# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

# PUERTO BOLÍVAR PROJECT – PHASE 1

## – AREA OF INFLUENCE AND SENSITIVE AREAS –

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# AREA OF INFLUENCE AND SENSITIVE AREAS

## 1. Introduction

The areas of direct and indirect influence were defined in order to obtain a comprehensive view of the project emplacement area, as were the areas of sensitivity for each of the environmental components analyzed in this study. This made it possible to identify environmental and social impacts and risks properly. Thus we can comply with the provisions of the Performance Standards (PS) administered by the IFC and to provisions of PS1, which indicates that the area of influence includes cumulative impacts or result of incremental impact on the areas or resources used or affected by the activity.

This transcends the traditional concept of the “area of direct influence” and emphasizes the need to analyze indirect and cumulative effects as well as the need to expand the geographic limits in assessing the impact and/or the time framework used for the analysis.

## 2. Area of Influence

According to Canter *et al*. (1998), the area of influence is “*The space where possible environmental and social impacts occur that are due to a project’s implementation*”; however, the scope of the area of influence concept may be significantly relative.

The area of influence is the fraction of the environment that interacts with project facilities and activities (resources, raw materials, labor, space) and their output (waste, emissions and jobs). The simple decision of establishing a circle of influence within a more or less broad radius around the unit being studied has no validity (Conesa, 1995), so methodological criteria established by the National Environmental Authority are used as described below.

The basic criterion to identify project areas of influence will be to recognize environmental components and the socioeconomic medium directly and indirectly affected by the activities developed as part of the project in all stages. In this respect, we must take into account that the environmental related to the project includes the physical environment (soil, water and air components) where it exists and where biodiversity develops (flora and fauna components) as well as the socioeconomic medium with their cultural manifestations.

## 2.1. Area of Influence Methodology

The Technical Guide for Defining Areas of influence prepared by the Undersecretary of Environmental Quality (2015) was considered in determining the area of influence along with the Terms of Reference issued by SUIA (Spanish acronym: Single Environmental Information System) for this project. These methodologies take into account each of the physical, biotic and social components for analysis and definition of the areas of influence and establish methodological criteria for each.

It is important to indicate that the exact determination of the extent of impacts is a complex technical process to undertake; therefore, the area of influence will be divided into area of direct influence and area of indirect influence in order to understand it.

Thus, the following environmental components and criteria will be analyzed to delimit the areas of direct and indirect influence based on the distinctive features of the Project using the methodology indicated:

*Table 1: Areas of Direct Influence Selection Criteria*

| ***COMPONENT*** | ***AREA OF DIRECT INFLUENCE (AID)*** |
|---|---|
| *Physical: Geology, geomorphology soil quality* | Methodology to be defined by the environmental consultant based on the areas that could be directly affected by project activities |
| *Physical: Noise and Vibrations* | Criteria for the methodology to be used by the environmental consultant to define the AID of this component may consider direct receptors and receptors sensitive to noise and vibration emissions generated by the project works and activities. |
| *Physical: Hydrology and Water quality* | Criteria for the methodology to be used by the environmental consultant to define the AID of this component may consider the basin / sub-basin / micro-basin, or hydrographic unit, water body or bodies present, flow, self-purification, consumption and non-consumption use of water, and downstream sensitive receptors, among others. |
| *Biotic: Flora and vegetation* | The following flora and vegetation criteria should be added to the methodology to be used by the environmental consultant to define the AID:<br>• Boundaries of natural vegetation areas, protected areas, protective forests and vegetation, Statutory Forestry Heritage, conservation areas (forest partner or others), with an emphasis on native or primary forests and secondary forests in recovery, as the case may be<br>• Physiographic aspects of terrain like brooks, flood zones, paramo (moorland), mangroves, high summit lines, plains, slopes, slope exposure, etc. |
| *Biotic: Fauna* | The following fauna criteria should be added to the methodology to be used by the environmental consultant to define the AID: |

| *COMPONENT* | *AREA OF DIRECT INFLUENCE (AID)* |
|---|---|
| | • Boundaries of natural, medium- and high-sensitivity vegetation areas<br>• Boundaries of protected areas (Heritage of Natural Areas of the State).<br>• Medium- or high-sensitivity areas in protective forests and vegetation with an emphasis on native or primary forests and secondary forests in recovery, as the case may be<br>• Medium- or high-sensitivity areas in Statutory Forestry Heritage with an emphasis on native or primary forests and secondary forests in recovery, as the case may be<br>• Conservation areas (forest partner) and others<br><br>The following fauna criteria should be added to the methodology to be used by the environmental consultant to define the AID:<br><br>• Boundaries of natural, medium- and high-sensitivity vegetation areas<br>• Boundaries of protected areas (Patrimonio de Áreas Naturales del Estado, State Natural Heritage Areas)<br>• Medium- or high-sensitivity areas in protective forests and vegetation with an emphasis on native or primary forests and secondary forests in recovery, as the case may be<br>• Medium- or high-sensitivity areas in Statutory Forestry Heritage with an emphasis on native or primary forests and secondary forests in recovery, as the case may be<br>• Conservation areas (forest partner) and others<br>• Biological aspects related to: flood zones, paramo zones, mangroves, migration routes, areas of medium and high biotic sensitivity (areas with endemic species, endangered species, migratory species, salt licks, watering holes, feeding grounds, nesting and reproduction sites), etc. |
| *Social: Levels of social integration* | By definition the methodology indicates that “The social area of direct influence is the social space based on direct interactions of one or more 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 occurs on at least two levels of social integration: first and second order individual social units and organizations. Individual elements are identified in order to guide the compensation actions while second level identification is carried out according to establishment of compensation actions” |

Source: Technical Guide for Defining Areas of Influence. Undersecretary for Environmental Quality (2015)

Moreover, the methodology tells us that delimitation or management of the area of indirect influence will be constructed at least based on the following considerations and inputs:

- Baseline analysis of the project, work or activity reference area
- Description and scope of project activities
- Positive and/or negative impact identification and assessment
- Environmental Management Plan activities

The management area or area of indirect influence corresponds to the spatial area where the promoter will handle positive and/or negative impacts on socio-environmental components caused by their activity and which may be included depending on the distinctive features of the project and the stage where the following occur:

*Table 2: Areas of Indirect Influence Selection Criteria*

| COMPONENT | AREA OF INDIRECT INFLUENCE (AII) |
|---|---|
| ***Physical: water resource*** | Based on the baseline analysis, the scope of project activities, impacts identified and Environmental Management Plan activities, the methodology will be outlined to define and delimit the spatial area where the promoter will manage the water resource; considering application of at least basic principles for prevention and control of water pollution, taking quality criteria into account for different uses. |
| ***Physical: soil resource*** | Based on the baseline analysis, the scope of project activities, impacts identified and Environmental Management Plan activities, the methodology will be outlined to define and delimit the spatial area where the promoter will manage the soil resource; at least considering application of basic principles for prevention and control of soil pollution in order to safeguard natural ecosystem functions in view of human activities which could modify its quality resulting from the various uses of the resource. |
| ***Physical: air resource*** | Based on the baseline analysis, the scope of project activities, impacts identified and Environmental Management Plan activities, the methodology will be outlined to define and delimit the spatial area where the promoter will manage the air resource; at least considering application of basic principles for prevention and control of air pollution due to gas emission, noise and/or disturbances caused by vibrations, taking into account quality criteria, permissibility and ecological and natural resource protection as provided under applicable environmental law. |
| ***Biotic: flora and vegetation*** | Based on the baseline analysis, the scope of project activities, impacts identified and Environmental Management Plan activities, the methodology will be outlined to define and delimit the spatial area where the promoter will manage flora and vegetation where the minimum management elements will be applied to:<br>• Strengthen conservation<br>• Recover ecosystems and wildlife<br>• Maintain ecosystem equilibrium and functionality |

| COMPONENT | AREA OF INDIRECT INFLUENCE (AII) |
|---|---|
| ***Biotic: fauna*** | Based on the baseline analysis, the scope of project activities, impacts identified and Environmental Management Plan activities, the methodology will be outlined to define and delimit the spatial area where the promoter will manage fauna where the minimum management elements will be applied to<br>• Strengthen conservation<br>• Decrease hunting and poaching<br>• Avoid illegal trafficking in wildlife<br>• Recover ecosystems and wildlife<br>• Maintain ecosystem equilibrium and functionality |
| ***Social: levels of social integration*** | By definition, the methodology indicates that "the area of indirect social influence is the socio-institutional space arising from the relationship of the project with political/territorial units where the project takes place: parish, canton and/or province".<br>The change to the landscape of the area is also added to the political/administrative location in defining the management area. |

Source: Technical Guide for Defining Areas of Influence. Undersecretary for Environmental Quality (2015)

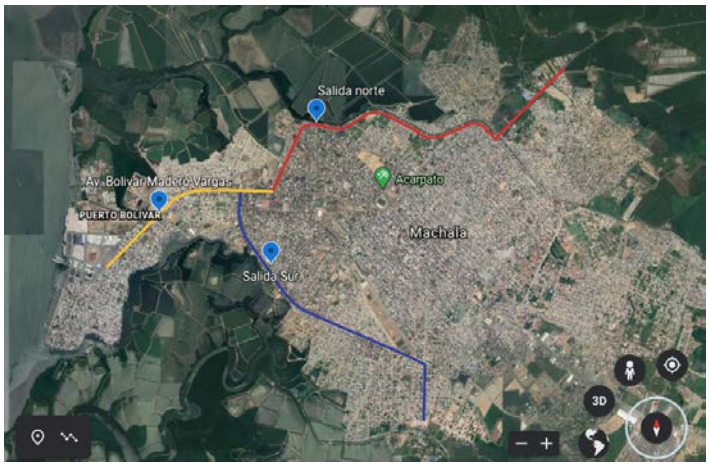
## 2.2. Definition of Areas of Influence

### 2.2.1. Area of Direct Influence

The area of direct influence is understood as **"…*the geographic area where environmental and socio-cultural impacts will be apparent*".**

Before defining these areas it is necessary to have a clear concept of environmental impact which is defined as *favorable or unfavorable alteration in the environment or in a component thereof caused by an activity or action* (Conesa, 1997: 25 et seq.), therefore under the physical criterion of potential environmental impacts the **area of direct influence** was established as the specific site where the project will be emplaced and the social, biotic and physical components that converge around it, as follows:

*Table 3: Area of Direct Influence by Component*

| COMPONENT | AREA OF DIRECT INFLUENCE (AID) |
|---|---|
| ***Physical: geology, geomorphology and soil quality*** | Coastal alluvial environment made up of the Santa Rosa estuary, where several estuaries come together. This is made up of a genetic fluvial group. The area includes current fluvio-marine deposits as well as other non-functional ones generated in different Quaternary epochs (primarily Holocene and Pleistocene): alluvial estuary deposits and mangroves, sand and alluvial estuaries made up of clay, silt and sand.<br><br>Environmental impacts on soil and subsoil may be localized so the area of port operation and expansion is confined. |
| ***Physical: noise and vibrations*** | Operation: the main contribution to noise and vibration in Puerto Bolívar's area of operations is caused by land traffic of cargo, the influence of which extends to access roads that encircle the city (north and south). Avenida Madero Vargas is the main access road. Cargo trucks must use the perimeter accesses of Av. Circunvalación Norte, which connects directly to the east access to the city (Vía Machala – Pasaje), and Circunvalación Sur, which connects to the south area of the province (Vía Balosa – Santa Rosa) to reach the above-mentioned Avenida Madero Vargas. The urban area is consolidated on these accesses which become urban roads.<br><br>Traffic flows trouble-free on these avenues, but there can be backups up to 0.8 km on Av. Bolívar Madero waiting for entry to the terminal. Nevertheless, the length of this avenue that receives all the heavy cargo transport (average of 25,000 vehicles per month) to and from the port is 2.3 km.<br><br>Construction activity: once again, transport will be the principal noise generator with the characteristics described above.<br><br>  |
| ***Physical: hydrology and water quality*** | Development of large, significant aquifers with generally high permeability and good yield. The Machala Hydrogeological Unit is composed of a principal watershed, basin of the Jubones River and 6 sub-basins: Balao, Gala, Tenguel, Siete, Pagua, Santa Rosa Rivers and Motuche estuary which correspond to a flat to even terrain. There are two deep wells in the area that belong to the Motuche River aquifer or recharge area. |

Operation: Water quality in the dock area is doubtless affected by activities like facility, equipment and vessel cleaning and maintenance as well as accidental spills of hazardous substances. A 1-km area next to the docks is considered the area of direct influence.

*Dredging:* ocean water quality in the sediment dumping area is directly affected by sediment dispersal which was quantified through a dispersion study

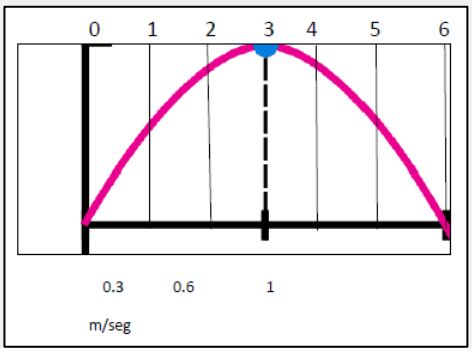
| Size | Sedimentation velocity (m/s) | Time to reach the bottom (hours) | Sedimentation distance in rising tide | Sedimentation distance in ebb tide |
|---|---|---|---|---|
| **Fine** | 3.7 x10-3 | 2.02 | 4.78 km | 6.02 km |
| **Sand** | 0.059 | 0.13 | 42.03 m | 52.91 m |
| **Gravel** | 14.87 | 5x10-4 (1.82 seg) | 1.19 m | 1.42 m |

**Source:** CONSULSUA C. Ltda. 2017

Dispersion during rising tide is to the northeast while at ebb tide it flows to the southeast.

Moreover, the access channel from which the sediment is removed by dredging is not affected to the same extent because the sediment suction is performed. Therefore, the area of direct influence can be considered 500 m from the affected area.

Se considera como The area of direct influence is considered to be the projected area of 15 km from the contour of the maneuvering area polygon and the access channel to be dredged in the Santa Rosa Estuary from the dredging dump basin. This is supported by the fact that local, twice daily tidal currents in the Jambelí channel (2 high tides and two low tides per day) reach speeds of greater intensities every two weeks (currents) with 5.5-hour periods; close to high tide or low tide there is one hour when the water does not move while the speed during the next hour is 0.3 m/s, then 0.6 m/s in the ensuing hour, arriving at 1 m/s at the peak of the rising or lowering water as follows:

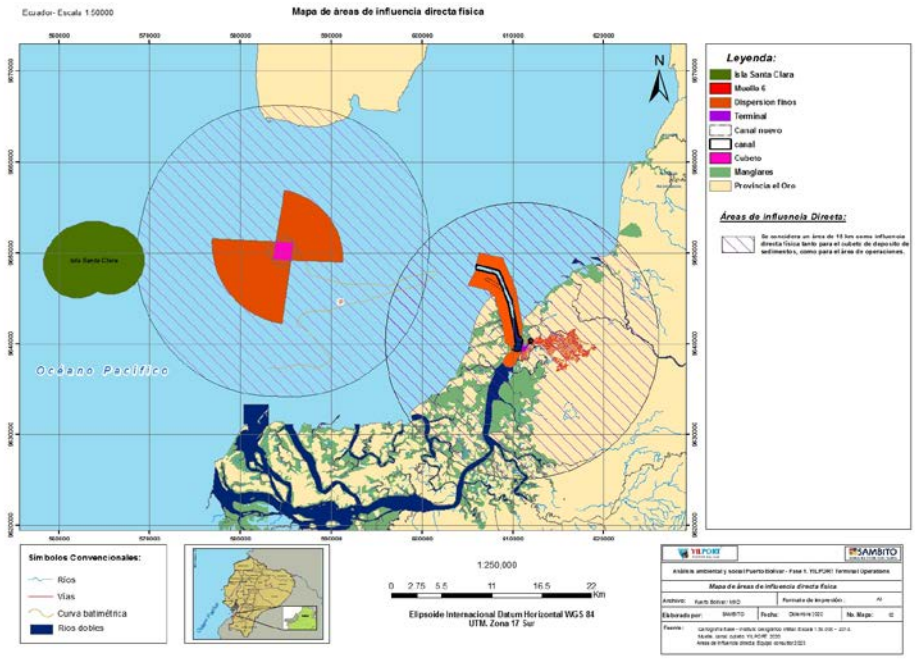



(1.5h * 0.3 m/sec= 1,620m) + (2h*0.6m/sec=4,320 m )+ (2h*1 m/sec=7,200 m)= **5.5h-> 13140m**

This distance does not consider w suggesting its expansion to **1500 m** or

The map of the physical area of direct influence is shown below :

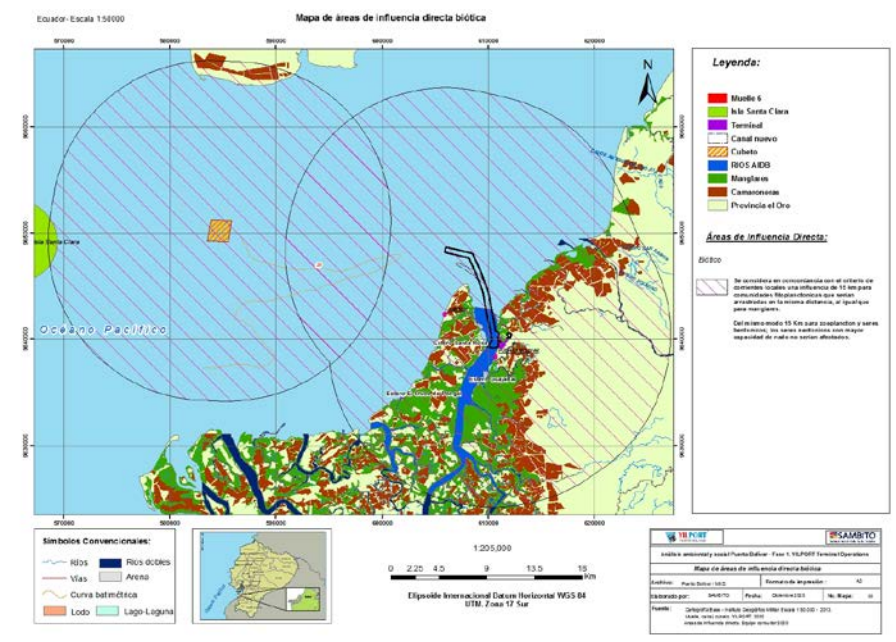
Map 1: Area of Direct Physical Influence




Leyenda = legend: Isla Santa Clara = Santa Clara Island; Muelle 6 = Dock 6; dispersión finos = fines dispersal; terminal = terminal; canal nuevo = new channel; new canal = channel; cubeto = basin; mangroves = mangroves; Provincia el Oro = province of El Oro; Áreas de Influencia Directa = Areas of Direct Influence; Se considera un área de 15 km como influencia directa física para el cubeto de depósito de sedimentos como para el área de operaciones = A 15-km area is considered as direct physical influence for the sediment dump site as the area of operations; símbolos convencionales = conventional symbols; Ríos=rivers; vías = roads; curva batimétrica = bathymetric curve; ríos dobles = double rivers; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de influencia directa física = Map of area of physical direct influence; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

| | |
|---|---|
| ***Biotic: flora and vegetation*** | A buffer of 15 km is considered for phytoplankton communities that would be dragged that distance based on the criterion of local currents, likewise for mangroves. |
| ***Biotic: fauna*** | Likewise, 15 km for zooplankton and benthonic organisms; nekton would not be affected with greater swimming capacity. |
| | The map of the area of direct biotic influence is shown below: |

**Map 2: Area of Direct Biotic Influence**



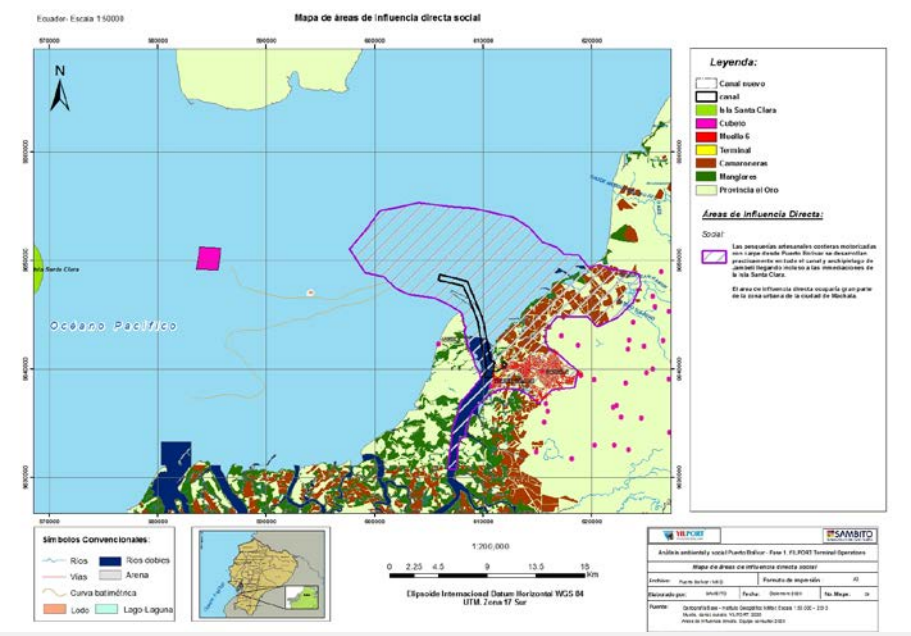

Isla Santa Clara = Santa Clara Island; Muelle 6 = Dock 6; dispersión finos = fines dispersal; terminal = terminal; canal nuevo = new channel; canal = channel; cubeto = basin; manglares = mangroves; Provincia el Oro = province of El Oro; Áreas de Influencia Directa = Areas of Direct Influence; Se considera un área [illegible] símbolos convencionales = conventional symbols; Ríos=rivers; vías = roads; curva batimétrica = bathymetric curve; ríos dobles = double rivers; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de influencia directa física = Map of area of direct physical influence; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

***Social: levels of social integration***

The parish of Puerto Bolívar in the canton of Machala is considered the area of direct influence. Here stakeholders made up primarily of a group of artisan fishers who have a mangrove concession to collect shells and crabs are found; they are the principal actors as the syndicate of motorized artisan fishers launching from Puerto Bolívar to the area of the channel.

The map of area of direct social influence is below:

**Map 3: Area of Direct Social Influence**




Isla Santa Clara = Santa Clara Island; canal nuevo = new channel; canal = channel; cubeto = basin; muelle 6 = dock 6; terminal = terminal; camaronera = shrimping; manglares = mangroves; Provincia el Oro = province of El Oro; Áreas de Influencia Directa = Areas of Direct Influence; Las pesquerías artesanales costeras motorizadas con zarpe desde Puerto Bolívar se desarrollan prácticamente en todo el canal y archipiélago del Jambalí llegando incluso a las inmediaciones de la isla Santa Clara = Motorized coastal artisan fishers launching from Puerto Bolívar work in practical all of the cannel and archipelago of Jambalí even up to the vicinity of Santa Clara Islands; El área de influencia directa ocuparía gran parte de la zona urbana de la ciudad de Machala = The area of direct influence would occupy a large part of the urban zone of the city of Machala; símbolos convencionales = conventional symbols; Ríos=rivers; vías = roads; arena = sand; curva batimétrica = bathymetric curve; ríos dobles = double rivers; lodo = sludge; lago-laguna = lake; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de influencia directa física = Map of area of direct physical influence; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

***Archeology***

The entire perimeter that will be affected by earth movement (2.4 ha) is considered the dock 6 area of direct influence.

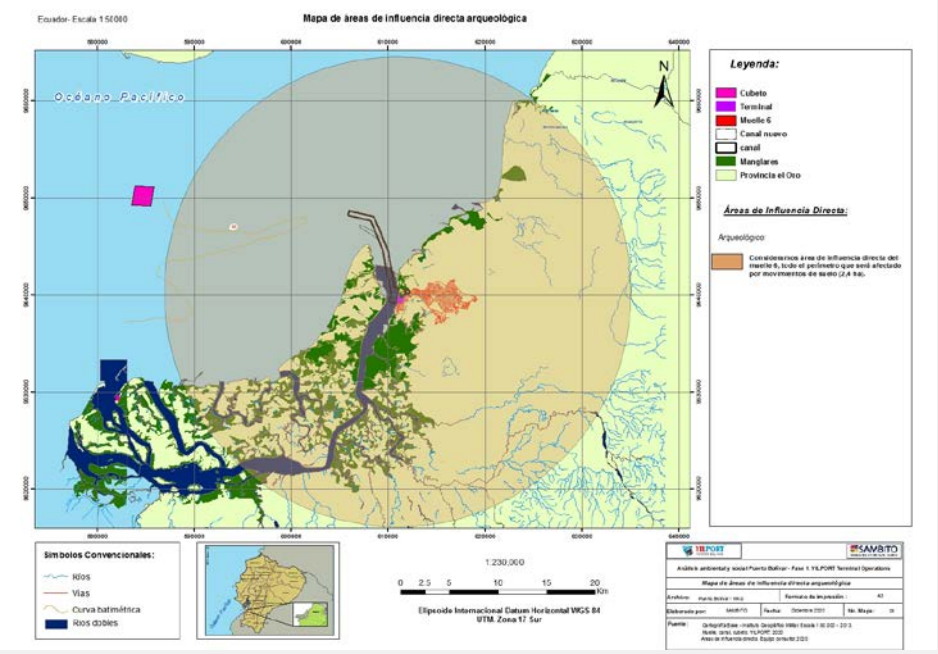
Analytical research or archeological site surveys were not required for previous environmental impact assessments, so any existence thereof is unknown as well as the actual impact thereon. Even though there are nearby archeological sites, the area of Port Terminal emplacement and expansion project has received large volumes of fill over time, thereby burying likely evidence.

Because the Organic Law of Culture (Art. 57 of soil and subsoil works) was not complied with in previous environmental impact assessment, we do not know the real impact on objects of archeological interest that could be present in the area of investigation (dock 6), which is close to archeological sites reported since the middle of the last century. A large part of the Port Terminal has been filled over time. Prior to dredging performed by Yilport, a Geophysical and Geomorphological survey was conducted the length of the access channel and the inner maneuvering channel in order to identify any variation within the soil

strata whereby the presence of foreign bodies could be inferred. This resulted in no evidence of archeological remains.

The map of the area of direct archeological influence is shown below:

**Map 4: Area of Direct Archeological Influence**




Leyenda = legend; cubeto = basin; Muelle 6 = Dock 6; dispersión finos = fines dispersal; terminal = terminal; canal nuevo = new channel; canal = channel; manglares = mangroves; Provincia el Oro = province of El Oro; Áreas de Influencia Directa = Areas of Direct Influence; arqueológico = archeological; consideremos área de influencia directa del muelle 6 todo el perímetro que será afectado por movimientos de suelo (2.4) ha = we consider the dock 6 area of direct influence to be the entire perimeter that will be affected by earth movement (2.4) ha; símbolos convencionales = conventional symbols; Ríos=rivers; vías = roads; curva batimétrica = bathymetric curve; ríos dobles = double rivers; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de influencia directa arqueológica = Map of area of direct archeological influence; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

Source: Field work 2020.
Prepared by: Ecosambito, 2020.

## 2.2.2. Area of Indirect Influence

The **area of indirect influence** is the territory where indirect or induced environmental impacts; i.e., those that occur at a different site from where the action causing the environmental impact occurs and at a different time compared with the time when the

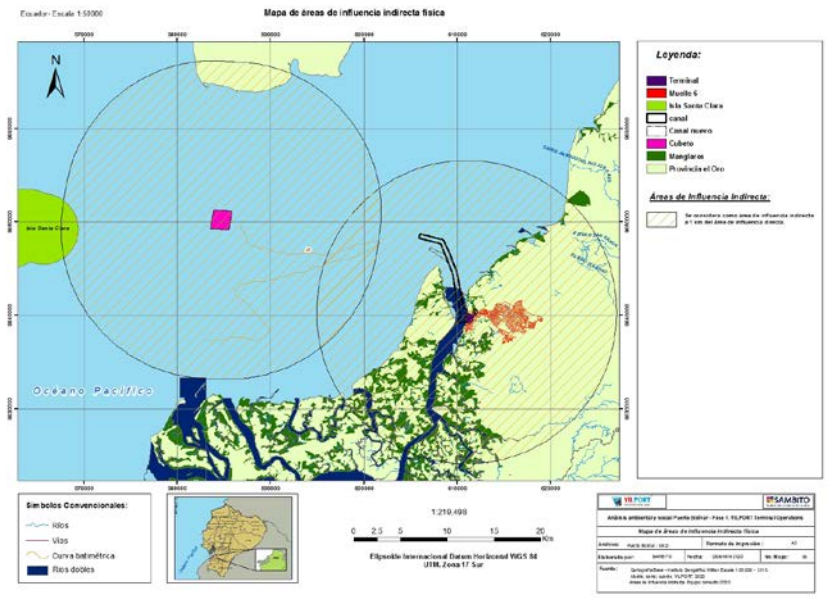
action causing the environmental impact occurred.

The area of indirect influence of the project has the following segments:

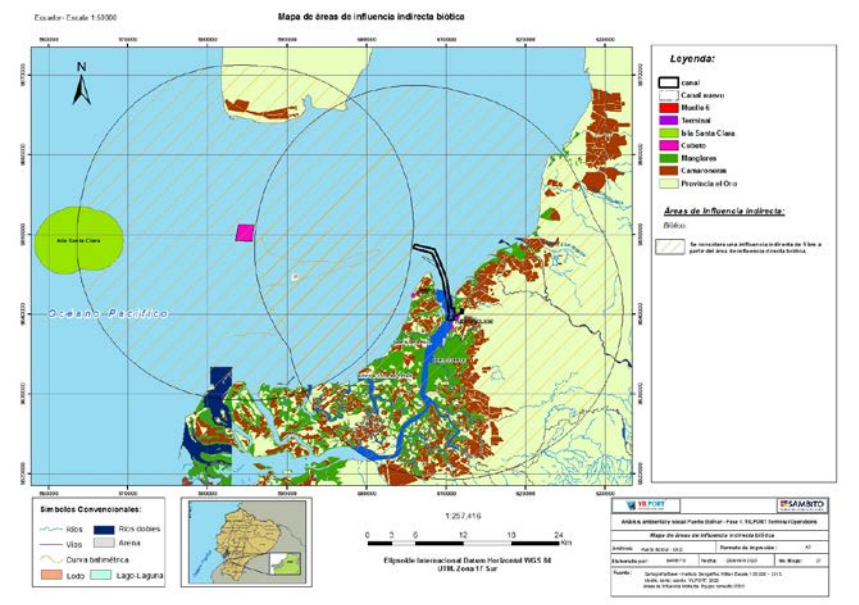
*Table 4: Areas of Indirect Influence*

| COMPONENT | AREA OF INDIRECT INFLUENCE (AII) |
|---|---|
| ***Physical: water resource*** | 1 Km around the area of direct influence.<br>Considering adverse climate conditions like storms or strong (gale force) winds, the area of indirect influence is considered with a buffer of 30 km projected from the polygons of maneuvering areas in the Santa Rosa estuary and the dredged material dump basin. |
| ***Physical: soil resource*** | 1 Km around the area of direct influence |
| ***Physical: air resource*** | 1 Km around the area of direct influence |
| | The map of the area of indirect physical influence is shown below: |

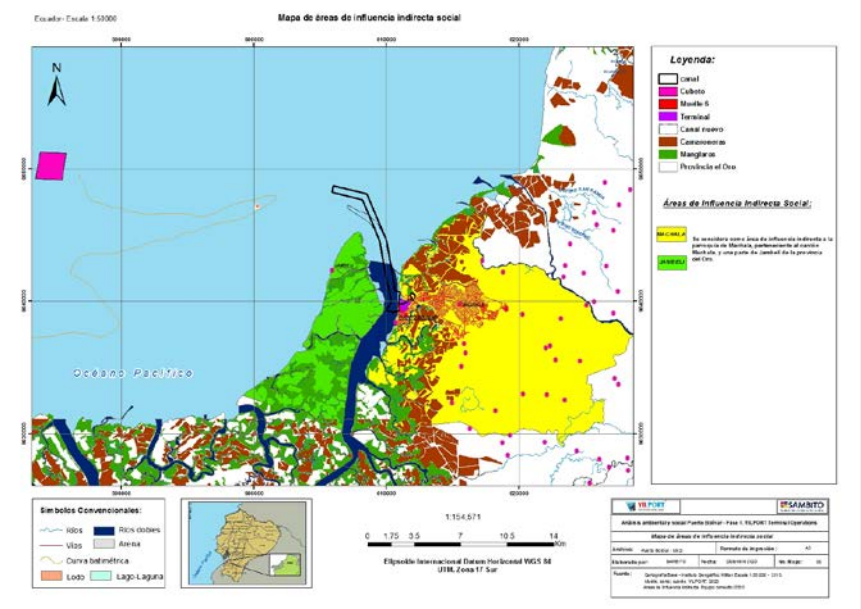
**Map 5: Area of Indirect Physical Influence**




Leyenda = legend; terminal = terminal; muelle 6 = dock 6; isla Santa Clara = Santa Clara Island; canal = channel; canal nuevo = new channel; cubeto = dump site; manglares = mangroves; provincia el Oro = province of El Oro; área de influencia indirecta = area of indirect influence; se considera como área de influencia indirecta a 1 km del área de influencia directa = the area of indirect influence is considered to be 1 km from the area of direct influence; símbolos convencionales = conventional symbols; ríos = rivers; vías = roads; curva batimétrica = bathymetric curves; ríos dobles = double rivers; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal

| | |
|---|---|
| | data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de influencia indirecta física = Map of area of indirect physical influence; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible] |
| **BIOTIC: FLORA AND VEGETATION** | The same physical oceanographic criterion |
| **BIOTIC: FAUNA** | Considering that there are species with swimming capacity should an anomalous event occur, such as oil spills, 30 km is considered an area of indirect influence. |
| | The map of the area of indirect biotic influence biótica is below:<br>**Map 6: Area of Indirect Biotic Influence**<br>  <br><br>Leyenda = legend; canal = channel; canal nuevo = new channel; muelle 6 = dock 6;terminal = terminal; isla Santa Clara = Santa Clara Island; cubeto = dump site; manglares = mangroves; provincia el Oro = province of El Oro; área de influencia indirecta = area of indirect influence; biótico = biotic; se considera como área de influencia indirecta bíotica a 5 km del área de influencia directa = the area of indirect biotic influence is considered to be 5 km from the area of direct influence; símbolos convencionales = conventional symbols; ríos = rivers; vías = roads; curva batimétrica = bathymetric curves; ríos dobles = double rivers; arena = sand; lodo – sludge; lago-laguna = lakes; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de influencia indirecta biótica = Map of area of indirect biotic influence; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible] |
| **SOCIAL: LEVELS OF SOCIAL INTEGRATION** | Comprised of the Cantonal Head of the canton of Machala, given that the main meeting centers are in this area, activities of the artisan fishers through the Jambelí Archipelago are also important, and even reach the vicinity of Santa Clara Island. |

**Map 7: Area of Indirect Social Influence**




Leyenda = legend; canal = channel; cubeto = dump site; muelle 6 = dock 6; terminal = terminal; canal nuevo = new channel; camareneros = shrimping; manglares = mangroves; provincia el Oro = province of El Oro; área de influencia indirecta social = area of indirect social influence; se considera como área de influencia indirecta a la parroquia de Machala, perteneciente al cantón Machala, una parte de Jambelí de la provincia del Oro = the area of indirect influence is considered to the parish of Machala belonging to the canton of Machala, a part of Jambelí of the province El Oro; símbolos convencionales = conventional symbols; ríos = rivers; vías = roads; curva batimétrica = bathymetric curves; ríos dobles = double rivers; arena = sand; lodo – sludge; lago-laguna = lakes; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de influencia indirecta social = Map of area of indirect social influence; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

Source: Field work 2020.
Prepared by: Ecosambito, 2020.

# 3. Definition of Sensitive Areas

## 3.1. Methodology and Determination of Areas of Physical Sensitivity

The analysis completed in the Baseline – Physical Component Chapter of this analysis selected the most significant elements within the characterization in terms of vulnerability to project actions in order to determine the area of physical sensitivity.

Three categories of sensitivity were defined in order to provide a qualitative assessment, which are shown in the following table:

*Table 5: Sensitivity Categories for the Qualitative Assessment*

| CATEGORY | DESCRIPTION |
|---|---|
| **HIGH** | The environmental components are unchanged. |
| **MEDIUM** | The environmental components are semi-changed. |
| **LOW** | The environmental components are changed. |

Source: Metodología Consulsua, 2012.

The sensitive areas are described below according to the socio-environmental component evaluated:

*Table 6: Physical Areas of Sensitivity*

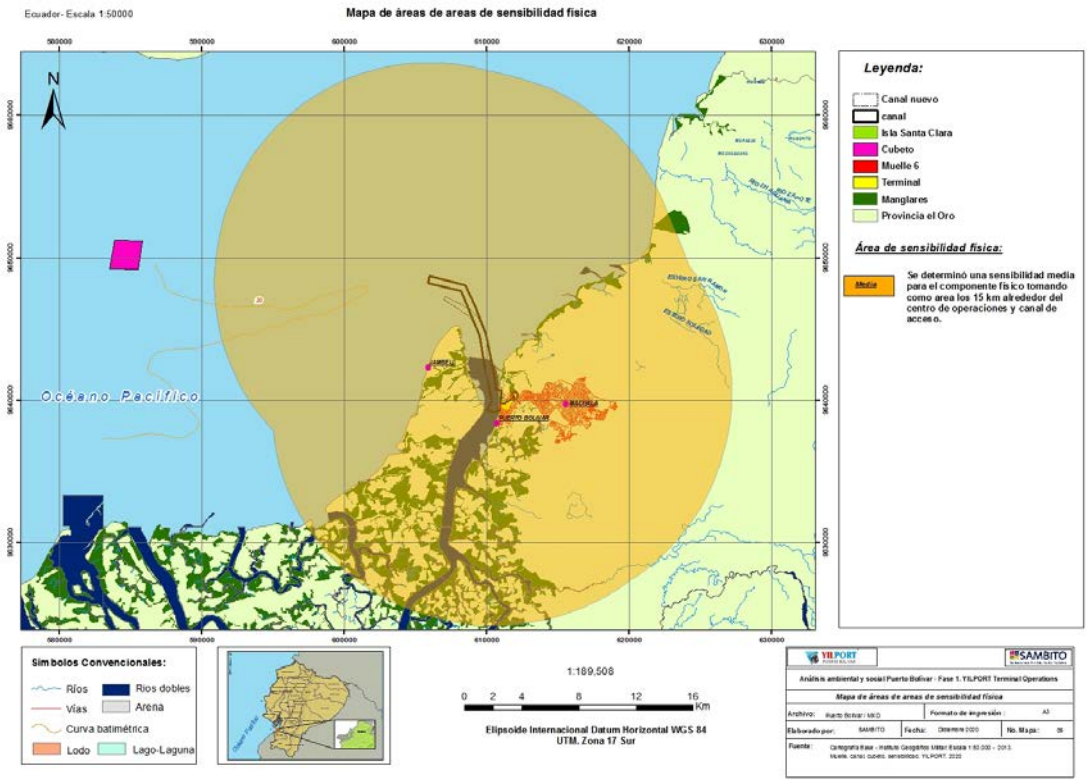
| COMPONENT | PHYSICAL AREAS OF SENSITIVITY | CATEGORY |
|---|---|---|
| Physical | Considering that the Port Terminal is already established, it can be assumed that the characteristics of the physical environmental components (water, soil and air) have been modified from their characteristics prior to project construction and operation; however, it should be taken into account that the project has their environmental authorization and environmental audits carried out have shown compliance with the Environmental Management Plan, so changes in the physical environmental components have not been extreme.<br><br>Because of the aforementioned, the physical sensitivity is set as Medium, and the following criteria are considered based on the analysis of the areas of influence:<br><br>- Variations in the soil component will occur locally in the area of port operation and expansion without changing soil conditions outside these areas.<br><br>- The air component is principally affected by the noise contribution due to land traffic. We also consider emissions due to land traffic as well as river traffic since those emissions may be dispersed by wind action; nevertheless, considering that emissions concentrations reported during air quality monitoring that was carried out are always below the levels allowed under the law. This factor will not enter into this assessment.<br><br>- Considering that the project is developed on a body of water, the environmental component most sensitive to being altered and taking into account that, as mentioned in the Environmental Impact Assessment, the project is in a zone at high risk of flooding, a band maneuver in | MEDIUM |

| COMPONENT | PHYSICAL AREAS OF SENSITIVITY | CATEGORY |
|---|---|---|
| | operational activities could drastically affect the conditions of the environment and speed up the process of flooding; any (chemical or sediment) spell could also cause changes in water conditions.<br><br>Based on the analysis of the dimensions established in the area of direct physical influence (AID), the area of physical sensitivity at the greatest distance considered in the physical AID is defined, i.e. 15 km from the contour of the maneuvering area polygon and the access channel to be dredged in the Santa Rosa Estuary of the dredged sediment dump basin. | |

Prepared by: Ecosambito, 2020.

The map of the area of physical sensitivity is shown below

**Map 8: Area of Physical Sensitivity**




Prepared by: Ecosambito, 2020.

Leyenda = legend; canal nuevo = new channel; canal = channel; isla Santa Clara = Santa Clara Island; cubeto = dump site; muelle 6 = dock 6; terminal = terminal; mangroves = mangroves; provincia el Oro = province of El Oro; área de sensibilidad física = area of physical sensitivity; Se determina una sensibilidad media para el componente físico tomando como área los 15 km alrededor del centro de operaciones y canal de acceso = A medium sensitivity is determined for the physical component taking the 15 km around the operations center and Access channel as the area; símbolos convencionales = conventional symbols; ríos = rivers; vías = roads; curva batimétrica = bathymetric curves; ríos dobles = double rivers; arena = sand; lodo – sludge; lago-laguna = lakes; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de sensitivity física = Map of area of physical sensitivity; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

## 3.2. Areas of Biotic Sensitivity

Sensitivity is the degree of vulnerability of a determined area in view of an action that brings about impacts, effects or risks.

According to the biotic component (flora and fauna), sensitivity is related to the presence of natural ecosystems and the presence of species with particular characteristics from en ecological point of view, such as vulnerable species, protected species under IUCN, CITES and flora and fauna Red Books, which could be altered by possible impacts generated by concession activities.

Sensitive areas for the biotic component were those, which, depending on the conservation status of the natural ecosystem and the presence of important species of flora and fauna, whether endemic or rare for sciences, may be vulnerable to possible impacts concession activities could cause.

### 3.2.1. Methodology and Determination of Sensitive Biotic Areas

Criteria from the Flora Component Study – Oglán (PUCE 2012) and the indications of Torres and Navarrete 2010 described below were used to categorize the sensitive areas.

Sensitive areas around this area were established based on previous studies of the edge effect that a platform may have on its environment (Torres and Navarrete 2010), establishing the following zones:

- 0 to 150 m - Very High Sensitivity
- 150 to 300 m - High Sensitivity
- 300 to 450 m - Medium Sensitivity
- Greater than 450 m-Low Sensitivity

Specific sites of ecological importance were determined by direct observation making tours of coastal navigation near the shoreline in a small vessel, geo-referencing sites that are later entered on maps.

Therefore, the following table indicates the biotic sensitivity of sectors and sites of ecological importance identified in coastal marine ecosystems of the area of influence**:**

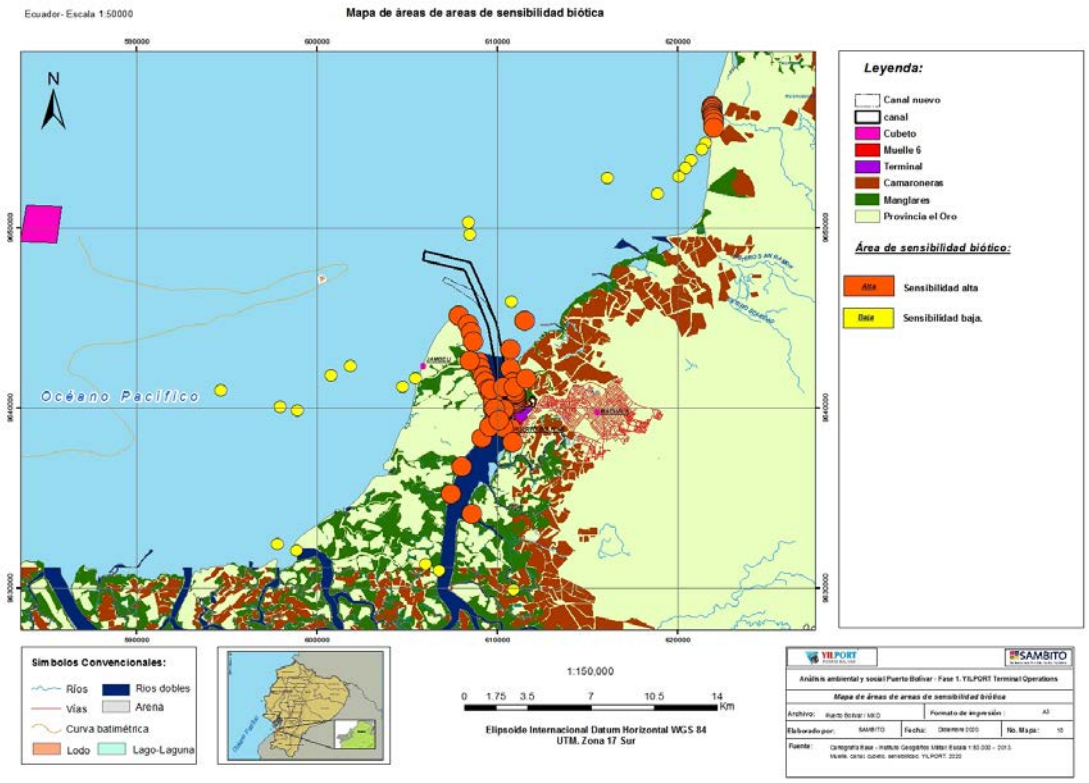
*Table 7: Biotic Sensitivity*

| SECTORS | BIOTIC SENSITIVITY |
|---|---|
| **MANGROVES** | Medium-High |
| **TRADITIONAL PACM FISHING GROUNDS (PACM = COASTAL MOTORIZED ARTISAN FISHING)** | Medium-Low |
| **ARTISAN PEDESTRIAN FISHING (PAP PESCA ARTESANAL PEATONAL)** | Low |
| **SITES OF STATIONARY ARTISAN FISHING (PAF PESCA ARTESANAL FIJA)** | Low |
| **BIRD GATHERING SITES** | Low |
| **PHYSICAL STRUCTURES THAT ACCOMMODATE ENCRUSTING COMMUNITIES** | Low |
| **MOUTHS OF BODIES OF FRESH WATER OR INLETS** | Low |

Source: Field Work 2020.
Prepared by: Ecosambito, 2020.

The map of the biotic sensitivity area is shown below:

**Map 9: Area of Biotic Sensitivity**




Prepared by: Ecosambito, 2020.

Leyenda = legend; canal nuevo = new channel; canal = channel; cubeto = dump site; muelle 6 = dock 6; terminal = terminal; camaroneras = shrimping grounds; manglares = mangroves; provincia el Oro = province of El Oro; área de sensibilidad biótica = area of biotic sensitivity; sensibilidad alta = high sensitivity; sensibilidad baja = low sensitivity; símbolos convencionales = conventional symbols; ríos = rivers; vías = roads; curva batimétrica = bathymetric curves; ríos dobles = double rivers; arena = sand; lodo – sludge; lago-laguna = lakes; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de sensitivity biótica = Map of area of biotic sensitivity; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

## 3.3. Area of Socioeconomic and Cultural Sensitivity

Socioeconomic and cultural sensitivity relates to the fragility of a population faced with external factors that can compromise or disturb their living condition; the level of this sensitivity is defined by the possible weakening of the factors that make up their social structure.

### 3.3.1. Methodology and Determination of Areas of Social Sensitivity

In the case of social composition of established groups in the area of influence of this project, the conditions of sensitivity establish the status of the set of socioeconomic and cultural relationships that make up the general social system of the area. The way the local society is integrated with regard to national society involves a status of influence and determination that was historically constituted as part of the social structure of settlements existing in the study area.

The degree of susceptibility of the area of influence is determined based on the levels of influence based application of the project on top of the current condition of the factors that make up the social system of influence. This socioeconomic and cultural susceptibility is defined, first, by the unstable spheres that could disability and conflict because of the project's existence and by measuring the degree of vulnerability of the affected factor. In order to characterize the status of sensitivity, three levels of susceptibility are considered:

**Low Susceptibility.** Insignificant effects on social spheres involved. No essential modifications are produced regarding living conditions, social practices and symbolic representations of the socioeconomic component. These are considered within the normal evolution of the project.

**Medium Susceptibility.** The intervention level transforms the economic and social conditions moderately and these can be controlled with socio-environmental management plans.

**High Susceptibility.** The consequences of the project involve profound modifications to the social structure and interfere with the logic of social reproduction of the groups in the area of influence.

Aspects like measures to control impacts considered in the project, acceptance of the project by the population, demands made of the agents, future possibility of expansion and occupation of the project area of influence and adverse effects on groups involved must be taken into account in rating the levels of sensitivity. In short, the degree of sensitivity is determined from the relationship of the general sensitivity condition with a project's execution.

The table below details and rates the levels of susceptibility based on the specific sensitive sphere:

*Table 8: Sociocultural Sensitivity in the Project Area of Influence*

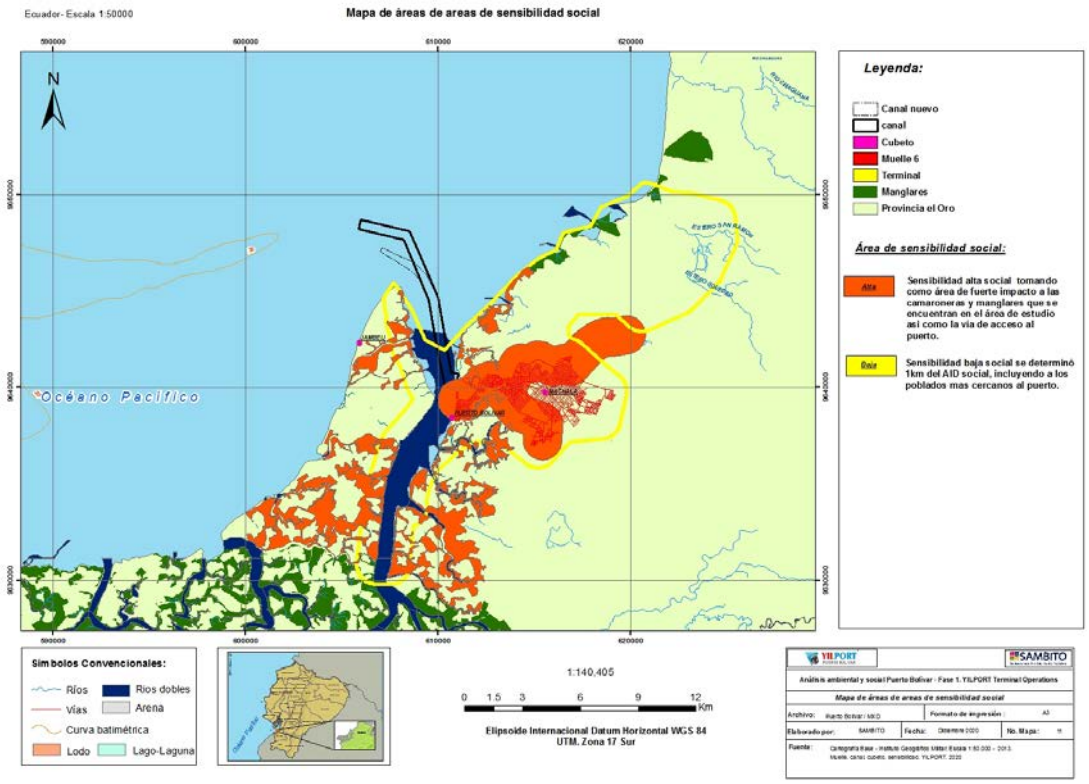
| FACTOR | SENSITIVITY | DETAILS |
|---|---|---|
| Jobs | MEDIUM | Temporary effect on fishing in the area of the dredging sediment dump basin.<br>Temporary jobs will be created in connection with the dock 6 construction works and other works considered in implementing Phase I. |
| Infrastructure and Basic Services | LOW | Basic services and infrastructure will not be affected by dock 6 construction works developed by the project and other works considered in implementing Phase I. |
| Social Organization and Conflict | HIGH | The lack of coordination and communication with affected parties and stakeholders may generate conflicts in regard to the dock 6 construction works, dredging activities and other works considered in implementing Phase I. |

| FACTOR | SENSITIVITY | DETAILS |
|---|---|---|
| Natural Landscape | LOW | Change in the landscape by maritime traffic |
| Land Transport | MEDIUM | Road bottlenecks and risks for pedestrians |
| Health and Public Safety | MEDIUM | Risks of traffic accidents, occupational accidents during the construction stage |
| Archeology | LOW | Low likelihood of remains on the beach, however, monitoring should take place continuously during the construction stage. |

Prepared by: Ecosambito, 2020.

The map of the area of social sensitivity is shown below:

**Map 10: Area of Social Sensitivity**




Prepared by: Ecosambito, 2020.

Leyenda = legend; canal nuevo = new channel; canal = channel; cubeto = dump site; muelle 6 = dock 6; terminal = terminal; mangroves = mangroves; provincia el Oro = province of El Oro; área de sensibilidad social = area of social sensitivity; sensibilidad alta social tomando como área de fuerte impacto a las camaroneras y manglares que se encuentran en el área de estudio así como la vía de acceso al puerto = high social sensitivity taking as the area of strong impact on shrimping and mangroves that are in the study area as well as the port access road; sensibilidad baja social se determine 1 km del AID social, incluyendo a los poblados más cercanos al puerto = Low social sensitivity is determined 1 km from the social AID, including towns nearest to the port; símbolos convencionales = conventional symbols; ríos = rivers; vías = roads; curva batimétrica = bathymetric curves; ríos dobles = double rivers; arena = sand;

lodo – sludge; lago-laguna = lakes; elipsoide internacional datos horizontal WGS 84 UTM Zona 17 Sur = international ellipsoid horizontal data WGS 84 UTM Zone 17 South; Análisis ambiental y social Puerto Bolívar – Fase 1 = Puerto Bolívar Phase 1 Environmental and Social Analysis; mapa de área de sensitivity biótica = Map of area of biotic sensitivity; archivo = file; formato de impresión = print format; elaborado por = prepared by; fecha = date; no. mapa = Map number; Fuente = source; cartografía [illegible]

# 4. Conclusions

- Based on the analysis of the area of physical influence, it is considered that the project activities may have a greater impact on the sub-component of water since it is most sensitive to environmental impacts that can also be carried toward zones outside the project area by the currents.
- A buffer of 15 km was established for the analysis of the biotic area of influence based on the effect of local currents on phytoplankton, zooplankton and benthic organisms. It should be mentioned that nekton organisms are not considered since they have a better ability to swim and would not be affected.
- Although the activities of the position directly or indirectly affect the population in the whole canton of Machala, the area of direct social influence would be composed primarily of the group of artisan fishers that have the mangrove concession near project activities.
- According to the methodology presented, the area of physical sensitivity was considered a Medium category since the environmental components are partially altered due to other contributors of pollution like agro-industrial, mining and urban activity due to the direct influence of polluting processes arising from activities in the area (discharges from shrimping pools, discharge from the Huaylá Estuary) and due to the fact that the project is in operation, with water being the most sensitive component.
- For the biotic sensitivity analysis, the sector most sensitive to project activity is the mangroves which is a valuable ecosystem threatened by clearing and changes in land use. Nevertheless, environmental monitoring and control reflect that, to date, this ecosystem has not been affected by port activity.
- The social factor that shows the greatest sensitivity is social organization and conflict to which the External Communication Plan must be applied, which will improve communication with stakeholders.