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Detailed Project Engineering Design, Bid Documents and Associated Safeguard Instruments Preparation for Agua Grande Coastal Protection and Reconstruction of Marginal Road

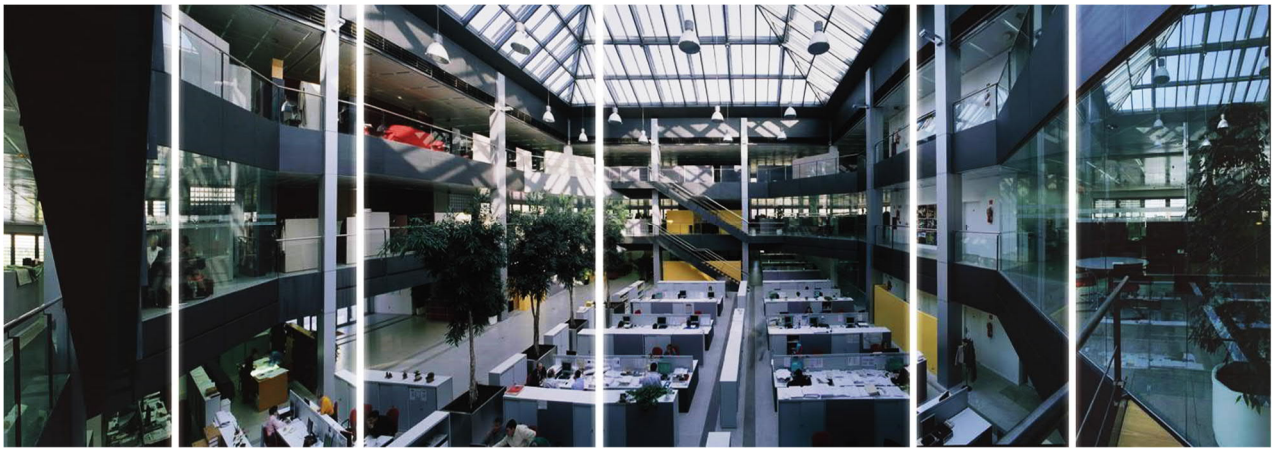
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PART 1

FINAL EDITION

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The authors take full responsibility for the contents of this report. The opinions expressed do not necessarily reflect the view of the European Union or the European Investment Bank or RVO

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List of Abbreviations

EA	Environmental Assessment
EIB	European Investment Bank
EPI	Personal Protective Equipment
ESIA	Environmental and Social Impact Assessment
GoSTP	Government of São Tomé and Príncipe
IFC	International Finance Corporation
IBA	Important Bird Area
ILO	International Labour Organization
INAE	National Roads Institute
MaB	UNESCO Man and the Biosphere Programme
MIRN	Ministry of Infrastructure and Natural Resources
MOPIRNA	Ministry of Public Works, Infrastructure, Resources Natural and Environment
NAPA	National Programme of Action for Adaptation
NCEA	Netherlands Commission for Environmental Assessment
PGA	Environmental Management Plan
PIB	Gross Domestic Product
PIU	Project Implementation Unit
PNOST	Obô de São Tomé Natural Park
PNOT	National Planning Plan
QGAS/ESMF	Environmental and Social Management Framework
RAP	Resettlement Action Plan
RDSTP	Democratic Republic of Sao Tome and Principe
SIDA/VIH	Syndrome/Immunodeficiency Virus
STP	Sao Tome and Principe
UNESCO	United Nations Educational, Scientific and Cultural Organization
VG	Vulnerable Groups

1. INTRODUCTION

1.1. PROJECT IDENTIFICATION, PROMOTOR AND LICENSING ENTITIES

The Government of São Tomé and Principe intends to implement the "Agua Grande Coastal Protection and Reconstruction of Marginal Road".

This document presents the Environmental and Social Impact Assessment (ESIA) for this project following the ToR, and the objectives and needs of the European Investment Bank (EIB), the Contracting Authority, and the Ministry of Public Works, Infrastructure, Resources Natural and Environment (MOPIRNA), The Promoter.

ESIA aims to comply with the Republic of São Tomé and Principe's national legislation and environmental and social requirements of EIB and IFC.

A dedicated Project Implementation Unit (PIU) National Road Institute (INAE) will implement the project.

The project integrates three sections:

- Lagarto bay
- Ana Chaves bay
- Pantufo Coastline.

1.2 STRUCTURE OF ESIA REPORT

This report corresponds to the Environmental and Social Impact Assessment and consists of thirteen chapters, including the Executive Summary and this Introduction, namely:

- Chapter 1 - Introduction, identifies the Project, Proponent and licensing entities and the team responsible for the ESIA.
- Chapter 2 – Project Justification, justify the implementation of the Project
- Chapter 3 - Background and Alternatives Assessment, presents a summary of the alternatives studied in the Feasibility Study
- Chapter 4 - Institutional and Legal Framework and EIB and IFC Standards, presents the main aspects of the Institutional and Legal Framework of Environmental and social issues in Sao Tomé, as well as brief presentation of gaps
- Chapter 5 - Sectorial Plans identifies plans and programs in this case, Strategic Marketing Plan in order to assess the conformity of these policy or territorial management instruments with this project.
- Chapter 6 - Consultation and Public Participation, presents a summary of the identification of the interested parties, the consultations carried out and the results obtained. In Volume 4, a Stakeholder Engagement Plan and Public Participation Report are presented.
- Chapter 7- Project Description describes alternatives of the project considered, including the zero alternative of the non-implementation of the project. This chapter also presents main activities generating impacts, workforce, construction and operation phases schedule, materials and energy use and produced, effluents, wastes and emissions, and associate and complementary projects.
- Chapter 8 – Project Influence Area, presents the Direct and Indirect Influence Areas for Marginal Road and Coastal Protection.

- Chapter 9 – Climate and Climate Changes presents the climate and oceanography data available, climate variable trends, climatic hazards and vulnerability analysis.
- Chapter 10 - Environmental Baseline Conditions, describes the current state of the environment (biophysical, quality of the environment).
- Chapter 11 - Social Baseline Conditions, describes the current situation regarding the state of the socio-economy, social and cultural
- Chapter 12 – Assessment of Environmental Impacts caused by the project considered in the construction , demobilization and operation phases of infrastructures are analysed and evaluated and several measures are proposed to be adopted in order to reduce the potential impacts or negative effects on the environment in the different phases of the project, as well as to enhance the impacts or positive effects.
- Chapter 13 – Assessment of Social Impacts caused by project. Considered in the construction, demobilization and operation phases of infrastructures are analysed and evaluated and several measures are proposed to be adopted in order to reduce potential impacts or negatives effects on the social and economic conditions in different phase as well to enhance the impacts or positive effects.
- Chapter 14 - Mitigating Measures of Environmental Impacts, in this chapter the general mitigating measures are indicated, that have been taken into account, to avoid, reduce and mitigate impacts.
- Chapter 15 - Mitigating Measures of Social Impacts, in this chapter the general mitigating measures are indicated, that have been taken into account, to avoid, reduce and mitigate impacts
- Chapter 16 - Monitoring Plan, presents environmental and social aspects that require confirmation on whether mitigation and benefit enhancement measures were applied, considering environmental and social components, frequency, indicators of performance, responsibilities
- Chapter 17 - Conclusions present the main results of the analysis made in the Preliminary Study of Environmental and Social Impact..
- Annexes - Containing diverse documentation to substantiate the present study.

The Environmental and Social Impact Assessment comprises two parts: Part 1 (from Chapter 1 to Chapter 11) and Part 2 (from Chapter 12 to Chapter 17).

Non-Technical Summary, Annexes of this ESIA and Environmental and Social Management Plan are presented separately.

2. PROJECT JUSTIFICATION

Due to its geographical situation, social and economic conditions, São Tomé e Príncipe (STP) has high levels of vulnerability to the global climate change phenomenon, mainly in temperature increase, precipitation decrease, sea-level rise (SLR) and coastal erosion.

The presence of economic activity and population along the coast, explains why the large part of the national road network is implemented at the shoreline. However stronger and increasingly unpredictable spring storm surges, combined with extensive illegal sand mining for construction, have led to high rates

of coastline erosion of about 0.2-1.2 meters a year6[1], which exacerbates the threat to STP's coastal resources as well as infrastructure.

Because of its location, on a volcanic chain of islands, STP's population and economic activities are mainly located along the coastline, away from the steep inland slopes that comprise the rest of the islands. Tourism has been associated with these coastal areas and remains an important source of revenue for the national economy. These coastal roads and increased tourism activity along them exacerbate the damage done by coastal erosion and increase the economic costs from loss.

As mentioned before, the three basins that comprise São Tomé's marginal city have a significant influence on the social and economic prosperity of its population. Infrastructure projects, such as this one, create assets that enhance the environment and stimulate economic growth through improved productivity.

According to the Preliminary Environmental Impact Study CDR (2019), climate change in the study area has been leading to substantial erosion of the coastline and beaches throughout the island of São Tomé, with particular incidence on the bays located in the capital city. The damages caused can be seen in the figure below and include:

- Dilapidation and disintegration of walls in Ana Chaves bay, and partially in Pantufo;
- Deterioration of pavements and collapsing of retaining walls;
- Beach erosion and consequent reduction of the fishermen's landing places;
- Occasional overtopping of the waves and resultant flooding of the marginal access roads.



Figure 1 Effects of sea level rise on São Tomé and Príncipe's marginal. Source: CDR, 2019

Legend: (a) overtopping in the northern part of Ana Chaves bay and flooded road b) destruction of the retaining wall and pavement in Ana Chaves bay; c) damage to the road protection; d) collapse of the retaining wall in Ana Chaves bay; e) beach erosion near the access to Pantufo.

[1] São Tomé e Príncipe Transport Sector Development and Coastal Projection Project, The World Bank Group, 2017.

Therefore, besides the reconstruction of the Marginal Road to improve its status, with consequent improvement of connections with the surrounding regions and the mobility within the urban area, with positive impacts for tourism and economic activities. The other main target of the present project is to **increase the protection of the coastal stretch along the road against coastal erosion and flooding**.

As the STP's *Intended National Determined Contribution to Climate* (2015) considered the country a carbon sink, the main objective is to provide STP the tools to **adapt** to the negative impacts of Climate Change, which are already evident in all sectors of the national economy (Agriculture and Livestock, Forest and Soil, Water, Energy and Fishing, Coastal Zone and Population, Health and Education).

Adapting to climate change means preparing for and adjusting to both the current effects of climate change and the predicted impacts in the future. Adaptation can include building flood defences, setting up early warning systems for cyclones and switching to drought-resistant crops, and redesigning communication systems, business operations, and government policies.

Several physical adaptation measures will be implemented in the road sections to be rehabilitated in the current project. These measures will guarantee sustainability and resilience to the predicted changes and protect the urban infrastructures and the local population (including the fishermen community) from the negative consequences of the climate changes in this coastal area.

3. BACKGROUND AND PROJECT ALTERNATIVE ASSESSMENT

At the end of 2017, The Ministry of Infrastructure, Natural Resources and Environment (MOPIRNA) of estrela Tomé e Principe assigned CDR International to carry out the consultancy services for a Vulnerability Analysis, Feasibility Study and Preliminary Environmental and Social Impact Analysis (ESIA) for the Água Grande Coastal Protection Project.

Based on Vulnerability Analysis, the subsequent revisions of the Feasibility Report and the comments and discussion regarding the draft revisions, three Alternatives (Alternative A, B and C) for the combination of coastal protection and road rehabilitation were prepared.

Based on the pros and cons of Alternative A and B, Alternative C including a combination of Alternative A and B was prepared and confirmed as the Preferred Alternative.

On 10th November 2020, the Executive Director of INAE confirmed Alternative C as the preferred option considering that it best responds to the need to rebuild the Marginal both from the point of view of road design and coastal protection.

As background documents of this contract are:

- Inception Report (November 2020).
- Preliminary Alignment Report (April 2021).

In his document, some adjustments were proposed for the forementioned Alternative C once the Consultant's multidisciplinary team analysed the alignment in order to determine the feasibility / adequacy at the construction level, determining the main limitations / limitations as road safety recommendations, space available for cross section, possible impact on the facades of closed buildings and other properties, overflow of land, space available to place coastal protection structures, impact on current landscaping (historical / relevant trees to protect), etc.).

- Draft Detailed Design for lots 1, 2 and 3 (August 2021).

- Observation/comments/suggestions from supervision reports from the Promoter (INAE), the Contracting Authority (European Investment Bank (EIB) and the financing entities, EIB and the Netherlands Business Agency (RVO).

The project will contribute to improve the road network and the tourist development of the island and consists of the design of coastal protection elements, landscaping and reconstruction of the Marginal Road from the airport of São Tomé (TMS) until 1 km south of the Pirata Bar to the south of Pestana Hotel (9 km approximate total length.

The Marginal Road is an urban road that contours the capital's coastal line and connects it to the only international airport (TMS), to the North, and the road to the village of Pantufo, to the South. It crosses the country's most densely populated urban area, the bays of Lagarto and Ana Chaves, several landmarks and links to the access road to the port. It is also at the center of the radial road network of the island, connecting the national roads EN1, EN2 and EN3. The Marginal is especially vulnerable to the consequences of climate change, namely rising sea levels and subsequent coastal erosion and flooding). The crossing of the Água Grande River mouth, inadequate coastal protection and lack of drainage aggravates the climate change consequences.



Figure 2 Marginal Road Source: CDR (2019)

Background of the Project and objectives as per the ToR

The purpose of the works is to reconstruct the existing road. The design scope comprises three civil engineering chapters:

- Road Rehabilitation
- Coastal Protection

- Landscaping

Additionally, the Detail Design includes several environmental and social measures.

According to the Terms of Reference (ToR), the project should comprise three detailed independent designs to be contracted independently. Due to its homogeneous characteristics, the Marginal Road is divided into the following lots:

- **Lot 1: The Lagarto bay (CH 0+000 – CH 2+760)**

  Length: 2.760 m

  The Lagarto bay section starts near the Airport, close to the "O Bigodes" Hotel (0+000), continues along Lagarto bay for 1.9 km, crosses inland the promontory between both bays and ends to the south of Central Hospital of São Tomé, specifically next to the access to CKDO Supermarket (2+760).



Figure 3 Aerial view of Section 1: Lagarto bay (CH 0+000 – CH 2+760)

- **Lot 2: The Ana Chaves bay section (CH 2+760 – CH 5+900)**

  Length: 3.140 m

  The Ana Chaves bay section is the most densely urbanised section of the Project as it contours the centre of the capital. Begins in the access to CKDO Supermarket (2+760), continues along Avenida 12 de Julho passing several landmarks: intersection (round about) with EN1 National

Road (3+700), Avenida Água Grande (4+800), Post Office (5+100), Parque Ucla (5+150), Praça da Juventude (5+650 and finally the Forte de São Sebastião (5+900).



Figure 4 Aerial view of Section 2: Ana Chaves bay. (CH. 2+760 – CH 5+900)

- **Lot 3: The Pantufo Coastline section (CH 5+900 – CH 8 +820)**

  Length:2.920 m

  The Pantufo Coastline section starts besides the Forte de São Sebastião (5+900) and ends around 1.000 m southwards the Pirata Bar, in the intersection with Estrada São Marçal (8+220 m) (the village of Pantufo) through several landmarks: Avenida da Independência (6+200), Liceu Nacional (6+600), Avenida Kwama N´Kruma (6+950), Avenida das Nações Unidas - Estrada Nacional 2 EN2 (7+150), Hotel Pestana (seaside) and Assembleia Nacional (landside) (7+500) and finally the Estrada São Marçal (8+820 m).

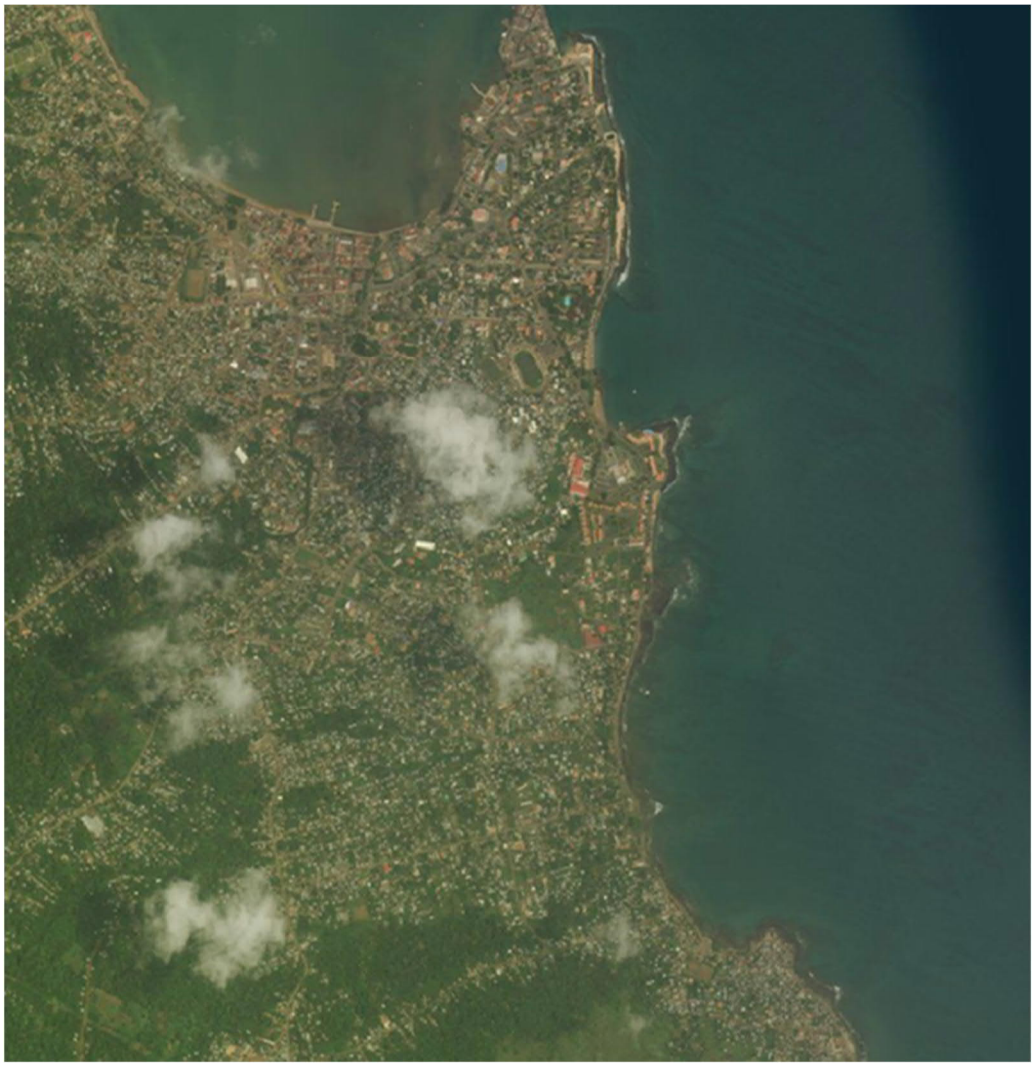


Figure 5 Aerial view of Section 3: Pantufo Coastline (CH.5+900 – CH 8+820)

Alternatives assessment

For components Coastal Protection and Road Rehabilitation, three alternatives have been considered: A, B and C. The main differences for the considered alternatives are presented below.

Section	Coastal protection			Road rehabilitation		
	Alternative A	Alternative B	Alternative C	Alternative A	Alternative B	Alternative C
Lagarto	Construction of a rock revetment structure, at places provided with concrete steps to allow access to the beach.	Construction of a rock revetment structure, at places provided with concrete steps to allow access to the beach. + Beach nourishment	Construction of a rock revetment structure, at places provided with concrete steps to allow access to the beach.	Road with a 7m width and 4m seaside pavement.	Road with a 6m width and a 2m seaside pavement. + Cycle path along the "outcrop" between Lagarto and Ana Chaves.	Road with a 6m width and a 4m seaside pavement. + Cycle path along the "outcrop" between Lagarto and Ana Chaves.
Ana Chaves	- Provision of a new sea wall, where the old one is falling apart and upgrade the sections still in good conditions; - Building of a new sea wall; - Improvement of the balustrade; - Placement of a rock berm.			Road with a 7m width and 4m seaside pavement and a 30 km/h-zone for motorised traffic.		
Pantufo	- Construction of a rock revetment along the unprotected sections; - Inclusion of a berm to the existing seawall (in a few locations); - Rebuilding of the balustrade. - Strengthening the berm under the balustrade.			Reconstruction and repair of Pantufo section road.		

Table 1 Comparison of Alternatives

The alternatives were subjected to the multicriteria evaluation presented in Appendix C of the Preliminary ESIA (Volume IV of the Vulnerability Analysis, Feasibility Study and Preliminary Environmental and Social Impact Analysis (ESIA) and based on the overall ranking of the three, Alternative C was preferred.

The main environmental and social considerations in the selection of alternatives are the folllowing:

- **Costal Protection -** All alternatives include safe coastal protection, however in Alternative B, middle part of Lagarto has a lighter rock revetment combined with a beach. This beach needs to be maintained to ensure long term stability of the revetment;
- **Construction Materials -** All alternatives do need construction materials and implementation. Considering the availability of rock of being less critical compared to sand, the impact of Alternative. B could be considered as more negative compared to Alternatives A and C;
- **Trees -** Alternatives A and C includes new coconut palms in sidewalk Lagarto, whereas Alternative B has more focus on keeping existing palm trees in combination with new trees. In all alternatives

new trees (coconut palms Lagarto; other trees in other areas) are included, in Alternatives B and C more attention is given to the beautification together with trees;

- **Social Impact** - All alternatives are considered as having positive social impact. Alternatives B and C do have more attention to tourism (job opportunities) and cycling (health) and the cycle path improves also access and conditions of houses along this path. Therefore, these are considered as slightly more positive compared to Alternative A. However, in Alternative. B, the presence of beach at Lagarto has a further positive impact on recreation.

According to Feasibility Study, the design criteria of Alternative C are the following:

- Depending on the present width of the carriageway and the parking bays, the road profile is adjusted to cater for motorized and non-motorized (pedestrians and cyclists) traffic. This especially holds for the pavements in the Ana Chaves bay area, where parking bays and sidewalks are provided in a balanced manner. Generally, a carriageway width of a minimum of 7 m is included, which offers space for cycle suggestion lanes on both sides. For cyclists, a cycle path between Lagarto and Ana Chaves upgrades the existing path along the rock promontory and connects the bays as an interesting route.
- For Lagarto a road width of 6 m (the level raised with 0.2~0.5m at the lower sections) and a seaside sidewalk of 4 m are included. The coastal protection is a rock revetment.
- The coastal protection in Ana Chaves exists of the rehabilitated seawall, including a closed balustrade on top and a rock berm in front of it. These additions serve the long-term stability of the wall and reduce significantly the overtopping. In Pantufo, the seawall's balustrade is also rehabilitated, and at a few sections, a rock revetment is included.
- Present fishery landing sites in Ana Chaves are incorporated in this integral design by increasing boat landing space, ensuring access to the road (openings in the balustrade with steps to the beach) and providing additional amenities (water and sanitation blocks). - At Lagarto beach, where there is a beach behind the revetment, the revetment crest will be kept at the same level as the sidewalk and some concrete steps on the revetment for easy beach access. As this area is popular for recreation and bathing, two toilet blocks are included at the parking bays opposite the beach area.
- The sidewalks are rehabilitated or newly designed to improve the safe mobility of pedestrians. At the seaside, at sections where overtopping of sea water will occur, they function as surface drainage by titling the seaside sidewalks towards the sea and including a shallow drain and weep holes. - The road shall have sufficient storm water run-off drainage: surface drainage (if no kerbs of sidewalk and space along the road) or with catch pits and sub-surface drains (for locations with kerbs of sidewalks) with outlets to the sea.
- Present utilities (telecom, power, water, street lighting) are considered. If present, these are located at the landside sidewalk or berm and do not require specific work. At Lagarto, the streetlights need to be shifted or replaced.
- For beautification, also street lighting is indicated.
- Road safety is addressed via the adequate selection of road profile, pedestrian crossings and 50 km/h and 30 km/h zones.
- The two Y-junctions in the Ana Chaves area are adjusted. EN1's connection is through a roundabout and shall be further analyzed (during the detailed design phase based on the design of the EN1 and the progress of that project). The other Y-junction is closed-off, the next junction is improved, or a roundabout can be included. The decision depends on this area's spatial planning, which is now used as an (informal) market.

4. LEGAL AND POLICY FRAMEWORK

The Project will be implemented in accordance with the laws and regulations of the Republic of São Tomé and Principe, which are largely aligned with EIB policies and standards and applicable IFC Performance Standards. Requirements. These are summarized below.

4.1. POLICY AND INSTITUTIONAL FRAMEWORK

Sao Tome and Principe has a central entity responsible for environmental issues in the institutional framework of its governance, the Directorate General of Environment, which is another demonstration of the high position that is intended to be given to this particular sector of development. Under the government currently in place the environment sector is embedded in the Ministry of Infrastructures and Natural Resources (MIRN).

The main areas of intervention include policy formulation, general promotion, planning, research/technologies, investment in infrastructure and other relevant areas, regulation, enforcement, development of extension/education/awareness actions, etc.

Understanding the environment as a cross-cutting theme coordinated by MIRN has led to the definition of environmental line ministries to integrate other ministries/sectors that deal directly with the leading environmental components, i.e., soil and subsoil, water, air and biotic components (flora and fauna). For ease of analysis, in general, these components can also be subdivided into two broad categories:

Institutions that directly depend on natural resources as their primary source of raw materials comprise:

- Fisheries (fishery resources) and Land and Forests - under the responsibility of the Ministry of Agriculture, Fisheries and Rural Development;
- Mines (mineral resources) - under the responsibility of the Ministry of Infrastructure and Natural Resources, although it is a fact that STP has practically no significant mining activity, which is currently dormant.
- Public Works (infrastructure) and Housing (water and land) - essentially under the Ministry of Infrastructure and Natural Resources and local and local governments.

Those components whose outcomes depend mainly on the provision of environmental services include:

- Energy (water, mineral resources, biotic elements for biofuels, etc.) - under the responsibility of the Ministries of Infrastructure and Natural Resources.
- Tourism (landscape and wildlife) - under the responsibility of the Ministries of Infrastructure, Natural Resources and Economy and International Cooperation International/Agriculture, Fisheries and Rural Development (Parks)
- Health (water and infrastructure) - under the responsibility of the Ministry of Health.

The MIRN is presented in practice as a "super-ministry" that encompasses under sectors and sub-sectors.

4.2. LEGAL FRAMEWORK

4.2.1. THE CONSTITUTION OF THE DEMOCRATIC REPUBLIC OF S. TOMÉ (1990)

The Constitution of the Democratic Republic of São Tomé and Príncipe was published in 1990. In 2003, it was revised to include some aspects such as article 10, which stipulates "Preserve the harmonious balance of nature and the environment" as a State's primary objective.

References to the environment and land use planning are made in article 49, stating that "Everyone has the right to housing and a humane living environment and the duty to defend it" and that "The State is responsible for planning and implementing a housing policy inserted in land use plans".

The Constitution is the supreme law of São Tomé and Principe. The sections of the Constitution that are more important for environmental and social management include, but are not limited to the following:

- Article 34 Right of Assembly and Demonstration says that the Citizens shall have the right to assemble peacefully and unarmed, including in places open to the public. All citizens shall have the right to demonstrate, in accordance with the law.
- Article 35 Freedom of Association. The Citizens shall have the right to freely form associations without any form of authorization, provided that they do not violate criminal law or jeopardize the Constitution and national independence. The Associations shall freely pursue their objectives. And, no one may be compelled to belong to an association or coerced by any means to remain in it.
- Article 36 Physical Freedom and Security. Everyone has the right to physical freedom and personal security.
- No one may be deprived of their liberty except in cases provided for by law and always by decision or with the approval of the competent court.
- Article 43 – Workers rights. Guarantees all workers the right to fail remuneration and work in a healthy and safe environment.
- Article 47 - Private property. Guarantees to all the country's citizens the right to own private property and transfer it in life and after death; the acquisition and expropriation of that property for public purposes may only be made based on the law.
- In its article 1308, the Civil Code also specifies that no one may be deprived of their right to property, in whole or in part, except as defined by law. Where there Article 61 is the expropriation in the public interest, adequate compensation to the owner (s) must be paid.
- Article 49 - Housing and environment. Provides that everyone has the right to housing and a human environment and ensures that all the citizens have the right and duty to defend these rights.

4.2.2. ENVIRONMENTAL LAWS

The Directorate-General for the Environment is in charge of environmental management and protection. Other institutions that play a role in this project include the Directorate General of Fisheries and the Ministry of Defence, which is also responsible for forwarding municipal waste. District Councils (Câmara) are responsible for the disposal of solid waste and other waste, and they also have a role in spatial planning.

Law Nº 10/1999 – Base Law on the Environment

The "Base Environment Law governs the environmental framework in São Tomé and Principe" and was formulated by the Directorate General of Environment within the Ministry of Natural Resources and Environment.

Environmental Impact Assessment is legally regulated by the Base Law on the Environment (Law nº 10/99) and by Decree-Law nº 37/99 of 20 November 1999, which refers to the Regulation on the Procedure for Environmental Impact Assessment.

According to Decree-Law 37/99, of 3 August 1999, on the Regulation of the Procedure of Environmental Impact Assessment, in its article 1, line e), the Environmental Impact Study is a central component of the Environmental Impact Assessment procedure. It consists of the elaboration of the technical and scientific analysis of the consequences of the realisation of certain proposed activities on the

environment, namely, the risks and benefits in the short, medium and long term, given the possible options for the activity and the area in which it is intended to implement.

According to the Decree mentioned above, "Programmes and projects that may directly or indirectly affect sensitive areas, such as coral reefs, areas of imminent erosion (mountain slopes, dunes of the seashore)" are included in the list of activities and require an Environmental Impact Study.

As EIS is an instrument for implementing the environmental management policy, of an eminently preventive nature, and which should be prepared in a preliminary phase of the planning of certain activities, being capable of modifying and enhancing the decision as to the choice of the most sustainable solution, among the possible alternatives of the project.

Article 7 of this law defines the principle of participation, according to which citizens and various social groups should be involved and participate in decision-making processes. In contrast, Article 8 guarantees everyone the right to adequate access to information on the environment.

Paragraph 4 of Article 8 requires the State to facilitate and stimulate public awareness and participation by making available the required information.

Paragraph 1 of Article 45 states that plans, projects, activities, and actions that impact the environment, the territory, or the quality of life of populations must satisfy environmental standards and be accompanied by an environmental impact assessment. This is particularly important for the project and is valid for the project regardless of the option adopted. If impacts are expected, an assessment must be made.

Article 45 further sets out the contents of an environmental impact assessment. It states that the approval of the environmental impact assessment by the Ministry of the Environment is a prerequisite for the authorisation of works. The practical aspects of this provision are further developed in the are further developed in the Regulation on the Environmental Impact Assessment procedure (Decree-Law Nº 37/99), better addressed below and which will guide the environmental licensing the project under consideration, as regards compliance with the requirements of the Sao Tomé Convention.

Decree Nº 37/1999 - Regulation on the Environmental Impact Assessment process

This Decree adopts the legal framework, which rules the environmental impact assessment process in São Tomé e Príncipe.

The Ministry of Environment is responsible for applying this diploma, which main stages and deliverables are presented in the figure below.

The Decree-Law Nº 37/99 comprises 20 articles distributed in five chapters and three annexes.

Annex I of Decree-Law Nº 37/99 contains a list of activities that may have a significant impact and require an environmental impact study. The list includes projects in areas ranging from agriculture, fishing, mining, waste management, large engineering projects, projects that imply permanent or temporary resettlement of people, and projects that might affect sensitive natural areas. Annex I point 10 referred transportation infrastructure.

For this Project, a preliminary ESIA was carried out and several alternative options for the coastal protection and road rehabilitation measures have been described and evaluated, based on the first assessment of potential impacts.

Despite coastal protection works and exploitation of construction materials are not listed in Annex I, the Netherlands Commission for Environmental Assessment (NCEA) considered that an ESIA would also be required as the Project is likely to affect one or more Annex I categories.

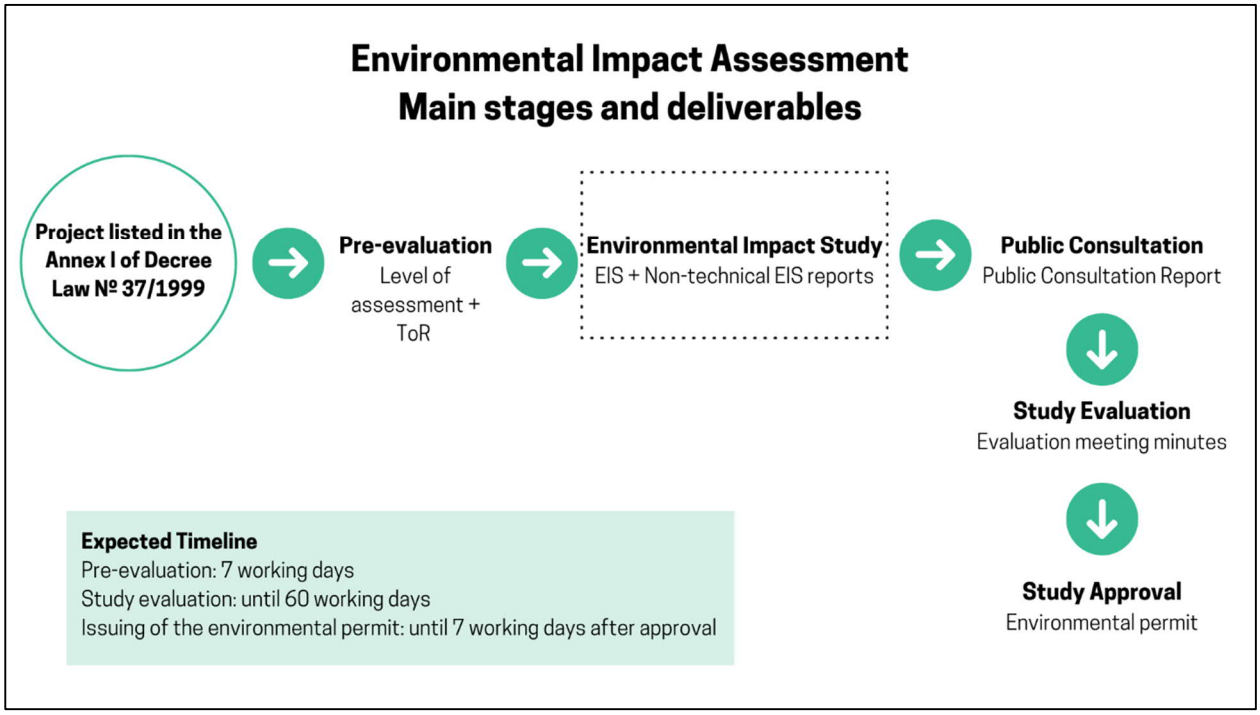


Figure 6 Summary of the Environmental Impact Assessment Process in São Tomé e Príncipe, according to the Decree-Law nº 37/1999, showing the stage of the present report (dotted rectangle).

The following laws are other laws inherent to Environment.

Law Nº 3/91 - Land Management Law

The Law on State Land Property Management defines the framework of issues related to state land and the basic principles of land reserve creation. It deals with ownership, identifies public and private state property, and defines the basis of private lease and the use of state land, particularly at the distribution level for investment purposes. Among others, the law specifies that "Land occupied by public roads or paths, as well as that occupied by airports, aerodromes of public interest, belongs to the state domain (paragraph e), Chapter I, Section I, Article 1 (Lands in the Public Domain). Also falling within this category are "the lands corresponding to the beds of rivers and maritime waters (paragraph a), of the same Chapter and Section).

In a certain sense, this law constitutes one of the attempts to correct the land problems in STP following the processes initiated in the post-independence period that were strongly marked by agricultural "nationalisation". This process led to the nationalisation and distribution of land to the population. This step is still seen by many as being at the root of most of the problems in the land sector that São Tomé and Príncipe still faces today.

Law n^{er} 9/2020, of 22/09/2020- Law on the Extraction of Inerts

Legal regime of inert extraction establish requirements general like norms concerning hygiene and health; environment, taxation and absence of debts to the State and social security.

The Article 53 Geographical demarcation of the extraction of coastal sand and aggregates indicates the following:

1. The Government, through a joint order of the Ministers in charge of Environment, Defence and National Security, may define an annual quota, the exploration and extraction season for sand and coastal aggregates, as well as the eligible beaches for the purposes of the present Chapter.

2. In the absence of a definition of the beaches included in the geographical delimitation provided for in the present article, sand extraction shall be prohibited and violators shall be subject to disciplinary, administrative or criminal liability, as the case may be.

The Article 55 Extraction of coastal aggregates within the scope of beach regeneration refers the following:

The competent authority may authorise the removal of sand or other inert material within the scope of beach recovery provided that

a) the beaches subject to the recovery price are previously identified in the studies of the competent entity;

b) there is a budget forecast for the purpose, as well as the availability of the respective fund

c) the quantity of material to be reclaimed does not jeopardise the maintenance of the beach from which the inert material is removed

(d) the beach from which the material is being removed is included in the list of beaches laid down in Article 53

(e) the spawning season of marine turtles and the reproduction cycle of other species are respected.

For licensing Extraction of Inerts requires presentation of an Environmental Impact Assessment (Article 20).

Law Nº 11/1999 - Law on the Conservation of Fauna, Flora and Protected Areas

This law adopts the legal framework for the conservation and protection of fauna, flora and the protected areas in the territory of the RDSTP.

The Fauna, Flora and Protected Areas Conservation Law occupies a vital place in the law, as it aims essentially at the conservation of animal and plant species and biological diversity, and should be considered as biological diversity, and should be understood as a set of technical and legal measures that allow the natural development of the genetic state of the animal, plant and biotic community, as a national and world heritage, as well as their sustainable social and economic sustainability.

Law Nº 5/2001 - Law on Forests

The importance of this law lies in the fact that it allows the organization of the Forestry Administration of the country, providing it with mechanisms of control, supervision of the process of production, exploration, transport and consumption of timber for various purposes, at the same time preventing the devastating action of those who use forestry resources in an irrational manner, with the objective of reducing the excesses verified in the process of exploration and use of timber and other forestry resources. in São Tomé and Principe.

Law Nº 9/2001 - Law on Fisheries and Fisheries Resources

The Law on Fisheries and Fisheries Resources defines the general principles of the policy for the conservation, exploration and management of the fishery resources and aquatic environment under the sovereignty and jurisdiction of São Tomé and Principe.

Law Nº 6/2006 and Law Nº 7/2006 - Law of the Obô Natural Park in São Tomé and in Principe

These two Laws create the Obô Natural Park in the island of São Tomé (Law nº 6/2006) and in the island of Principe (Law nº 7/2006) and intend to establish its boundaries and management rules.

Law Decree nº8/2014 - Regulation on Capture and Commercialization of Sea Turtles and their products

This Law criminalize the consumptive use of sea turtles and their by-products in São Tomé.

4.2.3. INTERNATIONAL CONVENTIONS

STP is a signatory to several protocols, international and regional conventions related to the sustainable use and management of environmental factors. Subsequently, the country has been developing national policies, strategies and plans to respond to the dictates of its membership and with value for national development. These instruments automatically become part of the domestic legal system once appropriate state bodies ratify them. For the case of this project, these are:

- The UN Convention on Biodiversity, 29th December 1993, ratified by STP on 28th December 1999;
- Convention on International Trade in Endangered Species (CITES) ratified by STP 2001;
- Convention on the Conservation of Migratory Species of Wild Animals, 1st November 1983, ratified by STP on 1st December 2001;
- Abidjan Convention (Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern Africa Region) ratified by STP in 2002;
- The Stockholm Convention on Persistent Organic Pollutants (POPs), 17th May 2004, ratified by STP on 12th April 2006;
- The United Nations Framework Convention on Climate Change, 1992, ratified by STP on 2nd November 2016;
- Kyoto Protocol, 2004, ratified by STP on 25th April 2008;
- Convention on Elimination of all forms of Discrimination Against Women, 1979, ratified by STP on 2003;
- International Convention on Elimination of all Forms of Racial Discrimination, 1965, ratified by STP, on 2017;
- International Convention on Economic, Social and Cultural Rights, 31th October 1995, ratified by STP on 10th January 2017;
- International Convention on the protection of the rights of all migrant workers and members of their families, 1990, ratified by STP on 10th January 2017;
- Convention of Rights of Children, 1989, ratified by STP on 14th May 1991;
- Convention on the Rights of Persons with disabilities, 2006, ratified by STP 2015.

São Tomé e Príncipe (STP) has ratified all the ILO fundamental conventions, which are currently in force in the country.

The eight ILO fundamental conventions aim the protection of fundamental principles and rights at work and are the following:

- Freedom of Association and Protection of the Right to Organise Convention, 1948, ratified by STP on 17th June 1992;
- Right to Organise and Collective Bargaining Convention, 1949, ratified by STP on 17th June 1992;
- Forced Labour Convention, 1930, ratified by STP on 4th May 2005;
- Abolition of Forced Labour Convention, 1957, ratified by STP on 4th May 2005;
- Minimum Age Convention, 1973, ratified by STP on 4th May 2005;
- Worst Forms of Child Labour Convention, 1999, ratified by STP on 4th May 2005;
- Equal Remuneration Convention, 1951, ratified by STP on 1st June 1982;
- Discrimination (Employment and Occupation) Convention, 1958, ratified by STP on 1st June 1982.

As a signatory of the ILO fundamental conventions, São Tomé e Príncipe developed legal instruments to ensure the implementation of actions established by these international commitments.

São Tomé and Príncipe legislation include the Strike Law (Law n.º 4/92), Union Law (Law n.º 5/92), Law n.º 6/92, on the regulation of individual working relationships and Decree-Law n.º 69/95, on the Statutes of the Labour Inspectorate.

The country has laws aimed at children protection that also prevent child labour, namely Law n.º 2/77, on the regulation of legal and family relationships and Decree-Law n.º 417/71, on the definition of children legal assistance.

4.2.3.1. The UN Convention on Biological Diversity

Through this Convention, the GSTP recognises that biological resources are a source of potential income that can bring significant benefits to people if they are managed sustainably.

Despite the efforts that have been made by national authorities and the international community for the protection of biological diversity, the degradation and loss of many species continues in São Tomé and Principe and in the world in general.

The document on "The National Strategy and Action Plan for Biodiversity Conservation" tries to reach out for the future of the environment in general and the biodiversity of São Tomé and Príncipe, especially.

The strategy and actions proposed by this Plan are based on four ecosystems defined for the country, including the **Coastal and Marine Ecosystems**, **Inland Waters Ecosystem**, **Forest Ecosystem and Forest** and **Agricultural Ecosystem Plan**. They contain measures that will be implemented in the short, medium and long term, at the national level, with support from the international community.

In 2006, STP developed its own *National Adaptation Plan of Action* (NAPA), agreeing with the Decision 28/CP.7 of the United Nations Framework Convention on Climatic Change. For the elaboration of the mentioned document, enquiries were performed in the south, centre and north of São Tomé, as well as in Príncipe. As a result of a sensitization campaign, the significant participation of the population allowed the identification of the phenomena of climate change in STP. For the whole country, the most critical phenomena identified were as follow:

- Decrease in river flow;
- Decrease in rainfall;

- Increase in the length of the dry season;
- Increases in temperature;
- Rise of the sea level;
- Floods and consequent contamination of water;
- Coastal erosion.

Appropriate solutions were identified to minimize the effects of climate change, in a total of 22 projects, mostly directed to social aspects (local communities and health), forest, agriculture, water and energy, but not specifically for sustainable infrastructures, as is the case of the current project.

4.2.3.2. STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS (POPS)

The ratification of this Convention by the Government of STP is based on the recognition that over the years, environmental pollution in general and pollution caused by the use of chemicals in nature have assumed alarming proportions with disastrous consequences for the future of socio-economic development.

Persistent Organic Pollutants, with the main emphasis on PCBs, Dioxins and Furans, and Persistent Organic Pollutants (POPs), have occupied an important place in chemical pollution with severe consequences for the health of the population and the atmosphere.

The Democratic Republic of São Tomé and Principe and many other countries of the Globe also used POPs in the fight against vectors that cause diseases, with particular incidence on mosquitoes that transmit malaria.

Aware today of the damage that these products cause to the environment, the national authorities have decided to join the efforts of the international community to provide appropriate treatment for these pollutants to minimise their harmful effects on nature.

Thus, after signing the Stockholm Convention on Persistent Organic Pollutants on 3 April 2002, São Tomé and Principe started to apply Article 7 of the Convention, which consisted of preparing a Strategy and Action Plan for sustainable management of these products in the national territory.

With the elaboration of the Strategy and Action Plan on Persistent Organic Pollutants, STP is aware that the international community will help São Tomé and Principe to implement the priority actions defined in the Plan, which will lead to a sustainable management of chemicals in the country, and contribute to a healthier environment.

4.2.3.3. UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Sao Tome and Principe acceded to and ratified, on 30 May 1998, the United Nations Framework Convention on Climate Change Framework Convention on Climate Change, thereby becoming a full member of the Conference of the Parties. Thus, it implicitly assumed the commitment to periodically elaborate, update publish and make available to the Conference of the Parties, national inventories of anthropogenic emissions by sources anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, in addition to providing a general description of measures mitigation and propose measures to facilitate adequate adaptation to climate change.

On this theme it should also be noted that STP has participated and ratified the agreements in principle on this phenomenon (November/December 2015) in Paris, COP 21[2].

The issue of climate change is of particular interest to the project under consideration in this document insofar as it aims to contribute to stanching part of the effects of this phenomenon, especially those related to the rise in sea level and the coastal zone. Indeed, the *increase of the resilience to erosion and maritime, river and storm flooding of coastal areas through improved Coastal Protection for vulnerable communities* is one of the medium and long term goals and targets for STP in the INDC document.

With the support of the NDC Partnership, the Government of STP elaborated in 2018 the NDC Implementation Plan to advance the mitigation and adaptation components of its NDC. The NDC Implementation Plan builds off national and sectoral priorities and was designed through an economy-wide and whole-of-society approach, including government institutions, NGOs, private sector, international partners, and academia.

STP's updated NDC[3] is more ambitious and presents improvements concerning its 2015 NDC (GHG reduction was at 57 ktCO2eq). Mitigation contributions, with a total GHG reduction goal of 109ktCO2eq, represent the additional reduction of these gases of approximately 90% (equivalent to about 51ktCO2eq). This increase in ambition is also reflected by the number of measures outlined concerning mitigation, adaptation, and cross-sectoral measures. The number of measures rose from 18 to 29 compared to 2015, especially targeting the increase of renewable energy generation from 26 MW to 49 MW and the increase in energy efficiency. The number of sectors covered is more comprehensive as they now include the energy, transport, fishery, agriculture, livestock farming, forestry, water, and waste sectors civil protection

The updated NDC includes two adaptation measures for coastal areas: *15. Strengthening of Resilience and adaptation of coastal communities* and *16. Strengthening of marine security for artisanal fishers*.

4.3. EIB AND IFC STANDARDS

4.3.1. EIB STANDARDS

The Environmental and Social Policy of the EIB outlines how the Bank will address the environmental and social impacts of the projects it finances by:

- Defining the respective roles and responsibilities of the designing, implementing and operating projects in line with this Policy and the Performance Requirements;
- Setting a strategic goal to promote projects with high environmental and social benefits;
- Mainstreaming environmental and social sustainability considerations into all its activities;

To help clients and/or their projects achieve environmental and social sustainability, the Bank has defined specific Environmental and Social Standards for key areas as listed below:

2 https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Sao%20Tome%20and%20Principe%20First/STP_INDC%20_Ingles_30.09.pdf

3 https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Sao%20Tome%20and%20Principe%20First/Updated_NDC_STP_2021_EN_.pdf

- EIB Standard 1 - Assessment and Management of Environmental and Social Impacts and Risks;
- EIB Standard 2 -Pollution Prevention and Abatement;
- EIB Standard 3 -Biodiversity and Ecosystems;
- EIB Standard 4 -Climate related standards;
- EIB Standard 5 -Cultural Heritage;
- EIB Standard 6 - Involuntary Resettlement;
- EIB Standard 7 - Rights and Interest of Vulnerable People;
- EIB Standard 8 - Labour Standards;
- EIB Standard 9 - Occupational and Public Health, Safety and Security;
- EIB Standard 10 - Stakeholders Engagement.

Each Environmental and Social Standard defines, in its objectives, the desired outcomes, followed by specific requirements clients have to ensure compliance with for projects to achieve these outcomes. Compliance with relevant national law is also an integral part of all Environmental and Social Standards.

4.3.2. IFC PERFORMANCE STANDARDS

IFC Environmental and Social Performance Standards defines promoters' responsibilities for managing their environmental and social impacts and risks.

The IFC Performance Standards are:

- IFC PS 1: Assessment and Management of Environmental and Social Risks and Impacts;
- IFC PS2: Labour and Working Conditions;
- IFC PS 3: Resource Efficiency and Pollution Prevention;
- IFC PS 4: Community Health, Safety, and Security;
- IFC PS5: Land Acquisition and Involuntary Resettlement;
- IFC PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- IFC PS 7: Indigenous People;
- IFC PS 8: Cultural Heritage.

4.4. GAP ANALYSIS

The following table compares São Tomé and Príncipe legislation and EIB And IFC requirements and proposed strategy.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Assessment and Management of Environmental and Social Impacts and Risks	Law N.º 37 / 1999 Regulation on the Environmental Impact Assessment process refers it is intended to ensure that, between others: (b) the rational management of environmental components and ecosystems is a permanent obligation of tenderers and supervisory and licensing bodies. (c) the public and the communities concerned, including non-governmental organizations, enterprises and other natural or collective entities, are involved in the assessment of the country's development projects and policies. f) The principle of prevention, adopted at the level of the various international conventions, the particular m of the Rio de Janeiro Convention signed in 1992, states that when the potential risks of an undertaking are, and departure alarming, the State must ensure that its implementation is not at the expense of the quality of life of the citizen, the community and the environment; (g) the process of assessing the environmental impact in its different forms and phases is nothing more than an instrument through which the possible consequences for the environment and the community can be foreseen, the adoption of a particular policy or undertaking. The option of analysis and evaluation prior to implementation is the only way to avoid irreversible effects on natural resources.	ESS 1 underscores the importance of managing environmental and social impacts and risks throughout the life of an EIB project through the application of the precautionary principle. The objectives are: • The development of an effective environmental and social management and reporting system that is objective and encourages continual improvements and developments. • Requirements for stakeholder engagement and disclosure throughout the life of the project.	PS 1 applies to all projects that have environmental and social risks and impacts and underscores the importance of managing environmental and social performance throughout the life of a project.	São Tomé law does not specify the need of monitoring and Stakeholder Engagement throughout the life of a project.	The strategy will be to present in the ESIA a monitoring, stakeholders engagement and grievance resolution mechanism along the time in a systematic way, taking in consideration all the phases of the project.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Projects categorization	The Annex I of Decree Nº37/99 presents a list of identification projects that require environmental impact study. Projects of coastal protection are not included in that list, but roads projects are included in point 10. Ports, airports, pathways of communication, rural roads, bridges and aqueducts. Marginal of São Tomé as a pathway of communication is included. Environmental licensing of projects subject to Environmental Impact Assessment is subject to the approval of the Environmental Impact Study. The legislation establishes the minimum content for an Environmental Impact Study.	ESS1 requires a comprehensive environmental and/or social assessment is carried out for projects classified under Annex I of the EU EIA Directive, and/or where an ESIA is required by national legislation or for projects where likely significant impacts and risks on the environment, population, human health and well-being have been determined.	IFC categorizes projects in A, B, C and FI.	São Tomé law does not establish the categorization of the projects, have a list of projects defines that all the activities that due to their nature, dimension or location are susceptible of causing significant impacts on the environment must submit their realization to the environmental impact assessment process	The aspects defined by national law will be taken into consideration, but following the EIB and IFC standards for project categorization
Environmental and Social Baseline	Article 6, paragraph b) of Decree N. º 37/1999 indicates that Environmental Impact Study shall contain at least: Diagnosis of the environmental situation of the area, considering the various environmental components (physical environment, biological environment, and socio-economic environment, spatial, historical and cultural planning and planning).	ESS1 considers the description of the baseline scenario – adequate and appropriate quantitative and qualitative, primary and secondary data on the relevant aspects of the existing state of the environment and social context and the likely evolution thereof without implementation of the project, paying attention to any area of particular environmental and social importance and the use of natural resources.	PS1 refers that risks and impact identification process will be based on recent environmental and social baseline at an appropriate level of detail.	No gaps identified.	ESIA will present environmental and social baseline characterization, based quantitative and qualitative, primary and secondary data on the relevant aspects of the existing in area of influence of project.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Environmental and Social Assessment	Article 6 of Decree nº 37/99 establishes minimum content of EIA, among others: Identification of direct, indirect, potential, global and cumulative effects more significant to environment resulting from activity. The approval process is described in Decree Law No 37/99 which provides the rules and principles applicable for environmental impact assessment. The law requires that all activities which by their nature, size or location may result in significant impacts upon the environment should undertake an environmental impact assessment prior to implementation. Annexure 1 of the law lists the type of activities for which environmental assessment required. And article 8 of Decree nº 37/99 refers that: 1. The effects of the impact of the proposed activity shall be determined on the basis of the following factors: (a) the number of persons and communities covered;(b) affected ecosystems, plants and animals;(c) the location and extent of the affected area;(d) duration and intensity of impact; e) reversibility or irreversibility of impact. 2. The environmental impact assessment shall be subject to minimum quality standards or levels of tolerable contamination in relation to air, soil and natural ecosystems. The law does not refer to residual impacts.	ESS1 objective is identifying, describing and assessing both adverse and positive, direct, indirect and induced environmental and social impacts, cumulative and in-combination impact/effects associated with the operation, its ancillary/associated facilities and the project area of influence.	PS1 objective is to identify and evaluate environmental and social risks and impacts of the project.	São Tomé law don't specify residual impacts in impacts/effects classification.	ESIA will present environmental and social impacts, positive, negative, direct and indirect, residual and cumulative for construction, operation phases and defined an area of influence of project.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Mitigation Measures	Decree nº 37/99 refers that is intend to identify and analyses the effects on the environment resulting from the various economic activities, to be determined, maximized where positive and minimized or eliminated where negative, before activities commence. Article 6, Decree nº 37/99 indicates that Environmental Impact Study shall contain at least: VII. measures to eliminate or reduce negative effects, with the indication of the system of control and counter-reparation of the expected impacts in the case of effects within the national territory;	ESS1 objective is applying the mitigation hierarchy by identifying measures to be taken to avoid, reduce and, if required, compensate/remedy significant adverse residual effects on workers, affected stakeholders, and the environment, so as to contribute to the avoidance of any deterioration in the quality of human life, the environment and any net loss of biodiversity and ecosystems	PS1 objective is to adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.	Mitigations measures are identified but not with a hierarchy.	The strategy will be to present mitigation measures with a hierarchy: avoid, reduce or compensate.
Monitoring	Article 6, Decree nº 37/99 indicates that Environmental Impact Study shall contain at least: XI. The proposal for a program, object and forms of monitoring.	ESS1 refers the follow up over time and in a systematic way, during construction, operation, and decommissioning, using certain parameters that are indicators of the status of the environment and human well-being so as to ascertain that after the implementation of mitigation and compensatory measures, no adverse impacts exceed those initially predicted;	According PS1 The client will establish procedures to monitor and measure the effectiveness of the management program, as well as compliance with any related legal and/or contractual obligations and regulatory requirements.	São Tomé law does not establish monitoring over time and in a systematic way, during construction, operation and decommissioning.	The strategy will be to present in the ESIA a monitoring along the time in a systematic way, taking in consideration all the phases of the project, during the construction, operation and decommissioning. using certain parameters that are indicators of the state of the environment and the human well-being in order to verify

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
					that after the implementation of mitigation and compensatory measures.
Public Consultation	Law Nº 37 / 1999 Regulation on the Environmental Impact Assessment process refers it is intended to ensure that (c) the public and the communities concerned, including non-governmental organizations, enterprises and other natural or collective entities, are involved in the assessment of the country's development projects and policies. As referred in article 6, During period of Public Consultation 1. Members of civil society, local authority, communities, economic associations, educational and research centers may be present or represented which have some direct or indirect interest in the proposed activity.	ESS 10 promotes the right to access to information, as well as public consultation and participation. The objectives are: • Promoters to uphold an open, transparent and accountable dialogue with all project affected communities and relevant stakeholders in an effective and appropriate manner. • The value of public participation in the decision-making process is stressed throughout the preparation, implementation, and monitoring phases of a project.	According PS1 When Affected Communities are subject to identified risks and adverse impacts from a project, the client will undertake a process of consultation in a manner that provides the Affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and allows the client to consider and respond to them. The extent and degree of engagement required by the consultation process should be commensurate with the project's risks and adverse impacts and with the concerns raised by the Affected Communities. Effective	EIB and IFC requires a particular attention in identifying and engaging vulnerable groups (doesn't are specified in São Tomé legislation) EIB and IFC requires stakeholders engagement along all phases of the project (doesn't are specified in São Tomé legislation) In São Tomé laws complaints are received only in Public Consultation period and not throughout the life of a project. EIB and IFC requires the establishment and implementation of GRM (accessible for all stakeholders, including vulnerable groups) in the Project. (doesn't are specified	The strategy will be to present in the ESIA stakeholders' engagement will take account implementation along all the phases of project, identifying and engaging vulnerable groups and claims in all phases of project in Stakeholder Engagement Plan

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
			consultation is a two-way process that should begin early in the process of identification of environmental and social risks and impacts and continue on an ongoing basis as risks and impacts arise.	in São Tomé legislation)	
Pollution Prevention and Abatement	Article 6, Decree nº 37/99 indicates that Environmental Impact Study shall contain at least: IV. the emission of waste, pollutants, noise levels and odors; V. risk analysis of serious accidents and their prevention measures and emergency plans; VIII. the brief indication of alternative technological or method and training solutions, including non-performance of the activity, and the justification for the choice made; X. The methodology adopted for the collection and sources of information, criteria and standards used.	ESS 2 recognizes the importance of avoiding and minimizing pollution from EIB-supported operations. The objective is a Project-level approach to resource efficiency and pollution prevention and control in line with best available techniques and internationally disseminated practices.	PS 3 recognizes that increased economic activity often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.	São Tomé legislation does not set limits on air quality water quality, noise and vibration.	ESIA will adopt IFC, WHO and EU standards for air and water quality, noise and vibration emissions,

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Biodiversity and Ecosystems	There is law Nº 11/1999 on the conservation and protection of fauna, flora and the protected areas essentially aims at the conservation of animal and plant species and biological diversity, and should be understood as a set of technical and legal measures that allow the natural development of the genetic state of the animal, plant and biotic community populations. Law nº 4/ 2003 regulates the protection and management of cultural and natural heritage.	ESS 3 recognizes the intrinsic value of biodiversity and that its operations may have a potential impact on biodiversity and ecosystems. The objectives are: • The promoter has to take an approach and measures to protect and conserve all levels of biodiversity. • The standard applies to all habitats (marine and terrestrial) whether or not previously disturbed or legally protected. • Focus on major threats and supports the sustainable use of renewable natural resources and the equitable sharing of benefits from the project's use of natural resources.	PS6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. Establish the following objectives: ▪ To protect and conserve biodiversity. ▪ To maintain the benefits from ecosystem services. ▪ To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities. Based on the risks and impacts identification process, the requirements of this Performance Standard are applied to programmes/ projects (i) located in modified, natural, and critical habitats; (ii) that	No gaps identified.	ESMP includes a Biodiversity Action Management Plan if necessary.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
			potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources (e.g., agriculture, animal husbandry, fisheries, forestry).		
Climate Changes	Presidential Decree nº9/2008 – described above National Adaptation Plan of Action (NAPA) (2006) – Identifies the main climate change effects and define appropriate solutions to minimize the effects of climate change Decree no 13/2012 – created the National Committee for Climate Change for the implementation, coordination, monitoring and evaluation of the United Nations Framework Convention on Climate Change Intended Nationally Determined Contribution (September 2015) – Climate change adaptation and risk reduction from climate change impacts is a priority in the document, besides contribute to raise awareness of the national adaptation program at the international level in order to attract technical, financial and capacity-building support for its implementation	ESS4 aims to ensure that potential adverse consequences of projects on the climate change vulnerability of natural ecosystems and human structures are addressed in SEA and EIA best practice. In addition, ESS1 assumes also the baseline description, the impact assessment and mitigation and monitoring of the climate changes and ESS10 stands out the importance of stakeholder engagement for a better assessment of the existing and predicted risks, as well in defining the best	PS1 - The risks and impacts identification process consider the emissions of greenhouse gases, the relevant risks associated with a changing climate and the adaptation opportunities. PS4 - Consider the effects of climate change on community risk and vulnerability in identification and evaluation of project risks and impacts to community health, safety, and security, with particular attention to vulnerable groups	The existing documents related to Climate Changes identify the major risks and define mitigation / adaptation measures to deal with these risks, involving the stakeholders. No gaps are identified	The ESIA will assess the impact of the project on the climate changes (mitigation) and the adaptation of the project to climate changes

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
	Updated NDC (2021) - represents a commitment towards mitigation and adaptation, with increase in the number of measures set forth in relation to mitigation, adaptation, and cross-sectoral measures	feasible adaptation measures	PS6 - Consider the effects of climate change to ecosystem services and natural habitat, and the role of each in mitigating climate risk, in identification of and evaluation of project impacts to the natural environment		
Cultural Heritage	Law nº 4/ 2003 regulates the protection and management of cultural and natural heritage. This Law provides a classification of cultural and natural heritage, regulates registration, zoning of protected areas and defines protection duties for central and local authorities.	ESS 5 recognizes the central role of cultural heritage within individual and collective identity, in supporting sustainable development and in promoting cultural diversity. The objectives are: • Identification, management and protection of tangible and intangible cultural heritage that may be affected by project activities consistent with the applicable international conventions and declarations. • Emphasize the need for the implementation of a “chance-find procedure”, which outlines the actions to be taken if previously	PS 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. It´s objectives are: ▪ To protect cultural heritage from the adverse impacts of programmed project activities and support its preservation. ▪ To promote the	No gaps identified.	ESIA will present cultural heritage characterization including colonial type houses situated close to the Marginal and (old) large trees (mostly Indian Almond) trees of the Ana Chaves bay and Pantufo Coastline.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
		unknown cultural heritage is encountered.	equitable sharing of benefits from the use of cultural heritage.		
Involuntary Resettlement	STP has no legal instrument to directly regulate involuntary resettlement issues arising from project development. The Law of State Land Management and Ownership (Law Nº 3/91) and other laws have partial aspects that can be used to ascertain restoration, compensation, etc. where a project interferes with the ways of living of individuals and other entities and their assets, but these are not organized into a consistent functional framework to guide an action plan. The country also has no tradition of resettlement actions	SS 6 recognizes that projects sometimes necessitate land acquisition, expropriation and/or restrictions on land use, resulting in the temporary or permanent resettlement of people from their original places of residence or their economic activities or subsistence practices. The objectives are: • Respect and protection of the rights to property and to adequate housing, and of the standard of living of all affected people and communities. • Mitigation of any adverse impacts arising from their loss of assets or restrictions on land use. • Assisting all affected persons to improve or at least restore their former livelihoods and living standards and adequately compensate for incurred losses.	PS 5 recognizes that programmed project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood as a result of programmed project-related land acquisition and/or restrictions on land use.	Resettlement is not sufficiently detailed in the STP regulations.	An Abbreviated Resettlement Plan was developed.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Vulnerable People	The law does not define vulnerable groups and does not differentiate between the most vulnerable and other members. STP legislation makes several references to the special of women to ensure social equity and social cohesion in the preparation and implementation of development actions.	ESS 7 seeks to protect all vulnerable project-affected individuals and groups, whilst seeking that these populations duly benefit from EIB operations. The objectives are: • Full respect for the dignity, human rights, aspiration, cultures and customary livelihoods of vulnerable groups including indigenous peoples. • The free, prior and informed consent of affected Indigenous groups. The EIB standard 7 stipulates the importance of paying attention to the minority rights and non-discrimination in the EU. Minority protection and participation are inherent in the EU's founding principles and in the principles of subsidiarity. The evolution of human rights protection has strengthened antdiscrimination legislation particularly with respect to women and to employment.	PS 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Indigenous Peoples are particularly vulnerable if their lands and resources are transformed, encroached upon, or significantly degraded. Their languages, cultures, religions, spiritual beliefs, and institutions may also come under threat. vulnerability may	São Tomé legislation does not specify vulnerable groups.	ESIA give special attention to vulnerable groups identified and how impacts in his living conditions could be affected with the objective to proposed appropriated measures and monitoring.

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
		Similar protection remains to be developed for ethno-cultural diversity. Protection of minorities and indigenous people is limited to dealings with external partners.	include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.		

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Labor Conditions	Law nº 6/2019 Labor Code in its Chapter XVII - Safety, Hygiene and Health at Work at Article 436 - General principles refers: The employer shall be obliged to organize and ensure that work is carried out under safe conditions of safety and health protection for workers; about conditions the law referred to in the preceding paragraph shall be defined by additional legislation, taking into account the specific constraints and characteristics of the various of the various sectors of economic activity, and defining the responsibilities of workers and employers in workers and employers in accordance with the complementary nature of such responsibilities. CHAPTER VII of the law deals with Maternity and Paternity Protection. Article 249 (1) Maternity Leave: The worker has the right to a maternity leave of 14 weeks, eight weeks of which must necessarily follow the birth and the rest of which can be taken, totally or partially, before or after the birth. Article 252, Dispensations for consultations, breastfeeding and breastfeeding, in point 1. A pregnant worker has the right to time off work to go to pre-natal consultations, for the time and number of times necessary and justified. CHAPTER VIII, Employment of Minors, in Article 268 Admission to work1. Only minors who have completed the minimum age for admission, have completed compulsory education and possess the physical and mental capacities appropriate to the workstation may be admitted to work,	ESS 8 recognizes the importance of good labor practices and the use of appropriate codes of conduct to ensure the fair treatment, non-discrimination and equality of opportunity of workers. The objectives are: • Ensuring that promoters of EIB projects comply with the core labor standards of the International Labor Organization and with national labor and employment laws. • The establishment, maintenance and improvement of worker-management relationships	PS2 refers that companies treat their workers fairly, provide safe and healthy working conditions, avoid the use of child or forced labor, and identify risks in their primary supply chain. It has the following objectives: ▪ To promote the fair treatment, non-discrimination, and equal opportunity of workers. ▪ To establish, maintain, and improve the worker-management relationship. ▪ To promote compliance with national employment and labor laws. ▪ To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. ▪ To promote safe and healthy working	No gaps identified.	The project complies with the conditions of the São Tomé and Principe labor law ESIA and ESMP will include labor standards

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
	whatever the type and method of payment. 2. The minimum age of admission to work is 15 years. Subsection I deal with Equality and Non-Discrimination in Article 16 Right to equality in access to employment and at work, 1. All workers have the right to equal opportunities and equal treatment as regards access to employment, vocational training and promotion, and working conditions.		conditions, and the health of workers. ▪ To avoid the use of forced labour.		

ESIA Topic	National Legislative Requirements	EIB Safeguards	IFC Policy	Gaps	Proposed Strategy
Occupational and Community Health and Safety	Law 14/2007 on Safety, Hygiene and Health at Work. It establishes a set of measures to ensure safety, hygiene and health at work in various sectors of activities in the country. Safety of constructions, protection of machinery, equipment and means of lifting, transport and storage, installations, equipment and utensils and individual protection equipment, hygiene and health of workers, defining the obligations of the employer and workers.	ESS 9 recognizes the importance of protecting and securing public and occupational health, safety and security and promote the dignity of the affected community in relation to project-related activities. The objectives are: • Particular attention to vulnerable groups. • Promoters to adhere to the international norms and relevant human rights principles when using security services.	PS4 recognizes that project activities, equipment and infrastructure bring benefits to communities including employment, services and can also increase the potential for community exposure to risks from development.	No gaps identified.	ESIA will include Occupational and Community Health and Safety standards and ESMP presents Occupational Community Health and Safety Plans

Table 2 Comparative analysis between São Tomé and Príncipe legislation and EIB and IFC requirements and proposed strategy.

5. SECTORIAL PLANS

5.1. STRATEGIC AND MARKETING PLAN

The instruments for promoting tourism in STP value a pattern of resources associated to leisure and ecotourism where the components of climate, landscape biodiversity, fauna and flora, volcanic landscapes and beaches, integrated with the natural landscape of São Tomé and Principe stand out.

The values associated with safety ("solid democracy"), friendliness, happiness and hospitality are also valued. The opinion of tourists visiting São Tomé and Príncipe projects a positive image associated with the beaches and the possibility of rest, a destination with a good climate and a peaceful, safe environment, where the local population is of outstanding importance.

In 2025, São Tomé e Príncipe will be the best-preserved island tourist destination in Equatorial Africa, with unique nature and biodiversity, heavenly beaches. São Tomé inhabitants show hospitality, based on its historical and cultural legacy of coffee and cocoa plantations, sharing their way of life and warm welcome. São Tomé has led to the development of entrepreneurial initiatives to offer local products and services that improve the quality of life of families and, consequently, to a high value-added tourist experience.

The Plan establishes a set of Priorities to guide policy and investment actions to achieve the ambition of the Vision formulated:

- **Priority 1**. Qualifying the supply at the level of current and developing infrastructures; raising the population's awareness of tourism; training human resources;
- **Priority 2.** Develop the attractiveness of the destination - through the complementarity of supply with products aligned according to the target markets;
- **Priority 3.** Reach the most suitable target markets for the destination offer - work with distribution channels to reach those markets;
- **Priority 4.** Develop partnerships with stakeholders in a collaborative marketing logic to maximize marketing efforts to get the best results for the destination.

5.2. NATIONAL LAND USE PLAN MASTER PLAN

In 2020 National Land Use Master Plan (PNOT) for Água Grande District established priorities, including the rehabilitation of the Marginal road of São Tomé. This plan was approved but not yet published.

In PNOT Map, zoning indicates for Area of Direct Influence of Marginal Road some land use zones as structured and to be structured housing spaces, existent green sites and proposed green areas in Praia Emilia, structured and to be rehabilitated touristic areas in Praia Lagarto, as presented in following Figure.

For Praia Lagarto, is proposed to recover the railway line (coming from Bela Vista), allowing the connection between the coastline and Roça Ferreira.

In addition, PNOT proposed to create a green and leisure area associated with the water line next to Maria Emilia and its flooded areas, which will allow this tourist area to have green spaces. PNOT suggested elaboration of a plan at 1:2000 scale to implement this proposal.

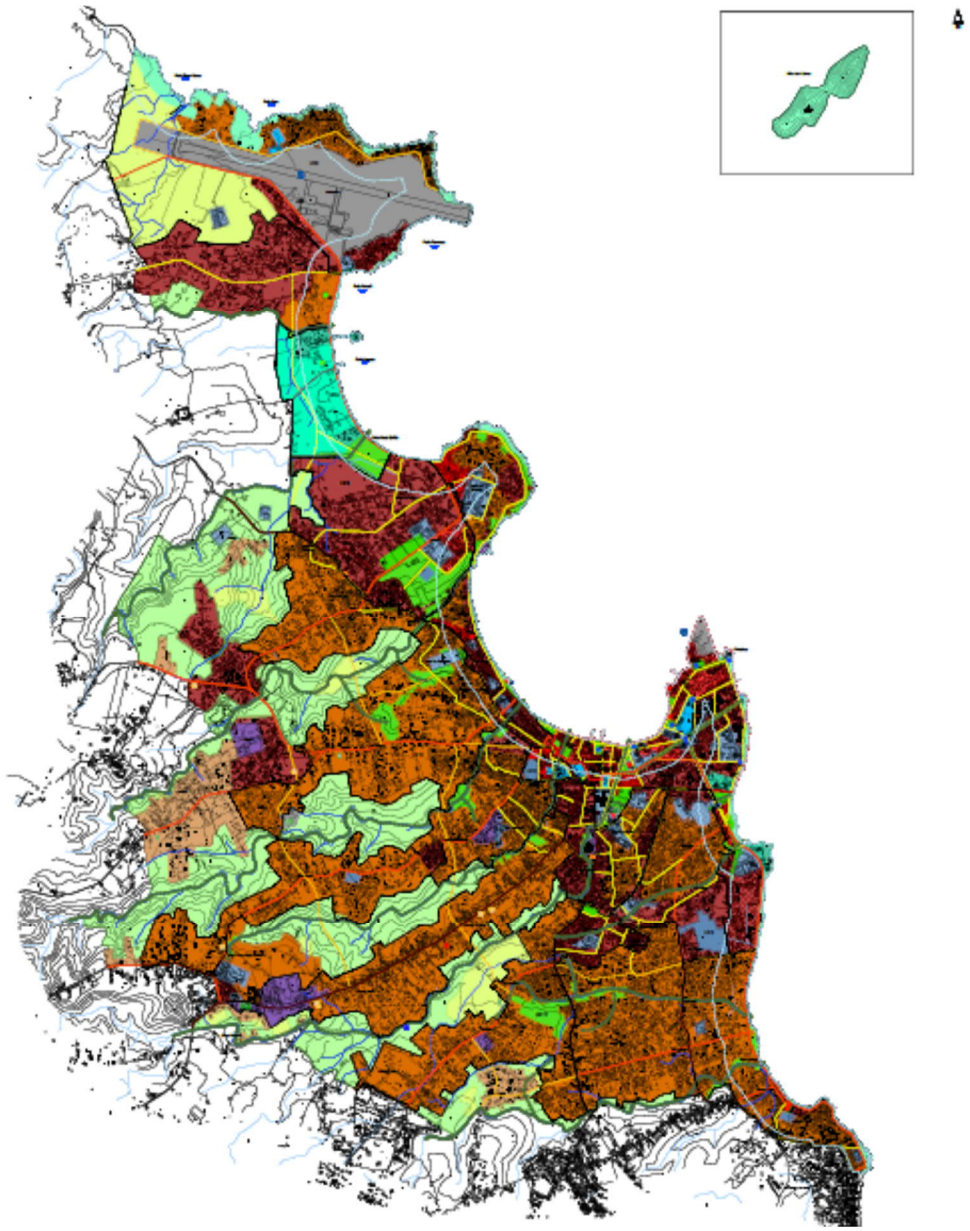


Figure 7 Land Use Planning Map Source: PNOT (2020)

In the Land Use, constraints map PNOT (2020), two inundation risk areas are identified in Emilia Beach and the other in Praia Lagarto Beach, marked in red in the following figure.

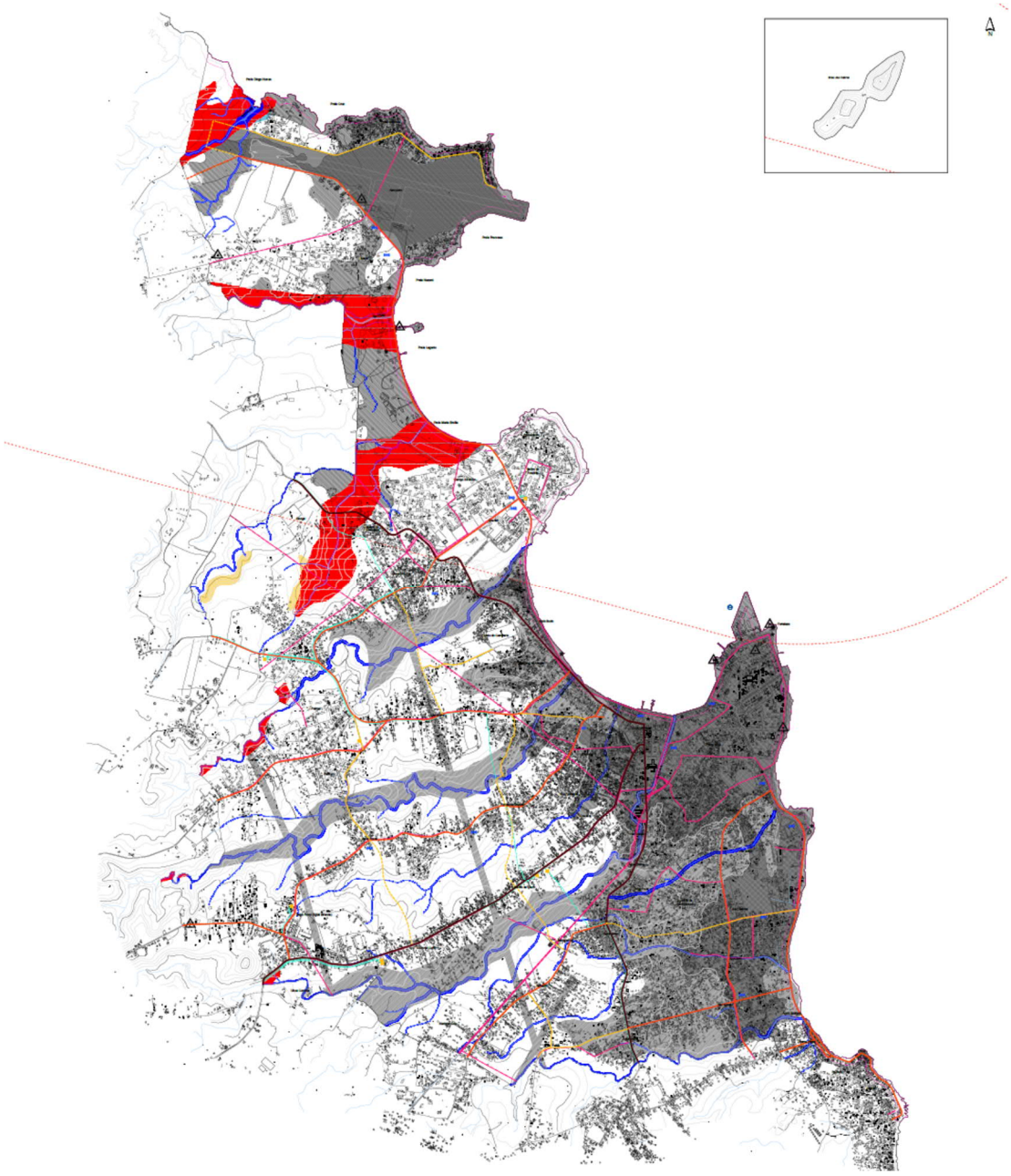


Figure 8 Land Use Constraints Map Source: PNOT (2020)

6. PUBLIC CONSULTATION

In the first phase of the project, a preliminary ESIA was prepared where consultation of stakeholders at all stages of the study, stakeholders were informed and consulted on the progress, options considered, and solutions proposed.

The primary stakeholders represented the different government agencies with a stake in the proposed project. In addition, interviews and discussions were held with the non-governmental stakeholders, like fishermen, street sellers and other persons with interest in the project.

Aspects discussed include: Priorities and preferred solutions; Modalities of implementation (design/layout and technical implementation); Potential impacts of the project. The nature of the proposed project and its location (at the boundary between land and sea, entails limitation of the influence of all stakeholders interested. For alignment of works is more or less fixed, security parameters (affecting dimensions of sea defence work) are a political choice. Everybody encountered favours a project envisaging improved coastal protection and improvement of the Marginal. Each stakeholder, of course, has its wishes and priorities, depending on the area of interest (economic, social). The listing below demonstrates some concerns of the stakeholders consulted:

The Marginal's improvement/rehabilitation is on everybody's wish list, while it is a top priority for the MIRNA.

- COMPREC (Civil Protection Department under the municipality) stresses the importance that the road and coastal protection works will not interfere with or limit the capacity of the outfalls of the streams/canals draining the land.
- Fishermen are concerned about improving and protecting their landing sites, expressing the need to maintain the sites at their current locations since the users typically live close to the landing site. Other points of improvement, brought forward by both fishermen and MARAPA (NGO 'Mar Ambiente e Pesca Artesanal'): 1) provision of toilet facilities, especially near the Old Pier and 2) water supply provisions near landing sites.
- Informal street sellers (vegetable and fish) fear that they would have to vacate their normal 'place of business' during and possibly after completion of the road rehabilitation works. They would be happy if they were given temporary 'sites for business' during construction works and allowed to return to their current place of business after completion of works.
- The concerns of the informal street vendors are also valid for the entrepreneurs exploiting a permanent establishment, e.g. the terrace and kiosk under the trees along Ana Chaves bay and the vegetable stall at the intersection Marginal and National Road EN1.
- Informal street sellers would greatly appreciate when the road surface of the Marginal would be drained appropriately, avoiding pools and stagnant water on the road surface.
- Most citizens of São Tomé would greatly value the continued presence of a sand beach along Lagarto bay. This beach plays an [important role in the cultural life of the people. During certain festival days, people gather at this beach in large numbers.
- The Fort area is considered an interesting location for recreation (swimming, sports) and further tourism development.

In 2021, during preparation of ESIA and in the scope of Stakeholders Engagement Plan prepared for this project public consultation were carried out, three with the communities and one with the Instituitions.

The meetings with the affected people took place in the three bays, the first on 28 June in the Lagarto bays, the second in the morning of 29 June in the Ana Chaves bay and the third in the afternoon of the same day in the Pantufo coastal area.

The meeting for the institutions took place on July 1, where besides the institutions, NGOs, hotels, restaurants etc., were also present. The following table includes the number of participants.

Public Consultation	Date	Local	Nᵉʳ. of Participants Men	Women
Lagarto bay	29-06-2021	"Tia Nanda" restaurant	10	15
Ana Chaves bay	30-06-2021	Salon Piroca de San Pedro	11	27
Pantufo Coastline	30-06-2021	National Lyceum São Tomé	18	12
Institutions and Society in general	1- 07-2021	Centro Brasil São Tomé	8	3
TOTAL			47	57

Table 3 Participants in Public Consultation

From stakeholders engagement and ESIA preparation some aspects are integrated in Design as:

- Laundry (Lagarto Bay);
- Workshop, fisheries (Ana Chaves Bay);
- Bus stop neat National Lyceum (Pantufo Coastline);
- Fitness Park (Ana Chaves Bay);
- Alteration of luminaries for LED low pressure downwards oriented to avoid lighting disturbance in turtles.

A summary of questions and answers are presented next.

LAGARTO BAY PUBLIC CONSULTATION

Question	Answer
Circulation and Access Impacts	
I would like to know what the situation will be for the students who will have to go to school, since the road will be blocked by the works?	With the works it is true that there will be constraints, but the roads can be used for routes, the works will be carried out in such a way as to maintain circulation, even with the difficulties inherent in the works.
When construction begins, what will happen to the children who travel along the road?	The roads will not be completely blocked, only in specific cases and it will not take long. We will also create alternative routes
Won't he barriers that they will put in the road prevent the access to the beaches?	Access to the beach will not be conditioned. There will always be access to the beach
Economic Impacts	
I work from Monday to Sunday, selling fruit by the side of the road. With the construction work, what will my situation be, since I'm a single mother?	There is a plan that you will then make known, plans to resolve situations like this. Remember that we will have other moments when we can talk again.
I am a fuel pump worker, I am sure that with the jobs the business flow will go down. I am worried about my job.	

Question	Answer
I am a motor-taxi, my profession will be very affected by the works, why don't they open another road during the works?	We will open another road, there will be constraints, but there will be circulation.
Will construction companies hire women for their work?	We will not build it ourselves, we are the design and study team, but we can leave it as a recommendation.
Environmental Impact	
When the tide is high, the waves invade the road, I suggest you build barriers that prevent the seawater from reaching the road.	One of the purposes of the project is just that, coastal protection
I wanted to know if the rehabilitation is from the square to the airport, the waterfront is in need of rehabilitation	The project contemplates these locations, the Reconstruction will be from Pantufo to the airport.
Duration / quality of the works	
We often notice that there are very beautiful projects on paper, but when these projects are executed, one notices that nothing is as beautiful as it looks on paper	**INAE** - Normally the projects are made with all the details, what happens is that at the moment of execution, unforeseen events appear that lead the projects to suffer alterations, but these alterations should not be profound
How long will the works last?	The population will be notified of the works in their entirety, before the project begins

Table 4 Lagarto bay public consultation

It was suggested that the road be widened, but the INAE representative said this depends as some conditions may prevent this (hotels, for example).

The population was asked about issues related to the laundries, and they said that the laundries could be improved by creating bathrooms and other enhancements. In the same way, it was also recommended to transfer the laundry located near Hotel Omali, to a place near CFAO Motor (a shop that sells car maintenance).

The lady fruit seller asked that a small kiosk be made like those in San Pedro Bay to give the place more beauty and dignity.

ANA CHAVES BAY PUBLIC CONSULTATION

Question	Answer
The presence of the company makes me satisfied. I've never travelled here, but everyone who sees it says that the marginal road is very beautiful, only that the company that is doing the work should improve the work.	This is another project, and today we are here to present the work team and the project for coastal protection and Reconstruction of the marginal road. The project you are referring to is the Reconstruction works of national road EN1

Question	Answer
In order to carry out these works, will the fishermen and the women who sell the fruit be removed?	We are still on the drawing board, so we can't talk about moving people or not. When things are ready, we will send it to the government to decide. This work has coastal protection aspects. The fishermen should see this.
ask this question because normally the government takes decisions without consulting the population	The waves are breaking. We wanted to know the best thing we could do to improve your lives.
The issue of the sea entering the land is due to sand theft.	The problem is not only due to sand theft but also to climate change. But would you like to move to a place with better security?
We are satisfied with where we are, if they take us away from here, where will they put us?	We are still studying,
We have been selling here for a long time and we already have identified customers, if you take us away from here you would have to put us in a place where our customers easily come to us. Our customers come to us because they are looking for fish fresh from the sea.	You can continue to sell your fish; we will always find an alternative that does not harm your economic situation,
We have been selling here for 20 years, yet we are still harassed by the police here. We always keep the place clean and tidy. If they want to take us away from here the government has to find another solution.	You can rest assured. Before the government implemented projects without looking at the social aspect, not today. We are always concerned with the social issue. In addition, we will carry out a survey to understand things even better, we will go to each one and listen to each one in particular.
There is no toilet, you also have to look at the wind. Where we sell the fruit, we get a lot of wind. The other thing I didn't like is that we are selling fruit next to the fishermen.	**INAE:** We are really here to find out if you feel comfortable where you are or if you can recommend another place.
Where I am is fine. I can earn my income.	
It's fine for me too. My concern is if they send us home, what will our situation be like.	**INAE:** We repeat again that we are not sending anyone home. Our intention is not to make people's lives worse. People will continue as they are, or they will improve their lives.

Table 5 Ana Chaves bay public consultation

PANTUFO COASTAL PUBLIC CONSULTATION

Question	Answer
Environmental Impact	
There are several stranded ships in the bays, I think that in this project they should be removed. This will give a better view of the waterfront.	We will propose to withdraw these vessels
There are sewers leading to the beaches. What will it be like?	The project has nothing to do with environmental sanitation
A lot of rehabilitations have been done, but the trees have been destroying the rehabilitations they do. Will the trees be renewed?	Only the degraded trees will be cut down. The trees on the waterfront are part of the character of the islands.
I am a taxi driver from Pantufo, the village of Pantufo is degraded, I would like them to rehabilitate the centre of Pantufo.	It must be said that the project will only go as far as the crossroads in front of Milu Bonfim
Won't the classes cause noise and disturb the classes? What about the buses, with the construction work, like where will we catch the school bus?	
If there is a delay in the works, to whom will we turn to complain?	Means must be created where anyone can complain about the works
I'm the owner of the petrol station and I've already done some containment works with my own resources to prevent the sea from entering the land and causing coastal erosion. But I would like that area in front of the Equador building to have an intervention as soon as possible, they could put some large stones there, there are some coconut trees there that are beautiful, but they are about to fall.	The project has a coastal protection aspect, which will take into account this issue.
Usually large stones are placed to prevent the sea water from entering the land, but if there are beaches that only have sand, what measures will be taken?	This meeting is to hear from you about what you think of the project and to let you know your concerns about what you will be affected by during the implementation of the project.
Isn't there anyone here representing the Navy, since they say they have authority over the coastline?	**Direc. Environment:** Consultations are being carried out, the studies have not yet been carried out, but there will be other consultations in which the Navy will be present
One of the things they could do to improve my condition is to do coastal protection works. My workshop will be affected if the sea continues to come inland.	One of the components of the project consists precisely in the intervention in coastal protection and
Circulation and Access Impacts	
I would like to know the consequences that the works would have. What would be the duration of the works, and how will the movement of students to and from	In the environmental and social impact study, all details will be studied to ensure road safety

Question	Answer
class be affected, as I have children that I take to school?	
Many families walk along the waterfront it would be good if there were several zebra crossings along the waterfront.	
Economc Impact	
Will there be compensation for those affected?	At the moment we cannot say.
What worries me are the fish sellers, they use the waterfront for their livelihood. How will they be?	We have already had a meeting with them where we talked about various aspects around this. We will deal with it. Thank you for your concern.
Where I am is where I earn my living, but if they have to move me to another location because of the works, it won't be a problem.	

Table 6 Pantufo coastal public consultation

MEETING WITH INSTITUTIONS

Question	Answer
This project has been discussed for a long time, I would like to thank you since it is a very important project. I would like to know if you only want to mitigate the problem of coastal erosion or also to widen the waterfront? We have 1001 km^2, with erosion, the land is being disturbed.	**INAE:** When we talk about upgrading, we talk about improving the waterfront. Due to limited funding, we are not going to widen the waterfront. What is certain is that what has been lost along the waterfront, we will certainly recover. If we notice well, the degradation has not lost the body of the road.
It's a pity it's only that way, a way to prevent coastal erosion should be considered.	**INAE:** In the project there is a coastal protection aspect. We at **INAE** would also like to see the road widened, but due to funding, this is not yet possible.

Question	Answer
For me, this project is very important. But I thought that we would be shown a drawing or a model so that we could see how the works would be. I think that if it were like this, it would give us a greater perception of things, and we would be able to know and issue better opinions on improvements. The other concern is that I would like to know if there is in this project the involvement of institutions such as **DOPU** (Directorate of Public Works and Urbanism), **CST (**Santo Tomé Telecommunications Company) **and INAE** (National Roads Institute)**.** Normally works here are not done without cooperation from other institutions and this results in damage to the works. There should be cooperation with the **DOPU** (Directorate of Public Works and Urbanism)**,** and you should even bring your own inspectors. You should also listen to **EMAE** (Empresa de Água e Eletricidade)	**INAE:** In this type of funding, inspectors will also be from international tenders. **Consultant team:** The public sounding had 3 sessions. The first was in Lagarto bay, 2nd session was in Ana Chaves bay and the 3rd was in Pantufo coastline. Why was this so? In order to be able to hear each stakeholder separately.
This project will affect numerous fishing activities. Along the waterfront we have several anchorages. Will the fishermen who will be affected by the works be compensated?	The project had 3 stakeholder consultation sessions. The first was in Lagarto bay, the second in Ana Chaves bay and the third in Pantufo. Why? To listen directly to those affected, we were in S. Pedro and there we spoke directly to the fishermen, we listened and recorded all their concerns. **INAE:** In this project there are studies that provide for the compensation of affected people. It should be noted that compensation can be more than just financial. For example, it could be rewarding with new boats, improvement of the place where they practice their activities. It may be in other ways, but one thing is certain, we will not let people become poorer.
It is notable that the waterfront needs to be requalified, but I would like to know what specifically they intend to do. I would like there to be a graph showing what they are really going to do. For example, are they going to use a breakwater for coastal protection?	We will have a type of protection adapted to the type of section. **INAE:** you have to understand that the project has several phases, at this stage it is to collect subsidies.

Question	Answer
What I can see from the drawing you presented is that you are going to need space to carry out this project. But if you look at the hotel that I represent, there's not much space. I don't know how they are going to do it. In the Praia Hotel, it may be possible because it is further inland, but in the Omali Hotel I don't think it will be possible without changing the characteristics of the hotel.	Each section will have its own specific characteristics. We will adapt according to the particularities of the roads. We will certainly not affect the OMALI Hotel in a negative way, because what we want is not to make people worse, no, we want to make people's lives better with this project.
I think that for this project, they should involve the Forestry Department. I remember when I was a child, along the waterfront they had trees that offered shade to people. Even on sunny days, people would walk, but they wouldn't feel tired. I think they should look at that issue.	
It is very important for us to be here. The institution I represent has had a lot of problems regarding access to our facilities. Our customers, due to the type of roads in São Pedro, have to go in the direction of Super CKDO and only then return. There should be space for parking in that area.	**INAE:** Road is our specialty; we will put some roundabouts in that project. You have to realise that the waterfront we have today came from a project, so the project we will do will have to be better than the previous project.

Table 7 Meeting with institutions

7. DESCRIPTION OF THE PROJECT

7.1. GENERAL OBJECTIVES

As stated in the Terms of Reference, the assignment's general objectives are to improve the reliability, quality, safety, and resilience to climate change of the Marginal road as a transport and coastal protection corridor. In addition, it should improve safety conditions for road users, including motorized vehicles, non-motorized vehicles and pedestrians on the road and the hinterland.

In particular, the Project shall:

- Improve the connection between the capital and the country's main airport;
- Improve the mobility conditions within the capital area;
- Contribute to the improvement of the overall road network by enhancing the link between the national roads EN1, EN2 and EN3;
- Increase the protection of the coastal stretch along the road against coastal erosion and flooding;
- Increase the attractiveness of the capital's waterfront for both locals and tourism development; and
- Improve accessibility to the coast and the conditions of fishery landing sites.

7.2. ADAPTATION TO CLIMATE CHANGES DESIGN CRITERIA IN THE THREE LOTS OF THE MARGINAL ROAD

7.2.1. INTRODUCTION

The preliminary studies of the project have already carried out a vulnerability analysis that identified the main risks associated with hazards produced by climate change. A detailed assessment of the impact of climate change has been conducted for all relevant variables: sea-level rise, waves, wind and precipitation.

Three hazards with impact on the project area were identified:

1. **Flooding**: due to a combination of heavy precipitation and high coastal and riverine water levels.
2. **Storm intensity:** described by wave height related to the wave that can cause damage to the structure as well as overtopping.
3. **Coastal Erosion:** as a cause of relative sea-level rise.

Based on this, the main problems in the study area have been identified:

- Erosion of the shoreline and beaches;
- Dilapidation and disintegration of seawalls in the Ana Chaves bay and partly at Pantufo Coastline;
- Damaged sidewalk pavements which are collapsed at some places;
- Eroding beaches result in a lack of space for fishermen boat landing sites and impact on potential tourism development (Lagarto bay);
- Occasional overtopping of the waves and flooding of the Marginal Road.

The most significant direct effects of climate change are related to the area's exposure to rising sea levels, floods, submergence of low-lying areas and the erosion of the coastline itself.

In the case of Agua Grande, the most significant direct impacts would be the loss of human settlements, damage to the protection structure itself, damage to the coastal road, and drainage infrastructures. Indirect impacts would be associated with economic losses due to the lack of connection through the road, the need to relocate fishermen, loss of heritage and adverse effects on tourism, among others.

7.2.2. COASTAL PROTECTION

The adaptation of the project considers coastal protection as the primary defense against these impacts. The aim is to avoid the direct impacts with protection elements that prevent structure failure, significant overtopping that affect the road or pedestrians and erosion along the coastline. In the Project areas, actions in coastal protection have been classified according to the state of the existing structures themselves and the need to adapt to future conditions as follows:

- Good: structure has its defence capacity, but some additional measures to reduce overtopping may be needed,
- Damaged: structure needs structural repair, and some additional measures to reduce overtopping may be needed
- Collapsed: structure needs to be replaced

The current beach has a small width at high tide periods in Lagarto bay. This area of the bay is a popular weekend spot for the inhabitants of the city of São Tomé and a potential touristic development. The road is located at a low level (estimated between +1,5 m and +2 m MSL), with no walkways and storm water runoff. Overtopping and coastal erosion are visible on some days of the year.

For the current project, a rock revetment along the northern part of the bay combined with a new road design at a higher level and walkways up to the beach wall is considered the most appropriate adaptation Climate Change measure. In the central and southern part of the bay, beach nourishment is proposed with pedestrian access to the beach and rehabilitates the road by providing it with a walkway, cycle line, and a wall high enough to prevent overtopping.

Along the whole Ana Chaves bay, the coastal protection exists of a seawall. At two locations (western end and at the “tree park”), the wall is collapsed. In most other areas, the main structure of the wall seems to be in relatively good condition.

The western part of the “tree park” has a concrete (or masonry) top wall / upper structure. This wall is about 50 cm of height and too low related to pedestrians' safety and overtopping. Towards the east, around the old jetties, some parts of the upper structure have been replaced by a concrete balustrade. This barrier doesn’t function well against overtopping as it is open.

Based on calculations of the condition of seawall and overtopping, the Consultant has proposed for most of the stretch to place a rubble rock berm / toe for adaptation to Climate Change. The upper structure of the wall is recommended to be everywhere about 1 m high for the safety of pedestrians and to reduce overtopping. This wall shall have a robust design to withstand the wave attacks / overtopping.

The area for fishermen's boats is proposed to be moved to the southern part of the bay by creating a new beach and a place to accommodate the fish market and services buildings for fishermen.

Along the eastern coast, towards Pantufo, there is no major coastal erosion in general. However, the seawall from Fort towards Pestana hotel needs rehabilitation of the upper part. At a few locations, during rough sea conditions, some overtopping occurs. Constructing the upper part as a closed wall of about 1 m reduce this. At a few locations, some rock revetment is recommended to support the seawall.

Just north of Pestana, a rock revetment is proposed as currently there is no coastal protection. South between Pestana and Pirata Bar, coastal erosion is visible, and a rock revetment proposed is the most suitable option.

Adaptation to Climate Change has been carried out considering the sea level rise (SLR) values provided by the IPCC AR5 of 2014. The following report (IPCC AR6) is expected to be published in 2022. However, a preliminary preview of some studies has been considered for this project.

The rise in sea level causes the coastline to recede and increases the wave height and the energy that reaches the coastal protections. For this project, the effects of rising sea levels over 50 years have been considered.

7.2.3. PRECIPITATION

Precipitation is one of the relevant variables to consider to study climate change and its impact on storm intensity and riverine flooding.

The climate of São Tomé and Príncipe is tropical, with one long rainy season lasting nine months, from September through May, and producing an annual average rainfall of 900 mm. The rainy season is interrupted by a short period termed “Gravana”, and occurs during December and January. A decrease in rainfall and average air temperature is observed during this short period.

To identify the risks associated with climate change, quantify their effects and inform the design, the following studies have been consulted:

- “Vulnerability, Risk Reduction and Adaptation to Climate Change”. The World Bank Group 2011.
- “Vulnerability analysis, natural resources and environmental and social impact analysis (ESIA)” from de Agua Grande Coastal Protection Project. March 2019.

The summary of the climate projection by the World Bank Group regarding precipitation, shows the mean annual rainfall increases over São Tomé and Príncipe for late 21st century, under RCP8.5 emissions scenario. This climate projection starts from a reference data period from 1986 to 2005, and provides data until 2100.

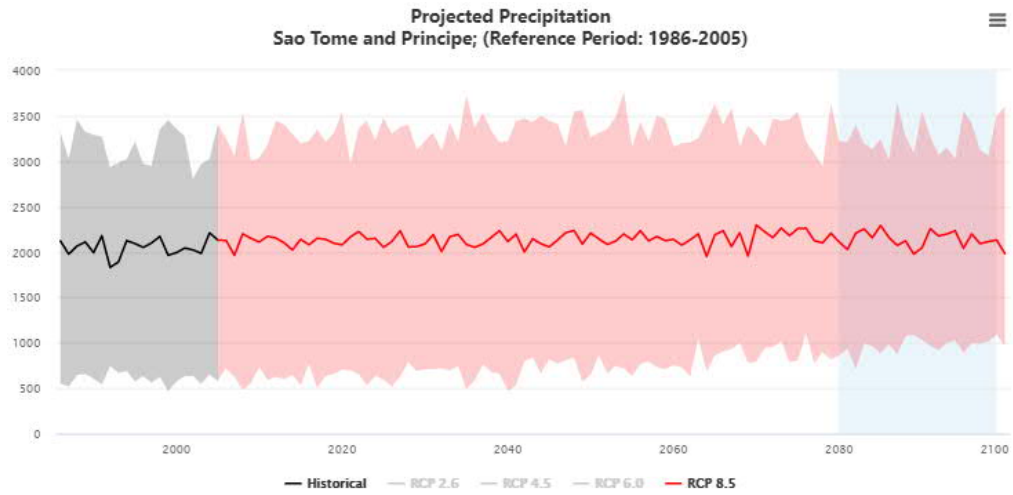


Figure 9 Projected precipitation evolution for the RCP 8.5 scenario in São Tomé and Príncipe (World Bank Climate Knowledge Portal)

On the other hand, the vulnerability analysis from Agua Grande Coastal Protection Project collected the daily observations of rainfall at Storm Total Precipitation in International Airport for the period 1998-2008. However, several significant data gaps were present, so the study “São Tomé and Principe: Adaptation of Climate Change Program” was carried out by Tadross (2011) and requested by UNESCO-IHE and Deltares was used.

From this data, the analysis obtains the daily precipitation for different probabilities. The results lead to a 1/10-year event of about 118 mm/d, a 1/2-year event of about 87 mm /d and a 1/1-year event of about 62 mm/d.

In summary, the study by Tadross suggests a slight increase in daily rainfall intensities with slight increases in the length of the dry season. It suggests using the following calculation assumptions taking into account climate change:

- Precipitation:
  - Dry scenario: -10 %
  - Wet scenario: + 10%
- Evapotranspiration: +5%

In addition, river flooding is another hazard caused by climate change.

According to the vulnerability analysis, from discussion with local representatives and MIRNA information, it appears that urban flooding is not a critical issue mainly because the intense precipitations events are relatively short (< 1hr) and storm water drains relatively quickly. It also indicates the need to design the coastal protection in a way that does not affect the drainage capacity of the system.

As a conclusion for the present project, the wet scenario and evapotranspiration of +5% suggested in the study " São Tomé and Principe: Adaptation of Climate Change Program” are adopted as design criteria for the drainage elements for adaptation to climate change.

Therefore, the maximum daily precipitations obtained for a 1/10-year event is about 142 mm/d, for a 1/25-year event is about 167 mm/d and 1/100-year event of about 204 mm/d.

7.3. PRELIMINARY ALIGMENT REPORT

In the Preliminary Alignment Report (April 2021) some adjustments were proposed for the forementioned Alternative C once the Consultant's multidisciplinary team analysed the alignment in order to determine the feasibility / adequacy at the construction level, determining the main limitations / limitations as road safety recommendations, space available for cross section, possible impact on the facades of closed buildings and other properties, overflow of land, space available to place coastal protection structures, impact on current landscaping (historical / relevant trees to protect), etc.).

Given that the road exists, the new geometrical design will be highly conditioned by the adjoining buildings and all the current accesses so that the changes in plan will respect the Right of Way (RoW). The vertical realignments were expected but small elevations, some of them already proposed in the afore mentioned Feasibility Study.

The process followed the following steps:

- To carefully review the mentioned alternative
- To transfer the geometric design of the Feasibility Study on the topography of the detailed design.

- To carried out an Internal Road Safety Assessment of the Feasibility Study Concept
- To analyze of the alignment by the multidisciplinary team in order to analyze:
  - Road safety suggestions/recommendations
  - Viability / reasonableness at the construction level, determining the main limitations (real space available, possible impact on the facades of closed buildings and other properties, overflow of land areas, space available for coastal protection structures, impact on current landscaping (trees to be protected), etc.).
- To hold a coordination meeting in which each expert comments / proposes his suggestions and reach an agreement.
- To prepare a Version-1 including drawings (plans and typical cross sections) of this Preliminary Alignment Report in order to explain and know the opinions / suggestions of the Promoter in relation to the different typical sections to be adopted along the different sectors of the Marginal Road. For this reason, several meetings have been held between the Promoter and the Consultant.
- To elaborate a Version-2 incorporating Promoter´s suggestions and comments. In general terms, the Promoter agreed with the proposal as long as it meets the following criteria:
  - Designing cycle lanes along the whole of the Marginal Road, or as much as possible and whenever possible from the beginning of Lagarto Bay to Pestana Hotel in Pantufo coastline.
  - Segregation of the bike lane and designing it on the sidewalk whenever possible.
  - Adoption of wide of carriageway 6 with two lanes of 3,0 m and sidewalks whenever possible.
  - To Insert parking lanes, whenever possible, and especially in the vicinity of public and / or commercial buildings, to prevent vehicles from parking on the road obstructing traffic.
  - To Adapt some junctions for functionality reasons.

7.4. LOT 1 LAGARTO BAY (CH 0+000 – CH 2+760)

7.4.1. LOCATION

The Lagarto bay section starts near the Airport, besides the “O Bigodes” Hotel (0+000), continues along Lagarto bay during 1.9 km, crosses inland the promontory between both bays, and ends to the south of Central Hospital of São Tomé, specifically next to the access to CKDO Supermarket (2+760).

Annex 1 presents the Layout for Lot 1 Lagarto bay.



Figure 10 Aerial view of Section 1: Lagarto bay (0+000-2+760)

7.4.2. TRAFFIC

For Detailed Design, an estimation of traffic was made considering background information for the feasibility stage. The new fieldwork was aimed at testing the extent of the effects of the current situation. The effects of the pandemic will probably distort the latest data. Then, the location of the control points to be surveyed coincided with the control points in the previous study. Thus, it may be possible to obtain new Average Daily Traffic data from a two-day survey by applying the coefficients obtained from the previous study and validating or updating the last data.

For traffic forecast, the variables usually involved are considered area Population, GDP and fleet per thousand inhabitants. The process is to gather information from different official and international sources.

- In case of population the source is the PROJECÇÕES DEMOGRÁFICAS DE S. TOMÉ E PRÍNCIPE NO HORIZONTE 2035 of Instituto Nacional de Estatística (INE) of Sao Tomé.
- GDP is taken from the last International Monetary Fund, World Economic Outlook Database, October 2020.
- For motorizing the source is the IV RECENSEAMENTO GERAL DA POPULAÇÃO E DA HABITAÇÃO 2012 (IV RGPH 2012) from INE and World DATA BANK
- The ADT evolution is taken from the traffic observed at the Manga station in EN1. This counting station was also used in the feasibility study. The traffic recorded at this station is verified with different variables to obtain different projection scenarios.

The following table summarizes the traffic forecast on the Lagarto bay sections from the base year 2021 to 2045 each ten-year.

				Pessimistic			Base			Optimistic		
LOT	**SECTION**		**TRAFFIC VOLUME 2021 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**
	PK – PK		**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**
Lagarto Bay	1	0+000-0+360	4.597(30)	6465(42)	7015(46)	7840(51)	6689(44)	10242(67)	12646(83)	8775(57)	14226(93)	19151(125)
	2	0+360-1+820	6.736(44)	9473(62)	10279(67)	11488(75)	9802(64)	15008(98)	18530(121)	12858(84)	20846(136)	28062(183)
	3	1+820-2+760	10.407(29)	14635(41)	15881(44)	17749(49)	15144(42)	23187(65)	28629(80)	19865(55)	32206(90)	43356(121)

Table 8 Lagarto Bay sections from the base year 2021 to 2045 each ten-year. Source:RD6767-FD-L1-SR-SumRep-D01

7.4.3. DESIGN SPEED

The design speed has been adopted according to the geometric characteristics of the road (horizontal and vertical) and its urban character (many accesses to properties and other streets).

- The design speed throughout the section is 50 km/h. But in some sections where the available space did not allow to create a segregated cycle lane, the Feasibility Study section (1.5 m suggested cycle lane + 4 m carriageway + 1.5 suggested cycle lane) has been maintained and speed limit has been reduced at 30 km/h.

7.4.4. Typical section

The configuration is a single carriageway with one lane in each direction. In the first 1.800 m, we have parking areas where the section allows it. Regarding the cross-section, the vehicular lanes proposed within road are 3,0 meters wide, and the proposed footpaths along the entire route are 2,0 m wide. A 2,5 m wide cycle lane (two-way traffic) is also proposed along Lagarto bay, up CH 1.800. This lane diverts to an area shared by the promontory road to the CKDO supermarket. Other Typical sections for Lagarto Bay are presented in Annex 2.

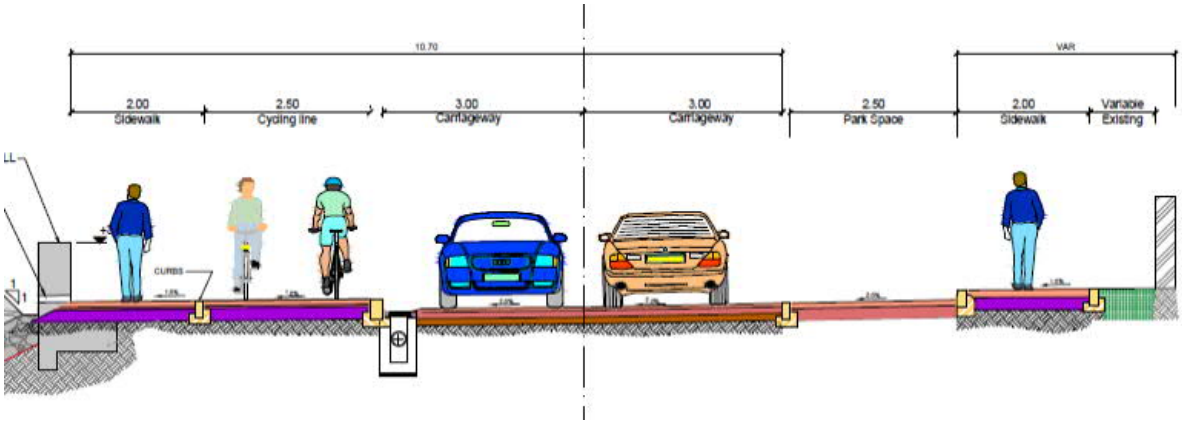


Figure 11 Typical section - Lagarto bay, Sao Tomé

From CH 1800 to CH 2760, the typical section consists of a lane for each direction, 3.0 m wide. Two sidewalks are also proposed on both sides of the 2 m wide.

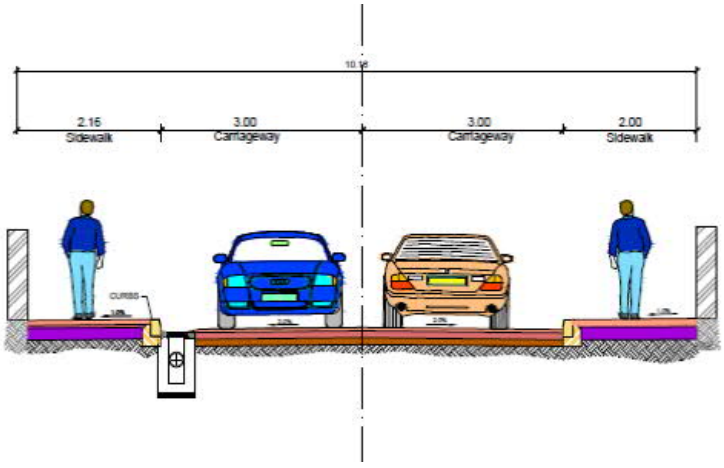


Figure 12 Typical section - Lagarto bay, Sao Tomé

7.4.5. DRAINAGE PROPOSED SOLUTION

As referred to in section 7.2.1.3 the design takes into account adaptation to climate changes, and the following design return periods are considered to the drainage study:

- 25 years for carriageway drainage
- 100 years for culverts

Two culverts will be affected by the new road. The remaining drainage elements, of which we only know its discharge point into the sea, will be considered elements to be demolished or replaced during the civil works.

Chainage (CH)	Existing Drainage				Affected by new road (Yes/No)	Comments
	Name	N	width / diam (m)	height (m)		
0+448	OF24	1	3,96	1,70	Y	Culvert/bridge
1+335	OF23	2	4,60	1,40	Y	Culvert/bridge

Table 9 Lagarto bay. (0+000 - 2+760). Existing culverts

The culverts affected by the road have been studied to review the existing hydraulic capacity. A new culvert with sufficient discharge capacity will be proposed if this structure does not have enough discharge capacity.

Thus, the culvert at CH 0+448 is proposed to be replaced by a 4,60 x 1,40 m twin boxes and the culvert at CH 1+335 is proposed to be replaced by a 4,60 x 1,40 m triple boxes.

Stream Names	Chainage	Section (m)	Peak flow(m^3/s) T 100 years
02 Agua Palito	0+448	3,96 x 1,70	21,88
02 Agua Melo	1+335	2 # 4,60 x 1,40	36,49

Table 10 Culverts analysed

7.4.5.1. Structure in CH 0+450 (Lagarto bay)

The platform length dimension of the existing structure does not accomplish the dimensions requirements of the projected new road. Therefore, an increase of 5,10 m in the structure length is proposed.

For this purpose, both parts of the structure, old and new, have to be designed with the same structural typology. Decks must be joined to avoid longitudinal displacements joints which are inconvenient for traffic scope. Displacements are considered not feasible in this case due to:

- Unfavourable conditions of the visible parts of the structural elements, deck and abutments, and uncertainty about the condition of the not visible parts make that type of approach impossible. In this case, the retrofit process required is considered not appropriate by its high cost and by not guaranteeing a proper behaviour of the final complete structure.
- In addition, the impact on traffic due to the construction works for a new structure to substitute the existing one would be not greater than the impact produced for the construction works of retrofit and enlargement, according to the process later defined.
- A very important point has to be noted: the current length of the existing structure is too short compared to the stream's width, producing a strangle of the water flow.

Consequently, a new structure is proposed as a better solution to replace the existing one. The design of this structure is planned to ease the traffic diversion during the construction works. To achieve this, the design will consider the construction in two phases. The first phase will be designed a new part parallel to the existing structure and with an extra width enough to let the traffic diversion during the second phase. During this first phase, the traffic will keep crossing along with the existing structure (with the caution measures needed in a construction works zone). After the first phase finishes, the traffic will be diverted along it, the existing structure will be demolished and the second phase of the new structure, joined to the first, will be executed to complete it.

The dimensions of the new structure will be 13,60 m total length, with two spans of 4,60 m free length each one, and 13,50 m width, 5,10 m in the first phase and 8,50 m in the second phase. This total length is similar to the stream's width, avoiding the strangle effect previously commented. The extra width compared to the theoretical (2,30 m) can be used to support the parapet, pedestrian use and disposal of ducts for services.

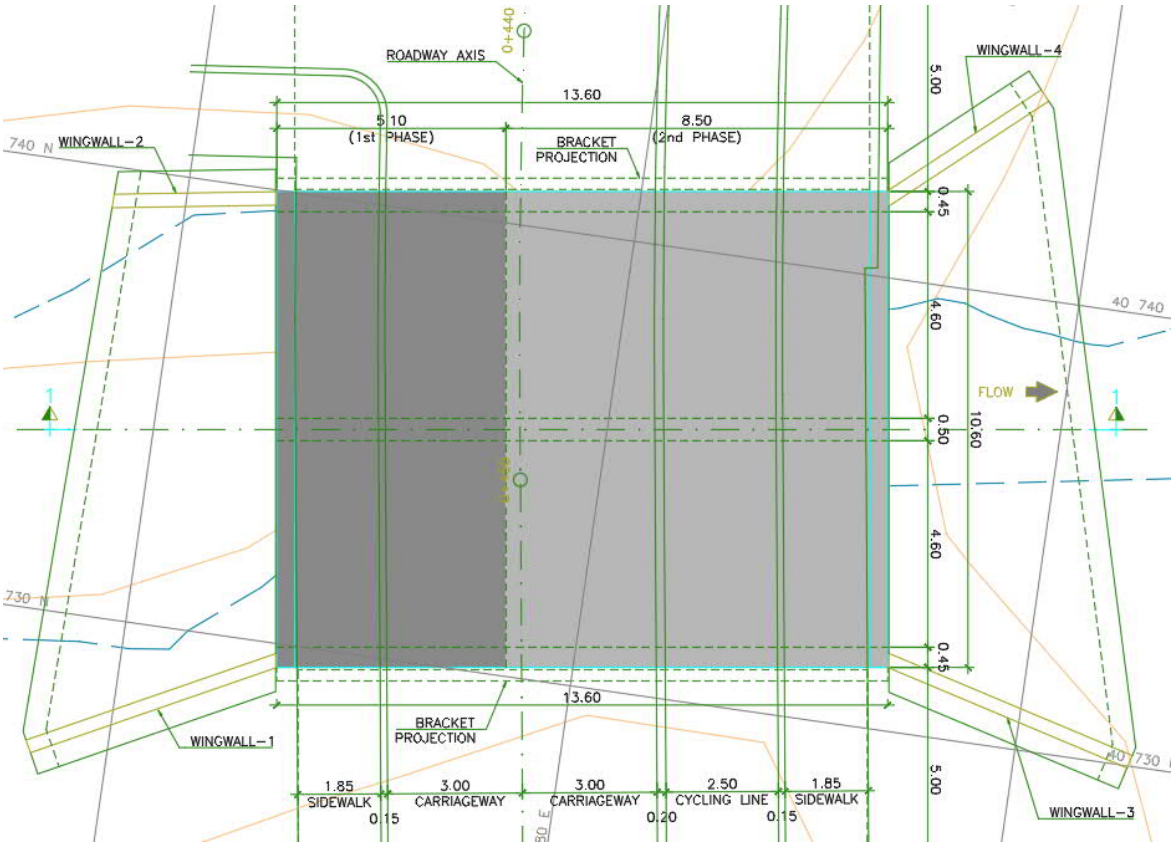


Figure 13 New structure proposed CH 0+450 (Lagarto bay)

7.4.5.2. Structure in CH 1+340 (Lagarto bay)

The platform length dimension of the existing structure does not accomplish the dimensions requirements of the projected new road. Therefore, an increase of 6,20 m in the structure length is proposed.

As for the previous structure, if increasing the width of the existing structure with a new one seems feasible, both parts (old and new) should be designed using the same structural typology, and the decks should be joined to avoid longitudinal movement (inconvenient for traffic). This type of performance is considered not feasible in this case due to:

- The bad condition of some visible parts of the structural elements, mainly the decks, and the logical uncertainty about the condition of the not visible parts make that approach not recommendable.
- The poor understanding of the design of the current structure (especially its foundation), to be a mix with some elements of the shortest structure previously exiting there, complicates the possible design of an enlargement.
- The great limitation to the water flow due to the existence of the old structure and having one span completely closed produces an important effect of strangling for the water flow.

Moreover, the affection to the traffic due to the construction works of a new structure to substitute the existing one would be not greater than the affection produced for the construction works of rehabilitation and enlargement, according to the process later defined.

A new structure is consequently proposed as the best solution. The design of this structure is planned to ease the traffic diversion during the construction works. Therefore, the new structure will be constructed in two phases. In the first phase, a new part parallel to the existing structure will be designed, with extra width (enough to let the traffic diversion in the second phase). During this first phase, the traffic will keep crossing along with the existing structure (with the caution measures needed in a construction works zone). When the first phase of the new structure is finished, the traffic will be diverted along with it, the existing structure will be demolished, and the second phase of the new structure, joined to the first, will be executed to complete it.

The dimensions of the new structure would be 14,10 m total length, with 4,60 m free length of each span and 15,70 m width (6,20 m in the first phase and 7,90 m in the second phase). The construction works will include cleaning the stream area to have functional both spans of the new structure. The extra width respect to the theoretic (1,40 m) can be used for support of the parapet, pedestrian use and disposal of ducts for services.

7.4.5.3. Road and sidewalks drainage

The typical section that can be found along the new road are the following:

- One parallel drainage system (seaside) according to platform road design (cross section and road profile). Inland sidewalk and the entire width of the road (including park space were defined) drains towards the seaside curb.
- The flow on the sea sidewalk will be conveyed with a semi-circular channel and diverted directly to the sea through weep holes.

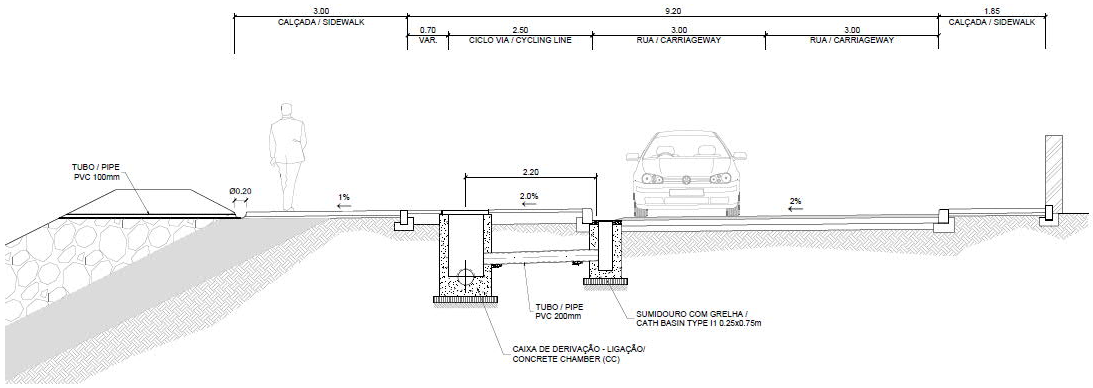


Figure 14 Typical section Lagarto bay without park space (0+000 – 1+880).

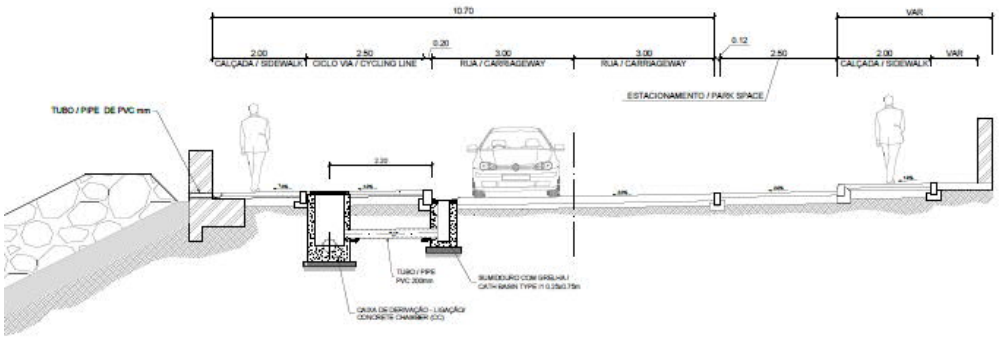


Figure 15 Typical section Lagarto bay with park space (0+000 – 1+880).

- A main pipeline on the right side is defined at the hill transition, with inlets every 15m, situated at the roadside gutter. On the left side, an adjacent gutter is defined with inlets to catch the run-off water with crossing pipelines to convey it to the main pipeline.

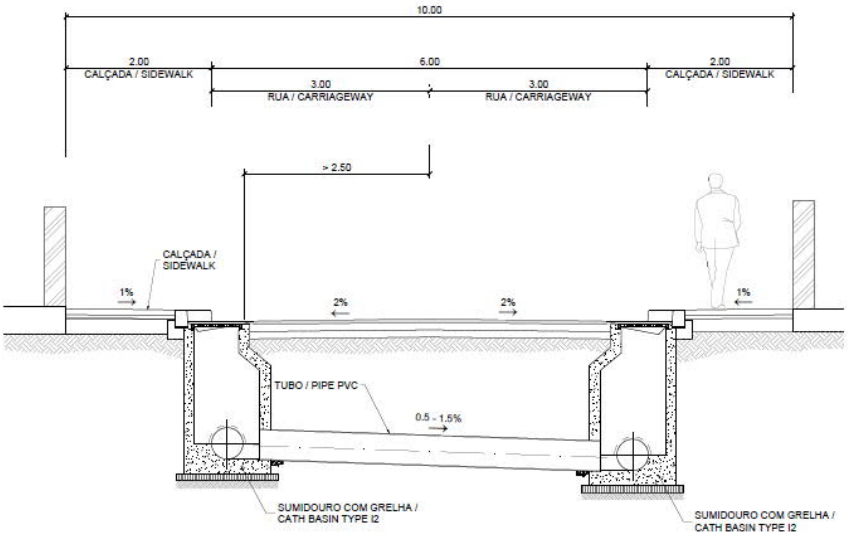


Figure 16 Typical section Lagarto bay (1+880 – 2+760).

The correct functioning of the longitudinal drainage system is essential for safety road. Longitudinal drainage ensures the rapid flow of surface water over the platform, ensuring pavement protection. To ensure this, a hydraulic checking has been carried out using the software MicroDrainage 2020.1.

7.4.6. PAVEMENT

These proposed interventions are based on the existing built-up pavement, the visual pavement assessment, the traffic study and the respective forecast and consideration of drainage continuity and constructability in relation to the existing pavement.

In terms of sustainability, conserving materials is the first option to maintain existing pavement structure instead of new pavements, but it will depend on condition of the pavement layers.

- At Marginal Road:

  Based on the Dynamic Cone Penetration (DCP) investigations, the unbound layer of the pavement presents very good strength, and it recommends to maintain and reuse. On the contrary, due to the condition of the asphalt layer (only a wearing course of 3 cm average), the surface layer should be planned before overlays and before the design of new asphalt layer. In sections where road level will be raised up, regulating base course or granular base will be laid under asphalt layers, in the quantities required to be heightened. All pavement will widen to a minimum of 1 meter at subgrade level as necessary to accommodate the roller at least 3 ton mass at all locations.

- Park space: Parking areas will be constructed with interlock concrete cobblestones with 8 cm thickness. Under the blocks, a 5 cm mortar bed, serving as a support base for the blocks and a 15 cm thin concrete layer, will absorb the vertical loads coming from the road traffic. The concrete layer should be laid on a 15 cm granular base as a minimum.
- Cycle path along Promontory:
  - Interventions consist of replacing pavement with bad condition and new concrete pavement on the unpaved central reserve. The section will be constructed with a 15 cm unreinforced concrete slab over a 15 cm granular base. Joints will be placed between the central reserve and wheel track lane between the concretes.
  - At the section from CH 1+420 to CH1+600, where there is no pavement, new concrete pavement is projected as the section mentioned above.
  - From 1+620 to the end of the promontory road (CH 1+860) where there is asphalt pavement, the proposed interventions plan the surface road and inlay 4 cm of asphalt wearing course. This intervention includes the CKDO's parking.

7.4.7. LANDSCAPING

The proposed intervention seeks to protect and improve the current space through the following actions:

- Creation of a paved pavement on both sides of the road with basalt cobblestones in the pedestrian area near the sea and concrete paving on the residential side.
- Creation of pedestrian space accessible to all passers-by with pedestrian fords, special paving and handrails to create a barrier-free public space.
- Creation of a cycle lane at pavement level with a concrete pavement that allows cycling along the entire length of the promenade. The decision to create the cycle lane at pavement level offers cyclists greater safety from road traffic. Also, it allows for the extension of pedestrian space when no cyclists are circulating.
- The creation of road fords with a maximum gradient of 20-30% for car access to private plots adjacent to the promenade.
- The relocation of the existing urban installation networks buried and complying with the minimum safety distances between them and aesthetically improving the urban space of the promenade.

- A new lighting design guarantees the correct illumination of all the spaces within the area of intervention. It creates an overall image between the different bays that extend along the promenade. The proposed lighting runs along the pavement adjacent to the building plots, allowing the illumination of the entire promenade, i.e., the road and pavements on both sides.
- New urban furniture is placed, such as concrete bins every 40 m and benches every 100 m approximately.
- A space on the side of the promenade adjacent to the sea between km CH 0+120- CH 0+320 of the road, which allows the development of a recreational area that includes;
    - A green area with shady trees and shadowed rest areas with benches.
    - A children's play area.
    - Lighting to enhance the value of the new recreational area.
    - Street furniture close to the sea (resistant to corrosion and vandalism):
        - Concrete bins.
        - Drinking water fountains in recreational areas.
        - Bike parking.
        - Benches: The benches are made of recycled concrete and glass. Currently, a local company makes urban furniture with these materials with interesting aesthetic results, mixing new designs that play with straight and curved geometric lines depending on the public space design, with others that recover the aesthetics of colonial models.
- To reduce the impact created by the new maritime protection wall along the promenade, a tile cladding is proposed as a solution that requires less maintenance (without the need for periodic coats of paint). It is easy to implement and provides beauty and identity to the wall. The wall is reused and it is proposed to make it larger in certain sections along the promenade to create new areas of benches.
- At CH 1+860 it is proposed to locate a new building, a wash house to allow the washing of clothes which is currently done on the Lagarto beach where there is a water access point. This measure aims to improve the current situation of the population by offering suitable space for the washing activity that is recurrent in their day-to-day lives in the public area due to the lack of water in their homes.

For green areas along the bay under study, the main tree species present are:

- Coconut palms (Sea steely);
- Evergreen woody trees, mainly Indian Almond (*Terminalia catappa*) (House sidewalk),

These trees are considered cultural heritage because they create a specific atmosphere typical for São Tomé city, its parks and promenades. This is why all trees in good condition and that do not represent a problem or danger to pedestrians within the public space are protected.

Along the pavement adjacent to Lagarto bay, there are no plans of proposing new trees due to the limited space of the pavement (approximately 2 m), and the alignment of coconut trees is maintained. The shaded walking space is on the other side of the pavement next to the houses where the large Indian Almond trees are located.

When a tree is occasionally affected by the new layout of the promenade, as well as in the case of existing trees that imply a danger to pedestrian or damage to the road or coastal protection works, it should be replaced by young saplings of other local tree species, salt resistant and that provide shade. A new species will always be placed close to the affected one, looking for the best location without compromising pedestrian accessibility. Another solution taken to respect as much as possible the existing trees on the sidewalk and to allow pedestrian access is to propose enclosed tree surrounded with electro-welded grating

In the case of the bay under study, the affected species and new proposals are detailed below:

- 36 new tree species (*14 robusta washingtonianas*, 17 *karroo acacias* and 5 tamarinds, or similar);
- 16 tree species affected (12 *coconut palms* and 4 *terminalia catappa*, or similar),

Annex 3 presents trees affected.

7.4.7.1 LAUNDRY

A Laundry is proposed to CH 1+880. Annex 4 presents location of Laundry.

It has been estimated for the available space a covered area to accommodate a double arrangement linear development that allows the simultaneous use of up to 9 people on each side, estimating that each one will need a minimum of 95 cm of washing basin to work comfortably. In addition, it is proposed to adapt the accesses by leveling the land by covering the floor with bricks, slabs or stones and providing an area of vegetation with shade trees that allow helping soften the temperature and environmental humidity of the site.

Likewise, there will be the provisions for electrical and water supply which allow the correct use and maintenance of the installation:

- Electrical supply for lighting.
- Water supply for clean water drawer.
- Installation of sanitation and drainage for evacuation.
- Installation of rainwater evacuation.

There will be a closed space for control of electrical and water supply.

All this is distributed according to the following table:

All this is distributed according to the following table:

	Total	Units
Total building area	40	m^2
Estimated minimum area per washing basin	1	m^2
Total Washing basins	18	units
Total area of the facility	105	m^2
Access area	40	m^2
Garden area	19.50	m^2

Table 11 Laundry areas

Agua Grande District Council will do maintenance of infrastructures.

7.4.8. COASTAL PROTECTION STRUCTURES DESIGN

A Concept Design prepared by CDR international for MOPIRNA, has been completed to identify alternatives for the construction of coastal protection infrastructure and the reconstruction of the Marginal Road. **Alternative C** has been selected as the preferred option.

TYPSA assess the preferred solution (alternative C) presented in the Concept Study and propose minor variation or correction to adjust alternative C.

Coastal protection of alternative C in Lagarto bay mainly consists of installing a rock protection restoring the existing armour stone. Within this Draft Detailed Design, the main variation from Concept Design is that a beach nourishment in the central and south part of Lagarto bay is proposed.

The reasons are the following: 1) to keep existing use of the area due to new armour stone protection reduces beach area, 2) this variation goes in line with the fifth specific objective of the project "*v) increase the attractiveness of the capital's waterfront for both locals and tourism development",* and 3) this sand contribution reduces wave agitation within the bay dissipating wave energy.

A comparative table between alternative C of Feasibility Design and Draft Detailed Design is shown below.

	FEASIBILITY DESIGN Alternative C	DETAILED DESIGN
Number of typical cross section designed	1	3 (Z1A, Z1B and Z1C)
Revetment	Revetment with crest at +3 m M.S.L. Armour rock 0,3-1,0 t. No seawall.	Z1A Revetment crest at +3 m M.S.L., Armour rock 1.5 – 2.8 t. Seawall up to +4 m Z1B Revetment crest at +3 m Armour rock 0.7 – 1.4 t. Seawall up to +3.5 m Z1C Revetment crest at +3 m M.S.L., Armour rock 0.3-0.5 t Seawall up to +3.5 m
Geotextile	YES	YES
Proposed beach nourishment	NO	YES CH 00+800-01+860

Table 12 Comparative table between Feasibility-Alternative C and Draft Detailed Design. Source: Own elaboration

A rock revetment is proposed to protect the road and coastline because in the present situation the beach is limited and is gradually eroding. The excavated sand to build the revetment will be placed at the beach location.

Three different sections are designed along Lagarto bay.

First section consists on installing a main protection of rocks 1.5-2.8 tons till +3.00 m r/MSL. A filter layer of 70-150 kg is placed under the main protection. The crest of coastal protection is crowned by a concrete wall that reaches +4.00 r/MSL. Additionally, a geotextile is placed between rock protection and natural terrain to avoid loss of terrain

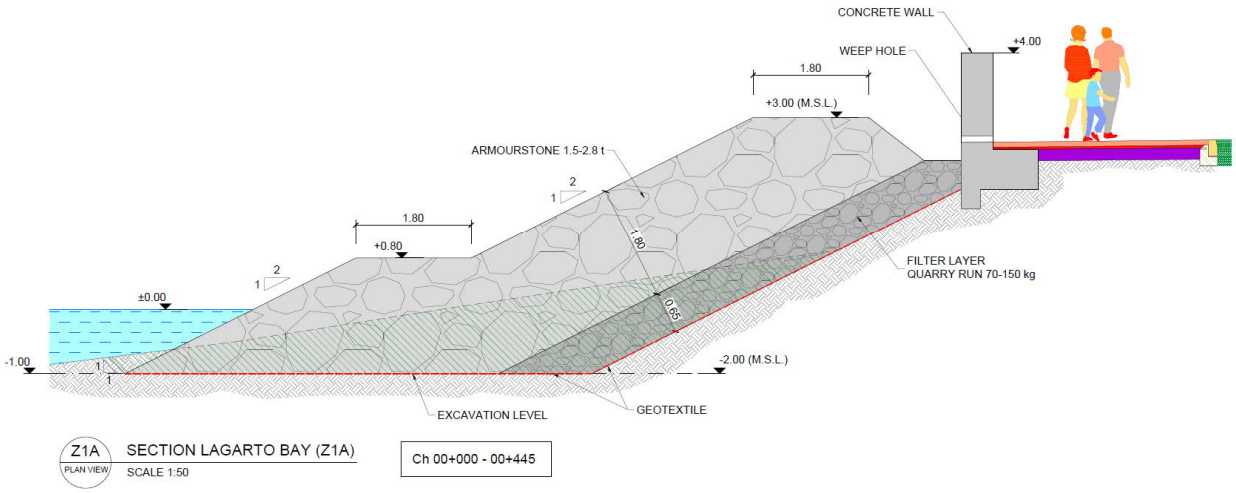


Figure 17 Typical cross section Z1A. Lagarto bay (CH 0+000 – 0+448)

Second section consists on installing a main protection of rocks 0.7-1.4 tons until +3.00 m r/MSL. A filter layer of 35-75 kg is placed. To crown the coastal protection a concrete wall that reaches +3.50 r/MSL and a geotextile between rock protection and natural terrain is placed.

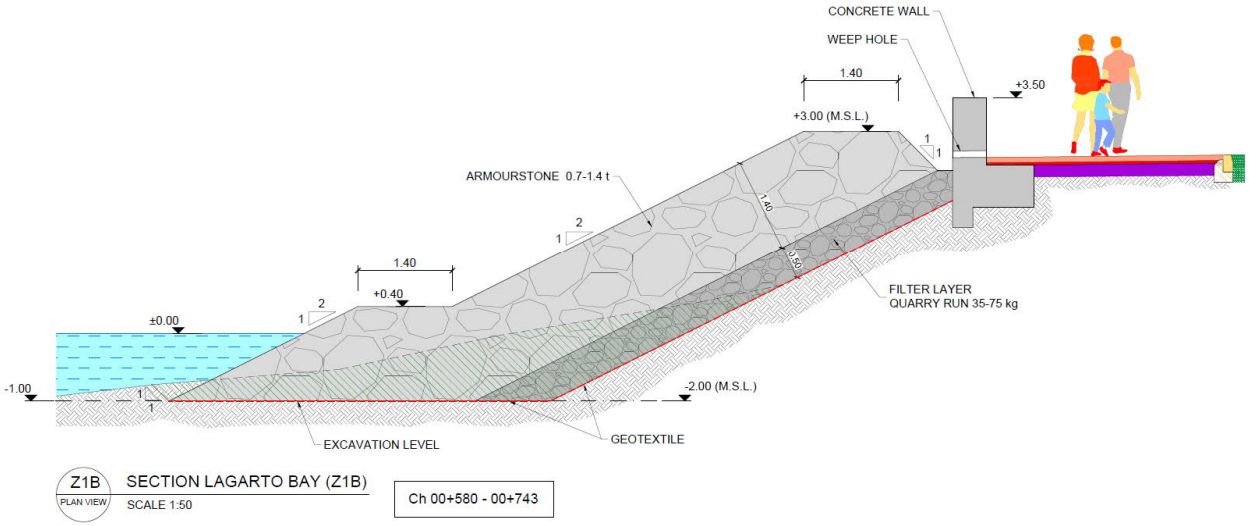


Figure 18 Typical cross section Z1B. Lagarto bay (CH 0+580 –CH 0+743)

Third section consists on installing a main protection of rocks 0.3-0.5 tons till +3.00 m r/MSL. A filter layer of 15-30 kg is placed. To crown the coastal protection a concrete wall that reaches +3.50 r/MSL is proposed and also a geotextile between rock protection and natural terrain.

.

Furthermore, to keep existing use of the area a beach nourishment is considered, also this sand contribution reduces wave agitation within the bay dissipating wave energy. This typical section is foreseen to CH 0+ 800 – CH 1+335, CH 1+345 – CH 1+740 and CH 1+750 – CH 1+860.

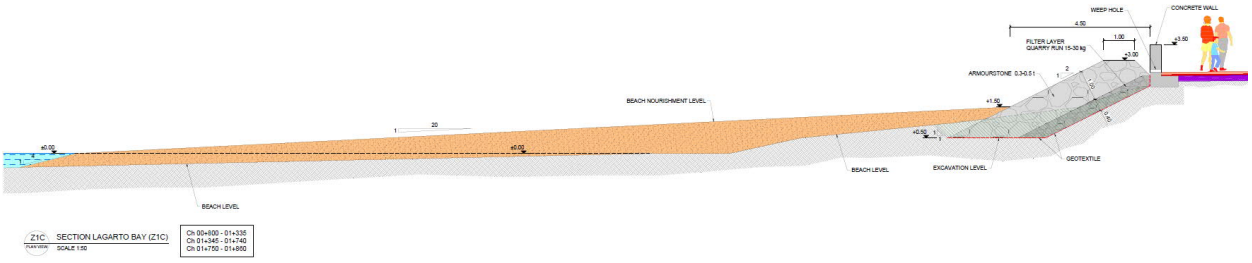


Figure 19 Typical cross section Z1C. Lagarto bay

7.4.9. ANCILLARY WORKS

7.4.9.1. Water supply network

In the scope contemplated in the project, it is foreseen the integration of different independent services, infrastructures, such as: Supply to Sources and Services and Supply for Irrigation from the existing drinking water network in the city.

The affected are made available according to the location of the service under the project.

Dripping will be carried out through PE80 polyethylene pipe with smooth inner wall, with a nominal pressure of 1.0 MPa (10 atm), for the river, and 1.6 MPa (16 atm), for spring and ornamental fountain.

7.4.9.2. Irrigation installation

The pipes will be made of plastic, resistant to tolerances and acid substances. In all the irrigation network will be used PE80 polyethylene pipes, resistant to UV radiation.

DN40 and PN 16 armoured irrigation channels will be installed, consisting of a hoop, body and cover made of ductile cast iron with a built-in valve and a 45 mm coupling for connection to the hose, in each of the green and gardened areas according to the irrigation flow rate of each area.

7.4.9.3. Fountain installation

One fountain will be installed according to the location represented on the drawings. The supply pipe for these fountains will be made of PE80 polyethylene with a nominal pressure of 16 atmospheres (PN16). This pipe will be 32 mm in diameter and will be connected to the nearest existing water mains.

Manholes will be installed in the branches or connections to the existing drinking water network.

The model chosen is a modern rectangular shaped fountain, with the foundation fixed by means of LM-18 shaped anchors made of 3mm steel plate, cast iron grid in the drain and push button in nickel plated brass.

A drainage pipe must also be installed to conduct excess water to the rainwater drainage system.

7.4.9.4. Lighting

The public lighting system will consist of luminaires at the top of columns or poles which will be connected to their own low-voltage electrical network (service voltage of 380 V between phases and 220 V between

phase and neutral) which will have the appropriate protection and control systems for switching the installation on and off in safe conditions which will allow both the correct lighting of the roads and energy saving by adapting the lighting periods to the hours when the system needs to be used.

For the protection of people and equipment, all luminaires shall be earthed by means of a separate earth plate located near the base of the pole.

The distribution of the luminaires on the roads has been carried out taking into account both technical criteria related to the level of illumination and urban planning criteria associated with the distribution of singular elements on the edges of the roads (pedestrian crossings, cycle and pedestrian crossings, green areas, etc.).

The electricity supply required for this installation will be provided from the low-voltage side of the existing power transformer stations in the project area.

From the low-voltage circuits assigned to the lighting installation, control and protection cabinets have been designed which will control the switching on of the luminaires according to the time of day and the intensity of the natural lighting. The on/off thresholds of the installation will be set at the start-up of the installation in such a way that they adapt as well as possible to the needs of the area and may subsequently be adapted to other thresholds depending on the experience of use that is acquired.

The electrical distribution network has been designed with single-pole LXV 0.6/1 kV cables with aluminium conductors and a minimum cross-section of 16 mm2. This selection has been made taking into account both installation safety criteria and simplicity in the construction and maintenance of the installation.

7.4.10. UTILITIES RELOCATION

The proposed interventions in the Lagarto bay are the following:

In the proposed action in the bay under study, a trench is executed under the pavement next to the houses where the existing and new networks are buried and channelled following these criteria:

- **The existing lighting network** will be demolished, and a new network is proposed with streetlights that provide adequate light power to illuminate the entire section of the promenade, in addition to complying with an aesthetic in accordance with the rehabilitation of the bay and creating a uniform image and continuity with the rest of the bays. These streetlights will be connected to the lighting cabinets located in the transformation centers near the road, which will be in charge of providing electrical energy to them. These lighting cabinets will house all the lighting protection and control elements.

- **Existing medium and low voltage** underground conductors will be extracted from the pipes and trenches that are located along the promenade, and will be relocated in tubes destined for medium and low voltage in the new proposed trench.

  The existing sections with overhead low voltage distribution line will be removed, and will be replaced by conductors with the same characteristics as the underground conductors for low voltage distribution. These new conductors will be placed in the pipes intended for low voltage distribution in the new trench.

  In addition, the existing electric service connections that supply electricity to homes and facilities along the promenade will also be replaced by new ones, adapting to the new location of the different electrical distribution networks.

- **Existing telecommunications network:** underground telecommunications network will be relocated along the new proposed trench layout, inside the pipes intended for such use, while the overhead

network will be eliminated, replacing the cables with new ones suitable for installation inside the pipes of the proposed trench. These cables must have the same characteristics as the existing underground cables.

In addition, the existing telecommunication service connections that supply the homes and facilities along the promenade will also be replaced by new ones, adapting to the new location of the different telecommunications networks.

- This **existing water network** will be relocated in a new trench parallel to the electricity and telecommunications trench, maintaining the regulatory distance between them.

  In addition, the existing water service connections that supply the homes and facilities along the promenade will also be replaced by new ones, adapting to the new location of the pipes.

The proposed sewerage network must always run under the rest of the previously collected networks, as it is a network that collects contaminated water and could affect the drinking water network.

7.5. LOT 2 ANA CHAVES BAY (CH 2+760 TO CH 5+900)

7.5.1. LOCATION

The Ana Chaves bay section is the most densely urbanised section of the Project as it contours the centre of the capital. The length of this section is 3+140 m.

Begins in the access to CKDO Supermarket (2+760), continues along Avenida 12 de Julho passing several landmarks: intersection (round about) with EN1 National Road (3+700), Avenida Agua Grande (4+800), Post Office (5+100), Parque Ucla (5+150), Praça da Juventude (5+650 and finally the Forte de São Sebastião (5+900).

Annex 1 presents Layout for Lot 1 Ana Chaves bay.

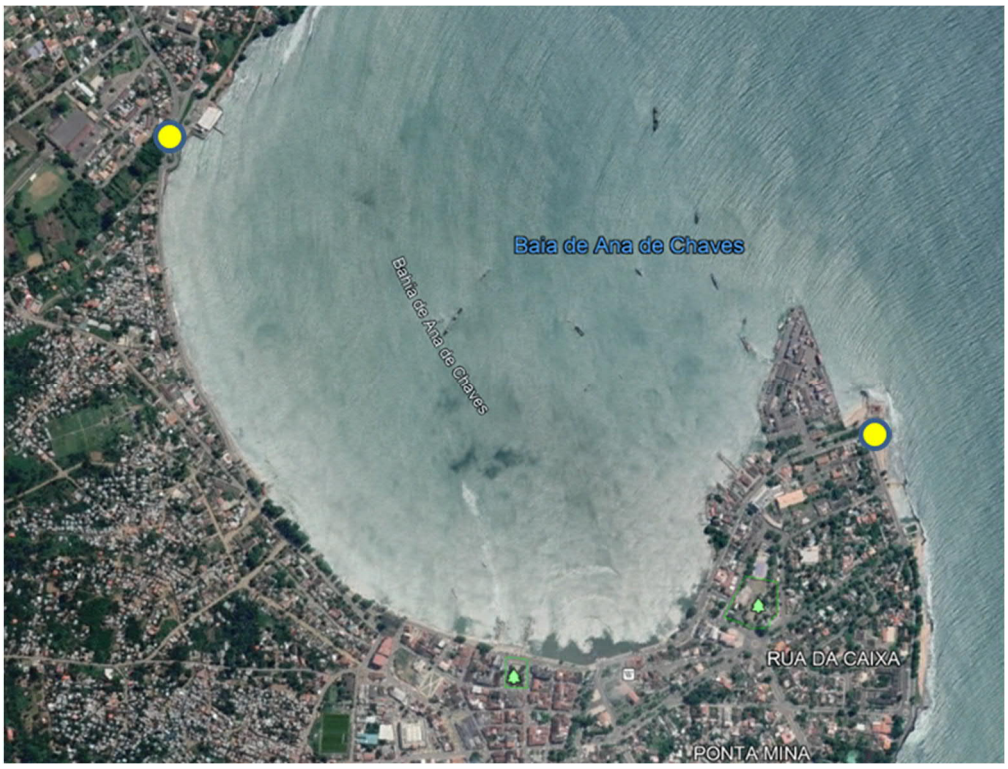


Figure 20 Aerial view of the Section 2: Ana Chaves bay. Ch. 2+760 – 5+900

7.5.2. TRAFFIC

The following table summarizes the traffic forecast on the Ana Chaves bay section from the base year 2021 to 2045 each ten-year.

				Pessimistic			Base			Optimistic		
LOT	**SECTION**		**TRAFFIC VOLUME 2021 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**
	PK – PK		**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**
Ana Chaves Bay	4	2+760-3+860	11.181(31)	15724(44)	17062(47)	19069(53)	16270(45)	24912(69)	30758(85)	21342(59)	34601(96)	46580(129)
	5	3+860-4+080	26.488(128)	37250(180)	40421(195)	45176(218)	38544(186)	59016(285)	72867(352)	50560(244)	81972(396)	110350(533)
	6	4+080-4+500	17.661(78)	24837(110)	26951(119)	30121(133)	25699(114)	39349(174)	48584(215)	33711(149)	54655(241)	73576(325)
	7	4+500-4+700	19.047(85)	26786(120)	29066(130)	32485(145)	27716(124)	42438(189)	52397(234)	36357(162)	58944(263)	79350(354)
	8	4+700-4+940	19.047(85)	26786(120)	29066(130)	32485(145)	27716(124)	42438(189)	52397(234)	36357(162)	58944(263)	79350(354)
	9	4+940-5+200	19.136(85)	26911(120)	29202(130)	32637(145)	27846(124)	42636(189)	52642(234)	36527(162)	59220(263)	79721(354)

				Pessimistic			Base			Optimistic		
LOT	**SECTION**		**TRAFFIC VOLUME 2021 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**
	PK – PK		**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**
	10	5+200-5+300	9.938(136)	13976(191)	15165(208)	16950(232)	14461(198)	22142(303)	27339(374)	18970(260)	30755(421)	41402(567)
	11	5+300-5+600	9.938(136)	13976(191)	15165(208)	16950(232)	14461(198)	22142(303)	27339(374)	18970(260)	30755(421)	41402(567)
	12	5+600-5+900	8.155(112)	11468(158)	12445(171)	13909(191)	11867(163)	18170(250)	22434(308)	15566(214)	25237(347)	33974(467)

Table 13 Ana Chaves section from the base year 2021 to 2045 each ten-year Source:RD6767-FD-L2-SR-SumRep-D01

7.5.3. ROUNDABOUTS PROPOSED

The design proposed for the planned urban area includes the incorporation of two roundabouts at different intersections of the projected road.

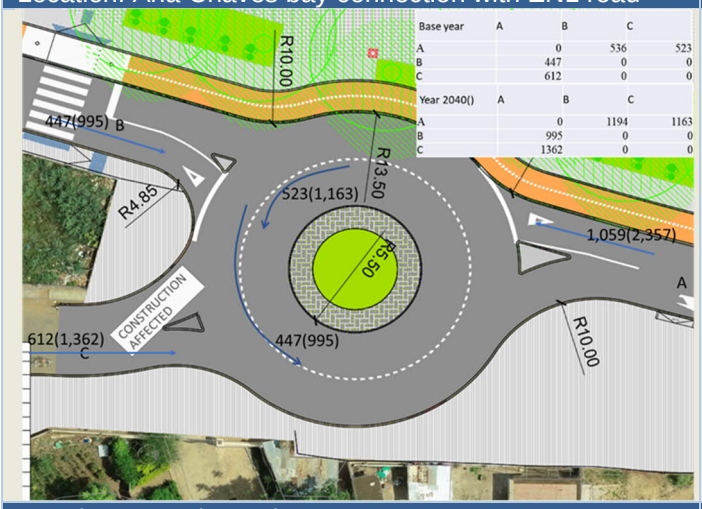
To analyse the operation of these roundabouts throughout their useful life, the traffic expected at these roundabouts is estimated based on the information provided by the surveys carried out.

The analysis is performed for the expected traffic in the baseline scenario and for a peak hour percentage of 10% of the daily traffic.

Light vehicle equivalent traffic (pcus) is estimated by taking 45% of motorbikes, with an equivalent of 0.5, and 3% of heavy vehicles with an equivalent of 2.

The following figures summarise the traffic calculations for the base year and the project cut-off year 2040, and a summary table with the intensity/capacity ratio at the entrances for the year 2040.

Location: Ana Chaves bay connection with EN1 road



I/C ratio. Functionality

	Base Year			Year 2040		
	A	B	C	A	B	C
Ce (Entrance Capacity)	**1,341**	**1,027**	**1,086**	**1,146**	**449**	**579**
I/C	0.79	0.44	0.56	2.06	2.22	2.35

Location: Ana Chaves bay. Port Access



I/C ratio. Functionality

	Base Year			Year 2040		
	A	B	C	A	B	C
Ce (Entrance Capacity)	**1,440**	**1,281**	**1,361**	**1,367**	**1,014**	**1,190**
I/C	0.28	0.10	0.19	0.65	0.29	0.49

All the roundabouts are in correct working order when it is put into service, although due to the logical restrictions imposed by the urban environment, the roundabout located at Ana Chaves bay in the connection with EN1 road, it is possible that it will present capacity problems before the end of its useful life. However, the new routes proposed in the city's future planning, which divert long-distance traffic, will mean that traffic at this intersection will be significantly reduced in the future.

7.5.4. DESIGN SPEED

The design speed has been adopted according to the geometric characteristics of the road (horizontal and vertical) and its urban character (many accesses to properties and other streets).

The design speed throughout the section is 40 km/h, except from CH 4150 to CH 4700, which will be 30 km/h due to the largest number of people on this section and the existence of several successive crossings.

7.5.5. TYPICAL SECTION

The configuration is a single carriageway with one lane on each direction. In the first 1.450 m (CH 4+250) we have parking areas where the section allows it. Regarding the cross section, the vehicular lanes proposed within the carriageway are 3.0 meters wide. The proposed footpaths along the entire route are 2.0 m wide. A 2.5 m wide cycle lane (two-way traffic)

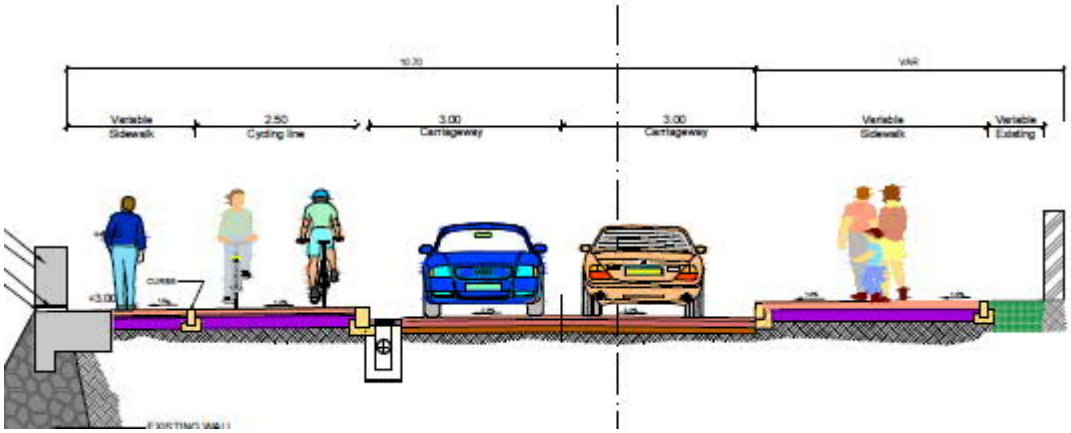


Figure 21 Typical section – Ana Chaves, São Tomé

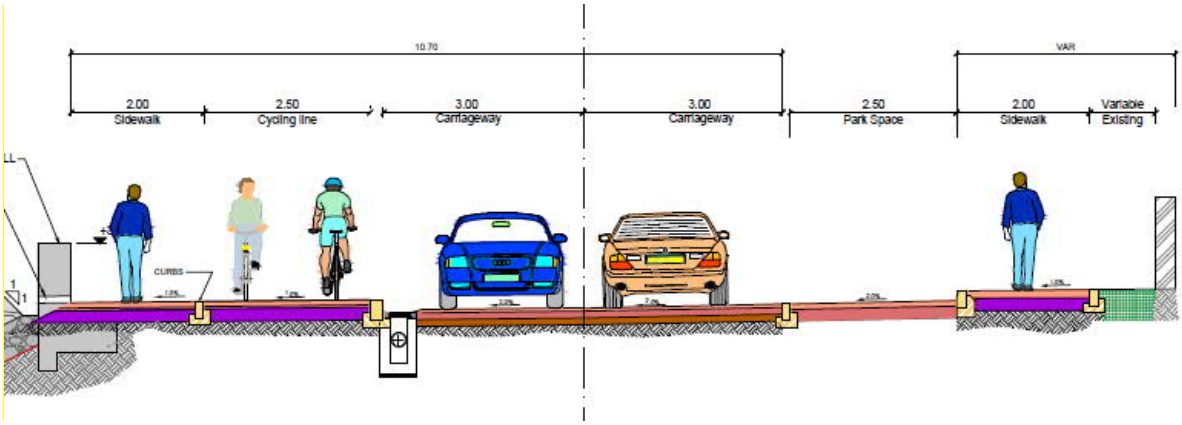


Figure 22 Typical section with parking – Ana Chaves, São Tomé

From CH 4+150 to CH 4+680, the typical cross-section changes. As said before, between CH 4+150 to CH 4+500 the Marginal Road platform has been extended to accommodate the cycle lane avoiding the construction of an external metal cycle bridge foreseen in the Draft Detailed Design. This cycle lane maintains the same dimensions as the bike lane adopted in other sections.



Figure 23 Typical section Cycle Lane on the maritime works– Ana Chaves, Sao Tomé

From CH 4+500 to CH 4+660, the typical cross section consists of two lanes in each direction and a north-west turning lane. The existing angled parking lane are maintained and extended to take advantage of the section and get a greater number of places.

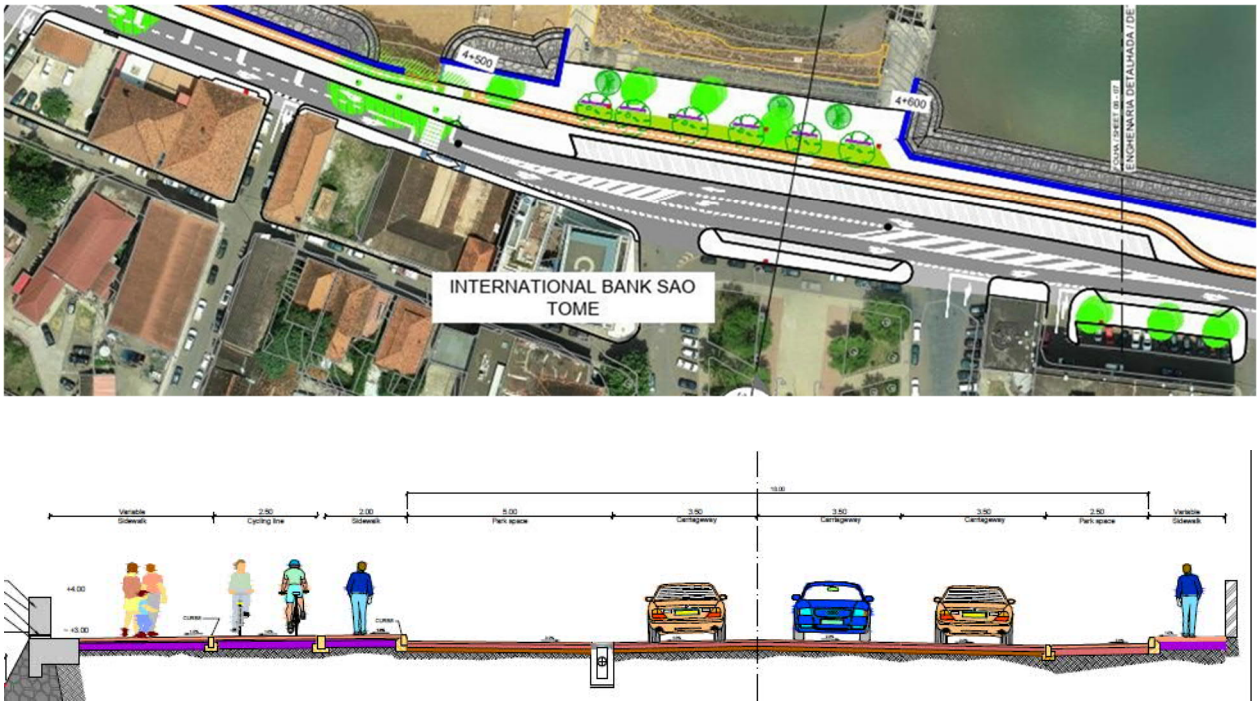


Figure 24 Typical section. Parking zone – Ana Chaves, Sao Tomé

In the rest of the section, until reaching the area of the Forte de São Sebastião, the initial typical cross section continues, with two lanes in each direction of 3 m wide, 2 sidewalks of at least 2 m wide, and a 2,5 m parallel parking lane where the area allows it.

In the area of the Forte de São Sebastião (National Museum) between CH 5+650 to CH5+850, the typical cross section changes and parallel parking lane is proposed in the south area (right side), to create a greater number of parking spaces, proposing a landscaped stay area on the north side (left side)

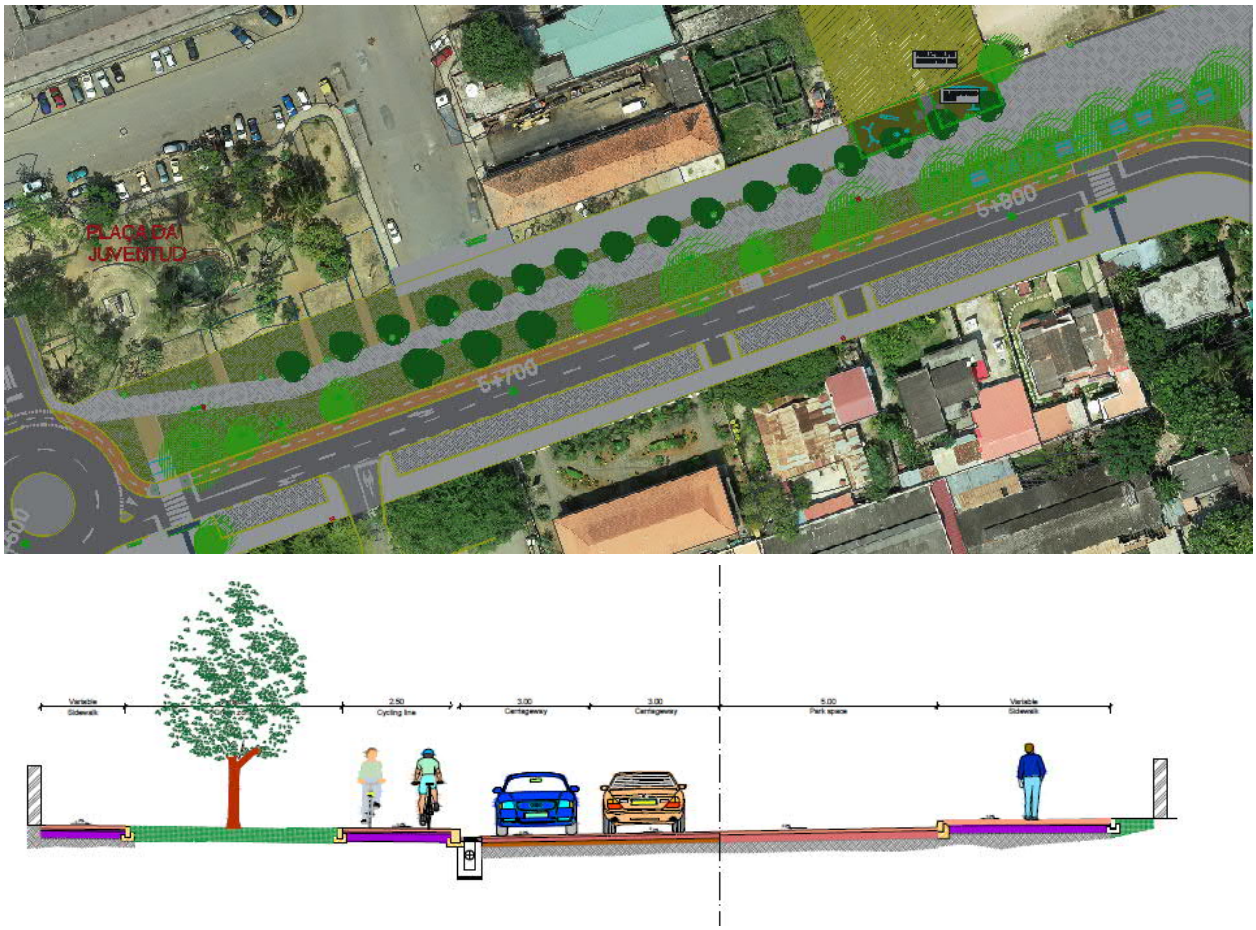


Figure 25 Typical section – Forte de São Sebastião, Sao Tomé

Annex 5 presents typical sections for Lot 2 Ana Chaves Bay.

7.5.6. PAVEMENT

These proposed interventions are based on the existing built-up pavement, the visual pavement assessment, the traffic study and the respective forecast and consideration of drainage continuity and constructability in relation to the existing pavement.

In terms of sustainability, conserving materials is the first option in order to maintain existing pavement structure instead of new pavements, but it will depend on condition of the pavement layers.

At Marginal Road:

- Based on the DCP investigations, the unbound layer of the pavement presents very good strength, and it recommends to maintain and reuse. On the contrary, because the bad condition of the asphalt layer (only a wearing course of 3 cm average), the surface layer should be planned before overlays with the new asphalt layers designed. In sections, where road level will be raised up, regulating base

course or granular base will be laid under asphalt layers, in the quantities that are required to being heightened. All pavement widening to be minimum 1 meter at subgrade level as required to accommodate the roller at least 3-ton mass at all locations.

- Park space and elevated crosswalk: Pavements will be constructed with interlock concrete cobblestones with 8 cm thickness. Under the blocks, a 5 cm mortar bed, serving as a support base for the blocks and 15 cm lean concrete layer will absorb the vertical loads coming from the road traffic. The concrete layer shall be laid on 15 cm granular base as minimum.
- Truck apron in roundabout: The pavement section for the blocked paved parking areas will be constructed with interlock concrete cobblestones with 10 cm thickness. Under the blocks, a 5 cm mortar bed, serving as a support base for the blocks and 15 cm lean concrete layer will absorb the vertical loads coming from the road traffic. The concrete layer shall be laid on 15 cm granular base as minimum.

7.5.7. DRAINAGE PROPOSED SOLUTION

As referred in section 7.2.1.3 the design is taken account adaptation to climate changes and the following design is considered to the drainage study:

- Design return periods:
  - 25 years for carriageway drainage
  - 100 years for culverts

Based on this information, collected and analysis has been carried out, firstly, by distinguishing between culverts, with a width of 1,0 m or more, and pipes, and then from the hydraulic and structural point of view.

Chainage (CH)	Existing Drainage				Affected by new road (Yes/No)	Comments
	Name	N	width / diam (m)	height (m)		
4+790	OF12	2	8,50	2,00	-	Culvert/bridge (Agua Grande)

Table 14 Ana Chaves bay. (2+760 - 5+900). Existing culverts

After this analysis, no culverts will be affected by the new road. The rest of the existing drainage elements of which we only know its discharge point into the sea, it has been decided not to use them for the proposed drainage system. They will therefore be considered as elements to be demolished or replaced during the civil works.

However, OF12 “Agua Grande Bridge” is analysed because of its relevance. The culvert has been studied to review the existing hydraulic capacity and, if this structure does not have enough discharge capacity, proposing a new culvert with sufficient capacity.

Stream Names	Chainage	Section (m)	Peak flow(m^3/s) T 100 years
04 Agua Grande	4+790	2 # 8,50 x 2,05	55,29

Table 15 Culvert analysed

After this, it is concluded that the existing culvert have the necessary hydraulic capacity. However, the structural state of the culvert is not optimal, so it is recommended to replace it with a new one with the same capacity.

Thus, the culvert at CH 4+790 is proposed to be replaced by a. 8.50 x 2.05 m twin boxes

7.5.7.1. Road and sidewalks drainage

The typical section that can be found along the new road are the following:

- Mainly, two parallel drainage systems (land side/seaside) that drain water from the road surface into the main pipeline along the centreline of the road.
- The flow on the sea sidewalk will be conveyed with a semi-circular channel and diverted directly to the sea through weep holes.

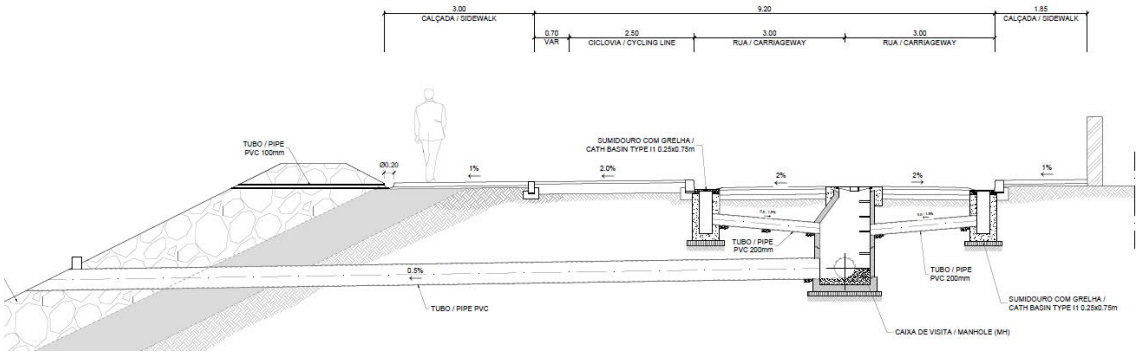


Figure 26 Typical section Ana Chaves bay without park space (2+760 – 4+520; 4+720 – 5+040; 5+440 – 5+900).

- Where a park space is defined, a low point is created between this area and the roadway limit. At this place a catch basin is placed every 15 m approx. Water drains towards these structures and is collected through a pipeline which is connected at the end of the parking area with the main pipeline along the centreline of the road. Park areas are placed at the right side of the roadway except between chainage 4+520 and 4+720 where it is placed at both sides.

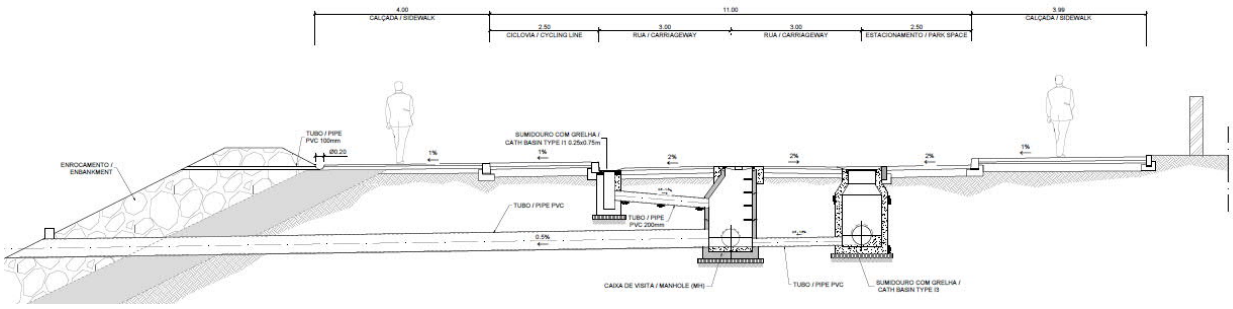


Figure 27 Typical section Ana Chaves bay with park space (2+760 – 4+520; 4+720 – 5+040; 5+440 – 5+900).

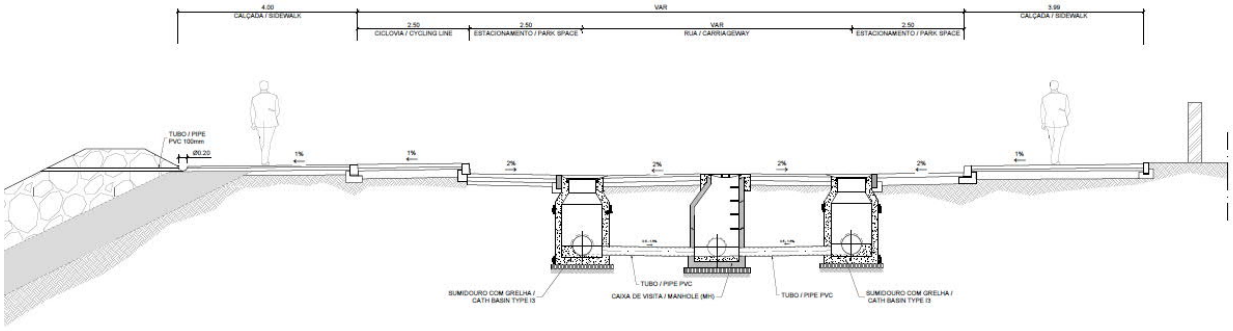


Figure 28 Typical section Ana Chaves bay (4+520 – 4+720).

- From chainage 5+040 to 5+440 there will be a beach nourishment to level +1,50 m r/MSL not allowing to continue with the conventional drainage design used for the rest of the project. For this area a shallow drainage is provided, using parallel underground channels on both sides of the road. One will be situated under the limit between the road and the park space, at the right side, and the other below the sidewalk near the road, at the left side. The channels will have inlets every 5 m and the outlets will be situated at the start and the end of the beach, to not affect it.

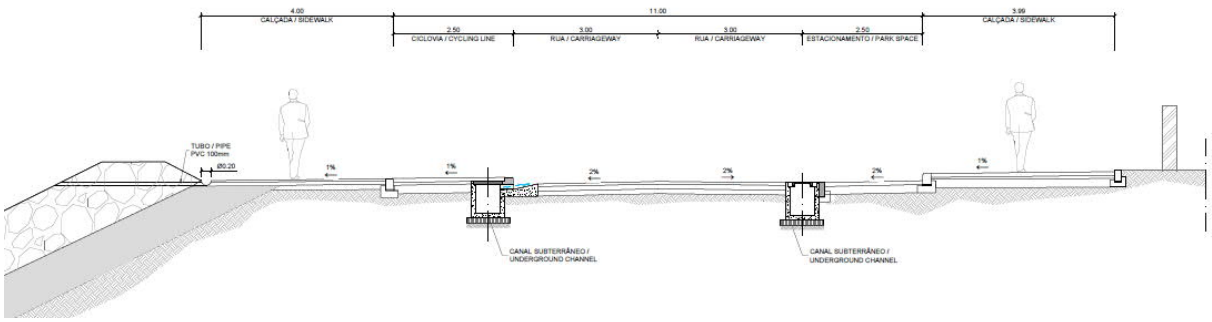


Figure 29 Typical section Ana Chaves bay (5+040 – 5+440).

The correct functioning of the longitudinal drainage system is essential for safety road. Longitudinal drainage ensures the rapid flow of surface water over the platform, ensuring pavement protection. To ensure this, a hydraulic checking has been realised with the software MicroDrainage 2020.1 for pipelines and with OpenFlows FlowMaster.

7.5.7.2. Structure in CH 4+790 (Ana Chaves bay)

The platform of the existing structure is enough in this case for the new requirements of the road. Although it wouldn´t need any construction task regarding to this matter, the condition of the structure is critical, according to the results of the inspection.

Only one proposal can be executed in these circumstances, with the idea of reconstruction that is the base of this Project, which is the substitution of the structure for a new one. This could have a similar typology than the existing with two spans.

Like this structure is placed in the most densely urbanized part of the city, there are enough possibilities for traffic diversion during the construction works using the existing streets. In consequence, the design of this new structure would be planned to be constructed in only one phase after being demolished the existing one.

The dimensions of the new structure would be 17,90 m total length, with 8,50 m free length of each span, 16,75 m total width.

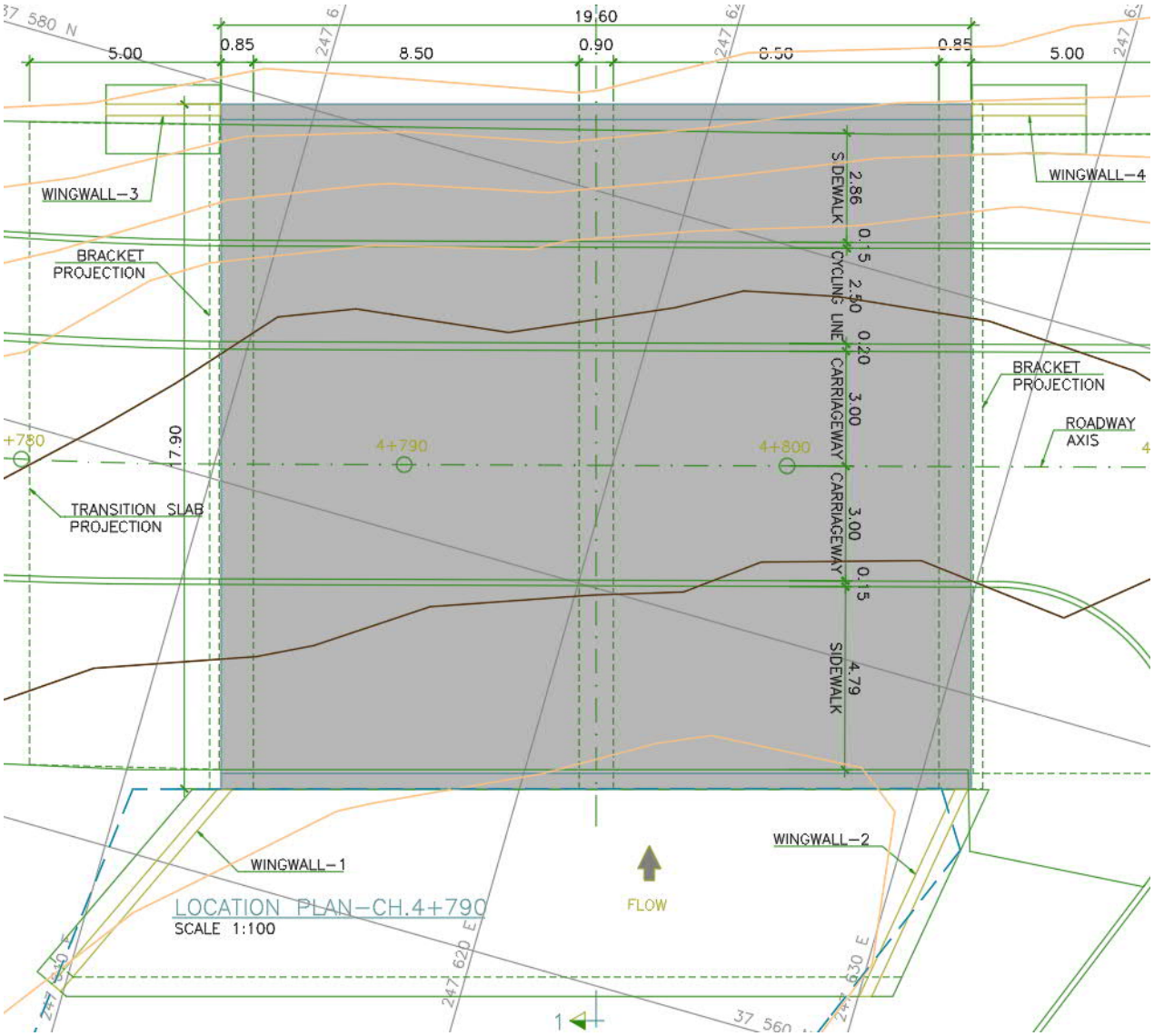


Figure 30 New structure proposed CH 4+790 (Ana Chaves bay)

7.5.8. LANDSCAPING

The proposed intervention seeks to protect and improve the current space through the following actions:

- Creation of a paved pavement on both sides of the road with basalt stone cobblestone in the pedestrian area near the sea and concrete paving on the side of the houses.
- Creation of pedestrian space accessible to all passers-by with pedestrian fords, special paving and handrails that create a barrier-free public space.
- Creation of a cycle lane at pavement level with a concrete pavement that allows cycling along the entire length of the promenade. The decision to create the cycle lane at pavement level offers cyclists greater safety from road traffic and also allows for the extension of pedestrian space when there are no cyclists circulating.
- Creation of rolling fords with a maximum slope between 20% for car access to the private plots adjacent to the promenade.

- The relocation of the existing urban installation networks buried and complying with the minimum safety distances between them, as well as aesthetically improving the urban space of the promenade.
- A new lighting design that guarantees the correct illumination of all the spaces within the area of intervention, as well as creation of a uniform image between the different bays that extend along the promenade. The proposed lighting runs along the pavement adjacent to the building plots, allowing the entire promenade to be illuminated, i.e., the road and pavements on both sides.
- New urban furniture is placed, such as concrete bins every 40 m and benches every 100 m approximately.
- Several spaces of singular presence appear due to their proximity to important buildings and squares of the city, where the development of recreational areas is proposed:
    - Area São Pedro Church:Ch 3+620- 3+920
    - Area Pier - Independência square: Ch 4+480- 4+600
    - Area Post Office Ch 5+020- 5+220
    - Area São Sebastião Fort: Ch 5+620- 5+860 (also in this area will be public toilets enabled in an existing spa building).
- In these areas, each with its own character and different landscape design, large green areas are proposed with existing trees and proposed shade-generating trees, under which rest areas with benches are provided, as well as other interventions:
    - A children's play area.
    - Fitness area (next to São Sebastião Fort)
    - Lighting to enhance the value of the new recreational area.
    - Street furniture, corrosion and vandalism resistant, close to the sea:
        - Concrete bins.
        - Drinking water fountains located in recreational areas.
        - Bike parking.
        - Benches: The benches are made of recycled concrete and glass. Currently there is a local company that makes urban furniture with this material with interesting aesthetic results, mixing new designs that play with straight and curved geometric lines depending on the public space design, with others that recover the aesthetics of colonial models.
- In order to reduce the impact created by the new maritime protection wall along the promenade, a tile cladding is proposed as a solution that requires less maintenance (without the need for periodic coats of paint), it is easy to implement, and it provides beauty and identity to the wall. The wall is reused and it is proposed to make it larger in certain sections along the promenade to create new areas of benches.
- Close to São Sebastião fort public toilets in existing building will be available in public space.

Green Areas

Along the bay under study, the main tree species is the Indian Almond (*Terminalia catappa*), with smaller numbers of palm species.

These trees are considered as cultural heritage because they create a specific atmosphere typical for São Tomé city, its parks and promenades. This is the reason why all trees in good condition and that do not represent a problem or danger to pedestrians within the public space are protected.

When a tree is occasionally affected by the new layout of the promenade, as well as in the case of existing trees that imply a danger to pedestrian or damage to the road or coastal protection works, it should be

replaced by young saplings of other local tree species, salt resistant and that provide shade. A new species will always be planted close to the affected one, looking for the best location without compromising pedestrian accessibility.

Another solution taken to respect as much as possible the existing trees on the sidewalk and to allow pedestrian access, is to propose enclosed tree surround with electro welded grating

In the case of the bay under study, the affected species and new proposals are detailed below:

- 100 new tree species (1 *Robusta washingtonianas*, 83 karroo acacias and 16 tamarinds, or similiar)
- 4 tree species affected (1 coconut palms and 3 *Terminalias catappa*, or similar)

Annex 3 presents trees affected.

Fishery, boat workshop and house public toilets

.

The fishery, boat workshop and house public toilets are designed between km 5+200- 5+280 (axis of new route). Annex 7 presents location and drainage and electrical networks The buildings that contain these facilities are conceived in three different volumes

- For the Fish Market, a large open-plan space is proposed as a commercial meeting point in the image of the traditional port fish markets of historic maritime towns.
- For the House Toilets, a unique construction is proposed in response to functional need to provide House Toilets to an area frequented by a large number of people. It is located in an area where the people usually walk and pass by, and at the same time, it serves to the parallel proposal of the aforementioned attached facilities.
- The Boat Workshop building is based on the market building, and the work space is delimited by walls that surround the same twin structure but eliminating the central supports. These enclosures will follow the same idea of air permeability, ensuring the environmental hygiene of the place and taking advantage of natural light for illumination, but visually delimiting the interior in an opaque way.

As objectives linked to the proper functioning and health standard and hygiene of the area, open buildings are proposed. They allow great environmental permeability and permanent ventilation. Additionally, it has been taken into account the accessibility requirements, responding to universal design criteria regarding the suitability of use for all types of users.



Figure 31 fishery, boat workshop & house public toilets

A) Fishery

It will be necessary to provide a covered space protected from strong sunlight and inclement weather for the development of the planned commercial activity, which will be arranged in an open and diaphanous space building.

A retail space has been estimated for the available space that allows the provision of product for sale in 9 exhibition workbenches, which would allow up to 36 exhibitors and 4 per workbench.

Likewise, there will be the provisions for electrical and water supply systems, which allow the correct use and maintenance of the installation:

- Electrical supply for lighting;
- Water supply for cleaning;
- Installation of sanitation and drainage for evacuation;
- Installation of rainwater evacuation.

There will be a closed space for control of supplies, storage, and use of maintenance personnel.

All this is distributed according to the following table:

	Fishery Areas
Total exhibition area	221
Estimated minimum area per stall	4.7
Exhibition workbenches	9
Individual stall per workbench	4
Maximum planned total stalls	36
Supply and Storage cabin	7.5

Table 16 Fishery areas

B) Public toilets

A capacity of 50 p / h for 10 hours a day has been established for the design of the House Toilets building, without distinction of gender or accessibility.

For this reason, a usual distribution of three differentiated spaces for men, women and disabled people is proposed, with direct access from the street. To these spaces, a toilet area is added with direct access from the Fish Market for its users.

The installation will have the provisions for electrical and water supply systems, which allow the correct use and maintenance of the installation:

- Electrical supply for lighting;
- Water supply for sanitary equipment and cleaning;
- Installation of sanitation and drainage for evacuation;
- Installation of rainwater evacuation.

There will be a closed space for control of supplies, storage, and use of maintenance personnel.

Both the male and female toilets will maintain a similar distribution: three toilets and sinks for simultaneous use in the female ones, and two urinals, two toilets, and three sinks for simultaneous use in the male ones. The accessible toilet for disabled people will have a capacity for one person, including any personal assistance that may need.

It is distributed according to the following table:

	Units (m^2)
Total area of the facility	157
Building occupancy area	70
Male Toilets	20
Female Toilets	28
Accessible Toilet	6
Sinks area	11
Cleaning room	1.5
Electrical supply room	0.4
Water supply room	0.4

Table 17 Public Toilets areas

C) Boat workshop

For the service of maintenance and repair of the boats, an open space has been designed to allow the correct development of the work to be carried out in its interior for two boats simultaneously.

Likewise, there will be the provisions for electrical and water supply systems, which allow the correct use and maintenance of the installation:

- Electrical supply for lighting.
- Water supply for cleaning.
- Installation of sanitation and drainage for evacuation.
- Installation of rainwater evacuation.

All this is distributed according to the following table:

	Work Boat Areas	Units
Total area	221	m^2
Working Area	127	m^2

Table 18 Boat Workshop areas

Água Grande District Council will do maintenance of infrastructures.

7.5.9. COASTAL PROTECTION STRUCTURES DESIGN

Coastal protection of alternative C in Ana Chaves mainly consists on installing a rock protection in front of existing rubble masonry seawall, restore masonry seawall and balustrade where are damaged and install sandy material to replenishment for beach.

The Feasibility Study considered to sustain and enhance the existing fishermen landing sites at Ana Chaves Bay. Beach nourishment was proposed at sites CH 3+550 to CH 3+670; CH 4+020 to CH 4+300 and CH 4+320 to CH 4+500. In the following figure these sites can be identified.



Figure 32 Beach nourishment proposed in Alternative C of the Feasibility Study

	FEASIBILITY DESIGN Alternative C	DETAILED DESIGN
Number of typical cross section designed	1	3 (Z2A, Z2B, Z2C and Z2D)
Revetment	Balustrade up to +1,0m above road level (+4,0 m r/MSL approx.) Berm in front of sea wall Berm crest at +1,00 m r/MSL Armour rock 0,2-0,5 t	Z2A Seawall up to +4,0 m Berm in front of sea wall Revetment crest at +2,30 m Armour rock 1,5 - 2,8 t. Z2B Seawall up to +4 m Berm in front of sea wall Revetment crest at +1,90 m Armour rock 0,7 - 1,4 t. Z2C Seawall up to +4m Berm in front of sea wall Revetment crest at +1,90 m Armour rock 0,7 - 1,4 t. Beach nourishment Z2D Seawall up to +4 m Berm in front of sea wall Revetment crest at +2,60 to 2,80 m Armour rock 0,7 - 1,4 t.
Geotextile	YES	YES
Proposed beach nourishment	YES Two specific areas San Pedro and Praia Chel. Ch 03+350-03-500 Ch 04+000-04+300	YES Ch 04+950-Ch05+300

Table 19 Comparative table between Feasibility – Alternative C and Detailed Design Source:Own elaboration

During the design process, as a result of several studies and public consultations with fishermen, fish and fruit vendors, it was found that their current location does not meet adequate safety and hygiene conditions.

On the other hand, at the current location there was not enough space for the necessary new facilities. Finally, it was an area very exposed to storms.

In this sense, the INAE proposal was that both the fishermen' workshop, the fish and fruit market as well as the public toilets, be located in an área specifically design between CH 5+200 and CH 5+300.

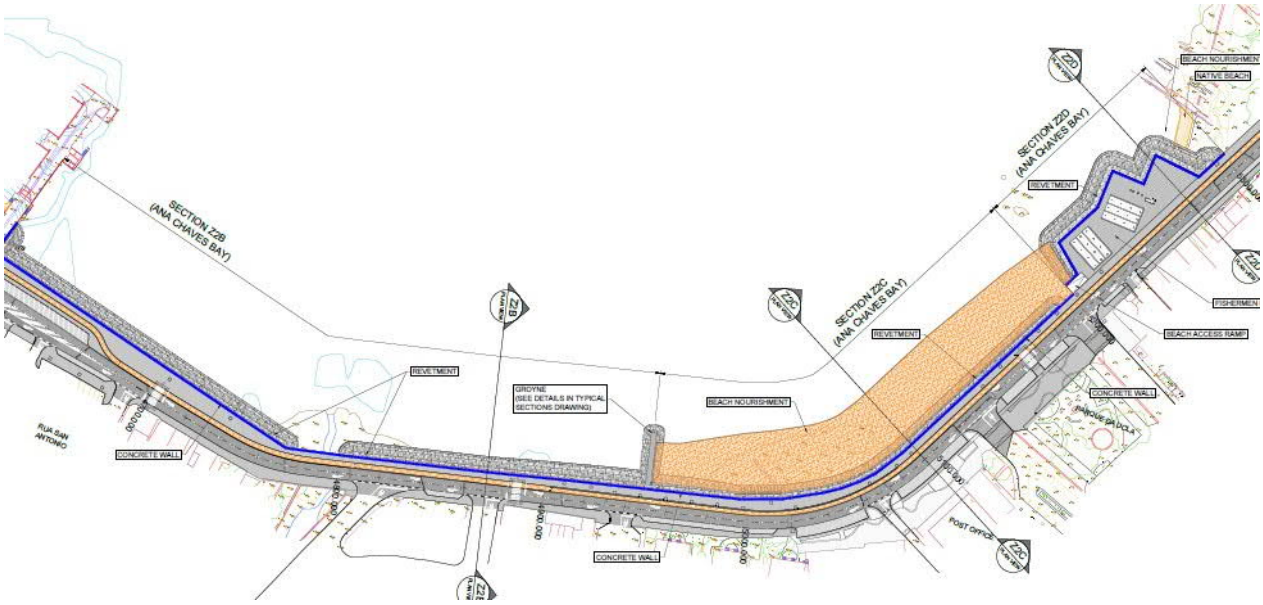


Figure 33 Beach nourishment and fishermen facilities proposed in Final Design

Following **typical cross section** are proposed:

First section consists on installing a main protection of rocks 1.5-2.8 tons till +2.30 m r/MSL. The crest of coastal protection is crowned by a concrete wall that reaches +4.00 r/MSL that is built on the existing wall. Additionally, a geotextile is placed between rock protection and existing wall and natural terrain as well to avoid loss of terrain.

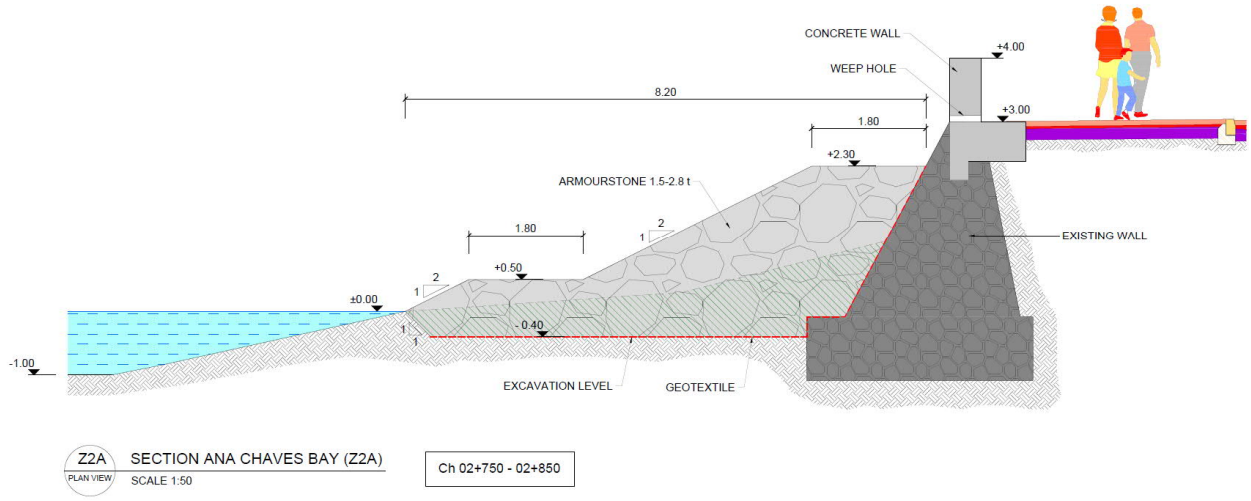


Figure 34: Typical cross section Z2A. Ana Chaves bay (CH 2+750 – CH 2+850)

Second section consists of installing a main protection of rocks 0.7-1.4 tons till +1.90 m r/MSL. To crown the coastal protection a concrete wall that reaches +4.00 r/MSL and a geotextile between rock protection and natural terrain and existing wall as well.

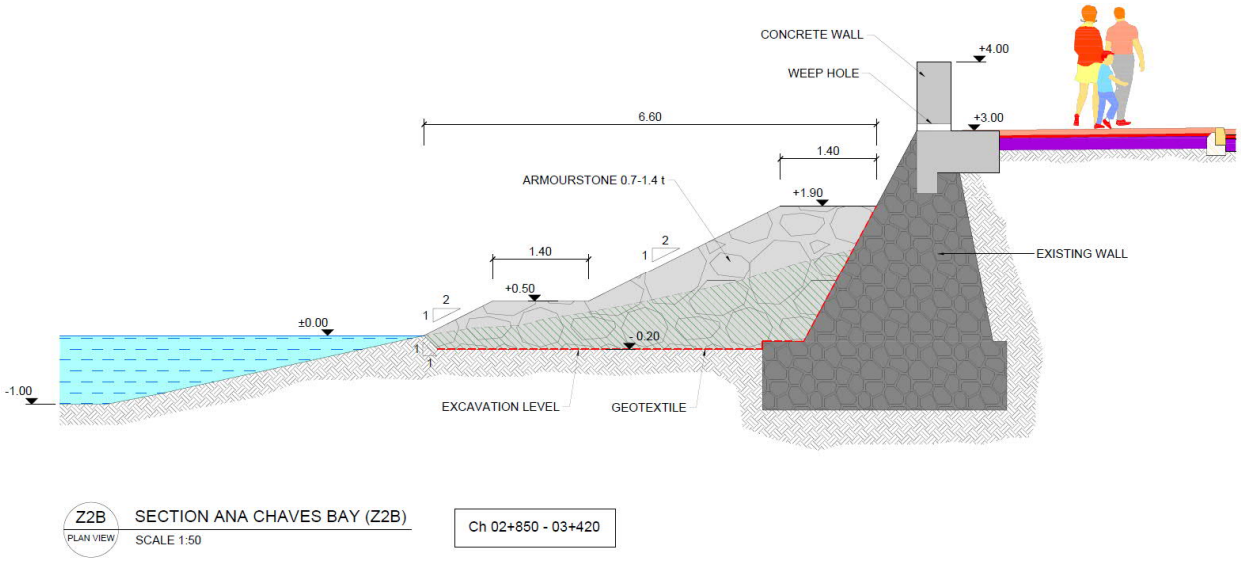


Figure 35: Typical cross section Z2B. Ana Chaves bay (CH 2+850 – CH 3+420)

Third section consists on installing a main protection of rocks 0.7-1.4 tons till +1.90 m r/MSL. To crown the coastal protection a concrete wall that reaches +4.00 r/MSL and a geotextile between rock protection and natural terrain.

Furthermore, a beach nourishment is considered this measure will ensure that these (beach) landing sites do have a minimum landing space required for fishing boats, also this sand contribution reduces wave agitation within the bay dissipating wave energy.

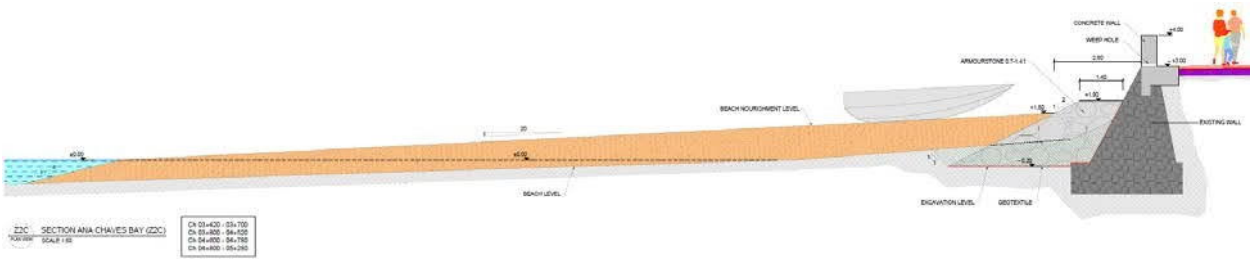


Figure 36: Typical cross section Z2C. Ana Chaves bay (CH 5+200 to CH 5+300)

The fourth section is installed for fill protection in the area of the cycle lane extension and the new platform for fishermen's buildings. It consists of installing a main rock protection of 0.7-1.4 tonnes up to the crest of the fill at +2.60-2.80m r/MSL. To complete the coastal protection, a concrete wall is designed to reach +4.00 r/MSL and a filter and geotextile between the rock protection and the natural terrain to prevent the loss of fines.

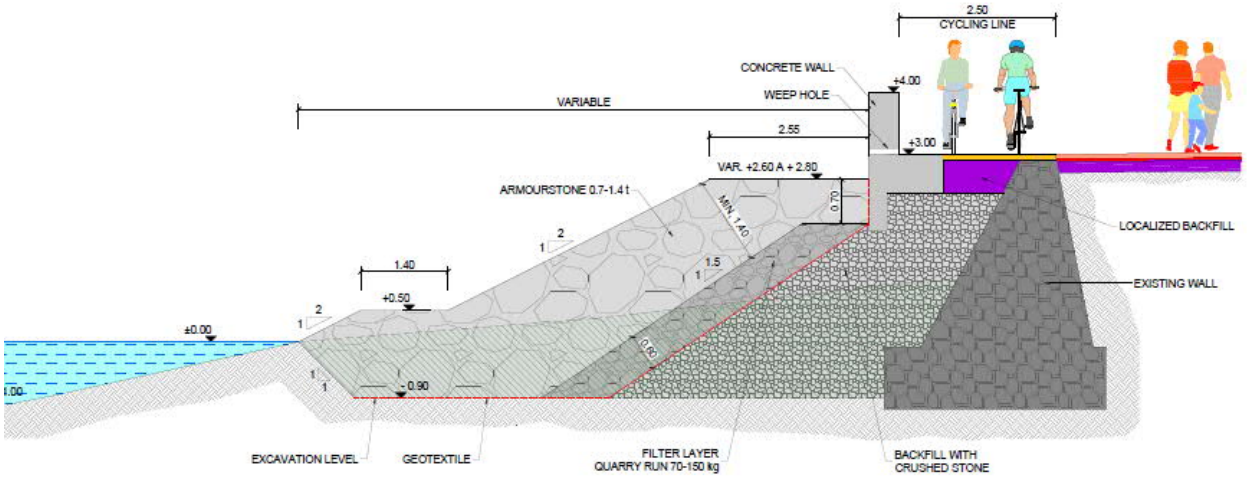


Figure 37: Typical cross section Z2D. Ana Chaves bay

Additionally, two groynes are implemented in the design to assure the stability of the beach at chainage 03+710 and 04+950. The groynes will have a length of 25 m long with a crest level at +1m r/MSL and side slopes of 2H:1V

7.5.10. ANCILLARY WORKS

7.5.10.1. Water supply network

In the scope contemplated in the project, it is foreseen the integration of different independent services, infrastructures, such as: Supply to Sources and Services and Supply for Irrigation from the existing drinking water network in the city.

The affected are made available according to the location of the service under the project.

Dripping will be carried out through PE80 polyethylene pipe with smooth inner wall, with a nominal pressure of 1.0 MPa (10 atm), for the river, and 1.6 MPa (16 atm), for spring and ornamental fountain.

7.5.10.2. Irrigation installation

The pipes will be made of plastic, resistant to tolerances and acid substances. In all the irrigation network will be used PE80 polyethylene pipes, resistant to UV radiation.

DN40 and PN 16 armoured irrigation channels will be installed, consisting of a hoop, body and cover made of ductile cast iron with a built-in valve and a 45 mm coupling for connection to the hose, in each of the green and gardened areas according to the irrigation flow rate of each area.

7.5.10.3. Fountain installation

The 5 fountains will be installed according to the location represented on the drawings. The supply pipe for these fountains will be made of PE80 polyethylene with a nominal pressure of 16 atmospheres (PN16). This pipe will be 32 mm in diameter and will be connected to the nearest existing water mains.

Manholes will be installed in the branches or connections to the existing drinking water network.

The model chosen is a modern rectangular shaped fountain, with the foundation fixed by means of LM-18 shaped anchors made of 3mm steel plate, cast iron grid in the drain and push button in nickel plated brass.

A drainage pipe must also be installed to conduct excess water to the rainwater drainage system.

7.5.10.4. Lighting

The public lighting system will consist of luminaires at the top of columns or poles which will be connected to their own low-voltage electrical network (service voltage of 380 V between phases and 220 V between phase and neutral) which will have the appropriate protection and control systems for switching the installation on and off in safe conditions which will allow both the correct lighting of the roads and energy saving by adapting the lighting periods to the hours when the system needs to be used.

For the protection of people and equipment, all luminaires shall be earthed by means of a separate earth plate located near the base of the pole.

The distribution of the luminaires on the roads has been carried out taking into account both technical criteria related to the level of illumination and urban planning criteria associated with the distribution of singular elements on the edges of the roads (pedestrian crossings, cycle and pedestrian crossings, green areas, etc.).

The electricity supply required for this installation will be provided from the low-voltage side of the existing power transformer stations in the project area.

From the low-voltage circuits assigned to the lighting installation, control and protection cabinets have been designed which will control the switching on of the luminaires according to the time of day and the intensity of the natural lighting. The on/off thresholds of the installation will be set at the start-up of the installation in such a way that they adapt as well as possible to the needs of the area and may subsequently be adapted to other thresholds depending on the experience of use that is acquired.

The electrical distribution network has been designed with single-pole LXV 0.6/1 kV cables with aluminium conductors and a minimum cross-section of 16 mm2. This selection has been made taking into account both installation safety criteria and simplicity in the construction and maintenance of the installation.

7.5.11. UTILITIES RELOCATION

- The proposed interventions are the following:
- The existing lighting network is demolished and a new network is proposed with streetlights that provide adequate light power to illuminate the entire section of the promenade, in addition to complying with an aesthetic in accordance with the rehabilitation of the bay and creating a uniform image and continuity with the rest of the bays.
- These streetlights are also fed from the proposed distribution cabinets, which are supplied by the existing transformer substations and house the protection systems and automatic lighting systems.
- The existing telecommunications network is relocated within the proposed trench, eliminating any overhead wiring that creates a deteriorated image of the promenade as a whole.
- Likewise, the low voltage network is relocated within the trench, complying with the minimum safety distances between the different networks.
- The lighting, telecommunications and low-voltage electrical networks will share the same trench and manholes.
- The existing water network will be relocated in a trench parallel to the proposed electrical trench, complying with the minimum safety distance between them.
- Provided that this existing water network is at a sufficient depth or distance from the new electrical trench and does not interfere, it will not be relocated and will remain as it is at present.
- The proposed sewerage network must always run under the rest of the previously collected networks, as it is a network that collects contaminated water and could affect the drinking water network.

7.6. LOT 3 PANTUFO COASTLINE (CH 5+900 – CH 8+820)

7.6.1. LOCATION

The Pantufo Coastline section starts besides the Sao Sebastian Fort (5+900) and ends around 1.000 m southwards the Pirata Bar, in the intersection with Estrada São Marçal (8+220 m) (the village of Pantufo) through several landmarks: Avenida da Independência (6+200), Liceu Nacional (6+600), Avenida Kwama N´Kruma (6+950), Avenida das Nações Unidas - Estrada Nacional 2 EN2 (7+150), Hotel Pestana (seaside) and Assembleia Nacional (landside) (7+500) and finally the Estrada São Marçal (8+820 m). The lenght is 2,920 m.

Annex 1 presents the Layout for Pantufo Coastline.



Figure 38 Pantufo Coastline Ch.5+900 – 8+820

7.6.2. TRAFFIC

The following table summarizes the traffic forecast on the Pantufo Coastline section from the base year 2021 to 2045 each ten-year.

				Pessimistic			Base			Optimistic		
LOT	**SECTION**		**TRAFFIC VOLUME 2021 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**	**TRAFFIC VOLUME 2030 (day)**	**TRAFFIC VOLUME 2040 (day)**	**TRAFFIC VOLUME 2045 (day)**
	PK – PK		**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**	**Vh/d (Heavy vh)**
Pantufo Coastline	13	5+900-6+960	3.317(27)-4.472(36)	4665(38)-6289(51)	5062(41)-6824(55)	5657(46)-7627(61)	4827(39)-6507(52)	7390(60)-9964(80)	9125(74)-12302(99)	6332(52)-8536(69)	10265(84)-13839(111)	13819(112)-18631(150)
	14	6+960-7+800	8.723(16)	12267(23)	13311(24)	14877(27)	12693(23)	19435(36)	23997(44)	16651(31)	26995(50)	36340(67)
	15	7+800 – end of the section	8.024(14)-4.173(8)	11284(20)-5869(11)	12245(21)-6368(12)	13685(24)-7117(14)	11676(20)-6072(12)	17878(31)-9298(18)	22074(39)-11480(22)	15316(27)-7965(15)	24832(43)-12914(25)	33428(58)-17385(33)

Table 20 Pantufo Coastline section from the base year 2021 to 2045 each ten-year. Source:RD6767-FD-L3-SR-SumRep-D01

7.6.3. ROUNDABOUTS PROPOSED

The design proposed for the planned urban area includes the incorporation of several roundabouts at different intersections of the projected road.

To analyse the operation of these roundabouts throughout their useful life, the traffic expected at these roundabouts is estimated based on the information provided by the surveys carried out.

The analysis is performed for the expected traffic in the baseline scenario and for a peak hour percentage of 10% of the daily traffic.

Light vehicle equivalent traffic (pcus) is estimated by taking 45% of motorbikes, with an equivalent of 0.5, and 3% of heavy vehicles with an equivalent of 2.

The following figures summarise the traffic calculations for the base year and the project cut-off year 2040, and a summary table with the intensity/capacity ratio at the entrances for the year 2040.

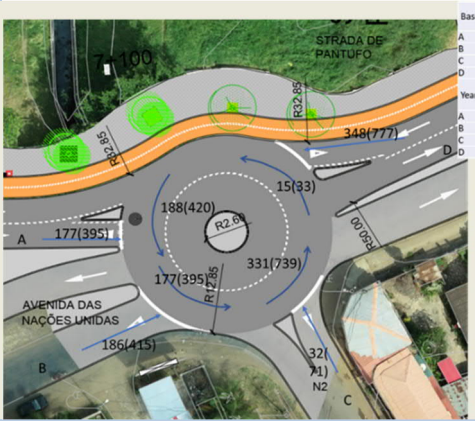
Location: Pantufo coastline. Liceo



I/C ratio. Functionality

	Base Year			Year 2040		
0.9	A	B	C	A	B	C
Ce (Entrance Capacity)	**1,430**	**1,403**	**1,457**	**1,344**	**1,284**	**1,406**
I/C	0.09	0.06	0.12	0.22	0.15	0.28

Location: Pantufo coastline. Naçoes Unidas



I/C ratio. Functionality

	Base Year				Year 2040			
0.9	A	B	C	D	A	B	C	D
Ce (Entrance Capacity)	**1,333**	**1,329**	**1,244**	**1,437**	**1,127**	**1,118**	**929**	**1,359**
I/C	0.13	0.14	0.03	0.24	0.35	0.37	0.08	0.57

All the roundabouts are in correct working order when it is put into service, although due to the logical restrictions imposed by the urban environment. However, the new routes proposed in the city's future planning, which divert long-distance traffic, will mean that traffic at this intersection will be significantly reduced in the future.

7.6.4. DESIGN SPEED

The design speed has been adopted according to the geometric characteristics of the road (horizontal and vertical) and its urban character (many accesses to properties and other streets).

The design speed throughout the section is 50 km/h except between CH 6+459 and CH 6+700 where it is 30 km/h, near the Natiional Lyceum.

7.6.5. TYPICAL SECTION

The configuration is a single carriageway with one lane on each direction. In the first 1.700 m (CH 7+600) Regarding the cross section, the vehicular lanes proposed within the carriageway are 3,0 meters wide. The proposed footpaths along the entire route are 2,0 m wide. A 2,5 m wide cycle lane (two-way traffic). We have parking areas where the section allows it.

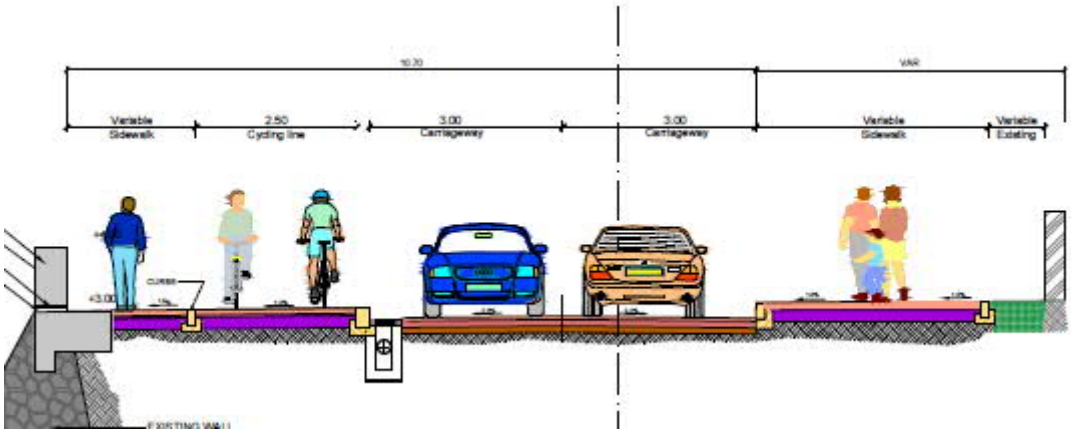


Figure 39 Typical section – Pantufo Coastline, São Tomé

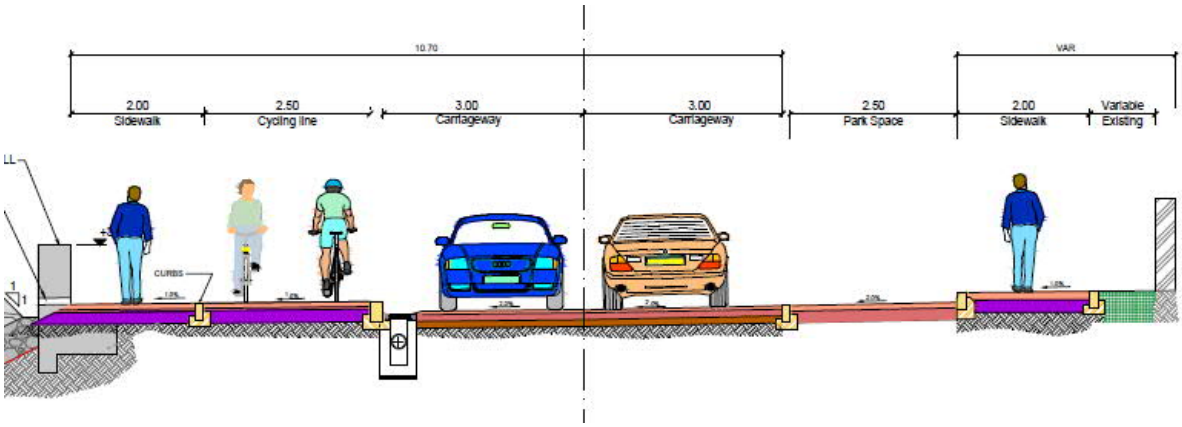


Figure 40 Typical section with parking – Pantufo Coastline, São Tomé

This section is interrupted between CH 6480 and CH 6600, in the area adjacent to the National Lyceum where a special urban area and the creation of car parks lanes are proposed to maintain the existing provision in the area.

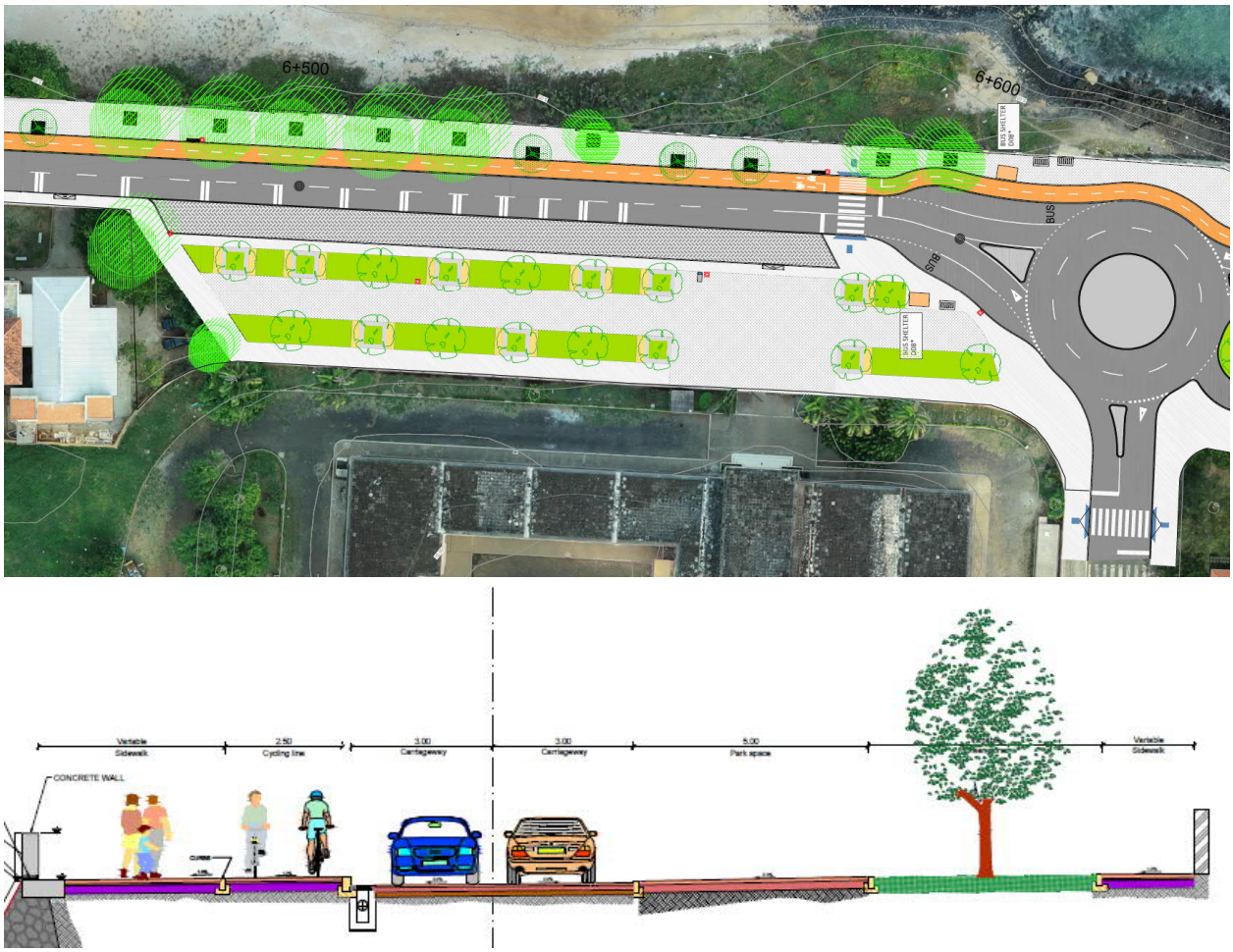


Figure 41 Typical section – Portuguese Lyceum area

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From CH 7600 to CH 7680, the typical cross section changes. The cycle lane disappears, but the 2 m wide sidewalks are maintained on both sides of the road.

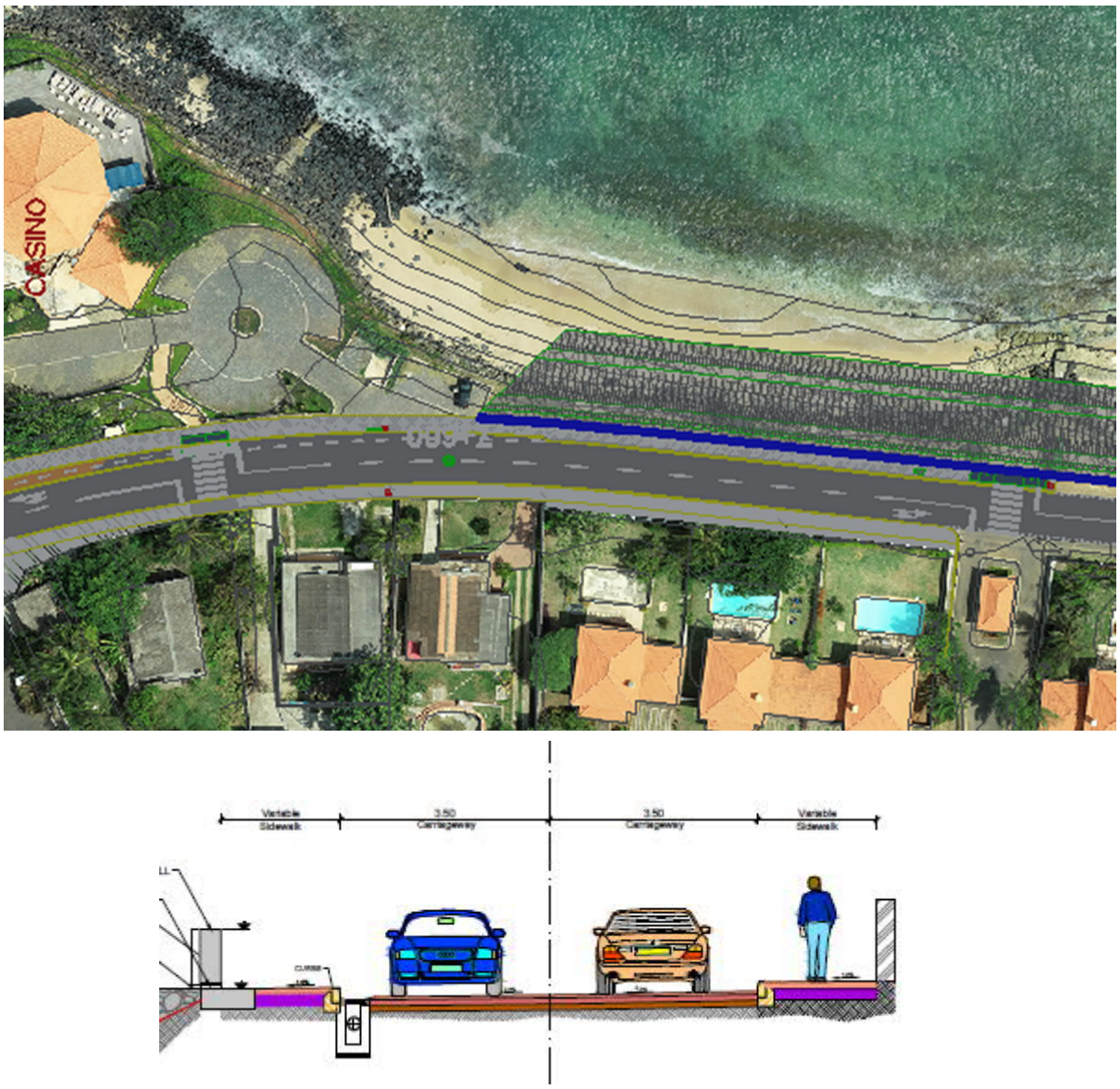


Figure 42 Typical section without cycle lane – Pantufo Coastline, São Tomé

As of CH 7680, the typical cross section consists of two lanes in each direction only, leaving the rest of the section as it is currently.

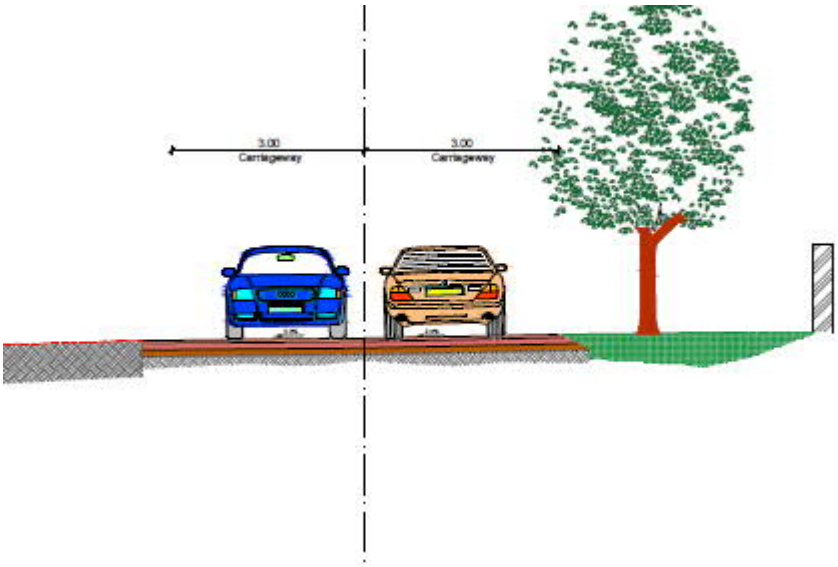


Figure 43 Typical section. Pantufo, Sao Tomé

Typical sections for Pantufo Coastline are presented in Annex 6.

7.6.6. PAVEMENT

These proposed interventions are based on the existing built up pavement, the visual pavement assessment, the traffic study and the respective forecast and consideration of drainage continuity and constructability in relation to the existing pavement.

In terms of sustainability, conserving materials is the first option in order to maintain existing pavement structure instead of new pavements, but it will depend on condition of the pavement layers.

- At Marginal Road:

  Based on the DCP investigations, the unbound layer of the pavement presents very good strength, and it recommends to maintain and reuse. On the contrary, because the bad condition of the asphalt layer (only a wearing course of 3 cm average), the surface layer should be planned before overlays with the new asphalt layers designed. In sections, where road level will be raised up, regulating base course or granular base will be laid under asphalt layers, in the quantities that are required to being heightened. All pavement widening to be minimum 1 meter at subgrade level as required to accommodate the roller at least 3-ton mass at all locations.

- Park space: Pavements will be constructed with interlock concrete cobblestones with 8 cm thickness. Under the blocks, a 5 cm mortar bed, serving as a support base for the blocks and 15 cm lean concrete layer will absorb the vertical loads coming from the road traffic. The concrete layer shall be laid on 15 cm granular base as minimum.

Access to Ministry of Foreign Affairs: The pavement section will be constructed with concrete pavers with 10 cm thickness. Under the blocks, a 5 cm mortar bed, serving as a support base for the blocks and 20 cm lean concrete layer will absorb the vertical loads coming from the road traffic. The concrete layer shall be laid on 15 cm granular base as minimum.

7.6.7. DRAINAGE SOLUTIONS PROPOSED

As referred in section 7.2.1.3 the design is taken account adaptation to climate change and the following design return periods are considered to the drainage study:

- 25 years for carriageway drainage
- 100 years for culverts

Based on this information, the analysis has been carried out, firstly, by distinguishing between culverts, with a width of 1,0 m or more, and pipes, and then from the hydraulic and structural point of view.

Chainage (CH)	Existing Drainage				Affected by new road (Yes/No)	Comments
	Name	N	width / diam (m)	height (m)		
7+312	OF10	2	2,60	2,13	Y	Culvert

Table 21 Pantufo Coastline. (5+900 - 8+280) Existing culverts

The rest of the existing drainage elements of which we only know its discharge point into the sea, it has been decided not to use them for the proposed drainage system. They will therefore be considered as elements to be demolished or replaced during the civil works.

The culvert affected by the new road, has been studied to review the existing hydraulic capacity and, if this structure does not have enough discharge capacity, proposing a new culvert with sufficient capacity.

Stream Names	Chainage	Section (m)	Peak flow(m^3/s) T 100 years
05 Agua Sela 2	7+312	2,47 x 1,12	6,99

Table 22 Culvert analysed

After this, it is concluded that the existing culvert have the necessary hydraulic capacity. However, the culvert will need to be enlarged because of the new road section.

Thus, the culvert at CH 7+312 is proposed to be enlarged with the same hydraulic section.

7.6.7.1. Structures in CH 7+300 (Pantufo Coastline)

The platform of the existing structure is also too narrow in this case for the new requirements of the road. It will be needed at least an increase of 2,00 m perpendicular to the road axis which means 2,55 m of enlargement of the box.

The enlargement of the box will be designed with a new box of the same dimensions joined to the existing one to avoid longitudinal joints.

Previously to this operation, a rehabilitation work of the existing structure will be done with the following aims:

- Removal of materials accumulated inside the box which reduce its drainage capacity.

- Cleaning of all the concrete surfaces with deterioration signs (degradation, coloration, etc.)
- Substitution of reinforcing bars damaged for others new rightly connected to the concrete.
- Disposal of a new layer of cover with high resistance and low shrinkage mortar.
- Application of protective painting against carbonation.

Like this structure is placed in the most densely urbanized part of the city, there are enough possibilities for traffic diversion during the rehabilitation works using the existing streets. During the construction of the new part of box, the existing structure could be used for traffic use.

The dimensions of the complete structure would be finally 3,10 m total length of span, with 2,50 m free length of span, and 19,10 m total box length (16,55 initial + 2,55 m of enlargement).

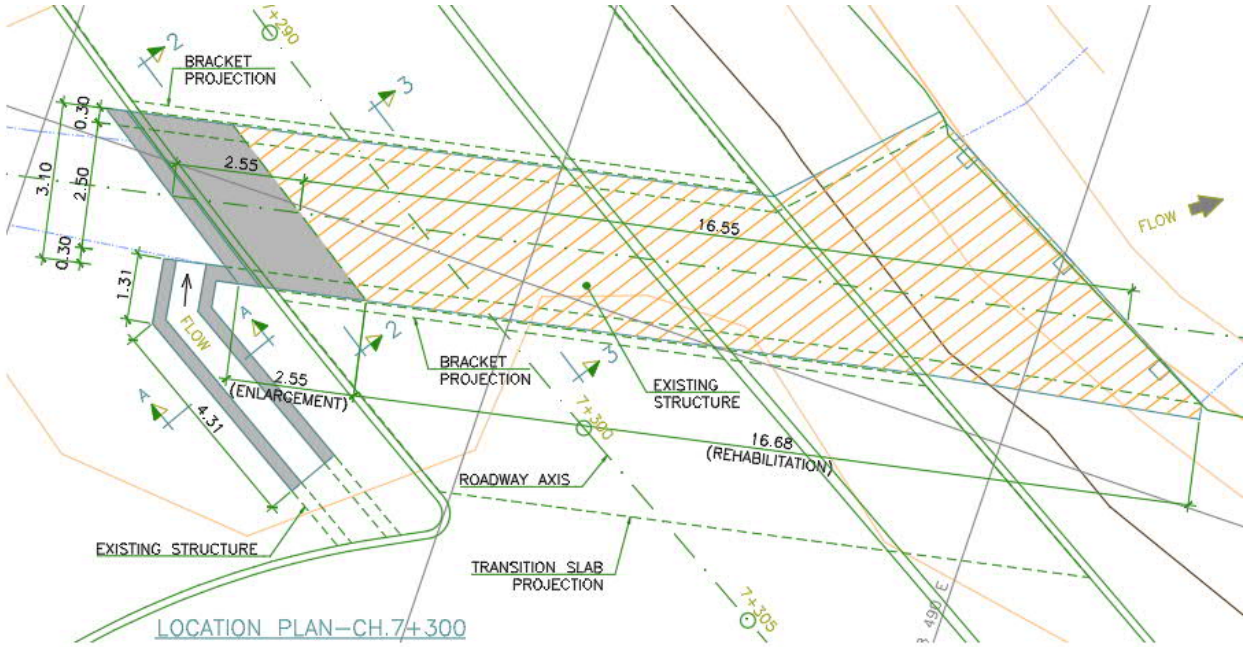


Figure 44 New structure proposed CH 7+300 (Pantufo Coastline)

7.6.7.2. Road and sidewalks drainage

The drainage system has been designed according to the hydraulic results and the information from previous documents. The typical section that can be found along the new road are the following:

- Mainly, two parallel drainage systems (land side/seaside) that drain water from the road surface into the main pipeline along the centreline of the road.
- The flow on the sea sidewalk will be conveyed with a semi-circular channel and diverted directly to the sea through weep holes.

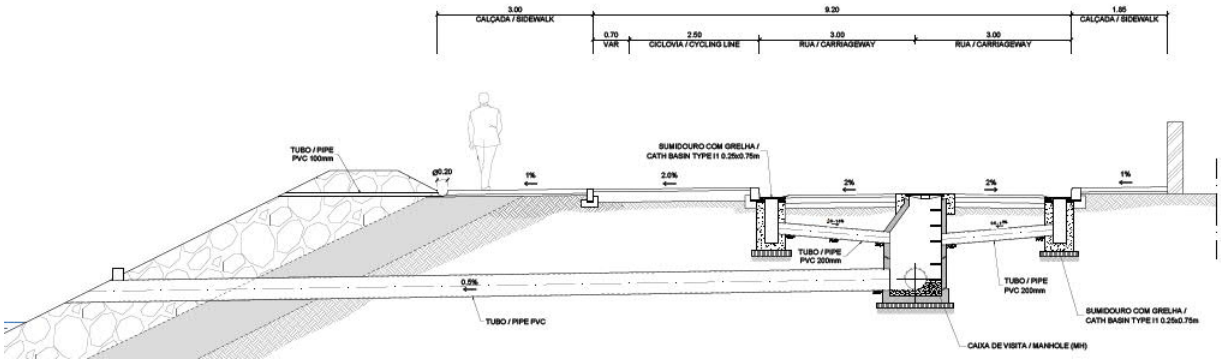


Figure 45 Typical section Pantufo Coastline without park space (5+900 – 7+370 and 7+625 – 7+660).

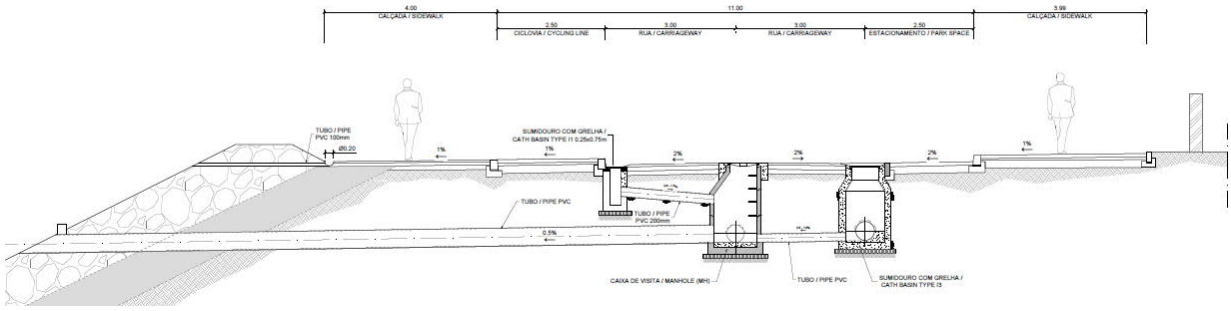


Figure 46 Typical section Pantufo Coastline with park space (5+900 – 7+370 and 7+625 – 7+660).

- Between CH 7+370 – 7+625, it is defined a main pipeline on the right side, with inlets every 15m, situated at the roadside gutter. This section drains into the previous typical sections after the curve at Pestana.

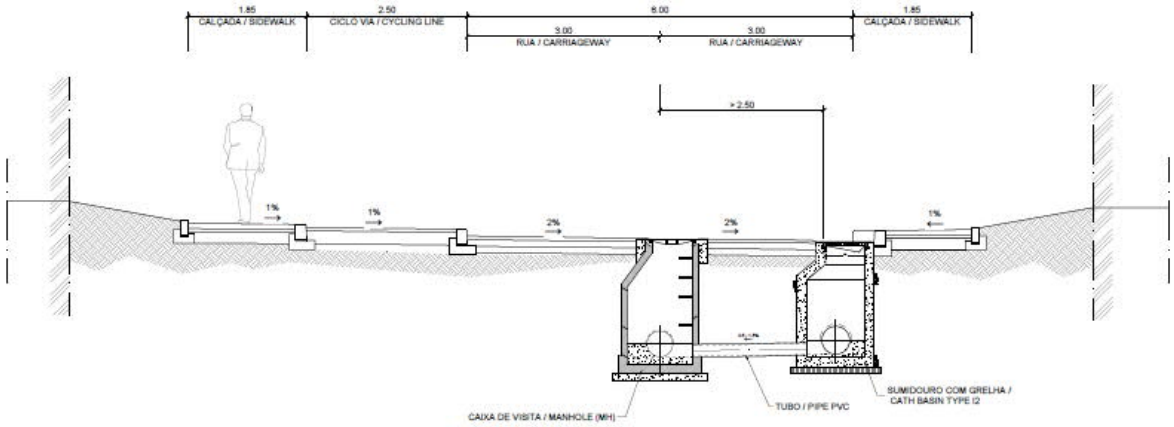


Figure 47 Typical section Pantufo Coastline (7+370 – 7+625).

- After Pestana, the road drains towards the berms in the typical road section without kerbs.

The correct functioning of the longitudinal drainage system is essential for safety road. Longitudinal drainage ensures the rapid flow of surface water over the platform, ensuring pavement protection. To ensure this, a hydraulic checking has been realised with the software MicroDrainage 2020.1.

7.6.7.3. Structures in CH 7+300 (Pantufo Coastline)

The platform of the existing structure is also too narrow in this case for the new requirements of the road. It will be needed at least an increase of 2,00 m perpendicular to the road axis which means 2,55 m of enlargement of the box.

The enlargement of the box will be designed with a new box of the same dimensions joined to the existing one to avoid longitudinal joints.

Previously to this operation, a rehabilitation work of the existing structure will be done with the following aims:

- Removal of materials accumulated inside the box which reduce its drainage capacity.
- Cleaning of all the concrete surfaces with deterioration signs (degradation, coloration, etc.)
- Substitution of reinforcing bars damaged for others new rightly connected to the concrete.
- Disposal of a new layer of cover with high resistance and low shrinkage mortar.
- Application of protective painting against carbonation.

Like this structure is placed in the most densely urbanized part of the city, there are enough possibilities for traffic diversion during the rehabilitation works using the existing streets. During the construction of the new part of box, the existing structure could be used for traffic use.

The dimensions of the complete structure would be finally 3,10 m total length of span, with 2,50 m free length of span, and 19,10 m total box length (16,55 initial + 2,55 m of enlargement).

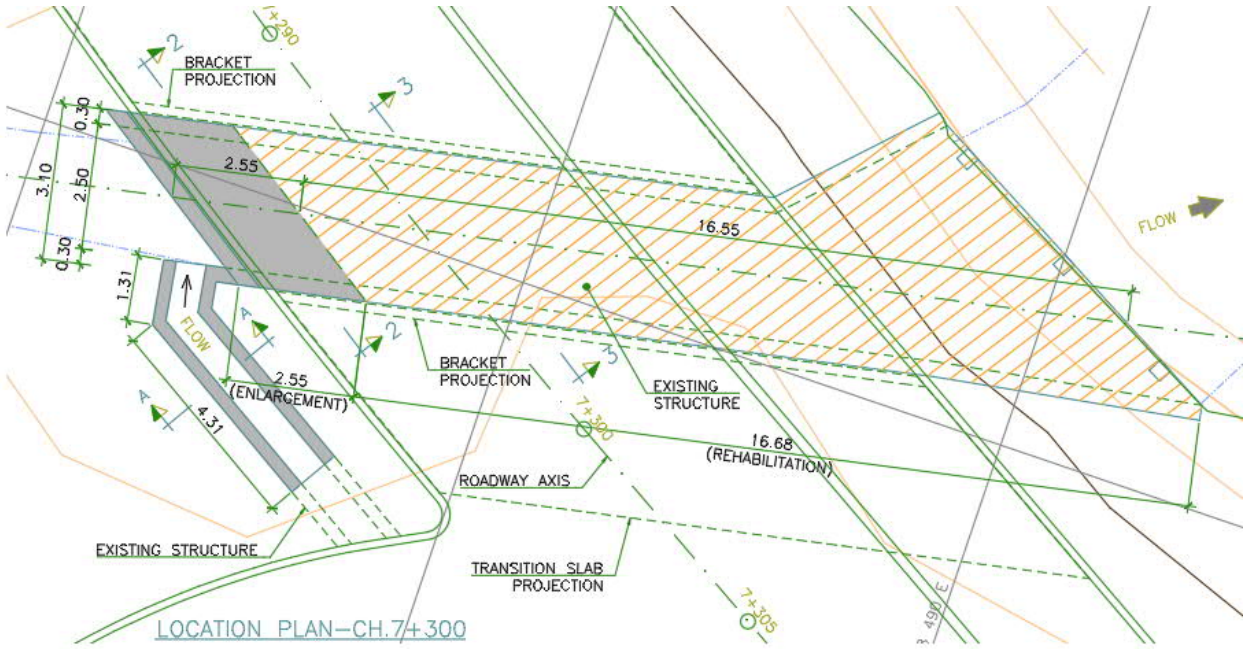


Figure 48 New structure proposed CH 7+300 (Pantufo Coastline)

7.6.8. LANDSCAPING

The proposed intervention seeks to protect and improve the current space through the following actions, executing new paving, furniture and facilities, among other actions, up to km 7+680, from this point an improvement of what exists is carried out.

- Creation of a paved pavement on both sides of the road with basalt cobblestones in the pedestrian area near the sea and concrete paving on the residential side of the road.

  There is an existing pavement with basalt cobblestones of which it is planned to recover even the proportional part of the masonry work necessary to clean them for their subsequent repositioning, only those cobblestones that demonstrate their adequate integrity will be recovered.
- Creation of pedestrian space accessible to all passers-by with pedestrian fords, special paving and handrails that create a barrier-free public space.
- Creation of a cycle lane at pavement level up to km 7+900, with a concrete pavement that allows cycling along the entire promenade. The decision of creating the cycle lane at pavement level offers cyclists greater safety from road traffic and also allows for the extension of pedestrian space when no cyclists are circulating.
- Creation of rolling fords with a maximum slope between 20% for car access to the private plots adjacent to the promenade.
- The relocation of the existing urban installation networks buried and complying with the minimum safety distances between them, as well as aesthetically improving the urban space of the promenade.
- A new lighting design that guarantees the correct illumination of all the spaces within the area of intervention, as well as creation of a uniform image between the different bays that extend along the promenade. The proposed lighting runs along the pavement adjacent to the building plots, allowing the entire promenade to be illuminated, i.e. the road and pavements on both sides.
- New urban furniture is placed, such as concrete bins every 40 m and benches every 100 m approximately.
- A space of singular presence appears between CH 6+480- CH 6+600, next to the National Lyceum and the Ministry of Foreign Business, which allows the development of a recreational area that houses:
    - A green area with shady trees under which there are rest areas with benches.
    - A children's play area.
    - Lighting to enhance the value of the new recreational area.
    - Street furniture, corrosion and vandalism resistant, close to the sea and vandalism:
        - Concrete bins.
        - Drinking water fountains located in recreational areas.
        - Bike parking.
        - Benches: The benches are made of recycled concrete and glass. Currently there is a local company that makes urban furniture with this material with interesting aesthetic results, mixing new designs that play with straight and curved geometric lines depending on the public space design, with others that recover the aesthetics of colonial models.

In order to reduce the impact created by the new maritime protection wall along the promenade, a tile cladding is proposed as a solution that requires less maintenance (without the need for periodic coats of paint), it is easy to implement, and it provides beauty and identity to the wall. The wall is reused and it is proposed to make it larger in certain sections along the promenade to create new areas of benches.

Green Areas

Along the Ana Chaves bay, the main tree species are the Indian Almond (*Terminalia catappa*), with smaller numbers of palm species.

These trees are considered as cultural heritage because they create a specific atmosphere typical for São Tomé city, its parks and promenades. This is the reason why all trees in good condition and that do not represent a problem or danger to pedestrians within the public space are protected.

When a tree is occasionally affected by the new layout of the promenade, as well as in the case of existing trees that imply a danger to pedestrian or damage to the road or coastal protection works, it should be replaced by young saplings of other local tree species, salt resistant and that provide shade. A new species will always be planted close to the affected one, looking for the best location without compromising pedestrian accessibility.

Another solution taken to respect as much as possible the existing trees on the sidewalk and to allow pedestrian access, is to propose enclosed tree surround with electro welded grating.

In the case of the bay under study, the affected species and new proposals are detailed below:

- 36 new tree species (15 karroo acacias and 21 tamarinds, or similar)
- 2 tree species affected (T*erminalia catappa* or similar)

Annex 3 presents the affected trees.

Annex 4 shows the proposal for Landscape and Land Use in Pantufo Coastline.

7.6.9. COASTAL PROTECTION STRUCTURES DESIGN

Coastal protection of alternative C in Pantufo Coastline mainly consists on installing a rock protection in some specific areas. Within this Detailed Design little variations are considered.

A comparative table between alternative C of Feasibility Design and Detailed Design is shown below.

	FEASIBILITY STUDY Alternative C	DETAILED DESIGN
Number of typical cross section designed	2	2 (Z3A and Z3B)
Revetment	Balustrade +1,0m above road level. (+4,0 m r(/MSL approx.) Berm in front of existing seawall Armour rock 0,3-1,0 t Revetment with crest +0,5m above road level (+5,00 m r/MSL approx.) Armour rock 1,0-3,0 t	Z3A Concrete wall up to +4,0 m r/MSL Revetment crest at +3,7 m r/MSL Armour rock 0.7-1.4 t Z3B Concrete wall 1,0 m above road level Revetment, crest +5,00 m r/MSL. Armour rock 0,7-1,4 t
Geotextile	YES	YES
Beach nourishment	NO	NO

Table 23 Comparative table between Feasibility-Alternative C and Detailed Design. Source: Own elaboration.

This document is mainly focused on the iv) specific objective stated on Terms of Reference (TOR), repair and improve the coastal protection along the road providing an adequate solution for Climate Change impacts (sea level rise) in each specific project area, including protection against expected coastal erosion and water overtopping. Furthermore, the coastal protection designed trying to ensure or just be in line with other specific objective of the project v) increase the attractiveness of the capital's waterfront for both locals and tourism development; and vi) improve accessibility to the coast and the conditions of fishery landing sites.

A Concept Design prepared by CDR international for MOPIRNA, has been completed to identify alternatives for the construction of coastal protection infrastructure and the reconstruction of the Marginal Road. **Alternative C** has been selected as the preferred option.

Following **typical cross section** are proposed:

First section consists on installing a main protection of rocks 0.7-1.4 tons till +3.70 m r/MSL. The crest of coastal protection is crowned by a concrete wall that reaches +4.00 r/MSL that is built on the existing wall. Additionally, a geotextile is placed between rock protection and existing wall and the natural terrain as well to avoid loss of terrain.

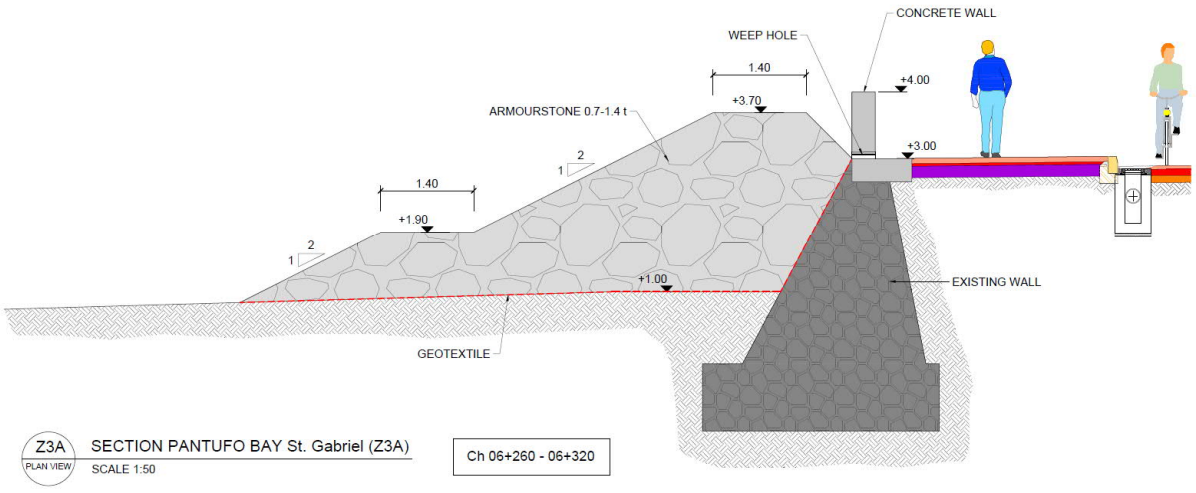


Figure 49 Typical cross section Z3A. Pantufo Coastline (CH 6+260 – CH 6+320)

Second section consists on installing a main protection of rocks 0.7-1.4 tons till +5.00 m r/MSL. A filter layer of 35-75 kg is placed. To crown the coastal protection a concrete wall that reaches +5.50 r/MSL is proposed and a geotextile between rock protection and natural terrain is placed.

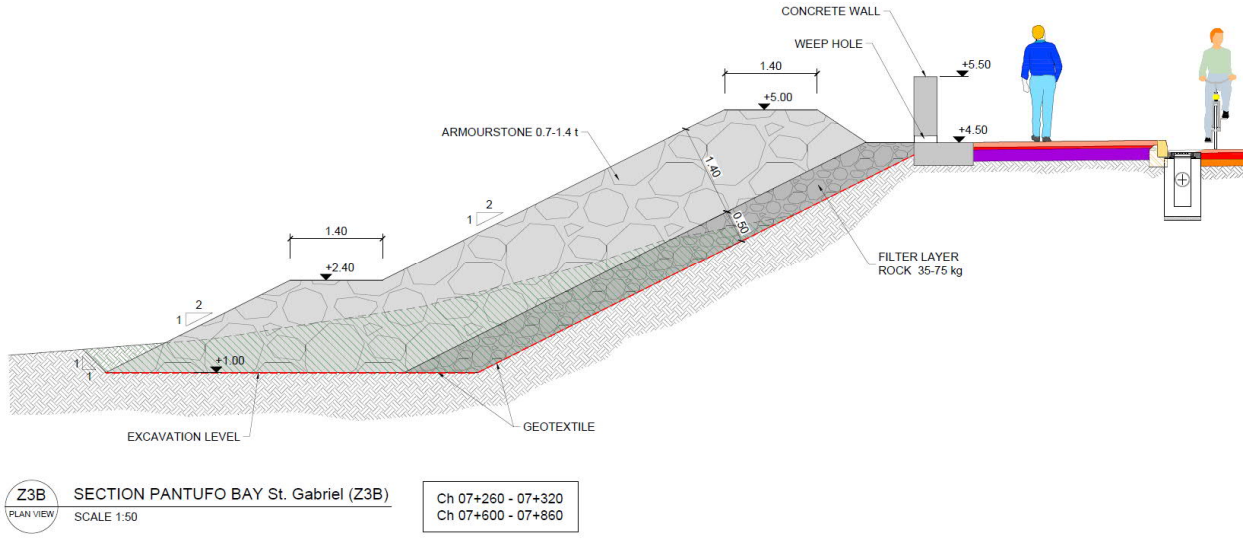


Figure 50 Typical cross section Z3B. Pantufo Coastline (CH 7+260 – CH 7+300; CH 7+600-CH 7+860)

7.6.10. ANCILLARY WORKS

7.6.10.1. Water supply network

In the scope contemplated in the project, it is foreseen the integration of different independent services, infrastructures, such as: Supply to Sources and Services and Supply for Irrigation from the existing drinking water network in the city.

The affected are made available according to the location of the service under the project.

Dripping will be carried out through PE80 polyethylene pipe with smooth inner wall, with a nominal pressure of 1.0 MPa (10 atm), for the river, and 1.6 MPa (16 atm), for spring and ornamental fountain.

7.6.10.2. Irrigation installation

The pipes will be made of plastic, resistant to tolerances and acid substances. In all the irrigation network will be used PE80 polyethylene pipes, resistant to UV radiation.

DN40 and PN 16 armoured irrigation channels will be installed, consisting of a hoop, body and cover made of ductile cast iron with a built-in valve and a 45 mm coupling for connection to the hose, in each of the green and gardened areas according to the irrigation flow rate of each area.

7.6.10.3. Fountain installation

The 3 fountains will be installed according to the location represented on the drawings. The supply pipe for these fountains will be made of PE80 polyethylene with a nominal pressure of 16 atmospheres (PN16). This pipe will be 32 mm in diameter and will be connected to the nearest existing water mains.

Manholes will be installed in the branches or connections to the existing drinking water network.

The model chosen is a modern rectangular shaped fountain, with the foundation fixed by means of LM-18 shaped anchors made of 3mm steel plate, cast iron grid in the drain and push button in nickel plated brass.

A drainage pipe must also be installed to conduct excess water to the rainwater drainage system.

7.6.10.4. Lighting

The public lighting system will consist of luminaires at the top of columns or poles which will be connected to their own low-voltage electrical network (service voltage of 380 V between phases and 220 V between phase and neutral) which will have the appropriate protection and control systems for switching the installation on and off in safe conditions which will allow both the correct lighting of the roads and energy saving by adapting the lighting periods to the hours when the system needs to be used.

For the protection of people and equipment, all luminaires shall be earthed by means of a separate earth plate located near the base of the pole.

The distribution of the luminaires on the roads has been carried out taking into account both technical criteria related to the level of illumination and urban planning criteria associated with the distribution of singular elements on the edges of the roads (pedestrian crossings, cycle and pedestrian crossings, green areas, etc.).

The electricity supply required for this installation will be provided from the low-voltage side of the existing power transformer stations in the project area.

From the low-voltage circuits assigned to the lighting installation, control and protection cabinets have been designed which will control the switching on of the luminaires according to the time of day and the intensity of the natural lighting. The on/off thresholds of the installation will be set at the start-up of the installation in such a way that they adapt as well as possible to the needs of the area, and may subsequently be adapted to other thresholds depending on the experience of use that is acquired.

7.7. UTILITIES RELOCATION

In the proposed interventions in Pantufo Coastal are the following:

- **Existing lighting network** for the illumination of the road is demolished and a new network is proposed with streetlights that provide adequate light power to illuminate the entire section of the promenade, in addition to complying with an aesthetic in accordance with the rehabilitation of the bay and creating a uniform image and continuity with the rest of the bays.

  These streetlights will be connected to the lighting cabinets located in the transformation centers near the road, which will be in charge of providing electrical energy to them. These lighting cabinets will house all the lighting protection and control elements.

- **Existing medium and low voltage underground** conductors will be extracted from the pipes and trenches that are located along the promenade, and will be relocated in tubes destined for medium and low voltage in the new proposed trench.

  The existing sections with overhead low voltage distribution line will be removed, and will be replaced by conductors with the same characteristics as the underground conductors for low voltage distribution. These new conductors will be placed in the pipes intended for low voltage distribution in the new trench.

  In addition, the existing electric service connections that supply electricity to homes and facilities along the promenade will also be replaced by new ones, adapting to the new location of the different electrical distribution networks.

- **Existing telecommunication network**: underground telecommunications network will be relocated along the new proposed trench layout, inside the pipes intended for such use, while the overhead network will be eliminated, replacing the cables with new ones suitable for installation inside the pipes

of the proposed trench. These cables must have the same characteristics as the existing underground cables.

In addition, the existing telecommunication service connections that supply the the homes and facilities along the promenade will also be replaced by new ones, adapting to the new location of the different telecommunications networks.

- **This existing water network** will be relocated in a new trench parallel to the electricity and telecommunications trench, maintaining the regulatory distance between them.

  In addition, the existing water service connections that supply the homes and facilities along the promenade will also be replaced by new ones, adapting to the new location of the pipes.

The proposed sewerage network must always run under the rest of the previously collected networks, as it is a network that collects contaminated water and could affect the drinking water network.

7.8. MAIN ACTIVITIES GENERATING IMPACTS

The construction activities for this Project are:

- Clearing;
- Demolition of infrastructures, layers of pavements;
- Demolition of existing bridges and construction of new bridges
- Embankments;
- Drainage in the foundation of Embankments or in the excavation floor;
- Protection of existing vegetation;
- Construction of pavement for road, tiled pavement and repair of existing pavement;
- Construction of wash area, public toilets, playground, fitness and green spaces,
- Installation of services of public services or restauration of those affected;
- Installation of electricity distribution network and public lighting;
- Movement of machinery, vehicles and workers between site construction and front works;
- Site Construction activities;
- Operation of quarries;
- Beach nourishment.

In the operation phase, it will be considered:

- Activities associated with the operation of infrastructure;
- Traffic generated by the operation of infrastructure;
- Maintenance of infrastructures.
- Beach nourishment.

7.9. WORK FORCE

7.9.1. CONSTRUCTION PHASE

The creation of jobs, at this time it is not possible to indicate a number, because it will depend on the work program, construction methods, number of defined fronts, number of workers defined by the contractor winner of the international competition for each section of Marginal Road.

7.9.2 Operation Phase

The operations of infrastructures and maintenance of road section covers the inspection of road, culverts coastal protection structures, public toilets and laundry area using human resources.

7.10. SCHEDULE FOR CONSTRUCTION AND OPERATION PHASES

For the construction of the Project it is foreseen a duration of about 24 months, with no further knowledge of the exact date previewed for the start foreseen for the start of construction works.The following work plans for RAP implementation and E&S activities. Construction works in coastal areas will be adapted to avoid intervention is in interstitial habitats during peak nesting periods for turtles (October – April).

During the preparation phase (Before the works' commencement)	weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
RAP approval												
Consulting with INAE & Administrations. Formalization or Agreements												
Consultation and information dissemination with PAPs												
Formation of AGCPRMR* (Resettlement Committee)												
Formation of the GRM (Grievance Redress) Committee												
Preparation of the project profile (RAP implementation schedule according to Project´s work plan)												
EIB approval												

Activities (During Project Execution)	1 st year											
	1	2	3	4	5	6	7	8	9	10	11	12
During the resettlement implementation												
Consultation with the PAPs												
Disbursing payment to the PAPs and Relocation												
Documentation of the compensation activities												
Documentation of the Grievances recipients and responses												
Documentation of operation and efficiency assessment of the RAP												
Monitoring and evaluation during RAP implementation (External Consultancy)												
Evaluation activities mid-term evaluation final impact												
	2nd year											
Monitoring and evaluation after RAP implementation (External Consultancy)												
Evaluation activities mid-term evaluation												
Final impact Report												

*Agua Grande Coastal Protection and Reconstruction of Marginal Road

Table 24 Work plan RAP implementation

	MONTHS																							
ACTIVITIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Abreviated Reseattlement Action Plan																								
Human Resources Management Plan preparation																								
Human Resources Management Plan implementation																								
Code of Conduct for workers preparation																								
Code of Conduct for workers training																								
Code of Conduct for workers implementation																								
Stakeholders Engagement Plan preparation																								
Stakeholders Engagement Plan implementation																								
Grievance Resolution Mechanism preparation																								
Grievance Resolution Mechanism training																								
Grievance Resolution Mechanism implementation																								
Contingency Plan for Covid 19 preparation																								
Contingency Plan Covid 19 training																								
Contingency Plan Covid 19 implementation																								
Traffic Management Plan preparation																								
Traffic Management Plan training																								
Traffic Management Plan implementation																								
Occupational Health and Safety Plan preparation																								
Occupational Health and Safety Plan training																								
Occupational Health and Safety Plan implementation																								
Community Health and Safety Plan preparation																								
Community Health and Safety Plan training																								
Community Health and Safety Plan implementation																								
Emergency Response and Preparedness Plan preparation																								
Emergency Response and Preparedness Plan training																								
Emergency Response and Preparedness Plan implementation																								
Solid Waste and Wastewater Management Plan preparation																								
Solid Waste and Wastewater Management Plan training																								
Solid Waste and Wastewater Management Plan implementation																								
Beach Nourishment Management Plan preparation																								
Beach Nourishment Management Plan implementation																								
Turtles Nesting Find Procedures preparation																								
Turtles Nesting Find Procedures training																								
Turtles Nesting Find Procedures implementation																								
Archeologic Chance Find Procedures preparation																								
Archeologic Chance Find Procedures Training																								
Archeologic Chance Find Procedures implementation																								
Monitoring																								
Monthly ESMP Reports preparation																								

Table 25 Work plan construction phase

During the time horizon of 20 years, it is foreseen that infrastructures require maintenance.

At longer time horizon will be necessary execute beneficiation works, however it is difficult to predict.

Relatively to deactivation of project given its nature it is not possible make any statement on this matter.

7.11. MATERIALS AND ENERGY USED AND PRODUCED

7.11.1. CONSTRUCTION PHASE

During construction phase the use of site construction and warehouses for materials and equipment is foreseen in several work fronts not yet planned.

Energy

With regard to **energy** consumption, if high consumption is expected, the adoption of autonomous sources installed by the contractor itself (generators) may be justified, this situation may prevent production and work rhythm losses resulting from power failures or cuts. At his time is not possible to determine the expected energy consumptions.

Road rehabilitation will involve replacement of the current pavement and implantation of new pavement. Asphalt, concrete and crushed aggregate will be used in these activities.

The literature mention that in the first three phases of a road life cycle, such as: extraction of raw materials, manufacturing, and placing of course pavement materials, Portland cement concrete (PPC) pavement demand more energy. The manufacturing of bitumen requires less energy than the production of cement. Furthermore, the major consumption of energy in the production of asphalt pavement occurs during the asphalt mixing and aggregates drying

The pavement cement consumes more energy than the hot mix asphalt. Warm mixing asphalt engineering can save 20-70 percent energy in contrast to the hot mixture asphalt because the mixing system lowers temperatures. In addition, asphalt mixtures and alternative technologies consume less energy and gas emissions than Portland cement mixtures[4]

A meta-study at the University of Washington found that a reasonable estimate of total energy consumption is between two and four terajoules per lane-km of roadway paved (for example, a one kilometer stretch of a standard two lane road represents two lane-km). For overlays of asphalt pavements in roadway rehabilitation, numbers range from about 100 to 300 megajoules for each square meter of pavement dependent on the thickness of the overlay, aggregate haul distance, and other variables such as the use of recycling[5].

Lagarto bay

Being Marginal road a two-lane road, with 2.7 km, it can be estimated a maximal total energy consumption of 21.6 TJ (using the higher number range), which will be less because not all road will be newly paved. The same exercise is performed considering the rehabilitation of total area of the Lagarto bay Marginal Road (38,553.60 m^2, which gives a total of 11,566,080.00 MJ (11.6 TJ**,** using the higher number range**).** Similar, this value will be less because not all road will be rehabilitated. Nevertheless, the energy consumption of rehabilitation is more advantageous, in comparison with the new pavement.

[4] **LENDRA, M A W & J U D Hatmoko (2020).** Literature Review on Energy Consumption in Road Construction Projects. *Journal of Physics: Conference Series* **1625** 012034

[5] https://pavementinteractive.org/energy-and-road-construction-whats-the-mileage-of-roadway/

The laundry will require also some energy to its construction, but will be negligible due to its dimensions. The same is true for the coastal protection structures.

Ana Chaves bay

Ana Chaves bay have a two-lane road, with 3.1 km, it can be estimated a maximal total energy consumption of 24.8 TJ (using the higher number range), which will be less because not all road will be newly paved. The same exercise is performed considering the rehabilitation of total area of the Ana Chaves bay Marginal Road (42,475.00 m^2), which gives a total of 12,742,500.00 MJ (12.7 TJ)**,** using the higher number range)**.** Similar, this value will be less because not all road will be rehabilitated. Nevertheless, the energy consumption of rehabilitation is more advantageous, in comparison with the new pavement.

The public toilets, the fish market and the boat workshop will require also some energy to their construction, but will be negligible due to their individual dimensions. The same is true for the coastal protection structures.

Pantufo Coastline

Being Marginal road a two-lane road, with 2.9 km, it can be estimated a maximal total energy consumption of 23.2 TJ (using the higher number range), which will be less because not all road will be newly paved. The same exercise is performed considering the rehabilitation of total area of the Pantufo bay Marginal Road (25,490.00 $m^{2)}$, which gives a total of 7,647,000.00 MJ (7.6 TJ)**,** using the higher number range)**.** Similar, this value will be less because not all road will be rehabilitated. Nevertheless, the energy consumption of rehabilitation is more advantageous, in comparison with the new pavement.

The coastal protection structures will require also some energy to their construction, but will be negligible.

Materials

In terms of materials, the road rehabilitation, the drainage system, the coastal protection structures and the beach nourishment for Lagarto bay and Ana Chaves bay will also require a significant amount of construction materials.

Materials and equipment will be transported to construction site and it is generally the contractor who plans the most appropriated processes for the transportations, storage and supply of materials for the works.

Materials and equipment are usually transported by the supplier who deliver the material on construction site. Sometimes a subcontract for the supply and installation of specific equipment is carried out.

A total of six quarries have been researched in the vicinities of the project then we proceed to the description of them. In the figure below there are shown some existing quarries located close to the project track. With the entry into force of the new Inert law in September 2021, all quarries were required to be licensed as well as to present an ESIA for this purpose.

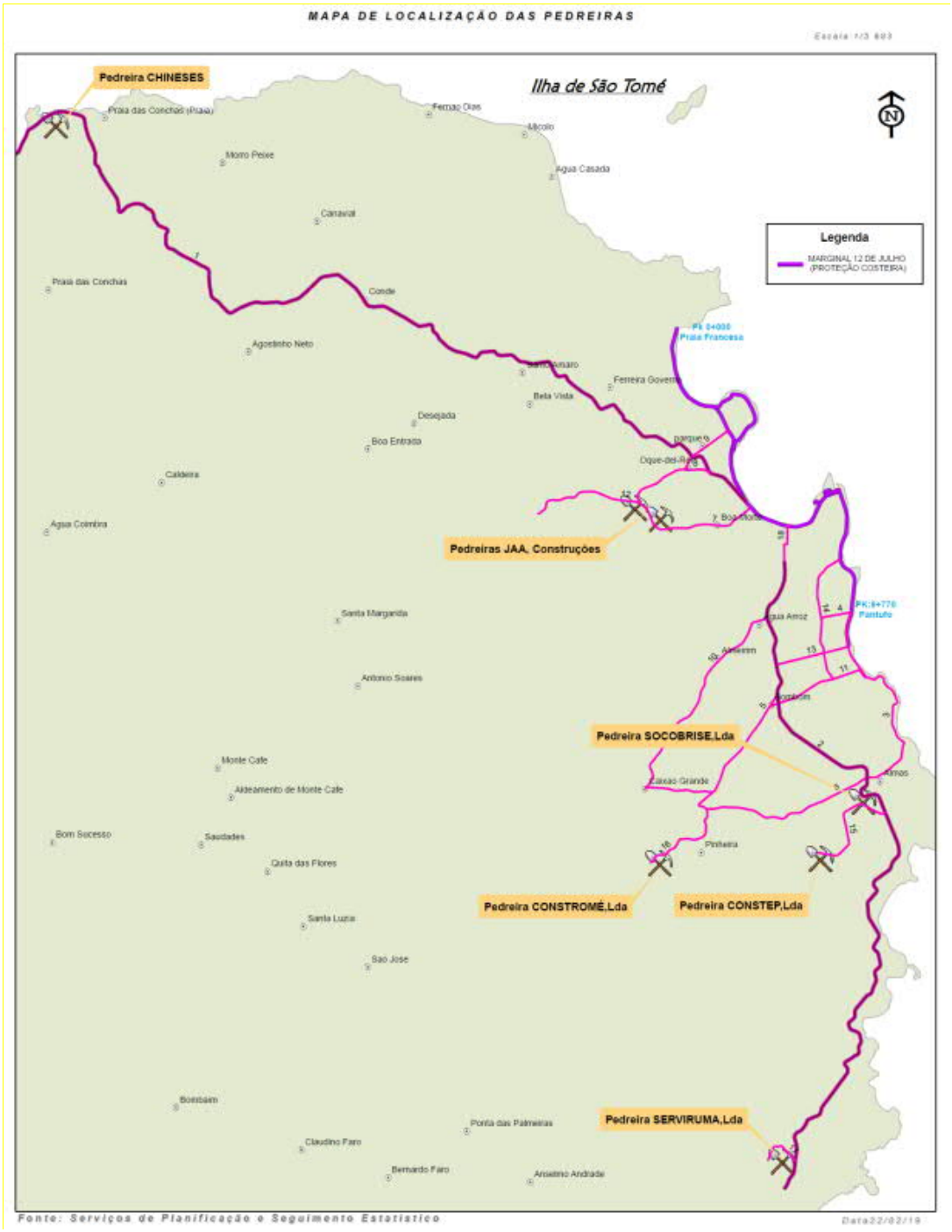


Figure 51 Location of quarries (INEA)

Quarry P-1 is located 5 km from the alignment. Basaltic rocks is mined in the quarry and it is given all kinds of uses, for gravel, concrete and agglomerates. The maximum production of the quarry is 500-1000 m^3 /month and the production is unlimited.

Quarry P-2 (SOCOBRISE) is located 6km from the alignment. Basaltic rocks are mined in the quarry and it is given all kinds of uses, for washed sand, gravel, concrete and agglomerates. The maximum production of the quarry is 100 m^3/month and the production is unlimited.

Quarry P-3 (CONSTEP) is located 8km from the alignment. Basaltic rocks are mined in the quarry and it is given all kinds of uses, for concrete and agglomerates. The maximum production of the quarry is 180 m^3/month and the production is limited.

Quarry P-4 (SERVIRUMA) is located 15km from the alignment. Basaltic rock is mined in the quarry and it is given all kinds of uses, for washed sand, gravel, concrete and agglomerates. The maximum production of the quarry is 200 m3/month and the production is unlimited.

Quarry P-5 (CONSTROME) is located 10 km from the alignment. Basaltic rocks are mined in the quarry and it is given all kinds of uses, for washed sand, tout venant, crack, gravel, concrete and agglomerates. The maximum production of the quarry is 100-150 m3/month and the production is unlimited.

Quarry P-6 (SAMULIN) is located 17km from the alignment. Basaltic rocks are mined in the quarry and it is given all kinds of uses, for washed sand, tout venant, crack, gravel, concrete and agglomerates. The maximum production of the quarry is 8000 m3/month and the production is unlimited.

Name of the Quarry	Exploration licence	Industrial permit	Environmental licence	Distance to the Marginal	Limited Production or No Limits	Location in protected area	Location in the residential area	Crossing inhabited areas to the project area
JAA	No	Yes	No	1 km	Limited to existing raw material	No	Yes	Yes
SOCOBRISE	No	Yes	No	6 km	Limited to existing raw material	No	Yes	Yes
CONSTEP	No	Yes	No	8 km	Limited to existing raw material	No	No	Yes
CONSTROMÉ	No	Yes	No	10 km	Limited to existing raw material	No	No	Yes
SERVIRUMA	No	Yes	No	15 km	Limited to existing raw material	No	No	Yes
SAMULIN	No	Yes	No	17 km	Limited to existing raw material	Yes	No	Yes

Table 26 Quarry Assessment

As shown in the table above, none of the existing quarries have an exploration license. This is due to the fact that the law that requires quarries to obtain an exploration license issued by the General Directorate of Natural Resources only came into force in September 2021. And, currently, all existing quarries in São Tomé operate through an Industrial License.

Under the new Inert Law, Decree-Law 9/2020, of 22/09/2020, existing quarries will have to start the licensing process at the Directorate General of Natural Resources. However, to date, only the CONSTEP quarry has submitted such a request for an exploration license and the process is under analysis.

With regard to environmental licensing, currently none of the quarries for the exploration of mineral resources has an environmental license.

Currently, a Chinese construction company, STP Urbanos Construções, holds an environmental license for a quarry in Boa Entrada, Lobata district, 14 km from the project area, but to date there is no forecast when the quarry will be operational.

With regard to location in protected areas, the SAMULIN quarry is the only one inserted in the Obô Natural Park, in a type II Partial Protection Area. This fact led the Directorate-General for the Environment not to issue the environmental license for it. The company that explores the quarry is in negotiations with the Ministry of Natural Resources and Environment, which granted them a new area to install the quarry. This new area is located next to the SOCOBRISE quarry, about 4.5 km from the Marginal de São Tomé.

Considering the location of the project's incidence area, in the most urbanized area of the country, the transport of materials from any of the quarries to the works, by truck, always crosses different urban areas to the construction site. Two of the 6 existing quarries (JAA and SOCOBRISE) are located in urban areas, with their processing activities established in these areas.

Considering the volume of materials needed for the requalification works on the three lots of the Marginal Road and the response capacity of the quarries in supplying the raw material for the work, it is considered that the CONSTEP and CONSTROMÉ quarries, due to their locations in relation to the work site and their response capacity in supplying these materials, are in the best position to supply this type of raw material for the work. However, these recommendations do not cancel the option of using the others if they meet the requirements for this.

The materials resulting from the demolitions will be taken to licensed flow, and this activity is usually carried out at the beginning of the work while the assembly of the site construction takes place.

The materials resulting from demolitions need a license do disposal or indicated by the Administration and this activity is usually carried out at the beginning of the works.

For quarries the following measures should be implemented:

a) The location of quarries and borrow areas shall be subject to approval by relevant authorities including DGA and PIU/Supervision.

b) Extraction sites shall not be located within the vicinity of settlement areas, cultural sites, wet-lands or any other valued ecosystem component and shall be located at not less than 500m from such areas.

c) Extraction sites shall not be located adjacent to stream channels, wherever possible to avoid siltation of river channels. Where they are located near water resources, borrow pits and perimeter drains shall surround quarry sites.

d) Extraction sites shall not be located in forest reserves. However, where there are no other alternatives, permission shall be obtained from the entity in charge of natural resources and an environment impact study shall be conducted.

e) Extraction sites shall not be located on high or steep ground or in areas of high scenic value.

f) Only sites that can easily be rehabilitated shall be chosen. Areas with minimal vegetation cover such as flat or bare ground or areas covered with grass only or covered with shrubs with height of less than 1.5m.

g) Extraction site boundaries shall clearly be demarcated and marked to minimize vegetation

clearing.

h) Vegetation clearing shall be restricted to areas required for safe operation of construction work. Vegetation clearing shall not be done more than three months in advance of the operation.

i) Extraction sites shall not be located in archaeological areas. Excavations in the vicinity of such areas shall proceed with great care and shall be done in the presence of Authorities.

j) Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exit from workings.

Lagarto bay

Regarding **materials** to be used, the following table presents estimative of the materials required for the different structures:

Description	Main use	Quantity ($m^{3)}$
Materials (concrete)	Work of art / Accesses (ramp and stairs) / Laundry	2974.87
Materials from quarries	Marginal Road (aggregate and pavement) / Promontory Cycle Path / Backfilling for excavated trenches / Accesses (ramp and stairs) / Drainage system / Replacing of Existing Electric Grids / Laundry	14477.45
Coastal Protection Stones	Costal protection structures	14497.5
Sand	Beach nourishment	14159,65

Table 27 - Calculation of quantity materials to be used in construction Lagarto bay

Ana Chaves bay

Regarding **materials** to be used, the following table presents estimative of the materials required for the different structures:

Description	Main use	Quantity (m^3)
Materials (concrete)	Work of art / Landscaping / Accesses (ramp and stairs) / Public toilets, Fish market and Boat workshop	7810.76
Materials from quarries	Marginal Road (aggregate and pavement) / Promontory Cycle Path / Backfilling for excavated trenches / Drainage system / Public toilets, Fish market and Boat workshop	10951.9
Coastal Protection Stones	Costal protection structures	34536.75

Description	Main use	Quantity (m^3)
Sand	Beach nourishment	4250.00

Table 28 – Quantity of materials to be used in Ana Chaves bay

Pantufo Coastline

Regarding **materials** to be used, the following table presents an estimative of the materials required for the different structures:

Description	Main use	Quantity (m^3)
Materials (concrete)	Work of art	595.91
Materials from quarries	Marginal Road (aggregate and pavement) / Promontory Cycle Path / Backfilling for excavated trenches / Drainage system / Replacing of existing electric grids	6164.92
Coastal Protection Stones	Costal protection structures	7458.12

Table 29 – Quantity of materials to be used in Pantufo bay

Water

Execution of works requires consumption of energy for motive force and lighting, as well drinking water for human consumption. It is also necessary to have water for other consumptions, such as washing, soil watering and other purposes arising from the activities of construction site and non potable water can be used.

Regarding **water** consumption, as is not known so far the number of workers in each work front, is not possible to estimate the amount of drinking water that will be used during construction phase.

Lagarto bay

For the other consumptions, it was assumed that for an average of 1 m^2 of road, 2 m^3 of water will be consumed (this includes consumption of concrete, construction / formwork and other washes and trucks, etc). Calculation of the water quantities are provided in the following table.

Sections	A (m^2)	Water coeficient consumption	Total (m^3)	Total (liters)
CH 0+000-1+800	28,800.00	2.00	57,600.00	57,600,000.00
CH 1+800 – 2+760	9,753.60	2.00	19,507.20	19,507,200.00
Total	**38,553.60**		**77,107.20**	**77,107,200.00**

Table 30 - Calculation of the estimated water consumption during the construction phase of the Marginal Road at Lagarto bay

Ana Chaves bay

For the other consumptions, it was assumed that for an average of 1 m^2 of road, 2 m^3 of water will be consumed (this includes consumption of concrete, construction / formwork and other washes and trucks, etc). Calculation of the water quantities are provided in the following table.

Sections	A (m^2)	Water coeficient consumption	Total ($m^{3)}$	Total (liters)
CH 2+760 - 4+150	18,125.00	2.00	36,250.00	36,250,000.00
CH 4+150 – 4+500	5,250.00	2.00	10,500.00	10,500,000.00
CH 4+500 – 4+660	3,600.00	2.00	7,200.00	7,200,000.00
CH 4+660 – 5+900	15,500.00	2.00	31,000.00	31,000,000.00
Total	**42,475.00**		**84,950.00**	**84,950,000.00**

Table 31 - Calculation of the estimated water consumption during the construction phase of the Marginal Road at Ana Chaves bay

For the other consumptions, it was assumed that for an average of 1 m^2 of road, 2 m^3 of water will be consumed (this includes consumption of concrete, construction / formwork and other washes and trucks, etc.). Calculation of the water quantities are provided in the following table.

Sections	A (m^2)	Water coeficient consumption	Total (m^3)	Total (liters)
CH 5+900 – 7+600	17,850.00	2.00	35,700.00	35,700,000.00
CH 7+600 – 7+680	800.00	2.00	1,600.00	1,600,000.00
CH 7+680 – 8+820	6,840.00	2.00	13,680.00	13,680,000.00
Total	25,490.00		**50,980.00**	**50,980,000.00**

Table 32 - Calculation of the estimated water consumption during the construction phase of the Marginal Road at Pantufo Coastline

7.11.2. OPERATION PHASE

In the operation phase, necessary **products and materials** will be mostly for the proper maintenance of the infrastructures in order to guarantee the maintenance of safe traffic conditions on the road. These interventions include, for example, maintenance of vegetation, painting, replacement of obsolete or damaged safety or signage elements, repair of slopes or pavement improvement. This involves small quantities of materials, compared to the construction phase.

Energy

Energy consumption will be needed for the lighting of the roadway and green areas and the laundry. Consumption of water will be needed for the landscape maintenance (green spaces irrigation), drinking fountains and for the laundry use.

The **energy** consumption of each of the circuits can be determined by taking into account the number of operating hours of the installation and the power of the circuit.

$$Energy = Power\ (kW) \cdot Time\ (h)$$

Lagarto bay

For the electricity consumption in Lagarto bay, it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is shown in the following table:

Circuit		Track		Power (kW)	Energy (kW/h)
Largato Bay street luminary	LAG-I	CT-1	000-029	3,270	39 kW/h
Largato Bay park luminary	LAG-II	CT-1	DP-LAG	1,260	15 kW/h
Largato Bay park luminary	LAG-II	DP-LAG	LAG-II	1,260	15 kW/h
Lagarto bay street luminary	LAG-III	CT-2	030-060	3,379	41 kW/h

Table 33 – Lighting energy consumption at Lagarto bay

In the case of the circuit corresponding to the laundry that will be installed in Lagarto bay, it will have an energy consumption corresponding to 8 hours of operation, and a power of 10% of the maximum power that this installation has:

Circuit		Track		Power (kW)	Energy (kW/h)
Largato Bay Laundry	LAG-IV	CT-2	DP-LAV	1,316	16 kW/h

Table 34 Laundry energy consumption at Lagarto bay

Ana Chaves bay

For the electricity consumption in Ana Chaves bay, it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is shown in the following table:

Circuit		Track		Power (kW)	Energy (kW/h)
Ana Chaves bay Street Luminary	ANA-I	CT-3	061-083	2,507	30 kW/h
Ana Chaves bay Street Luminary	ANA-II	CT-4	084-136	5,777	69 kW/h
Ana Chaves bay Park Luminary	ANA-III	CT-4	DP-ANA1	2,844	34 kW/h

Circuit		Track		Power (kW)	Energy (kW/h)
Ana Chaves bay Park Luminary	ANA-III	DP-ANA1	DP-ANA2	1,008	12 kW/h
Ana Chaves bay Park Luminary	ANA-III	DP-ANA2	DP-ANA3	0,612	7 kW/h

Table 35 Lighting energy consumption at Ana Chaves bay

In the case of the circuit corresponding to the buildings that will be installed in Ana Chaves bay, it will have an energy consumption corresponding to 8 hours of operation, and a power of 10% of the maximum power that this installation has:

Circuit		Track		Power (kW)	Energy (kW/h)
Ana Chaves bay Restaurant	ANA-IV	CT-4	DP-CHE	3,949	47 kW/h
Ana Chaves bay Fountain	ANA-IV	DP-CHE	DP-FUE	1,316	16 kW/h
Ana Chaves Fish Market	ANA-IV	DP-CHE	DP-FIS	1,316	16 kW/h

Table 36 Buildings energy consumption at Ana Chaves bay

Pantufo Coastline

For the electricity consumption in Pantufo Coastline, it has been considered that the lighting of the roadway and green areas is maintained for 12 hours, coinciding with the hours when there is no natural lighting, and at 100% power. The consumption of each of the lighting circuits is shown in the following table:

Circuit		Track		Power (kW)	Energy (kW/h)
Pantufo Coastline street luminary	PAN-I	CT-5	137-180	4,687	56 kW/h
Pantufo Coastline street luminary	PAN-II	CT-5	DP-SCH	3,528	42 kW/h
Pantufo Coastline park luminary	PAN-II	DP-SCH	DP-SAO	1,512	18 kW/h
Pantufo Coastline street luminary	PAN-III	CT-6	181-224	4,796	58 kW/h

Table 37 Lighting energy consumption at Pantufo Coastline

Water

For **water** consumption, the following estimative are provided:

a) Maintenance of green spaces:

To know the water consumption for the irrigation of green areas, the sum of green areas within the scope of the project was multiplied by 1.8 l/m2, the estimated flow for each irrigated green area, considered in

one hour (data shown in RD6767-FD-L1/L2/L3-AN-IE-A17-Ancillary-D01.docx, point 2.4 “Irrigation installation”, page 31).

Lagarto bay

Total Green areas: 1.514m^2

Irrigation Consumption: 1.514m^2 x 1,8 l /m^2= **2.725,2 l per hour**

Ana Chaves bay

Total Green areas: 3.888,6m^2

Irrigation Consumption: 3.888,6m^2 x 1,8l /m2= **6.999,48 l per hour**

Pantufo Coastline

Total Green areas: 1.306m^2

Irrigation Consumption: 3.888,6m^2 x 1,8l /m2= **2.350,9 l per hour**

b) Drinking fountains:

To calculate the consumption of drinking water at the fountains, considered in one hour, the number of fountains was multiplied by the estimated flow rate of 2 l/min as given in RD6767-FD-L1/L2/L3-AN-IE-A17-Ancillary-D01.docx,

Lagarto bay

1 fountain x 2 l/min x 60 min= **120 l per hour**

Ana Chaves bay

5 fountains x 2 l/min x 60 min= **600 l per hour**

Pantufo Coastline

3 fountains x 2 l/min x 60 min= 360 l per hour

c) Buildings:

For the calculation of the water consumption in the buildings, the existing sanitary equipment in each building is taken into account as shown on the plans and the flow rates listed in the following table corresponding to the Basic Document on Sanitation of the Technical Building Code (DBHS4).

Device Type	Minimum instantaneous flow of cold water [dm³/s]	Minimum instantaneous flow of ACS [dm³/s]
Washbasin	0,05	0,03
Sink	0,10	0,065
Shower	0,20	0,10
Bath of 1.40 m or more	0,30	0,20
bathtub under 1.40m	0,20	0,15
Bidet	0,10	0,065
Toilet with cistern	0,10	-
Toilet with flush	1,25	-
Urinals with timed faucet	0,15	-
Urinals with cistern (c/u)	0,04	-
Domestic sink	0,20	0,10
Non-domestic sink	0,30	0,20
Domestic dishwasher	0,15	0,10
Industrial dishwasher (20 services)	0,25	0,20
Laundry	0,20	0,10
Domestic washing machine	0,20	0,15
Industrial washing machine (8 kg)	0,60	0,40
Isolated faucet	0,15	0,10
Garage faucet	0,20	-
Dump	0,20	-

Table 38 Water Consumption Sanitation Equipment

Taking into account the previous flow rates (Qi), the flow rate (Qc) was calculated by applying the simultaneity coefficients, since not all the devices will be working at the same time.

$$Q\_c=A\cdot Q\_i\text{^}B+C$$

Where:

Qc: calculated flow rate after applying the concurrency coefficients [l/s].

Qi: Minimum instantaneous flow rate of AFS or DHW per appliance type [l/s].

A, B, C: concurrence coefficients. They depend on the installed flow rate and the type of installation (home, office, hospital, school...) obtained according to UNE 149201.

Lagarto bay

The following table show the estimated consumption for the laundry building:

Description	Installed flow	Minimum pressure (mm.c.a)	Laundry	Flow (l/s)	Installed flow Qi (l/h)	Simultaneity coefficient A	Simultaneity coefficient B	Simultaneity coefficient C	Estimated flow Qc (l/s)	Estimated flow Qc (l/h)
Laundry	0.80	1500	4	0.80	2880	1.000	1.000	1.000	0.80	2880

Table 39 Water consumption at Lagarto bay laundry

The water consumption in laundry will **be less than 2.880 l/h.** The normal use will only be 2 times a week, about 2 hours each for washwomen.

Ana Chaves bay

The following table show the estimated consumption for the installations to be built:

Description	Installed flow	Minimum pressure	Washbasins	Odorless with cistern	Isolated faucet	Urinary with cistern	Spilway	Flow washbasin (l/s)	Odorless flow with cistern	Isolated faucet flow (l/s)	Urinary flow with cistern	Spilway flow (l/s)	Installed flow Qi (l/h)	Simultaneity coefficient A	Simultaneity coefficient B	Simultaneity coefficient C	Estimated flow Qc (l/s)	Estimated flow Qc (l/h)
Toilets	1.13	1500	9	6		2	1	0.45	0.60		0.08	0.20	4068	1.700	0.210	-0.700	1.04	3759
Markey	0.15	1500			1					0.15			540	0.682	0.450	-0.140	0.15	542
Workshop	0.15	1500			1					0.15			540	0.682	0.450	-0.140	0.15	542

Table 40 Water consumption at Ana Chaves bay buildings

Water consumption in toilets will **be less than 3.759 l/h**. Water consumption in fishery will **be less than 542 l/h**. Water consumption in boat workshop will **be less than 542 l/h**.

7.12. EFFLUENTS, WASTES AND EMISSIONS

7.12.1. CONSTRUCTION PHASE

During the construction phase, **wastes** will be generated associated with the execution of the works, which have the following main typologies, according to the European Wastes Codes (EWC)

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11

Code	Solid Wastes
08 03 18	Waste printing toner other than those mentioned in 08 03 17
13 02 06 (*)	Synthetic engine, gear and lubricants oils
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used Tires
16 06	Bateries and Accumulators
16 01 07 (*)	Oil filters
17 01 01	Concrete
17 01 02	Bricks
17 01 03	Tiles, roof tiles and ceramic materials
17 01 06 (*)	Mixtures or separate fractions of concrete, bricks, tiles and ceramic materials containing hazardous substances
17 01 07	Concrete mixtures, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 02 04 (*)	Glass, plastic and wood containing or contaminated with hazardous substances
17 03 01 (*)	Bituminous mixtures containing tar
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 03 03 (*)	Tar and tar products
17 04	Metals (including alloys)
17 04 01	Copper, bronze, and brass
17 04 02	Aluminum
17 04 03	Lead
17 04 04	Zinc
17 04 05	Iron and steel
17 04 06	Tin
17 04 07	Mixed metals
17 04 09 (*)	Metal waste contaminated with hazardous substances
17 04 10 (*)	Cables containing hydrocarbons, tar or other hazardous substances
17 04 11	Cables other than those mentioned in 17 04 10

Code	Solid Wastes
17 05 03 (*)	Soils and rocks containing hazardous substances
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infection(for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20 01 21	Fluorescent tubes and other mercury-containing waste
20 02	Garden and park wastes
20 03 04	Septic tank sludge

Table 41 Construction wastes

(*) Hazardous wastes

In terms of quantification, for the **solid waste and effluents (fuel and wastewater)** produced during construction phase, it was assumed similar values as other projects developed in São Tomé and Principe[6] and are presented in the following table:

Type / Waste category		Quantities produced (Kg)	
Solid waste		Day	Week
Packages	Bags / Plastic Straps	21	126
	Cement bags	30	180
Work front	Demolition debris	450	2.700
	Road pavement scarification	1.350	8.100
	Remains of Materials	45	270
	Used waters	900	5.400
	Fuel	4,5	27
Office	Paper	36	216
	Used materials	7,5	45
	Dejects	72	432
	Wastewaters	900	5.400

Table 42 Estimate of category and amount of solid waste and wastewater to be generated at Lagarto bay

A considerable part of the solid wastes produced on the different work fronts, mainly debris resulting from the demolition of works of art and solid wastes resulting from the scarification of the asphalt pavement will be recovered for use in repair work on dirt roads and macadam.

The remaining demolitions and debris in STP will be transported to Penha Dump. All wastes are transported and disposed in Penha Dump.

[6] • The construction of the Fishing Dock Building, currently CKADO Supermarket; • Hospital Road Retaining Wall, in front of CKADO Supermarket • Containment of the seafront along the 250 m after the CKADO Supermarket, towards the center of São Tomé city

The vegetation wastes can be reutilized in a nursery for the planted trees in the landscape project.

Ecocenter in Penha Dump, where selective disposal is done, is not in operation. Hazardous wastes are deposited in Penha Dump separate containers waiting for an adequate disposal.

The main volumes of waste to be produced correspond to non-hazardous inert waste, most of which have a high potential for material recovery. The risks normally associated with waste management, especially hazardous waste, will be minimized during the construction phase by the implementation, by the Contractor, of a Waste Management Plan, which will ensure the correct storage and forwarding of waste to management operators of licensed waste.

Regarding **emissions**, refers the emissions of atmospheric pollutants, in particular suspended particles resulting mainly from earth moving and combustion gases from vehicles, machines and equipment used in the work.

Contractors should consider IFC Environmental, Health, and Safety (EHS) Guidelines General EHS for Waste Management, as following:

Waste Management

Facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to **local regulatory requirements.** Effective planning and implementation of waste management strategies should include:

- Review of new waste sources during planning, siting, and design activities, including during equipment modifications and process alterations, to identify expected waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure;
- Collection of data and information about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition;
- Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner;
- Definition of opportunities for source reduction, as well as reuse and recycling;
- Definition of procedures and operational controls for onsite storage;
- Definition of options / procedures / operational controls for treatment and final disposal.

Waste Prevention

Processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes;
- Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials;
- Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed.

Recycling and Reuse

In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements:

- Evaluation of waste production processes and identification of potentially recyclable materials;
- Identification and recycling of products that can be reintroduced into the manufacturing process or industry activity at the site;
- Investigation of external markets for recycling by other industrial processing operations located in the neighborhood or region of the facility (e.g., waste exchange);
- Establishing recycling objectives and formal tracking of waste generation and recycling rates;
- Providing training and incentives to employees in order to meet objectives.

Treatment and Disposal

If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment.

Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include on-site or off-site biological, chemical, or physical treatment of the waste material to render it non hazardous prior to final disposal.

Hazardous Waste Management

Hazardous wastes should always be segregated from non hazardous wastes. If generation of hazardous waste can not be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment, according to the following additional principles:

- · Understanding potential impacts and risks associated with the management of any generated hazardous waste during its complete life cycle
- · Ensuring that handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled
- · Ensuring compliance with applicable local and international regulations.

Waste Storage

Hazardous waste should be stored so as to prevent or control accidental releases to air, soil, and water resources in area location where:

Waste is stored in a manner that prevents **the coming ling** or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. Examples include sufficient space between incompatibles or physical separation such as walls or containment curbs

- · Store in closed containers away from direct sunlight, wind and rain
- · Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment

- Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters.
- The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location;
- Provide adequate ventilation where volatile wastes are stored;
- Hazardous waste storage activities should also be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes;
- Provision of readily available information on chemical compatibility to employees, including labeling each container to identify its contents;
- Limiting access to hazardous waste storage areas to employees who have received proper training;
- Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan;
- Conducting periodic inspections of waste storage areas and documenting the findings;
- Preparing and implementing spill response and emergency plans to address their accidental release;
- Avoiding underground storage tanks and underground piping of hazardous waste.

Transportation

On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public. All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards.

Treatment and Disposal

In addition to the recommendations for treatment and disposal applicable to general wastes, the following issues specific to hazardous wastes should be considered:

Commercial or Government Waste Contractors

In the absence of qualified commercial or government-owned waste vendors (taking into consideration proximity and transportation requirements), facilities generating waste should consider using:

- Have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment;
- Have all required permits, certifications, and approvals, of applicable government authorities;
- Have been secured through the use of formal procurement agreements.

Small Quantities of Hazardous Waste

Hazardous waste materials are frequently generated in small quantities by many projects through a variety of activities such as equipment and building maintenance activities.

Examples of these types of wastes include: spent solvents and oily rags, empty paint cans, chemical containers; used lubricating oil; used batteries (such as nickel-cadmium or lead acid); and lighting equipment, such as lamps or lamp ballasts. These wastes should be managed following the guidance provided in the above sections.

Monitoring

Monitoring activities associated with the management of hazardous and non-hazardous waste should include: regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored.

When significant quantities of hazardous wastes are generated and stored on site, monitoring activities should include:, among others:

- o Inspection of vessels for leaks, drips or other indications of loss;
- Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors;
- Tracking of waste generation trends by type and amount of waste generated, preferably by facility departments;
- Characterizing waste at the beginning of generation of a new waste stream, and periodically documenting the characteristics and proper management of the waste, especially hazardous wastes;
- Keeping manifests or other records that document the amount of waste generated and its destination.

7.12.2. OPERATION PHASE

During the operation phase, **wastes** will be generated associated with operation of road and infrastructures which have the following main typologies:

Code	Solid Wastes
08 01 11 (*)	Waste paint and varnish containing organic solvents or other hazardous substances
08 01 12 (*)	Waste paint and varnish other than those mentioned in 08 01 11
08 03 18	Waste printing toner other than those mentioned in 08 03 17
15.01 01	Paper and carton packages
15.01 02	Plastic packages
15.01 03	Timber packages
15.01 04	Metal packages
15.01 05	Composite packaging
15.01 06	Mixed packages
15.01 07	Glass packages
15.01 08	Textile packages
15.02 03	Absorbents, filtering materials, cleaning cloths and protective clothing not covered by 15 02 02.
16.01 03	Used tires
16 01 07 (*)	Oil filters
16 01 12	Brake pads other than those specified in 16 01 11
16 01 17	Iron metals

Code	Solid Wastes
16 01 18	Non-iron metals
16 01 19	Plastic
16 01 20	Glass
17 01 01	Concrete
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 03 02	Bituminous mixtures other than those mentioned in 17 03 01
17 04 07	Mixed metals
17 05 03 (*)	Soils and rocks containing hazardous substances
18 01 03	Wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	Wastes whose collection and disposal is not subject to special requirements in order to prevent infection(for example dressings, plaster casts, linen, disposable clothing, diapers)
20 01 01	Paper and Cardboard
20.01 02	Glass
20 01 19	Pesticides
20 01 39	Plastics
20 02	Garden and park wastes
20 03 04	Septic tank sludge
20 03 01	Other urban and similar waste, including waste mixtures

Table 43 Operation wastes

(*) Hazardous wastes

These wastes will be managed by Água Grande District Council, in accordance with its waste and wastewaster management plan (SWWMP), with emphasis on the practices of reuse and regeneration of materials.

The **emissions** foreseen at this stage are those resulting from emissions of air pollutants (CO2, CO, NOX, SOX, HC, COV's) and noise related to road traffic and fishermen boats.

In the operation phase, the **effluents** produced come mainly from rainwater and runoff from the road platform. These waters are collected and routed through the road's longitudinal drainage systems and directed to the sea in all lots.

Other source of effluents is the buildings operation for Lagarto bay and Ana Chaves bay Next table presents the calculations for domestic waste waters (from the laundry), according to report RD6767-FD-L1/L2-AN-IE-A17-Ancillary-D01.docx.

Building	Unit	Sewage contribution (L/day)	Fresh sludge contribution (L/day)
Factory (in general)	person	70	0.3
Office	person	50	0.2
Public or commercial buildings	**person**	**50**	**0.2**
Schools (boarding schools) and long-stay places	person	50	0.2
Bars	person	6	0.1
Restaurants or similar	person	25	0.1

Building	Unit	Sewage contribution (L/day)	Fresh sludge contribution (L/day)
Cinemas, theatres and short-stay venues	person	2	0.02

Table 44 General wastewater and sludge contributions from buildings

Lagarto bay

The Laundry is considered to be included in the *public or commercial buildings.*

The septic tank to be installed for the laundry will have the capacity for 3181.2 l.

Facility	Laundry
Installation type	Commercial or public buildings
Potential users	38,00
Wastewater contribution (l/day)	50,00
Retention time (days)	0,92
Digested sludge accumulation rate	57,00
Fresh sludge contribution (l/day)	0,20
Required volume (l)	**3181,20**
Cleaning interval (years)	1,00

Table 45 Septic tank required volume for Lagarto bay laundry

Ana Chaves bay

The buildings are also considered to be included in the *public or commercial buildings.*

The septic tank to be installed for all the installations to be built will have the capacity for 10,100.00 l, as calculated in the above report.

Facility	Toilets, Fish market and Workshop
Installation type	Commercial or public buildings
Potential users	300,00
Wastewater contribution (l/day)	50,00
Retention time (days)	0,50
Digested sludge accumulation rate	57,00
Fresh sludge contribution (l/day)	0,20
Required volume (l)	**10100,00**
Cleaning interval (years)	1,00

Table 46 Septic tank required volume for Ana Chaves bay buildings

These wastes will be managed by the Água Grande District Council, in accordance with its waste management plan, with emphasis on the practices of reuse and regeneration of materials.

Includes also here the fish scales from the fishermen's market, which are included in the biodegradable waste. This could be recovered from the main sinks (with nets) and used as local handcraft.

It is suggested to have an oil separator is system that received wastewater from workshop. Oils can be used as lubricant, as is usual in STP avoiding to be disposal in sea.

7.1.2.3 ENVIRONMENTAL AND SOCIAL RISKS RELATED WITH SUPPLY CHAINS

Three IFC Performance Standards on Environmental and Social have sections that give detail the primary supply–chain specific requirements.

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 1 objectives are "to identify and evaluate environmental and social risks and impacts of the project and to adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.

There are two situations:

- Where the client can reasonably exercise control, the contractor's risks and impacts identification process, the Environmental and Social Management System (ESMS) will include, as relevant, a supply chain component that considers the risks and impacts associated with its primary suppliers, as defined in Performance Standard 2 and Performance Standard 6.

  Supply chain incorporates elements of policy and procedures, supply chain mapping, risk assessment and management, corrective measures, training, monitoring, and reporting.
- Where the client does not have control or influence over the management of certain environmental risks and impacts in its supply chain.

  Client identify the entities involved in the value chain and the roles they play, the corresponding risks they present to the contractor, and any opportunities to collaborate with these entities in order to help achieve environmental and social outcomes that are consistent with the Performance Standards.

Performance Standard 2: Labor and Working Conditions

The Performance Standard 2 objective is "*to protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.*"

As part of an ESMS and subject to the client's level of management control or leverage over its supply chain, the client will assess and document risks and impacts in its primary supply chain when there is the potential for child/forced labor or significant health and safety issues.

Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

The objectives of Performance Standard 6 are "*to protect and conserve biodiversity; to maintain the benefits from ecosystem services and to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities*."

IF6 Guidance Note Biodiversity Conservation and Sustainable Management of Living Natural Resources (2019) refers "The risks and impacts identification process will vary depending on the nature, scale, and location of the project. At a minimum, the client should screen and assess the risks to and potential impacts on biodiversity and ecosystem services in the project's area of influence, taking into account the following:

(i) the location and scale of project activities, including those of associated facilities;
(ii) (ii) its supply chains (as required in paragraph 30 of Performance Standard 6);
(iii) (iii) the project's proximity to areas of known biodiversity value or areas known to provide ecosystem services;
(iv) (iv) the types of technology that will be used (for example, underground mining versus open pits, directional drilling and multi-well pads versus high-density single-well pads, air-cooled condensers versus wet-cooling towers, and so forth) and efficiencies of the proposed equipment; and (v) the project's potential to induce impacts by third parties es (e.g., via new modes of access to remote areas), such as informal settlers or hunters.

Performance Standard 6 will not be applicable where no known risks to biodiversity or ecosystem services, including risks related to potential knowledge gaps, are identified through robust screening

The Paragrah 30 of IFC Standard 6 refers " *Where a client is purchasing primary production (especially but not exclusively food and fiber commodities) that is known to be produced in regions where there is a risk of significant conversion of natural and/or critical habitats, systems and verification practices will be adopted as part of the client's ESMS to evaluate its primary suppliers.*

The systems and verification practices will

(i) identify where the supply is coming from and the habitat type of this area;
(ii) *provide for an ongoing review of the client's primary supply chains;*
(iii) *limit procurement to those suppliers that can demonstrate that they are not contributing to significant conversion of natural and/or critical habitats (this may be demonstrated by delivery of certified product, or progress towards verification or certification under a credible scheme in certain commodities and/or locations); and (iv) where possible, require actions to shift the client's primary supply chain over time to suppliers that can demonstrate that they are not significantly adversely impacting these areas.*

The ability of the client to fully address these risks will depend upon the client's level of management control or influence over its primary suppliers."

Contractor must adopt a verification process to evaluate its suppliers of primary production, as for potential quarries for rock and sand, in order to demonstrate that raw materials are not being purchased from sources where there is significant adverse impact on natural and/or critical habitats.

The following tables presents examples of risks on mining exploration:

Risk category	Potential risks
GHG emissions	• Deforestation and reduction of
Air pollution	• Increase of dust • Increase of air pollution by vehicles and equipment
Noise and vibrations emissions	• Increase of noise and vibration by vehicles and equipment
Water pollution	• Degradation of water quality in surroundings of quarries

Natural resources consumption	• Water consumption • Energy consumption • Rocks and sand consumption
Hazardous waste	• Increase of hazardous wastes generation and inappropriate
Biodiversity	• Deforestation and habitat conversion for mining
Land Use	• Land competition endangering wellbeing of local populations and leading to their impoverishment
Natural disaster	• Increase od consequences of natural disasters due deforestation and decrease vegetal cover
Environmental accidents	• Dangerous working conditions, accidents and fatalities can cause safety problems in local communities

Table 47 Environmental Risks of Mining Exploration

Risk category	Potential risks
Labour rights	• Discrimination in employment • Child labour • No employment contract • Abuse of temporary contracts • Lack of respect for freedom of association
Working conditions	• Wages below living wage levels • Excessive work hours • Abusive treatment • Lack of access to grievance mechanism
Health and Safety	• Safety and health living conditions for communities • Decrease of road safety
Conflicts	• Conflicts with local community due use of land, use of water, pollution of water
Governance issues	• Tax evasion • Fraud • Corruption

Table 48 Social Risks of Mining Exploration

7.1.2.4 ASSOCIATED PROJECTS

Marginal Road makes connection between the capital and the country's main airport and also with road network between the national roads EN1, EN2 and EN3.

EN1 road project under rehabilitation is an associated project of Marginal Road, with a link in round about in São Pedro at Ana Chaves bay.

8. PROJECT INFLUENCE AREA

The current ESIA considered the following Study Areas:

- Areas directly affected by the Project - **Direct Affected Area**
- Areas under the direct influence of the Project - **Direct Influence Area**
- Areas under the indirect influence of the Project - **Indirect Influence Area**

The **Directly Affected Area** comprises the physical environment where all Project components - road rehabilitation, coastal protection, and landscape works - will occur.

The terrestrial part of this area includes the road network in São Tomé city and surroundings, used by vehicles, personnel, and heavy machinery. It also includes areas close to the Project and where citizens might be disturbed by noise and air pollution from machinery, vehicles, or generators during construction.

The bays and the existing sandy and rocky beaches belong to this area.

The **Direct Influence Area** is potentially directly impacted by the Project's implementation, operation and associated activities.

In the terrestrial part, negative impacts are expected on the Marginal Road traffic, its connections, and other activities carried out by the population in São Tomé city.

In the marine part, the physical loss or removal of habitats caused by coastal protection structures and beach nourishment (for sections of Lagarto Bay and Ana Chaves Bay) may cause direct impacts on the marine ecosystems and seawater quality.

The Indirect Influence Area is ample for the social component.

The terrestrial part comprises the whole Island of São Tomé as Marginal Road connects with the country's main airport, port and links to the national road network (EN1, EN2 and EN3).

Almost everyone will be directly or indirectly affected by the Project as the Marginal road is used by all or nearly all people that come daily to the city of São Tomé for school, work, services, leisure. Other Project impacts are related to local employment generation and increased demand for local goods and services on Island.
The marine part of this area includes fisheries, maritime traffic and routes of marine fish and other marine fauna, like sea turtles.

The following Figure presents the **Direct Influence Area** of the Project.



Figure 52 Areas of Direct Influence

9. CLIMATE AND CLIMATE CHANGES

9.1. CLIMATE

9.1.1. TEMPERATURE AND PLUVIOSITY

In Guinea Gulf, where São Tome and Principe islands are located, the climate is typically equatorial and, therefore, with little variation throughout the year and characterized by persistent high temperatures and frequent episodes of high humidity. The climate of São Tomé and Príncipe (STP) is influenced by the north and south migrations of the Intertropical Convergence Zone (ITCZ), associated with the southwest monsoon and the Northeast trade winds (Heileman 2009).

The islands are located in the humid tropical range resulting in average annual temperatures ranging from a maximum of 30° to 33°C to a minimum of 18° to 21°C, with little seasonal variation and high humidity throughout the year (WWF, 2012; McSweeney et al., 2012). Annual precipitation ranges from 1,000 mm in the northeast of São Tomé Island to over 4,000 mm in the southwest, with the pattern of precipitation being similar (WWF, 2012).

In São Tomé and Príncipe, the main rainy season runs from October to May, with an average recorded rainfall of 200mm per month (McSweeney et al., 2012). This rainy season is punctuated by a short, slightly drier period between January and February, followed by a very dry season from June to September, when rainfall is lower (McSweeney et al., 2012). The figure below illustrates the monthly averages of temperature and precipitation.

The average frequency of maritime fog in the high seas of São Tomé and Príncipe is low, less than 1 percent in any given month, following the same pattern as we reach the coast. Low visibility (less than 8 km) is slightly more common, with about 10 to 15 percent occurring in the rainy season and 4 to 6 percent in the Gravana period (Hydrographer of the Navy, 2006).

Regarding sea water temperature, based on historical data for a period of ten years, the highest sea water temperature recorded in São Tomé was 27.4 °C in 2019, and the lowest temperature was recorded in 2015 with a temperature of 25.8 °C. Monthly averages are shown in the following figure (Sea temperature, 2020), and range from a minimum of 26.6 °C in July to a maximum of 30.5 °C in March.



Figure 53 Monthly Sea water temperatures. Sea temperature website, 2020 (Based on historical data over a ten-year period).

9.1.2 WIND

The northeast trade winds predominate around August, reaching about 3º to the north (northwest of São Tomé Island) in December and January, and retreating to the north in February. In January prevails winds from the southwest which extend to the north in July. The average intensity of these winds is 1-3 on the Beaufort scale but can increase up to 5-6. Strong and stormy winds are rare and very few situations occur in the Project area (only 1-2%) of winds with an intensity of 7 or higher (Hydrographer of the Navy, 2006).

The southern part of the island of São Tomé is listed as the windiest and Gravana is the time of year when occur the most winds in the territory of São Tomé and Príncipe, together with the period from May to August (ALER, 2020[7])

For the project area, in the northeast part of São Tomé Island, the closest weather station is located at ST airport. The following figure shows the average annual compass rose at the São Tomé airport weather station, corresponding to the latest publicly available data (period 2010-2021). As seen, the majority of

[7] https://www.aler-renovaveis.org/contents/activitiesdocuments/aler-relatorio-stp-nov2020_8419.pdf

winds come from South and Southeast, with higher velocities (3.6-11.3 m/s, Beaufort scale of 3 to 5) occurring in low percentages (below 20%), a little higher in June (about 40%).

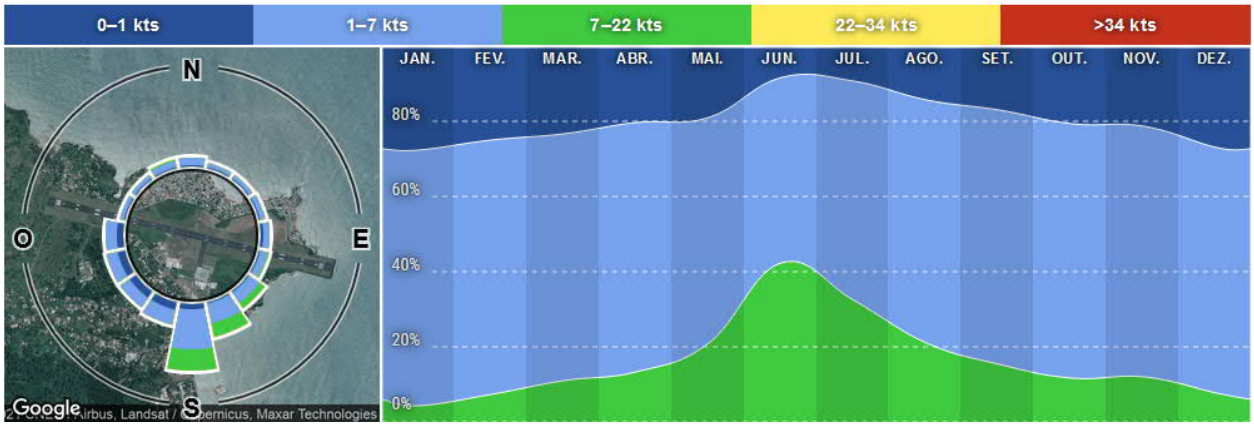


Figure 54 Annual windfinder at São Tomé airport weather station. Source: Windfinder 2021



Figure 55. Major winds direction in the project area

9.2. OCEANOGRAPHY

The information about oceanographic conditions in the Gulf of Guinea and São Tomé waters indicated in the following sub-sections correspond to the most recent scientific information publicly available.

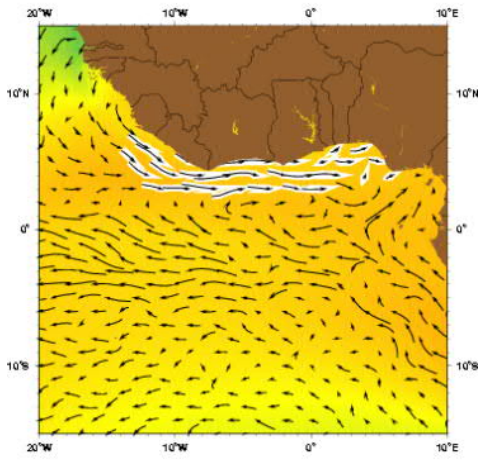
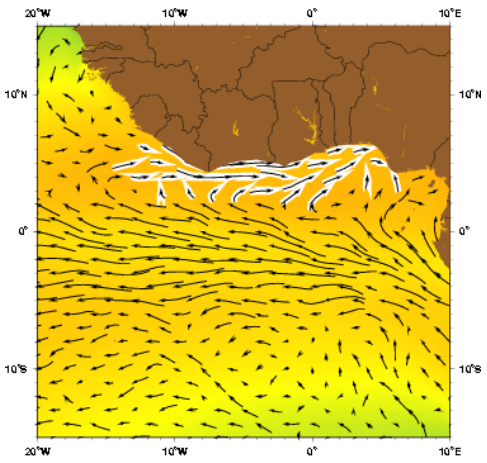
9.2.1. MARITIME CURRENTS

The Project area is located on the coastline of the Island of São Tomé, the water column consists of distinct layers that circulate at different speeds and directions. In general, the water circulation in the Gulf of Guinea is dominated by the Guinea Current, which flows parallel to the coast from Senegal to Nigeria, and the South Equatorial Current or Benguela Current, which flows northwards along the coast of Gabon and then in a westerly direction along the equator.

The predominant surface current in the study area is therefore the South Equatorial Current (or Benguela Current), which flows westward at a velocity of approximately 0.25 m/s (at depths of 0 to 100 m) (Findlay et al., 2006). Records show that its highest velocities occur in the south during the Gravana and in the north during the wet season, a pattern that corresponds to seasonal winds. The prevailing winds are responsible for the strong Ekman transport and resulting coastal upwelling of nutrient-rich water that stimulates primary productivity (Boye et al., 2000, Skogen 1999).

In maritime areas farther from the coast, the Gabon-Congo current flows under the South Equatorial Current in a southeast direction, with estimated velocities between 011-0.23 m/s, depending on the exact location and time of the year (Gyory, 2005).

As pointed out by Colin (1988), and advocated by several authors (Longhurst, 1962; Boisvert, 1967; Ingham, 1970; Bakun, 1978 and Richardson and Philander, 1987) the Guinea Current passes through a period of minimum intensity during rainfall (between November to February) and maximum intensity during Gravana (between May to September). The following figure shows the average seasonal directions of the Guinea and Benguela Currents.

jan. – feb. – mar.	apr. – may – jun.
	
jul. – ago. – set.	out. – nov. – dez.

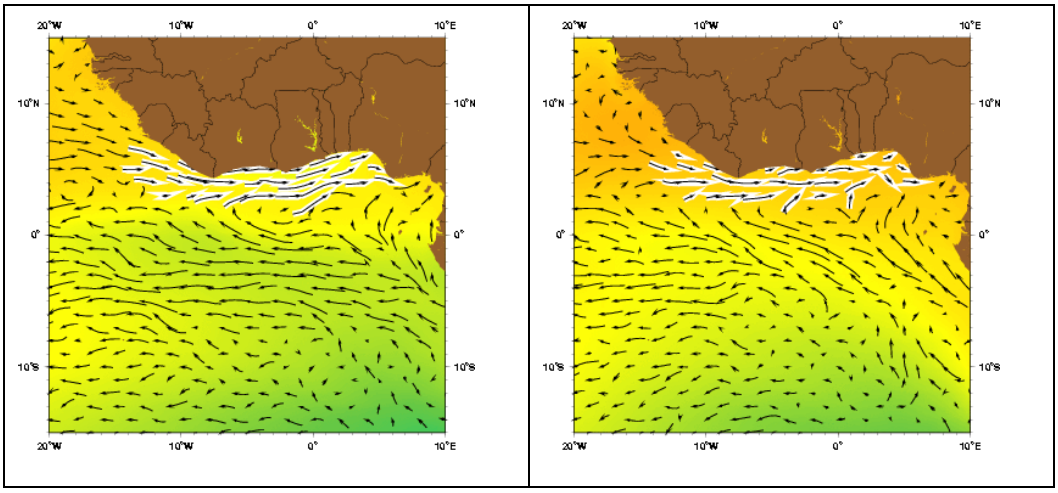


Figure 56 Mean Annual and seasonal directions of the Guinea and Benguela Currents (CGG, 2017)

Note: the white shaded arrows correspond to the Guinea Current, while the westward arrows, located south, correspond to the western portion of the Benguela Current, which in turn is over the Project site.

Current data revealed that the main directions of currents at 0 and 30 m depth range from NW to SO, while velocities vary between 0.1 and 0.6 knots with occasional peaks of up to 1 knot at 30 m depth and between 0.8 and 1.4 knots at 10 m depth, where the wind influence is strongest (CGG, 2017).

As mentioned above, the highest velocities of the Benguela Current in the project area (north of ST island) occur during the wet season (October to May). A cool current as is the Benguela current causes moisture in winds blowing over them to condense and form fogs, etc. The winds are deprived of their moisture so they tend to absorb rather than deposit moisture at the adjacent coasts, therefore causing dry conditions in these areas, justifying the lower precipitation in the north area of Sao Tome.

9.2.2. TIDE AND SWELL

Tidal currents in São Tomé and Príncipe islands are semi-diurnal, reversing direction four times a day and water movement is predominantly determined by ocean currents (Hydrographer of the Navy, 2006).

In Sao Tome and Principe during the rainy season, south to southwest swells predominate (82% of all swells). The most frequent height varies from 0,5 to 2 meters (80% of the waves and swells). During gravana (drier weather), the pattern of swells is similar, with the predominance of south to southwest swells corresponding to 83% of all swells, the heights of swells vary little, and the most frequent heights remaining between 0.5 to 2 meters, but with the occurrence of slightly larger waves of 2.5 to 3 meters (Hydrographer of the Navy, 2006).

In the area of influence of the project a wave modelling of the study area was carried out where wave measurements were available in Lagarto Bay over a one month period, and it was found that the study area presents simultaneous waves with little difference between their directions. The polarization is approximately 10 degrees. The following Figure shows the resulting wave field from the large model domain. The colours show the significant wave height and the arrows show the average wave direction. It is clear that the protective effect of the island is large (Heijboer, 2019).

The following Figure also shows the most frequent wave propagation for the detailed grid and that the waves near the coast are significantly lower than at sea. The waves refract in the bays and are somewhat higher in the northern part of Lagarto Bay (CDR, 2019)

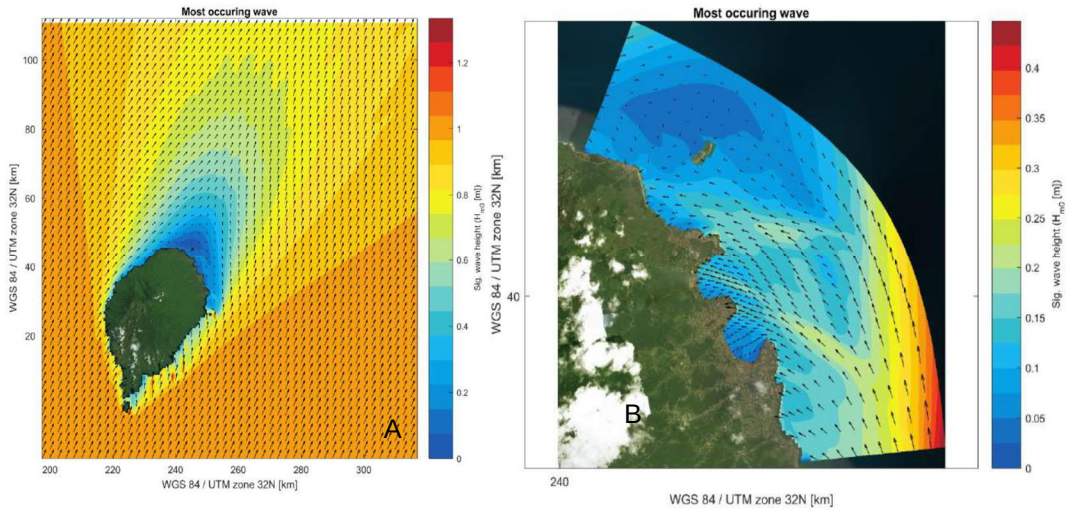


Figure 57 Wave propagation close to constant. A) comprehensive grid of the most frequent waves, B) detailed grid of waves close to the project's area of influence. Source: (CDR, 2019)

The local wave climate has been characterized from the model results for the representative points that have been selected along the target area in the domain. Figures below show the selected points 21, 33, 43 and 49, and the Hs associated with the most energetic event in the project area at these points.

The waves come from the ESE or E depending on the point analysed. The highest significant wave height is found at point 49 which is more exposed to the ocean and has more depth.

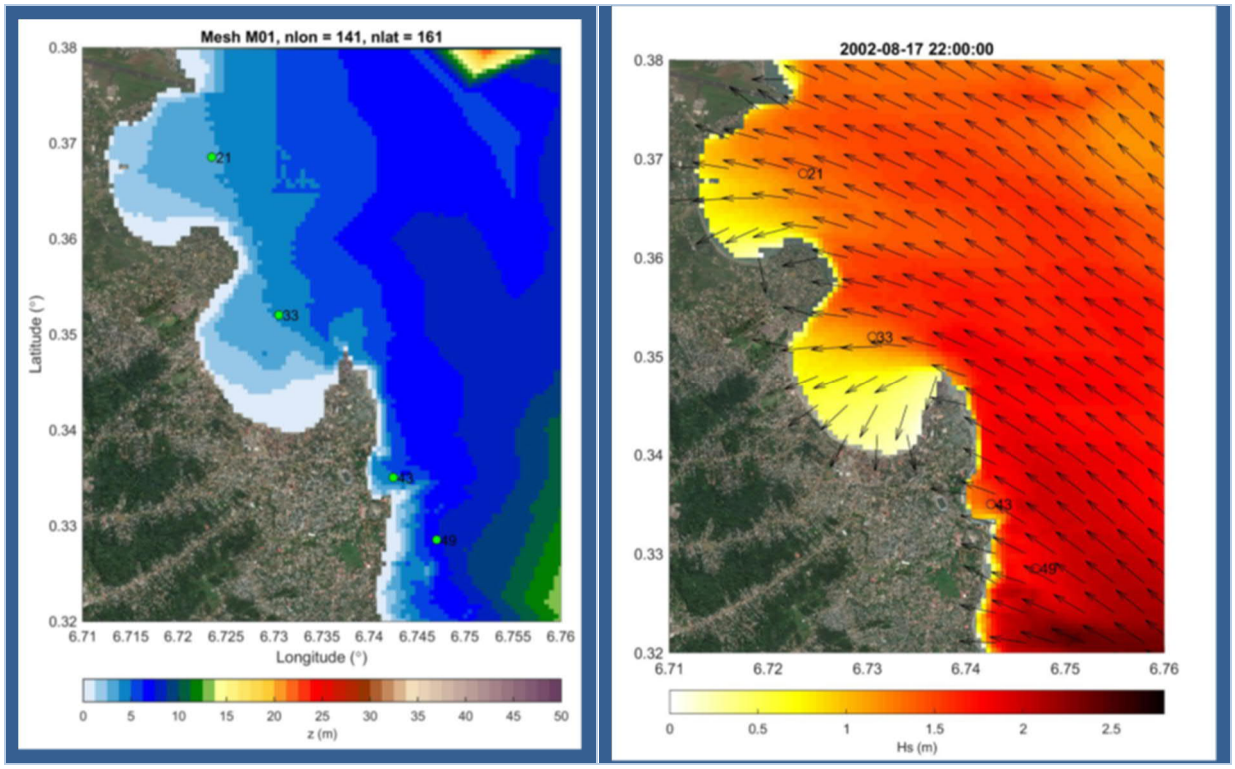


Figure 58 Point locations used to characterise the local wave climate and Significant Wave Height associated to the most energetic event in the project area with the selected points. Source: RD6767-DD-AN-CP-A5-Meteo-D01a

The extreme regime at each point has been studied, different methods have been analyzed which are POT (Peaks Over Threshold) and the maximum annual values at GEV and Gumbel to select the method with the best adjustment of the maximum values and with the best characterization of the Extreme Regime.

The following table represent the values of Significant Wave Height in extreme regime obtained in each point, the table include the parameters of the gumbel function, the values of Hs for a return period of 50 and 100 years and the confidence bands of 90% (confidence intervals of 5% and 95%):

ID	μ	ψ	50 years			100 years		
			Value	CI 5%	CI95%	Value	CI 5%	CI 95%
21	1,037	0,105	1,45	1,31	1,58	1,52	1,36	1,68
33	0,935	0,107	1,35	1,22	1,49	1,43	1,28	1,58
43	1,227	0,131	1,74	1,58	1,90	1,83	1,65	2,02
49	1,398	0,143	1,96	1,78	2,14	2,06	1,85	2,27

Table 49 Hs results extreme characterization. Source: RD6767-DD-AN-CP-A5_Meteo-D01a

The associated peak period to the extreme values of Hs have been estimated. The results of the central estimation of Tp values associated to each value of Hs and their boundary bands are shown in the following Table.

ID	a	b	50 years						100 years					
			Hs	Tp	Hs CI 5%	Tp	Hs CI 95%	TP	Hs	Tp	Hs CI 5%	Tp	Hs CI 95%	TP
21	12.123	0.220	1.45	13.15	1.31	12.87	1.58	13.41	1.52	13.29	1.36	12.98	1.68	13.58
33	14.016	0.196	1.35	14.88	1.22	14.58	1.49	15.15	1.43	15.03	1.28	14.71	1.58	15.33
43	13.434	0.150	1.74	14.60	1.58	14.39	1.90	14.80	1.83	14.71	1.65	14.48	2.02	14.93
49	13.106	0.171	1.96	14.70	1.78	14.46	2.14	14.93	2.06	14.83	1.85	14.56	2.27	15.07

Table 50 Tp (s) value associated to each value of Hs (m) and their confidence interval. Source: RD6767-DD-AN-CP-A5-Meteo-D01a

Significant Wave Height varies between 1, 23 m and 1,96m in period of return of 50 years and 1,43 m and 2,06 m in period of return of 100 years.

Based on the "*Plano ulti-setorial de investimentos para integrar a resiliência às alterações climáticas e o risco de desastres na gestão da zona costeira de São Tomé e Príncipe (2017)",* it must be mentioned the maritime flood that occurred in 1995 in the São Tomé city, although without affected people.

Recently, an event of intense rain occurred on the island of São Tomé, on December 28 and 29, 2021, causing urban flooding in the city of São Tomé. The hardest hit area was the north of the island causing the death of two children and damage to 3 bridges and the Marginal Road, having opened a crater on a bridge and road damage in Lagarto Bay

9.2.1 BATHYMETRY

The continental shelf off the northwest coast of Africa is narrow (<50 km in most places) with the 200m isobaths located at distances between 40 and 60 km from the coast. This effect is even more pronounced in the case of STP, where the continental shelf is limited to less than 5 km for São Tomé Island and about 10 km for the east coast of Príncipe Island. São Tomé (836 km²) is much larger in terms of land area than Príncipe (130 km²), but if measured from the fracture of the continental shelf, Príncipe would be slightly larger, since the southern part of the volcanic peak that forms the island, on bathymetric charts, appears to form a wide platform to depths of about 100 m, beyond which the bottom has a precipitous drop. In fact, almost two thirds of the total continental shelf area of the country is located around Príncipe Island (Krakstad et al. 2010).

The bathymetry is one of the important aspects for this project. The study area presents two distinct bathymetric zones: one characterized by a very shallow slope zone in the north (Lagarto and Ana Chaves Bay) with dispersed rocky areas with depths between 0 and 5 metres, and a second zone (Pantufo) with a steeper slope, plus rocky area to the south, with depths between 0 and 9 metres, see Figure below.

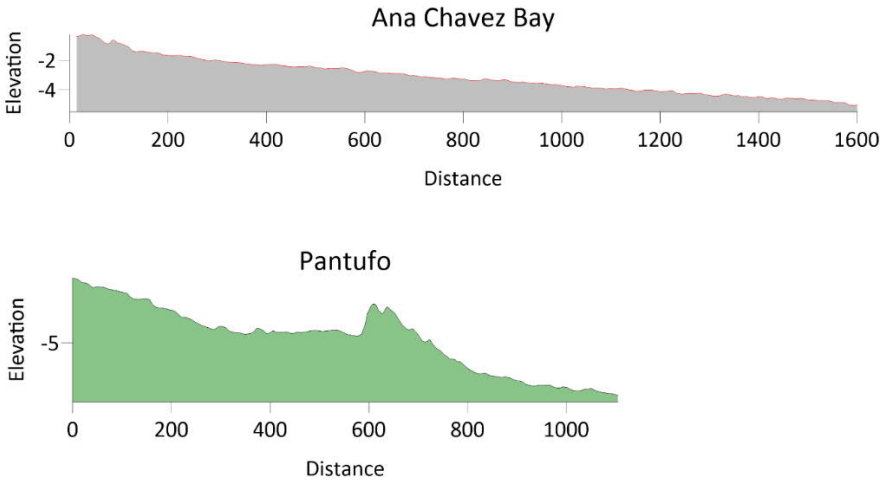


Figure 59 Cross-sections of the different zones. Source: bathymetric survey RD6767-DD-AN-CP-A2-BatSur-D01a.

The study area has approximately 8 km^2, mostly formed by sand and scattered rocks, with greater concentration in the north of Ana Chaves bay and mainly in the Pantufo area, where we can observe several rocky hills, elevations and protrusions that compose it, while the southern area has a higher relief.

The entire area of influence of the project is strongly influenced by the tides, with about 1.5 - 2 m difference between low and high tide (Figure below). This variation and the low gradient of the bay in some areas, results in a large, emerged area during low tide. The following figure shows the detailed result of this bathymetric survey.

As described before, the waves near the coast are significantly lower than at sea. The waves refract in the bays and are somewhat higher in the northern part of Lagarto bay. Waves come from the ESE or E depending on the point analysed. The highest significant wave height is found at point 49 (Pantufo bay) which is more exposed to the ocean and has more depth.

The main winds in this area are mainly from the south and southeast, having also these winds more potential for higher velocities (below 11 m/s, corresponding to Fresh Breezes, which can cause *Moderate waves taking a more pronounced long form.*

But as seen, these higher winds only occur during one month and are contained by the bays contour and bathymetry.

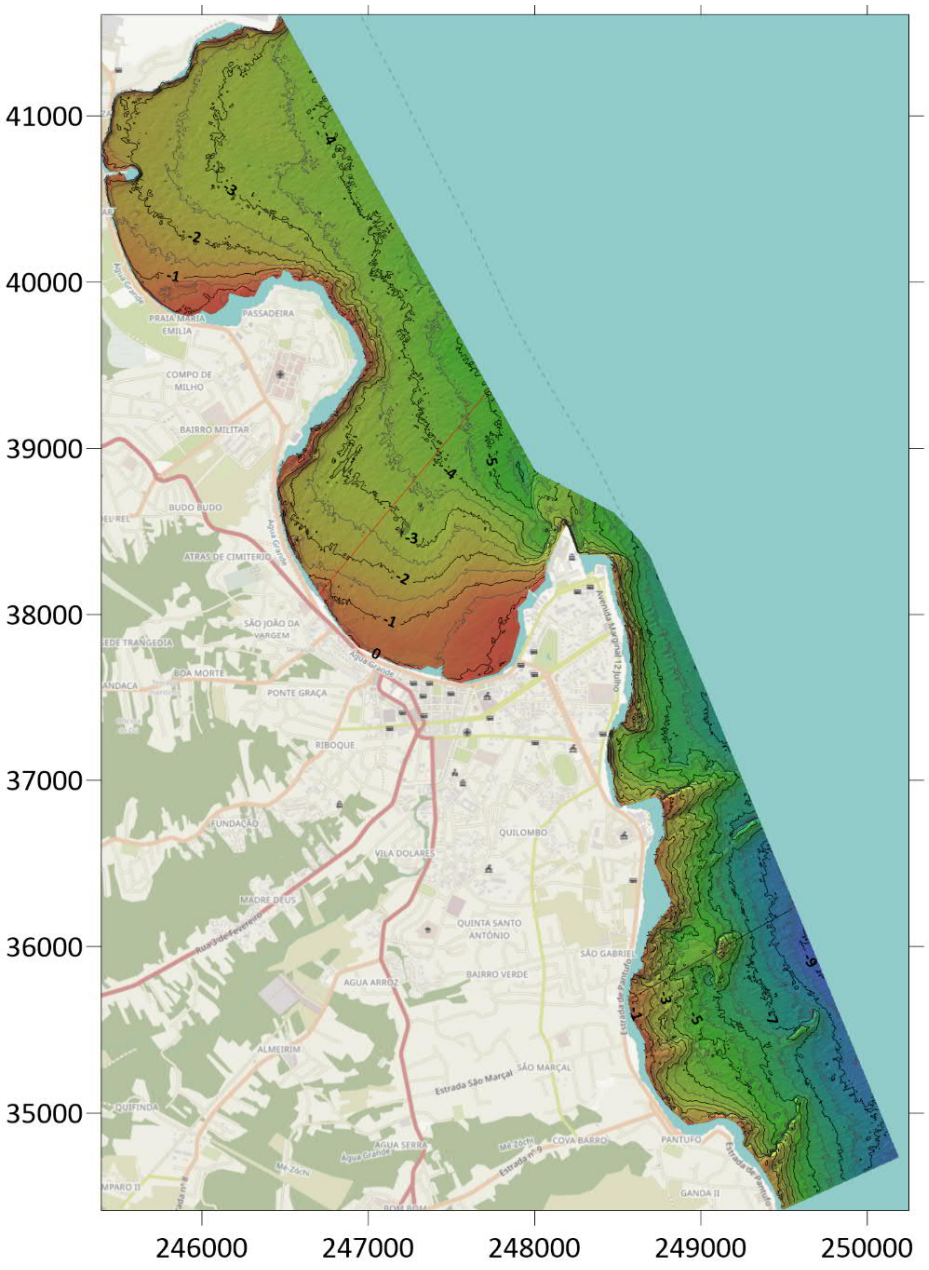


Figure 60 Contour map of the survey area. Source: Bathymetric Survey RD6767-DD-AN-CP-A2-BatSur-D01a

Seabed sediments can be classified as indicated below (Manh Hai LE, 2008):

1. Terrestrial sediments, originating from the erosion of pre-existing rocks carried by the wind or rivers;

2. Biogenic sediments, resulting from the skeletons of living organisms, plants or animals;

3. Hydrogenic sediments, precipitation of minerals in sea water (salt, etc.)

Sediment characteristics may be important in assessing the potential transport capacities of sediments and hence coastal erosion. From several different locations along Lagarto, Ana Chaves bay and Pantufo, coastal sediment samples were collected, sieved and evaluated to assess their grain size distribution. The

grain size distributions resulting from this assessment resulted in a wide variation in grain sizes, which can be clarified based on the different conditions between the sites (CDR, 2019).



Figure 61 Grain size distribution of samples collected from 6 points located in Lagarto bay. Source: CDR, 2019

9.2.3. COASTAL DYNAMICS

São Tomé and Príncipe is made up of small volcanic islands with very rugged relief and heavily covered with vegetation. Thus, the coastal zone is the economic space par excellence where almost all economic infrastructure is concentrated, including the social habitat.

The coasts of the island of São Tomé, sometimes cut straight, sometimes constituting low sandy or pebbly beaches, form inlets with points that penetrate into the sea (Cardoso, 1962 in CARRASCO *et al*., 2017[8]). In the coastal zone there are marshy areas caused by the invasion of the sea which, during spring tides, leaves small lakes of brackish water in the terrain depressions, and increases the level of mangroves.

The rise in sea level or the deluge or untimely rains, resulting from climate change, as well as the reckless extraction of inert materials on the coast, give worrying acuity to the erosion of the coastal zone. The current change in the morphology of the coastal zone results from the combination of different natural and anthropogenic phenomena. For example, there is also the unrestrained extraction of sand in the coastal interior of the three bays that make up the city of São Tomé (the present project area), resulting in large

[8] CARRASCO, N., H.P. COSTA & R.M. SÉCA (2017). *Plano multi-setorial de investimentos para integrar a resiliência às alterações climáticas e o risco de desastres na gestão da zona costeira de São Tomé e Príncipe*. World Bank Group Document.

and numerous trenches reaching sea level, allowing underground communication with invasion movement or water retraction depending on the tides, with the consequent damage to roads and housing.

This extraction of aggregates, mainly sand and pebbles, is a practice that began with the use of cement in STP after the First World War and gained greater intensity due to the recognized resistance and longevity that the combination of cement and sand conferred on the works. The intense use of sand and gravel from the beaches for construction caused the progressive destruction of beaches, with the aggravation of breaking the natural cycle of sand replacement by the tides. The coastal zone, then stripped of an element to mitigate the invasive action of the sea, became the object of multiform erosion of the zone, to which the rise in sea level due to climate change gave greater relevance

Currently, there is a growing exodus of populations from inland areas to the cities and towns in the coastal zone, which have then become cosmopolitan, even covering the former marginalized areas due to the risk of erosion, invasion of the sea and unhealthy conditions. This massive and unplanned deployment of constructions in the coastal zone has led to accelerated degradation and depletion of the zone's own resources, particularly coastal land, sand, coral reefs, algae, mangroves and coastal protective rocks

The coastline of the northeast quadrant of the island of São Tomé has been the object of more noticeable disasters in the last 70 years, perhaps because it is the most inhabited. For example, from the mouth of the river Manuel Jorge, at Praia Melão, to the mouth of the river Melo, at Praia Nazaré, the sea has invaded the coastal zone causing damage and loss of infrastructure and other goods for the local population. The action of the tides has also manifested itself at the foot of the coastal escarpments of the northwest quadrant of the island of São Tomé, eroding them until separating them from the rest of the island, forming numerous rocky outcrops along the coast, or destroying the support base of the roads from the maritime coast. The construction of the Santa Catarina tunnel in the 60s is an example of an alternative to the constant invasive action of the sea that destroyed the so-called “elbow curve”, a stretch of coastal road currently submerged in the sea, precisely in the opposite area to the tunnel.

Vertical erosion in the beds of upstream watercourses is also very intense, and is often accompanied by material slides from the slopes, which are dragged towards the sea.

9.3. CLIMATE CHANGES

9.3.1. GENERAL FRAMEWORK

The latest report from the International Panel on Climate Change, points to increases in greenhouse gas (GHG) concentrations. It also found that this increase is unequivocally caused by human activities. Since 2011 (measurements reported in AR5 (2014), concentrations have continued to increase in the atmosphere, reaching annual averages of 410 ppm for carbon dioxide (CO2), 1866 ppb for methane (CH4) and 332 ppb for nitrous oxide (N2O) in 2019. Land and ocean have absorbed an almost constant proportion (globally, about 56% per year) of CO2 emissions from human activities over the past six decades

Each of the last four decades has been successively warmer than any decade since 1850. Global surface temperature in the first two decades of the 21st century (2001-2020) was 0.99 [0.84-1.10]°C higher than 1850-1900. Global surface temperature was 1.09 [0.95 to 1.20] ° C higher in 2011-2020 than 1850-1900, with larger increases on land (1.59 [1.34 to 1.83] °C) than in the ocean (0.88 [0.68 to 1.01] °C). The estimated increase in global surface temperature since AR5 is mainly due to additional warming since 2003-2012 (+0.19 [0.16 to 0.22] °C). In addition, methodological advances and new datasets contributed approximately 0.1°C to the updated estimate of warming in AR6.

The global predictions of the latest International Panel on Climate Change IPCC 2021 assessment report show various types of scenarios for future climate change. This report assesses the climate response to five illustrative scenarios covering the range of possible future developments of anthropogenic drivers of climate change found in the literature.

Starting in 2015 the paper includes scenarios with high and very high GHG emissions (SSP3-7.0 and SSP5-8.5) and CO2 emissions nearly doubling from current levels by 2100 and 2050, respectively, scenarios with intermediate GHG emissions (SSP2-4. 5) and CO2 emissions remaining around current levels until mid-century, and scenarios with very low and low GHG emissions and CO2 emissions falling to net zero around or after 2050, followed by varying levels of negative net CO2 emissions (SSP1-1.9 and SSP1 -2.6) as illustrated in the following Figure.

Emissions vary between scenarios depending on socioeconomic assumptions, levels of climate change mitigation and, for aerosols and non-methane ozone precursors, air pollution controls. Alternative assumptions may result in similar emissions and climate responses, but socioeconomic assumptions and the feasibility or likelihood of individual scenarios are not part of the assessment.

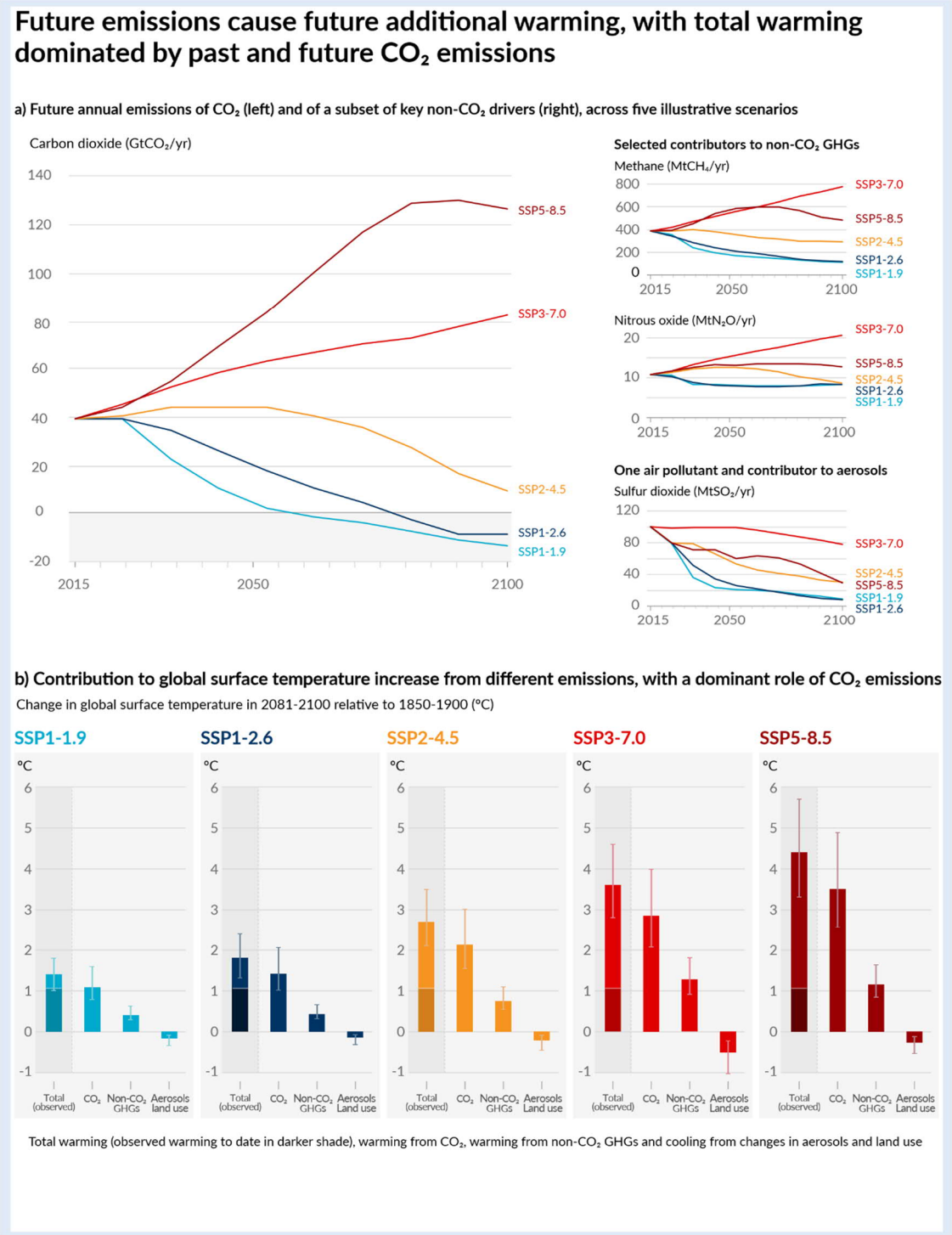


Figure 62 Forecast of the various future scenarios according to varying levels of net CO2 emissions. Source IPCC, 2021

This report assesses the results of climate models participating in Phase 6 of the World Climate Research Programme's Coupled Model Intercomparison Project (CMIP6). These models include new and improved representation of physical, chemical and biological processes, as well as higher resolution, compared to

climate models considered in previous IPCC assessment reports. This has improved the simulation of the recent average state of most indicators of large-scale climate change and many other aspects of the climate system. Some differences from observations remain, for example in regional precipitation patterns. The historical CMIP6 simulations assessed in this report have an ensemble global mean surface temperature change within 0.2°C of observations over most of the historical period, and the observed warming is within the very likely range of the CMIP6 ensemble. However, some CMIP6 models simulate warming that is above or below the assessed very likely range of observed warming.

The CMIP6 models considered in the report have a wider range of climate sensitivity than the CMIP5 models and AR6 assessed the very likely range, which is based on several lines of evidence. These CMIP6 models also show a higher average climate sensitivity than CMIP5 and the best estimate assessed by AR6. The higher climate sensitivity values of CMIP6 compared to CMIP5 can be attributed to amplifying cloud feedback that is higher in CMIP6 by about 20%.

This was the first time in an IPCC report that assessed future changes in global surface temperature, ocean warming and sea level are constructed by combining multi-model projections with observational constraints based on simulated past warming as well as AR6 assessment of climate sensitivity. For other quantities, such robust methods do not yet exist to constrain the projections.

Despite significant deforestation and forest degradation, STP is not a country that emits greenhouse gases (GHG) at levels that are significant. The country is essentially a carbon sink, i.e. a country where GHG absorption levels are higher than emission levels.

Nevertheless, the country comprises factors that translate into the possibility of a certain degradation of its current condition in the future, if adaptation and mitigation measures are not taken in a timely and decisive manner. As in other developing countries, the poverty levels in which most of the population lives and their heavy dependence on natural resources turns most of the country's inhabitants into agents who present threats to global warming. These are driven by activities such as the extraction of aggregates on beaches and other inadequate areas (por ex. mountain slopes), uncontrolled cutting of trees and fires in which a significant part of the population engages, on a regular basis.

Two sectors of activity, namely Energy and Forests and Land Use Change are responsible for the emission of total Carbon Dioxide, i.e. 163.49 Gg in the country, with the energy sector being the largest emitter with 66, 29 Gg. These emissions result from the combination of the use of firewood and charcoal as the main source of energy as well as the generation of electricity based on fossil sources, which is the main form of energy generation in STP (Second National Communication (SCN) On Climate Change (Ministry of Public Works and Natural Resources/Directorate General for Environment (August 2011).

Above all, and as already mentioned, due to its geographical situation, social and economic conditions, STP has high levels of vulnerability to the global climate change phenomenon, mainly in the form of temperature increase, precipitation decrease and sea level rise (slr), and coastal erosion. The later two with the potential to occurring in the project area.

9.4. CLIMATE VARIABLES TREND

Although the existence of a more detailed assessment as described above, the following characterization of the main climate variables trend related to climate changes is based on the CMIP5 model for RCP8.5 (high emissions) and RCP2.6 (low emissions), as presented in *Health & Climate Change Country Profile 2021* (WHO & UNFCCC, 2021).

Rising Temperature

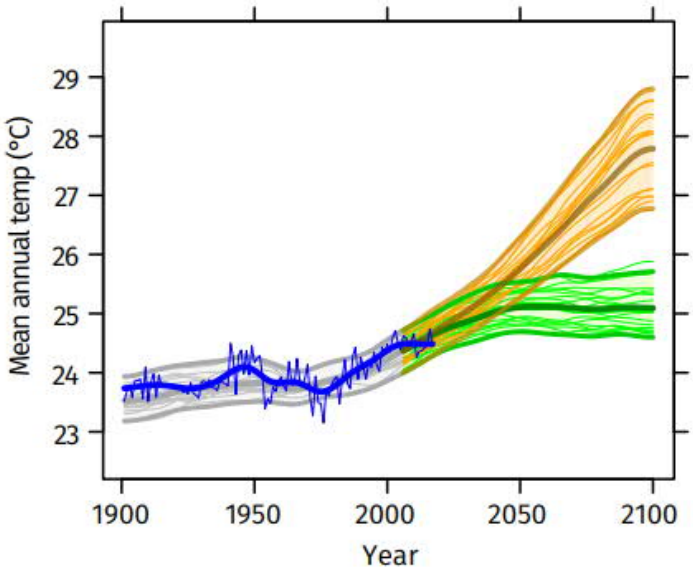


Figure 63 Mean annual temperature 1900-2100

Under a high emissions scenario, the mean annual temperature is projected to rise by about 3.2°C on average by the end-of-century (i.e., 2071–2100 compared with 1981–2010). If emissions decrease rapidly, the temperature rise is limited to about 1°C.

Small increase in total precipitation

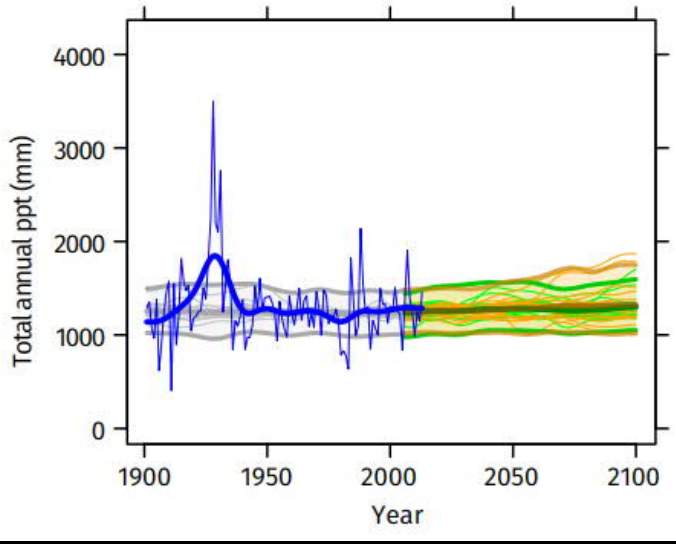


Figure 64 Total annual precipitation 1900-2100

Total annual precipitation is projected to increase by about 7% on average under a high emissions scenario, although the uncertainty range is large (-10% to +44%). If emissions decrease rapidly, there is less projected change on average: an increase of 4% with an uncertainty range of -5% to +20%.

Small increase in extreme rainfall

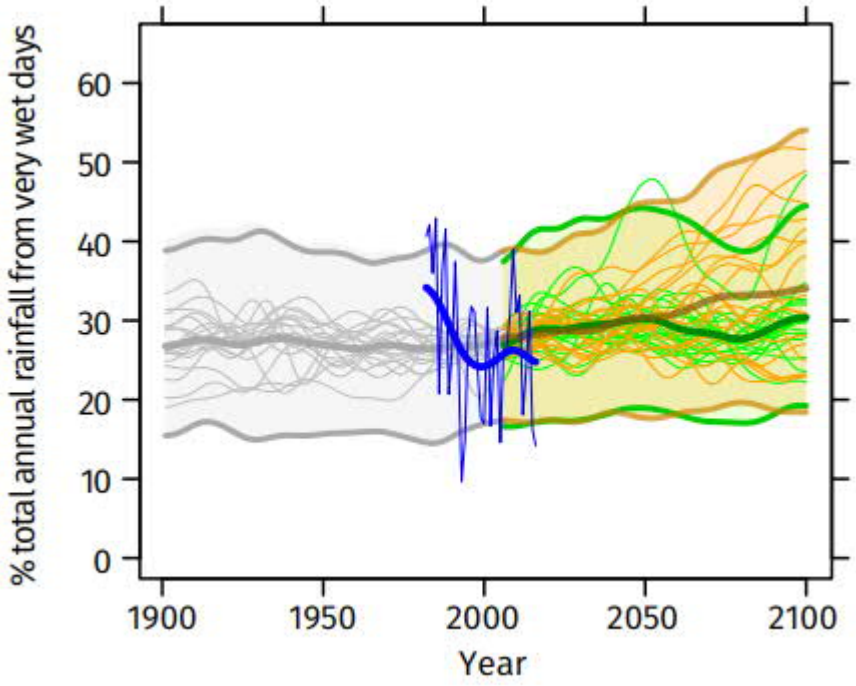


Figure 65 Contribution to total annual rainfall from very wet days ('extreme rainfall' and 'flood risk'), 1900–2100

Under a high emissions scenario, the proportion of total annual rainfall from very wet days (about 28% for 1981–2010) could increase a little by the end-of-century (to about 33% on average with an uncertainty range of about 20% to 50%), with little change if emissions decrease rapidly. These projected changes are accompanied by small increases in total annual rainfall under a high emissions scenario

Wind

Based on the *Vulnerability Analysis* document (CDR, 2019), marginal effect of climate change on the offshore wind conditions has been observed in the climate simulations. It is therefore assumed no climate change effect on the wind conditions (both extreme and average normal climate) will take place till 2100.

9.5. CLIMATIC HAZARDS

This section presents a synthesis of chapter of hazards presented in Volume 1 - Vulnerability Assessment, that integrates the Vulnerability Analysis, Feasibility Study and Preliminary Environmental and Social Analysis prepared by CDR in 2019. These studies were considered in the design.

The boundary conditions, dominantly related to climate change, are translated into the hazards, by means of spatial (numerical) modelling. For this assessment the following numerical models have been set up:

- Delft3D flow model
- SWAN spectral wave model.

CDR (2019) are identified three hazards that are considered to have impact on the project area:

1. Flooding

2. Storm intensity (described by wave height)

3. Coastal Erosion

The following sections presents main assumptions and results for these three hazards for period of return of 100 years.

The coastal design has been carried out for a design life of 50 years and a return period of 100 years. In some cases, different return periods have been tested in order to analyse the sensitivity of the design.

Flooding

Flooding can occur due to (a combination of) heavy precipitation and high coastal and riverine water levels.

The expected inundation of land is highly related to the local topography and therefore important for this assessment.

As referred recently, an event of intense rain occurred on the island of São Tomé, on December 28 and 29, 2021, causing urban flooding in the city of São Tomé.

The inundation is mapped using the DEM model that has been created of the project area. By imposing the extreme water levels on to the DEM model the inundation depth is determined. The following Figure shows the inundation map for the years 2060 and 2100.

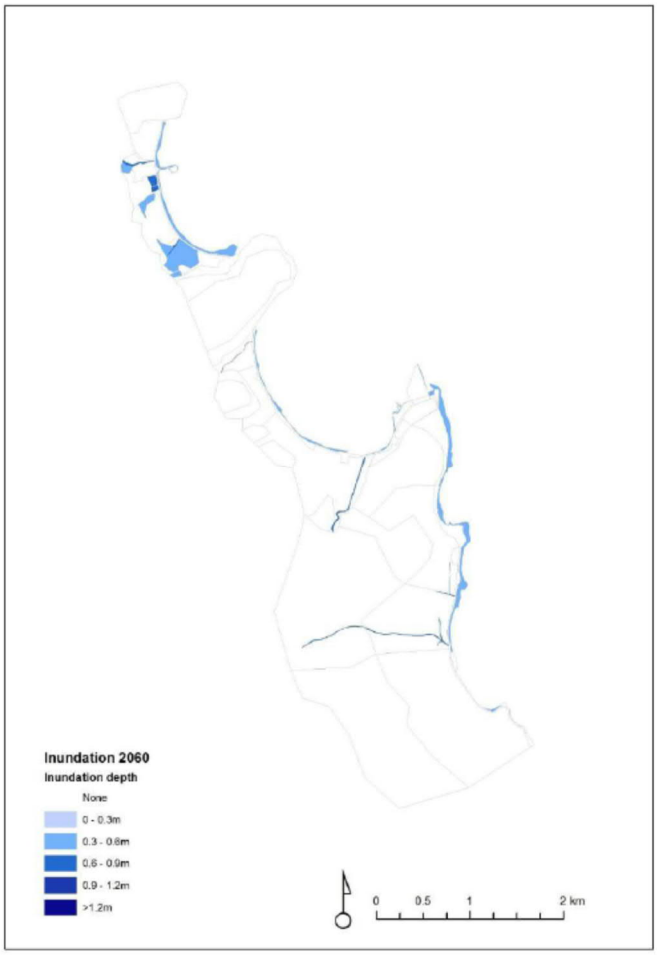


Figure 66 Inundation map for the year 2060 Source: CDR (2019)



Figure 67 Inundation map for the year 2100 Source: CDR (2019)

For riverine flooding and precipitation there are two main catchments in the project area: the Agua Grande and one smaller river outflow in Lagarto bay. Studies done by CDR (2019) concluded that although some areas are getting wet, the impact of intense precipitation events is small, mainly because such events are relatively short (<1 hr) and storm water drains relatively fast. Urban flooding is not consider a critical issue.

The following figure presents location of hotels and riverine flooding areas.

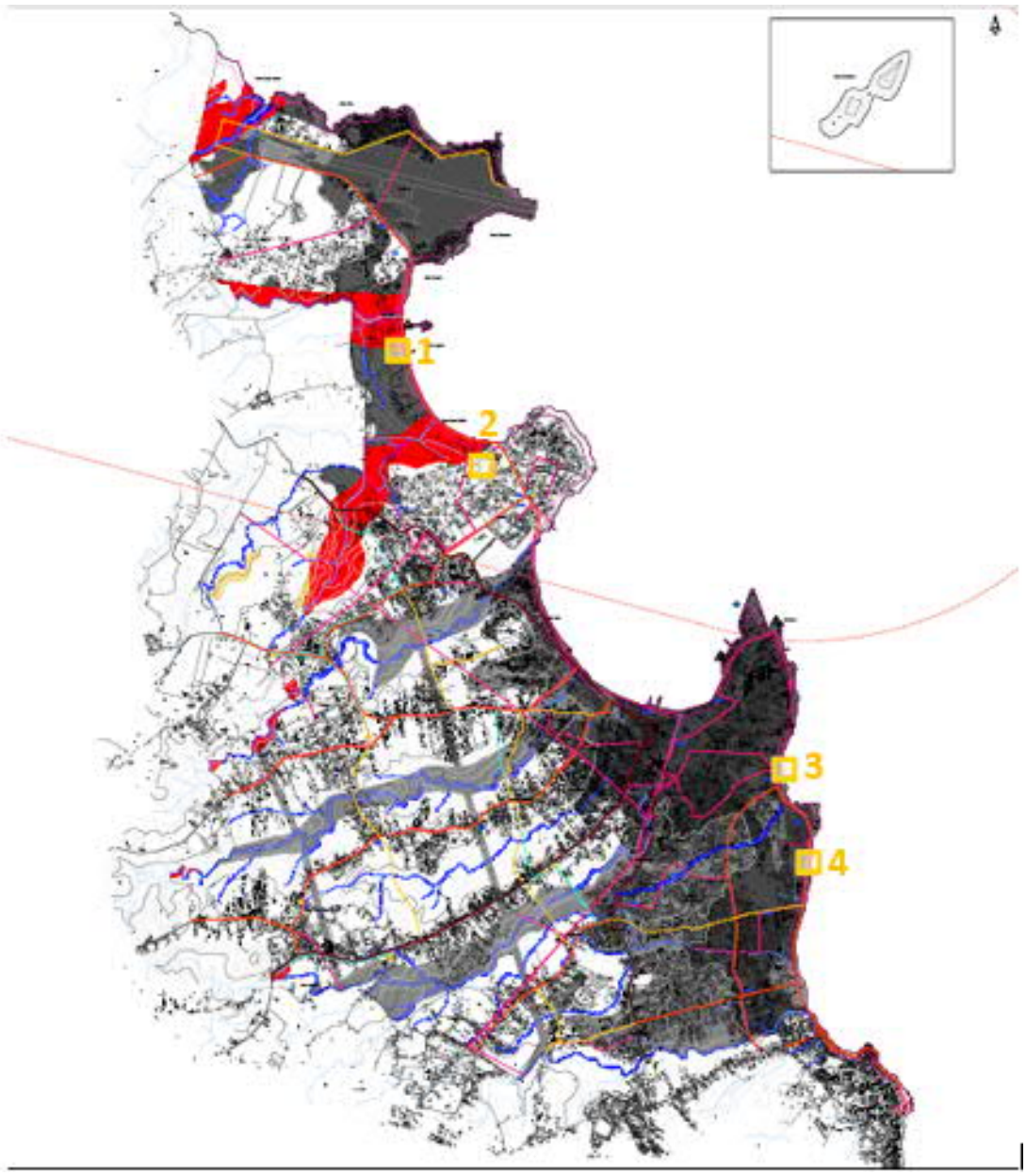


Figure 68 Hotels and flooding areas

Áreas ameaçadas pelas cheias

Hotéis

1 – Hotel Praia
2 – Hotel Omali Lodge
3 – Hotel Miramar
4 – Hotel Pestana

CDR also concludes that the discharge capacity of the outlets (bridges / culverts) is not considered as a bottle neck resulting in urban flooding, given that the outlets always have their full capacity and are not

blocked. Based on the field surveys, although some of the culverts need replacement due to bad conditions, their dimensions will be maintained since full capacity was also confirmed.

The hazard related to overtopping and damage to structures is incorporated in following section related to the hazard Storm intensity.

The storm intensity shows the relative impact of large waves on the coastal area which may cause overtopping. It is considered that overtopping although it is hazard and may damage the roads and have some impact by indirect damage such as reducing the speed of cars on the road occasionally, does not have major impact on flooding depth. From visual observations of overtopping, it is shown that in general overtopping volumes are directly drained to sea.

Coastal flood is expected due to too high coastal water levels which results in inundation of the coastal zone. In general, the coastal water level consists of the following components:

1. Tidal water levels

2. Sea level rise

3. Storm surge (wind setup)

The periodic tidal variation has been determined by means of an analysis of astronomic tidal constituents obtained from a local tide station. The tidal constituents have been obtained at Ana Chaves bay from the International Hydrographic Organization IHO. Based on these tidal constituent's, time series of more than 20 years have been constructed, from which in turn the tidal levels are estimated. This period is considered to give representative tidal levels since the duration of measurements exceed one lunar nodal cycle (18.61 year).

The sea level rise (SLR) adopted in CDR (2019) for 2100 is 0,74 m. The values that have been applied for sea level rise correspond with the mean of the upper and lower bound projections of the RCP8.5 scenario.

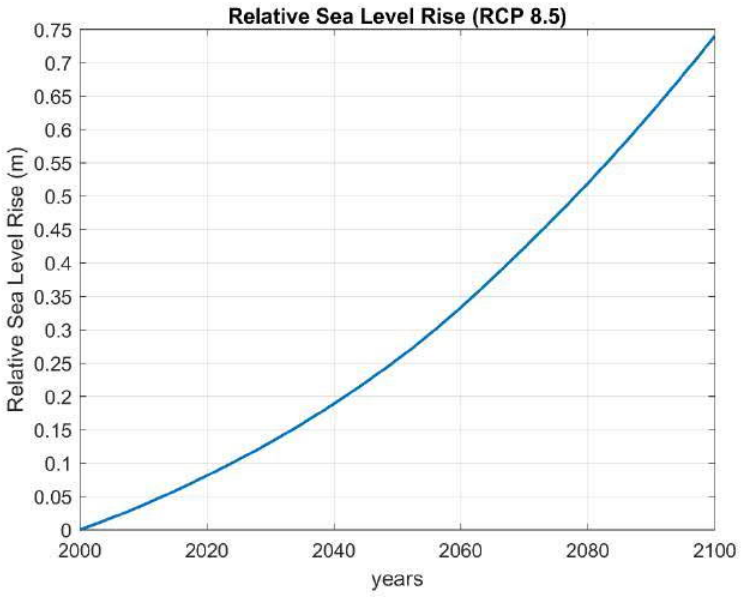


Figure 69 Relative Sea Level Rise (RCP 8.5) (note: an uncertain range around the RSL can be added) Source. CDR 2019

Year	SLR (m)
2020	0.08
2040	0.19
2060	0.33
2080	0.52
2100	0.74

Table 51 Sea level rise projections for projection years (compared to year 2000) Source: CDR (2019)

The expected storm surge (wind setup) has been calculated for an extreme wind speed from North-East direction based on the most governing fetch. The extreme wind conditions from these directions follows from an analysis of the wind measurements at the airport and hindcast data. The resulting extreme wind conditions from the North Easterly conditions are shown in the following table.

Return period Years	JRASS relative extreme values(*)	Airport 10 min average (m/s)	Airport 60 min average (m/s)	Mean wind direction (N)
2.5	1.00	13.7	10.7	55
10	1.15	15.5	12.5	55
100	1.35	19.0	15.00	55

Table 52 Extreme North Easterly wind conditions Source: CDR (2019)

As mentioned before, marginal effect of climate change on the offshore wind conditions has been observed in the climate simulations. It is therefore assumed no climate change effect on the wind conditions (both extreme and average normal climate) will take place till 2100.

The wind setup has been calculated using the Delft3D model that has been set up. The following figure shows the calculated wind setup by applying a wind speed with a return period of 100 years (15 m/s from 60°N). The maximum expected wind setup with these wind speeds is not larger than 5 cm, which is considered negligible. This can be explained by the fact the coastal shelf in this area is very narrow. Wind will only induce a water level gradient at shallow waters, which explains that the expected wind setup in these bays is relatively small.

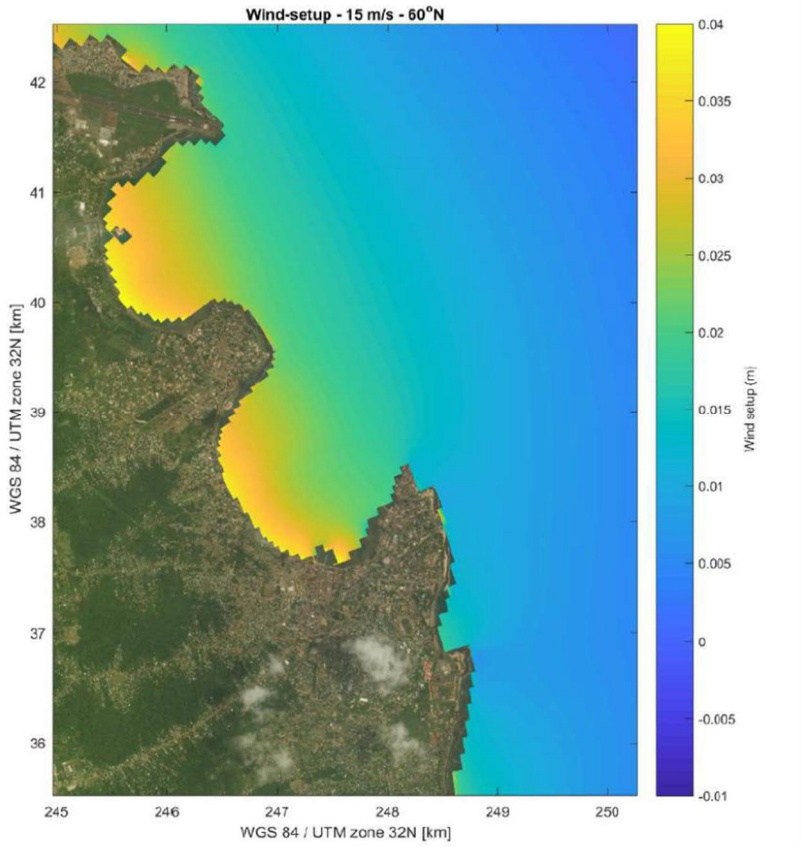


Figure 70 Wind setup for Return period of 100 years Source: CDR (2019)

The extreme storm related surge (wave setup, wind setup and barometric pressures) is smaller than the difference between HAT and MHWS. In other words, it is more probable that HAT will occur than MWHS plus storm surge. The probability of an event that HAT occurs with extreme storm surge for a Return Period of 100 years simultaneously is considered negligible. In the inundation calculations the storm surge component is omitted, which means that the coastal water level is considered only dependent on the tide and sea level rise. The most extreme case is considered for the inundation calculations which is the combination of HAT (+1.04m+MSL), considering MSL and sea level rise.

In Marginal Road the sea level does not reach the buildings. As mentioned before (section 8.7.1.2.2), refers the maritime flood that occur in 1995, although without people damage.

Storm intensity

For storm intensity the extreme wind speeds are determined from the wind data from the ERA Interim data set. These values are directly used for all projection years, assuming no climate change effect for this parameter (as already described previously). The wind direction is chosen to be equal to the wave direction, which is considered realistic given the offshore wind climate.

To be conservative the wind speed and wave height are assumed to be statistically fully dependent. That means that it is assumed that the wind speed and the wave height will occur simultaneously with equal return period.

In the calculations a water level equal to MHWS including sea level rise has been adopted. The following Figure shows the resulting wave height maps of the swell conditions for the years 2060 and 2100 and a return period of 10 years (left) and period of return of 100 years (right). Swell waves have longer periods than waves, from 8 to 30 seconds, and consequently more energy.

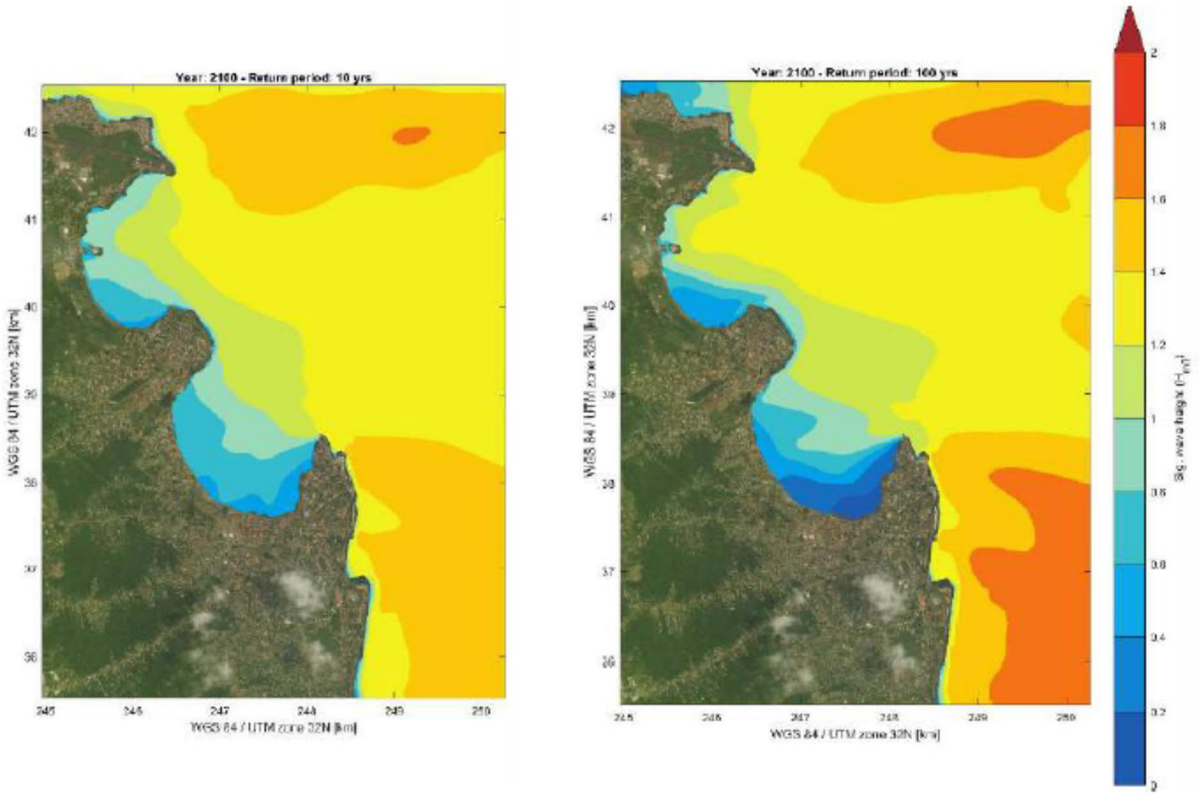


Figure 71 Extreme swell waves conditions for year 2100 with return period 10 years (left) and 100 years (right)
Source: CDR (2019)

The risk of swell waves is very limited for Lagarto and Ana Chaves bay and a little higher for Pantufo bay, due to its exposition to the sea and depth.

Wind Sea

For the analysis of wind sea, the extreme North Easterly waves have been assessed using local wind measurements from the airport. These measurements include the wind conditions for a period of approximately 2.5 years (September 2013 till April 2016). The following Figure shows a scatter plot of this data showing the wind direction on the x-axis and 10 minute average wind speed on the y-axis. It is clear that the dominant wind direction at the airport is SSW.

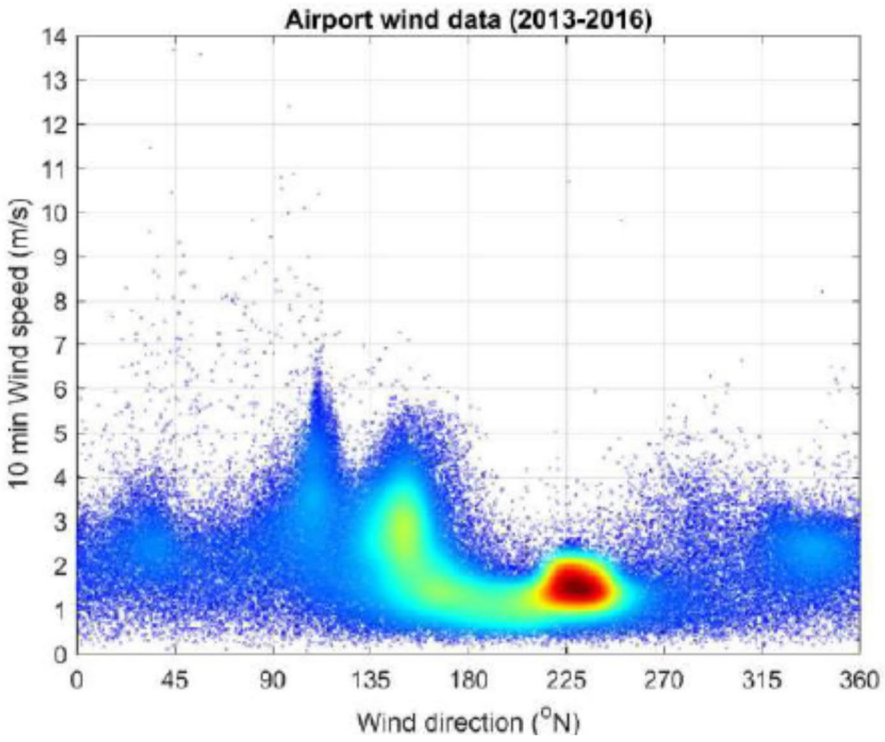


Figure 72 Wind direction and 10 min average wind speed scatter plot for airport wind data Source: CDR (2019)

An example of the calculated wave height is shown in the following figure where the wave height is shown for the year 2100 for the return period of 10 years (left) and 100 years (right). It is evident that these waves are higher compared to the arriving swell waves. The wind sea waves are therefore considered governing and used for the hazard (indicator) mapping.

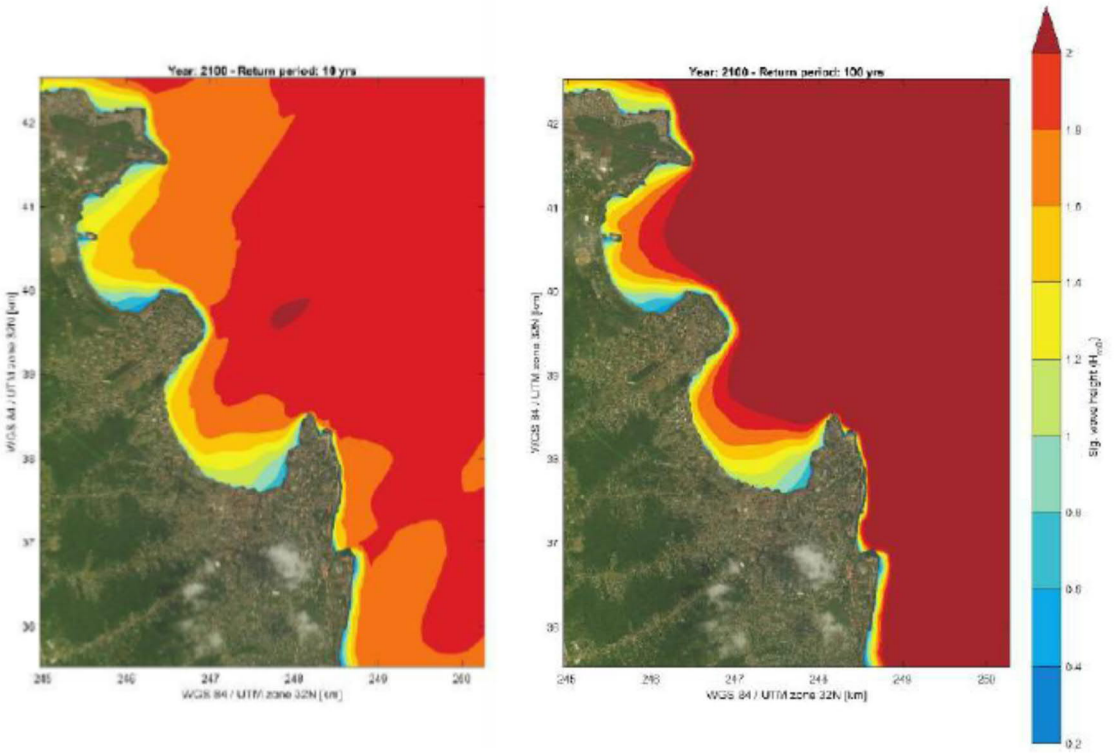


Figure 73 Extreme wind sea conditions year 2100 with a period of 10 years (left) and 100 years (right) Source: CDR (2019)

Coastal erosion

The rocky promontory between Ana Chaves Bay and the Pantufo coastline stretch has been occupied ages ago, providing a stable foundation as well as protection against erosion. The promontory between the Ana Chaves Bay and the Lagarto Bay consists of volcanic harder deposits, whereas the bays itself consist of sand and alluvial deposits, possibly underlain by harder volcanic material. So the bays are more susceptible to erosion by hydraulic forcing from the ocean (mainly waves and wave induced currents discharging the sediments in the bay), which is also the reason why the bays have been formed and developed this way.

Along project area in the eastern coast, towards Pantufo Coastline, there is no major coastal erosion in general. In Lagarto bay marginal road is located at a low level (estimated between +1,5 m and +2 m MSL), with no walkways and storm water runoff. Overtopping and coastal erosion are visible on some days of the yea.

At South between Pestana and Pirata Bar, coastal erosion is visible.

The spatial coastal erosion rates for different scenarios are prepared for the:

- Ana Chaves bay (alluvial deposits areas);
- Lagarto bay (alluvial deposits / sand deposits (lifted) beach areas);
- Pantufo area (alluvial deposits areas).

Most of the coastline is already protected and the remaining small strip of beach is already eroding. For a more simplified analysis the Bruun model was used to assess the potential coastal erosion by sea level rise

(the major impact of climate change) and is considered conservative as it assumes that the present coastline is completely sandy without presence of structures. The presence of the existing structures and its interaction with the beach makes it very complex to assess this with more detailed (numerical) models.

Therefore, the involved uncertainty and complexity of these more detailed models will make such an assessment not contributing to the total interpretation and usability of the vulnerability maps. Besides, it is expected that the vulnerability index will not change drastically. The coastal erosion is estimated along the bays for several transects (every 25 m) applying the local wave conditions. The Bruun model for the determination of the coastal recession is a function of the expected sea level rise and the local wave climate.

The results of application of Brun model are practically a mass balance assuming a displacement of the cross-shore profile because of a rise of the mean sea level.

For every bay (Ana Chaves, Lagarto and Pantufo) separately a constant Dean profile is assumed, which is determined by taking the average of the observed profiles along the bay.

Based on the bathymetry it has become clear that the profiles at Pantufo are steeper compared to the relative gentle slopes in Ana Chaves bay and Lagarto bay. Along the bays a berm elevation (B) of 2 m+MSL has been considered. Sea level rise (S) values as depicted in the following Figure shows the resulting potential coastal erosion for the year 2100 with respect to the year 2020. In the year 2100 the expected erosion is approximately between 15 and 25 meters. Note that these values may be interpreted as potential erosion as it assumes a complete sandy profile without any hard layers or structures. The following figures shows potential coastal erosion in 2060 and 2100.

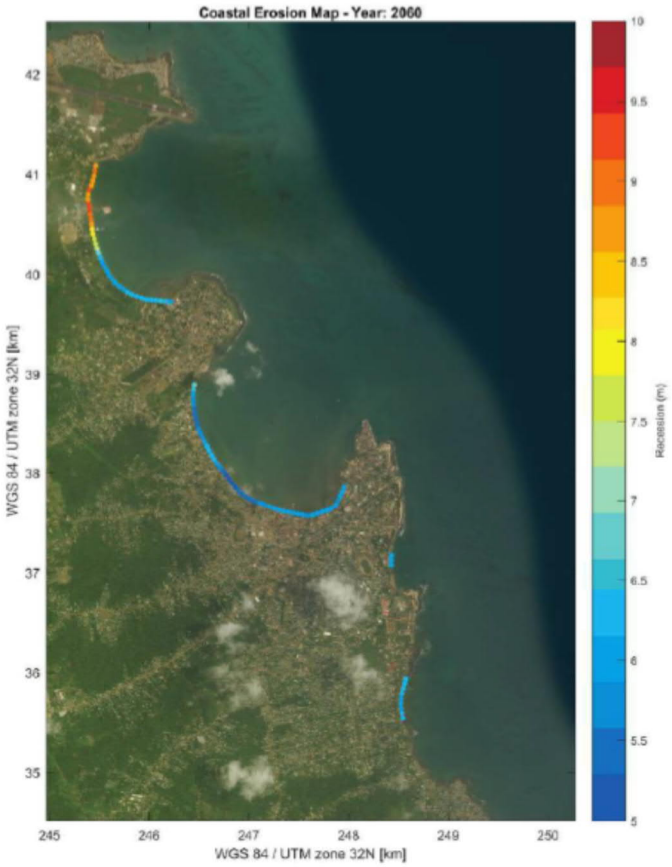


Figure 74 Potential coastal erosion due sea level rise for year 2060 Source: CDR (2019)

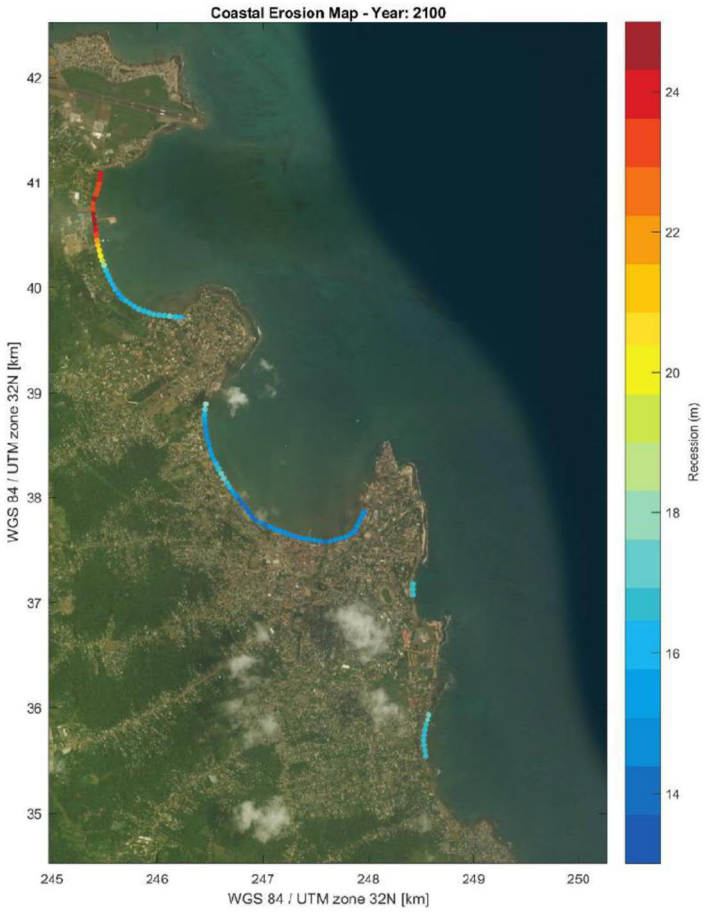


Figure 75 Potential coastal erosion due sea level rise for year 2100 Source: CDR (2019)

9.6. VULNERABILITY ASSESSMENT

A set of vulnerability maps is developed (one map for each type of hazard and combined exposure for different years in the future, see the following figures (CDR, 2019) . These maps are used to evaluate the vulnerability and to identify focus areas for investing in interventions.

These “hotspots” will have more attention during development of effective and feasible adaptation options.

These maps are shown in following figures, the higher the value of the indicator the more vulnerable the area is. These maps clearly show the increase of the vulnerability with time and changes in location of most vulnerable areas.

Risk perception and acceptance is an essential part of an accurate evaluation of vulnerability of the Água Grande district. Therefore, these maps were discussed in the stakeholder meetings on 26th and 28th of February 2018 and hotspots were checked with the existing experiences of different stakeholders.

As it is clear in the maps both bays are very vulnerable to storm (wave attack and overtopping) and erosion and Lagarto Bay and the (potential) touristic areas around it due to low level of land is vulnerable to inundation due to sea level rise..

The following areas are considered the most vulnerable and in need of interventions, ranked from 1 to 7:

1. The most vulnerable place is the south part of the Ana Chavez Bay, were the national road and Marginal merges into one road and it has a big potential for tourism. On the other hand in this area there are fisherman who are suffering from the changes in the condition of the beach and the bay. Also in this area the existing sea wall has already collapsed and occasional overtopping is happening.

2. The second area of which is identified as vulnerable in this study is the north of the Praia Pier in Lagarto Bay, This part is under the wave attack and part of the coastal defence is already collapsed. The authorities in Agua Grande have relocated the road in this location landward once, but again erosion is reaching the new road. Given the important hotel for tourism in this area and the fact that at the moment this is the only road connecting the airport to the city and hotels, this part is considered in need of intervention as well.

3. North of Ana Chavez Bay is the other vulnerable point mainly due to overtopping and flooding of the road during the extreme events.

4. South of Lagarto Bay, due to its low level , no protection, continuous erosion and wave run-up on the road on one hand and existing hotels and potential new hotels in the area on the

5. Fishery location at Pantufo has an important socio-economical role for the people leaving in this area, but fisherman are suffering from lack of proper landing grounds and occasional wave attack that may destroy the boats and coastal defence in this area.

6. Along the Road of Pantufo there are two main problems, the existing structure that protect the road from wave attack is damaged in different locations and in some other places the erosion is getting dangerously close to the road.

7. In the hazard analyses it is also shown that the wave attack on the most eastward part of the runway of the airport will increasingly be vulnerable to wave attack, and give the fact that airport activities cannot be interrupted, this point should also be considered as an upcoming hotspot. Evaluation of the vulnerability gives rise to the identification of an appropriate safety level for design of adaptation options. This is strongly related to the risk acceptance and desired resilience and needs

Locations 5 and 7 are outside the Area of Direct Influence of this ESIA.

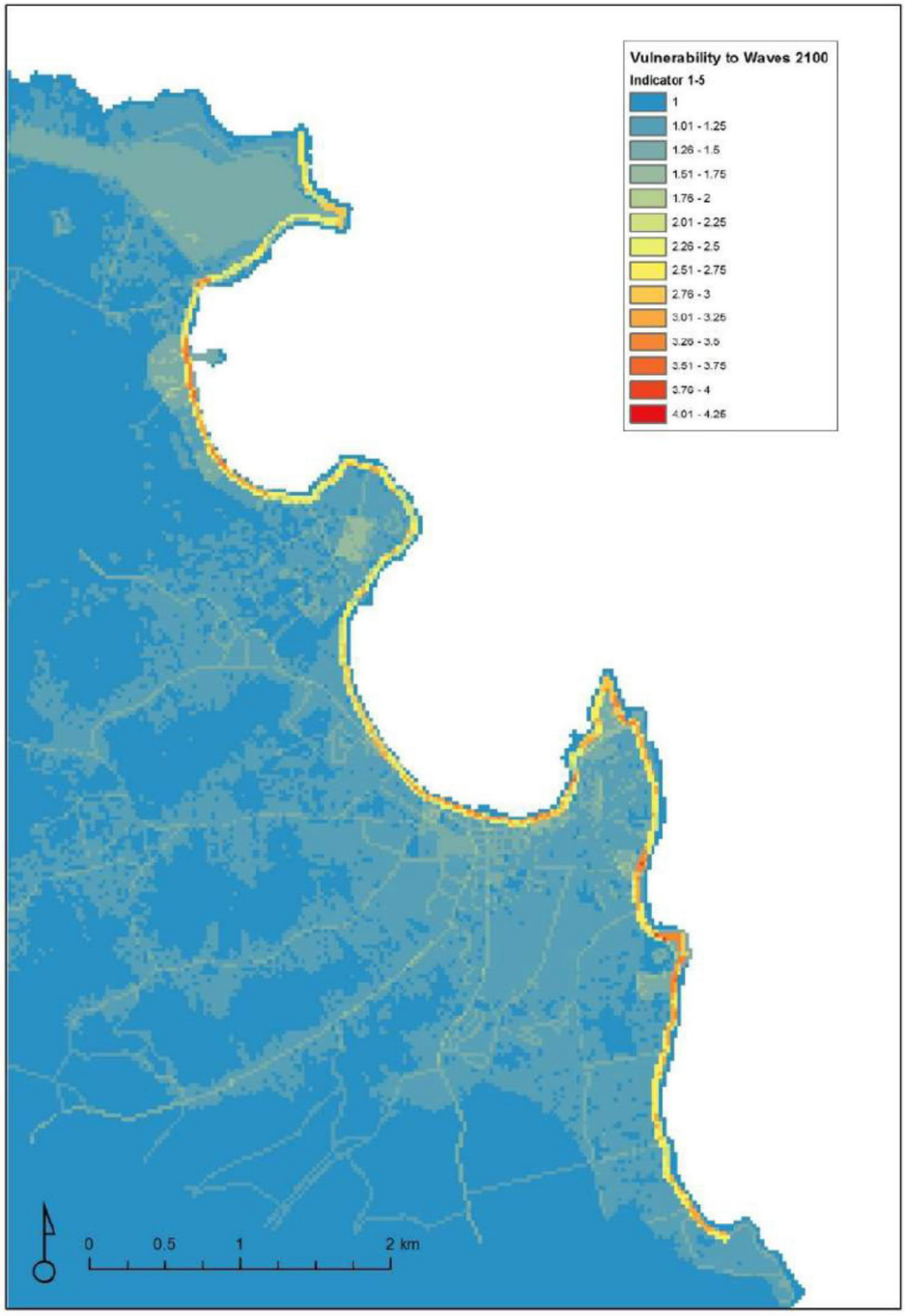


Figure 76 Vulnerability to storm intensity (waves) map in 20100 Source: CDR (2019)

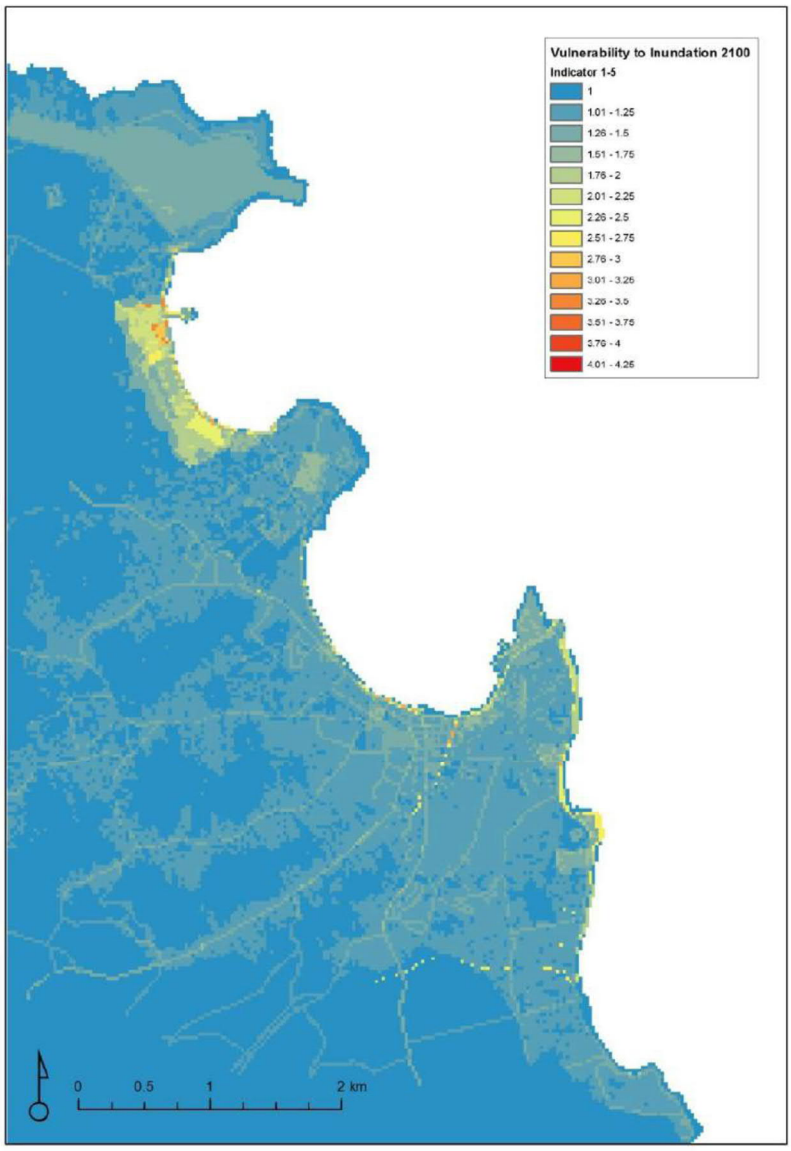


Figure 77 Vulnerability to inundation map in 2100 Source: CDR (2019)

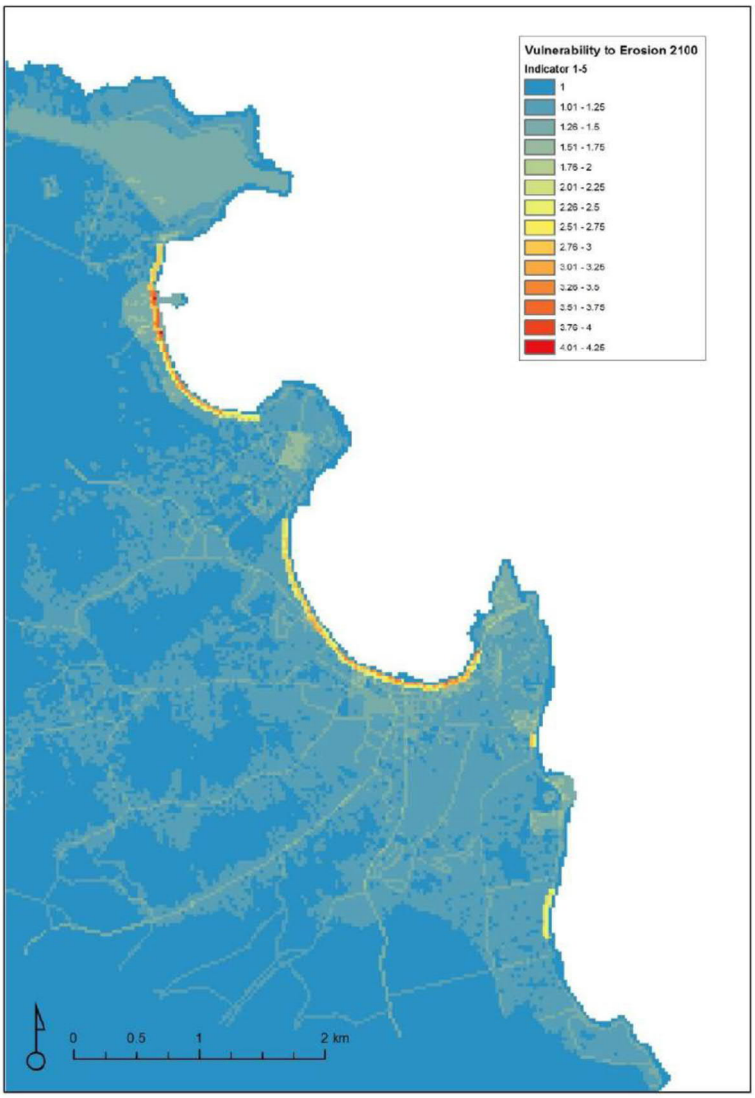


Figure 78 Vulnerability map potential coastal erosion in 2100 Source: CDR (2019)

The maps show that Marginal road that the vulnerability in the coastal area in 2100 is higher for coastal erosion, comparatively to storm intensity (waves) and inundation.

Exposure maps for Tourism, infrastructure and population helps to identify areas where impacts of climate change risks are higher.

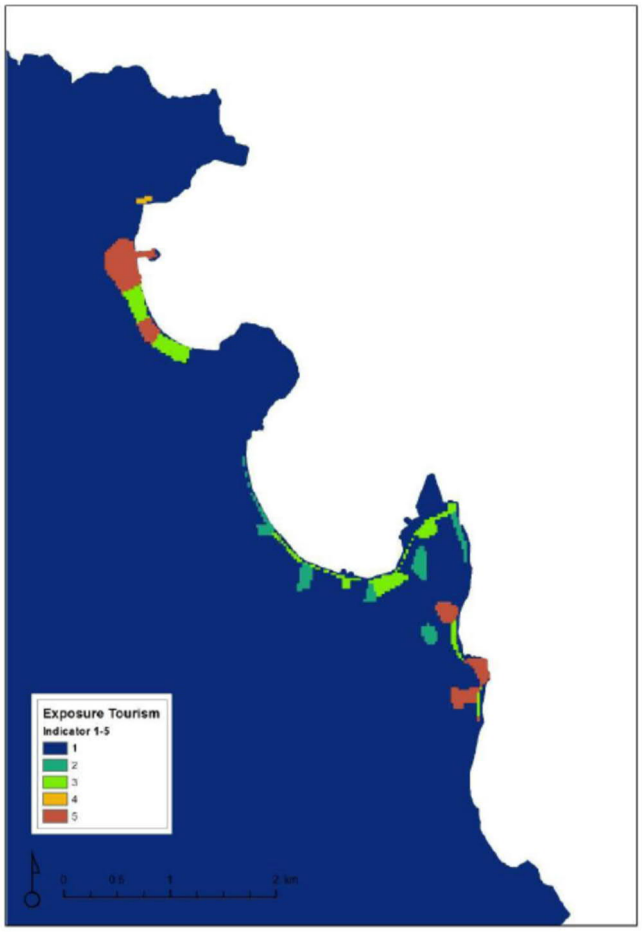


Figure 79 Exposure for Tourism CDR (2019)

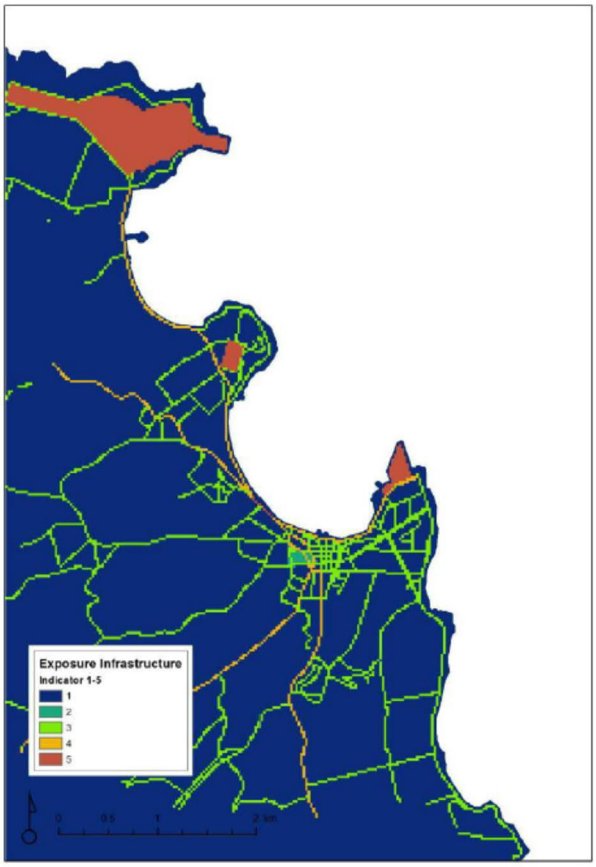


Figure 80 Exposure Infrastructure Source: CDR (2019)

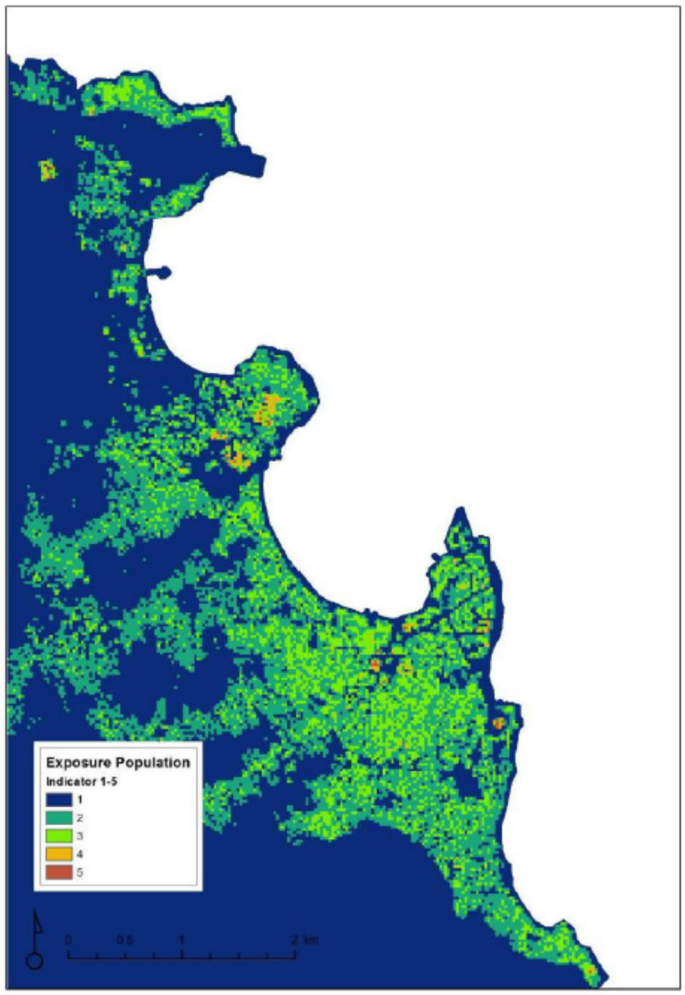


Figure 81 Exposure for Population Source: CDR (2019)

10. ENVIRONMENTAL BASELINE CONDITIONS

10.1. INTRODUCTION

This chapter presents a description of the existing environmental conditions in relation to the Marginal de São Tomé project.

This project is divided into three sections: Lagarto bay, Ana Chaves bay and Pantufo coastline, up to the São Gabriel junction.

Whenever possible, the characterisation will refer each of the sections, given that specific information exists for that section.

The description of the environmental characterization is based on a number of primary and secondary sources, including:

- Internationally published sources and databases, such as the Food and Agriculture Organization (FAO) and the International Union for Conservation of Nature (IUCN);
- International peer-reviewed and published scientific articles;
- Primary data derived from informal conversations with local stakeholders;
- Biodiversity information developed by São Tomé and Príncipe institutions and NGO technical reports on relevant topics (e.g., biodiversity, ecology, marine and coastal biodiversity, and fisheries).

The following table presents the field work done for the present ESIA.

Factors	Scope	Period
Hidrology	Visual observation	March 2021
Geology and geomorphology	Visual observation	March 2021
Soils	Visual observation	March 2021
Fauna	Visual observation	October 2021
Flora and Vegetation	Identification of trees the need to be cut	September 2021
Water Quality	Visual observation	March 2021
Air Quality	Visual Observation	March 2021
Noise		March 2021
Waste disposal	Visit to Penha Dump and visual observation in Marginal	April 2021
Stakeholders consultations and interviews	Identification of Stakeholders	March 2021 to March 2022
Landscaping	Visual Observation	September 2021
Characterization of population affected	Inqueries/ Census	June/July 2021 March 2022
Economic Activities	Identification of economic activities	March 2021
Sensible receptors	Identification of schools and Hospitals	October 2021
Cultural Heritage	Identification of colonial houses	August 2021
Land Use	Visual observation	April 2021

Table 53 Field works

10.2. PHYSICAL ENVIRONMENT

10.2.1. GEOLOGY AND GEOMORFOLOGY

The island of São Tomé is located in the Gulf of Guinea, 2 km north of the Equator. It is a complex trato-volcano about 5000 m high. It rises from the abyssal plain, about 3000 m depth, to an elevation of 2024 m above sea level (Pico de São Tomé).

Due to the volcanic origin of the island, the topography is quite rugged and steep, mainly in the central area of the island, where the Pico São Tomé and Pico de Ana Chaves are located, reaching 2024 m and 1631 m in altitude, respectively, and reaching sea level in the coastal areas (see next Figure). The project area, in the western half of the Island in the Água Grande district, is located the coastal zone and has the lowest altitudes.

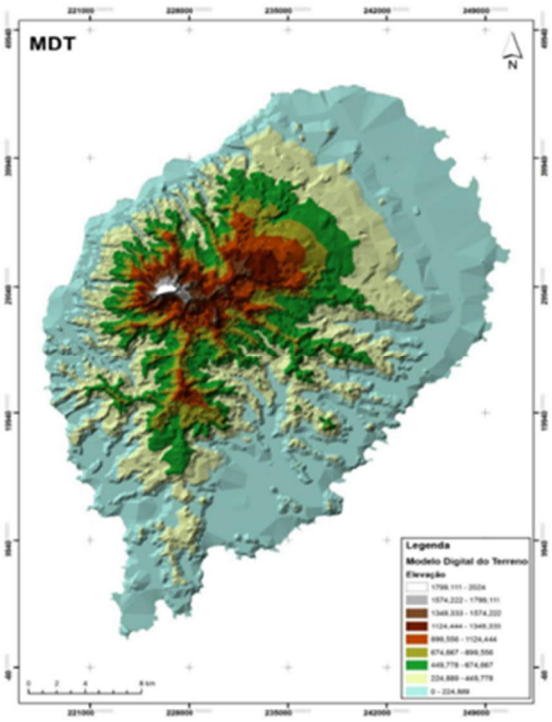


Figure 82 Hipsometric Map of island of São Tomé (Direcção dos Serviços Geográficos Cadastrais, São Tomé 2016)

São Tomé is a volcanic island, which is made essentially of basaltic lavas. Phonolitic plugs and necks are abundant in the southern part of the island.

The island of São Tomé comprises, with the island of Príncipe and some small islets, the tiny archipelago of São Tomé and Príncipe, the second smallest African state (in area). This archipelago consists of volcanic islands that form part of the oceanic sector of a major volcanic alignment known as the “Cameroon Volcanic Line” (see next figure).

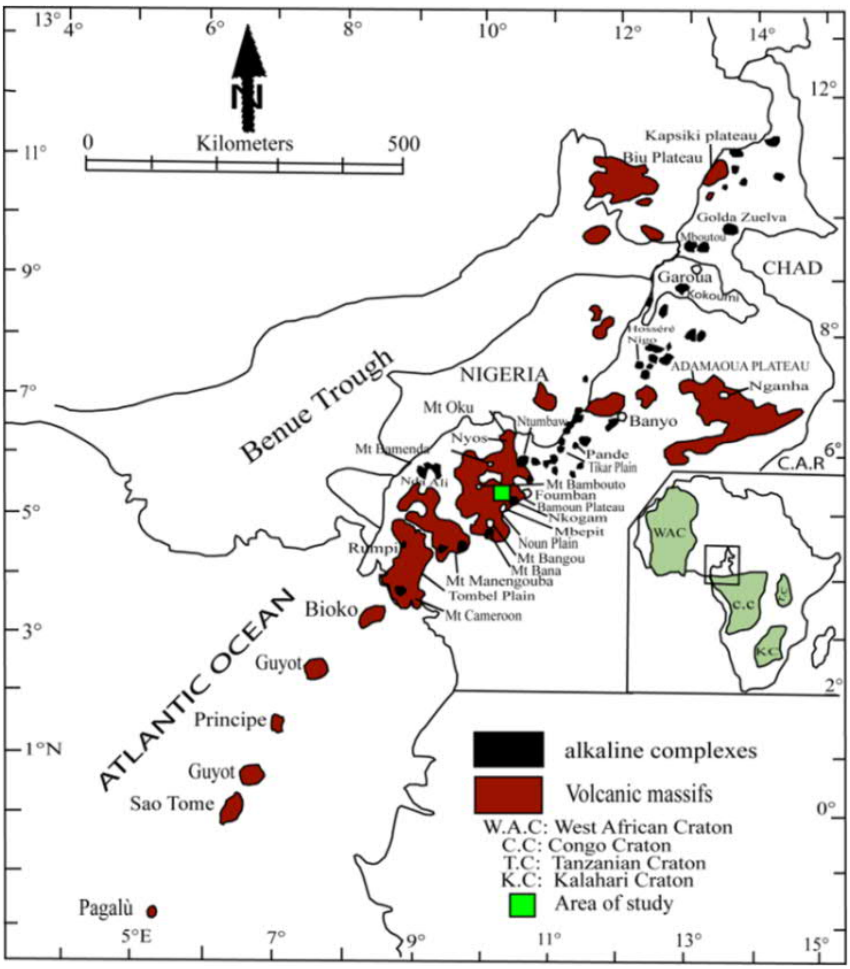


Figure 83 Alignment of the Cameroon Volcanic. Source VERIF-I (2017):

The oldest rocks on the island are conglomerates, sandstones and shales of the Ubabudo Formation. These materials outcrop in stream sections in a small area in the eastern part of the island and are accompanied by oil seepages. The volcanic succession is dominated by alkaline lavas, ranging in mineralogical compositions from basalt to trachyte and phonolite.

In the North-eastern part of the island, these basalts are locally covered by ‘raised beach deposit’, probably of Pleistocene age. This unit consists of coarse bioclastic sand (shell fragments and coral debris). It is found above the present sea level, from a few meters above mean sea level (land bordering Lagarto bay) to 15 m above the current mean sea level. Its thickness ranges from a few decimeters to more than 2.5 m.

During the Pleistocene, in periods of low sea level, streams incised into the basalt base, partly removing the older raised beach deposits. The valleys formed in this manner, have been filled-up with recent alluvial deposits, consisting of sandy and clayey material.

Along the coast, the basalt basement is found at sea level on protruding headlands (near the airport, the Hospital Promontory and the area around São Sebastião Fort in São Tomé city). In between these headlands, the basalt basement is eroded and covered with alluvium and recent beach deposits.

At various stretches along the coast, the recent beach deposits have developed into ‘beach rock’ layers. Beach rock is defined by Scoffin and Stoddart (1987, 401) as "the consolidated deposit that results from lithification by calcium carbonate of sediment in the intertidal and spray zones of mainly tropical coasts."

Beach rock units form under a thin cover of sediment and generally overlie unconsolidated sand, although they may rest on any type of foundation (Turner, 2005).

According to the Geological map of Água Grande district, the alignment mainly goes through alluvial deposits and sandy beaches that cover volcanic spills and basaltic rocks.

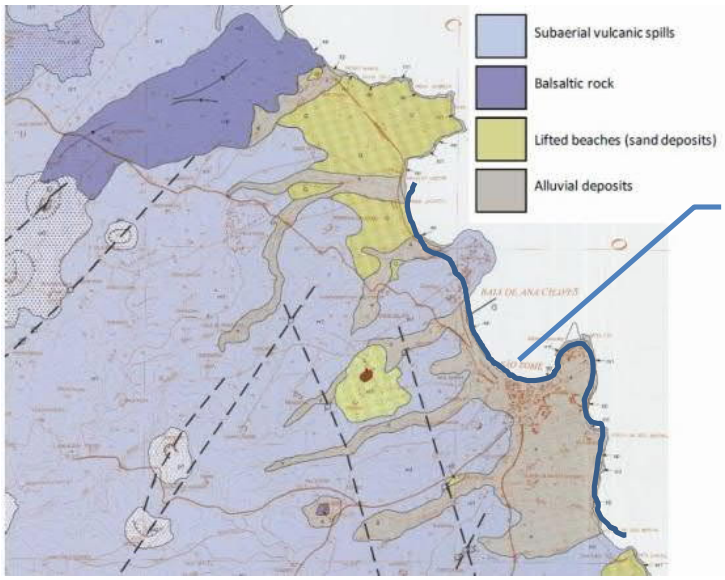


Figure 84 Geological map of Áqua Grande district

In the Áqua Grande district, most of the land is underlain by basaltic lava flows.

Lagarto bay

Lagarto bay is located between CH 0+000 to CH 2+760. The alignment is in a flat area over Quaternary soils.

There are alluvial soils related to the river streams coming from the mountain area of the central island. In the coast there are beach deposits and outcrops of basaltic rocks. This feature could be a sign of a small thickness of soils with the exception of the alluvial areas. In the final part of the section, the area of the hospital a small hill exists with a ground of basaltic rocks, as shown in the following figure.

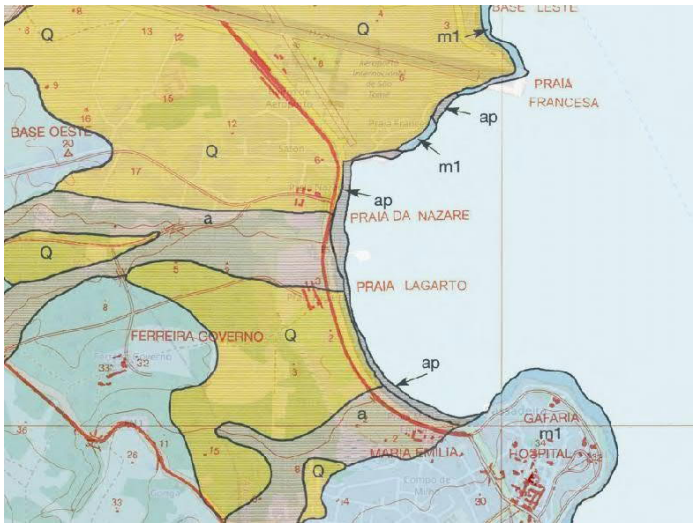


Figure 85 Geological map detail for Lagarto bay Section CH 0+000 - CH 2+760

Ana Chaves Bay

Along Ana Chaves bay, located between CH 2+760 and CH 5+800, alluvial soils cover most of the area, although in the coastal strip, there are beach deposits and outcrops of volcanic rocks, is presented in the following figure.

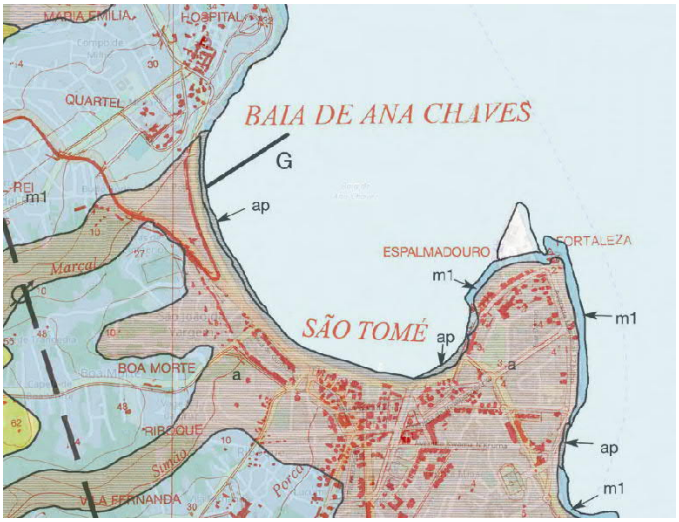


Figure 86 Geological map detail for Ana Chaves bay Section: From CH 2+760 to CH 5+800

Pantufo Coastline

Alluvial soils are expected to cover most of the area, although in the coastal strip, there are beach deposits and outcrops of volcanic rocks. Quaternary soils are expected to cover this area, covering the basaltic rock substratum. The rock outcrops can be identified in several sections of the coastal strip, as shown in the figure below.



Figure 87 Geological map detail for Pantufo Coastline

Seismotectonic Province where São Tomé Island is located, is generally considered to be a stable part of Africa, although several major historical and recent earthquakes have struck the region. The Guinea earthquake (1983, Mw 6.4) is a good example of an event of intraplate seismicity which occurred on a stable West African craton.

This aspect is consistent with the fact that, in this area, there are no identified earthquake ruptures, neotectonics or kinematic faults.

Therefore, seismicity in São Tomé Island is infrequent according to the geological context.

10.2.2. HYDROLOGY

The island of São Tomé has a dense hydrographic network, with a radial distribution from the centre to the coastline. The hydrological regime of the rivers depends on the precipitation regime. In the dry season, from June to September, the run-off represents no more than 10% of the annual total.

The rivers and streams of the island of São Tomé present a peculiar morphology, with springs in the mountains located in the centre of the island, and by several water courses with an average length between 5 to 27 km, which feed the different hydrographic basins and an important number of aquifers. Most of these rivers originate in the Obô forest, in the southwest and south of the island and present torrential characteristics. The main rivers in the island of São Tomé are: Yô Grande (the biggest in the country), D'Ouro, Contador, Lembá, Quijá, Manuel Jorge and Abade.

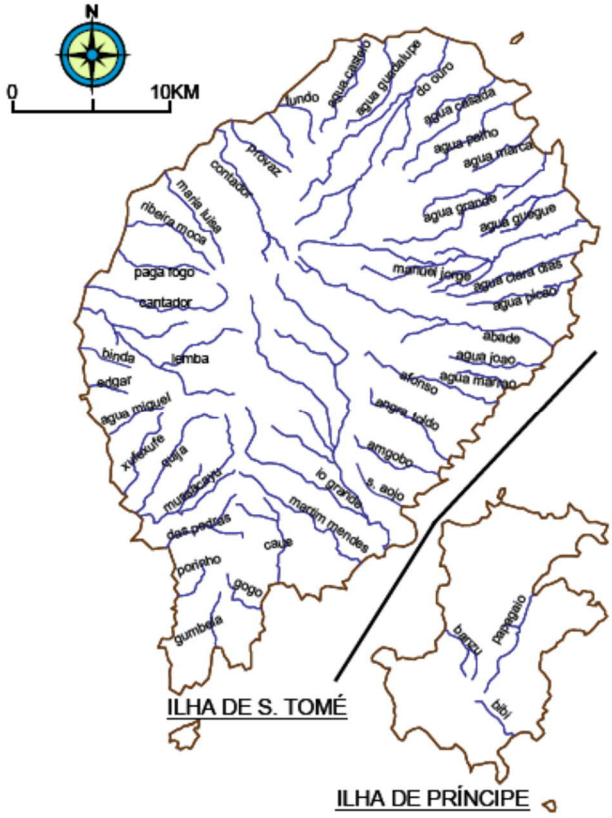


Figure 88 São Tomé and Príncipe's Hydrographic Network. Source: Global Water Resources Development Plan of S. Tomé & Príncipe, Nov 2009.

The mountain area is drained by numerous torrents, frequently interrupted by waterfalls (cascades). The rainfall regime in São Tomé and Príncipe is the humid intertropical type and precipitation is highly dependent on the passage of the Intertropical Convergence Zone (ITCZ) which directly follows the path of the sun. On the island of São Tomé, more than 60% of the runoff is located in the less populated southwest quadrant, which represents 20% of the island's total area (200km^2).

Among the main rivers, the Hydrographic Basin of Rio d' Ouro is located between the districts of Mé-Zóchi (upper course) and Lobata (middle and lower course). In Lobata District, as illustrated in image 11, is a water course which originates on the northern coast of the Amélia Lagoon at an altitude of 1,412 meters. Its basin has a symmetrical shape and widens in a northwest direction from the source to the mouth. In its middle and lower course, part is diverted for irrigation and water supply to the surrounding localities, namely the communities of Monte Macaco, Potó, Praia das Conchas, Agostinho Neto, among others. However, in its upper course, it runs through a medium-altitude forest, and in the intermediate course flows in the shade forest for cocoa and coffee. In the lower course, mangroves predominate. The average annual rainfall in the basin is 1 700 mm and the estimated end of gravana flow is 177 L/s (Hydroconseil, 2011).

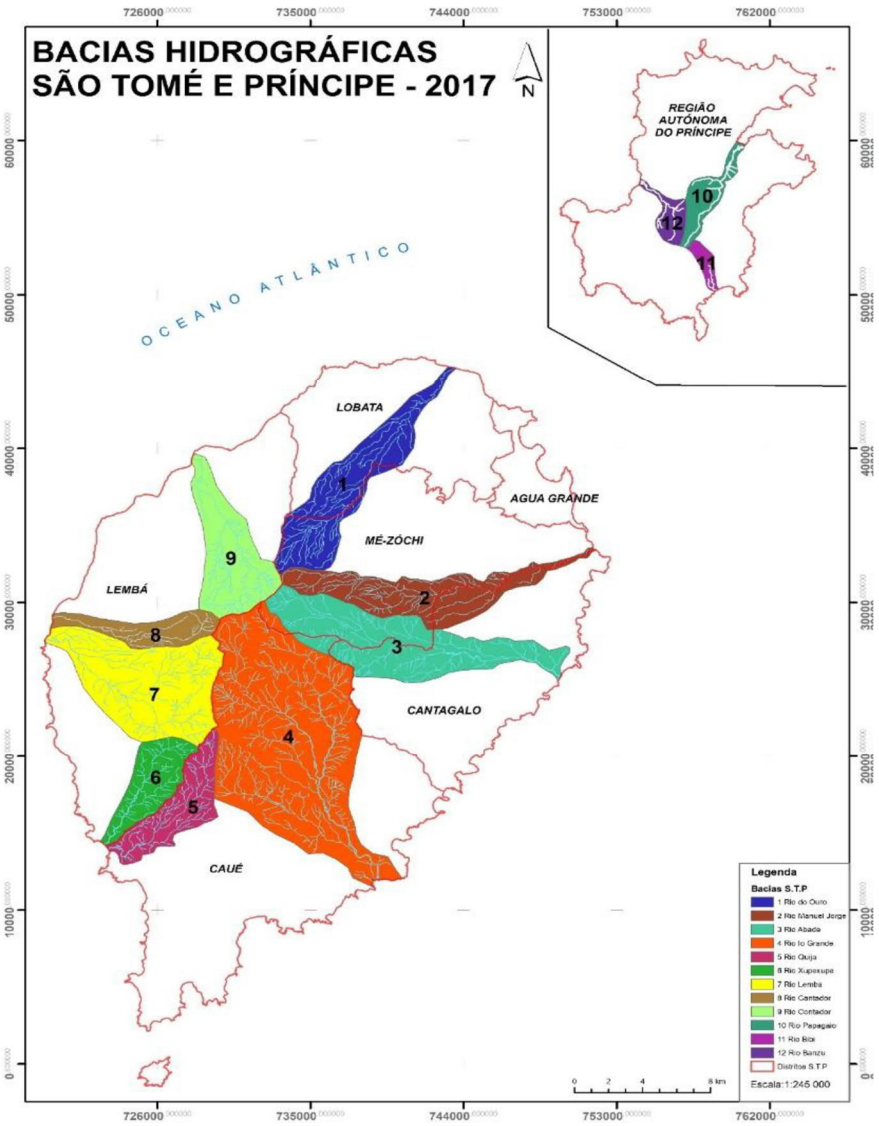


Figure 89 Main Hydrographic Basins of São Tomé and Príncipe. Source: Integrated Water Resources Management Implementation Plan, 2017

According to (PIGIRH, 2017), with regard to groundwater, no actual assessment or investigations are available for São Tomé and Príncipe. The country does not have a piezometric network for the quantification and monitoring of groundwater fluctuations.

We have not found any springs in the study area. The water tables found in the boreholes and test pits are between 1.70 and 2.50m.

10.2.2.1. River basins in project area

Lagarto bay

Água Palito: has an elongated shape; it covers an area of approximately 10,38 km^2. The main tributaries, all on the left bank, are Água Telha and Água Xóxó and Água da Vila. The main watercourse is 6,72 km long up to its mouth. The average slope of the basin is 0,02 m/m and the Time of Concentration 1,69 h and rain intensity is 34,80 mm/h.

Água Melo: also has an elongated shape, but longer than Água Palito with 11,69 km and covers an area of approximately 18,62 km^2. The average slope of the basin is 0,06 m/m and the Time of Concentration 2,00 hours and the rain intensity is 31,32 mm/h. The headwaters are in the medium-altitude forest. For almost all of its extension, it covers areas of shade forest of cocoa and coffee. In the mouth, located between Nazaré beach and Lagarto beach, the last stretch of the basin has been occupied with tourist development,

Ana Chaves bay

Água Grande: This watercourse runs in a southwest-northeast direction, flowing to the Ana Chaves bay in the city of São Tomé. The basin has an area of approximately 26.09 km^2 and an average slope 0,06 m/m. In the Água Grande district, the basin drains in an area occupied by precarious constructions in the peri-urban area of the capital and in the final stretch, by consolidated urban area. Upstream, the shade forest for cocoa and coffee represents the largest strip of land occupation. From its source (approx. 800 m altitude) in the Mé Zóchi district, to its mouth, the watercourse is about 13 km long. The rain intensity in the basin is 29,68 mm/h.

Pantufo Coastline

Água Selá 2: This watercourse is about 500 m long. The catchment area is approximately 0,31 km^2 and has an average slope of 0,01 m/m. The rain intensity is 90,82 mm/h. Almost the entire length of the catchment and the floodplain of the watercourse is occupied by precarious constructions in the peri-urban area of the city of São Tomé.

The basins in the project area are present in the figure below.



Figure 90 General Basins Map

Hydrological studies for Detailed Design referred that according to DNIT recommendations, the rational is the one to determine peak flood magnitudes for the design of road drainage structures.

Peak flows for a period of return of 25, 50 and 100 years are presented in the following table.

Catchments	Chainage	Discharge (m^3/s) TR25	Discharge (m^3/s) TR50	Discharge (m^3/s) TR100
02 Água Palito	0+448	17,19	19,39	21,88
03 Água Melo	1+335	28,68	32,25	36,49
04 Água Grande	4+790	43,45	49.02	55,29
05 Água Sela 2	07+312	5,49	6,20	6,99

Table 54 Peak flows calculated by the rational method

There are three main rivers in the project area that should be taking account for urban flooding and precipitation: Palito and Melo rivers in Lagarto bay and Água Grande river in Ana Chaves bay.

According to the vulnerability analysis, discussions with local representatives and information from MIRNA, it seems that urban flooding is not a critical issue. It has been concluded that, although some areas are getting wetter, the impact of intense precipitations events is small, mainly because such events are relatively short (< 1 hour) and storm water drains relatively fast.

Likewise, the vulnerability study made during the feasibility phase, a maximum daily rainfall for 1/10 yer event of 120 mm/d is used to obtain the design peak flow.

The conclusion of the vulnerability analysis is that the discharge capacity of the outlets (bridges and culverts) is not considered as bottle neck resulting in urban flooding, given that the outlets always have their full capacity and are not blocked. Proper attention to urban flooding will be given in the design of the the coastal protection to avoid consequences to the drainage capacity of the system.

10.2.3. MARINE ECOSYSTEM BIOLOGIC ENVIRONMENT

The study area is located in the Guinea Current Large Marine Ecosystem (GEM), which extends along the area occupied by the Guinea Current and the northern boundary of the Benguela Current.

The GEM is characterised by a water column that overlies the West African continental shelf and is fed by the seasonal upwelling of nutrient-rich water, particularly during the rainy season, as a result of offshore winds. This phenomenon sustains high phytoplankton productivity, which in turn provides a diverse marine ecosystem and associated fisheries.

The following subsections present the major biological groups that can reasonably be expected to occur in the project's area of influence. Many of these groups and species are widely distributed and cover areas close to the shores of the islands of STP. Migratory species occasionally approach the study area either in migration, resting or daily foraging.

10.2.3.1. Benthos, Coral Reefs, and Corals

The benthonic community consists of organisms living on the seabed, including those living on the seabed surface (*epibenthos*), and those living within the seabed sediments (*infauna*).

Benthic systems in coastal regions are thought to be strongly influenced by the intensity of resurgence (Pfannkuche et al., 1983), together with the rocky and sandy substrates, typical of these habitats.

The most diverse benthic systems in tropical regions are generally associated with the presence of hard substrates and coral reefs, which are biogenic submarine structures consisting of calcium carbonate, built by colonies of marine invertebrates and commonly present on continental shelves, slopes, banks, ridges and seamounts (Roberts at al 2006). These reefs play an important role in the balance of the marine ecosystem as they provide hard substrates for colonisation by other encrusting organisms, as well as shelter and refuge for a wide variety of invertebrates and fish (including commercially important species).

The corals have a limited scope of occurrence in the area directly affected and its surroundings. This fact may be related to the anthropic action resulting from the sewage discharges that are made in this area, as well as by the heavy existing maritime traffic due to the presence of the only commercial port in the country. The following figure shows some benthic organisms of the *Zoanthids* order, sighted in the area of influence of the project.



Figure 91 Example of different species of *zoanthids* found in Southern end of Lagarto bay

In addition to these organisms, it is common to find algae colonies formed mainly by *Fucus platycarpus* and *Porphyra Spp*.



Figure 92 Colony of *Porphyra Spp*. observed in the area indicated for the development.

With regard to decapods and other invertebrates that are part of the benthic fauna, it was possible to catalogue a total of 32 species during observations in the project area, with particular emphasis Crustaceans, Molluscs and Echinoderms (see the following table). Among the species of invertebrates catalogued in the project area, it is important to mention that none presents concerns in terms of their conservation status.

Scientific Names of Invertebrates Species	Common Names
Actinostella flosculifera	
Alpheus rugimanus	
Buccinum sp.	Spiral babylon
Cavernous guineensis	
Cerianthidae	
Cerianthus	
Crassostrea	
Dermopsamma cf. anchorata	
Euapta lappa	Beaded sea cucumber
Eucidaris tribuloides	
Eunicella Gracilis	
Geryon maritae	Red crab
Gnathophyllum americanum	Striped Bumblebee Shrimp

Scientific Names of Invertebrates Species	Common Names
Goniaster tessellatus	*Common sunfish*
Floridian Holothuria	*Florida sea cucumber*
Garay Holothuria	
Holothuria princeps	
Leptogorgia gaini	
Lysmata grabhami	Cleaner shrimp
Montastrea cavernosa guineensis	Great star coral
Nephrops sp.	Lobster
Octupus sp.	
Ophiothrix sp.	Brittle star
Oreaster clavatus	Sea star
Ostrea	Oyster
Pachycerianthus	
Paguroidea	Hermit crab
Palythoa caribaeorum	
Phoronis australis	White encrusting zoanthid
Bernardi Porites	
Sepia sp	Cuttlefish
Siderail	

Table 55 List of invertebrate species catalogued in the area indicated for the project during field observations.



Figure 93 Some invertebrate specimens were catalogued in the direct influence area during the expedition.

10.2.3.2. Fish

The Gulf of Guinea is considered a highly productive ecosystem and is therefore home to several pelagic and demersal fish species, particularly in discrete resurgence zones.

A total of 364 marine fish species are currently recorded in São Tomé and Príncipe waters (Fishbase, 2021). The main sources of information on fish species along the Project Area are the articles by Alfonso et al. (1999), Wirtz et al. (2007); Floeter et al. (2008), Carneiro (2011), using fish records based on fish caught, photographed or observed during diving or landing by local artisanal fishers and Vasco-Rodrigues et al. (2016). The study reports 244 confirmed coastal species representing a total of 67 families. The results suggest that the islands have a distinct fish community despite their proximity to the African coast.

Demersal fishes are normally distributed according to the location of their benthic food sources and shelter, whereas for pelagic fishes, their presence in the bays is related to nutrient availability.

DEMERSAL FISH

The shallow waters surrounding the STP islands are influenced by the diverse coastal habitats that provide spawning and nursery grounds for many fish species. On the continental shelf there is a considerable presence of demersal fish species, due to the shallow waters and the enrichment caused by organic sediments from rivers.

The demersal fish community of the Gulf of Guinea is structured by the depth of the water and the type of sediment on the seabed. Demersal species include the sand corvina (*Pseudotolithus senegalensis*), the longneck corvina *(P. typus*) and the African golden snapper (*Lutjanus fulgens*) (Heileman, 2009). These species, along with members of the bigeye family (*Priacanthidae*) and the sea bream family (*Sparidae*) are also targeted for commercial fishing.

The shallow water demersal fish community in STP is generally dominated by *Congridae, Serranidae, Carangidae, Gobiidae* and *Labridae*. In the slightly deeper waters up to 100 metres, sharks and rays, including the *Carcharhinidae* family, are common and are usually referred to as requiem sharks (tiger shark, *Carcharias taurus*; blue shark, *Prionace glauca*; bull shark, *Carcharhinus leucas*), reef sharks

(*Hemigaleidae*), and hammerhead sharks (*Sphyrna lewini*) (Ministry of Natural Resources and Environment, 2007).

Due to the characteristics, conditions and types of habitats of the Lagarto, Ana Chaves and Pantufo bays, together with the intense anthropic action they suffer, one migh infer that the area of influence of the project shows a very reduced source of demersal species.

This area stands as one of the least productive coastal zones of the country. This fact is justified by the high level of pollution that takes place there. However, through interviews with local fishermen and observations in the study area, it was possible to determine a total of 38 species of marine vertebrates such as *Tylosurus acus rafale, Caranx crysos, Cephalopholis taeniops, Dentex macrophtalmus, Decapterus punctatus, Decapteurus macarellus, Diodon hiystrix, Holocentrus adscensionis, Sargocentron hastatus, Scorpaena scrofa* and *Lutjanus goreensis*. During the interviews, the fishermen also reported the frequent occurrence of shoals of small pelagic fishes in the bays of the study area, such as *Hemiramphus balao, Cypselurus melanurus* and *Sardinella sp*.

Scientific Names of Ichthyofauna	Common Name
Acanthostracion notacanthus	Island cowfish
Acanthurus monroviae	Monrovia doctorfish
Apsilus fuscus	African forktail snapper
Auxis Thazard	Frigate tuna
Balistes puntactus	Bluespotted triggerfish
Bodianus pulchellus	Spotfin hogfish
Bodianus speciosus	Blackbar hogfish
Caranx crysos	Blue runner
Caranx hippos	Crevalle jack
Cephalopholis nigri	Niger hind
Cephalopholis taeniops	Bluespotted seabass
Chaetodon robustus	Three-banded butterflyfish
Filleycore nigricans	
Hemiramphus balao	Balao halfbeak
Holocentrus adscensionis	Squirrelfish
Lethrinus atlanticus	Atlantic emperor
Lutjanus agennes	African red snapper
Lutjanus fulgens	Golden African snapper
Lutjanus goreensis	Gorean snapper
Mulloidichtys martinicus	Yellow goatfish
Muraena melanotis	

Scientific Names of Ichthyofauna	Common Name
Myripristis jacobus	Blackbar soldierfish
Pagellus bellotti	Red pandora
Parakuhlia macrophthalmus	Dara
Paranthias furcifer	Creole-fish
Sargocentron hastatum	Red squirrelfish
Scorpaena scrofa	
Thalassoma newtoni	
Tylosurus acus rafale	
Sardinella sp.	Sardinella

Table 56 List of *ichthyofauna* species catalogued in the area indicated for the project during field observations.

PELAGIC FISH

Pelagic fish species can be found near the sea surface or in the water column in coastal and deep waters, but not on the sea floor where benthic and demersal species are present.

In general, pelagic fish are important fishery resources for local communities and commercial fishing fleets. Among these, the *Clupeidae* family constitutes the most commercially valuable pelagic resource in the coastal waters of the Gulf of Guinea, including herring (*Clupea harengus*), sardine (*Sardinella spp*.) and anchovy (*Engraulis encrasicolus*) (Carneiro, 2011).

Other common pelagic species present in São Tomé and Príncipe waters includes bonito (*Caranx crysos*), gobies (*Stigmatogobius*), flying fish *Cheilopogon spp*., salmonetes and members of the Carangidae family, such as mackerel (*Trachurus spp.),* and the Moreidae family (*Laemonema laureysi*).

Within the Guinea Current GEM large pelagic fish are common and commercially sought after, including pelagic tuna species such as skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), fire tuna (*T. obesus*), marlins (family Istiophoridae), marlin and sailfish, such as Atlantic sailfish (I*stiophorus albicans*) and Atlantic swordfish (*Xiphias gladius*) (Heileman, 2009). Firefin tuna and albacore are listed, respectively, as Vulnerable and "Near Threatened" on the IUCN Red List of threatened species (IUCN, 2012).

In the project area along Marginal discharges of wastewater exists from São Tomé city. Despite the intense pollution in the project area and its surroundings, it is frequent to sight shoals of some small pelagic fish such as the Frigate tuna (*Auxis thazard),* Balao halfbeak (*Hemiramphus balao*), Madeiran sardinella (*Sardinella sp.).*

10.2.3.3. Protected and/or Threatened Species

In the Gulf of Guinea, there are 26 species considered threatened according to the IUCN Red List of Endangered Species (IUCN, 2020). These are listed in the Table below.

In São Tomé and Príncipe, only seahorses (Hippocampus spp.) and other species of ornamental invertebrates are designated as protected by São Tomé legislation (Decree-Lei n.º 19/2020). Among fish species recorded for project area none presents concerns in terms of their conservation status.

Common Name	Scientific Name	Red List Category	Habitat
Cation	*Galeorhinus galeus*	CR	Neritic-Oceanic
Knitted Angel (angelote)	*Squatina oculata*	CR	Deep Neritic-Benthic
Hammerhead shark	*Sphyrna lewini*	CR	Neritic-Oceanic
Viola	*Rhynchobatus luebberti*	CR	Neritic
Whitetip Shark	*Carcharhinus longimanus*	CR	Neritic-Oceanic
Whale shark	*Rhincodon typus*	EN	Neritic-Oceanic
Black-bearded Viola	*Glaucostegus cemiculus*	EN	Neritic
Ray tairoga Skate, White	*Rostroraja alba*	EN	Neritic-Benthic
Corvina Cassava	*Pseudotolithus senegalensis*	EN	Neritic-Oceanic
Shark Ray (rabeca)	*Rhinobatos rhinobatos*	EN	Neritic
Margarita Ray	*Fontitrygon margarita*	EN	Neritic
Gobídeo	*Bathygobius burtoni*	EN	Intertidal
Anequin shark	*Isurus oxyrinchus*	EN	Ocean
Mere	*Epinephelus marginatus*	VU	Neritic
Pigfish	*Oxynotus centrina*	VU	Ocean
Fire-fired tuna	*Thunnus obesus*	VU	Neritic-Oceanic
Caneja	*Mustelus mustelus*	VU	Neritic-Benthic
Sardinela Madeira	*Sardinella maderensis*	VU	Neritic-Oceanic
Night shark	*Carcharhinus signatus*	VU	Ocean
Toiro shark	*Carcharias taurus*	VU	Neritic-Oceanic
Sweet mouth	*Carcharhinus plumbeus*	VU	Neritic
Butterfly ray	*Gymnura altavela*	VU	Neritic
Bearded mullet	*Pseudupeneus prayensis*	VU	Neritic
Rape-knitted	*Rhinobatos albomaculatus*	VU	Neritic
African seahorse	*Hippocampus algiricus*	VU	Neritic
Yellowfin tuna	*Thunnus albacares*	NT	Neritic-Oceanic

Table 57 Endangered fish in Gulf of Guinea Source: IUCN, 2020

10.2.3.4. Marine Mammals

The waters of the Gulf of Guinea and STP are considered a favourable habitat for marine mammals, especially due to the seasonal upwelling in the region, which increases productivity and ensures the availability of food for these species. Although recognized areas of occurrence of marine mammal species include the waters of the Gulf of Guinea and STP, there is limited knowledge about the distribution, population estimates and ecology of cetaceans in the region.

There are three orders of the class of Mammals that contain marine mammals: Cetaceans, Carnivores and Syrines:

- Infra-Order of Cetaceans (whales and dolphins), which can still be subdivided into odontocethos (whales with teeth and dolphins) and mystics (bearded whales);
- Infra-Order of Sirenians (manatees and dugongs). The sirenians are not present in STP waters and are not considered later in this report.
- Infra-Order of Carnivores: including the families Otaridae (sea lions and seals), Phoids (common seals) and Odobenidae walruses); none are present in STP waters and are not seen further in this report.

10.2.3.5. Cetaceans

The distribution and abundance of cetaceans remain little documented in the scientific literature on the Gulf of Guinea. Most of the data is based on opportunistic observations/sightings, on accidental catches and strandings, and data on species abundance in the Gulf of Guinea are particularly scarce (Weir, 2010). Most sightings in the Gulf of Guinea area tend to occur to the south, towards Angola, where the cold-water upsurge of the Benguela Stream provides richer feeding areas compared to the warm coastal waters further north of the Gulf.

The archipelago of São Tomé and Príncipe is considered an important area for cetaceans due to the high concentration of prey and the presence of small bays and shallow waters, which are used as "resting" places (Picanço et al., 2009).

According to data collected from comprehensive studies of marine mammals in the wider Gulf of Guinea area, up to 29 species of cetaceans may be present permanently or temporarily in STP waters: 22 species of toothed whales (Odontocethos) and seven species of fin whales (Mysticetids). Among these, there are eight species whose presence in STP waters is considered most likely (Weir, 2010); having also been confirmed by acoustic monitoring data in STP waters .(Kosmos/BP, 2019)

The complete list of cetacean species whose presence has been confirmed or potentially present, including their conservation status and main habitats, is presented in the following Table, with information collected from a seismic study conducted by Kosmos in the waters of São Tomé and Príncipe, from January to August 2017. (Kosmos/BP, 2019).

The 8 species most likely to be spotted in STP waters include: fin whale (Balaenoptera physalus), Bryde's whale (Balaenoptera edeni), humpback whale (Megaptera novaeangliae), sperm whale (Physeter macrocephalus), orca whale (Orcinus orca), short-finned pilot whale (Globicephala macrorhynchus), bottlenose dolphin (Tursiops truncatus) and the Atlantic spotted dolphin (Stenella attenuata). Recent passive acoustic monitoring data indicate that the most detected species on fixed and autonomous recorders correspond to odontocete / delphinid species (especially dolphins, pilot whales, orca whales and sperm whales) (Kowarski, 2018 and 2019; Pierpoint, 2019); as well as mysticetes such as the humpback whale.

In addition, 2017 records of cetacean observations from a seismic survey conducted along the offshore blocks of eastern STP also found that the most observed/discovered species of mystics was the humpback whale; while the most-noted odontocethos corresponded to the sperm whale and short-bell pilot whales;

along with several species of delphinids (mainly rough-toothed dolphins; Clymene, Striped, Pantropical and Roaz Dolphins).

Of these, the humpback whales *(Megaptera novaeangliae)* and the roaz dolphin (Tursiops *truncatus)* are the species whose presence near the area of influence of the Project is more common.

The following table shows the records of cetacean observations.

Common name	Scientific name	General occurrence	IUCN Red List	Home Habitat
Mysticeti (Baleen whales)				
Common Whale	*Balaenoptera physalus*	Cosmopolitan in its distribution and usually found south of 50 ° S during the summer, migrating north in West African waters during winter. Found in deeper West African waters in winter and spring.	Endangered	High seas
Bryde's Whale #	*Balaenoptera edeni*	It inhabits tropical waters and does not take on extensive migrations to feeding areas in cold waters of high latitudes. Seasonal migrations of the population on the high seas were observed from Angola in March, to the north in the vicinity of São Tomé during April, and Gabon during August to October. An individual was spotted during the 2017 seismic survey.	Insufficient data	Coastal and high seas
Humpback Whale	*Megaptera novaeangliae*	Humpback whales occur globally and migrate seasonally between breeding zones in the tropics/low latitude to feeding areas at high latitudes. From July to November humpback whales are found around the islands of São Tomé and Príncipe, mainly for breeding and childbirth. A total of 67 individuals were sighted during the 2017 seismic survey.	Less concern	Coastal (potentially high seas during migration)
Right Whale	*Eubalena australis*	It migrates between summer feeding areas at high latitudes and mating and breeding areas at low latitudes in winter. Records of sightings and captures in Gabon.	Less concern	Coastal and high seas
Blue Whale	*Balaenoptera musculus*	All over the world in polar, temperate and tropical waters. There are records in the Eastern Atlantic from antarctica to Angola and Gabon. Whale catch records in Angola and Gabon.	Endangered	High seas
Sardinheira Whale#	*Balaenoptera borealis*	In places of summer in low latitudes around the world. Usually found in deep water >1,000 m. Records of gabon whalers and sightings of Angola, although there are doubts as to the accuracy of the identification of the species.	Endangered	High seas
Antarctic Minke Whale	*Balaenoptera bonaerensis*	Dwarf whales are considered as gifts, but unusual, to the western waters of South Africa and Angola. It has been suggested that many sightings are inconclusive in the Gulf of Guinea. Beach records in Angola.	Insufficient data	Coastal and oceanic
Odontoceti (Whales with teeth)				

Common name	Scientific name	General occurrence	IUCN Red List	Home Habitat
Sperm whale #	*Physeter macrocephalus*	Sperm whale is found all over the world, but there is spatial segregation based on age and gender. Females and immature individuals occur in warm waters. The sperm whale population in West Africa is described as located between 20°O and 20°E.	Vulnerable	High seas
Orca	*Orcinus orca*	Orcas are the most widely distributed species of cetaceans worldwide, having been found in a variety of habitats; deep waters of the open sea in and around the oceanic islands, and seem to be found throughout the year.	Insufficient data	Coastal and oceanic
Short fin pilot whale #	*Globicephala macrorhynchus*	This species is known to inhabit warm waters around the world and is known to occur off the coast of Gabon. Sightings of Angola and São Tomé were made in deep water.	Insufficient data	High seas
Roaz dolphin #	*Tursiops truncatus*	The dolphin is found globally in tropical and temperate regions. This species is believed to inhabit coastal areas along the entire west coast of Africa.	Less concern	Coastal and oceanic
Pantropical-painted dolphin #	*Stenella attenuata*	Pantropical-painted dolphin inhabits tropical and subtropical waters around the world; however West African records are rare. Sightings of this species at sea are usually in deep water.	Less concern	High seas
Sperm Whale	*Kogia sima*	Nursery groups of females and immature animals occur in the Gulf of Guinea throughout the year. Childbirth can occur here during February and March. Usually found in deeper waters towards the sea in the breaking zone of the platform. Sightings in Angola, peaking between January and May. The only capture was made in Ghana.	Insufficient data	Ocean
Cuvier beaked whale	*Ziphius cavirostris*	Wide distribution in tropical deep waters and temperate cold waters. A single sighting has been recorded in the Sea of Angola.	Less concern	Ocean
False orcas #	*Pseudorca crassidens*	It inhabits tropical and temperate waters, but West African records are scarce. Sighted in Angola in deep waters > 1,400 m. Beach records in Côte d'Ivoire and Gabon, a single capture in Ghana and sightings in Gabon.	Insufficient data	Coastal and oceanic
Melon-headed Whale #	*Peponocephala electra*	They inhabit deep, warm waters all over the world. A unique log of occasional capture in Ghana and individual sightings recorded in Gabon and Angola.	Less concern	Ocean

Common name	Scientific name	General occurrence	IUCN Red List	Home Habitat
Rough-toothed Dolphin #	*Steno bredanensis*	They inhabit warm seas around the world, including the west coast of Africa. Mainly found in the waters of the edge of the platform and deep ocean waters along with roaz dolphins off Gabon, and with pilot whales off Angola and Gabon. Sightings in Ghana, Gabon, Angola and St Helena and catches in Côte d'Ivoire and Ghana.	Less concern	Ocean
Twilight Dolphin	*Lagenorhynchus obscurus*	They inhabit cold < 18ºC and are therefore found near the cold waters of the Benguela Current further south (southern Angola, South Africa and Namibia). Only two individuals were sighted in southern Angola.	Insufficient data	Cold coastal waters
Risso Dolphin #	*Grampus griseus*	In tropical and temperate seas around the world, predominantly in the outer oceanic region on the edge of the platform. It is thought to be present all year round, at least off Angola. Records of sightings in Côte d'Ivoire, Gabon and Angola, and catches in Ghana.	Less concern	Coastal and oceanic
Painted Atlantic Dolphin	*Stenella frontalis*	Endemic species of tropical and temperate waters of the Atlantic Ocean, but the distribution in West Africa is little known. Sightings in Benin and capture records in Côte d'Ivoire, Ghana and St Helena (unconfirmed).	Insufficient data	Coastal and oceanic
Spinner Dolphin	*Stenella longirostris*	Warm tropical and temperate waters from around the world, but distribution in West Africa is little known. Of the 3 known records for the Gulf of Guinea, all were at water depths >3,500 m. Sightings in Ghana and Angola, capture records in Côte d'Ivoire and Ghana.	Insufficient data	Ocean
Clymene Dolphin #	*Stenella clymene*	Endemic species of tropical and subtropical deep waters of the Atlantic Ocean. Considered the most abundant cetacean off Ghana from accidental by-catch records.	Insufficient data	Ocean
Scratched Dolphin #	*Stenella coeruleoalba*	It inhabits warm temperate and tropical waters around the world. Published records of their presence in West Africa are scarce. Beaching in Côte d'Ivoire and sightings in Angola at water depths of 1,500 m to 2,400 m.	Less concern	Ocean
Short-billed Common Dolphin	*Delphinus Delphis*	They occur throughout the tropical Atlantic. Regarded as one of the most common high seas dolphins in West Africa. They occur on the platform, on the edge of the platform and in the ocean deep waters. Registration of stranding and catches in Côte d'Ivoire, Gabon and Angola.	Less concern	Coastal and oceanic

Common name	Scientific name	General occurrence	IUCN Red List	Home Habitat
Long-billed Common Dolphin	*Delphinus capensis*	They occur throughout the tropical Atlantic. Considered as one of the most common dolphins in the high seas of West Africa. They occur on the platform, at the edge of the platform and in the deep ocean waters. Logs of stranding and captures in Côte d'Ivoire, Gabon and Angola.	Less concern	Costeira (plataforma continental)
Fraser Dolphin	*Lagenodephis hosei*	They inhabit deep, tropical and subtropical oceans around the world, at water depths > 1,000 m, but their presence in the Gulf of Guinea has only been recently recognized. It is thought that they may occur throughout the year, but the data are insufficient to confirm this hypothesis. Beach records in Angola and Nigeria (unconfirmed).	Less concern	Ocean
Heaviside Dolphin	*Cephalorhynchus heavisidii*	An endemic species off the west coast of South Africa and Namibia, where it inhabits in waters of the platform with temperatures >15ºC. Observation and capture log only in Angola.	Insufficient data	Cold coastal waters

Note: Common names in bold refer to cetacean species whose presence in STP waters is considered more likely.

Indicates species that were recorded by Marine Mammal Observers as part of a seismic survey conducted by Kosmos in São Tomé and Príncipe waters in the period January to August 2017.

Table 58 Cetaceans species. Source: Weir, 2010; RPS, 2017; IUCN, 2021.

10.2.3.6. Sea Turtles

The Archipelago of São Tomé and Príncipe is a breeding ground for four of the world's seven known species of sea turtles. With all species coming ashore on the archipelago's beaches between July and April each year, the green (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) turtles are all listed on the IUCN Red List of Threatened Species. A fifth species is also sporadically found at sea, the loggerhead turtle (*Caretta caretta*).

Four of the sea turtle species (the exception being the loggerhead turtle) are fully protected and included in the Memorandum of Understanding on measures for the conservation of sea turtles on the Atlantic Coast of Africa. All five species are listed in Appendix I of CITES and Appendix I of the Convention on Migratory Species (CMS Convention). In São Tomé and Príncipe, Decree-Law No. 6/2014 and Regional Decree No. 3 establish the protection framework for sea turtle species, including the prohibition of their capture and commercialization. All species, with the exception of two, that are considered Endangered (*Chelonia mydas*) and Critically Endangered (*Eretmochelys imbricata*.

In West and Central Africa (including STP), sea turtles have been victims of direct exploitation for centuries, and even today remain vulnerable to incidental capture by industrial fishing fleets (Billes et al., 2006). Females are sought after for their meat, eggs, and shells are used in the local craft industry. In some areas of Africa, traditional fishing of sea turtles still persists (Billes et al., 2006). Other threats to the population include severe habitat changes (in particular development on nesting beaches) and fishing, floating plastics and pollution, where the emerging threat of hydrocarbon pollution along the West African coast is included (Billes et al., 2006; Tomas et al., 2010).

Most sea turtle species lay multiple clutches of eggs in a nesting season and remain in the vicinity of nesting beaches for several weeks, this is called the inter-nesting period. However, there can be considerable variability in inter-nesting movements between species on different nesting beaches and within the same nesting population (Godley et al., 2008). Data on inter-nesting periods and areas in STP are largely unknown.

Data on inter-nesting periods and areas in STP are largely unknown.

In terms of the study area, some stretches of the shore have conditions for the occurrence of sea turtle nesting species.

In an interview with Programa Tatô, the NGO responsible for the conservation of sea turtles in São Tomé island, it was reported that four species of sea turtles were observed in the study area: (*Chelonia myda* – Green Turtle; *Lepidochelys olivacea* – Olive ridley *Eretmochelys imbricata* – Hawksbill e *Dermochelys coriacea* – Leatherback). All of them use the beaches in the area of study for nesting. The graph below shows the nesting frequency on the sea turtle nesting beaches located in the direct influence area in the last 5 years.

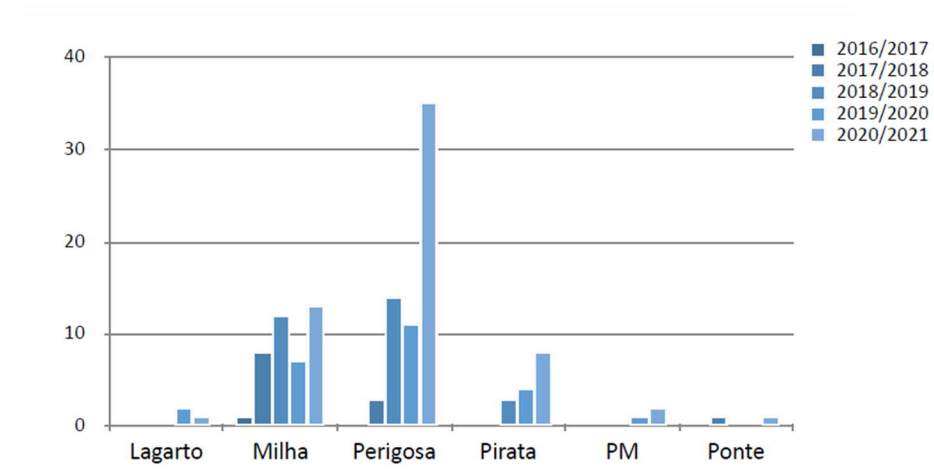


Figure 94 Nesting records of *Chelonia mydas*; *Lepidochelys olivacea*; *Eretmochelys imbricata* and *Dermochelys coriacea* in the area of direct influence from 2016 to 2021. Source Programa Tatô, 2021

The high incidence of human activities on the beaches, and the strong presence of dogs on them, increase the disturbance of nesting females and the level of nests predation by the dogs. To mitigate those impacts, Environmental authority and Programa Tatô monitors these areas frequently and all nests laid on those beaches, considered to be at risk due to poaching, predation or beach erosion, are immediately collected and relocated to the closest sea turtle hatchery located at Micoló.

The map below shows the location of these beaches in the Area of Direct Influence.



Figure 95 The beaches with the occurrence of the nest in the project area

Further data regarding the existing turtle population in São Tomé and Príncipe as well as and a more detailed analysis on the effect of the Project on these animals, can be found in the Annex 8 – Sea Turtles.

The high incidence of human activities on these beaches, and the strong presence of dogs on them, increase the rate of predation of turtle eggs in the nests. So, Programa Tatô monitors these areas frequently and whenever they record occurrences of the nest, the eggs are immediately collected and taken to the hatchery of the turtle breeding center located at Praia de Micoló. The map below shows the location of this beach.



Figure 96 Location of the Praia de Micoló

10.2.3.6.1. Hawksbill Sea Turtles (*Eretmochelys imbricata*)

STP is considered an important nesting site for hawksbill sea turtles, although this species has also been recorded as a nesting along the coast of Central Africa, with its southern boundary being the Congo (Billes et al., 2006). The largest populations of hawksbill turtles are thought to nest on the STP islands, as well as an important year-round population of juveniles, sub-adults and adult male foragers (Monzón-Argüello et al., 2011). In particular, it has been assessed that, on average, 152 comb turtle nests are installed per year on the beaches of STP, with a particular focus on the eastern side of the islands (Girard et al., 2016). Adult females are only considered to be present in this aggregate during the breeding season (November to February) (Monzón-Argüello et al., 2011).

10.2.3.6.2. Green Turtle (*Chelonia mydas*)

Green turtles are considered widespread in West Africa and their breeding grounds range from Mauritania to Angola (Fretey, 2001; Billes et al., 2006). According to Girard et al. (2016) the beaches of São Tomé and Príncipe constitute the most relevant nursery for green turtles, representing an average estimate of 649 nests per year; however, this species has also been recorded along all Central African coasts (Billes et al., 2006).

Hancock et al. (2019) studied the inter-nesting behaviour of Green Turtles in STP having determined an average inter-nesting period of 12.3 days, similar to other observations of this type of behaviour in the Atlantic, Indian and Pacific. Additionally, it was found that on São Tomé Island, Green Turtles nest mainly in (1) Jalé, (2) Cabana and (3) Planta (SafariNews, 2019).

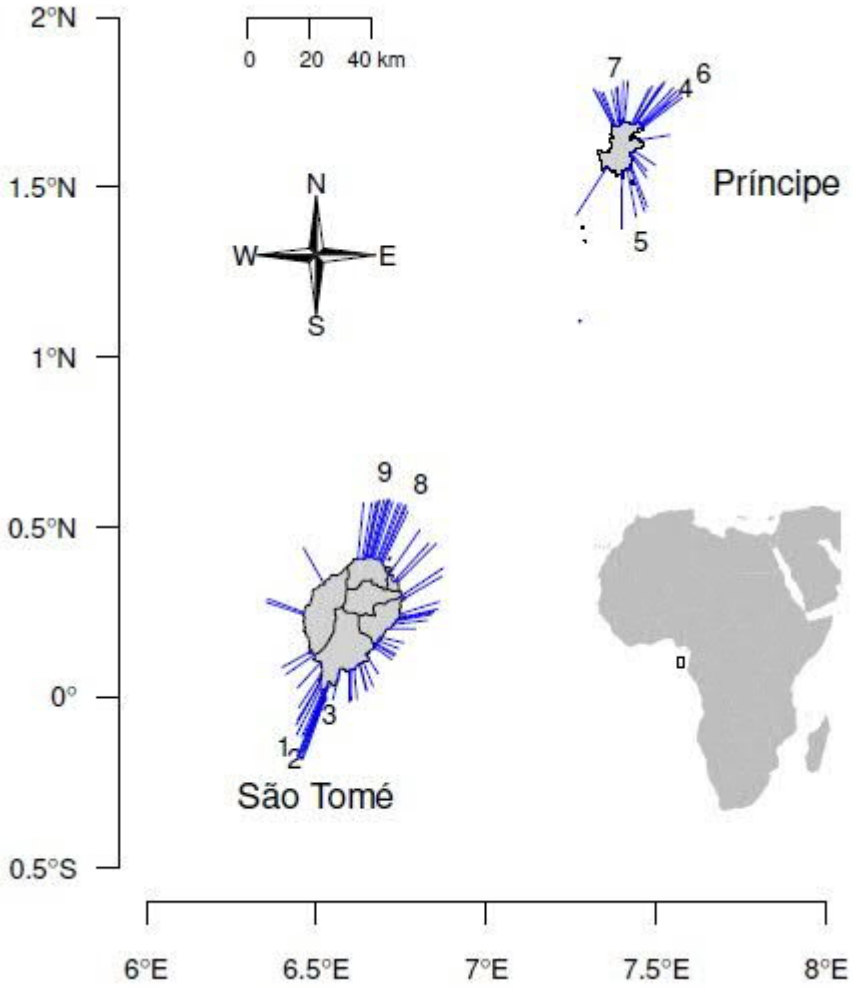


Figure 97 Beaches used by Green Turtles and Olive Ridley Turtles in STP for nesting. Source: Hancock et al., 2019

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Joana Hancock research for the period 2016/2017 refers to beaches used by Green Turtles and Olive Ridley Turtles for nesting and includes the intervention, despite being very few compared to other beaches in São Tomé Island (maximum up to 9 activities/season). Due to human presence on beaches near São Tomé city, this situation is not confirmed in the present and could occur occasionally.

10.2.3.6.3. Loggerhead Turtle (*Caretta caretta*)

Loggerhead turtles are predominantly found in the northern part of the Gulf of Guinea region and only appear sporadically south of the Cape Verde Islands. Loggerhead turtle mating has been observed in São Tomé waters and incidental capture has also been reported on several occasions (Billes et al., 2006). Fishermen describe the loggerhead turtle as "rare" and are not of the opinion that it nests in São Tomé (Graff, 1996). Juveniles of this species have also been observed in STP waters and in Gabon, Cameroon and Congo (Fretey, 2001). However, according to the Sea Turtle Conservancy (2015), the loggerhead turtle does not nest on equatorial beaches, preferring more subtropical and temperate regions for its reproductive stages.

10.2.3.6.4. Leatherback turtle (*Dermochelys coriacea*)

The leatherback turtle is the least abundant species in São Tomé and Príncipe. Leatherback turtles are considered widespread in West Africa and their breeding grounds range from Mauritania to Angola (Fretey,

2001; Billes et al., 2006). The island of Bioko is considered the second most important nesting area after Gabon for leatherback turtles (Tomas et al., 2010). In most leatherback turtle populations, females cover extensive areas between nesting events, although they usually remain within the continental shelf (Georges et al., 2007). Furthermore, Eckert (2006) having studied the movements and behaviour of female leatherback sea turtles up to one year after leaving their nesting beaches, determined that female leatherback turtles spend most of their time directly on nesting beaches and up to 30 km offshore during the inter-nesting period. During the 2017/2018 nesting season only 8 leatherback turtle nests were observed in Príncipe (SafariNews, 2019).

10.2.3.6.5. Olive Ridley Turtle (Lepidochelys olivacea)

Ridley's olive ridley turtles nest in virtually all countries along the west coast of Africa from Guinea-Bissau to Angola (Billes et al., 2006). The olive ridley turtle is the second most numerous species on São Tomé Island, although its distribution is less wide than that of the green turtle; furthermore, it has been observed that this species only nests on São Tomé and does not do so on Príncipe Island (Hancock et al. 2019).

According to the 4th National Biodiversity Report (2009), Lepidochelys olivacea (Olive Ridley Turtle) is the rarest of the turtle species. In São Tomé, the fishermen know it as the "lazy turtle" because they are easily caught when they go to the beach to lay their eggs. For this reason, the protection of this species is a priority for the conservation of natural resources in the archipelago. A study conducted by Carvalho (2008) for the NGO MARAPA, reported that the local population captures this species of turtle due to the scarcity of other types of meat food resources.

Dawson (2017) monitored the inter-nesting movements of 21 olive ridley sea turtles from Pongara National Park, one of the largest nesting beaches in Gabon, over three nesting seasons (2012, 2013 and 2015). Telemetry tracks indicated that tagged females remained in close proximity to the nesting beach (<20 km), and spent most of their time within the Komo estuary; with some of the females have remained in the area for over a month before switching to the transit phase and moving south, likely to known foraging areas off the coast of Angola. Similar results were obtained by Maxwell et al. (2011).

Hancock et al. (2015) indicated that for Ridley's Olive Ridley Turtle the nesting season generally begins in August and extends into February each year, with a peak in December and January.

Additional information on the last five turtle species, with their IUCN Red List population status, as well as their protected status under São Tomé and Príncipe legislation, is summarized in the following Table:

Common name	Scientific name	IUCN Red List Statute	Protection Status in STP	Distribution & Habitat; Reproductive ecology	Diet Plan
Comb turtle	*Eretmochelys imbricata*	Critically Endangered	Critically Endangered	In tropical seas in general, near coastal reefs, bays, estuaries and lagoons. They nest on sandy beaches.	Mainly sponges and other reef dwellers
Green Turtle	*Chelonia mydas*	Endangered	Endangered	Common subtropical species around oceanic islands. Oceanic islands and coastal areas with white sand beaches	Herbivores grazing feeding on seagrass and algae
Loggerhead Turtle	*Caretta caretta*	Vulnerable	Vulnerable	They occupy all ecosystems during their lives: beaches and coastal areas (adults), ocean area/open sea as juveniles.	Carnivorous species that feed mainly on molluscs, crabs, sea urhogs and jellyfish
Leather Backturtle	*Dermochelys coriacea*	Vulnerable	Vulnerable	Oceanic, deep diving sea turtle that inhabits tropical, subtropical and subpolar seas. Leather backturtles make extensive migrations between different feeding areas in different seasons, to and from nesting areas. There are no records of leatherback turtles feeding in the coastal waters of São Tomé and Príncipe; however, Eckert (2002) had identified São Tomé and Príncipe as a forage area for juveniles of this species	They feed predominantly on jellyfish, salpas and syphonophores
Olive Turtle of Ridley	*Olive lepidochelys*	Vulnerable	Vulnerable	Widely present in tropical and subtropical regions, especially in shallow waters with muddy bottom, rich in debris and with low salinity content. It especially prefers nesting beaches supported by mangrove vegetation.	Opportunistic generalist, feeding on fish, gastropods, shrimps, oysters and algae.

Table 59 Sea turtles potentially present on São Tomé coast

10.2.3.6.6. SEA TURTLES NESTING SEASON

Nesting seasons of sea turtle species in Sao Tomé depends on sea turtle specie. Following chart summarizes nesting seasons and sea turtle specialist reference.

Scientific name	IUCN Statute	January	February	March	April	May	June	July	August	September	October	November	December	References
Chelonia mydas	E	■	▒	▒	▒	▒		▒	▒	▒	▒	▒	■	July to May, with a nesting peak in December and January (Ferreira-Airaud et al. 2022).
Eretmochelys imbricata	CE	■	▒									▒	■	November to February (Monzón-Argüello et al., 2011).
		■	▒	▒	▒				▒	▒	▒	▒	■	From August to April, with a nesting peak in December and January. (Ferreira-Airaud et al. 2022
		■											■	Nesting peak occurs in December and January. (Hancock, et al. 2015)
Dermochelys coriacea	*Vu*	▒	▒	▒						▒	▒	▒	■	September to March, with a nesting peak in December. (Hancock et al 2015)
Lepidochelys olivacea	Vu	▒	▒	▒	▒	▒		▒	▒	▒	▒	■	■	Nests year-round (except June) with a nesting peak in November and December (Ferreira-Airaud et al. 2022).
		▒	▒						▒	▒	▒	▒	■	Begins in August and extends into February each year, with a peak in December and January. (Hancock et al. (2015)
Caretta caretta	Vu													No evidences that this species has ever nested frequently in São Tomé and Príncipe (Fretey 2001).

Table 60 Sea turtles Nesting seasons

For environmental protection measures to nesting behaviour of sea turtles and for Project implementation viability a 7 months Sea turtle nesting protection period, from October to April, has been assumed in this report. This period includes the identified peak months (December and January) and gives a buffer of 2 pre-peak months and 3 three post-peak months.

This Sea turtle nesting protection period should be considered for Project work plan and implementation, considered that Project´s action that can disturb or impact on sea turtle females trying to or nesting in Project beach areas shall be avoided.

Further data regarding the existing turtle population in São Tomé and Príncipe as well as and a more detailed analysis on the effect of the Project on these animals, can be found in the Annex 8 – Sea Turtles.

10.2.3.6.7. EIB's Standard 3: "Biodiversity and Ecosystems"

Ecologically appropriate area of analysis (EAAA)

The identified project area of influence includes:

- Areas physically occupied by infrastructure and project facilities and where project activities will be carried out, including facilities directly connected with or necessary to support the project,
- Areas that may be affected by emissions and effluents,
- Areas occupied or affected by associated facilities.
- The physical footprint of non-project activities in the surrounding area that are caused by or stimulated by the project ("induced growth"), plus any areas affected by their emissions and effluents.
- Tourism activities, recreational activities.

In accordance with Standard 3 of EIB, EAAA has been defined particularly for Sea turtle species and for project area.

The Project can impact not on the ecosystem or habitat where sea turtles forage, breed or even live, while being marine animals, but particularly where these species lay their eggs; the coast and terrestrial stretch of coast sand deposits: the sandy beaches.

Project area of influence is therefore the beach, the terrestrial stretch next to the coastline and the tidal interval of the coastline from airport at the starting point until Pantufo coastline at the end of the project.

Critical Habitat Determination and population of a critically endangered, endangered or vulnerable species

The following table summarized the applicable criterions under Critical Habitat Determination and population of a critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of EIB Standard 3 and EIB Guidance Note for Environmental and Social Standard 3 on Biodiversity and Ecosystems.

Criterions, Standard 3 Biodiversity and Ecosystems	Applicable to the Project Assessment
Criterion 1: Highly threatened or unique ecosystems.	No
Criterion 2: Population of critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of threatened species and in relevant legislation.	Yes
Criterion 3: Population range or distribution of endemic or restricted-range species, or highly distinctive assemblages of species.	No
Criterion 4: Habitat required for the survival of migratory species and/or congregatory species.	Yes
Criterion 5: Biodiversity and/or ecosystem with significant social, economic, or cultural importance to local communities and indigenous groups.	No
Criterion 6: Habitat of key scientific value and/or associated with key evolutionary processes.	No

Table 61 Criteria Standards Biodiversity and Ecosystems

- Criterion 1 has been considered not applicable since Lagarto Bay beach or any other beach sections along São Tomé city can´t be considered so.
- For criterion 3 it has been considered not applicable since sea turtles are not considered endemic or restricted species.
- Criterion 5 and 6 are directly not applicable since this is not the case for the project.

Population of sea turtles estimated on Project area of Intervention

Besides the low numbers of nests and its occasionally occurrence within the EAAA and although these are not the main nesting areas in the island its occurrence should not be neglected.

The data exposed in the above chapters regarding turtle population and trends, in a conservative way, are used for assessment in the sections below.

Criterion 2. Population of critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of threatened species and in relevant legislation.
Areas will be considered critical habitat under Criterion 2 if they are occupied by or are needed to support:

a) A population of an IUCN Red-listed endangered or critically endangered species that is > 0.5% of the global population and/or > 5 established reproductive units of an endangered or critically endangered species;

Endangered or critically species in project area is <0.5% of the global population.

Endangered (*Chelonia mydas*) - 1 reproductive unit (about 6 nets by year in project area, each female lays about 5 nests, which is equivalent to 1 female per year)

Critically endangered (*Eretmochelys imbricata*) - 3 reproductive units (about 11 nests by year in project area, each female lays about 4 nests, which is equivalent to 3 maximum females per year**).**

Project does not meet the above criterion 2a.

b) Significant concentration of an IUCN Red-listed vulnerable species or of multiple IUCN Red-listed vulnerable species, especially where the loss of the area would result in the change of the IUCN Red List status to endangered or critically endangered.

Dermochelys coriacea - 1 reproductive unit in project area and *Lepidochelys olivacea* – 13 reproductive units in project area.
Project does not meet the above criterion 2b.

c) Nationally or regionally-important concentration of a species listed as endangered or critically endangered on a regional/national IUCN Red List, or equivalent on national/regional listing.

Applicable endangered *Chelonia mydas* - Green or a critically endangered *Eretmochelys imbricata* - Hawksbill are regionally important.

The EAA does not hold important concentration of turtle species, being the “population size” or nests per year for E and CE species at a minor figure of the total for the STP.

Project does not meet the above criterion 2c.

d) A population of species listed in Annex II and IV of the Habitats Directive.

Criterion 2d has been considered not applicable since geographic distribution of these species does not match with geographical range of application of EU Habitats directive.

Based on the population size and its estimation for the four sea turtles, Project area does not meet any of the above criterion.

Criterion 4: Habitat required for the survival of migratory species and/or congregatory species.
Areas will be considered as critical habitats under Criterion 4 if:

a) They sustain ≥ 1%of the global population of a migratory or congregatory species at any point of the species' lifecycle on a cyclical or otherwise regular basis.

b) They are needed to support migratory or congregatory species during periods of environmental stress.

Based on the population size and its estimation for the four sea turtles, Project area does not meet any of the above criterion.

Caretta caretta is not assessed since only sporadic observations are made. Only two nests were recorded, in 2017 Praia Inhame and 2021 Praia Marcação.

The following Table summarizes the assessment of whether the identified habitats trigger criteria 2 and 4 or not. An assessment has been carried out for Critically Endangered (CR), Endangered (EN) and Vulnerable species (VU).

Criterions	Critical Habitat for Project Area summary table for species Trigger Criterion Yes/ No			
	Chelonia mydas (EN)	*Eretmochelys imbricata (CE)*	*Dermochelys coriacea (VU)*	*Lepidochelys olivacea (VU)*
Criterion 2				
a) A population of an IUCN Red-listed endangered or critically endangered species that is > 0.5% of the global population and/or > 5 established reproductive units of an endangered or critically endangered species;	No	No	No	No
b) Significant concentration of an IUCN Red-listed vulnerable species or of multiple IUCN Red-listed vulnerable species, especially where the loss of the area would result in the change of the IUCN Red List status to endangered or critically endangered.	No	No	No	No
c) Nationally or regionally-important concentration of a species listed as endangered or critically endangered on a regional/national IUCN Red List, or equivalent on national/regional listing.	No	No	No	No
d) Population of species listed in Annex II and IV of the Habitats Directive.	NA	NA	NA	NA
Criterion 4				
a) They sustain ≥ 1%of the global population of a migratory or congregatory species at any point of the species' lifecycle on a cyclical or otherwise regular basis.	No	No	No	No

Criterions	Critical Habitat for Project Area summary table for species Trigger Criterion Yes/ No			
	Chelonia mydas (EN)	*Eretmochelys imbricata (CE)*	*Dermochelys coriacea (VU)*	*Lepidochelys olivacea (VU)*
b) They are needed to support migratory or congregatory species during periods of environmental stress	No	No	No	No

Table 62 Critical Habitat for Project Area

Net gain and no net loss

No Net Loss: The Project will not directly affect turtles population, coastal protection component, a critical component of the project, could affect the high subsection of some sandy beaches during construction of rock revetment since that type of coastal protection is needed as adaptive measures against climate change for the marginal road of São Tomé city. We can consider that the project will not means a loss of critical or natural habitat and therefore meets the No Net Loss definition.

Net gain: Additionally, beach nourishment will improve the current conditions of Lagarto bay beach and a section of Ana Chaves Bay coastline, both currently under high erosion pressure. Beach nourishment can improve beach conditions for turtle nesting since gives a large surface and volume of sand nesting resources for sea turtles, therefore increase the suitable coastline for sea turtle nesting not only within the EAAA but for the north-east shoreline of São Tomé island That can be considered as a Net gain for sea turtles critical or natural habitat.

Further details on this analysis can be found in Annex 8 – Sea Turtles.

10.2.4. TERRESTRIAL ECOSYSTEMS

The geostrategic location of the São Tomé and Príncipe archipelago, combined with the isolation of the African coast, gave the islands a favourable scenario for the existence of very rich and distinct biodiversity (Vaz & Oliveira, 2007). The climate and the type of existing reliefs are the main factors for the existence of this great biological diversity. Due to these facts, São Tomé and Príncipe is classified as the country with one of the highest levels of endemism in the world (Government of the Democratic Republic of São Tomé and Príncipe, 2009), with taxa such as birds, amphibians, plants superiors, bats, reptiles, butterflies and molluscs distributed in different habitats and ecosystems that have greater representation in the conspicuous biodiversity present on the islands (Vaz & Oliveira, 2007).

This rich and peculiar biodiversity, both of habitats and of native and endemic species of the islands, has led to the recognition of its international importance for conservation, and the classification by Bird Life International as EBA (Endemic Bird Area), as one of the 200 most important IBA's (Important Bird Area) in the world, and by the WWF as one of the 200 most important ecoregions in terms of biodiversity, is also recognized as one of the 10 most important "hotspots" on the planet (Vaz & Oliveira, 2007).

The richness of biodiversity also determined the recognition of the national primary forests as the second in terms of conservation priority in Africa (WorldBank 1993 cited by Vaz & Oliveira, 2007). In addition to constituting habitats for various endemic species, they are also the source of the main rivers that supply the country's large urban centers (Government of the Democratic Republic of São Tomé and Príncipe, 2009). The importance of national forest areas transcends the conservationist aspects, assuming the

forest as a preponderant fact for the galvanization of the national economy, especially in the domain of agriculture.

The introduction of cocoa and coffee cultivation in the mid-19th century, on the two main islands of the archipelago, caused major changes and widespread destruction of the low-altitude primary forests that until then predominated in the archipelago. However, many endemic species have adapted to the rainforest found in plantations.

From 1930s onwards, many plantations began to be abandoned and, a situation that worsened with national independence, there was a process of extensive regeneration of low-altitude humid forests, to the point of secondary forest, known locally as capoeira, to be a recognized vegetation type.

Many of these species have internationally threatened species status. Taxa such as Amphibians, Angiosperms, Birds and Invertebrates have a large number of representatives on the IUCN Red List 2019. Particular attention falls on Testudines where all species that frequent São Tomé and Príncipe habitats are on this list.

In São Tomé and Príncipe, the environmental legislation in force has allowed for the creation of two main conservation units at the national level: Obô Natural Park - PNOST on the island of São Tomé and Príncipe Natural Park - PNP on the island of Príncipe.

PNOST, created in 2006, has most of its extension coinciding with the Obô Primary Humid Forest. This is made up of woody formations with flowers, brambles, bushes and thickets, occupying an area of approximately 25,000 ha. PNOST is currently uninhabited and has no permanent human settlements, as its relief and high rainfall make access difficult and promote the unsuitability of the soils for agricultural activities in general. These are the factors that, in general, have ensured the absence of major negative impacts by human action, although the management of these spaces has become urgent, given the increase of depletive activities of its natural heritage, such as unordered hunting, extraction of aggregate from beaches, planting of palm trees and, above all, the disorderly and illegal felling of trees (PNOST Management Plan, 2005).

Much of the park area is located in the heart of São Tomé Island. However, a fraction of it is located in the northern part of the island of São Tomé and is approximately 11 km away from the study area.

The exuberant vegetation cover of São Tomé and Príncipe, typical of tropical areas, aggregates an enormous biological diversity to a high number of endemic species to some of the representative ecosystems of the Afrotropical equatorial zone. The southern and central part of the island of São Tomé is made up of hills with a more jagged orography, an accentuated slope near the coast and a small mountainous massif where we find Pico Cão Grande, which rises to a height of 663m. It has several islets and rocks, of which the Rolas islet, located on the south coast, stands out.

The Island is part of the biodiversity hotspot of the West African tropical forests. As an oceanic island, the autochthonous biological wealth of São Tomé and Príncipe is accentuated by its geographic isolation, containing several endemic flora species and subspecies. The available information points out that, in all Archipelago of São Tomé and Príncipe there are a number of species of flora of the order of 1.260, of which about 148 are endemic to this territory.

Regarding terrestrial fauna, the level of endemism is considered very high for all groups of vertebrates and also for the groups of invertebrates that have more information. In general, and with the exception of birds, São Tomé and Príncipe is relatively little endowed in terms of the absolute number of autochthonous species. This fact results from the geographical isolation of the São Tomé and Príncipe islands and the long separation from the African continental coast. However, these characteristics of the islands seen from a conservation perspective constitute an added challenge for the country's authorities and all other agents interested in the country's natural heritage.

10.2.4.1. Mammals

This taxon is composed of 11 autochthonous species of terrestrial mammals, 6 introduced species and 8 domestic species, being one of the best known and common species, the primate *Cercopithecus mona* with stable populations and distributed throughout the country (MNRE, 2007).

The autochthonous terrestrial mammal fauna of the island of São Tomé consists mainly of bat and shrew species. The PNOST territory is also home to populations of an endemic species of the shrew *Crocidurathomensis* and ten species of bats, namely: the fruit bats *Eidolonhelvum*, *Myonycterisbrachycephala* and *Rousettusaegyptiacus* and the insectivorous bats *Chaerephon newpumila, Miniphornis, M*. It is also important to mention that the mammals of São Tomé are constituted by stable populations of species, either native or introduced (MNRE, 2007).

Regarding the terrestrial mammals, it is possible to verify in the project's areas of influence only 4 species of mammals: *Canis lupus familiaris, Capra aegagrus hircus* and *Felis silvestris catus* and the bat *Hipposideros commersoni*, of which only *Hipposideros commerso*ni is a wild species.

10.2.4.2. Birds

The Class of Birds represents the most abundant vertebrate group in the archipelago. The combination of great richness of avifauna species and endemism resulted in the inclusion of the islands of São Tomé and Príncipe as a priority for the conservation of birds in Africa. Clement, 2016 (Check list of the birds of São Tomé & Príncipe) attributes to São Tomé and Príncipe a total of 163 bird species (including wandering species), with an endemism of 25 species.

On the island of São Tomé, the bird species register is 127 species, with endemism amounting to 18 species, three of which are shared with Príncipe island (see http://avibase.bsc-eoc.org/checklist.jsp) 2019.

Of these, 127 species referred to the island of São Tomé, nine are classified as threatened, with three being classified as critically endangered: *Bostrychiabocagei, Laniusnewtoni* and *Crithagra concolor*. In addition to these, another ten species are classified as near threatened. In the expeditions carried out in Morro Carregado and its surroundings, it was possible to catalogue a group of avifauna species, especially those adapted to areas under strong human interference.

In the area of the project, birds are represented with a total of 9 species: *Prinia molleri, Streptopelia senegalensis, Ploceus velatus peixotoi, Serinus mozambicus, Vidua macroura, Lonchura c. cuculata, Uraeginthus angolensis, Milus migrans and Quelea eryrthrops*. All species sighted in the study area are wild species that easily adapt to urban areas. Within the species that occur in the project area, two are endemic species exclusive of the São Tomé island: *Prinia molleri and Ploceus velatus peixotoi.*

Among the species of bird fund in the project area, some of them are present concern about its conservation status: *Prinia molleri* (LC - low concern), *Ploceus velatus peixotoi* (LC - low concern), *Uraeginthus angolensis* (LC - low concern) and *Serinus mozambicus* (LC - low concern).

Important Bird and Biodiversity Areas (IBAs)

The Important Bird and Biodiversity Areas (IBAs) programme is a global initiative to identify and protect areas that are of particular importance for bird species globally. These sites are designated by BirdLife International and are often already part of a network of protected areas. In order to be selected as an IBA, sites must meet one (or more) of the following criteria:

- Contain significant numbers of one or more globally threatened species;

- To constitute one of a set of sites hosting a suite of limited distribution species or a biome of limited distribution species;
- Contain exceptionally high numbers of migratory or congregating species.

There are five IBAs in STP, three terrestrial IBAs in São Tomé (Northern São Tomé Savannas, São Tomé Lowland Forests and São Tomé Nebular and Montane Forests), one terrestrial IBA on Príncipe Island (Florestas da Ilha do Príncipe) and a marine IBA named Ilhas Tinhosas, the latter being the only one where seabirds are expected to occur.

The closest IBA to the project about 17 km is Northern São Tomé Savannas. This area is situated on the northern coast, between Lagoa Azul and Diogo Nunes, and includes a succession of grasslands, coconut plantations, herbaceous swamps, mangroves and estuarine waters. Around the coastal lagoon of Lagoa Azul there are also thickets and dry lowland forest along narrow gullies. Only the mangroves and dry forests appear to be natural, and the latter may represent a vestige of the original vegetation of this part of the island.

The Tiny Islands are considered an Important Bird Area as they are home to the largest seabird colonies in the Gulf of Guinea, including species such as Barn Swallow, Black-throated Swallow, Black-throated Tern, Black tern and Orange-bellied Sandpiper (*Phaethon lepturus*), which also regularly breeds there in small numbers. Non-breeding visitors to the islands include, in small numbers, Straw-tailed Stilt, Greater Atobá, Red-footed Atobá (*Sula sula*) and Scissors-tailed Shearwater (*Fregata aquila*). These birds are assumed to come from colonies on Ascension Island, 2,500 km to the southwest (Birdlife International, 2012).

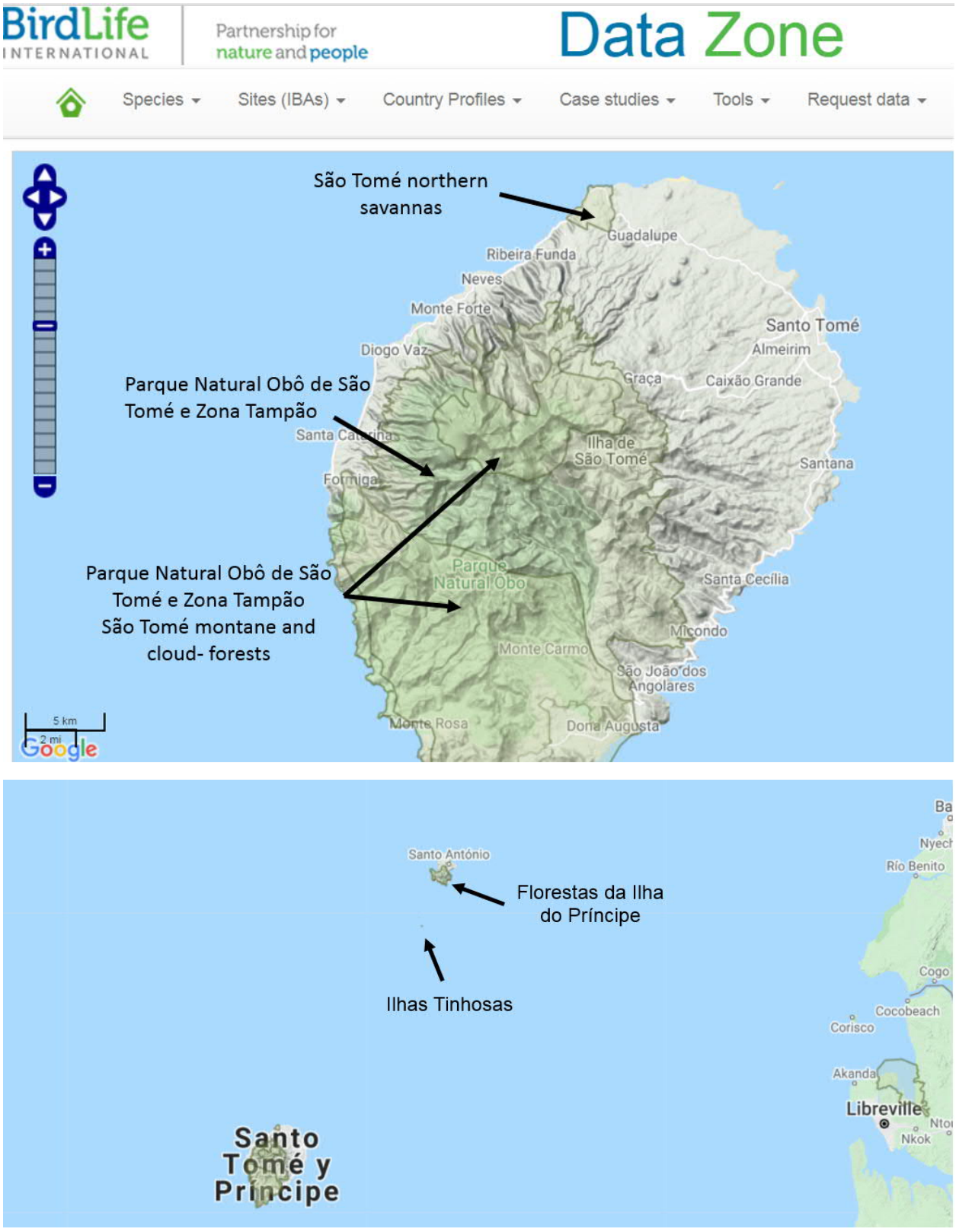


Figure 98 IBAs at Sao Tomé Island. Source: Birdlife International Data zone

10.2.4.3. **Amphibians and Reptiles**

The existing studies point to the existence of seven species of amphibians, with a percentage of endemism of 100%. Of the catalogued species, only the *Leptopelis Palmatus*, the largest species of arboreal anuran known for Africa, is the exclusive endemic species of Príncipe Island, being other two endemic shared between the islands, and the others, with exclusive representatives on the island of São Tomé (Jones &Tye, 2006; https://islandbiodiversityrace.wordpress.com/).

Regarding reptiles, there is a total of 19 terrestrial species catalogued for São Tomé and Príncipe, where twelve of them are endemic, of which three are endemic exclusive of São Tomé Island, and six are endemic shared among the islands (Jones, 1993; MNRE, 2007).

The bays of Lagarto, Ana Chaves and Pantufo, which constitute the project's areas of influence, are urban areas with strong human activities. Thus, the presence of wild species both in terms of flora and fauna is uncommon.

It is only possible to verify in the project's areas of influence only two species of reptiles: *Mabuya maculilabris* and *Hemidactylus mabouia* on the walls of buildings in the study area. Among Amphibians and Reptiles recorded in area of project none presents concerns in terms of their conservation status.

With regard to flora, the occurrence of shade trees (*Terminalia catappa*) is considerable, many of them planted since colonial times. In addition to these, in certain points of the project's area of influence, it is also possible to observe *Cocos nucifera* also planted since the colonial period.

10.2.5. AIR QUALITY

The country does not have a specific regulation for air quality, but the Environment Base Law 10/99, in its article 34, establishes the prevention and control of air quality. It states that any release of any substances into the atmosphere, whatever their physical state, is likely to adversely affect air quality and ecological balance or imply risk, damage or nuisance to people, property and resources must be subject to special regulation, as well as all facilities, machinery and means of transport whose activity may affect the quality of the atmosphere must be equipped with appropriate devices or processes to retain or neutralize pollutants.

The study area is located in the urban area of the city of São Tomé and there is no monitoring of air quality in the city, however direct observation allows to identify as main sources of air pollution: circulation of motor vehicles and diesel generators in operation.

As the study area is an urban area with heavy motor vehicle traffic, largely devoid of forest patches, it is expected that the air quality in the project's area of influence will be relatively compromised by suspended particles from motor vehicle traffic, with particular importance in the gravitational period.

On the other hand, the air quality in the area of influence of the project can be affected by the emission of gases and particles into the atmosphere (CO, CO2, NOx, SOx, Pb), resulting from the circulation of motorcycles, light and heavy vehicles that travel with frequency on the roads located in the area of influence of the project. These particulate materials can have greater or lesser impact on air quality due to their concentration in the air mass in question and weather conditions.

10.2.6. WATER QUALITY

One of the factors that have been changing significantly is the standard of water quality throughout the project's area of influence. Although the water quality throughout the project's area of influence has not been measured, several events contribute to the decrease in seawater quality in the bay:

- During the rainy season, there is an increase in siltation of rivers with sediment deposits along the Bays;

- Over several years, there has been a discharge of hydrocarbon wastes in the Bay through the Água Grande River during the supply and disposal of wastes by the power station of EMAE, Empresa de Água e Eletricidade.

PNOT (2020) refers that "in the sanitation sector, the situation observed in the district Água Grande is characterized by the generalized lack of effluent drainage systems and the absence of collective treatment systems. Globally there are three domestic wastewater sanitation systems in use in the Água Grande district:

- Sewage network, limited to the center of the capital city in the case of already very old networks. they are unit-like, i.e., there is a single system that drains rainwater and waste water, discharging to the main water lines or into the sea, without any kind of treatment, which constitutes a relevant source of pollution;
- Septic areas, used in urbanized and semi-urbanized areas;
- Latrines (simple or improved), used in informal settlements and periurban areas in general. "

In the Direct Influence Area, outdoor defecation is a constant the Pantufo and Ana Chaves bays by residents and citizens.

10.2.7. NOISE AND VIBRATION

Noise is an important aspect to measure the quality of the environment, which directly reflects on the quality of life of neighbouring populations, and one of the main causes of degradation of the quality of the environment, whether in wild fauna, habitats, or in settlements. Noise pollution occurs when, in a given environment, sound alters the normal hearing condition. Although it does not accumulate in the environment, like other types of pollution, noise pollution causes several damages to the quality of life of populations and strongly harms fauna species in any habitat.

Noise presents itself as a level of discomfort, which depends on the characteristics of the sound and the susceptibility of the receiver, which is caused by a set of human activities such as industry, construction, displacement of motor vehicles, among others. Different biological species have specific noise tolerance limits.

However, there is no specific legislation in force for the prevention and control of noise pollution, aiming to safeguard human health and the well-being of populations, for example, setting exposure limit values.

In this context, there is no reference to acoustic measurements and/or assessments carried out anywhere in the country, so there is no data on this environmental factor.

In the area of influence of the project and its surroundings, its characteristics of urban centers, which implies a strong presence of human activities, give this area high levels of noise pollution, especially during daytime periods when these activities are more intense. Noise pollution is mainly associated with light and heavy vehicle traffic along the waterfront associated with the transport of people and goods (fish, and other products) in the city and towards the capital city.

10.2.8. WASTE MANAGEMENT MANAGEMENT

Solid Waste: Small Island states such as São Tomé and Príncipe face added difficulties in solid waste management due to their isolation and location distant from major recycling centres and the small number of inhabitants. The correct waste management assumes particular importance due to the exiguity of the territory, as well as the urgent need to improve salubrity levels for sustainable development.

Currently, in Sao Tome and Principe, the responsibility for the **collection and transport** of waste lies with waste is the responsibility of the District Councils and the Regional Service of Salubrity in the Autonomous

Region of Príncipe. In the capital city of São Tomé, with approximately 80.000 inhabitants, containerization and collection, besides being insufficient, are limited to the main roads of the city, which leads to most of the waste being deposited on the ground.

In the rest of the city and the Água Grande district, there is no containerisation or collection by the municipal services, which causes the proliferation of garbage in the proximity of houses, schools, markets and hospitals. However, the final destination of the waste, including hospital waste, is also inappropriate.

The town of São Tomé, just as other population centres, operate solid waste collection systems. This exercise is done by the District Council of Água Grande are numerous concrete waste collection facilities are spread across the different neighborhoods, with different compartments for waste separation.

The waste is collected on a regular basis (once a week) but often this frequency is inadequate. At some points, there is uncontrolled dumping of garbage. A substantial part of this uncontrolled dumped waste ends up, directly or indirectly, in the sea.

Água Grande District uses as **wastes deposit** Penha Dump, located at 3 km of São Tomé city. Penha Dump eceives domestic, industrial and hospital wastes about 23 tons per day in an area of about 2,25 ha. The waste Deposit is near houses and the main impacts are the burning of waste and contamination of water courses.

Urban Solid Waste Management Plan PGRSU (2018-2023) referred that Ecocenter in Waste Deposit constructed in 2011, used to deposit glass, tires and hazardous waste, is no longer active. The location are presented in the following figure.

There is a waste treatment facility for hospital wastes, an Incinerator at Hospital Ayres Menezes that receives hospitals wastes from hospital, health centers and Campaign Hospital for Covid 19. Private clinics are not included in this process of wastes treatment.

For **recycling** there a Wastes Processing Center for glass bottles (CPR -Centro Processamento de Resíduos) in Lobata. The Organic Waste Recovery Station is not active.

In Annex 9 is presented a Declaration of Directorate General of Environment with responsibilities and current status of wastes management in STP.

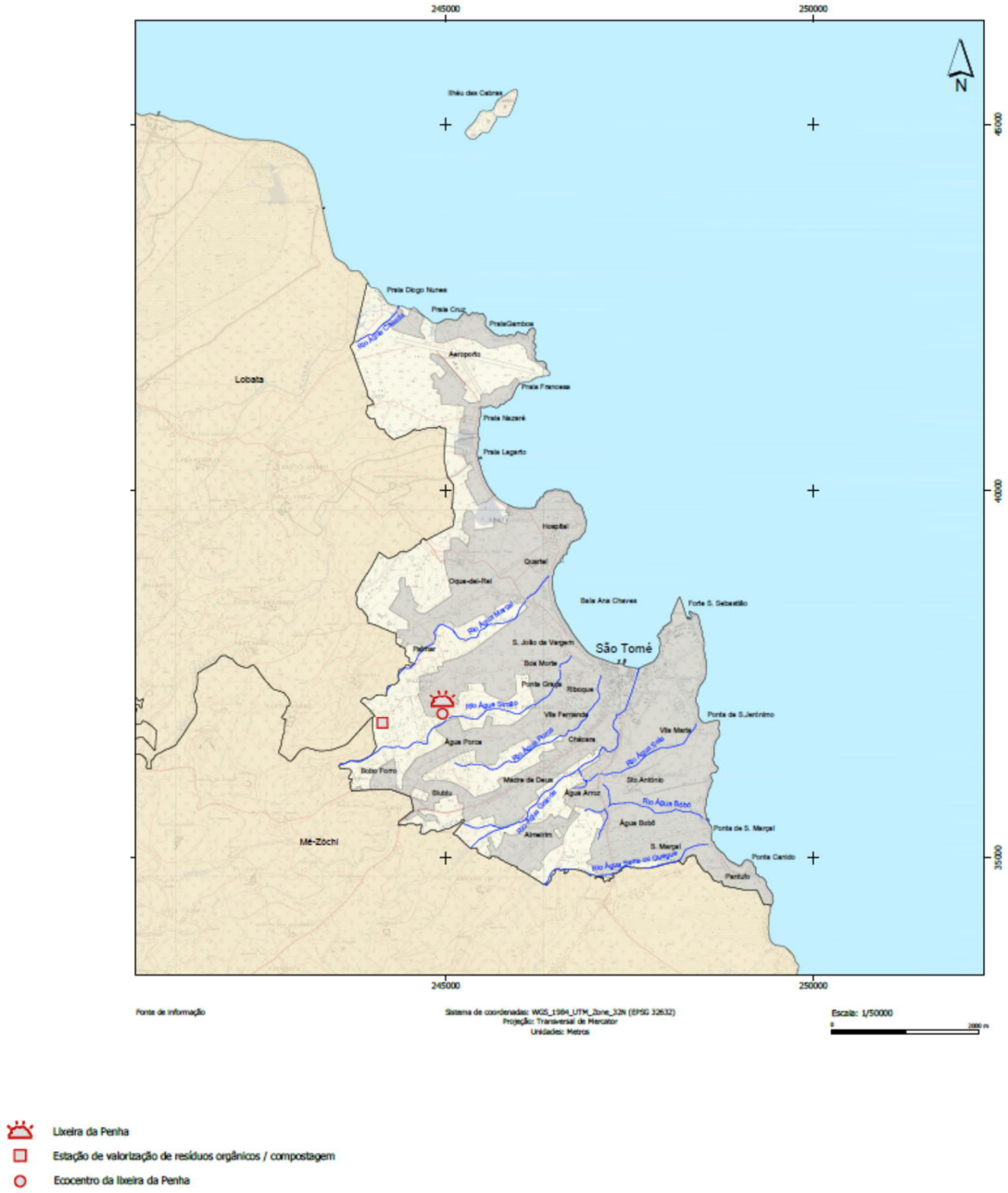


Figure 99 Location Waste Deposit, Ecocenter and Organic Waste Recovery Station Source: PNOT 2020

Urban Solid Waste Management Plan PGRSU (2018-2023) referred that Ecocenter in Waste Deposit constructed in 2011, used to deposit glass, tires and hazardous waste, is no longer active.

Água Grande District uses Waste Deposit of Penha, localized at 3 km of São Tomé city, receives domestic, industrial and hospital wastes about 23 tons per day in an area of about 2,25 ha. The waste Deposit is near houses and the main impacts are the burning of waste and contamination of water courses.

For hospital waste, one incinerator exists but with a lack of capacity for all wastes produced in São Tomé island.

Cans, plastics, waste batteries and accumulators are stored in the place where they later wait to be sent to a suitable final destination. There is no information about this process.

Hazardous wastes are stored in containers in the waste Deposit of Penha, but don't have a designed final destination. As hazardous wastes, mineral oils at the end of their life cycle, burned by internal combustion engines, are reused and sold as machines lubricant.

The company Africarecycle transports electronic and electric equipment to CPR in Lobata, where they still waiting in separate containers waiting for an adequate disposal or recycling.

According (PNGIRSU) 2018-2023, the main causes of the current situation are the following: i) the obsolete legal framework; ii) the scarcity of financial, technical and human resources for an adequate integrated waste management waste; iii) the lack of coordination, planning and clear attributions in the sector's institutions iv) the existence of inadequate and insufficient infrastructures.

In light of the above, an action programme is proposed that, aligned with the National Plan for Integrated Management of Municipal Solid Waste (PNGIRSU) 2018-2023, intervenes in four strategic axes:

1. Strengthening the legal and institutional framework, which includes i) reviewing and updating the existing legal framework existing; ii) application of DL 64/2013 - Environmental Impact Fee; iii) coordination of the sector; iv) capacity building for waste management;

2. Improvement of the waste management system, which contemplates: i) the elaboration of district waste management plans; ii) adoption of a programme for the eradication of rubbish dumps and indiscriminate rubbish dumps; iii) investment in infrastructure and equipment (controlled dumpsites in equipment (controlled dumpsites in the districts, construction or acquisition of containers, acquisition containers, acquisition of means of transport).

3. Sustainability and green jobs, which implies: i) the creation of green jobs; ii) the integrated solutions (substitution of chemical fertilisers by organic compounds, reduction of organic compounds, reduction of GHG, costs and increased income for farmers) costs and income increase for farmers);

4. Environmental information and communication, considering that communication for behavioural change is fundamental to the success of environmental policies.

10.2.9. LANDSCAPE

Lagarto bay

Lagarto bay has a length of 1,800m and is characterised by tourism assets (hotel plots) at the landside of the coastal road, and contains a beach profile at the seaside of the coastal road for the larger share of the bay length. The coastal road in this bay is the main connection between the capital and the airport. This coastal stretch has a typical 'beach appearance' with a sandy beach and coconut trees along the road. Tourists staying at the hotels have to cross the road to go to the beach. Further potential tourism development is expected in this area. Without beach nourishment this location may not become a 'perfect beach' location, however the present beach still has some potential for recreation. In the case of future investors, beach maintenance could become a private investment.

Ana Chaves bay

Ana Chaves bay has a length of 2,500m and is an urbanised environment, having higher building densities. The capital's centre is located along this bay, having a mixed-use of residential, commercial and governmental functions. Also, one of the national roads merges with marginal for a certain stretch of the bay. The bay has clear spatial and architectural values, among other aspects expressed by its typical colonial features and old trees with wide canopies.

Pantufo Coastline

The North-South oriented stretch of coastline up to Pantufo has a lower building density and has mainly residential functions and a few hotels. With a length of 4,400m, it is the longest stretch of coastline in the project area as well as the most varied with respect to adjacent functions to the road, coastal protection types, topography, urban typologies, landscape, etc.

São Tomé and Príncipe has a bicephalous structure, and São Tomé city is the big metropolis of the country.

Considering only the island of São Tomé, the urban system is organized around a polynucleated urban network structurally outlined along the coast, although the importance of the country's capital and the enormous unbalance of the urban system is evident in the extent of the functional, demographic and territorial gap between the country's capital and the district capitals. In turn, at levels hierarchically subsequent to the district capitals, the capacity to polarise the territories close to the remaining centres is relatively reduced and is affirmed, fundamentally, for the functions of education and health and some commercial and service functions, often of a very informal nature.

11 SOCIAL BASELINE CONDITIONS

11.1 METHODOLOGY

The analysis of the social baseline conditions was performed using available desktop data for São Tomé and Principe complemented, by a socioeconomic survey carried out in the areas of Lagarto bay, Ana Chaves bay and Pantufo Coastline in July 2021.

The survey aimed to understand the socioeconomic situation of individuals and groups who may be directly or indirectly affected by the project, analyse their household situation, as well as the social and economic aspects of groups identified.

The area of direct influence of the Project is the Marginal de São Tomé, which crosses the city of São Tomé and presents in its 3 sections distinct characteristics that were characterized in the ESIA in socio-economic terms, with several surveys carried out: schools, hospitals, colonial houses, etc.

Within the scope of the present ESIA for socioeconomic surveys, it was considered that it was only necessary to carry out surveys to those potentially affected and not to all those who live, work, use or visit the Marginal. The total number of surveys are 55.

Besides the results of the socioeconomic surveys, to ensure the involvement of the local communities in the project, a Stakeholder Engagement Plan (SEP) has been developed and implemented in line with and IFC requirements, This plan describes results of the stakeholder consultation and engagement programme for the Project as important Project information became available.

This document covers the following:

- Identification of stakeholders and other affected groups.
- Public consultations and information disclosure requirements.

The project not only will somehow affect all the users **living** along the three basins that make up the marginal but all users of the project roads. Consequently the consulted stakeholders were divided into three groups

- Directly and indirectly project-affected persons.
- Stakeholders having an interest in or influence on the project.

- Individuals and institutions that participate in the implementation of the project.

11.2 DEMOGRAPHY

The trend line of population evolution has been of clear and expressive growth: during the period of the present millennium (2001 to 2012), according to the projection data from the National Institute of Statistics in 2020, São Tomé and Príncipe has a total of 210.240, 104.120 men and 106121 women. (INE 2020). However, only the district of Água Grande concentrates 80.908, approximately 40% of the country's total population.

The population volume of 2012 will have risen to the year 2018, to 201.785 inhabitants according to the Demographic Projections of São Tomé and Príncipe in the horizon of 2035 (INE), or in other words, only in the present millennium (2001/2018), the population may have increased 47%, equivalent to 64 thousand individuals.

The demographic structure of the population of São Tomé and Príncipe is as shown in the following table:

Population indicators	2020
Total population	210.240
Male population	104.120
Female population	106.121
Proportion of the pop. 0-4 years	12,1
Proportion of the pop. 5-14 years old	24,8
Proportion of the pop. 15-24 years old	20,8
Proportion of the pop. 15-49 years old	52,1
Proportion of the pop. 15-64 years old	59,9
Proportion of the pop. 65 + years old	3,2
Prop. pop. female 15-49 years old	51,8
Urban population	143.055
Rural population	67.185
Proportion urban population	68,0
Proportion of the rural population	32,0

Table 63 Demographic Structure of Population Source: INE. São Tomé and Príncipe. Demographic Projections: Summary of Demographic Indicators, 2012-2035

As shown in the table above, the population of São Tomé and Príncipe is mostly young. For example, 52.1% of the population is between 15 and 49 years old, and 20.8% is between 15 and 24 years old.

The District of Água Grande, where the country's capital and area of intervention of the project is located, has about 40% of the total population.

According to the socioeconomic survey, the number of people per household varied from one person to 13 people, but the more common is to find whether four or six people living together (19.64% each). The average household have 4.3 people.

The largest household was registered in Lagarto Bay (13 people) followed by Ana Chaves Bay (11 and 10 people).

In terms of the number of men and woman in the household, there was not much dispersion. A perfect balance was found in 17.86% of the households and while in some, the difference was up to 5 people more than the opposite sex, in most cases, the difference was only one person (33.93%).

11.3 POPULATION DYNAMICS

São Tomé and Príncipe is a small country both in terms of territorial size and population, but it has a clear upward demographic curve in which, despite an asymmetrical internal distribution, all districts are recording positive growth dynamics.

According to INE-2017 estimates, the country's population density was 197.5 inhabitants per km^2, but with great disparity at the district level. The district of Água Grande, where the country's capital is located, has a higher density of 3,700 inhabitants per km^2, being an area of high population density.

With a population of 204 454 (INE, 2018 estimate), spread over a total area of 1 001 km², São Tomé and Príncipe is the second least populous African sovereign state, after Seychelles, as well as the smallest Portuguese-speaking country. Its people are predominantly of African and mixed-race descent, with the majority practising Roman Catholicism. The legacy of Portuguese rule is also visible in the country's culture, customs and music, which fuse European and African influences.

It should also be noted that the population volume will have reached 214,610 inhabitants in 2021, according to the Demographic Projections of São Tomé and Príncipe by 2035 (INE), which results in an increase of about 55%, equivalent to 77,011 individuals, in two decades (2001/ 2021).

The average life expectancy was around 67.3 years, and the literacy rate was around 90.1%, according to the National Institute of Statistics in 2017. However, the country continues to face the great challenge of combating poverty that it reaches about 66.7% of the population (IOF- Survey of Family Budgets 2018).

The Avenida 12 de Julho where the intervention will take place, is one of the main circulation routes for people, goods and products in the city of São Tomé and connects the country's two strategic infrastructures, the Port of Ana Chaves and the International Airport.

11.4 ECONOMIC ACTIVITIES

11.4.1 EMPLOYMENT

Economic activity in São Tomé and Príncipe is characterised by high levels of informality that result from the fragilities in the structuring of the economy and the weaknesses of the entrepreneurial fabric in the majority of economic sectors.

The consequences at the level of employment are complex and translate into a marked and recognized precariousness of employment in the country - high indexes of inactivity and situations of underemployment, even in structured sectors of the economy and public administration.

Recent studies on the situation in Sao Tome and Principe, prepared with support from the International Labour Organisation, reveal that only 15.9% of Sao Tomean workers work under contract, 37.5% work for an employer, but without a contract, and 34.9% are self-employed.

In São Tomé and Príncipe according to UNICEF 63.8 per cent of the age group between 18 and 24 years old are candidates for a job. These numbers seem consistent with the data from INE, which point out that the age group understood between 15 and 34 years represents about 69 per cent of the unemployed.

Along the Marginal, one can find several informal employment posts. In the Lagarto bay we find women selling vegetables on the side of the road and young people selling coconut water in front of Emilia beach. At Ana Chaves bay one sees ladies selling fruit, particularly in the São Pedro area and fish sellers. All along the waterfront, a growing number of people, mostly women, sell recharge cards for telephone companies and some traditional sweets. In Pantufo coastline the dominant informal business is the sale

of fish by the fish sellers “palaies”, there are many small greengrocers and sales of used clothes and shoes and fast-food restaurants.

From the socioeconomic survey, the observed job distribution was the following:

- 32.20% Fishermen (19 people)
- 20.34% Self-employed (12 people)
- 16.95% Fruit Sellers (10 people)
- 11.86% Unemployed (7 people)
- 3.39% Informal Employees (2 people)
- 1.69% Seasonal Workers (1 person)

In terms of working years, 41.82% respondents work in their field of activity for 0 to 10 years, 30.91% for 11 to 20 years, 9.09% for 21 to 30 years and 7.27% for 31 to 40 years, while 10.91% of the respondents could not say clearly how long they are in their current job.

As the predominant employment, the most sold product is fish (40%) followed by fruit (18.18%). Other types of products/services provided by 1.82% of the respondents include ready-to-eat food, burger, vegetables, car and moto taxi, building blocks, mechanics and coconuts.

Other products/services are handcrafted drinks (7.27%), washers (7.27%) and palma wine (3.64%).

With regard to income earned at the end of the day, none of the respondents reported earning less than 150 STN per day (approximately 6 EUR).

11.4.2 TOURISM AND LEISURE

According to data from the Tourism Directorate in 2019, the period before the COVID 19 pandemic, international tourist arrivals to São Tomé and Príncipe was 34900. The biggest driver of this economy is Portugal, followed by Angola, France and Germany. The months of August and September are the months of greatest flow, which coincides with the holiday period in European countries.

Based on the tourism inventory carried out by DGTH in 2016, with the support of the World Bank, relevant data regarding accommodation, restaurants, nightlife venues, handicrafts, game room and nightlife.

With regard to accommodation, the number of hotel establishments, holiday villages, tourist flats and other accommodation totals 54 units.

In terms of geographical distribution, there is a clear predominance of hotel units in Água Grande district, where is located the country's capital, followed by Mé-Zochi district.

The current hotel supply in São Tomé and Príncipe offers 723 rooms, with a total of 1508 beds. The district of Água Grande district concentrates more than half of the country's accommodation capacity.

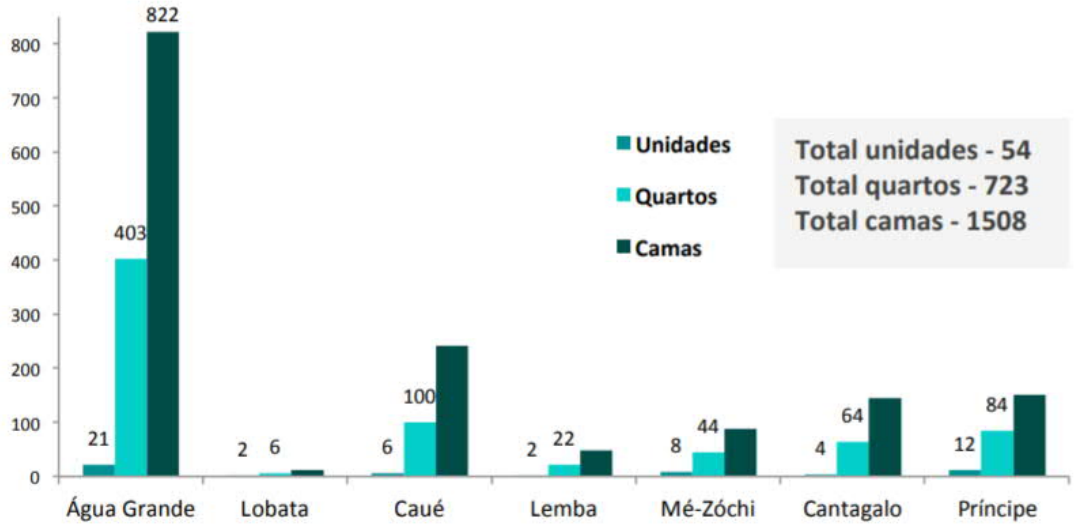


Figure 100 Hotel Suplly Source: Strategic and Marketing for tourism in São Tomé and Príncipe

In the Direct Influence Area there are 4 hotels: Hotel Praia, Hotel Omali Lodge, Hotel Miramar and Hotel Pestana.

The pandemic of COVID19 has severely affected tourism and consequently the economy of STP, mainly through losses in the tourism industry. The STP economy has been hit by an almost total drop in foreign tourist arrivals since early March 2020. The tourism industry, which has been an engine of private sector growth in recent years and accounts for a large share of formal and informal employment, came to a complete halt, resulting in a loss of labour income, foreign exchange and tax revenue.

Lagarto bay

Lagarto Bay stretches from the Bigodes Hotel to the CKDO Super Market. There are already some hotels located on land off the coastal road, such as Hotel Omali Lodge and Hotel Praia and a travel agency (Mistral Voyage). There is also potential land available for future hotel development. The location is close to the airport and close to the city of São Tomé and Príncipe.

Lagarto bay would also be an ideal place where local tourists and tourists from neighbouring countries can use it extensively for recreational purposes. Moreover, this area can be used for business tourists who are coming for a few days to explore the country. This area is considered of potential for tourism due to some important aspects, such as:

- Type of coastal road (traffic, use by pedestrians, etc.) and impact on hotels/tourists;
- Location of hotels is near to beach/sea;
- The proximity of the hotels to the airport.

One of the most frequented beaches by the national population and tourists is Emilia beach in Lagarto bay. It is one of the most beautiful beaches in the capital city. Every day hundreds of people, including tourists and nationals, choose this beach for their leisure time, physical exercise or simply for a walk.

Despite the state of the sidewalk, the waterfront is used daily by hundreds or thousands of people, pedestrians, sports enthusiasts, cyclists, and joggers.

Emilia beach is one of the reference places for end of the year festivities in São Tomé City.

Ana Chaves bay

Ana Chaves bay runs from the CKDO Super market to the National Museum.

There are no hotels, but we can find attractive establishments, like guesthouses, restaurants, bars and chocolate houses, banking, commerce and car stands. The boulevard along this bay has been developed for recreation and tourism. Several attractions in the area are of interest to the visitor and are within walking distance of each other. Such places are also identified in “Plano de Turismo” and also mentioned above. According to “Step in London” this area is most similar to the Frontier II type of experience, where São Tomé culture and traditions can be experienced.

The Bay of Ana Chaves is perhaps the most emblematic site, and the history of the city of São Tomé and Príncipe Old wharf (port) in the city where raw materials produced in the country were shipped to the old metropolis.

This Bay encompasses several emblematic points of our city and country. The port of Ana Chaves the largest port in the country, was built in the 1950s. The Independência square, where the independence of São Tomé and Príncipe was declared, is the historical landmark of our history and culture.

The Cathedral, the largest church, is a symbol of Catholicism and our social, cultural and religious heritage.

The ex-PM beach is situated in the bay and is one of the capital's emblematic beaches and a meeting and leisure place for the young population of São Tomé. Usually has a large number of bathers especially on Sundays. This beach is also one of the reference places for New Year festivities.

As is tradition in São Tomé and Príncipe, communities celebrate the festivities of popular saints. the beach community São Pedro, annually celebrates the popular festival alluding to the patron saint of fishermen, São Pedro.

The waterfront of Ana Chaves bay, despite the state of the sidewalk, is used daily by hundreds or thousands of people, pedestrians, sports enthusiasts, cyclists, and joggers.

It is worth mentioning that the only museum in the country is located there, in the old São Sebastião Fort, a unique cultural and historical site in the country.

Pantufo Coastline

In the south where Pantufo coastline is located, goes from Museu Nacional to São Marçal. This bay encompasses three of the capital's main hotels, the Miramar Hotel, the Pestana Hotel, the Emoyeny Garden Hotel, and several restaurants and cafés, as well as other economic activities.

It encompasses areas of strong historical, cultural and touristic interest, such as the Fort of São Jerónimo. Further to the south along the Pantufo road, one can see the places of interest or potential sites of tourism development, such as the landing sites of fishery boats and places suitable for the promotion of local souvenirs sales.

An example is the land space opposite the school. The area (city center with hotels and places to visit further south) is considered where São Tomé culture and traditions can be seen. Furthermore, the Pantufo bay area can be promoted for tourists who are coming for a fishing excursion and for those who want to indulge in community tourism activities. A tourism potential to be initiated in partnership with the local fishermen.

The Liceu Nacional (National Lyceum), the largest national high school, until recently the only one in the country, where almost the entire national political and intellectual elite studied, is one of the most important buildings in the city.

The Pantufo bay also gives access to the Estadio Nacional 12 de Julho, the largest football stadium in the country.

The Palácio dos Congressos, the country's largest venue for events and the current home of the National Assembly, is also located in this bay.

We can also observe along the bay small informal businesses such as the sale of phone recharges from communication companies, small kiosks and greengrocers and some street vendors, especially “palaies”.

This waterfront of Pantufo Coastline bay, is used daily for sports pratices and walking for students of National Lyceum.

Dangerous Beach (Praia Perigosa) in Pantufo Coastline, usually has a large number of bathers especially on Sundays and Tourists.

11.4.3 FISHERIES

General situation with nearly 15 percent of the nation’s workforce employed in artisanal fisheries (about 2,700 people directly and an additional 3,000 indirectly), they encompass the poorest and most vulnerable segment of the country’s population. Over 80 percent of the 3,440 fishing vessels are small dugout canoes (3-4 meters) using paddles, sails, and traditional gears (lines and nets). Only 520 vessels are motorized and made of fiberglass.

Artisanal fishers are particularly vulnerable to the changing climate and sea-level rise which can threaten their safety at sea and also because they are very dependent on the beach for landing their boats, drying and repairing nets and partly selling their catch.

The total catch in STP in 2020 was 10,300 tons. Local fisheries production contributes 7 % to the GDP and provides 18% protein needs of the population.

There are approximately 28 fishing communities around the island and the main locations are Água Grande, Lobata and Cantagalo. Most of the fish are consumed locally. There are no fish processing facilities on the island.

There is a great deal of enthusiasm in STP for a Blue Growth approach to development that seeks to balance economic growth and food security with the conservation of aquatic resources. STP has an EEZ (Exclusive Economic Zone) 160 times greater than its landmass.

The Government recognizes that future development must revolve around a sustainable ocean-based economy. The Ministry of Agriculture, Fisheries and Rural Development is the responsible for the management of this sector.

The Government is working towards integrated spatial planning, which would allow it to redirect the growth of vulnerable communities away from high-risk areas (through incentives such as public infrastructure and redistribution of public land). A new Fisheries Management Plan is to be prepared under the Blue Economy that will improve fisheries management and allow it to delineate exclusive fishing zones for artisanal fishers (3 in ST and 1 in Príncipe) and to create marine sanctuaries.

The Directorate for Fisheries has stepped up efforts for improving the collection of fisheries data since 2015. These fisheries management measures are expected to be important complementary long-term

measures to the safety at sea as over-exploitation of nearshore resources is one of the key factors motivating artisanal fishers to venture further offshore.

The Government is exploring new opportunities in sport fishing, diving and aquaculture.

In the distribution between the two islands, the Census data allow us to highlight the following elements:

- 90% of the fishermen were registered on the island of São Tomé;
- 91.3% of the fish sellers carry out their activity on the island of São Tomé;
- 2,365 boats, only 22.3% are motorized, and 88.5% of the total were registered on the island of São Tomé.

Artisanal fisheries catch lower quality pelagic fish sold on the local market, but also channelled, to a lesser extent, for export.

In terms of infrastructure, the fisheries sector is experiencing difficulties related to the weak material structure to support the catch activity and inadequate or non-existent infrastructure for the production, processing and conservation of fisheries products.

Fisheries in the Project Area

Agua Grande is one of three main fishing sites in São Tomé with around 710 fishermen. Within the project area there are two fishing communities: San Pedro and the Old Pier, with a total of about 120 fishermen. San Pedro Beach is situated in the centre of the Ana Chaves Bay, near the small chapel with the same name. About 40 canoes (pirogues) operate from here, employing about 50 fishermen. Only 11 boats have outboard engines. Most fishermen are seasonal fishermen from Nevis who come here during November-March as they are closer to Tuna populations from here than from Nevis. Coastal erosion / dynamic behaviour of the beach severely restricts space for landing the boats. Occasionally, fishermen have to take their boats over the wall onto the side-walk for more safety, putting them close to the Marginal road.

At the Old Jetty, about 16 mechanized multiday boats with inboard engines take advantage of the anchoring facilities provided by the old jetty. At least 60 fishermen operate here. They go out for 3-5 days sometimes as far as Gabon and Príncipe. Around 120 boats operate from Pantufo Beach. Over 86% are non-mechanised. They employ about 135 fishermen providing for approximately 600 persons.

The main problem for them is the lack of boat landing facilities. Since there is only a very narrow beach, fishermen need to pull the boats onto the rock revetment. It is noted that not all of Pantufo's fishing community is within the area where coastal protection is expected. The main landing sites are in São Pedro and opposite of the church, was part of the current project.

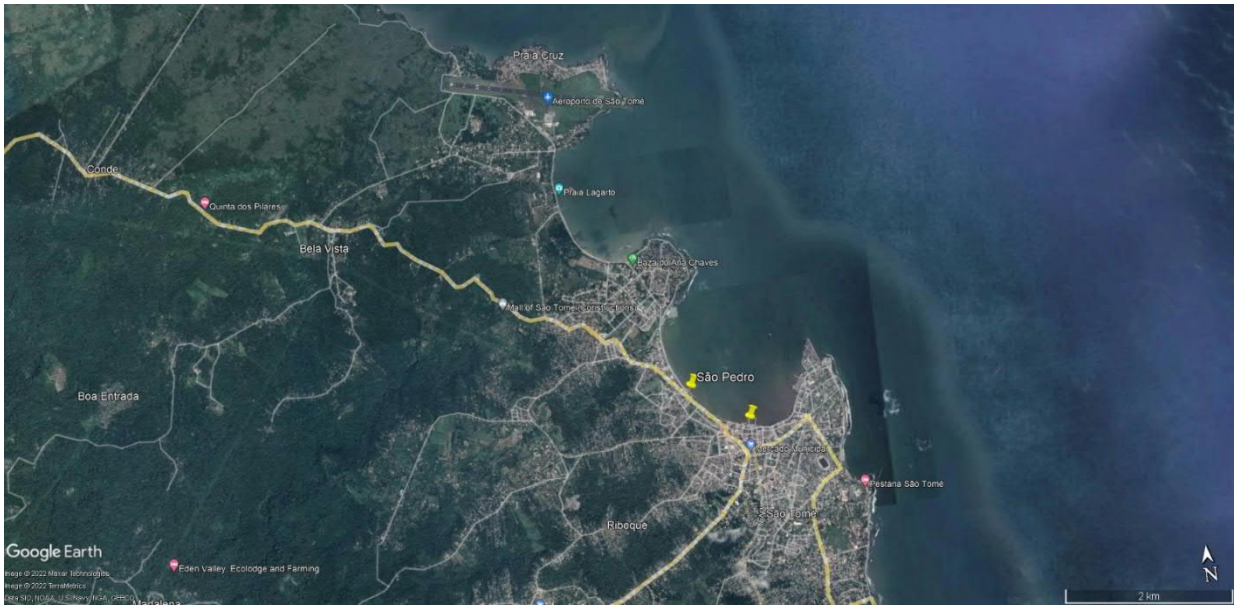


Figure 101 Location of Fishing Landing Areas

The Government of STP has given the highest priority under the NAPA (National Adaptation Plan of Action; 2006) to the provision of navigation and safety equipment and strengthening of its early warning system in order to improve safety at sea for the artisanal fishermen.

11.4.4 EDUCATION

The structure of São Tomé and Príncipe's educational system was recently modified with the approval of the new Basic Law of the Educational System in 2018 (LBSE, No. 4/2018). The current educational system includes: (i) two years of Pre-School Education (4-5 years); (ii) nine years of Basic Education divided into three cycles (1st to 4th Grade - ages 6 to 9); (5th to 6th Grade - ages 10 to 11); (7th. to 9th. Grade - ages 12 to 14)) and (iii) three years of Secondary Education, ranging from 10th. The 12th. Class (15 to 17 years old). The total number of students is 74,115, with 38,781 students in the first two cycles of Basic Education (1st to 6th classes).

Organization of the San Toméan educational system:

- Infant cycle, from 3 to 5 years old;
- Primary - 1st to 4th grade;
- Basic - 5th and 6th grade;
- Secondary - 7th to 10th grade
- Pre-university - 11th and 12th grades;
- University - Instituto Universitário de Contabilidade, Administração e Informática (IUCAI), Universidade Lusíada.

Education is compulsory up to grade 6, and the extension of this obligation to grade 9 is in the process of being approved. This measure has encountered some setbacks in its application because the number of secondary schools is very small and are located in the largest urban centres. However, it is expected to be implemented in 2018.

The illiteracy rate reaches around 6.3% of the population (over 15 years of age), having this rate has been decreasing significantly in recent years, as a result of education policies.

Compared to the rest of Africa, where about 32% of adults are illiterate, the RDSTP shows very favourable development results.

With regard to primary education, 92.7% of children of appropriate age attend school. The percentage of adults who have attended and concluded primary education is currently 67.7%, while these figures drop significantly when we analyse the attendance and conclusion of secondary education (28.2%). The average for the African continent for primary school attendance, the percentage of adults who have concluded primary and secondary education is 71.2%, 67.75% and 22.1%, respectively.

The situation is inverted when we analyse the rate of adults who attended and concluded higher education, which stands at 2.1%, while in the African continent this rate is 3.2%.

The National Lyceum is in the direct area of influence and one kindergarten and a school are in the indirect area of influence at a distance less than 200 m on the Marginal road.

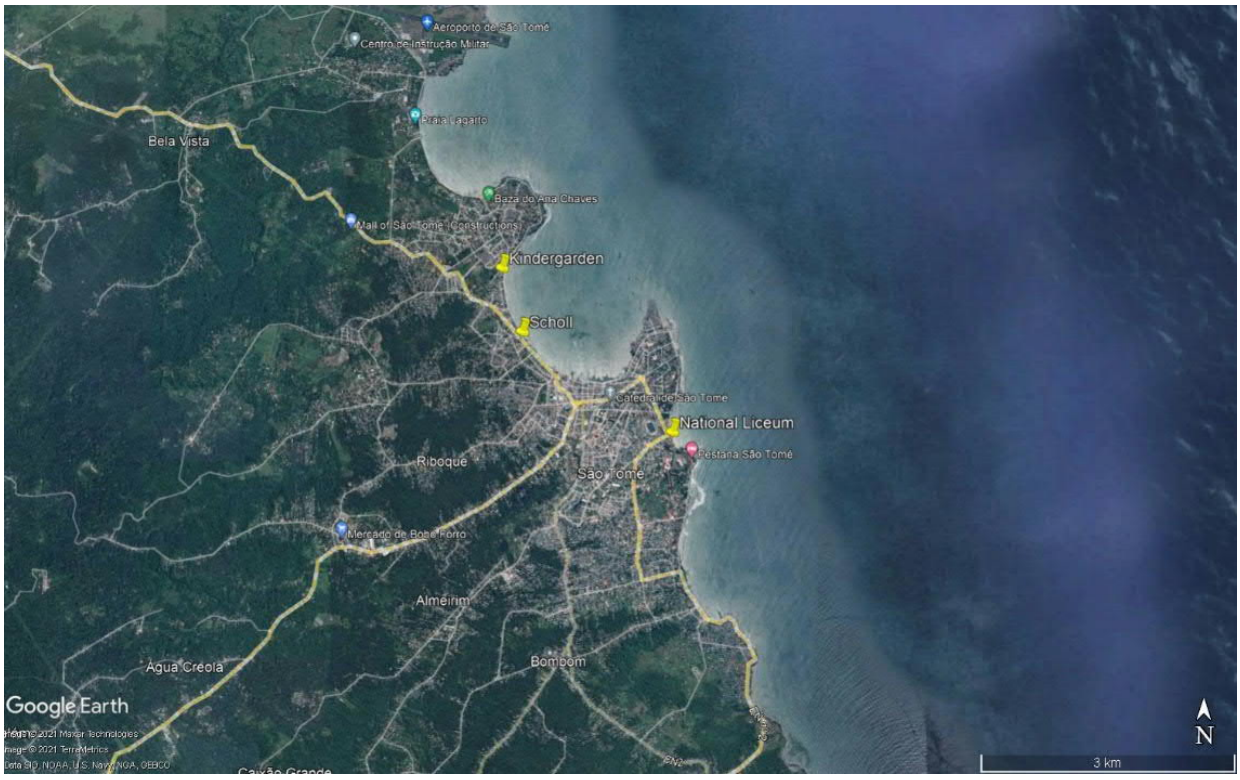


Figure 102 Location of Schools

11.5 HEALTH

The Basic Health Law, Law No. 09/2018, recently published, provides for the administrative division of the National Health System structured at two levels: Regional and Central.

The regional level of the National Health System is organized into 4 health areas, namely the North Region Health Area (districts of Lobata and Lembá), the Center Region Health Area (Água Grande and Mé-Zóchi

districts), the Health Area of the Southern Region (districts of Caué and Cantagalo) and the Health Area of the Autonomous Region of Príncipe (the health district of Príncipe).

The Central level, with national coverage, has political-strategic competencies, conducting general and sectoral policy, allocating resources, coordinating technical cooperation and standardizing procedures and conducting in the strategic alignment of the government's program and its options. The only reference hospital in the country, Dr Ayres de Menezes Hospital is located in the capital city, very close to Largo Bay and the Key Ana Bay.

The epidemiological profile of São Tomé and Príncipe is marked by the predominance of non-communicable diseases whose trend is increasing. Communicable diseases continue to be a public health problem, with a high incidence of acute respiratory diseases, diarrheal diseases and other communicable diseases or those linked to the environment. These constitute the main causes of morbidity and mortality in the country.

Non-communicable diseases (NCDs) are major causes of morbidity and mortality according to hospital records and the limited factual data available on them. However, interventions to fight NCDs and their risk factors are insufficient and irregular due to a lack of financial resources. The NCDs that cause the greatest problems in terms of morbidity and mortality in the country are diabetes mellitus, cardiovascular diseases (CVD) (namely hypertension, heart failure, ischemic heart disease and stroke), chronic renal failure, which is an important cause of medical evacuation, trauma (particularly those caused by car accidents) and malignant tumours.

STP is one of the pioneers in Africa with good practices in malaria control and treatment, although the disease still presents a challenge to the National Health System. The annual incidence of malaria went from 411.6 to 12.5 cases per 1000 population from 2001 to 2017 and the number of deaths from 180.2 to 0.5 deaths per 100 000 population in the same period.

The most recent data shows the trend towards reduction in HIV/AIDS Infection. New infections had an incidence rate of 0.6% in 2013 (UN/SIDA report 2014).

Currently, STP has a low prevalence epidemic: in the population aged 15-49 years, the incidence rate went from 1.5% in 2008 to 0.5% in 2014 and from 15-24 years went from 0.8% in 2008 to 0.1% in 2014. Data from the national programme indicate that HIV prevalence during these years does not exceed 0.6%, being 0.2% in 2016 and 0.3% in 2017.

In April 2020, the first cases of Covid 19 appeared in São Tomé and Príncipe. On 23 December 2021 it amounted to 3737 confirmed cases of Covid 19 and 57 deaths.

São Tomé and Príncipe have a National Health Service structure that theoretically covers the whole national territory, as mentioned above. However, most of its units operate in very precarious conditions due to the poor quality of the facilities, lack of essential equipment and medicines, lack of human resources with the essential skills to perform their functions. Some young people frequently emigrate to obtain training abroad, and it has been verified that many of them end up staying in the country of training.

The Ayres Menezes Hospital and Nursing Home are in the direct area of influence at a distance less than 200 m the Marginal road.

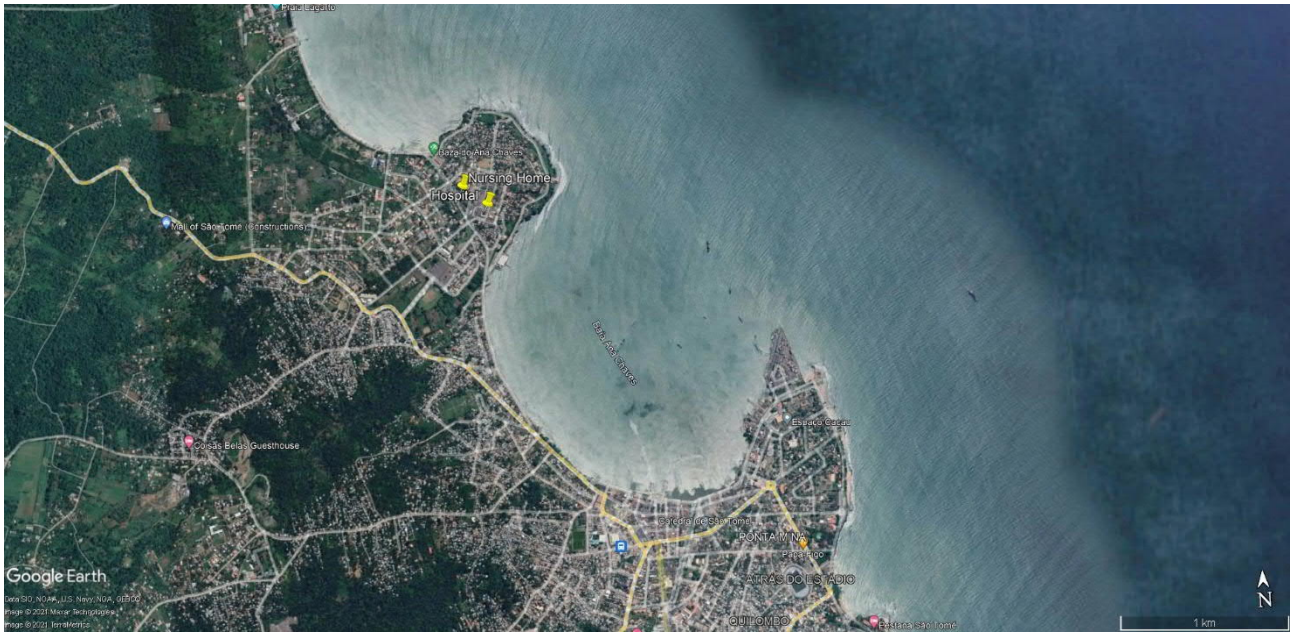


Figure 103 Location of Hospital and Nursing Home

11.6 ECONOMY

Sao Tome and Principe, like most African countries, has a fragile economy that is vulnerable to external shocks and is essentially based on agriculture and trade. The country has a production structure based on cocoa monoculture, which was exploited in the past by large state-owned agricultural companies, where more than 90% of the land with agricultural value was concentrated.

São Tomé and Príncipe, like most African countries, has a fragile economy that is vulnerable to external shocks and is essentially based on agriculture and trade. The country has a production structure based on cocoa monoculture, which was exploited in the past by large state-owned agricultural companies, where more than 90% of the land with agricultural value was concentrated.

According to the Bank of Portugal, in recent years São Tomé and Príncipe's economy has recorded a steady growth rate of between 4% and 4.5%.

The performance of the economic activity in 2020 was attributed firstly to the industry sector which grew by 4.4%, driven by Construction activities (5.8%); followed by the Services sector with 2.6%, where the activities of Public Administration Defence, Health and Social Welfare were those that grew most in this sector 13% and 6.1% respectively. It should be noted that Accommodation and Catering activities fell by 16.2% due to the decrease in tourism in the country as a result of the pandemic. The Primary sector, despite showing a decrease in the year in question (-1.1%), Agriculture, Animal Production, Hunting and Forestry and Extractive activities showed a growth of 2.5% and 4% respectively, which was not enough to boost the sector. The Taxes on Products and Import Duties presented their growth of 22.9% and (2.3%).

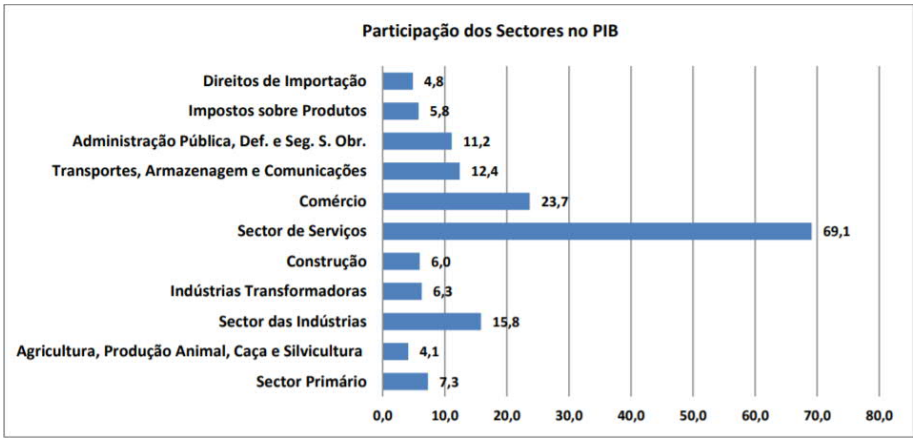


Figure 104 PIB by economic sectors. Source: site National IStatistics Office

In terms of participation of Sectors in GDP, the services sector is the largest contributor. Around 69.2%, with Commerce activities standing out (23.7%), followed by the Transforming Industries sector (15.8%), with Transformation activities standing out (6.3%). Finally, the Primary sector (7.3%), with Agriculture, Animal Production, Hunting and Forestry (4.1%) as the most important sector of the GDP. It should be noted that the Import Duty and Taxes on Products had a participation of 4.8% and 5.8% respectively.

11.7 TRANSPORTS INFRASTRUCTURES

The basic economic infrastructure (transport and communication infrastructure, water and energy) required to develop the private sector and stimulate growth does not yet match current needs.

Road Transport: The República Democrática de São Tomé e Príncipe (RDSTP) benefits from a road network of around 1180 km, of which 250 are asphalted. However, road infrastructure suffers from a chronic lack of maintenance. The state of the roads, particularly the unpaved ones, continues to be one of the constraints on economic competitiveness and the quality of life of those living in rural areas.

Maritime transport: The country is endowed with four seaports, three of them on São Tomé and the fourth in the city of Santo Antonio on the island of Príncipe. The port of Ana Chaves in São Tomé, apart from the low productivity of its equipment, associated with its obsolescence, is very shallow (the depth reaches a little more than 3 m at high tide), which makes it unsuitable for international vessels. With these restrictions, most freight services are forced to load and unload outside the port, on barges that provide transport between the ship at anchor and the port. This force ships into long waiting times (typically 5 to 8 days) and increases the risk of container damage and cargo loss.

Air transport: São Tomé and Príncipe have two airports, one in São Tomé and another on the island of Príncipe. The management of the airports is ensured by a public company - the ENASA.

S. Tomé International Airport is in need of urgent rehabilitation and does not meet international safety, security and quality standards, which limits the number of international flights and further aggravates the costs of insularity linked to distance and the territory's discontinuity.

Air links are limited to eight flights a week with the mainland (Abidjan, Libreville and Luanda, Lomé, Cape Verde) and two flights a week to Europe (Lisbon), and the waterfront where the intervention will take place is one of the main circulation routes for people, goods and products of the city of São Tomé, serving the International Airport and the port of Ana Chaves.

Marginal Road have an important function in urban traffic, links with EN1, EN2 and EN3, airport and Ana Chaves Port (see the following Figure).

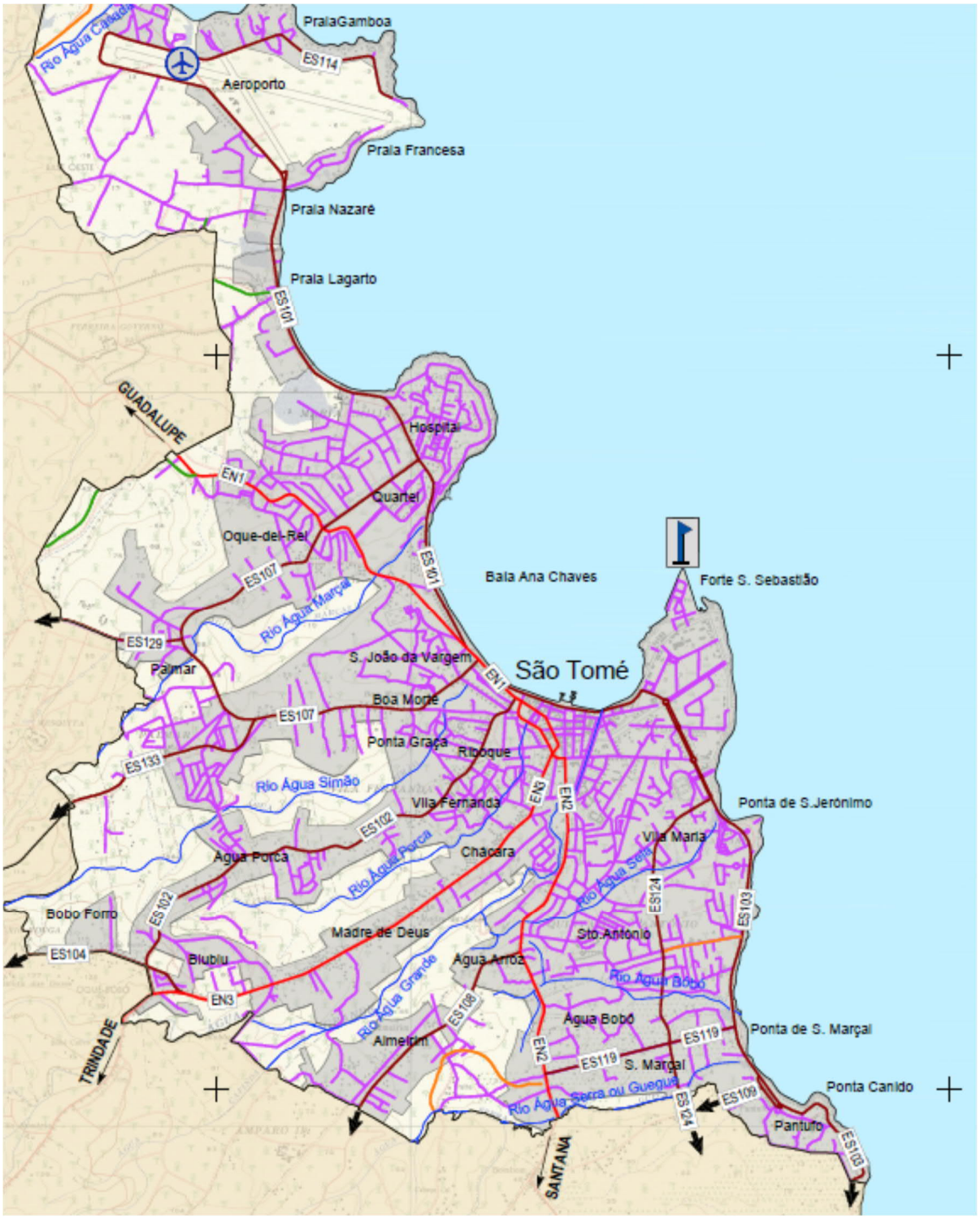


Figure 105 Transports network. Source: PNOT (2020)

There is no public transport in the city of São Tomé, people who don't have a car use taxi or moto taxi.

11.8 ENERGY INFRASTRUCTURES

The National Water and Energy Company (EMAE) has a network of 52.030 customers (in September 2021). Electricity access rate is around 90%. i.e., about 90% of the population has access to 15

megawatts of electricity produced. During the period 2003-2010, energy received on average only 3.8% of the total investment in the Public Investment Public Investment Programme (PIP).

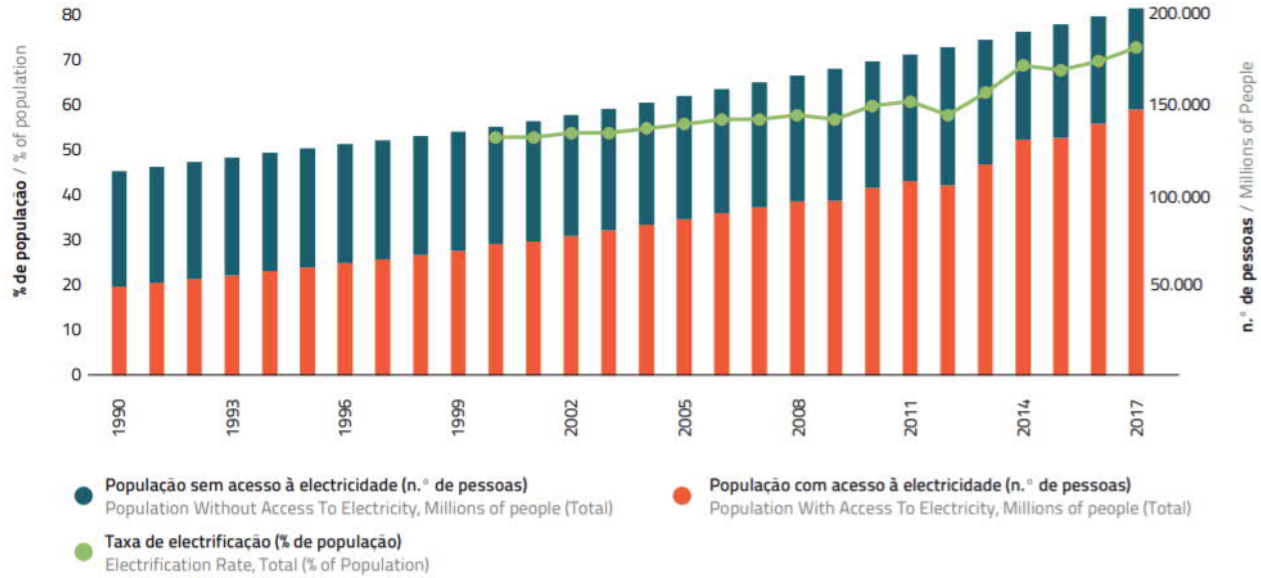


Figure 106 Evolution of electrification rate from 1990 to 2017 in STP Source: Website Tracking SDG 7

In terms of energy infrastructure, the country faces enormous problems, which is hindering the development of the business/private sector. Many entrepreneurs are to resort to electric generators, with the economic costs that this entails, thus increasing the cost of investment and thus increasing the cost of investment and operation.

The energy sector faces difficulties of various kinds: production well below the real installed capacity, frequent losses in the distribution network, approximately 40%, due to obsolescence of the networks, lack of storage capacity, lack of emergency generators, limited installed capacity, high cost of electricity generation (due to the high dependence on imported fuel for by the high dependence on fuel imports for electricity production), expiry of the technical-economic life of generators.

The São Tomé and Príncipe electricity system is composed of generation power plants, transmission and distribution grid and electricity supply. The transmission and distribution grid consists of medium voltage (MV) of 30 kV and 6 kV, low voltage (LV) of 0.4 kV, 30/6 kV substations and switching stations. The island of São Tomé is composed of two levels of MV; the 6 kV underground in the capital area and aerial in the southern peripheral area of the capital, and the 30 kV that covers most of the island. In the island of Príncipe the entire MV grid is 6 kV, one part being aerial and the other underground. According to EMAE's annual report for 2017, the electricity transmission and distribution grids in São Tomé have an estimated 203 km of MV grid of 30 kV and 300 km of LV. In the ARP the grid is estimated to comprise 25 km of MV grid and 25 km of LV.

The transmission and distribution of electricity in São Tomé and Príncipe is done on the same route, i.e., the same MV transmission grid serves as the distribution along its route. In this case, electricity transmission and distribution are merged, and there are transforming stations in derivation in the transmission line, thus making the electricity system quite complex and the national electricity grid difficult to manage. Faced with this situation and the growing electricity demand, EMAE initiated actions aimed at separating the electricity transmission and distribution infrastructures.

11.9 LANGUAGES AND RELIGION

The origin of the inhabitants of São Tomé is diverse. They are a mix of people from different parts of Africa and people from Europe, mainly Portugal. Besides the official language of Portuguese, three distinct Afro-Portuguese Creole languages are spoken. After independence, the government promoted the Lunga Santomé, or Forro, to the national language. In daily life at home the, Creole is used and spoken by the majority of the people. Only the upper class speak Portuguese in their private lives. Portuguese remains the official language, however, as well as the language of education. Except for a few lyrics, (written) literature on the islands is in Portuguese.

The local creole languages rely on oral literature. A “contagi” is a popular folk tale that features figures familiar from both African and European folktales, such as royalty, giants, and witches, and frequently deal with encounters of men and animals. The turtle often plays a prominent role as a sympathetic, intelligent, and bright animal, comparable to the fox in European stories. The tales reflect important aspects of social life in the archipelago, such as the natural environment, the plantation, hunting, traditional medicine, and beliefs.

The vast majority of the people are Christians, with around 80% Roman Catholic, 15% Protestant and the remainder other or no religion. Protestant groups are growing and include New Apostolic, Baptist, Evangelical, Seventh Day Adventist, the Portuguese Maná and pentecostal denominations. There is also a growing number of Jehovah‘s Witnesses, a growing community of about 200 Muslims and a similar number of the Baha‘i faith (Becker 2008). The moral teachings of the traditional church seem not to really interfere with the local way of life. Few couples marry, causing the rate of births outside marriage to be the highest in the world. Animist traditions that believe in the unity of body and soul, and the existence of souls in plants and animals, remain strong and exist alongside with Christian rituals. Traditional healers and ritual specialists, often members of a major religion, oversee the local spirit-possession cult, djambí.

11.10 VULNERABILITY

In this project vulnerable goups are considered based in the results of the socioeconomic survey and the focus discussion groups process s, between the groups of identified PAPs, those included in this situation of vulnerability is the group of **Women fruit sellers**, due to

- The informality and precariousness of their economic activity;
- They are displaced from their original area of activity due construction works in EN1 road ;
- and the fact that most of them are single mothers and head of the family (60%).

Within this heterogeneous group, there may be different situations. A minority of the fruit sellers may not meet all the requirements to be considered vulnerable, since, like any other socioeconomic group, certain heterogeneity can be expected. However, and for an appropriate social management of the Fruit sellers, as considered them as a homogeneous group (with same problems, needs and social considerations)

The vulnerable group are in 15 Fruit sellers in Ana Chaves Bay namely 15 fruit vendors.bay.

11.11 GENDER

There is no current statistical data with a degree of specificity on the numbers of gender-based violence that would allow characterizing the context of GBV in the country.

However, the results of the first publication in 2016 of the National Institute for the Promotion of Gender Equality and Equity (INPG) in partnership with the National Statistics Institute (INE), with the aim of contextualising gender equality and equity at the national level, confirmed that from 2013-2015 the numbers of recorded cases of violence continue to be mostly against women.

According to the study, the main social groups at risk are girls and children from low-income families, female heads of households, women without technical and professional qualifications, the elderly and the disabled.

Similarly, data from the study commissioned by UNICEF in 2017 for the Analysis of Interventions in the area of Fight Against Domestic and Gender Violence in São Tomé and Príncipe in the last 10 years confirm that 90% of victims reporting to the CACVD are women.

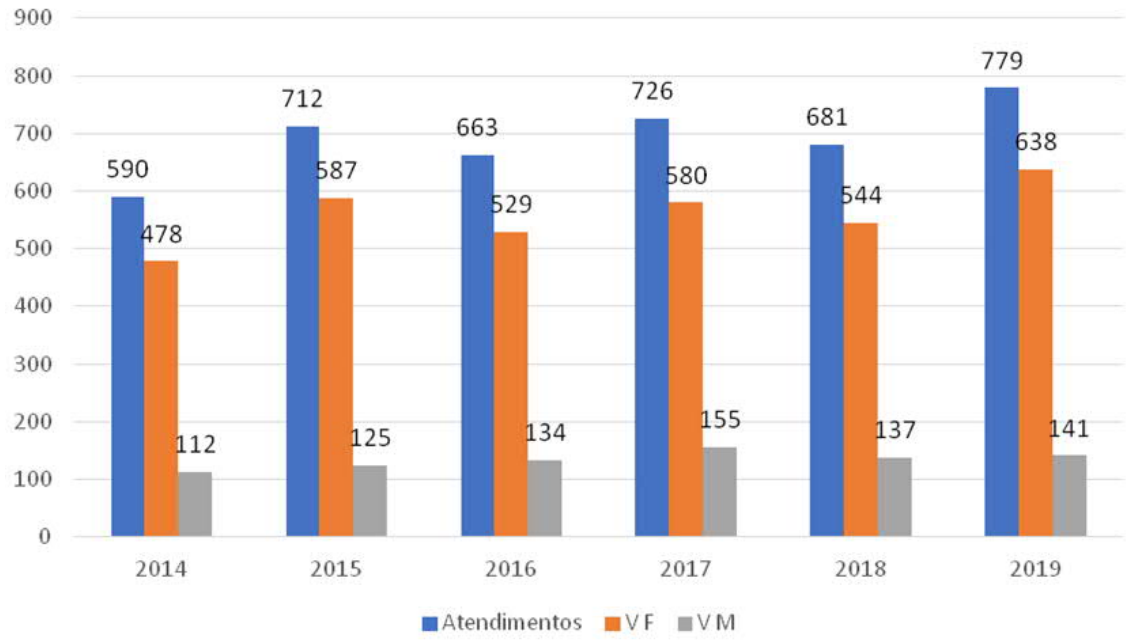


Figure 107 Number of attendances per gender. Source: CAVD (2020) Annual Report of the Counselling Centre Against Domestic Violence.

In São Tomé and Príncipe, the National Institute for the Promotion of Gender Equality and Equity (Instituto Nacional para Promoção da Igualdade e Equidade de Género), created in 2007 by the Decree-Law No. 18/2007, and located in the city of São Tomé, conducts activities to promote women and gender equality and equity in the country. Its main responsibility is to ensure that the government policy translated into the National Strategy for Gender Equality and Equity (ENIEG - Estratégia Nacional para a Igualdade e Equidade de Género) is duly executed and implemented. The institute often organises events and meetings to disseminate actions for the inclusion and empowerment of women.

ENIEG, developed with technical and financial support from the United Nations Population Fund, was adopted in 2007 and revised in 2013 and is structured under five strategic guidelines:

i. Economic promotion of women in rural and urban areas;
ii. Promotion of equality and equity in education and training;
iii. Improvement of the reproductive health and sexual health status of young adolescents and women;
iv. Strengthening the implementation of women's rights and participation in decision-making;

Strengthening the intervention capacities of institutional mechanisms in favour of gender equality and equity.

In addition to ENIEG, in the national regulatory framework the Constitution of the Republic of São Tomé and Príncipe also defends gender equity in the Principle of Equality (Article 15): "1. All citizens shall be equal before the law, shall have the same rights and shall be subject to the same duties, without distinction as to the social origin, race, sex, political views, religious beliefs or philosophical convictions; women are equal to men in rights and duties and are guaranteed full participation in political, economic, social and cultural life".

In the international regulatory framework, in February 2010 São Tomé and Príncipe signed the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (2003), although to date it has not ratified it.

In September 2015, São Tomé and Príncipe participated in the Fourth World Conference on Women Beijing Declaration, where the country committed itself to do the following:

i. Take all necessary measures to eliminate all forms of discrimination against women and girls, and remove all obstacles to gender equality and the advancement and empowerment of women;
ii. Implement an Action Platform to ensure that all policies and programmes reflect the gender perspective.

In addition to the National Institute for Gender Equality and Equity, some organisations promoting gender equality operate in São Tomé and Príncipe, such as the Association for Cooperation between Peoples (ACEP), the Federation of Non-Governmental Organisations in São Tomé and Príncipe (FONG-STP), the Human Rights and Gender Equity Platform (PDHEG), The Santomean Association of Jurist Women (ASMJ), the Social and Development Association (ADM Estrela), the Santomean Association for Family Promotion, the Forum of Santomean Women (FMS) and the Centre for Reception Against Domestic Violence (CACVD).

São Tomé and Príncipe have acted to create and make operational bodies to apply the adopted strategies and action plans and to raise awareness in Sãotomean society about the relevance of gender equality in promoting sustainable development.

Among the operationalized measures, the following stand out:

1. The holding of the 1st São Tomé and Príncipe Women's Forum in 1996, within the scope of which the "Platform for Action of Santomean Women" was approved;

2. The creation of the Women's Forum of São Tomé and Príncipe, which consists of an association of several Non-Governmental Organizations (NGOs) of women and also individuals ;

3. The performance of the Counselling Centre Against Domestic Violence (CACVD);

4. The action of the National Institute for the Promotion of Equality and Gender Equity (the organism responsible for the promotion of gender equality, created in 2007);

5. The creation of the Sãotomean Association of Women Jurists (since 2009, aims to disseminate women's rights), the same that created the Office of Legal Support to Women (2009);

6. The creation of the Platform for Human Rights and Gender Equity (PDHEG) - Sãotomean NGO created in 2013, dedicated to the promotion of gender equity in São Tomé and Príncipe;

7. The development of the project "Women's Rights - knowing, empowering, raising awareness".

Along the waterfront from Lagarto to Pantufo we find the sexual division of labour clearly evident. Women wash clothes and cutlery in the rivers, sell fruit and fish, while men are mainly fishermen.

With regard to fishing, only the men practise it and sell it to the women, who in turn sell to the final consumer. When a husband and wife are involved, the man fishes and delivers to his wife, who sells to the consumer and then bills him. In the area of the old pie, many consumers go to buy directly from the canoes in the hands of the fishermen, although some of the fish is sold to fish sellers “palaies”.

There are young boys under 18 selling coconut water on Emilia beach in Lagarto bay, an activity carried out exclusively by boys.

11.12 INFORMATION AND COMMUNICATION MEDIA

In 2012, the State of São Tomé and Príncipe approved a decree-law allowing the entry of other operators in the country, which culminated with UNITEL, so that the country now has two operators in telecommunications sector.

The entry of the undersea cable to São Tomé and Príncipe in 2012 and its operation took place in January 2013 a commercial operation of the undersea fibre optic cable of the ACE consortium, African Coast to Europe.

About 20 countries of the African coast are connected to the cable that connects to France. Nine of them will first receive the connection to a submarine cable to South Africa.

The country created the Higher Council of the Press with the main task of supervising and guaranteeing pluralism and freedom of expression and the press where power interferes in the work of journalists.

In terms of traditional media, there is only one television channel, TVs, but the line is open to other international broadcasters such as RTP África and RFI International.

As for radio, apart from the national state radio, there are private radios, Rádio Jubilar and Rádio Viva, and the community radios Tlacha, Anguéné and Lobata. With the advent of the internet, there has been a proliferation of online radio stations.

The Institute for Innovation and Knowledge (INIC) was created in 2008 by the Decree-Law 19/2008 with the main objective of implementing the Information and Knowledge Society in São Tomé and Príncipe and promoting Scientific Research, Development and Technological Innovation (R+D+i).

The INIC is responsible for formulating and implementing strategies to integrate the New Information and Communication Technologies in the processes of human activities that should contribute to sustainable development in the areas of public administration, education, health, employment, tourism, environment, agriculture, livestock, fisheries, science and to support companies in their modernisation.

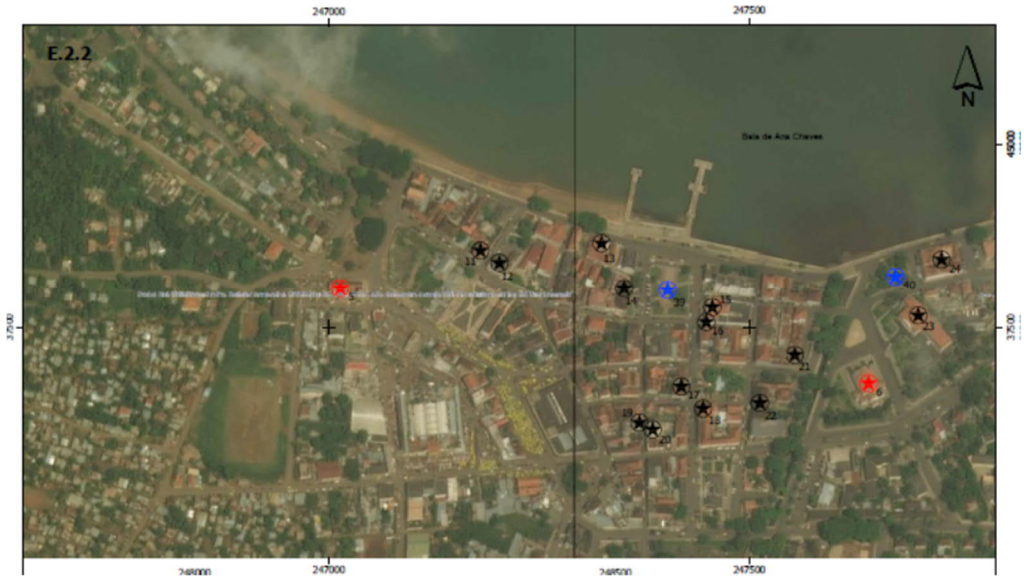
The dissemination of the project to directly and indirectly interested parties, is essential for better engagement and appropriation of the project by the population. In this sense, in addition to its dissemination in the above-mentioned media channels, meetings and gatherings have been held in the communities closest to or directly affected by the project, or the group of individuals whose project intervention may affect their activities.

11.13 CULTURAL HERITAGE

The following figures show the location of cultural heritage identified for Ana Chaves bay and Pantufo coastline. In Lagarto bay no elements were identified.

Along Ana Chaves bay was identified Colonial Wharehouse (13), Discovery Monument (40) and Justice Palace (24), Church of Bom Despacho (3), Church of Bom Jesus (4), Port Buildings (28), Ministry of

Finance (29), Santa Casa da Misericódia Building (30), Statue and Obelisk near São Sebastião Fort (46) and São Sebastião Fort (37) and in Pantufo coastline, a colonial building (21).



IMÓVEIS

Religioso:
5 Igreja de Nossa Senhora da Conceição
6 Sé Catedral de Nossa Senhora da Graça

Civil:
11 Casa da Cultura
12 Residência do 1º Ministro
13 Armazém Colonial (Av. 12 de Julho)
14 Direção Geral de Finanças
15 Banco Central de São Tomé e Príncipe
16 Farmácia Epifanio da França
17 Edifício Ayres Beirão
18 Armazém Pereira Duarte
19 Edifício Colonial (Av. Moçambique)
20 Banco do Equador
21 Edifício Colonial (Av. Água Grande)
22 Edifício Colonial (Av. Patrice Lumumba)
23 Palácio Presidencial
24 Palácio da Justiça/Registo Civil

Comemorativo:
39 Pedestal de Pedro Escobar
40 Monumento aos Descobridores

Figure 108 Cultural Values Source: PNOT 2020



IMÓVEIS

Religioso:
3 Igreja do Bom Despacho
4 Igreja do Bom Jesus

Civil:
21 Edifício Colonial (Av. Água Grande)
25 Cinema Marcelo Veiga
26 Arquivo Histórico de São Tomé e Príncipe
27 Biblioteca Nacional
28 Edifícios Portuários
29 Ministério das Finanças
30 Santa Casa da Misericórdia de São Tomé e Príncipe/BISTP

Militar:
37 Forte de São Sebastião

Comemorativo:
41 Esculturas de Madeira (Praça UCLA)
42 Monumento dos Heróis da Liberdade
43 Busto do Rei Amador
44 Fontanário da Passagem do Século
45 Esculturas (Praça da Juventude)
46 Obelisco e Estátuas junto do Forte de São Sebastião

Figure 109 Cultural Values in Ana Chaves and Pantufo bays Source: PNOT 2020

Along Pantufo bay was identified the Portuguese Embassy (32) and Infante D. Henrique Monument (47).



Figure 110 Cultural Heritage Buildings in Pantufo coastline Source: PNOT 2020

Along Marginal of São Tomé the historical and cultural buildings are:

1. São Sebastião Fort (current National Museum): with a quadrangular plan and four bastions, its construction began in 1566, possibly restarted and completed in 1575, in the reign of D. Sebastião, due to the revolt of the Angolans in 1574, and due to the attacks of the French corsairs on the other Atlantic islands dominated by the Portuguese. a) The concern to ensure the defense of the city was at the base of the creation of a set of fortifications.



Figure 111 São Sebastião Fort

2. The Customs Building: built in the second phase of urban development, the implantation of new institutional buildings, with the increase of commercial activities, with emphasis on the slave trade and the cultivation of sugar cane. This building controlled the goods, and its location is only known in the cartography from 1888/89.

3. Building of the Post and Telephone Services/current building of the Courts: built with stones resulting from the demolition in 1913 of the Misericórdia Hospital.

4. Church of the Cathedral/Mother Church of Nª Sª da Graça: it was built next to the foundation of the old church of Santa Maria, by order of D. Sebastião, in the year 1576, when a new church of the Cathedral was opened and continued to work on it until the year 1578. Construction was not completed. In March of 1863, repair works began.

5. Republic Square/current Independence Square: it came about during the third phase of urban development - the expansion of the city, (late 16th century beginning of the 17th century). This is a period marked by the development of maritime commercial activities. After 1975 it was renamed Independence Square.

6. Ana Chaves bay: where the city of São Tomé is based; the village was founded by Álvaro de Caminha in 1506-1510. By then it already had 250 houses of modest construction, made of wood, only one or two rooms and covered with wood. The first constructions existing in the early sixteenth century were the Tower, the churches of Santa Maria and S. Francisco, the church Mother of Our Lady da Graça, the Conceição church and the church of the Misericórdia Hospital.

7. Bom Jesus Chapel: built in 1770, it benefited from restoration works in 1936, whose extension is unknown. The tombstone inscribed on the façade of the tower refers that it was "rebuilt in MCMXXXVI".

8. Chapel of Our Lady of Belém/present Bom Despacho: it was founded around 1617. It was restored in 1965 under the works of the architect Luis Benavente.

9. Silva Cunha Technical School/current National Lyceum with a balanced expression between the traditional and the modern, evident in several other Portuguese high schools around the world in the years 1950-60: a central and elevated portico presents on each side two long wings of rational design in two floors, with spans modulated and sequential corridors.

10. Porto and the warehouses to store sugar: they constituted the fundamental urban elements of the origin of the city of São Tomé. The warehouses were located near the coast and near the port, in the place where later (century XIX), warehouses were installed to store cocoa and coffee. Besides serving to

increase the commercial activities, the port was the access by sea and the facility to access to the sea by the beach and revolving plate of the entrance and exit of the slaves (golden period of the slave traffic). It was during the second phase of urban development of the city of São Tomé.

11. Fortaleza de S. Jerónimo: a simple construction, now in ruins, whose date according to the scoreboard in Roman numeration is: MDXXX. Built in the year 1613 or 1614. According to Lopes de Lima, "a fort was built - the fort of São Jerónimo - whose objective was to defend the fortress and the port connected to the city." Located in the coast near Congress Palace in Pantufo Coastline.

Colonial houses

Along Marginal Road in Ana Chaves bay and Pantufo Coastline are identified 66 colonial houses. Some of them are in Bad Conservation Status or with altered architectural elements. Annex 10 presents the colonial houses considered to be most representative in Direct Area of Influence of Project and their location. The following figures present examples of Colonial House in São Tomé City.



Figure 112 Colonial Houses

11.14 LAND USE

In Água Grande, marginal land use activities include gardens, parks, squares, tree-lined avenues and other green areas near built-up areas. The public spaces along the waterfront of the Ana Chaves bay, which include the Independence Square, the green spaces framing the Cathedral of São Tomé and the Presidential Palace, the UCCLA Park, the surroundings of the Church of Bom Jesus/Bom Despacho and the green space next to the Captaincy, are currently highlighted in the urban mesh. In addition, next to the coastline, there is also an expressive green space around the United Nations. Inside the urban mesh, we highlight the space around the Curadoria, the alignment of spaces along Avenida Água Grande Avenue and the Gago Coutinho square. It is also important to mention the tree-lined streets, which are extremely important in articulating the different green spaces and in materializing the intended green structure, namely along the avenues Marginal 12 de Julho, Água Grande, Independência and Nações Unidas.