI form 101 Section 799 of the last fiscal year.

Scopes, Reassessments, and Updates of the PMA (Environmental Management Plan) for Licensing Purposes
0.001 of the total cost of the project (minimum USD 1000). The costs shall be based on the documentation that legally proves the amount to be invested. Payment for Monitoring and Control (PSC, as per its Spanish acronym) upon compliance with the Environmental Management Plan.

DESCRIPTION	BASIS FOR CALCULATION
Control and Monitoring (PSC) payment	PCS = PID * Nt * Nd
Daily inspection (PID) payment	80 USD
Number of technicians for monitoring and control (Nt)	4
Number of days for the technical visit (Nd)	3
VALUE	960,00 USD

On December 1, 2017, by means of the Single Environmental Information System, in response to Official Letter No. MAE-DPAEO-000524-2017 of November 16, 2017, the legal representative of the project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, submits the following documents to this State agency:

- Performance Bond for the Ex Ante Environmental Management Plan of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, in the amount of $ 214,830.00;
- Bank Transfer, using the SPI, of $ 960.00, for Control and Monitoring, and $ 26,438.00, corresponding to 0.001 of the total cost of the project.

On December 12, 2017, the Legal Representative of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, enters the supporting documents (Sworn Statement) of the total amount to be invested in the project, as complementary information to the documentation entered on December 1, 2017, using the Single Environmental Information System, in response to Official Letter No. MAE-DPAEO-000524-2017 of November 16, 2017.

For the reasons set out above, and in use of the powers established in Paragraph 1 of Article 154 of the Constitution of the Republic of Ecuador, in accordance with Article 17 of the Statute of the Administrative Legal Regime of the Executive Function and Ministerial Agreement No. 025 of 15 March, 2012, whereby THE CODIFICATION OF THE ORGANIC STATUTE FOR ORGANIZATIONAL MANAGEMENT BY PROCESSES OF THE MINISTRY OF THE ENVIRONMENT is issued, in accordance with the the issuance and signing of Environmental Permits delegated by the Minister of the Environment to the Provincial Directors by means of Ministerial Agreement No. 268 of August 29, 2014;

HEREBY RESOLVES:

Art. 1. Approve the Ex Ante Environmental Impact Study of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974; based on Technical Report No. 2017-169-OTZ of November 9, 2017, issued by the Natural Heritage Unit of the Provincial Directorate of the Environment of El Oro; and consolidated Technical Report No. 007857-DPAEO-2017 of November 16, 2017, prepared by the Environmental Quality Unit, and based on the coordinates indicated in the Certificate of Intersection issued by Official Letter No. MAE-SUIA-RA-DPAEO-2017-207553 of April 20, 2017, by the National Directorate for the Prevention of Environmental Pollution of the Ministry of the Environment, for the CONSTRUCTION AND/OR OPERATION OF DREDGING WORKS IN RIVER AND/OR SEA SOURCES.

Art. 2. Grant the Environmental Permit to the Legal Representative of YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A. for the execution of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974.

Art. 3. The qualifying documents submitted to reinforce the environmental

impact evaluation of the project shall become an integral part of the Environmental Impact Study and the Ex Ante Environmental Management Plan of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974, which shall be strictly complied with, otherwise the Environmental Permit shall be suspended or revoked, as established in Articles 281 and 282 of Ministerial Agreement No. 061, published in the special edition of Official Record No. 316, of Monday, May 04, 2015, which reforms Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment.

Duly notify this Resolution to the legal representative of YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A., owner of the Ex Ante Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974.

This Provincial Directorate of the Environment of El Oro shall be responsible for controlling and monitoring the compliance with this Resolution.

Duly notify and publish the foregoing,

Issued in Machala on December 19, 2017.

Space for signature

Eng. Reinaldo Daniel Sánchez Cevallos,

Provincial Director of the Environment of El Oro

Area	**Supervisor**	**Signature**
DIC.	Reinaldo Sánchez Cevallos	
UCA	Claudia Bustamante Silva	
UCA	José Guerrero Ayala	
UPNEO	Mayra Estrella Costa	
UPNEO	Margarita León Suquilanda	
UAJ	Marco Yaguachi Mendoza	
UAJ	Carina Becerra Robles	

ENVIRONMENTAL PERMIT FOR THE EXECUTION OF THE EX Ante PROJECT "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974.

The Ministry of the Environment, in its capacity as National Environmental Authority, and in compliance with the responsibilities set forth in the Constitution of the Republic of Ecuador and the Environmental Management Law of protecting the public interest in preserving the environment, preventing environmental pollution, and guaranteeing sustainable development, hereby confers this Environmental Permit to YILPORT TERMINAL OPERATIONS (YILPORTECU) S.A., hand-delivered to its Legal Representative, so that they continue with the execution of the Project, in the established terms, in accordance with the Environmental Study and the Ex-Ante Environmental Management Plan of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974.

By virtue of the foregoing, the company agrees to the following:

1. Strictly comply with the provisions set forth in the Ex-Ante Environmental Study and Environmental Management Plan of the Project "DREDGING OF PIERS 1, 2, 3, 4, 5, AND 6, THE MANNEUVERING AREA, AND THE ACCESS CANAL OF PUERTO BOLÍVAR," located in the Province of El Oro, canton of Santa Rosa, parish of Jambelí, canton of Machala, parish of Puerto Bolivar, with Code No. MAE-RA-2017-297974.
2. Maintain a continuous program for the environmental monitoring and follow-up of the measures established in the Environmental Management Plan, whose results must be provided to the Ministry of the Environment in a timely and frequent manner, as established therein.
3. In the execution of the Project, use processes and activities, technologies and methods that mitigate and, as far as possible, prevent negative impacts on the environment.
4. Be entirely liable for the activities carried out by its contractors or subcontractors.
5. Submit Environmental Compliance Audits, in accordance with the provisions of Article 269 of Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment, issued by Ministerial Agreement No. 061 of April 7, 2015, published in the special edition of Official Record No. 316 of Monday, May 04, 2015.
6. Strictly comply with the provisions of Section II of Chapter VI of Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment, issued by Ministerial Agreement No. 061 of April 7, 2015, published in the special edition of Official Record No. 316 of Monday, May 04, 2015, for the management of hazardous and / or special waste.

7. Obtain the registration of hazardous chemicals, and hazardous and special waste under the procedures established by the Ministry of the Environment, in accordance with Art. 88, Paragraph b), and in relation to the Fourth Transitory Provision of Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment, issued by Ministerial Agreement No. 061 of April 7, 2015, published in the special edition of Official Record No. 316, of Monday, May 4, 2015.
8. Fully assist the technical personnel of the Ministry of the Environment in carrying out the monitoring, control, follow-up, and compliance processes of the approved Environmental Management Plan, during the execution of the Project, which is the subject for the granting of this permit.
9. Subject to the duration of the project, make the payments related to Administrative Environmental Management and Quality Services for monitoring and controlling the compliance with the approved Environmental Management Plan, as established in Ministerial Agreement No. 083 B, published in the Official Record No. 387 of November 4, 2015.
10. Comply with Art. 38 of Book VI of the Unified Text of the Secondary Legislation of the Ministry of the Environment, issued by Ministerial Agreement No. 061 of April 07, 2015, published in the special edition of Official Record No. 316, which establishes that "This performance bond or policy shall not be required when the executors of the project, work, or activity are public sector entities. However, the executing entity shall be administratively and civilly liable for the full and timely compliance with the Environmental Management Plan of the licensed project, work, or activity, as well as the contingencies that may cause environmental damages or damages to third parties, in accordance with the provisions set forth in applicable regulations."
11. Keep a valid performance bond during the lifespan of the project.
12. Comply with current national and local environmental regulations.

The term of validity of this Environmental Permit starts as of the date of its issuance until the end of execution of the project.

Failure to comply with the provisions and obligations set forth in the Environmental Permit shall lead to the suspension or revocation thereof, in accordance with the provisions of the governing legislation; the permit is granted at the cost and risk of the interested party, leaving the rights of third parties harmless.

This Environmental Permit is governed by the provisions of the Environmental Management Law and the standards of the Unified Text of the Secondary Legislation of the Ministry of the Environment, and by the Statute of the Administrative Legal Regime of the Executive Function.

The Provincial Directorate of the Environment of El Oro shall be responsible for controlling and monitoring compliance with this Resolution.

Duly notify the Legal Representative of this Resolution and publish it in the Official Record as it is of general interest.

The registration of the Environmental Permit is available in the National Registry of Environmental Records and Permits.

Duly notify and publish the foregoing,

Issued in Machala, on December 19, 2017.

Space for signature

Eng. Reinaldo Daniel Sánchez Cevallos,

Provincial Director of the Environment of El Oro

Area	**Supervisor**	**Signature**
DIC.	Reinaldo Sánchez Cevallos	
UCA	Claudia Bustamante Silva	
UCA	José Guerrero Ayala	
UPNEO	Mayra Estrella Costa	
UPNEO	Margarita León Suquilanda	
UAJ	Marco Yaguachi Mendoza	
UAJ	Carina Becerra Robles	

Guayaquil, 28 DE JULIO DEL 2017

DATOS DE MUESTREO

Fecha, Hora y lugar de Muestreo:	16/07/17 16:15 Altamar - Entre Isla Puna e Isla Sta. Clara
Fecha y Hora de Recepción:	17/07/17 14:15
Punto e Identificación de la Muestra:	Agua en Altamar.
Norma Técnica de muestreo:	N/A---
Matriz de la muestra:	AGUA NATURAL MAR
Muestreado por:	ECOSFERA CIA LTDA
Muestreador:	Cliente
Tipo de Muestreo:	Simple
Coordenadas Geográficas:	17M0585628 - 9651120---

Muestreo: Actividad Acreditada: Muestreo de Aguas naturales y residuales. Parámetros: Demanda Química de Oxigeno, Demanda Bioquimica de Oxigeno, Aceites y Grasas, Hidrocarburos totales de petróleo, Solidos totales y Solidos Suspendidos totales

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS ORGANICOS:					
Tensoactivos-Detergentes (3)	< 0.023	---	mg/l	PEE-GQM-FQ-21	20/07/17 JV
Aceites y Grasas (3)	< 0,44	---	mg/l	PEE-GQM-FQ-03	25/07/17 NS
Demanda Bioquimica de Oxigeno (3)	4,02	0,19	mgO2/l	PEE-GQM-FQ-05	17/07/17 CT
Demanda Quimica de Oxigeno	16,00	3,08	mgO2/l	PEE-GQM-FQ-04	20/07/17 CT
Hidrocarburos Totales de Petroleo (3)	< 0,04	---	mg/l	PEE-GQM-FQ-07	26/07/17 NS

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
MICROBIOLOGIA:					
Coliformes Fecales (1)	< 1	---	NMP/100ml	9222 D	17/07/17 GL

-----	No. Aplica	N.E.	No Efectuado	Método Analítico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Limite Máximo Permisible	
U	Incertidumbre	P.E.E.	Procedimiento especifico de ensayo de GQM	

1: Parámetros no incluidos en el alcance de acreditación ISO 17025 por el SAE.
2: Parámetros subcontratados no acreditados
3: Parámetros acreditados cuyos resultados están fuera del alcance de acreditación
4: Parámetros subcontratados acreditados por el laboratorio subcontratista, competencia evaluada - Cap. 5 MC; ver alcance en www.acreditacion.gob.ec

Q. F. FERNANDO MARCOS V.
Director Tecnico

Q.F. LAURA YANQUI M.
Coordinadora de calidad

Los resultados de este informe de ensayo solo son aplicables a las muestras analizadas.
Este informe de ensayo no deberá reproducirse más que en su totalidad, con autorización escrita de G.Q.M.
Las muestras serán retenidas por 7 días a partir de la fecha de entrega de resultados.

ECOSFERA CIA LTDA
Representante Legal: CORDERO ESPINOSA CLAUDIA MERCEDES
Avenida Bolivar y Colon - Machala
Machala , Tel. 0992909970
Atención: Ing. Harry Veintimilla
Tipo de Industria

Guayaquil, 28 DE JULIO DEL 2017

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Tipo de Muestreo:	Simple
Coordenadas Geográficas:	17M0585628 - 9651120---

GRUPO QUIMICO MARCOS Cia. Ltda.
LA AUSENCIA DE ESTE SELLO INVALIDA EL ORIGEN DEL INFORME DE RESULTADOS
MC2201-12

Muestreo: Actividad Acreditada: Muestreo de Aguas naturales y residuales. Parámetros: Demanda Química de Oxigeno, Demanda Bioquimica de Oxigeno, Aceites y Grasas, Hidrocarburos totales de petróleo, Solidos totales y Solidos Suspendidos totales

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
AGREGADOS/COMPONENTES FISICOS:					
Solidos Suspendidos Totales	56	7	mg/l	PEE-GQM-FQ-06	19/07/17 NS

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
INORGANICOS NO METALES:					
Oxigeno Disuelto	6,02	0,96	mgO2/l	PEE-GQM-FQ-37	17/07/17 CT
Amoniaco (3)	< 0,034	---	mg/l	PEE-GQM-FQ-31	19/07/17 LS

Parámetro	Resultado	U K=2	Unidades	Método Analítico	Analizado
METALES:					
Arsenico (3)	< 0,0031	---	mg/l	PEE-GQM-FQ-33	21/07/17 AUT
Cadmio (3)	< 0,0004	---	mg/l	PEE-GQM-FQ-33	21/07/17 AUT
Cromo total (3)	< 0,0024	---	mg/l	PEE-GQM-FQ-33	21/07/17 ER
Cobre (3)	< 0,0037	---	mg/l	PEE-GQM-FQ-33	21/07/17 ER
Hierro (3)	< 0,0047	---	mg/l	PEE-GQM-FQ-33	21/07/17 AUT
Mercurio (1)	< 0,00500	---	mg/l	ICP-OES	21/07/17 ER

-----	No. Aplica	N.E.	No Efectuado	Método Analitico: Standard Methods 2012, 22 th edition
< LD	Menor al Límite Detectable	L.M.P.	Límite Máximo Permisible	
U	Incertidumbre	P.E.E..	Procedimiento especifico de ensayo de GQM	

1: Parámetros no incluidos en el alcance de acreditación ISO 17025 por el SAE.
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Guayaquil, 28 DE JULIO DEL 2017

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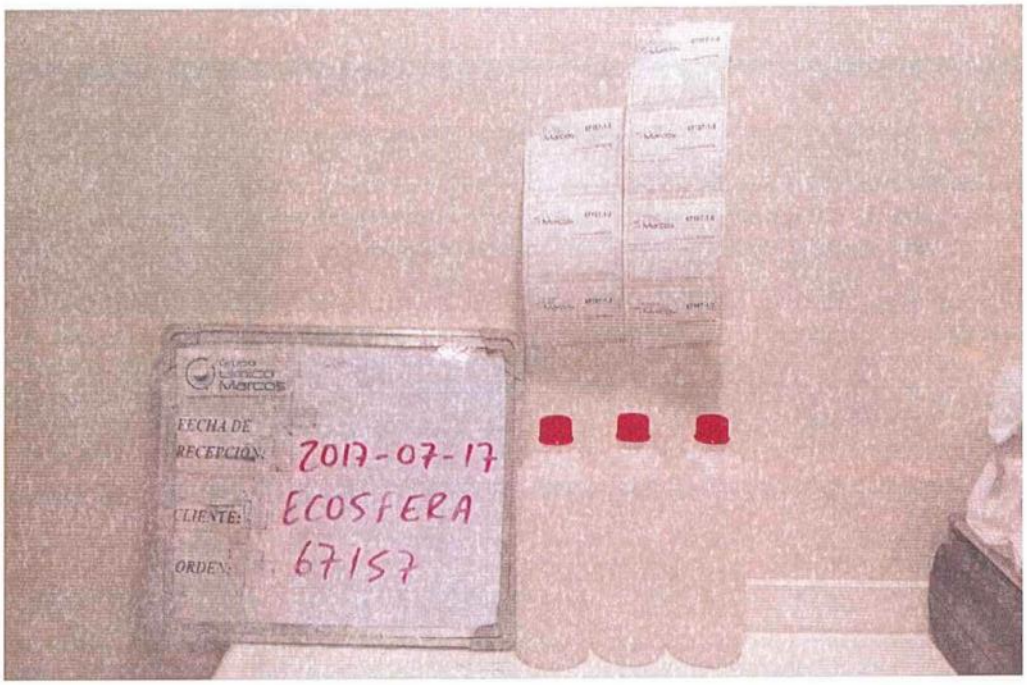
MEMORIA FOTOGRAFICA



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Director Tecnico

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Coordinadora de calidad