REPORT

Quilonga Grande Project

Environmental and Social Impact Assessment (ESIA) - Addendum

Submitted to:

GAUFF

Submitted by:

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Study Limitations

This report is prepared during April - December 2023 by WSP for the benefit of ASGC and GAUFF in accordance with the conditions set out in the Terms and Conditions agreed and signed by both parties in March 2023. However, ASGC has exited the Project in August 2023 and is no longer the main contractor of the Lots 1, 10, 8 and 3. That role is now under responsibility of Sinohydro.

To the extent practicable, WSP relied on information made available by the Clients, EPAL and also in the previous ESIA prepared by Artelia in 2014. However, much of the information is commercially sensitive and protected by confidentiality agreements between the parties to the contracts and its accuracy could not be independently verified. Project designs are still not concluded and therefore limited some aspects of the impact assessments.

Furthermore, the primary data for the baseline studies were collected by the local consultants. Although WSP provided guidance to the study design and review of the deliverables, the outputs remain the work of the appointed consultant.

The Human Rights Assessment presented in this ESIA is limited to a screening-level assessment as agreed with the ASGC and GAUFF and was partially based on ASGC corporate polices. Therefore, the assessment is no longer valid.

The Climate Change Risk Assessment guidance has been updated in May 2023. The Physical Climate Change Risk Assessment presented in this ESIA – Addendum does not include some of the new requirements of the guidance update as the scope of work was agreed with the clients before May 2023.

LIST OF FREQUENT ACRONYMS

Acronyms	Definition
24 WCFSC	24 World Climate and Food Safety Charts
AETFAT	Association for the Taxonomic Study of the Flora of Tropical Africa
AHT	Average Hourly Traffic
AMN	Maritime National Agency
ANC	African National Congress
ANPG	*Agência Nacional de Petróleo, Gás e Biocombustíveis* (National Oil, Gas and Biofuels Agency)
ARII	Africa Regional Integration Index
AoI	Area of Influence
APCM-Namibe	Academy of Fisheries and Sea Sciences of Namibe
BPs	Bird survey points
BRT	Bus Rapid Transit
BTs	Bird survey transects
CBD	Convention on Biological Diversity
CCRA	Climate Change Risk Assessment
CEI	Centre for Environmental Information
CESMP	Construction Environmental & Social Management Plan
CHIRPS	Climate Hazards group Infrared Precipitation with Stations (dataset)
CICES	Common International Classification of Ecosystem Services
CIF	China International Fund
CITES	Convention on International Trade in Endangered Species of Fauna and Flora
CMS	Conservation of Migratory Wildlife Species
CNL	*Clube Naval de Luanda* (Luanda Nautical Club)
CO	Carbon Monoxide
COBEJE	Companhia Bebidas Bom Jesus (Bom Jesus Drinks Company)
COMIFAC	Establish the Central African Forests Commission
CR	Critically Endangered (level according to IUCN Red List of Threatened Species)
CRA	Constitution of the Republic of Angola
DC	Distribution Centers

DD	Data Deficient (IUCN status)
DGPC	Directorate-General for Cultural Heritage
DNPAIA	National Directorate for the Prevention and Assessment of Environmental Impacts
EAAA	Ecologically Appropriate Area of Analysis
EAC4	Atmospheric Composition Reanalysis 4
EASU	Uíge Public Water Company
EBRD	European Bank for Reconstruction and Development
ECA	European Export Credit Agencies
ECMWF	European Centre for Medium-Range Weather Forecast's
EHS	Environmental Health & Safety
ELISAL	*Empresa de Luanda e Saneamento de Luanda,* an entity of the Government of the Province of Luanda dedicated to the cleaning and sanitation of the capital of Angola
ELP	Entry Level Project
ELV	Emission Limit Values
EN	Endangered (level according to IUCN Red List of Threatened Species)
ENDE	Electricity public network
EOO	Extent of Occurence
EP	Equator Principles
EP	Public Companies
EPAL	*Empresa Pública de Aguas de Luanda* (Luanda Public Water Company)
ES	Environmental and Social
ES	Ecosystems services
ESS	Environmental and Social Standards
ESA	European Space Agency
ESDD	Environmental & Social Due Diligence
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ETL	Luanda Taxi Company
ETP	Public Transport Company
FAO	Food and Agriculture Organization

FC-UAN	Air Quality Station of the Agostinho Neto University
FDI	Foreign direct investments
FEWS-NET	Famine Early Warning Systems Network
FNU	Formazine Nephelometric Unit
FPs	Terrestrial flora and habitat survey points
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoA	Government of Angola
GOME	Global Ozone Monitoring Experiment, an optical spectrometer
GPL	Provincial Government of Luanda
HRRA	Human rights risk screening
H&S	Health and Safety
HEA	Household Economy Approach
IAMAT	International Association for Medical Assistance to Travelers
IBEP	Integrated Survey on the Welfare of the Population
ICOMOS	International Council on Monuments and Sites
IDR	Expenditure and Revenue Survey
IDREA	Expenditure and Revenue and Employment Survey in Angola
IDPs	Internally Displaced Peoples
IFC	International Finance Corporation
IFIs	International Finance Institutions
IICT	Tropical Scientific Research Institute from Portugal
ILO	International Labour Organisation
IMPA	Maritime and Port Institute of Angola
INAMET	*Instituto Nacional de Meteorologia e Geofísica* (National Institute of Meteorology and Geophysics)
INAVIC	National Institute of Civil Aviation
INCFA	National Institute of Railways of Angola
INE	*Instituto Nacional De Estatísticas* (National Statistics Institute)
INGA	Environmental Management Institute of Angola
INPC	National Institute of Cultural Heritage

INTR	National Institute of Road Transport
ISCED	Higher Institute of Educational Sciences
ISPT	Higher Polytechnic Institute of Tete
ITCZ	Intertropical Convergence Zone
IUCN	International Union for the Conservation of Nature
LC	Least Concern (IUCN status)
LCCS	Land Cover Classification System
LSA	Later Stone Age
MAV	Maximum Admissible Values
MDGs	Millennium Development Goals
MEA	Millennium Ecosystem Assessment
MEP	Ministry of Economy and Planning
MERRA-2	Modern-Era Retrospective analysis for Research and Applications, Version 2
MEW	Ministry of Energy and Water
MINADERP	Ministry of Agriculture and Rural Development
MRV	Maximum Recommendable Values
MSA	Middle Stone Age
NDIR	Non-dispersive infrared gas sensing
NDP	National Development Plan
NIP	Property Identification Number
NE	Not Evaluated (IUCN status)
NMVOC	Non-Methane Volatile Organic Compounds
NOOA	National Oceanic and Atmospheric Administration
Nox	Nitrogen Oxides
NT	Near Threatened (level according to IUCN Red List of Threatened Species)
NTU	Nephelometric Turbidity Unit
OECD	Organisation for Economic Cooperation and Development
PAH	Polycyclic Aromatic Hydrocarbons
PDGML	*Plano Director Geral Metropolitano de Luanda* (Metropolitan General Plan for Luanda)
PDM	Viana Municipal Master plan

PID	Photo Ionization Detector
PIIM	Plan for Intervention in Municipalities
PIV	Polo Industrial de Viana
PM	Particulate Matter
PR	President of the Republic
PRESGRU	Strategic Plan for Urban Waste Management
RAPP	*Relatório dos Resultados das Explorações Agro-Pecuárias/Piscatórias e Aquícolas Familiares* (Results Report for Family Agricultural/Livestock/Fisheries and Aquaculture Farms)
REAA	General Environmental Status Report of Angola
REE	Regional Ecological Extent
RR	Restriction Range
RVAA Program	Regional Vulnerability Assessment and Analysis Program
SADC	Southern African Development Community
SASSCAL	South African Science Services for Climate Change and Adaptive Soil Management
SCADA	Supervisory Control and Data Acquisition Systems.
SCB	Standard Chartered Bank
SCIAMACHY	a satellite instrument that measures trace gases in the Earth's atmosphere and surface
SDGs	Sustainable Development Goals
SINOHYDRO	Chinese state-owned hydropower engineering and construction company
SODIBA	*Sociedade de Distribuição de Bebidas de Angola* (Beverage Distribution Society of Angola)
STP	Sludge treatment plant
TEEB	The Economics of Ecosystems and Biodiversity
TCFD	Task Force on Climate-Related Disclosures
TCUL	Transportes Coletivos Urbanos de Luanda
TDH	Total Dynamic Head
TURH	Water Resources Using Titles
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization

UNFCCC	United Nations Framework Convention on Climate Change
UN	United Nations
UOPGs	Operational Planning and Management Units
USAID	United States Agency for International Development
UV	Ultraviolet
VU	Vulnerable (level according to IUCN Red List of Threatened Species)
VMA	Maximum Allowable Value
VMR	Maximum Recommended Value
VOCs	Volatile Organic Compounds
WBG	World Bank Group
WHO	World Health Organization
WTP	Water Treatment Plant
WWIS	World Weather Information Service
WWT	Wastewater Treatment
ZEE	*Zone économique exclusive* (Special Economic Zone)

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1.0 INTRODUCTION

1.1 Quilonga Grande Project overview

Due to high fertility rates and urban migration after many years of civil unrest, the population of the province of Luanda is facing a rapid growth as well as its demand for drinking water. The Ministry of Energy and Water (MEW) of Angola intends to further develop the drinking water supply to fulfil that demand. Currently the Luanda province has three main water supply systems with capacity of 655 838 m^3/d and 12 smaller systems with capacity of 125 436 m^3/d). However, 40 % of water losses is estimated due vandalization, illegal abstraction and ruptures in the systems.

The Water Supply Master Plan (“Plano Director de Abastecimento de Água”) prepared in 2005 was the basis for the construction of new systems/components as well as the expansion of several existing systems in Luanda. In 2009, this Master Plan was revised considering the urban growth and the forecast of new areas of urban expansion. In 2011, this Plan was issued as Presidential Decree 59/11 (“Decreto Presidencial 59/11”), in which the Water Supply Projects known as “Bita – S4 “and “Quilonga Grande – S5” were included for implementation (Figure 1). In view of the rapid urban expansion and the immense demand for water, it was necessary to update the said Plan whose revision was prepared in 2015.

This revision considered the situation of the water systems and the Population Census issued in 2014. A projection up to the year 2040 was thought in accordance with the official data from the National Statistics Institute (INE). The Plan was made compatible with the approved General Master Plan of Luanda (“Plano Director Geral de Luanda”) and in update/revision.

The Bita Project, set to supply the south region of Luanda with capacity of treatment of 3 m^3/s by 2026, is in a more advanced stage and an Environmental and Social Impact Assessment (ESIA) was already elaborated in 2019. The expansion of the Bita System to further increase its capacity to 6 m^3/s is planned to a later stage (2027-2029).

The present Scoping Report concerns the Quilonga Grande System only, which the Government of Angola considers as a priority project. It is anticipated to have a capacity of treatment of 6 m^3/s and has infrastructures to be implemented in the municipalities of Icolo e Bengo, Viana e Cacuaco and covers an area of 60.370 ha. It is intent to benefit 5 million people in the East part of the city by reducing the deficit of drinking water supply of Luanda by 33% and increase the supply of up to 95 L/per capita/per day). The Project involves capturing water from River Kwanza, pumping and transfer to a Water Treatment Plant (WTP), and transporting it through 100 km of water transmission pipelines to seven Distribution Centers (DC) as well as a process water treatment station plus all ancillary facilities.

The company promoting the Project is the provincial water authority “Empresa Pública de Aguas de Luanda” (EPAL) which is responsible for carrying out studies, projects, operation and maintenance of water collection, treatment, supply, and distribution systems, under a public service regime, in accordance with the concessions and licenses granted by the competent authorities. EPAL collects, treats, transports, distributes, and commercializes water for human consumption in the city of Luanda, for domestic use, industry, commerce, and several services, under concession.

The Quilonga Grande Project is separated into 10 Lots which were divided in to three groups, managed by separate contracts and three main contractors - ASGC, Sinohydro and GAUFF. Three of those Lots have already been constructed.

Standard Chartered Bank (“SCB”) has been mandated by the Ministry of Energy and Water (the “Borrower”) to structure and arrange the financing for the Project and SCB is financing using European Export Credit Agencies (“ECA”), in particular Euler Hermes for three of the Lots. The ECA for the remaining six Lots if yet to be confirmed.

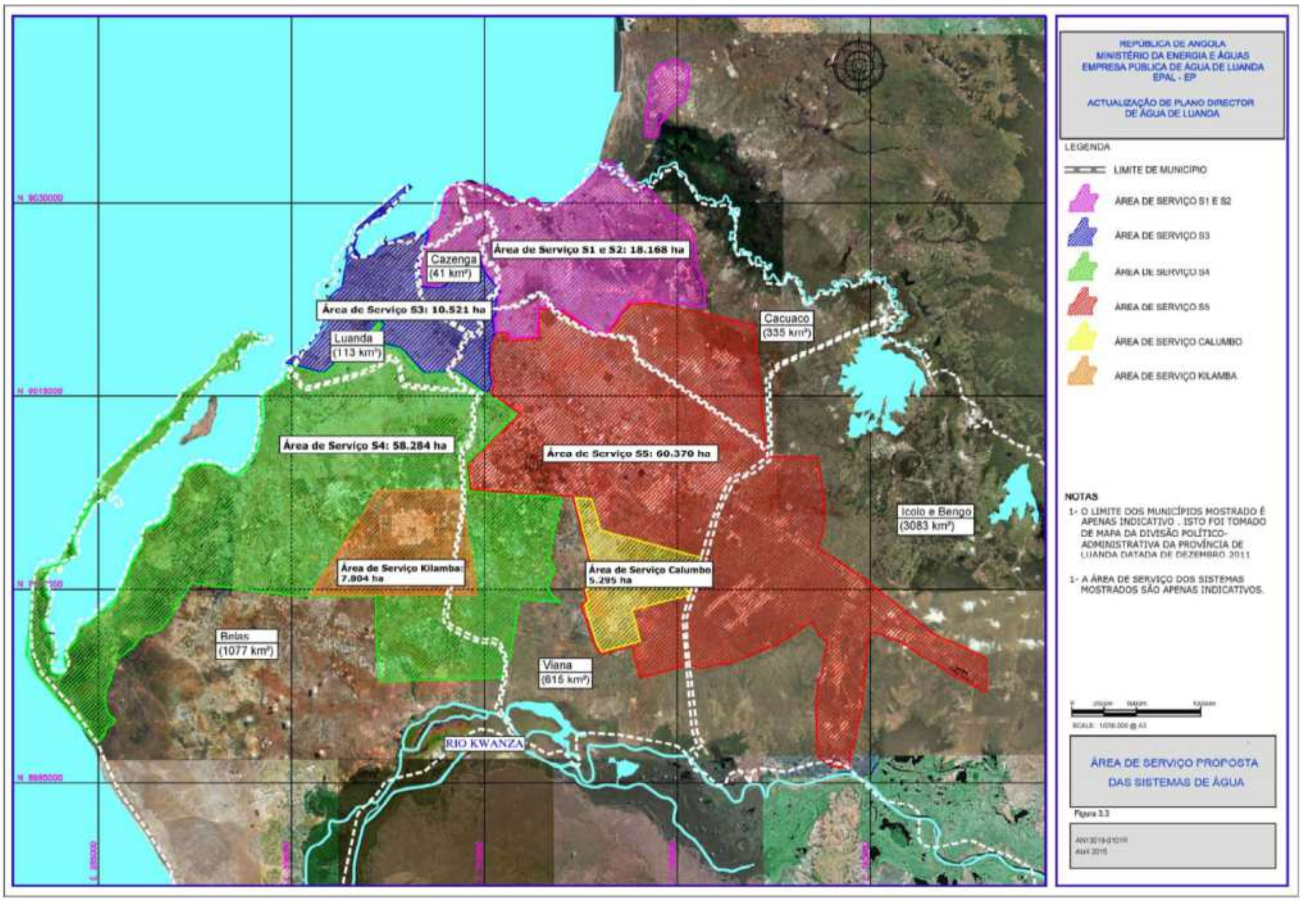


Figure 1: Existing and Planned Systems of Drinking Water Supply for Luanda Province, Including S4 Bita (in green) and S5 Quilonga Grande (in Red). (EPAL, 2015-2020).

An Environmental & Social Impact Assessment (ESIA) for the construction and operation phases has been developed by Artelia and its local environmental partner Ecovisão in 2014 to meet national and international standards (International Finance Corporation, IFC). The study has now been considered incomplete and aged.

WSP was retained as a consultant by ASGC and GAUFF (referred to as ‘the Clients’) to carry out an analysis to identify gaps of the existing ESIA Report and suggest actions to close these gaps to reach a full bankable ESIA in line with the National Regulations and International Finance Institutions (IFIs) Performance Standards:

Equator Principles (EP), World Bank Group (WBG) Environmental Health & Safety (EHS) Guidelines, Environmental and Social Framework and Environmental and Social (ES) Standards; International Finance corporation (IFC) Performance Standards and Guidelines along with the national legislation. The next step is to elaborate an ESIA Addendum in order to assure compliance with international financing.

1.2 Purpose of the Environmental and Social Impact Assessment (ESIA) Addendum

The ESIA addendum purpose is to complete the existing ESIA gaps to assure a thorough and systematic analysis of the project impacts and risks and to define mitigation and compensation measures. For this, the following activities were undertaken :

- Update the description of the proposed project by providing a summary description of the relevant project components ;
- Describe the political, legal, and institutional framework of the project, highlighting the key changes since 2014 ;
- Define and justify the project area of influence for the assessment of environmental and social impacts ;
- Describe and analyze the baseline conditions of the physical, biological, and social environment components in the study area before the project is carried out ;
- Conduct field surveys to understand the presence of sensitive ecosystems and or species; and needs for involuntary physical or economical displacement of persons ;
- Examine potential cumulative impacts considering other initiatives planned or existing in the study area;
- Consider the effects of climate change in the project design ;
- Conduct additional stakeholder consultations (after producing a stakeholder engagement plan and identifying gaps) to be aware of their views and concerns about the project, and to provide them information on the result of the analysis ;
- Prepare a Framework for the Environmental and Social Management Plan (ESMP) for the project in compliance with the Angolan legislation and procedures, the international standards as well as ASGC and GAUFF Group's policies, standards, plans and processes.

1.3 Outline of the ESIA addendum report

The ESIA report includes the following chapters:

- Summary of Project Description: presentation of the location of all lots, technical aspects, and phasing of the Project (Chapter 2.0) ;
- Legal and institutional framework : presentation of national and international regulations and requirements (Chapter 3.0) ;
- Proposed Project E&S categorisation: Classification of the project in terms of social and environmental risks (Chapter 4.0) ;
- General Methodology: description of the methodology for the definition of the study areas, baseline studies, impact assessment as well as the environmental and social management plans (Chapter 5.0) ;
- Stakeholder consultation results: description of the consultations carried out and their results (Chapter 6.0);

- Baseline Conditions: establishment of the initial state of the physical, biological, and social components study area of each of project components, only for to the data gaps identified for the ESIA 2014 report (Chapter 7.0) ;
- Impact Assessment: assessment of the potential impact of the project on physical, biological, and social components of each of the project components, definition of mitigation measures, and assessment of the residual impact (Chapter 8.0) ;
- Summary of the main impacts of the project once mitigation measures are applied (Chapter 9.0) ;
- Cumulative Impacts: assessment of possible environmental changes resulting from a combined action with other projects (Chapter 10.0) ;
- Alternative analysis presentation of the reasons why the Project is being carried out as it is, and what the possible options (Chapter 11.0) ;
- Framework for the Environmental and Social Management during construction phase (Chapter 12.0) ;
- References used in the study (Chapter 13.0).

1.4 Presentation of the ESIA team

The ESIA team includes specialists from WSP (France, Italy, and Canada) and consultants of one Angolan company (Saioz).

WSP

WSP is one of the world's leading engineering and sustainability professional services consulting firms. We are dedicated to our local communities and propelled by international expertise. Our technical specialists and strategic advisors include engineers, technicians, scientists, architects, planners, surveyors, and environmental and social specialists, as well as other design, program, and construction management professionals. We design lasting solutions in the Transportation & Infrastructure, Property & Buildings, Environment, Industry, Resources (including Mining and Oil & Gas) and Power & Energy sectors as well as project delivery and strategic consulting services. With more than 66,000 talented people in 500 offices across 50 countries, we engineer projects that will help societies grow for lifetimes to come.

WSP has an extensive experience in Environmental and Social services on behalf of Sponsors and Lenders throughout ESIA, ESDD, construction and commissioning, and operational phases for international projects. We are familiar in working with International Finance Institutions (IFIs), Equator Principles Banks, Donors, and Lenders. We have also built a significant experience in internal reporting to project sponsors and Lenders groups, as well as in external reporting to project stakeholders. We are recognized by our clients for our technical expertise and service excellence.

Saioz

Saioz Environmental Engineering, Lda., is an Angolan company that operates in the environmental consultancy area and that is registered with the Environmental Ministry of Angola with the consultancy certificate number 8857435238 and registered with the Environmental Management Institute of Angola (INGA), according to communication reference 0506/04.GDG/INGA/2018, for the development of Environmental Monitoring Services in the whole national territory.

ESIA key members

The key members of the team are presented in the Table 1 below.

Table 1: ESIA Project team

Team	Role	Name	Company
Management team	Project director	Christophe André	WSP
	Project manager	Rosana Moraes	WSP
Discipline leads	Physical lead	Christophe André	WSP
	Biological lead	Cecilia Amosso	WSP
	Social lead	Manuela Lapadat	WSP
Environmental experts	Senior Aquatic Biologist	Warren Aken	WSP
	Climate Change specialist	Cristian Villata	WSP
	GHG emissions assessment specialists	Giovanni Marsilio Roberto Gaveglio	WSP
	GIS specialists	Sabrina Lafrej Laura Basso	WSP
	Environmental specialists	Lauriane Bitton Florine Chaudot Marco Asnaghi	WSP
National experts	Catarina Silva	Project director	SAIOZ
	Ricardo Nogueira	Project manager/Physical lead	SAIOZ
	Américo Reis	Social lead	SAIOZ
	Pedro Martins	Biological lead	SAIOZ
	Pedro Duarte	Geologist lead	SAIOZ
	Luis Castro	Archeologist lead	SAIOZ
	Vanessa Mateus	Environmental engineer	SAIOZ
	Dealdino Lemos	Social lead	SAIOZ
	Luisa Gonçalves	Biologist	SAIOZ

2.0 SUMMARY OF PROJECT DESCRIPTION

2.1 Project organizational chart

Ultimate responsibility for the Project construction and operation will lie with the Promotor (EPAL, *Empresa Pública de Aguas de Luanda* - Luanda Public Water Company) Administrative Council who is responsible for:

- Compose a Project Implementation Unit (PIU)
- Appoint its subcontracted Project Management Consultant (PMC).

DAR, as the PMC, is responsible for Project quality management and site supervision. On behalf of EPAL's Project Implementation Unit (PIU), DAR shall:

- Oversight and coordinate Project activities,
- Produce Project progress reports for compliance with requirements, including monitoring and reporting for each Lot.

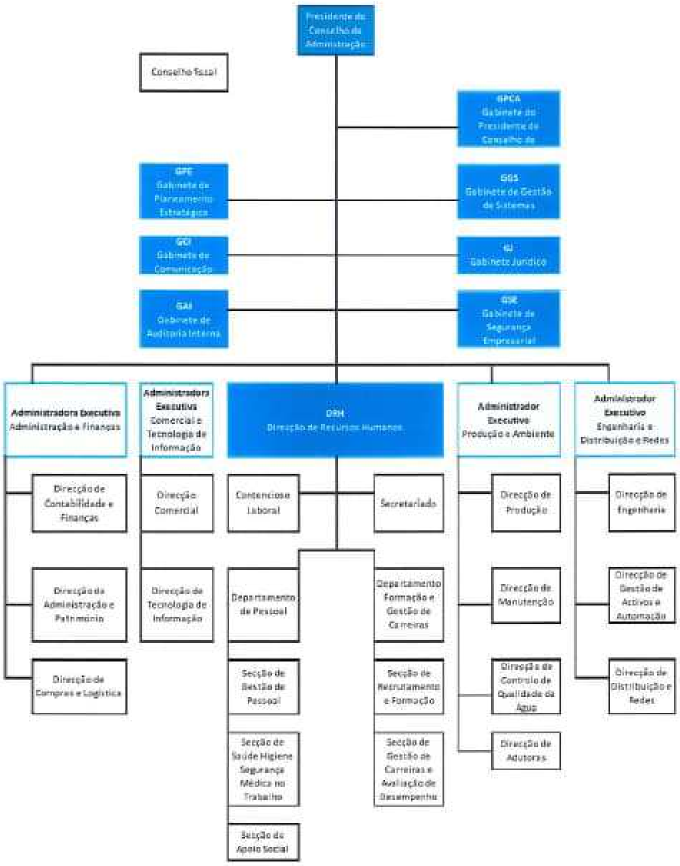


Figure 2: Organizational structure of EPAL (EPAL 2021))

2.2 Project main contractors

ASGC

ASGC, the management contractor, is a highly regarded, Dubai-based international construction company with revenues of around USD1 billion and employing 15,000 worldwide. They operate across a wide range of sectors including healthcare, residential, aviation, industrial, commercial, retail, culture, hospitality, and infrastructure. The Group through his main construction company has been recognized for his EHS/OHS excellency achieving certifications on ISO 14001:2015 and ISO 45001:2018, as well as being a member of the British Safety Council.

GAUFF Engineering

GAUFF GmbH & Co. Engineering KG offers professional services in the fields of Urban water management, Energy, Transportation and Financing. Together with internationally renowned finance institutes, GAUFF co-ordinates the funding of large-scale projects, thus ensuring the best possible certainty for execution.

2.2.1 Main contractors' corporate policies

ASGC and GAUFF follow several policies which are respectively described in Table 2 and Table 3 below:

Table 2: ASGC ESG Policies

Name	Date	Description
Sustainable Procurement	-	ASGC Contraction LLC endeavor's that all procurement activities undertaken are to be conducted in a manner to promote the concept of sustainability within its supply chain. In line with their Environmental Policies they will strive to incorporate environmental and social considerations into our procurement processes. ASGC recognize that it is their responsibility to encourage our supply chain to minimize negative. environmental and social effects associated with the products and services they provide.
Corporate Social Responsibility	2018	ASGC is committed to maintain the highest standards of integrity and corporate governance practices in order to maintain excellence in its daily operation, and to promote confidence in our governance systems. ASGC recognizes the importance of protecting all of human, financial, physical, informational, social environmental and reputational assets.
Drug Free & Alcohol	2021	The Company is committed to maintaining a safe, productive work environment. An employee who is under the influence of drugs or alcohol poses a serious threat to individual safety, productivity, and quality.
Employee Code of Ethics and Business Conduct	2018	ASGC is committed to maintain a safe work environment by defining a code of conduct to be applied by all employees and affiliates regarding their behavior towards their colleagues, supervisors, and coverall organization.
Environmental and sustainability	2020	ASGC is committed to identify occupational environmental aspects in their business operations and when possible, eliminating or reducing any negative impacts on the environment that may arise from them.
Human rights	2021	ASGC is committed to respect Human Rights as described by the UN Guiding principles, the International Bill of Human Rights, and International Labour Organization (ILO), Declaration of Fundamental Principles and Rights at work in its business activities.
Non-Discrimination and Harassment	2018	ASGC is committed to a work environment in which all individuals are treated with respect and dignity. Everyone has the right to work in a professional atmosphere that promotes equal employment opportunities and prohibits unlawful discriminatory practices, including harassment.
Occupational Health and Safety	2020	ASGC is committed to identify occupational H&S risks in their business operations and eliminating them, when possible, with the aim to provide safe and healthy working conditions and preventing workplace injury and ill health.
Quality	2018	ASGC is committed to comply with the current international ISO 9000, quality Management System, to provide high standards of product and service to their customers and achieving and maintaining business excellence in all their activities.
Worker's employment	2021	The policy aims at setting forth minimum mandatory requirements with respect to recruitment, living and working conditions and general treatment of Workers engaged in construction and other projects at ASGC UK and its subsidiaries or "ASGC".
Workplace violence	2018	ASGC is committed to provide a safe workplace for employees and for visitors to the workplace. ASGC believed that each employee and everyone with whom ASGC will come in contact in their work deserves to be treated with courtesy and respect.
Complaints & Grievances Procedure	2018	ASGC is committed to provide a fair, equitable and productive work environment for all employees. This policy seeks to support the achievement

Name	Date	Description
		of this goal by providing a transparent and consistent process for resolving grievances.
Worker Welfare Procedure	2018	ASGC is committed Worker Welfare. The document describes ASGC Polices in terms of equality and diversity, recruitment practices and process, managing workers' accommodation, medical facilities and healthcare, leisure; social and telecommunication facilities, security; workers' rights, rules, and regulation on their accommodation; compensation; working hours, worker communication and grievance process
Welfare Police	-	ASGC is committed to producing a caring and supportive working environment which is conducive to the welfare of all employees

Table 3: GAUFF ESG Policies

Name	Date	Description
Anti-Corruption Directive	2022	It provides the framework for avoiding corruption and other conflicts of interest in relations with customers and business partners
Short Manual Quality Management	2022	It provides company profile and principles, including the application of internationally recognized Environmental and Social Standards like Equator Principles, IFC Performance Standards, and EHS-Guidelines of the World Bank Group
Code of Conduct	2022	It describes the Code of Conduct for Contractual Partners of GAUFF and its affiliated companies and subsidiaries in terms of conflicts of interest, prohibition of corruption, fair competition, conduct with integrity, human rights, compliance with the International Labor Organization fundamental labor standards, health and safety protection, protection of the environment, business secrets and business partners of the contractual partner

2.3 Project general description

2.3.1 Presentation of the 10 Lots

The construction Project involves the following actions:

- To build a water intake pump station for capturing water from the north bank of the Kwanza River;
- To build a raw water pipeline to transport the raw water to the Water Treatment Plant (WTP);
- To build a WTP with a capacity of 6 m^3/s. The plant will include the WTP and a sludge treatment plant (STP) plus all ancillary facilities;
- To build a treated water transport system of approximately 100 km aimed to transport the treated water produced by the WWT to seven Distribution Centers (DC).

The Project is separated into 10 Lots (presented in Table 4 and illustrated in the Figure 3) which were divided in to three groups, managed by separate contracts and three main contractors - ASGC, Sinohydro and GAUFF. The construction work supervision is under responsibility of the companies DAR Angola and Impulso. Supply network is not part of the scope of the current ESIA and its construction will be subject of a different tender and in a later stage.

The operation phase will be under responsibility of EPAL.

Table 4: Presentation of the 10 Lots

Lot	Type of facility	Municipality	District	Contractor responsible	% Completion (Status April 2023)
Lot 1 - WTP	Water abstraction and Water treatment Plant	Icolo and Bengo	River Kwanza	SinoHydro / Griner/ASGC	7.41
Lot 10 -STP	Sludge Treatment Plant	Icolo e Bengo	n/a	SinoHydro / Griner/ASGC	0
Lot 8 - Quilonga Grande DC	Distribution Centre	Icolo e Bengo	Bom Jesus	SinoHydro / Griner/ASGC	0
Lot 3 - DC Cacuaco	Distribution Centre	Cacuaco	Cacuaco 2	SinoHydro / Griner/ASGC	8.47
Lot 2 - Network	Network for transportation drinking water to DC	Cacuaco, Viana, Icolo e Bengo	Miscellaneous	Consortium CNT / GAUFF / CASAIS / OPAIA	0
Lot 6 - DC km 30	Distribution Centre	Viana	n/a	Consortium CNT / GAUFF / CASAIS / OPAIA	0
Lot 7 - DC Kapalanga	Distribution Centre	Viana	Kapalanga	Consortium CNT / GAUFF / CASAIS / OPAIA	0
Lot 4 - DC Zango 5	Distribution Centre	Viana	Zango	SinoHydro	90
Lot 5 - DC New Airport	Distribution Centre	Icolo e Bengo	30km	SinoHydro	79
Lot 9 - DC PIV	Distribution Centre	Viana	Special Economic Zone	SinoHydro	97

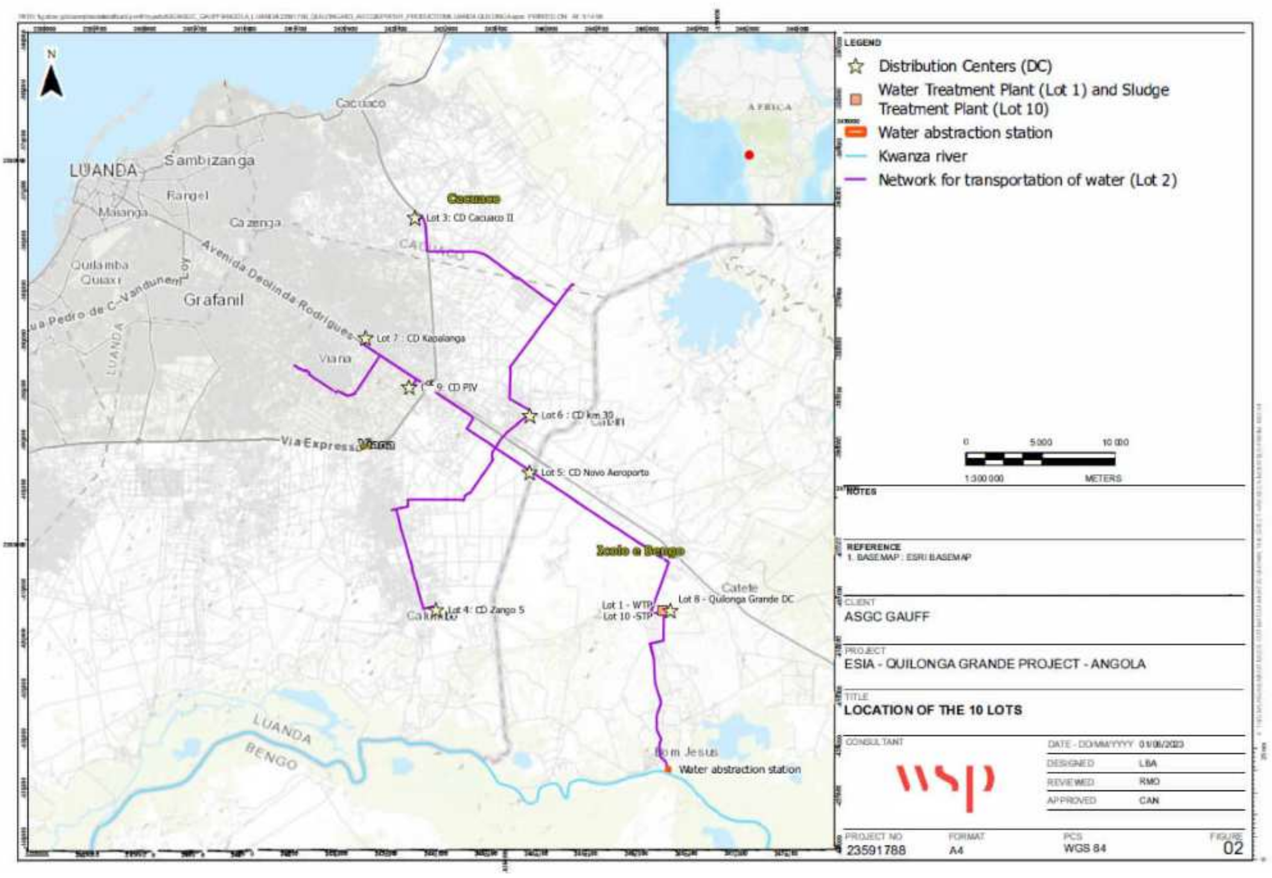


Figure 3: Location of the 10 Lots

2.3.2 Project timeline

The Figure 4 below shows the preliminary schedule presented in the Artelia report. As demonstrated above, the DC Zango (Lot 4), DC New Airport (lot 5) and DC PIV (Lot 9) are nearly finished. Detailed schedules for construction of each lot is presented further below.

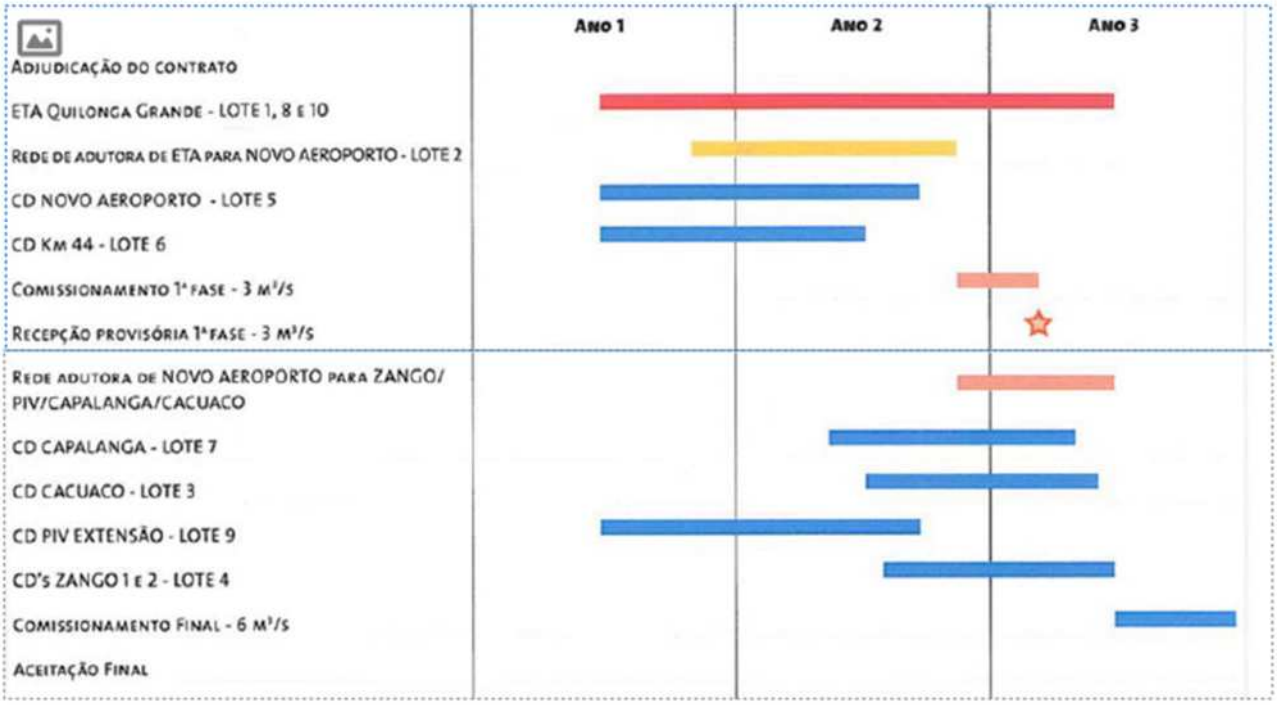


Figure 4: Previous schedule for the construction phase of the project (Artelia, 2014)

Water supply systems are normally intended to operate for a prolonged period. Treatment plants, CDs and pipelines are more likely to be repeatedly upgraded rather than a site or line totally decommissioned. Therefore, no indicative of closure is provided.

2.3.3 Lots under responsibility of SinoHydro / Griner/ASGC

2.3.3.1 Lot 1 - Water abstraction and Water Treatment Plant (WTP)

Components include water abstraction units, raw water pumping stations, pumping station, conveyance to treatment system, water treatment plant (WTP), auxiliary buildings and installations of the distribution system.

The water treatment plant (which is a component of the Lot 1), sludge treatment plant (Lot 10) and the Distribution Centre Quilonga (Lot 8) are all to be constructed in one area located 1,3 km to the east side of Estrada de Bom Jesus highway (Figure 5). Total available land area for those components is about 450 m in the east-west direction, about 400 m in the north-south direction?

Figure 5: Surrounding environment of the site of the Lot 1- WTP, Lot 10 and Lot 8 (EPAL 2020)

Legend: the red polygon includes Lot 1 WTP, Lot 10 and Lot 8

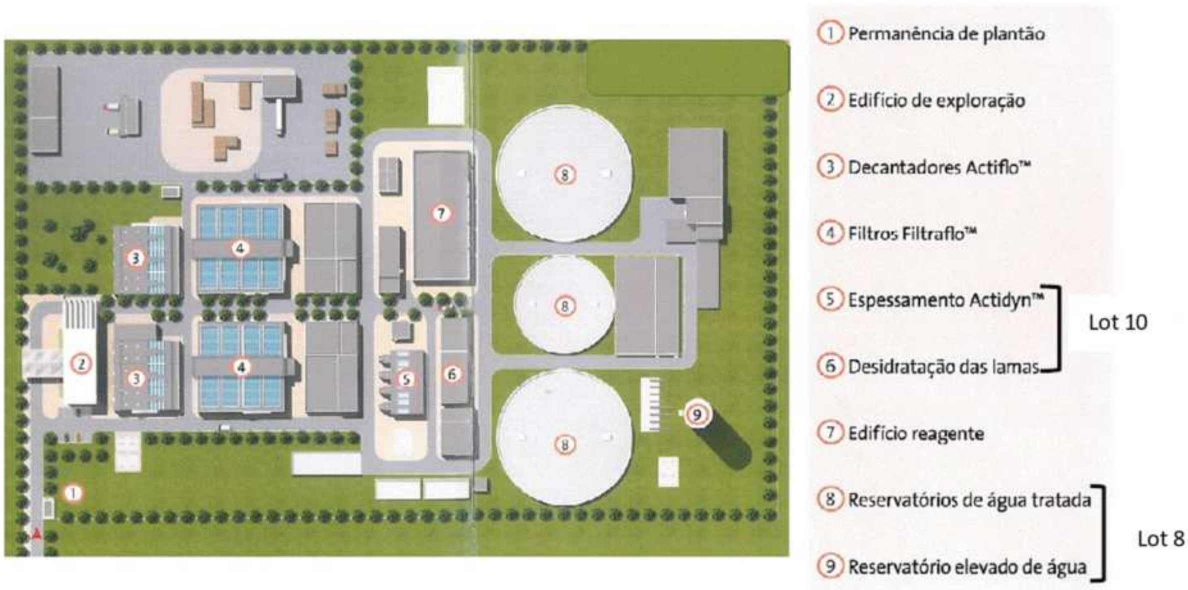


Figure 6: View of Lot 1 -WTP, Lot 10 and Lot 8 (Artelia 2014)

The **water abstraction pumping station** will be located on the right bank of the Kwanza River. The intake will be located on the east side of the Bom Jesus Water Plant (Figure 8). The site will be about 106 m long in the east-west direction, about 213 m wide in the north-south direction within the fence line, covering an area of about 14,500 m^2. The current terrace is low in the south and high in the north, low in the east and high in the west, and exist wetlands and marshes in the east.

Figure 7: Photomontage of a 3D drawing of the proposed abstraction plant infrastructure (ESIA 2014)

The water taken into the Kwanza River passes through the diversion canal, gate, coarse trash rack, fine trash rack, suction sump, inlet butterfly valve, water pump unit, water pump control valve, and outlet hydraulically controlled service brake valve in turn, and transports water to the terminal water treatment plant through two water transmission mains with length of 12.0 km and nominal diameter of DN1400. A grille of 13 m x 2.3 m will be installed the intake channel of the water pump house/

Figure 8: Surrounding environment of the site of the water intake pump station and location of the Bom Jesus Water Plant (EPAL 2020)

A set of 6 vertical line-shaft **pumps**, with a unit flow rate of 1 m^3/second, and a TDH (Total Dynamic Head) of more than 100 m (the exact value will be determined depending on the definitive location of the works) guarantees the pumping of a total flow of 6 m^3/second to the treatment station.

The pumps' electrical energy will be supplied by an underground electrical line of 11 KV from the treatment station and 5 generators, with unit power of 2,500 KVA installed as backup.

The pumps' motors will be installed in a dry atmosphere, in a location equipped with a crane to facilitate maintenance. Cement partitions isolate each pump, preventing the mutual influences of the pumping, retention and blocking valves will be installed upstream and downstream from the pumps, which unload into a common nucleus for the supply consisting of 2 channeling lines, which corresponds to two projected processing lines.

An anti-water hammer device completes the apparatus, which will be equipped with measuring devices (electromagnetic flow measurers).

The **supply to the treatment station** consists of two steel pipes with a diameter of 1,200 mm, and a thickness of 8/8 inches. These two lines correspond to the 2 treatment lines of 3 m^3/s to be constructed in the treatment station. The steel, chosen due to its resistance and the possibilities for adapting it to the site, is coated inside and outside in accordance with the standard in force (standard AWWA-C-210). The anchorage blocks guarantee resistance to the pressures exerted in the work equipped with discharges in the low points and suction cups in the higher points along the channeling. The hydropneumatics reservoirs serving the anti-water hammer devices, connected in the pipes, and mentioned above, contain air supplied by a compressor and water, and may be equipped with butyl membranes, if avoiding the dissolution of air in the water is desired.

The length of the supply channels is currently 11 km, after modifying the treatment center implementation site. The longest distance (3.5 km to the origin) may justify the installation of an intermediary pumping station. As indicated above, the station comprises two rigorously identical treatment lines with a flow of 3 m^3/s, for a total treatment of 6 m^3/s, or 518,000 m^3/day. It is anticipated subsequently to add a new line of 3 m^3/s, which will increase the treated flow of the Quilonga Grande project to 9 m^3/s.

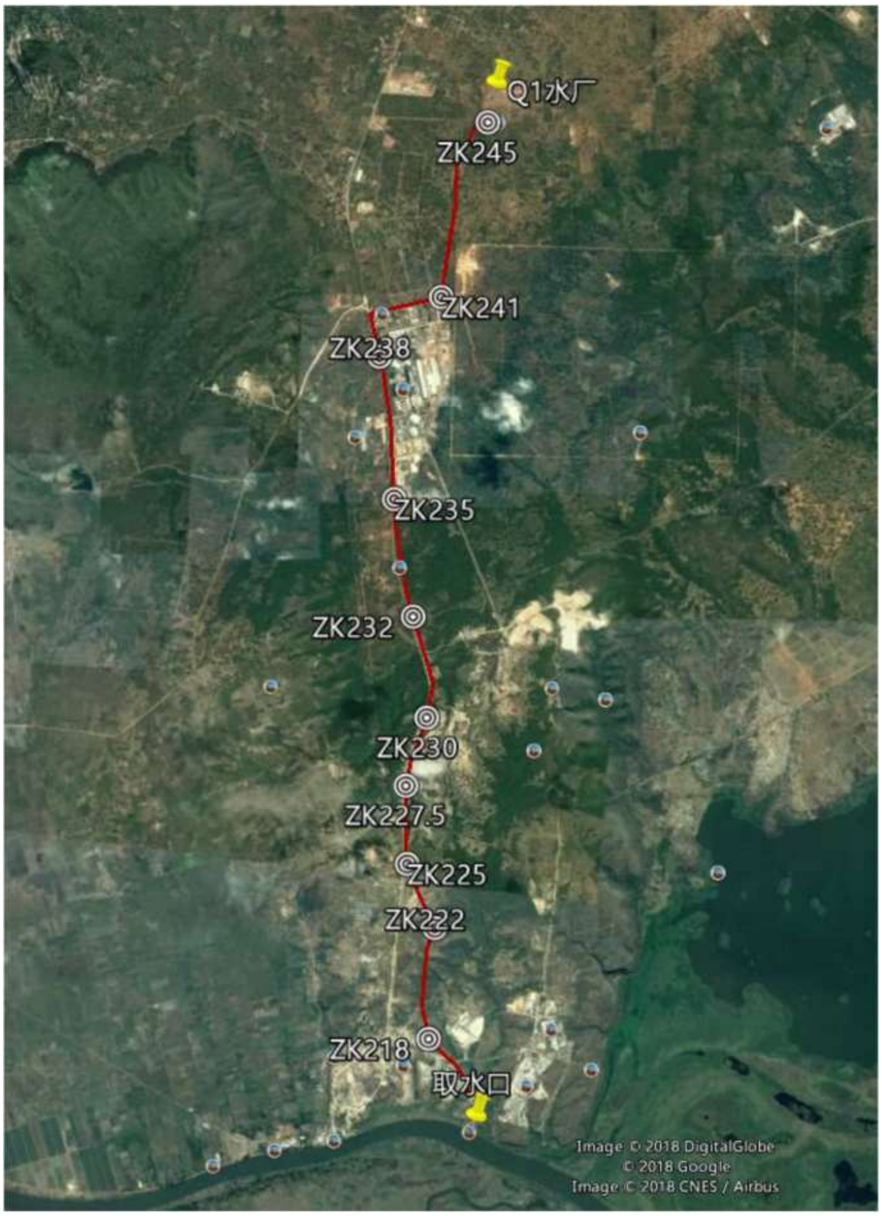


Figure 9: Location of the pipelines to transmit raw water from the abstraction point from Kwanza River to the WPT (Sinohydro 2019)

Legend: red line = pipeline

Water treatment plant (WTP)

The WTP will comprise two identical treatment lines with a flow of 3 m^3/s, for a total treatment of 6 m^3/s, or 518,000 m^3/day. The treatment will be consisted of decanting, filtration, and disinfection (Table 6 and Figure 11).

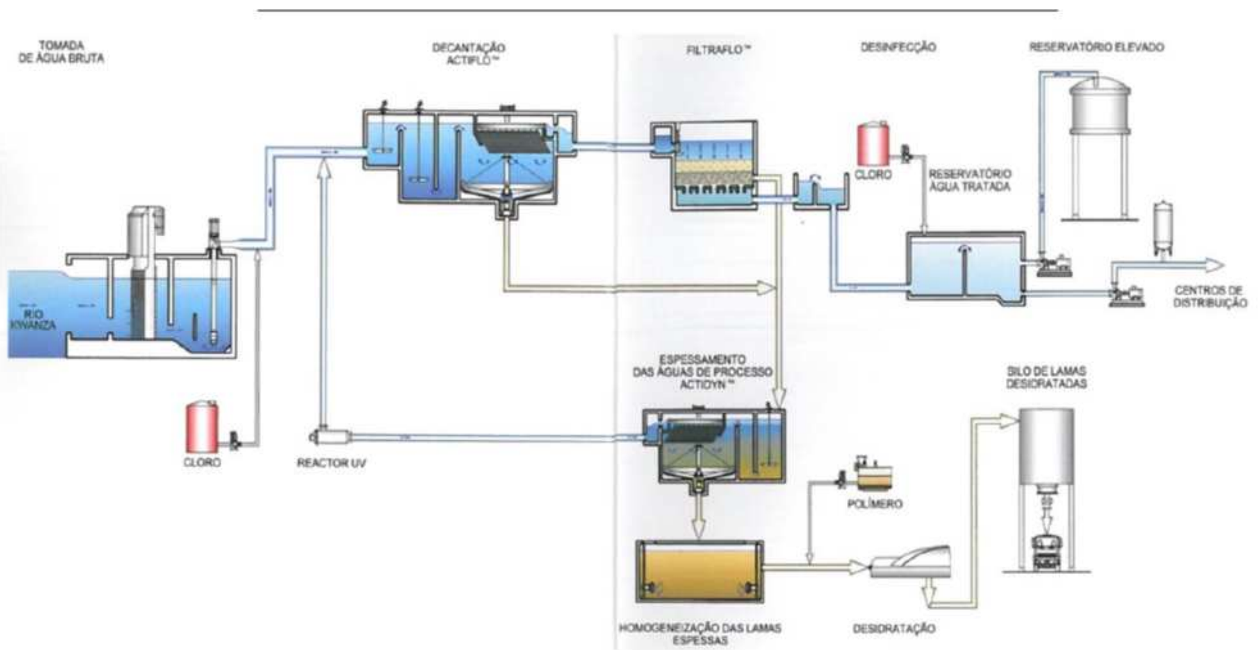


Figure 10: Overview of the Wastewater Treatment Plant and Sludge Treatment Plant (Artelia ESIA 2014, extracted from Epalango Consortium 2012)

- **Decanting**

The first stage is to eliminate the iron, which is oxidized in an insoluble manner ($Fe(OH)3$) in order to change its oxidization potential. The oxidant used is chlorine, thus pre-chlorination will be performed at the top of the station. There then follows the clarification stage for removing the turbidity and the color. This operation is performed in a lamellar decanter, with plates arranged in the form of nests inclined to 60°, the purpose of which is to increase the decantation surface. This decanter, crossed by an ascending flow, is preceded by coagulation and flocculation vats. In these vats, the suspended materials charged with negative-charge electricity are agglomerated by adding positively charged salt (aluminum sulphate) and deposited by injecting micro sand intended to considerably increase the speed of decantation. Lastly, polymers are added to the reaction as catalysts. Actiflo is the work that combines the abovementioned vats to the decanter.

The materials decanted (known as sludge) are scraped from the bottom of the decanter and sent through the pump and hydro-cyclones, which separate them from the micro sand, so that they are largely recovered. The sludge is then directed to the Actidyn thickeners, while the fluctuating waters are sent to the top of the Actiflo, after passing through UV-ray treatment, top prevent bacteriological pollution being sent back to the top.

- **Filtration**

The finer materials that cannot be decanted are then reduced in the sand filters in high velocity flow (for this reason, they are called "TGV filters"). A sand filter consists of a structure of slabs lined with fin tubes that allow the filter to be cleaned periodically against the air and water current, topped by a fine layer of gravel and sand with a thickness in the order of 1.20 m high.

This layer of sand is a true biological environment in which bacteria develop that eliminate the polluting materials present in the water.

The water from cleaning the filters (also known as "sludge") is also sent to the Actidyn technology. The thick and homogenized sludge is then ready for the final treatment, the object of Lot 10.

- **Disinfection**

The final stage is eliminating bacteriological pollution by disinfection with chlorine gas.

Each treatment line of 3 m^3/second includes (Figure 11):

- 3 parallel Actiflo decanters, with a unit volume of 535 m^3;
- A battery of 8 sand filters, with a unit surface of 104 m^2;
- 2 Actidyn, with a unit volume of 60 m^3, one for decanting sludge, and the other for the sludge from cleaning the filters;
- 2 treatments with UV rays.

Lastly, a pumping station equipped with 6-unit flow pumps of 1m^3/s releases the treated water through the large-diameter pipelines (object of Lot 2) to the distribution centers, object of Lot 3, 4, 5, 6, 7, 9, and from 3 final storage tanks, object of Lot 8.

Other treatments include the elimination of aluminum and neutralization. During the first, the aluminum precipitates at a pH between 6 and 6.5 and as coagulation can reduce the pH below 6, it is necessary to increase the value, which can be obtained by adding lime milk. The lime milk is then injected at the two of the Actiflo decanters. As the water from the Kwanza is known as aggressive (low level of bicarbonates), with it being necessary to neutralize them to protect the pipes from corrosion. This operation is performed by injecting lime water into the reservoirs of treated water (after filtration). The lime water is prepared from the lime milk.

The physiochemical and microbiological treatment of raw water will be performed from the dosage of chemical products. The project thus anticipates the construction of various buildings for storing, preparing, and dosing chemical products, namely:

- Chemical-product storage area ;
- Chlorination building ;
- Reagent building ;
- Lime-saturators building ;
- Area for conditioning and dosing chemical products.

The project envisages two distinct treatment processes, which on one hand reduce the volume of sludge to be evacuated by dehydrating them, and on the other hand assess the overflow waters, sending them for recirculation in the WTP to be re-used on agricultural irrigation systems.

The dirty process water originating from the WWT consists of:

- thick sludge originating from the WTP thickeners (Actiflo Decantation), which is transferred to the sludge treatment installations (Lot 10) ;
- Overflow water from various hydraulic structures.

The overflow water originating from the sludge thickening from the ACTIFLOTM decanters are pumped to an ACTIDYNTM decanter thickener and recycled at the start of the treatment, after disinfection by UV rays. The totality of the water from the FILTRAFLOTM filters is stored in a tank, pumped to the ACTIDYNTM decanter, and finally sent for tertiary treatment in Lot 10.

The tertiary treatment consists of filtration on a reed bed and disinfection by UV rays, for possible re-use in an agricultural irrigation network. This final step of a possible connection to an irrigation network is outside the scope of the project under study.

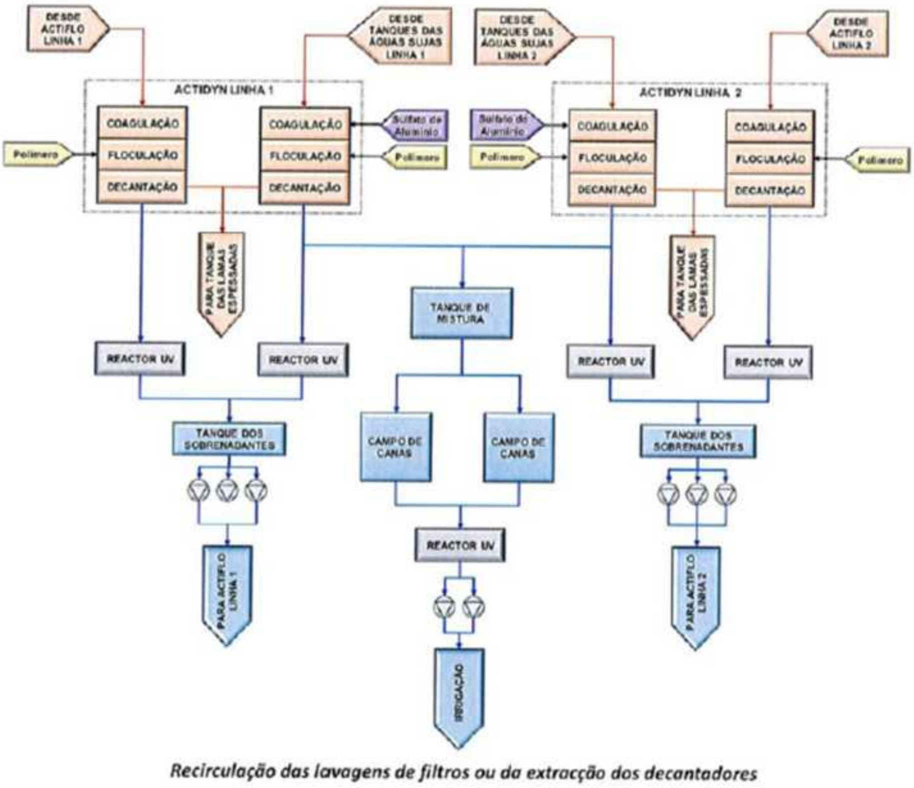


Figure 11: Overview of the dirty-water treatment system of the WTP process (Artelia Report ESIA 2014, adapted from Preliminary Draft, 2013)

Liquid waste will be treated by the STP.

Monitoring and administration structures

In order to perform exploration and maintenance services to the WTP, a two-storey building of 656 m² in total will be built, consisting of reception rooms, two laboratories, bathrooms and male and female changing rooms, circulations, meeting rooms, control, archives, kitchen, and canteen.

A three-stored building will be built for management and administration that will be house the reception, IT rooms, archive, offices, meeting room, maintenance room, toilets, secretariat, and conference room.

Those building are located within the footprint of the lot 1.

2.3.3.2 Lot 10 - Sludge Treatment Plant (STP)

Lot 10 relates to the final **treatment of the sludge** (Figure 12) produced during the water-treatment process and is integrated at the area regarding the WTP of the Quilonga Grande. It comprises an ultraviolet (UV) treatment, a dehydration building, a neutralization tank, cane fields and a sludge storage area.

The dry sludge quantity is expected to be 6.6 t/d, and the sludge treatment structures include a sludge discharge tank, a sludge thickening tank, an equalization tank, and a dewatering room, which are of combined form.

The thick-sludge treatment process is performed in the dehydration building that is integrated into the continuation of the sludge-thickening process. Sludge contains lime, aluminum sulphate, chloride ions and polyacrylamide. For the time being it is considered that the dry sludge will be sent to the Mulenvos landfill. However, during the operation, depending on the sludge characterization data, other uses may be considered such as land application.

The thickened sludge from Lot 1 is transferred through pumping to a 1,500 m^3 homogenization tank, also known as a thickened sludge tank, which is equipped with submersible agitators. From this step, the sludge continues to the mechanical dehydration facility consisting of two centrifuges.

The dehydrated sludge is sent to screw pumps for storage, being injected with a polymer to facilitate this transfer.

The **overflow water** is sent to a neutralization tank and from this, a part of the flow goes to a filtration phase on a reed bed and then, disinfection by UV (Figure 13).

The overflow is sent to a 195 m^3 neutralization tank equipped with submersible agitators.

A part of this neutralized overflow is conveyed to tertiary treatment for disinfection and re-usage in agricultural irrigation networks.

The tertiary treatment consists of the following stages:

- Filtration on 2 reed filter beds (cane fields), with a unit surface of 175 m² ;
- Treatment with UV rays, for eliminating pathogenic germs ;
- Pumping for irrigation.

This plot will be equipped with a road scale for weighing lorries transporting sludge.

The treated water will be discharged to the Kwanza River if the water quality meets regulatory requirements (Decreto 261 about water discharges limits).

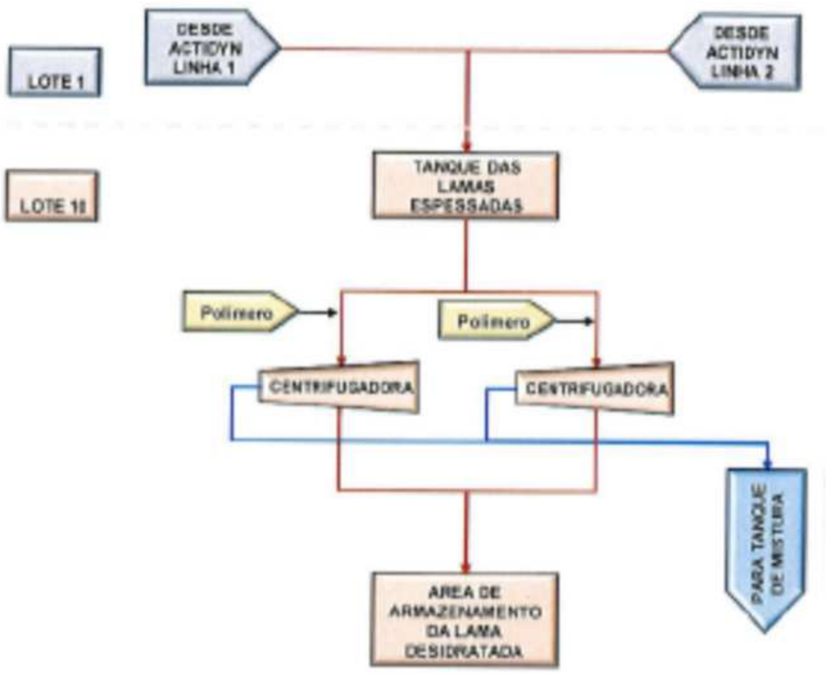


Figure 12: Overview of the Sludge Treatment Plant (Artelia ESIA 2014, extracted from Epalango Consortium 2013)

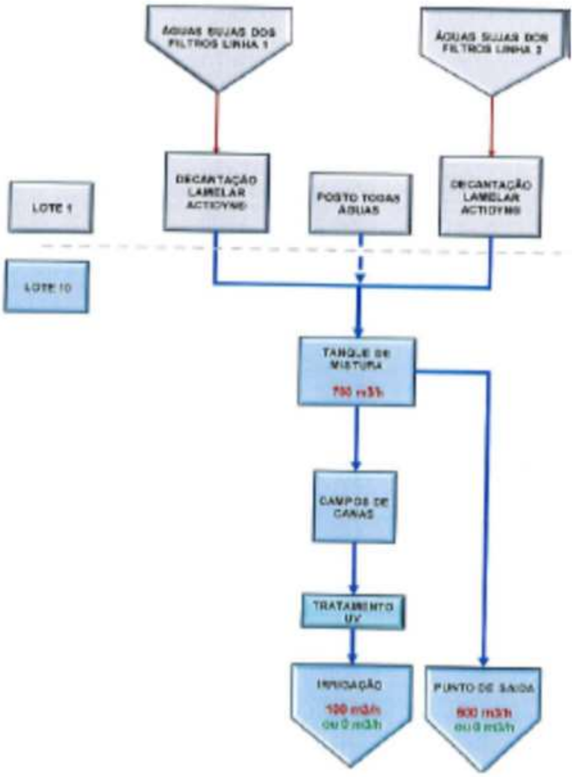


Figure 13: Overview of the overflow-water treatment process (Artelia ESIA 2014, extracted from Preliminary Project Q10, 2013)

2.3.3.3 Lot 8 - Distribution Center (DC) Quilonga Grande

Components include chlorination section, reservoir, water tower, administrative building, pumping building, and chlorine store. All the characteristics of DC Quilonga Grande are presented in the Table 5 below.

Differently from the other DCs, the Quilonga Grande DC was not designed to directly supply the population, but to supply all the drinking water from the WTP to all the CDs of the Project.

Auxiliary facilities for Lots 1, 10 and 8

Access roads

A road project is an auxiliary project for the WTP and water pump station. The purpose is to offer the access way for continuous maintenance and supervision for the water plant and pump station. There are two access roads connecting to the water plant and the raw water pump station respectively. The access road of the water plant starts from Bom Jesus road in the west, stretches to Quilonga Grande water plant in the east, and its full length is about 1.6 km; the access road of the pump station starts from the pump station at Kwanza River in the south and stretches to the current road in the north along the current temporary unpaved construction road. Its full length is about 0.7 km. The road engineering design includes the design of the route, road base, pavement, drainage, traffic, and safety facilities etc. of the above two access roads.

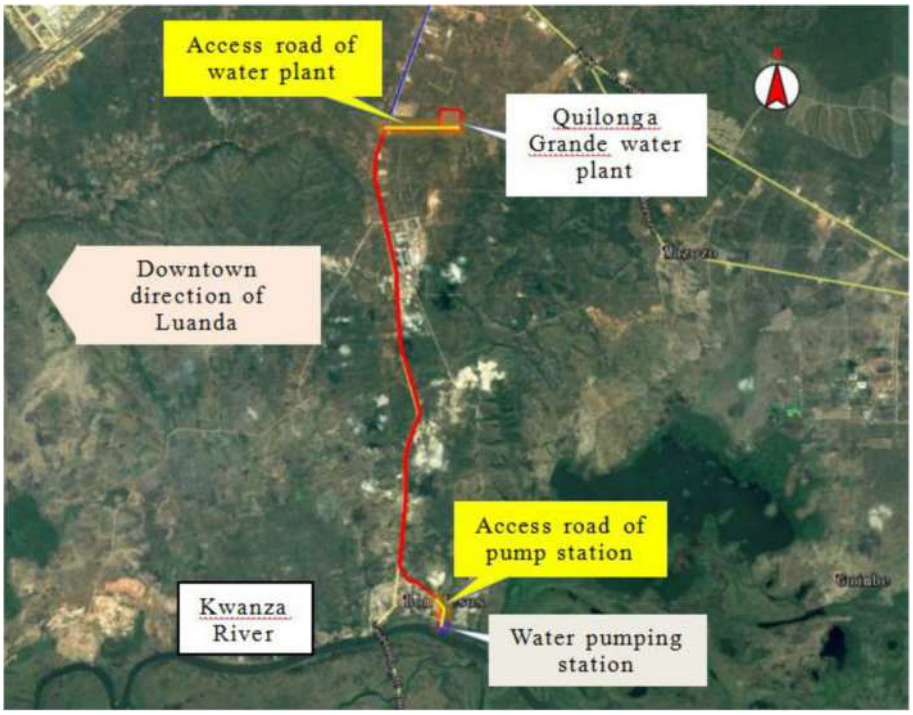


Figure 14: Auxiliary project road for the WWP and water pump station (Lot 1) (Feasibility Study Report, provided by ASGC)

Figure 15: Zoom on the auxiliary project road for water pump station (Lot 1) (Feasibility Study Report, provided by ASGC)

Power Generation

A generator house and a fuel tank for the raw water pumping station will be built to supply back-up power to the Lot 1. The station will be located about 500 meters east of the commune of Bom Jesus and 700 meters north of the Kwanza River. There are few residential houses in the north-west. The vegetation on the site is dominated by low grasses. The main structures main structures are the generator room with 13 generators and the fuel tank systems with two 250 m^3 fuel tanks and a 40m^3 daily fuel tank (Sinohydro 2020).

Figure 16: Location of generator house and a fuel tank for Lot 1 (red polygon) (Sinohydro 2020)

Legend: zone where the generator house and a fuel tank will be constructed = red polygon

Power Transmission lines

The proposed transmission line is divided into two sections, Line I and Line II. The main structures are metal transmission towers and concrete transmission poles.

Line I should start at the SE Bom Jesus 60 kV substation and end at the water intake and pumping station with a total length of 2.2 kilometers. This line will be a single-circuit 60 kV line supported by supported by metal transmission towers. Line II is to start from the SE KM44 substation and end at the WTP with a total length of 7 km. This line will be a single circuit 15 kV line supported by concrete transmission poles.

Figure 17: Location of power transmission line for the lots 1, 8 and 10 (Line I) (Sinohydro 2018b)

Legend = power transmission line in blue

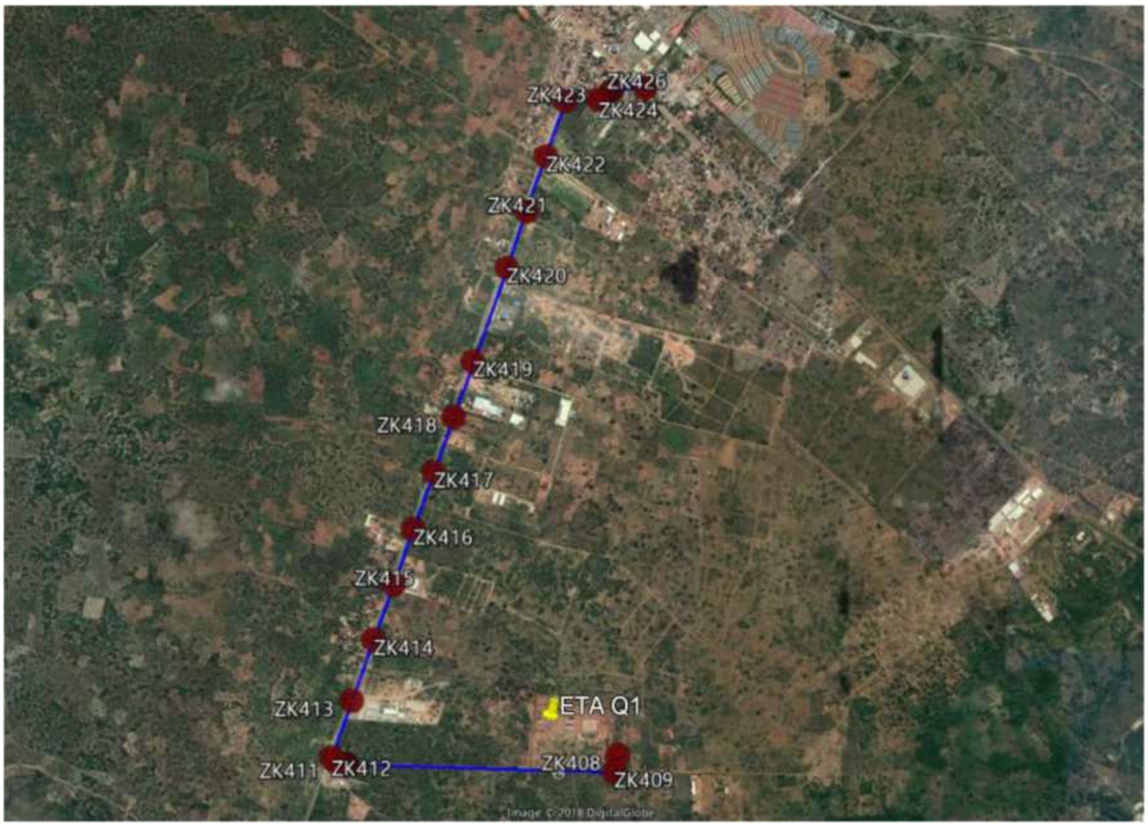


Figure 18: Location of power transport line for the lots 1, 8 and 10 (Line II) (Sinohydro 2018b)

Legend = power transport line in blue

2.3.3.4 Lot 3 – Distribution Center (DC) Cacuaco

This DC is located in Cacuaco, on the south side of the existing Via Expresso (Figure 19). The site is about 178 m long and 105 m wide, covering an area of about 18,690 m^2. It will be composed of a reservoir, an elevated tank, and auxiliary buildings (administration, laboratory, and safety check). All the characteristics of DC Cacuaco are presented in the Table 5 below.

Figure 19: Surroundings of the Lot 3 DC Cacuaco (EPAL 2020)

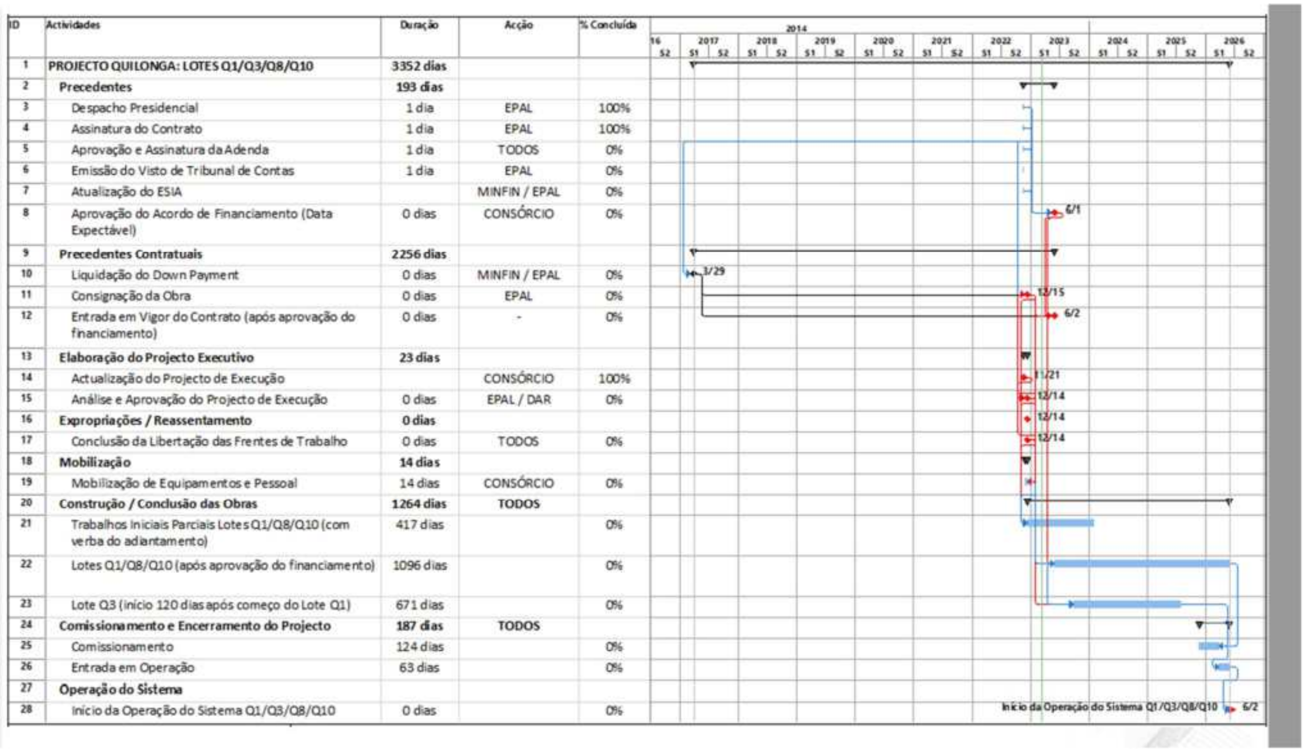
Table 5: Characteristics of the DC Quilonga Grande and Cacuaco

	DC Quilonga Grande (Lot 8)	DC Cacuaco (Lot 3)
Reservoir capacity	50,000 m^3	35,000 m^3
Water tower capacity	2,000 m^3	500 m^3
Water tower hight	50 m	45 m
Population benefiting	-	290,499
Districts benefiting	-	Pedreiras, Mulundo, Sequele, Mulenvos de Baixo, Bairro 30 and Sepa do Bengo
Municipality		Cacuaco

2.3.3.5 Schedule

Construction of the 4 Lots is planned to last over 36 months as described in Figure 20 below.

DC Cacuaco (Lot 3) construction started in 2017, but it was stopped due to lack of financing. So far, the tasks completed are construction site, reservoir excavations, application of the cleaning concrete in the reservoirs, electric transformer assembly and executive project.



ID	Actividades	Duração	Acção	% Concluída
1	PROJECTO QUILONGA: LOTES Q1/Q3/Q8/Q10	3352 dias		
2	Precedentes	193 dias		
3	Despacho Presidencial	1 dia	EPAL	100%
4	Assinatura do Contrato	1 dia	EPAL	100%
5	Aprovação e Assinatura da Adenda	1 dia	TODOS	0%
6	Emissão do Visto de Tribunal de Contas	1 dia	EPAL	0%
7	Atualização do ESIA		MINFIN / EPAL	0%
8	Aprovação do Acordo de Financiamento (Data Expectável)	0 dias	CONSÓRCIO	0%
9	Precedentes Contratuais	2256 dias		
10	Liquidação do Down Payment	0 dias	MINFIN / EPAL	0%
11	Consignação da Obra	0 dias	EPAL	0%
12	Entrada em Vigor do Contrato (após aprovação do financiamento)	0 dias	-	0%
13	Elaboração do Projecto Executivo	23 dias		
14	Actualização do Projecto de Execução		CONSÓRCIO	100%
15	Análise e Aprovação do Projecto de Execução	0 dias	EPAL / DAR	0%
16	Expropriações / Reassentamento	0 dias		
17	Conclusão da Libertação das Frentes de Trabalho	0 dias	TODOS	0%
18	Mobilização	14 dias		
19	Mobilização de Equipamentos e Pessoal	14 dias	CONSÓRCIO	0%
20	Construção / Conclusão das Obras	1264 dias	TODOS	
21	Trabalhos Iniciais Parciais Lotes Q1/Q8/Q10 (com verba do adiantamento)	417 dias		0%
22	Lotes Q1/Q8/Q10 (após aprovação do financiamento)	1096 dias		0%
23	Lote Q3 (início 120 dias após começo do Lote Q1)	671 dias		0%
24	Comissionamento e Encerramento do Projecto	187 dias	TODOS	
25	Comissionamento	124 dias		0%
26	Entrada em Operação	63 dias		0%
27	Operação do Sistema			
28	Início da Operação do Sistema Q1/Q3/Q8/Q10	0 dias		0%

Figure 20: Schedule for the construction of Lots 1, 8, 10 and 3 (DAR presentation April 2023)

2.3.3.6 Construction activities, materials, and workforce

The energy source for the construction phase for Lot 1 and 10 Water abstraction and STP will come from the Bom Jesus electrical substation and for the WTP from Km 44 electricity substation (ENDE). For the Lot 3 the energy source will come from the public network (ENDE) and generator set.

In terms of residuals, the contractor is required to collect all the waste produced for subsequent disposal in a landfill.

In terms of workforce (approximately 60 for the Lots 1, 8 and 10), the constructor will preferably use local labor and plants to boosts local trade by acquiring local products for various types of consumption material. Drinking water for the construction phase will come from the Bom Jesus WTP.

Water pollution sources of will be mainly production wastewater generated during constructions (muddy wastewater produced during pipe-jacking construction, oily washing wastewater produced by construction machinery and concrete mixing, system washing wastewater, and wastewater produced during pipeline pressure test), and domestic sewage from construction workers. Domestic sewage will be treated at first and then discharged into the drainage system.

All the construction waste produced during the construction are planned to be handed over to the local garbage disposal system. The average domestic waste generated during the construction period is about 48 kg/d, which will be disposed of by the local sanitation department.

Construction machineries are expected to produce noise with intensity of 70~110 dB.

2.3.3.7 Operation phase

The facilities will operate 24 hours/day, 365 days a year.

The tasks are the operation of the WTP, sludge treatment station, DC, and intake conduits; and maintaining all of the infrastructures.

Lot 1 – Water abstraction and WTP

For the Water abstraction facilities, there will be a need to periodically clean the catchment channel because the abstraction of raw water from the river. The liquid and solid wastes generated during the operation will be disposed of in a landfill. The amount of waste will depend on the dynamics of the river. The energy will be provided by the public network: Bom Jesus electrical substation for the abstraction and pumping station as well as alternative sources consisting of generator sets.

For the WTP, activities include monitoring and maintenance of electromechanical equipment, monitoring of chemical dispensers, laboratory activity, administrative activity, various maintenance and repair activities, cleaning, and security. The liquid waste will be treated by STP for later use. Regarding rainwater drainage, the project includes external drainage pipes. Solid waste will be disposed of in a landfill.

For the Lot 8 – DC Quilombo Grande, activities include monitoring and maintenance of electromechanical equipment, monitoring of chemical dispensers, laboratory activity, administrative activity, various maintenance and repair activities, cleaning, and security. Treated water may occasionally overflow from the tanks, in which case it is channeled into the drainage system of the DC and into a public sewer. The solid waste generated by the DC will come from the accommodation of the (domestic) operating staff, cleaning, and the periodic washing of the reservoirs. The waste resulting from these activities will be collected and disposed of in the landfill.

For those 3 lots, vehicles will be used for transportation of operating and maintenance personnel and waste removal.

The access to Lots 1, 10 and 8 be by the National road EN100, main road of Bom Jesus (paved) and paved accesses that connect the WTP and catchment to the main road of Bom Jesus. The project includes a connection to ENDE's public network and an alternative source consisting of generator sets. The access to Lot 3 will be the Via Espressa Benfica - Cacuaco.

The number of works need for the operation of those 4 lots is yet to be defined by EPAL.

2.3.4 Lots under responsibility of CNT / GAUFF / CASAIS / OPAIA

2.3.4.1 Lot 6 and 7 - Distribution Centers (DC) km30 and Kapalanga

The components of each of those Lots are two ground reservoirs, a water tower (elevated reservoir), administrative buildings, a pumping station building and a chlorine building. All the characteristics, defined in the base project phase, of DC km30 and Kapalanga are presented in the Table 6 below. The preliminary layout of DC km30 is presented in the Figure 21 and DC Kapalanga's preliminary layout is presented in the Figure 22 below.

In the ongoing Detailed Design phase, the final architecture of the buildings and the DCs final layouts will be defined, the reservoirs main characteristics shown in the table below will nevertheless remain.

Table 6: Characteristics of the DC km30 and Kapalanga

	km 30	Kapalanga
Reservoir capacity	2 x 10,000 m^3	2 x 5,000 m^3
water tower height	45 m	25 m
Population benefiting	395,000 people	197,486 people
Districts benefiting	Musseque Baia, Tando, Mercado do Km 30 and surroundings	Kapalanga and nearby zones

Figure 21: Layout of the DC km 30 (Dar presentation April 2023)

Translation: reservatorio = reservoir; torre = water tower, edificios auxiliaries = auxiliar buildings, Estação de bombagem = pumping station

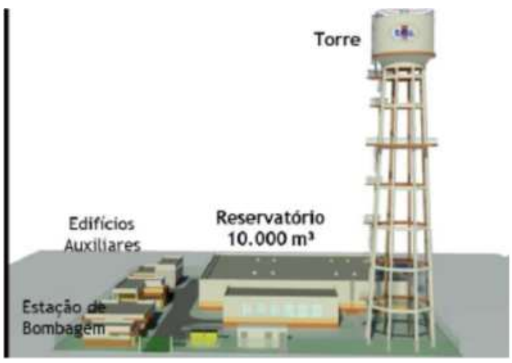


Figure 22: Schematic figure of the DC Kapalanga (Dar presentation April 2023)

At this stage the final pumps models for lots 6 and 7 are not yet defined. Nevertheless, below are the currently foreseen pumps characteristics and configuration. Those pumps with the same motor size (200 kW) have a motor noise pressure level of 73 dBA and they will be installed inside the pumping station buildings.

Lot	Flow Per Pump (l/s)	Pump Head (m)	Power Requirement per Pump (kw)	Pump Configuration
Lot 6 - CD KM30	285	45	220	2 Working + 1 Standby
Lot 7 - CD Kapalanga	350	30	160	3 Working + 1 Standby

2.3.4.1.1 Construction schedule

The schedule is described in Figure 24.

2.3.4.1.2 Construction activities, materials, and workforce

The main activities are: fencing the site, earth movement, execution of foundations and structure (reinforced concrete), application of buried pipelines, execution of masonry, electrical and plumbing installations, finishing work, execution of external arrangements and application of equipment.

The construction of the DC will require steel, concrete (aggregates, water cement), paints, aluminum, ceramics, electrical and plumbing materials. As the project is under development, it is not yet possible to determine the quantities. Additional equipment required during construction of DC are the topographic support equipment, radio intercommunication, Computers and AUTOCAD and Office Tools.

The pipes, valves, fittings, and electromechanical equipment to be installed will be transported from Germany to Angola by sea, and then transported by truck between the port, the storage site, and the construction site; the sand for concrete production will be transported by truck between the source and the site of use; the concrete will be produced in-house and transported to the construction site by concrete mixer trucks.

No service providers will be used, all services will be provided in-house.

Wastewater will be transported and taken to the nearest wastewater treatment plant. If there is an excess of treated water or rainwater, it will be directed to the nearest watercourse.

Vehicles will be used to transport construction materials and equipment to be installed in the DC. The number and types are described in Figure 25 and they will use National public roads (Estrada de Catete and Via Expresso). Road widening will not be necessary for the transportation of materials, but improvements will be necessary through earthworks (mostly dirt roads partially degraded by the rains). As this is a fixed-site project, no major impact on traffic is expected.

The liquid waste produced during the construction phase (expected 15,000L/month) of each DC will be wastewater and water from washing work equipment.

Approximately 100 unskilled local workers are expected for each DC. As many local workers as possible will be recruited, according to the needs and specificities of the work to be carried out. Approximately 2 expatriate specialists are expected to join the team. Expatriate workers will be housed in existing living centers, local workers will stay in their own accommodation. There will be two sources of drinking water for workers, either from local distributors (the common "giraffes" of Bom Jesus, Quinfangondo and Calumbo) or via bottled water.

The H&S team will be made up of a safety and quality coordinator who will report to the Project Director. This coordinator will be supported by 1 field technician. With regard to the environmental team, the monitoring work will be subcontracted to a company specializing in this area. Creation of a team dedicated to managing complaints and interfacing with the public. As the work has not yet started, there are no complaints or grievances registered.

The construction yard for Lots 6 and 7 are located withing the footprint of the future DCs.

2.3.4.1.3 Operation phase

The activities during the operation phase are the same as described for Lot 3 and 8.

The number of works need for the operation of Lots 6 and 7 are yet to be defined by EPAL.

2.3.4.2 Lot 2 - Network for transportation drinking water to DC

Lot 2 is composed of a network of 100 km of steel pipes to transport the drinking water from Lot 8 (DC Quilonga Grande) to the distribution centers (Figure 23). The network is divided into 12 sections, each of them with specific dimensions and lengths (Table 7).

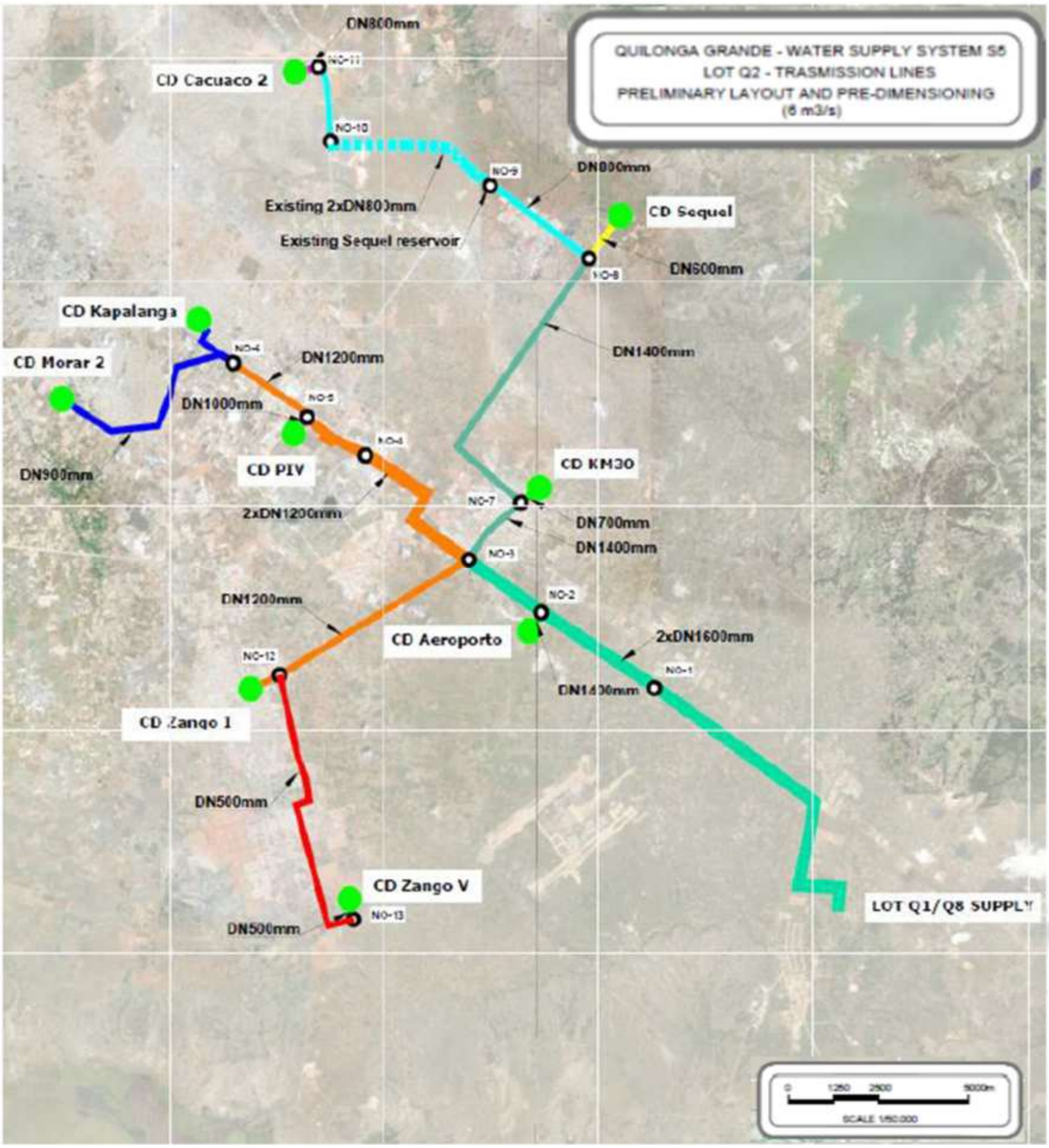


Figure 23: Preliminary layout and proposed dimensions of the transmission lines of Lot 2 (Presentation used by Dar during Stakeholder Meeting 20.04.2023)

Table 7: Extensions and diameter of the different sections of the water transmission network of Lot 2 (“Memoria descritiva” Consortium CNT / GAUFF / CASAIS / OPAIA)

QUILONGA GRANDE			
SECTION	DIMENSION	LENGHT	TOTAL LENGHT
	DN	[m]	[m]
ETA Q1 / CD Q8 (EBAT) ---- NO-3	1600 (2 un)	18.900 * 2	37.800
NO-2 ---- Q5 (CD novo aeroporto)	1400	50	12.350
NO-3 ---- NO-7 ---- NO-8		12.300	
NO-3 ---- NO-12	1200	9.330	27.940
NO-12 ---- CD Zango I		390	
NO-3 ---- NO-5	1200 (2 un)	7.660 * 2	
NO-5 ---- NO-6	1200	2.900	
NO-5 ---- Q9 (CD PIV)	1000	830	830
NO-6 ---- Q7 (CD Kapalanga)	900	1.845	9.945
NO-6 ---- CD Morar 2		8.100	
NO-8 ---- NO-9	800	3.100	12.625
NO-9 ---- NO-10		5.615	
NO-10 ---- NO-11		3.330	
NO-11 ---- Q3 (CD Cacuaco 2)		580	
NO-7 ---- Q6 (CD KM 30)	700	100	100
NO-8 ---- CD Sequele	600	1.915	1.915
NO-12 ---- Q4 (CD Zango V)	500	7.850	7.850

2.3.4.2.1 Construction schedule

Figure 24 illustrates the schedule for, not only the Lot 2 but also two of the DC (Lots 6 and 7) which are also under responsibility of the consortium CNT / GAUFF / CASAIS / OPAIA. The construction of temporary installations is planned to start on Q3 2023. The construction of the Lot 2 is planned to start Q1 2024 and last until Q4 2025. Workers will be split into 4 work fronts (“Frentes” 1, 2, 3 and 4 in Figure 24) each one of them with a work rate of approximately 50 meters per day. In order to minimize disturbances and improve safety conditions open trenches should be closed in a short period of time (couple of days).

The area for construction of the main shipyard is already identified and the survey of the foreseen pipe alignments has already started in late 2022. For 2023 the plan is to begin with the survey of interferences, whether of plots to be expropriated, services affected and social impacts (based on topographical survey) as well as the planning of the construction of the shipyards.

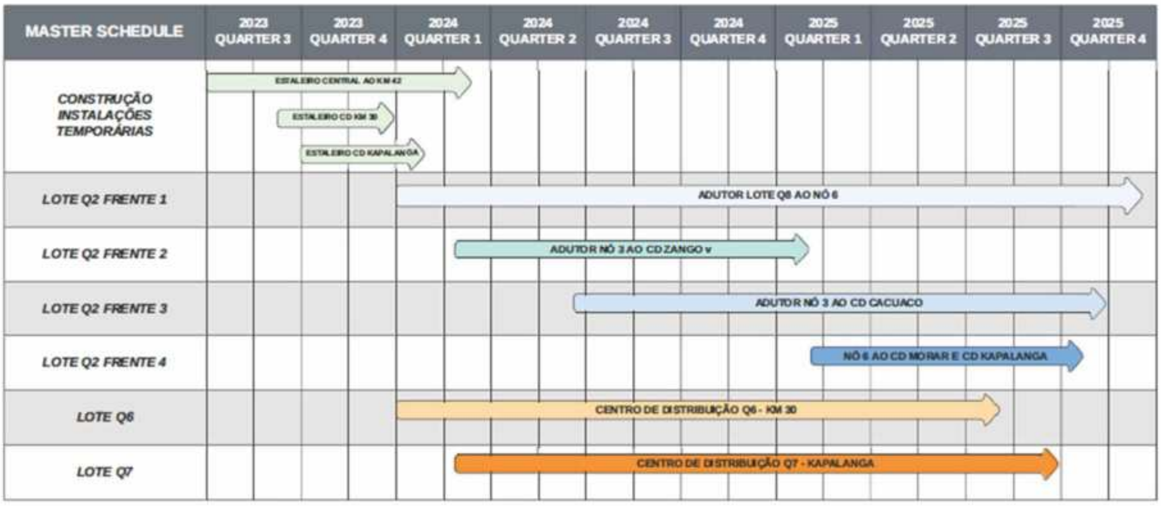


Figure 24: Construction phase: master schedule of the Lots 2, 6 and 7 (Consortium CNT / GAUFF / CASAIS / OPAIA)

2.3.4.2.2 Construction activities, materials, and workforce

The main construction activities are geotechnical tests, clearing of the land, ditch excavation, background layer execution, placement of conduct, welding, welding tests, landfill, maneuvering chambers, and replacement of existing conditions.

The main international standards which will be considered and respected in regard to the dimensioning, planning and construction/installation of Lot Q2 steel mains are:

- AWWA M11 (steel pipe design and installation)
- DIN EN 805 (Requirements for water supply systems and components outside buildings)
- DIN EN 10224 (Non-alloy steel pipes and fittings for the conveyance of water for human consumption)
- DIN 30670 (Polyethylene coatings on steel pipes and fittings)
- DIN EN 12501-1 (Protection of metallic materials against corrosion, corrosion likelihood in soil)
- DIN EN 10220 (Seamless and welded steel tubes dimensions and masses

Moreover, all national legislation regarding the system installation and its hydraulics (maximum velocities, minimum and maximum pressures, installation depths, minimum and maximum pipe slopes) as well as distance to other buried infrastructures, etc) were also considered in the system's planning.

The depth of the pipeline installation will be at the minimum 1.20 meters, but may be deeper (up to 2.2 meters) in some sections, depending on the design specs for specific areas (crossing existing facilities, major roads, railways, etc.).

There will be two types of pipe installation techniques:

- Open-trench installation (99% of the pipeline) where the shoring systems will be used in all the pipe welding locations and whenever appropriate/necessary for the protection of workers and existing neighboring facilities;

- Pipe-jacking encasement of the water pipe (1% of the pipeline) to be used to cross the major roads (Estrada de Catete e Via Expresso) and the railway lines. The constructor will pipe-jack an encasement pipe and later install the water pipe, without any disturbance to the normal use of these infrastructures (roads and railway). There will be 14 of these crossings.

Pipeline construction right of way (RoW) width is ideally 12 meters total for the execution of the works including operation of excavators, trucks for the removal of excavated soils, trucks for the transport of pipe. It also represents the safety distance to be guaranteed from the edge of the trench to the circulation tracks. However, most of the lines will be installed in urban areas (structured or semi-structured areas) and there is a need to use the existing streets and roads, circumstances that will limit the RoW. The only areas without space constraints are the areas under the protection of the New Airport (DN 1600 pipeline with a length of 10 to 12 kms Figure 23), and the DN 800 pipeline that connects DC Sequele to DCThe electrical energy required for the construction phase will be provided through the use of diesel generators.

In terms of construction material, for the installation of the pipelines, a bed of sand or crushed materials (reused excavation material) of 15 cm is foreseen along its entire length of approximately 100 km pipelines. Approximately, a total of approx. 40,000 m^3 of sand/crushed material is foreseen for this purpose; and the remaining trench refill material should be excavation material. Furthermore, additional sand, cement, aggregates, and water will also be needed for the production of concrete for the valve boxes/chambers, which at this stage cannot yet be quantified. The location of borrow pits, at this stage is not yet determined. The final planning of the pipes' longitudinal sections – definition of high and low points – must be performed so that these locations can be defined.

The pipes, valves and accessories will be transported from Germany to Angola by sea and will then be transported in trucks between the port, the storage site, and the construction front. Sand for pipe installation (where ditch excavation soil cannot be used) and concrete production shall be transported in trucks between the origin and the place of use; The concrete will be produced in-house and will be transported to the front of the work in concrete mixer trucks.

Additional equipment required during construction of Lot 2 are the topographic support equipment, radio intercommunication, Computers and AUTOCAD and Office Tools.

The vast majority of services will be provided in-house, the constructor will only have external suppliers for environmental monitoring and welding services. Pipe suppliers will be selected according to EPAL's final decision regarding the material to be considered for pipes and fittings (at this point steel is the selected material manufactured in Germany). The final suppliers will be selected according to the EPAL's indications and preferences.

As the network will be buried, there will be no significant implications for rainwater drainage. There will be portable toilets on all construction sites, with periodic collection carried out by an accredited company.

The liquid waste produced during the construction phase (expected 60,000 L/month) will be wastewater and lubricants from equipment maintenance, for which an accredited local company will be hired to collect, transport, and treat.

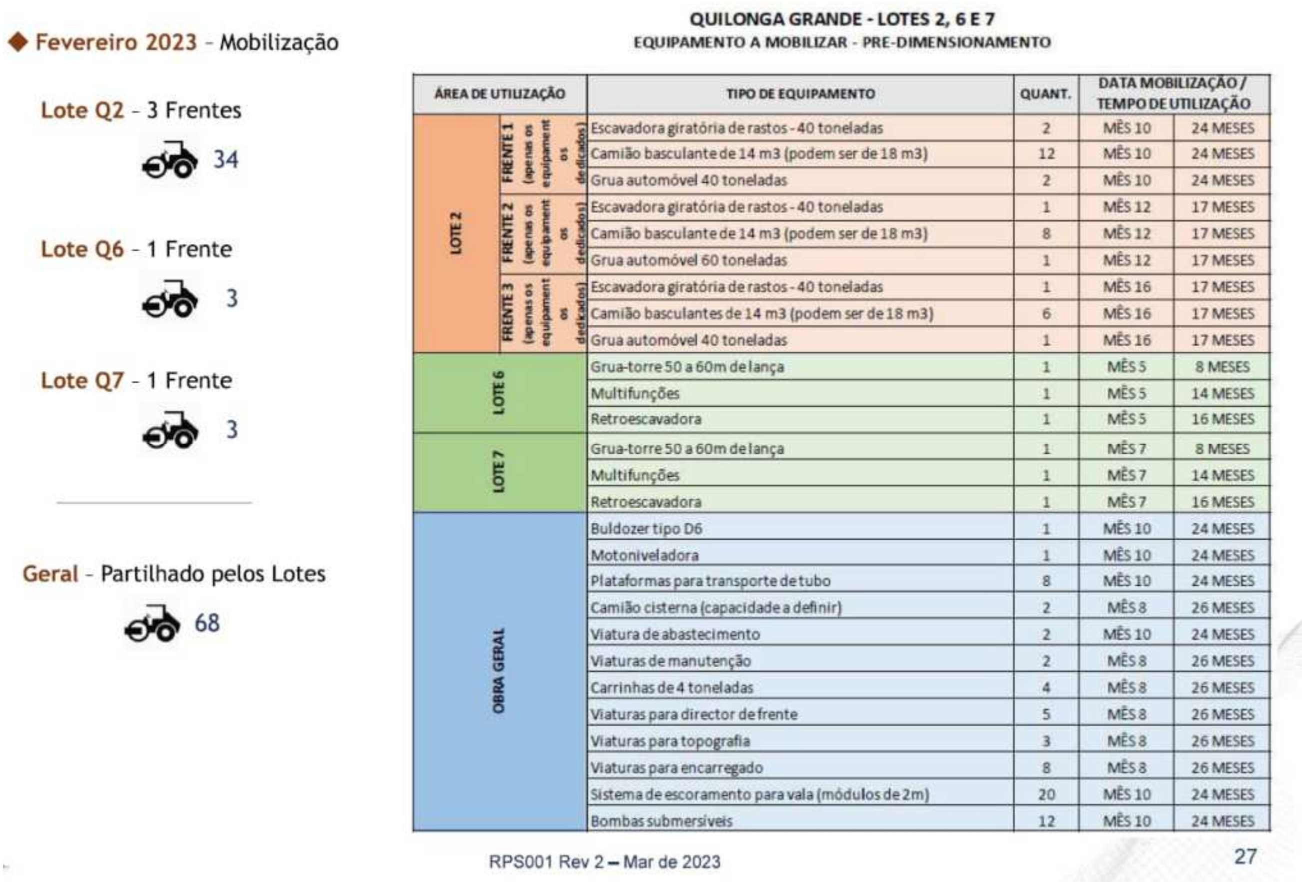
In terms of workforce, the recruitment of locals will be privileged, according to the needs and specificities of the work to be carried out. About 200 workers will be needed for the construction of Lot 2, 80 % of them will be hired locally. Approximately 12 expatriate specialists are expected. It is planned to train 40 people for special tasks, recruited locally. Expatriate workers will be housed in existing living centers, while local workers will stay in their own accommodation (as they will be recruited locally).

There will be two sources of drinking water for workers, either from local distributors (the common "giraffes" of Bom Jesus, Quinfangondo and Calumbo) or via bottled water.

The H&S team will be made up of a health and safety coordinator who will report to the Project Director. This coordinator will be supported by 3 field technicians. With regard to the environmental team, the monitoring work will be subcontracted to a company specializing in this area. The constructor plans to create a team dedicated to managing complaints and interfacing with the public.

The number and type of vehicles needed for the constructions are illustrated below. Essentially, the vehicles will be used to transport material and equipment (pipes, valves, and fittings) and for the installation/assembly of the pipeline network. They will use National public roads “Estrada de Catete” and “Via Expresso”. Road widening will not be need for the transportation of materials, but improvements will be necessary through earthworks (mostly dirt roads partially degraded by the rains).

The pipeline routes will be mostly developed in low-traffic areas, however, to mitigate constraints, the appropriate temporary signalization will be applied, as well as the implementation of signposts to help with the flow of traffic and, whenever necessary, the construction will happen during the night. As the crossings are made by horizontal driving, there will be no cuts in roads or railways.



ÁREA DE UTILIZAÇÃO		TIPO DE EQUIPAMENTO	QUANT.	DATA MOBILIZAÇÃO / TEMPO DE UTILIZAÇÃO	
LOTE 2	FRENTE 1 (apenas os equipamentos dedicados)	Escavadora giratória de rastos - 40 toneladas	2	MÊS 10	24 MESES
		Camião basculante de 14 m3 (podem ser de 18 m3)	12	MÊS 10	24 MESES
		Grua automóvel 40 toneladas	2	MÊS 10	24 MESES
	FRENTE 2 (apenas os equipamentos dedicados)	Escavadora giratória de rastos - 40 toneladas	1	MÊS 12	17 MESES
		Camião basculante de 14 m3 (podem ser de 18 m3)	8	MÊS 12	17 MESES
		Grua automóvel 60 toneladas	1	MÊS 12	17 MESES
	FRENTE 3 (apenas os equipamentos dedicados)	Escavadora giratória de rastos - 40 toneladas	1	MÊS 16	17 MESES
		Camião basculantes de 14 m3 (podem ser de 18 m3)	6	MÊS 16	17 MESES
		Grua automóvel 40 toneladas	1	MÊS 16	17 MESES
LOTE 6		Grua-torre 50 a 60m de lança	1	MÊS 5	8 MESES
		Multifunções	1	MÊS 5	14 MESES
		Retroescavadora	1	MÊS 5	16 MESES
LOTE 7		Grua-torre 50 a 60m de lança	1	MÊS 7	8 MESES
		Multifunções	1	MÊS 7	14 MESES
		Retroescavadora	1	MÊS 7	16 MESES
OBRA GERAL		Buldozer tipo D6	1	MÊS 10	24 MESES
		Motoniveladora	1	MÊS 10	24 MESES
		Plataformas para transporte de tubo	8	MÊS 10	24 MESES
		Camião cisterna (capacidade a definir)	2	MÊS 8	26 MESES
		Viatura de abastecimento	2	MÊS 10	24 MESES
		Viaturas de manutenção	2	MÊS 8	26 MESES
		Carrinhas de 4 toneladas	4	MÊS 8	26 MESES
		Viaturas para director de frente	5	MÊS 8	26 MESES
		Viaturas para topografia	3	MÊS 8	26 MESES
		Viaturas para encarregado	8	MÊS 8	26 MESES
		Sistema de escoramento para vala (módulos de 2m)	20	MÊS 10	24 MESES
		Bombas submersíveis	12	MÊS 10	24 MESES

Figure 25: Construction phase: Vehicles for the Lots 2, 6 and 7 (Consortium CNT / GAUFF / CASAIS / OPAIA)

The construction yard for Lot 2 will be temporary and demobilized at the end of the commissioning phase. The land is owned by Casais Angola and its future use has not yet been defined. Once the work is completed, only the walled perimeter will remain. All other facilities will be removed. All materials resulting from the demolition will be reused or processed in the Casais group's industries (concrete will be crushed in Casais' quarry and reused, wood will be processed in Casais' industrial carpentry, etc.). Materials that cannot be reused will be collected by licensed waste processing companies.

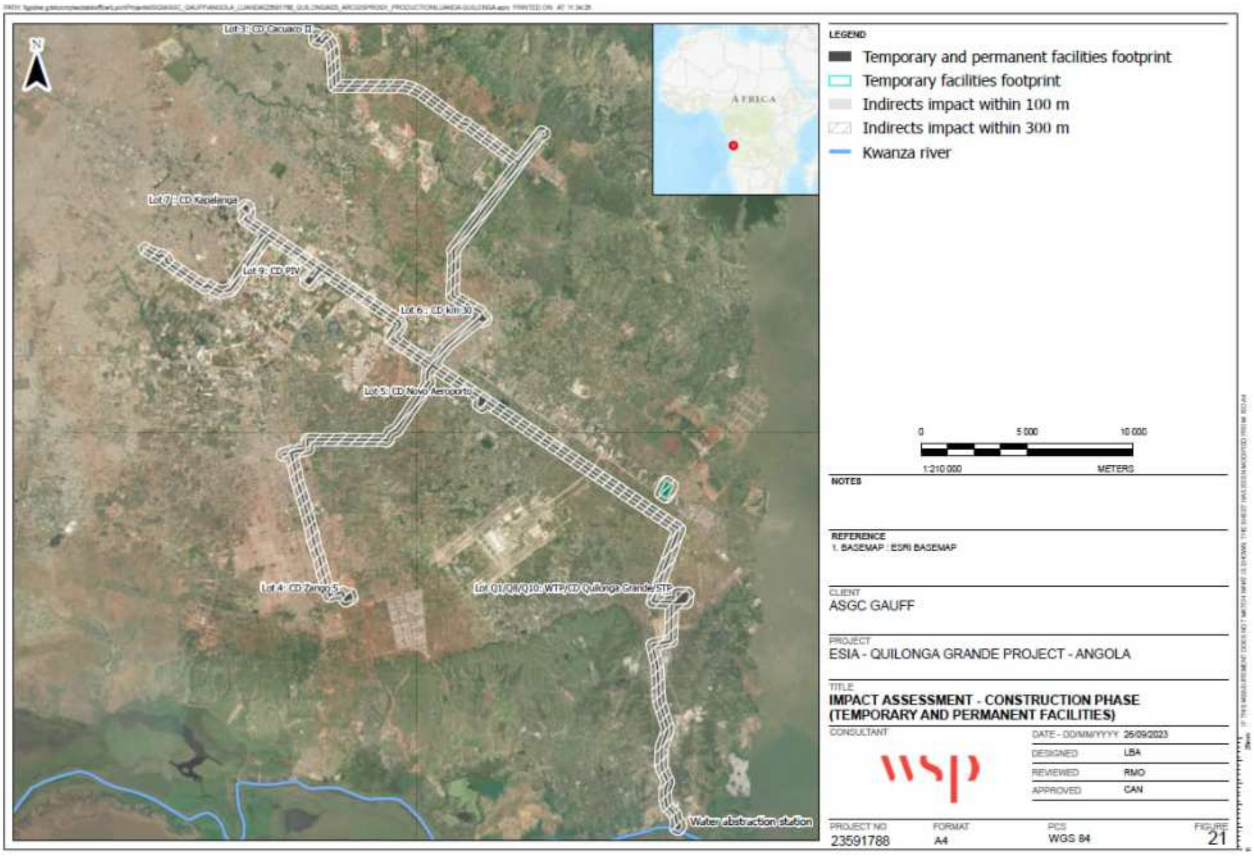


Figure 26: Temporary construction yard for Lot 2

Note: Temporary footprint marked in light blue

2.3.4.2.3 Operation phase

The operation of the pipes will be almost entirely done remotely via the telemetry to be installed in the system – the telemetry system will control the Lot Q8 pumping station and the levels and flows entering the different DCs, regulating the water pumped through Lot Q2 transmission mains. However, a monitoring plan is usually defined for the underground chambers to be installed along the pipelines to check their state, as well as the equipment installed inside them (pipes, valves, and fittings). This monitoring also makes it possible to check the corridors where the pipeline is laid. One or two vehicles (normal pick-ups) can be used for this purpose, but no specific equipment/machinery is normally required. Given the size of the system and, consequently, the considerable number of boxes that will be installed a daily use of these monitoring vehicles is likely to be needed.

The main activities are :

- the operation and maintenance of the switchgear (valve boxes); knowing that a Supervisory Control and Data Acquisition Systems (SCADA) system is planned that can allow remote readings and operation of some equipment ;

- repairs to the pipeline in the event of damage caused by external agents (unauthorized excavations, etc.)
- maintenance and monitoring of the pipeline corridors (prevention of clandestine construction, control of the growth and proliferation of large trees, installation of new infrastructure in the vicinity of the pipeline, etc.) ;
- inspection and maintenance of purge systems (bottom discharge) ; and
- repair works in case of accidental pipe ruptures ;
- cleaning and disinfection in the event of accidental contamination of the system, or periodically (to be defined by EPAL).

In terms of residuals, during operation oils and chemical products are used in the maintenance of mechanical systems that are used in very small quantities and at very long intervals (weeks to months). Waste resulting from any repairs/replacement of damaged pipes is reusable and/or recyclable (basically, these are short stretches of pipes (1 to 2 meters), and all steel is reusable. The water resulting from washing the piped is not contaminated as the products used for disinfection are necessarily suitable for drinking water pipes and limits the aggressiveness of the components to be used.

The number of workers need for the operation of Lot 2 is yet to be defined by EPAL.

The land plots reserved for lots 6 and 7 are considerable in size. The idea for the new DCs layout planning is to optimize the size and location of the necessary buildings, so that the final DC footprint is smaller than the size of the available plot areas. This will give flexibility to better adapt to the alignments of Lot 2 transmission mains and eventually to adapt to potential partial utilization of these plots by the local population.

Permanent easement will require no building development and no deep-rooted plants within 3 to 6 meters from the pipeline implantation axis. Such easement should not affect future constructions or activities on the pipeline trenches located under existing streets and roads, or areas with special status regarding construction and/or agriculture, such as the area of protection of the new airport and the Economic Special Zone (ZEE), which together, correspond to approximately 90 % of the total pipeline length.

During the construction phase, the executed sections of the pipeline will be under the surveillance and supervision of the EPC consortium. Any attempts to construction, or other activities, in the pipeline corridor will trigger a notification to the Owner (EPAL) and local authorities and will stop immediately.

After commissioning and delivery of the project, the operation, maintenance, surveillance, and protection of the infrastructure will be transferred to the Owner (EPAL), and they will bear the responsibility to define the restrictions and make sure these restrictions will be legally enforced in case of any violation.

The Consortium will hand over to the Owner all the detailed information about the exact location and depth of all the sections of the pipeline and other hydraulic organs, and a set of general and specific recommendations regarding the physical protection of the system. The whole extension of the pipeline will be adequately signaled on the surface. The local Administrations will be informed about the exact location of the pipelines, so that they will integrate this information on future urban and/or industrial development plans.

The general restrictions of land use near Lot 2 will be:

- No excavation works allowed in a 6-meter corridor (3 meters for each side of the pipeline axis).
- No construction (temporary or permanent) allowed in a 6-meter corridor (3 meters for each side of the pipeline axis).
- No agricultural use of the land in a 6-meter corridor (note that more than 95 % of the pipeline will be in urban areas, and in areas protected by the government (ZEE and New Airport are examples of that).

- The construction of new roads or macro-drainage infrastructures crossing the pipeline must include specific works designed to protect the pipeline.

2.3.5 Lots under responsibility of SinoHydro

2.3.5.1 Lot 4, 5 and 9 - Distribution Centers (DC) Zango, New Airport, PIV

The components of those lots are a chlorination section, a reservoir, a water tower, administrative buildings, a pumping building, and a chlorine store. All the characteristics of DC Zango, New Airport and PIV are presented in the Table 8 below.

The PIV already existed but was expanded to meet demands.

Table 8: Characteristics of the DC Zango 5, New Airport and PIV

	Zango 5 (Lot 4)	New Airport (Lot 5)	PIV (Lot 9)
Reservoir capacity	10,000 m^3	20,000 m^3	30,000 m^3 (existing) 20,000 m^3 (new)
Water tower height	-	-	45 m
Population benefiting	104,695	7,486	327,723
Districts benefiting	Nzamba Calumbo, Calumbo Sede, Kakila, Km 40, Zango IV, Zando V, Cajueiro and Santa Paciência	Dimba, Quilometro 35, Desvio, Bemba, KM 36, Vai e Volta	Kapalanga, Zona Industrial, 4 de Abril-Viana, Zee (Kikuxi-II), Nova Centralidade, km 30-A

PIV = Polo Industrial de Viana

2.3.5.1.1 Construction schedule

The construction of those three DCs are nearly finalized.

2.3.5.1.2 Operation phase

The activities during the operation phase are the same as described for Lot 3 and 8.

The number of works need for the operation of those two lots is yet to be defined by EPAL.

The access to Lot 4 is done via the Zango main road, main access to the Zango 800 town center and asphalt access of approximately 300 m; to Lot 5 via the EN 100 and a paved access of approximately 500 and to Lot 9, via the Zango main road, main access to the Zango 800 town center and asphalt access of approximately 300 m.

3.0 LEGAL AND INSTITUTIONAL FRAMEWORK

This study has been developed in compliance with national and international regulation.

The following sections outline the national legislation and international standards applicable to the Project.

3.1 National Legislation

Article 21st of the **Constitution of the Republic of Angola** states that it is a fundamental task of the Angolan state, among others, to promote the harmonious and sustainable development in all national territory, protecting the environment, the natural resources, and the historical, cultural, and artistic heritage.

The need for environmental protection and the requirement for achieving sustainable development is founded on the right of all citizens to live in an unpolluted, healthy environment, as well as the duty to defend and preserve it, as defined in Article 39/1 of the Constitution. The same article determines that the state should adopt all necessary measurements to protect the environment, the flora and fauna species in the national territory as well as maintain ecological balance through the correct location of economic activities, the rational use of all natural resources, within a framework of sustainable development, respect the rights of future generations and ensure the preservation of different species.

With this vision, the Angolan government approved Law No. 5/98 of 19th of June, which established the **Environmental Framework Law**. This Framework Law instituted environmental rights in the legal framework of the country, highlighting the collective and individual responsibilities in face of the complexity of environmental questions.

Law No. 5/98 establishes the generic duty to defend the environment and to use natural resources in a sustainable way, as well as contribute to the quality of life.

Angola Constitution, as well as the Environmental Framework Law, establish the generic legal baseline for Environmental Protection in the country, and set the basis for future environmental legislation.

The relevant legal local framework to this Project is presented below in Table 9. The shaded boxes are regulations that do not appear in the 2014 ESIA.

Table 9: Summary of Applicable Angolan Regulations

Area	Act	Topic	Notes	Applicability
Environmental Sector	Law No. 5/98, of June 19th 1998	Environmental Framework Law	Establishes the general duty regarding environmental protection and the sustainable use of natural resources.	General law – all activities
Environmental Sector	Presidential Decree No. 117/20, of April 22nd 2020	Environmental Impact Assessment Regulation and Environmental Licensing Procedure	Agricultural, forestry industrial, commercial, housing, tourism, and infrastructure projects that, by their nature, dimension, or location, have impacts on the environmental and social balance and harmony are subject to an environmental impact assessment study and licensing.	Environmental licensing of the project – Installation, operation, and decommissioning licenses
Environmental Sector	Presidential Decree No. 83/22, of April 12th 2022	Taxes for Emission and Renewal of Environmental Licenses	Establishes the fees to be charged for the issuance and renewal of environmental licenses for the Environmental Impact Assessment, as well as the registration and renewal of environmental consulting companies.	Taxes and costs associated with the environmental licensing
Environmental Sector	Executive Decree No. 92/12, of March 1st 2012	Term of Reference for the Development of Environmental Impact Studies	Establishes the guidelines for the preparation of studies subject to an Environmental Impact Assessment, including laying out the minimum content that must be contained within the Environmental and Social Impact Assessment report.	ESIA

Area	Act	Topic	Notes	Applicability
Environmental Sector	Executive Decree No. 87/12, of February 24th 2012	Regulation on Public Consultation	Regulates the development of public consultation within an environmental impact assessment process.	ESIA
Environmental Sector	Presidential Decree No. 194/11, of July 7th 2011	Regulation on Responsibility for Environmental Damage	Establishes the responsibility regarding the risk and degradation of the environment based on the "polluter pays" principle in order to prevent and remedy environmental damage.	General law – all activities
Environmental Sector	Decree 01/10, of 13th January 2010	Regulation on Environmental Auditing	Regulates the development of environmental auditing to public and private entities whose activities are susceptible of provoking significant environmental impact.	Future auditing processes, developed in environmental licensing renewals and environmental operation license
Biodiversity	Resolution No. 82/14, of 14th January 2014	National Policy on Forests, Wild Fauna, and Conservation Areas	Promote the sector's contribution to the sustainable development of the country, through the preservation, conservation, development and wise use of forests, wild fauna, and conservation areas, for the benefit of present and future generations.	Project impacts and mitigation measures
Biodiversity	Presidential Decree No. 26/20, of February 6th 2020	National Biodiversity Strategy and Action Plan (2019-2025)	The National Strategy and the Biodiversity Action Plan aims to ensure the conservation and sustainable use of biodiversity components, considering the fair and equitable sharing of the benefits from the use of resources conservation, preservation, protection, and restoration of biodiversity in Angola.	Project impacts and mitigation measures
Biodiversity	Law 06/17, of 24th January 2017	Framework Law of Forests and Wild Fauna	It establishes the norms which aim to ensure the preservation and rational and sustainable use of forests and wild fauna existent in national territory, and regulates the activities related to it.	Project impacts and mitigation measures
Biodiversity	Law 08/20, of 16th of April 2020	Law of the Environmental Conservation Areas	It establishes the National System of Environmental Conservation Areas, which defines the criteria and rules for its creation, classification, and management, through principles that ensure the preservation, conservation, and sustainable use.	Project impacts and mitigation measures
Biodiversity	Presidential Decree No. 148/22, of	Regulation of Green Spaces	It establishes the national regulation for the management of green spaces, including requirements regarding the creation of green	Project Landscape Integration

Area	Act	Topic	Notes	Applicability
	9th of June 2022		spaces proposed in landscape integration plans for new urban projects and the maintenance of vegetation in public and private proprieties.	
Biodiversity	*Executive Decree No. 252/18, of 13th of July*	*Red List of Species of Angola*	It publishes the Angolan Red List of Species, identifying 4 Categories: A - Ex – Extinct; B – AEx – Threatened; C – Vul – Vulnerable; and C - Invasive	Applicable to the ESIA Baseline characterization, the Impact Assessment, and all future biodiversity monitoring campaigns.
Waste and Wastewater	Presidential Decree No. 190/12, of August 24th 2012	Regulation of Waste Management	Establishes that all public and private entities that produce waste or carry out activities related to waste management shall prepare a Waste Management Plan (WMP) prior to the commencement of their activity, containing at least all information set out in Appendices I and II, respectively.	Waste management in all project phases
Waste and Wastewater	Executive Decree No. 17/13, of January 22nd 2013	Regulation of Construction and Demolition Waste Management	Establishes legal regulations relating to waste management resulting from the construction or demolition of buildings or landslides, briefly referred to as construction and demolition wastes, including its prevention and reuse and operations of collection, transport, storage, sorting, treatment, recovery, and disposal.	Waste management in the construction phase
Waste and Wastewater	Presidential Decree No. 265/18, of November 15th 2018	Regulation for the Transfer of Waste for Reuse, Recycling, and its Recovery to the outside of the country	Establishes the rules and procedures relating to operational and administrative control over the transfer of waste for reuse, recycling, and its recovery abroad. This Diploma is only applicable to non-hazardous waste destined for reuse, recycling, and recovery, to be transferred abroad. It applies to non-hazardous waste.	Waste management in all project phases
Waste and Wastewater	Executive decree 24/15 of 29th January 2015	Regulation on the registry and licensing of companies that develop activities in the area of waste and wastewater management and treatment	Establishes the requirements and procedures for the licensing of waste and wastewater operators.	External waste management operators subcontracted in the construction and operational phases

Area	Act	Topic	Notes	Applicability
Waste and Wastewater	Joint Executive Decree n. 527/21 of 15th October 2021	Legal regulation on taxes and fees charged by the National Waste Agency	Establishes the taxes and fees charged by the National Waste Agency in the services developed for the regulation of the Waste Management Sector.	External waste management operators subcontracted in the construction and operational phases. Waste Management Plans Certification process
Health and Safety at work	Executive Decree No. 6/96, of February 2nd 1996	General Regulation of Occupational Health and Safety Services	Establishes the principles that aim to promote safety, hygiene, and health at work in companies, commercial and industrial establishments, and cooperatives.	All activities and workers in the construction and operational phases
Health and Safety at work	Decree No. 53/05, of August 15th 2005	Legal System for Work-Related Accidents and Occupational Diseases	Establishes the legal regime of work-related accidents and occupational diseases, considering as such events that occur during the course of employment within a company or institution that cause the employee injury or bodily harm resulting in inability, partial or total, temporary, or permanent to work or resulting in death.	All activities and workers in the construction and operational phases
Health and Safety at work	Law No. 7/15, of June 15th 2015	General Labor Law	Applies to all workers providing services paid on behalf of an employer within the organization and under its supervision and direction and provides the framework for the rules and procedures for employee and employer relationship.	All workers in the construction and operational phases
Health and Safety at work	Decree No. 31/94, of 5th of August 1994	Health, Safety and Hygiene at Work System	Establishes the requirement for health, safety, and hygiene at work systems for state, mixed and private companies, and associations.	Health safety and hygiene at work management system in the construction and operational phases
Health and Safety at work	Executive decree No. 128/04, of 23rd of November 2004	General Regulation on Health and Safety at Work Signage	It established the minimum prescriptions for placing and using Health and Safety at Work Signage.	Health and safety at work signage in the construction and operational phases
Health and Safety at work	Presidential Decree No. 195/11, of 8th of July 2011	Legal regime for the prevention of fires in buildings	Establishes the requirements in safety prevention in buildings, including the consideration of safety conditions in the project phase, maintenance of safety conditions during the life cycle of the buildings, and the requirement of previous inspection by firefighters or civil	Fire safety measures in the construction yard and the future buildings

Area	Act	Topic	Notes	Applicability
			protection services, with the emission of an approval certificate.	
Health and Safety at work	Presidential Decree No. 285/22, of 8th of December 2022	List of forbidden or conditioned jobs for minors	It establishes the list of forbidden jobs for minors and the conditions for certain jobs allowed to minors.	All workers in the construction and operational phases
Work and Social protection	*Law No. 7/04, of 15th October 2004*	Social Protection Law	Is establishes in Angola the Social Protection System, Including the Base Social Protection, the Mandatory Social Protection, and the Complementary Social Protection	All Companies and workers allocated to the project are included in the Mandatory Social Protection System, having to pay contributions to the national social security system and being covered by the social protections (unemployment, disease, maternity, work accidents and diseases, retirement, death, child support, etc.).
Water sector	Law No. 6/02, of June 21st 2002	Water Law	Establishes the general principles of the legal systems regarding the use of water resources.	General law – all activities
Water sector	Presidential Decree No. 261/11, of October 6th 2011	Regulation of Water Quality	Establishes water quality standards and criteria for the purpose of protecting the aquatic environment and improving the quality of water based on their main uses. Applies to inland waters, both superficial and groundwater, as well as the water for aquaculture, livestock, agricultural irrigation, and seaside resorts.	Quality of the used water and quality of wastewater discharged
Water sector	Presidential Decree No. 83/14, of April 22nd 2014	Regulation of Public Water Supply and Sanitation of Wastewater	Defines the rules regulating public water supply and wastewater sanitation activities.	Requirements for the water distribution network and wastewater discharge system in project design
Water sector	Presidential Decree No. 82/2014, of 21st of April 2014	Regulation on the general use of water resources	It regulates the water uses established in the water law, including the licensing of water extraction, wastewater discharge and commercial aquiculture, with the emission of water resources using titles (TURH).	Licensing of water extractions and wastewater discharges in the project

Area	Act	Topic	Notes	Applicability
Water sector	Presidential Decree n. 255/20 of 7th October 2020	Tariff regulation for Water supply and wastewater sanitation services	Establishes rules for the tariffs used in the operation of water distribution systems and wastewater collection and treatment systems	Tariff system in the operational phase
Water Sector	*Presidential Decree No. 126/17, of 13 June 2017*	National Water Plan	This plan establishes the national strategy and guidance for management of water resources.	As a strategic guidance document, it is important to assess if the water use proposed is aligned with the National Strategy. The document considers that water supply and sanitation for the population is a priority water allocation, so the project is aligned with the national strategy proposed.
Water Sector	*Presidential Decree No. 141/12, of 21st of June 2012*	Regulation for Pollution Prevention and Control in National Waters	This regulation establishes rules to prevent and control water pollution originating in ships, boats, marine rigs, and industrial units. The regulation is focused at implementing disposition from the MARPOL 73 and 78 Conventions, thus being specially focused at sea pollution management originating in ships and oil rigs. However, it also mentions hydrocarbon pollution from industries and pollution prevention in inner waters, giving it a broad applicability spectrum.	Since the project is not industrial, it is considered not applicable. The pollution prevention dispositions applicable to the construction and operational phases are already covered by Presidential Decree n.º 194/11 (Regulation on Responsibility for environmental damage)
Water Sector	*Presidential Decree No. 41/21, 12 February 2021*	Legal Framework for the Water Extraction in Public Domain Fees	This diploma establishes the taxes/fees applicable for water use in public domain, namely associated with raw water extraction licenses and concessions attributed according to Presidential Decree No. 82/2014 (Regulation on the general use of water resources)	This diploma will establish the values to be paid by EPAL, during the operational phase, for it's water extraction concession.
Spatial Planning and Land Use	Law No. 3/04, of June 25th 2004	Spatial and Urban Planning Law	This law has as its object the biophysical space, consisting of all urban soils and rural areas, subsoil, the continental shelf, and inland waters, with a view to ensure actions which result in the occupation and	General law – project location and design

Area	Act	Topic	Notes	Applicability
			use of the spaces above, through the implementation of spatial and urban planning instruments.	
Spatial Planning and Land Use	Law No. 9/04, of November 9th 2004	Land Law	Establishes the general bases of the legal regime of land included in the original property of the State, land rights that may be levied on them, and the general scheme of transmission, constitution, exercise, and extinction of these rights.	Land use rights for the project's installation areas
Spatial Planning and Land Use	Decree No. 58/07, of July 13th 2007	General Regulation Land Concession	Establishes the legal framework for the concession of free lands within Angola and does not apply for private property lands. It also indicates that where there is expropriation for public use or for temporary requisition of lands, fair and adequate indemnity to the owner and to affected holders of other property rights is always owed.	Land use rights for the project's installation areas
Spatial Planning and Land Use	Law no. 23/21, of 18th October 2021	Legal Framework on Land Registry	It establishes the methodology and norms for developing, renewing, and maintaining land records, stating that each property should be identified through a numeric code, namely the property identification number (NIP), to be used in all public documents as a way to identify registered properties.	Land use rights for the project's installation areas
Spatial Planning and Land Use	Presidential Legislative Decree 9/18, of 18th of June 2018	Legal Framework for Geodesy and Cartography	It defines the rules to produce cartography and maps, including technical standards and requirements of licensing and homologation.	Topography and cartography services used in project design and construction phase
Spatial Planning and Land Use	Law n. 1/21 of 7th of January 2021	Law of Expropriation for Public Use	Establishes the principles and rules to observe in expropriation for public use by the competent entities of the public administration	Land use rights for the project's installation areas
Spatial Planning and Land Use	Presidential Decree n. 117/16 of 30th of May 2016	Resettlement Operations Regulation	Establishes rules, procedures, and criteria in the resettlement process for areas subject to urban requalification or reconversion, in order to safeguard public interest and the protection of rights and interests of the inhabitants	Land use rights for the project's installation areas
Spatial Planning and Land Use	Presidential Dispatch n. 298/19 of 11th October 2019	Metropolitan General Master Plan for: Luanda (PDGML)	General masterplan for the development of the Luanda Region	Project planning, dimensioning, and execution plan

Area	Act	Topic	Notes	Applicability
Spatial Planning and Land Use	Presidential Dispatch n. 308/20 of 4th December 2020	Viana Municipality Master Plan	Urban Masterplan for the Viana Municipality	Project planning, dimensioning, and execution plan
Spatial Planning and Land Use	*Law No. 41/20, of 23rd December 2020*	Public Contracting Law	It establishes the legal framework for development and execution of Public Contracts, applicable to public works and purchase of goods and services by public entities.	Applicable to the contracts developed by EPAL, the Ministry and other public entities related to the project.
Spatial Planning and Land Use	Presidential decree n.º 81/2021 of 8th April	Luanda-Bengo Special Economic Zone (ZEE) revision	It redefines the Luanda-Bengo Special Economic Zone (ZEE) limits. It also transmits the land rights of the land inside the ZEE to the Luanda-Bengo Special Economic Zone Development Society, which becomes the entity that can then transmit land rights for any uses inside the ZEE	Land use rights for the project's installation areas
Heritage	Law No. 14/05, of October 7th 2005	Cultural Heritage Law	Defines cultural heritage as all material goods and intangible assets which, by their recognized value, shall be subject to the authority and protection of the law, presenting a series of activities which are considered infringements against cultural heritage.	Mitigation measures in the construction phase
Heritage	Presidential Decree No. 53/13, of 6th of June 2013	Regulation on immobile cultural heritage	Regulates the norms and procedures to protect, preserve and value monuments and architectonic places and sets, classified or in the process of classification.	Mitigation measures in the construction phase
Social protection	*Law No. 25/11*	*Law Against Domestic Violence.*	It establishes the legal framework for preventing domestic violence as well as ensuring protection and assistance to the victims. This diploma is applicable only to facts that occur in family context or in other contexts associated with proximity, affectional, natural, or educational relations, namely: kindergartens, nursing homes, hospitals, schools, male and female boarding schools, and relevant social and community spaces.	Only Informative.
Social protection	Law No. 21-B/92, of 28th of August	National Health System Base Law	It establishes the Angolan National Health System (SNS)	Only Informative.

Area	Act	Topic	Notes	Applicability
Construction Sector	Decree 80/2006, of 30th of October 2006	General regulation for the licensing of construction, urbanization, and allotment operations	It establishes the requirement of licensing for a set of construction works, including buildings, setting the requirements for the licensing process. It also establishes the requirement of obtaining an operation permit prior to use of the buildings.	Project design requirements and construction and building use permits
Construction Sector	Decree No. 13/07, of 26th of February 2007	General regulation of urban edifications	It establishes the general rules for the use of urban buildings, including the existence of a using permit, as well as the development of Periodic conservation works (8 years). It also defines some technical requirements for the urban buildings.	Project design requirements and construction and building use permits
Construction Sector	Presidential Decree No. 146/20, of 27th of May 2020	General regulation on the development of activities in civil construction and public works, project design development and construction works' supervision	It establishes the rules for the companies that work in the construction sector, including the requirement of registry and permits.	Construction companies contracted for the project
Construction Sector	Executive Decree n. 29/21 of 21st of April 2021	Regulation on the import, storage, transport, use and safety of Asphalts for road paving and maintenance	Establishes technical requirements related to the use of bituminous materials for road paving	Road rehabilitation/Paving if needed in the project
Construction Sector	Executive Decree n. 15/22 of 13th of January 2022	Technical regulation on steel for reinforced concrete	It establishes technical requirements for the use of steel in reinforced concrete structures	Reinforced concrete structures in the project
Transports	Presidential Decree n. 195/12 of 29th of August 2012	Regulation on hazardous materials road transportation	Establishes technical requirements for the vehicles and drivers involved in the transport of hazardous substances	Hazardous substances transport during the construction and operational phases
Transports	Executive Decree n. 57/08 of	Regulation of the road	Establishes requirements for vehicles that transport oil products, including fuel	Fuel transport during the

Area	Act	Topic	Notes	Applicability
	22nd of April 2008	transport of oil products		construction and operational phases
Other Legislation	Law n.19/22 of 7th of July 2022	Administrative Offences Law	Establishes the general bases applicable to administrative offences committed by an individual or collectively by citizens or public or private collective entities.	General law – all activities
Other Legislation	Law n. 38/20 of 11th November 2020	Angolan Penal Code	Is establishes as crime, in articles 282 and 283, a set of actions against the environment and pollution discharge	General law – all activities
Other Legislation	Presidential Decree 153/11, of 15th of June 2011	Regulation on Ozone Depleting Substances	Regulation that establishes the rules for producing, exporting, re-exporting, and importing of substances, equipment and devices that contribute to the depletion of the ozone layer.	Cooling equipment gases and other gases used in the construction and operation phases
Other Legislation	Joint Executive Decree 518/18, of 5th of December 2018	HCFC'S and other mixtures import quotas	It sets limits, requirements, and permits for the import of ozone depleting substances.	Cooling equipment gases and other gases used in the construction and operation phases
Other Legislation	Presidential Decree n. 216/22 of 23rd of August 2022	National Strategy for Climate Change 2022-2035	Establishes the national strategy related to mitigation and adaptation for climate change	General law – all activities
Other Legislation	Decree No. 40/2004, of 2nd of July 2004	Regulation for the licensing of installations for the use of electric energy	Establishes technical requirements for electrical installations, including in buildings, that must be considered in the electrical project and licensing requirements prior to the use of the building.	Project design requirements and licensing (building's electrical grid)
Other Legislation	Decree No. 39/04, of 2nd of July 2004	Statute of the technician responsible for electrical installations	Establishes rules regarding the management of electrical installations, including the requirement of a responsible technician for the operation of self-supply systems with capacity over 50 kVA.	Self-supply diesel generators used in the construction phase and the operational phase
Other Legislation	Decree No. 41/04, of 2nd of July 2004	Regulation on the licensing of electrical energy production, transport, and distribution installations	It establishes licensing requirements for several types of electric energy installations, including for self-supply diesel generators.	Self-supply diesel generators used in the construction phase and the operational phase

Area	Act	Topic	Notes	Applicability
Other Legislation	Presidential Decree No. 173/13, of 30th of October 2013	Licensing of storage installations for oil, fuel, gas, and LPG products	It establishes requirements for the licensing of different types of storage installations and equipment for oil products, including diesel storage units, such as those used for support to self-supply diesel generators.	Diesel storage units used in the construction phase and the operational phase

The shaded boxes are regulations that do not appear in the 2014 ESIA or regulations after the 2014 ESIA.

Regarding the Presidential Dispatch n. 298/19 of 11th October 2019, which establishes the Metropolitan General Master Plan for Luanda (PDGML), it was considered to present some additional information to clarify its applicability.

This General Master Plan was developed with the goal of establishing the main strategic development guidelines for the city of Luanda. Its scope covers the Metropolitan Area of Luanda, not being limited to specific municipalities, but also not having a full provincial scope. As stated in the document, its scope lies between the Provincial Land Use Planning Master Plans (PPOT) and the Municipal Master Plans (PDM).

This General Masterplan does not establish a legal framework, but is a strategic planning tool, that will guide the development of other land use master plans, such as the Municipal Master Plans, which then establish the legal framework for land use.

The Economic Development Strategy presented considers several priority dynamics, namely:

- Economic diversification ;
- Effective management of demographic growth ;
- International Competiveness ;
- Balanced Economic Development.

The plan also presents an economic specialization vision for each municipality.

The 3 Municipalities where the project is located have the following strategic vision:

- Viana:
  - New centre of the province, motivated by the connection between the centre and the new airport, with mixed uses ;
  - Industrial pole of the province, along with Cacuaco ;
  - Collaboration with Belas in the creation of Agricultural Clusters.
- Cacuaco:
  - One of the Province’s industrial Poles, including Heavy Industry, induced by the strategic positioning between the new airport and planned port of Dande ;
  - Includes logistics and mixed uses activity.
- Ícolo e Bengo:
  - Strong Development of logistics and industrial activities near the airport ;

- One of the Province's agricultural poles, integrating the duality of urban and rural realities, along with touristic spots by the rivers and lakes.

Regarding the Water supply sector, this plan presents a general economic assessment of the water supply system for the city, from 2015 to after 2030. This plan considers the implementation of 8 water supply systems and assumed that the highest level of estimated investment is for the system V (Quilonga Grande), followed by the System IV (BITA). Systems I to IV are already implemented and the plan considers the investment for systems VI to VIII only during the 2020-2030 period.

It was also considered important to present some further details regarding the Viana Municipality Master Plan, Approved by Presidential Dispatch n. 308/20 of 4th December 2020.

The Viana Masterplan establishes, in Volume IV of the Masterplan, the land use regulations, including land use plants and restriction plants.

The masterplan classifies the municipal territory in land use classes and establishes the limits and restrictions for land use in each class. It also establishes restrictions for land uses around several elements and infrastructures (considered Total or Partial Protection Areas), including heritage elements, roads, railroads, water supply systems, electrical supply systems, waste management infrastructures and others.

According to this master plan, Water Supply infrastructures, namely Pipelines, Canals, Reservoirs, Pumping Stations, and Water Treatment Plans are considered areas of Partial Protection, thus establishing buffers zones with land use restrictions. This Masterplan states that water pipelines for human consumption have a 10-meter buffer zone, on each side of the pipeline, where it is forbidden to build any type of buildings or plant any trees (with some exceptions for landscape activities).

As for reservoirs, pumping stations and Water Treatment Plants, the Viana Masterplan considers a 100-meter buffer zone where it is forbidden to construct new buildings, install commercial or industrial units, slaughterhouses, graveyards, waste dumpsites, hydrocarbons deposits, develop agriculture activities with the use of manure or artificial fertilizers, discharge wastewater or other pollutants and other restrictions.

It should be noted that, regarding Cacuaco Municipality, there are no references of a Municipal Master Plan, nor there are any official publications of this type of legal document for that municipality.

As for Ícolo e Bengo Municipality, the Municipal Master Plan has been in development since 2015, initially promoted by the National Institute for Land Use Planning and Urban Development (INOTU) and developed by COTEFIS Angola and COTEFIS Portugal.

This masterplan was approved by the Luanda Provincial Government in 26 of August of 2021. However, the Ìcolo e Bengo Masterplan still hasn't been published in the official Journal of Angola and, as such, still lacks any legal value. Only after ratification through Presidential Decree will the Master Plan be in place as a legal framework. After that publication, the project's activities should be compliant with the requirements established in the final, ratified version of the masterplan.

Permitting and licensing requirement of the Projet

Regarding the main Permitting and Licensing Requirements for the Construction and Operation Phases, as described in the National Legislation Chapter, it is considered the applicability of the following legal regimes:

- Construction Phase :
  - Construction License (or confirmation of exemption - applicable to public works) from local authorities (Decree No. 13/07) and associated licenses (electrical grid of buildings, electrical generators, fuel

storage units, connections to public electrical network (ENDE) and Public Water Network (EPAL), others) ;

  - Installation Environmental Licensing (Presidential Decree No. 117/20) ;
  - Construction Phase Waste Management Plan Certification by ANR (Presidential Decree No. 190/12 and Executive Decree No. 17/13) ;
  - Ensure Land Use rights for all plots (Land Law - Law No. 9/04).
- Operational Phase :
  - Operational Environmental Licensing (Presidential Decree No. 117/20) ;
  - Operational Phase Waste Management Plan Certification by ANR (Presidential Decree No. 190/12) ;
  - Certification of Fire safety condition of constructed buildings, emitted by Firefighter Department or Civil Protection (Presidential Decree No. 195/11) ;
  - Obtain License or Concession rights for water extraction (Presidential Decree No. 82/2014).

3.2 International Agreements

Considering the location of the Project, several international conventions and regional agreements on environmental protection signed by the Angolan Government are applicable to the Project including :

- African Convention on the Conservation of Nature and Natural Resources of 15 September 1968 in Algiers (Date of signature: 27/01/2012; Date of ratification: 31/08/2020) ;
- Revised African Convention on the Conservation of Nature and Natural Resources, Maputo, (Entry into force in Angola: 20/01/2014) ;
- Kunming-Montreal Global Biodiversity Framework (Date of signature: 19/12/2022) ;
- Convention on the Conservation of Migratory Wildlife Species (CMS) of 23 June 1979 in Bonn (Entry into force in Angola: December 2006) ;
- UNESCO Convention on the Protection of Cultural and Natural World Heritage of 16 November 1972 in Paris (Date of ratification: 07/11/1991) ;
- Convention on Wetlands of International Importance, especially as Waterfowl Habitats (Ramsar Convention) (Letter of accession submitted by the Republic of Angola in 16/07/2022) ;
- Convention on International Trade in Endangered Species of Fauna and Flora (CITES) (Date of ratification: 14/02/2017) ;
- Treaty on the Conversation and Sustainable Management of Forest Ecosystems in central Africa and to Establish the Central African Forests Commission (COMIFAC) (Entry into force in Angola: 27/10/2021) ;
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Elimination of 22 March 1989 (Entry into force in Angola: 07/05/2017) ;
- Bamako Convention on the Prohibition to import hazardous waste in Africa and the control of their Transboundary Movements of 30 January 1991 (Date of ratification: 01/12/1997) ;

- Rio Convention (agreed at the Earth Summit held in Rio de Janeiro in June 1992), which led to the following 3 conventions :
  - United Nations Framework Convention on Climate Change (UNFCCC) of 9 May 1992 in New York (Entry into force in Angola: 28/08/1998) ;
  - United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/ or Desertification, particularly in Africa (UNCCD) of 14 October 1994 in Paris (Date of ratification: 09/05/2000) ;
  - Convention on Biological Diversity (CBD) 1992. (Date of ratification: 01/04/1998) ;
- Kyoto Protocol to the United Nations Framework Convention on Climate Change of 11 December 1997 (Date of ratification letter for accession: 17/03/2020) ;
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity of 29 January 2000 (Entry into force in Angola: 28/05/2009) ;
- Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (Date of ratification: 06/02/2017) ;
- Convention for the Safeguarding of the Intangible Cultural Heritage of 17 October 2003 (Entry into force in Angola: 28/10/2020) ;
- Convention on the Protection and Promotion of the Diversity of Cultural Expressions (Entry into force in Angola: 24/11/2011) ;
- Convention on Persistent Organic Pollutants of 22 May 2001 in Stockholm (Entry into force in Angola: 21/01/2007) ;
- Paris Climate Agreement of 15 December 2015 (Entry into force in Angola:16/12/2020).

The shaded lines are agreements after the 2014 ESIA.

3.3 International Financing Institutions Guidelines

The ESIA will be compliant with the World Bank guidelines and International Finance Corporation (IFC) Performance Standards (PS), and with Equator Principles (EP), presented hereafter.

3.3.1 International Finance Corporation (IFC)

The IFC has developed general and industry-specific performance standards, policies, and guidelines on environmental social sustainability in the areas of environment, health, and safety to minimize the negative environmental and social impacts of the development projects it supports and to maximize their benefits.

IFC Performance Standards (PS)

Eight performance standards define the standards to be met throughout the life of an IFC funded project. These performance standards are each accompanied by detailed guidance notes.

The general requirement encompassing the performance standards is to identify individuals and communities likely to be directly, differently, or disproportionately affected by the project due to their disadvantaged or vulnerable position. Where the study establishes that such individuals or communities are disadvantaged or vulnerable, the client will propose and implement selective measures to ensure that such individuals and groups are not disproportionately affected by adverse impacts and are not disadvantaged in the distribution of benefits and opportunities from the project.

The IFC PSs considered material for this Project are summarized in Table 10 below. The shaded boxes are Guidance Notes updated since the 2014 ESIA.

Regarding the PS7, the ethnic group Kimbundu represents the majority in the Luanda Province and is not specific to the region, being widely distributed throughout Angola and which is not socially and culturally distinguished from the rest of the population (further details in Chapter 6.1). The presence of indigenous people was not identified in the study area of this Project and therefore the PS 7 is not applicable.

Table 10: IFC Performance Standards applicable to the Project

PS number	Title	Applicable to Project	Date of issue
PS1	Assessment and Management of Environmental Risks and Impacts and Associated Guidance Note	✓	2012
PS2	Labour and Working Conditions and Associated Guidance Note	✓	2012
PS3	Resource Efficiency and Pollution Prevention and Associated Guidance Note	✓	2012
PS4	Community Health, Safety and Security and Associated Guidance Note	✓	2012
PS5	Land Acquisition and Involuntary Resettlement and Associated Guidance Note	✓	2012
PS6	Biodiversity Conservation and Sustainable Management of Natural Living Resources	✓	2012
GN	Associated Guidance Note updated	✓	**2019**
PS7	Indigenous Peoples and Associated Guidance Note*	×	2012
PS8	Cultural Heritage and Associated Guidance Note	✓	2012

*No indigenous people were identified during this ESIA

The shaded boxes are Guidance Notes updated since the 2014 ESIA.

IFC General EHS Guidelines

The General EHS Guidelines (dated April 30th, 2007) provide guidance to users on common EHS issues potentially applicable to all industry sectors. During the design, construction, operation, and decommissioning of a project (the project lifecycle) the project owner will consider ambient conditions and apply pollution prevention and control technologies and practices (techniques) that are best suited to avoid or, where avoidance is not feasible, minimize or reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective. The project-specific pollution prevention and control techniques included in General EHS Guidelines involve the subjects listed below:

- Air emissions and ambient air quality ;
- Energy conservation ;
- Wastewater and ambient water quality ;
- Water conservation ;
- Hazardous materials management ;

- Waste management ;
- Noise ;
- Contaminated land ;
- Occupational Health & Safety ;
- Community Health & Safety ; and
- Construction and Decommissioning.

IFC EHS Guidelines for Project-Specific

The IFC and World Bank Group (WBG) Environmental Health and Safety (EHS) guidelines are technical reference documents that complement performance standards and provide general and industry-specific examples of Good International Industry Practice.

The General EHS Guidelines (2007) contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors and contain guidance on environment air emissions and air quality, waste water and ambient water quality, hazard material , waste management, noise etc), community health and safety (water quality and availability, traffic safety, disease prevention etc), occupational health and safety (personal protective equipment, training, etc) and construction and decommissioning.

In addition to the IFC General EHS Guidelines, the following sector-specific guidelines have also been considered in the assessment:

- IFC Environmental, Health, and Safety Guidelines for Waste Management Facilities (2007) ;
- IFC Environmental, Health, and Safety Guidelines for Water and Sanitation (EHS) Guidelines (2007).

Good practices

- IFC Addressing Gender-Based Violence and Harassment: Emerging Good Practice for the Private Sector ;
- IFC and EBRD Guidance Note on workers' accommodation: processes and standards (2009) ;
- IFC Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (2013) ;
- IFC Environmental and Social Management System Implementation Handbook: Construction (2014) ;
- IFC Environmental and Social Management System Implementation Handbook: General (2015) ;
- IFC Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (2013) ;
- IFC Good Practice Note on Addressing Grievances from Project-Affected Communities (2009) ;
- IFC Good Practice Note on Managing Contractors' Environmental and Social Performance (2017) ;
- IFC Handbook for Addressing Project-Induced In-Migration (2009) ;
- IFC Introduction to Health Impact Assessment (2009) ;
- IFC Stakeholder Engagement Handbook: A Good Practice Handbook for Companies Doing Business in Emerging Markets (2007).

The shades lines are Good Practices Handbooks subsequent to the 2014 ESIA.

3.3.2 Equator principles (EP)

The Equator Principles (EP) are intended to serve as a common baseline and risk management framework for financial institutions to identify, assess and manage environmental and social risks when financing Projects. There are 10 EPs and their applicability to the Project are summarized in the Table 11 below. The shaded boxes are EP Principles updated since the 2014 ESIA.

Table 11: Equator Principles applicable to the Project

EP	Title	Applicable to Project	Date of issue
EP1	Review and Categorisation	✓	**2020**
EP2	Environmental and Social Assessment	✓	**2020**
EP3	Applicable Environmental and Social Standards	✓	**2020**
EP4	E&S Management System and EP Action Plan	✓	**2020**
EP5	Stakeholder Engagement	✓	**2020**
EP6	Grievance Mechanism	✓	**2020**
EP7	Independent Review	×	**2020**
EP8	Covenants	×	**2020**
EP9	Independent Monitoring and Reporting	×	**2020**
EP10	Reporting Transparency	×	**2020**

The shaded boxes are EP Principles updated since the 2014 ESIA that are applicable to the project.

The EP make a distinction between Designated and Non-Designated Countries in the application of the EP. Designated Countries are those countries deemed to have robust environmental and social governance, legislation systems and institutional capacity designed to protect their people and the natural environment. Angola is not referred to as a Designated country in the Equator Principles referencing.

According to requirements of EP1, a process of ES categorization should be carried out to reflect the magnitude of a project risks and impacts. Based on results of categorization process, the ESIA will be commensurate with the nature, scale, and stage of the project, as well as with the level of ES risks and impacts.

The EP make a distinction between Designated and Non-Designated Countries in the application of the EP. Designated Countries are those countries deemed to have robust environmental and social governance, legislation systems and institutional capacity designed to protect their people and the natural environment. Angola is not referred to as a Designated country in the Equator Principles referencing. EP4 requires that for projects located in non-designated Countries (as is the case of Angola), the assessment process evaluates compliance with the applicable IFC PSs on ES sustainability and with the IFC EHS Guidelines.

According to the EP, the following assessments should be included in the ESIA:

- Potential human rights impacts, according to the United Nations Guiding Principles on Business and Human Rights (UNGP 2011) ;
- Climate change risks assessment, aligned with the Climate Physical Risk and Climate Transition Risk categories of the TCFD (Task Force on Climate-Related Disclosures, 2017, 2021), but the depth and nature of the climate change risks assessment depends on the type of project and nature of risk.

The shaded lines are the main Guidance Notes that have been updated since the 2014 ESIA, in the 4th version of the Equator Principles (IV) in 2020:

- Guidance Note on Implementation of Human Rights Assessments Under the EPs (September 2020) ;
- Guidance Note on Climate Change Risk Assessment (CCRA) (September 2020) ;
- Guidance Note on Biodiversity Data Sharing for EPFI Clients (September 2020).

3.3.3 OECD Common Approaches

The Project will be covered by export credit guarantee and thus needs to comply with the OECD Common Approaches within which projects are expected to be benchmarked against international standards as part of the environment and social impact assessment process. For projects in the private sector, these international standards include:

- IFC Performance Standards; and
- World Bank Group EHS Guidelines.

These standards are already guiding WSP's study in addressing the various components and phases including Project Classification.

The OECD Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence (the "Common Approaches") was adopted on 28 June 2012 and revised by the OECD Council on 6 April 2016. This agreement sets common approaches for undertaking environmental and social due diligence to identify, consider and address the potential environmental and social impacts and risks relating to applications for officially supported export credits as an integral part of Members' decision-making and risk management systems. While an OECD Recommendation is not legally binding, it expresses the common position of whole OECD memberships.

Equator Principals (EP4) Project categorization is based on the E&S categorization process of the IFC and considers three categories:

- Category A: Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible, or unprecedented ;
- Category B: Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures ;
- Category C: Projects with minimal or no adverse environmental and social risks and/or impacts.

The construction of drinking water supply systems construction of drinking water supply systems is not listed as sensitive sector in the OECD Common Approach document ("Recommended on Common Approaches on the Environment and Officially Supported Export Credits)". However, the project will require economical and physical displacements and the abstraction from the Kwanza River may have an impact on the aquatic ecosystem. Based on the classification above and the current knowledge of the Project, we suggest that, in accordance with the OECD categorization, **Category B** is triggered for this Project.

3.3.4 Other International Standards

The following standards are referred to within the IFC Guidelines:

- World Health Organization (WHO) guidelines relatives to air quality (which is referred to in the IFC EHS guidelines) and have been updated in 2021 ;

- WHO Guidelines for Community Noise 1999 (which is referred to in the IFC EHS guidelines) ;
- WHO Drinking Water Standards (2017).

In addition, the following guidelines and standards may be utilized:

- IUCN Red Data Book for protected species (fauna and flora) ;
- Guidance on Heritage Impact Assessments for Cultural World Heritage Properties, ICOMOS 2011 ;
- United Nations (UN) Guiding Principles on Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework United Nations, New York, and Geneva (UNGP 2011) reference HR/PUB/11/04.

The shaded lines are Standards subsequent to the 2014 ESIA.

4.0 PROPOSED PROJECT E&S CATEGORISATION

According to the IFC's Policy on E&S Sustainability (January 2012), as part of the review of environmental and social risks and impacts of a proposed investment, IFC uses a process of environmental and social categorization to reflect the magnitude of risks and impacts. The resulting category also specifies IFC's institutional requirements for disclosure in accordance with the IFC's Access to Information Policy. Accordingly, all projects are divided in four categories:

- Category A: business activities with potential significant adverse ES risks and/or impacts that are diverse, irreversible, or unprecedented ;
- Category B: business activities with potential limited adverse ES risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures ;
- Category C: business activities with minimal or no adverse ES risks and/or impacts; and
- Category FI: business activities involving investments in financial intermediaries or through delivery mechanisms involving financial intermediation. This category is further divided into three risk categories (FI-1, FI-2, FI-3).

As per the E&S categorization criteria of the applicable standards given above, based on the available data lots under the responsibility of the Consortium CNT / GAUFF / CASAIS / OPAIA (lots 2, 3 and 7) can be categorized as "Category B". However, the entire Quilonga Grande Project may be considered as Category A because there is potential for potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented. In particular, the proposed water treatment plant (lot 1) and sludge treatment plant (lot 10) pose the highest level of environmental and social risk of all of the Project lots and those lots elevate the project from Category B to Category A.

5.0 GENERAL METHODOLOGY

5.1 Review of existing documentation

A desktop review was undertaken of relevant E&S documentation made available via email and hard copy. Although not an exhaustive list of the documents reviewed, a list of the key documents is provided in Table 12:

Table 12: Key Documents provided for review

References
Artelia and Ecovisão. 2014. Environmental & Social Impact Assessment for the Luanda Drinking Water Supply (System 5), Quilonga Grande, prepared by to EPAL (Empresa Publica de Aguas)
Projeto de Abastecimento de Água para a Cidade de Luanda 5 – Quilonga Grande – Relatorio Ponto de Situação. Março 2023 (Presentation Power Point used by Dar during Stakeholder Meeting 20.04.2023) at EPAL
SOAPRO. 2016. Environmental & Social Impact Assessment Zoenzo Hydroelectrical power plants in Kwanza River. April 2016.
PROGESR, FLUIDEX. 2015. Environmental Impact Study Summary Report. Aproveitamento Hidroeletrico de CaculoCabaça. Dec 2015
GAUFF ESG Polices – various documents
ASGC ESG Polices – various documents
Quilonga Lots Q2, Q6 Q7 : Project Schedule (provided by GAUFF)
Quilonga Project Lots Q2, Q6 Q7 : Metodologia do Projeto (provided by GAUFF)
Quilonga Project Lots Q2, Q6 Q7 :Equipamento Obras (provided by GAUFF)
Quilonga Project Lots Q2, Q6 Q7 : Steel Pipes Summary (provided by GAUFF)
Quilonga Project Lots Q2, Q6 Q7 : answers provided by GAUFF to request of information by WSP about the construction phase
EPAL 2020. Feasibility Study Report on the Q1, Q3 and Q10 Lots of the Quilonga Grande Water Supply Project (Provided by ASGC)
Request and transfer of land Lot 5, 2016 (Provided by ASGC)
Request and transfer of land Lot 4, 2015 (Provided by ASGC)
Request and transfer of land Lot 3, 2017 (Provided by ASGC)
Request and transfer of land Lots 1, 8, 10 - 2013 (Provided by ASGC)
Registers of water parameters of Kwanza River 2013 and 2015 (provided by ASGC)
Water level of Kwanza River – Camambe station 1959-1963 - Minister of Energy and Water (provided by ASGC)
Water level of Kwanza River – Cangandala station 1967-1970 - Minister of Energy and Water (provided by ASGC)
Water level of Kwanza River – Lucaba km 34 station 1953-1957 - Minister of Energy and Water (provided by ASGC)
Water flow of Kwanza River – Lucaba station 1967-1974 - Minister of Energy and Water (provided by ASGC)
Water flow of Kwanza River – Cambambe station 1951-1956, 1967-1974 and 1967-1982 - Minister of Energy and Water (provided by ASGC)
Data from the Kuanza River provided by the National Institute of Water Resources (INRH) 2017 (provided by ASGC)

Additionally, WSP consulted the following public available sources:

- DAR. 2019. Bita System IV Water Supply Scheme – TFS, ESIA and Tender Documents for the Distributions of 4 CDs. May 2019: Resettlement Policy Framework and Environmental & Social Impact Assessment ;
- (EPAL 2015) Linhas de Orientação do Plano Estratégico 2015-2020

5.2 Scoping visit and first meetings with stakeholders

An in-country visit was done by a Portuguese speaking international expert between April 19th and 21st, 2023 according to the schedule presented in Visits to the 10 Lots were organized by EPAL and included representatives of EPAL, representants of the Icolo e Bengo and Viana Municipalities, GAUFF, ASGC, Sinohydro, Casais, Griner, Saioz and Dar (Table 13). Mapping have been produced in advance as well as checklists and detailed methodologies and schedules, with respect to social, physical, and biological features, to allow for more structured note taking and reporting. Part of the information collected has been incorporated in the chapter 2.0.

Table 13: Scoping visit

	April 19	April 20	April 21
Morning	Visits to the different Lots 4 and 7	Stakeholder's meeting at EPAL: Presentation of the Project	Visits to the Lots 5, 1, 8, 10, 3, 9
Afternoon		Meeting with Casais / GAUFF /OPAIA	Meeting ASGC / Sinohydro / Ginger

A meeting with the Chairman of the Board of directors of EPAL as well as its technicians were hold in EPAL headquarters in Luanda to discuss data needs and project schedule on April 20th. The meeting was followed by a presentation of the Quilonga Project by DAR (the construction work supervision) to stakeholders. Invitation letters to that presentation were sent by GAUFF and ASGC to the Ministry of Energy and Waters, Provincial Government, and the Municipalities of Cacuaco, Icolo and Bengo and Viana.

WSP expert and Saioz also met members of the consortium CNT / GAUFF / CASAIS / OPAIA and ASGC / Sinohydro / Ginger to discuss the Project details and explain the type of information will be required from them to complete/update the Project description for the different Lots.

A photographic report as well as a copy of DAR presentation and the minutes of the site visit prepared by EPAL (including the list of participants) can be found in the site visit report (APPENDIX A).

5.3 Definition of the project area of influence

Physical

For soil and air quality components, the Project Area of Influence (AoI) encompassed (Figure 27):

- the primary Project elements ;
- associated facilities whose viability and existence depend exclusively on the Project ;
- a buffer area drawn by considering maximum 100 m from the borders of all the Project facilities and associated facilities, in order to consider the potential impacts deriving from the Project.

For noise, the Project Area of Influence (AoI) encompassed a buffer area drawn by considering maximum 200 m from the borders of all the Project facilities and associated facilities, in order to consider the potential impacts deriving from the Project.

For surface water component, the Project Area of Influence (AoI) is the same as for the freshwater biological component and it encompassed 1 km upstream and 1 km downstream of the abstraction point (Figure 29).

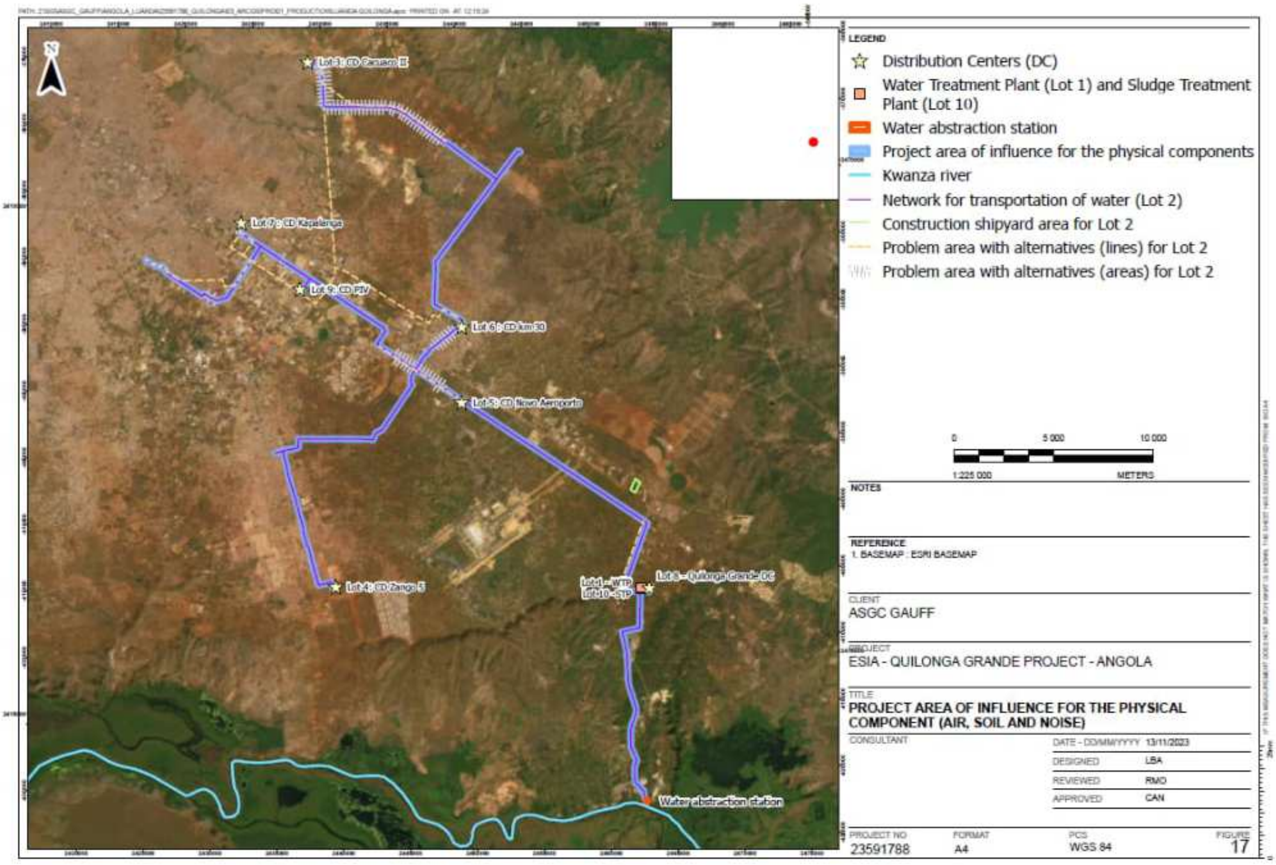


Figure 27: Project Area of Influence for the physical component (air, soil and noise)

Biological

For terrestrial biological components, the Project Area of Influence (AoI) encompassed (Figure 28):

- the primary Project elements ;
- associated facilities whose viability and existence depend exclusively on the Project ;
- a buffer area drawn by considering a distance of 500 m from the borders of all the Project facilities and associated facilities, in order to consider the potential impacts deriving from the Project.

For freshwater biological components, the AoI encompassed (Figure 29) :

- the River Kwanza at Bom Jesus, and will include a 1 km upstream and 1 km downstream of the abstraction point.

The Project AoIs are located within the terrestrial ecoregion “AF07 - Angolan scarp savanna and woodlands” (Olson *et al.*, 2001), which is part of the broader terrestrial biome category “Tropical and Subtropical Grasslands, Savannas and Shrublands”. The freshwater ecoregion “551 – Kuanza” (Abell 2008) from the name of the Kuanza River (i.e., the River from which the Project will abstract water) with is part of the broader category “Tropical and sub-Tropical Costal Rivers”. The terrestrial and freshwater ecoregions can be considered as Regional Study Areas for the biological components where to literature review will be conducted to determine the species and habitats potentially occurring within and in the vicinity of the Project.

The Project is located within Kwanza ((FEOW) 2019). This region covers a narrow coastal plain and a stepped escarpment rising to an altitude of over 1 000 m and encompasses all the westward flowing rivers of Angola (Hughes 1992) (FEOW, 2019).

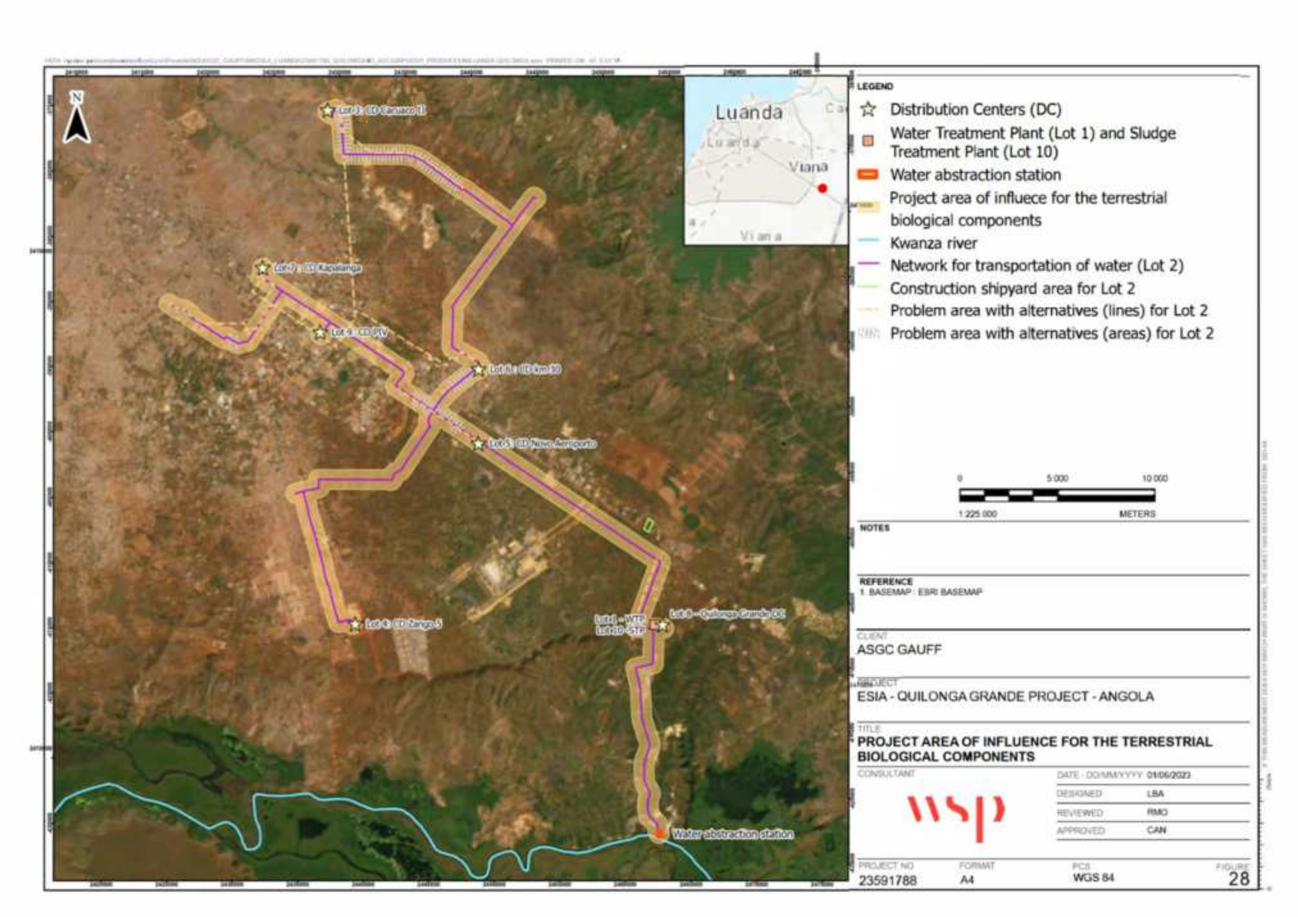


Figure 28: Project Area of Influence for the terrestrial biological component

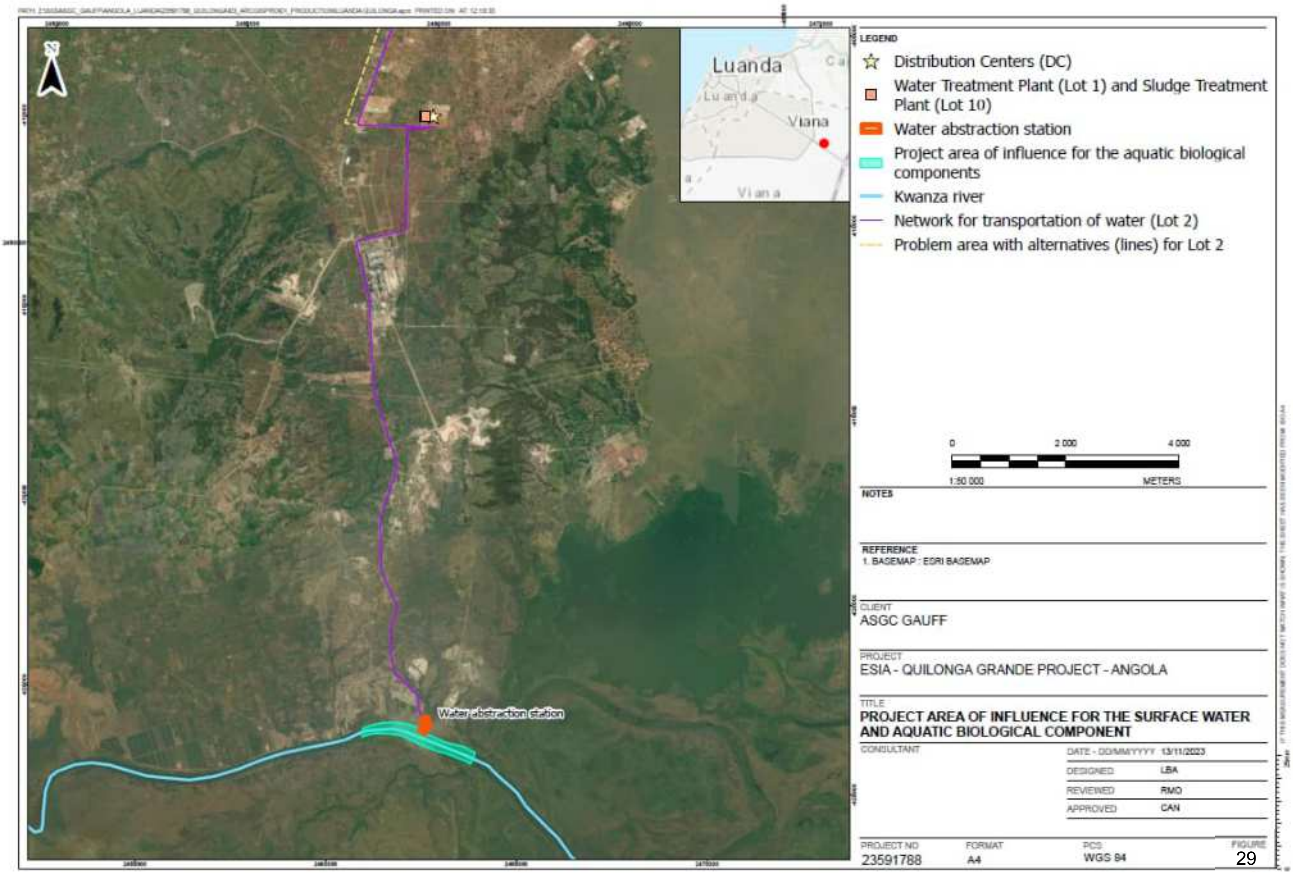


Figure 29: Project Area of Influence for the surface water and aquatic biological component

Social

The Quilonga Grande Project System 5 area is contained solely in the Luanda. Luanda is subdivided into nine municipalities: Luanda, Icolo e Bengo, Quiçama, Cacuaco, Cazenga, Viana, Belas, Kilamba Kiaxi and Talatona. Municipalities are further divided into Communes and Urban Districts (see details and maps in Chapter 7.2 Administrative Framework).

The Quilonga Grande System 5 unfolds from south to north, from the right bank of the Kwanza River in the Bom Jesus Commune, Municipality of Ícolo e Bengo, where the facilities - Water abstraction and Water Treatment Plant (WTP) and Sludge Treatment Plant (STP) will be constructed. The remaining components of the Project (Distribution Centers) will be deployed in the municipalities of Viana and Cacuaco.

For the social component, the AoI includes the municipalities Icolo and Bengo, Viana e Cacuaco where the different Lots will be constructed, and it includes the communes/districts benefiting from the Project are located (Figure 30).

The socioeconomic baseline study occurred in those 3 municipalities and covered a sample of 15 to 25 farmers, households and water traders in each area mentioned above.

While characterizing the baseline situation, special attention is given to the locations of the deployment of several project components, as impacts resulting from the construction and exploitation phase will be felt most strongly in those areas and the surrounding locations.

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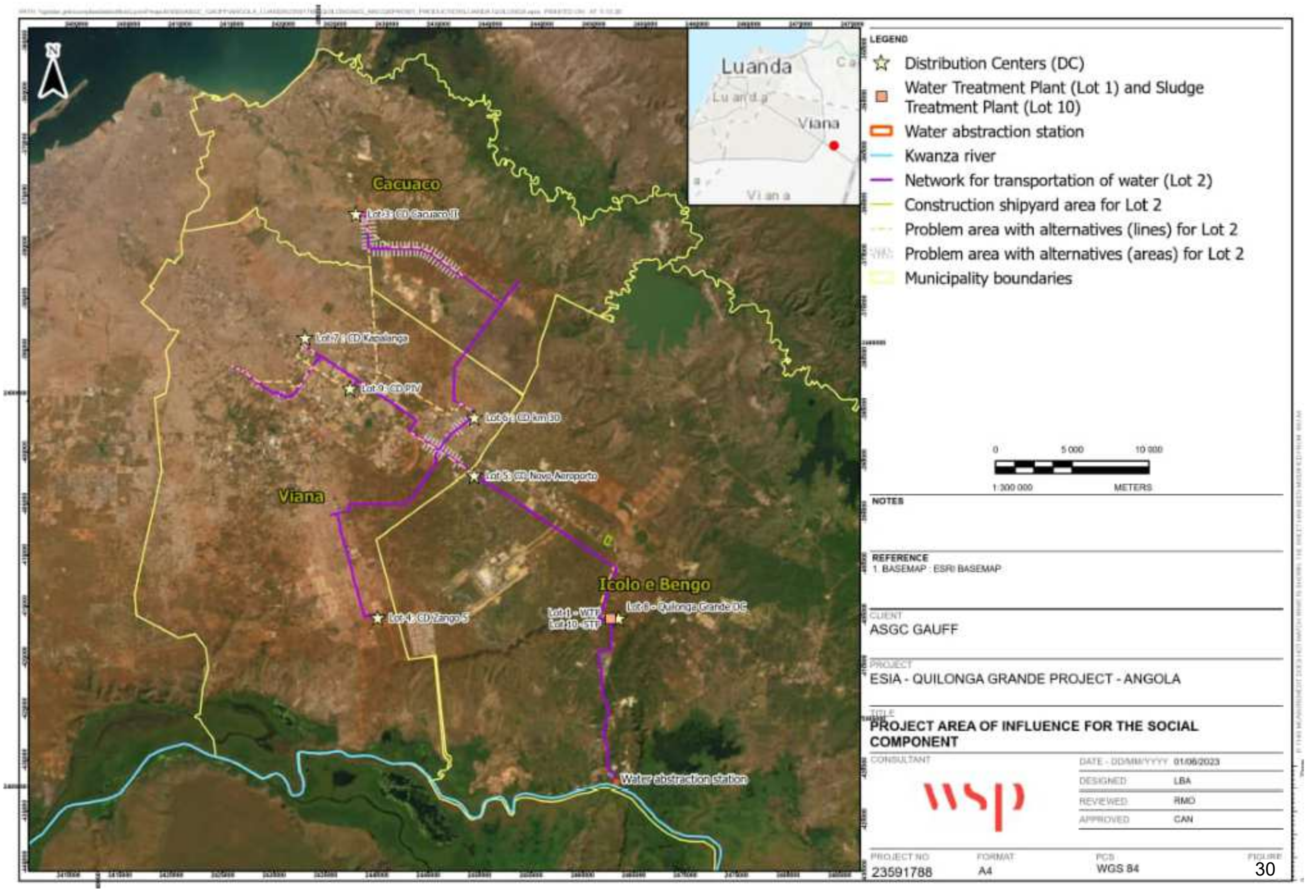

Figure 30: Project Area of Influence for the social component

5.4 Baseline methodology

5.4.1 Physical component

5.4.1.1 Meteorology and climatic data

5.4.1.1.1 Desktop studies

The baseline characterization includes historical data from existing weather station in the Luanda Area, as well as data from reference projects based on satellite observations, modelling, historical data and the following reference documents and platforms:

- World Bank Climate Change Knowledge Portal (World Bank Group 2021) ;
- Geographical Atlas of Angola (2008 Edition) - by the Education Ministry of Angola ;
- World Map of the Köppen-Geiger climate classification (Kottek 2006) ;
- National Meteorological and Geophysics Institute – INAMET portal (http://inamet.gov.ao/ao/ 2024) ;
- Meteorological Information Service on a World Scale of the World Meteorological Organization (Organizacao mundial de meteorogia 2022)
- South African Science Services for Climate Change and Adaptive Soil Management (SASSCAL) weathernet (SASSCAL 2023) ;
- National Centre for Environmental Information (CEI), of the National Oceanic and Atmospheric Administration (NOOA) of the United States of America (NOAA 2023) ;
- WeatherUnderground WebPortal (Weather underground 2023);
- Meteoblue Web Portal (Meteoblue 2023) ;
- 24 World Climate and Food Safety Charts from the International Association for Medical Assistance to Travelers (IAMAT) (IAMAT 2023) ;
- Climate Hazards group Infrared Precipitation with Stations (CHIRPS) dataset, developed to support FEWS-NET - Early Warning Systems Network against Hunger of the United States Agency for International Development (USAID) (Funk 2015).

5.4.1.2 Geology and geomorphology

5.4.1.2.1 Desktop studies

The baseline study consisted of analyzing several data sources such as:

- Geological Map of Angola at 1:1,000,000 scale (Heitor de Carvalho 1980);
- Geological Map of Luanda at 1:25,000 scale ;
- Geotechnical Map of the Luanda region ;
- Geographical Atlas of Angola - Secondary Education (2008) ;
- Map of Seismic Risk Distribution in Africa.

The following websites were also consulted:

- http://earthquake.usgs.gov/earthquakes/search/
- https://www.jornaldeangola.ao/
- https://www.sonangol.co.ao/

Site specific geological and geomorphological data was made available by the Client deriving from the feasibility and design studies.

5.4.1.3 Hydrogeology

5.4.1.3.1 Desktop studies

The baseline study consisted of analyzing data from (Luís Miguel et Rebollo 2003)

Consultation of the "Instituto Nacional de Recursos Hídricos (INRH 2024) website yielded no additional information on the hydrogeology of the Luanda region.

Site specific hydrogeological data made available by the Client deriving from the feasibility and design studies.

5.4.1.4 Hydrology of the Kwanza Watershed

A reconstruction of the hydrology of the Kwanza in the study area was therefore carried out, using as references, and based on the daily flow records recorded by the Kwanza station at Cambambe. Details are presented in APPENDIX N.

5.4.1.5 Surface water quality

5.4.1.5.1 Desktop studies

The main references used to describe surface water quality in the region, mainly focused on the Kwanza River, include the previous ESIA, from Ecovisão/Artelia, from 2014, that included several monitoring samples in the river, and also additional information provided by the client, related to water quality monitoring developed by EPAL, associated with the existing water supply systems.

5.4.1.5.2 Field studies

Location

One water sample from Kwanza River was sampled for subsequent laboratory analysis. The sampling point, referenced as WR01 has the following geographical coordinates: S 09º 10’ 22,69’’ / E 13º 34’ 23,04’’ (Figure 2). The sampling took place on July 13, 2023.

Figure 31: Kwanza River water sampling.

Sampling technique and equipment

The water sample was collected in laboratory glass and plastic bottles provided by the laboratory, in volume, material and color adjusted to each parameter to be determined.

All bottles were previously rinsed with water from the sampling location.

Water sampling was performed using a telescopic rod with the bottle attached to one end, with water collected at the surface.

The samples were stored in a cooling box, with ice, and transported immediately after sampling to the laboratory for processing.

In-situ parameters were measured in-situ using a portable multi-parameter probe (Hanna Instruments HI9829). Before the measurement, the equipment was calibrated using solution standards.

Laboratorial analysis

The analytical program was the following:

- dissolved O_2, conductivity, temperature, ORP, TDS, pH (in situ if possible) ;
- Total suspended solids ;
- Petroleum hydrocarbons (TPH) ;
- BOD_5, COD ;

- Total and fecal coliforms ;
- Major elements (Mg, Ca, Na, K, Cl, F, HCO_3, SO_4, SiO_2) ;
- Cyanide ;
- Nitrogenous materials (NH_4, NO_3, NO_2), phosphates ;
- Dissolved metals: Ag, As, Al, Cr, Pb, Zn, Ni, Hg, Cd, Cu, Fe, Mn, Cr^{6+} ;
- E. coli and total coliforms ;
- Fecal streptococci ;
- Fecal coliform ;
- No. of Colonies at 22ºC ;
- No. of Colonies at 37ºC.

Chemical analyzes were carried out by a laboratory located in Luanda (Ecosapiens, Centro de Estudos Ambientais e Tecnológicos).

5.4.1.6 Soil Quality

5.4.1.6.1 Field studies

Locations

The initial characterization of surface soil around the site was conducted collecting between 1 and 3 samples per Lot (total of **9** soil samples recommended over the 4 DC and WTP remaining to be built) distributed as proposed in the Figure 33 below, depending on the evolution of land use of each site over the last 20 years based on the analysis of the historical photographs and activities that could have led to soil pollution.

Last July, in order to refine our knowledge of the soils in the project area, nine soils were sampled (Figure 32) for subsequent laboratory analysis. The sampling points, referenced as S01 to S09 have the following geographical coordinates:

S01: S 09º 04' 29,41'' / E 13º 34' 28,29''	S02: S 09º 04' 31,77'' / E 13º 34' 25,05''	S03: S 09º 04' 28,14'' / E 13º 34' 30,11''
S04: S 08º 50' 20,89'' / E 13º 25' 17,87''	S05: S 08º 54' 38,58'' / E 13º 23' 26,50''	S06: S 08º 54' 38,45'' / E 13º 23' 26,42''
S07: S 08º 57' 27,45'' / E 13º 29' 26,86''	S08: S 08º 57' 27,39'' / E 13º 29' 27,02''	S09: S 08º 57' 26,92'' / E 13º 29' 27,33''

Sampling point	Sampling date	Lot	Coordinates (WGS84)
S01	13/07/2023	1/10	S 09º 04' 29,41'' / E 13º 34' 28,29''
S02	13/07/2023	1/10	S 09º 04' 31,77'' / E 13º 34' 25,05''
S03	13/07/2023	1/10	S 09º 04' 28,14'' / E 13º 34' 30,11''
S04	13/07/2023	3	S 08º 50' 20,89'' / E 13º 25' 17,87''

S05	13/07/2023	7	S 08º 54’ 38,58’’ / E 13º 23’ 26,50’’
S06	13/07/2023	7	S 08º 54’ 38,45’’ / E 13º 23’ 26,42’’
S07	13/07/2023	6	S 08º 57’ 27,45’’ / E 13º 29’ 26,86’’
S08	13/07/2023	6	S 08º 57’ 27,39’’ / E 13º 29’ 27,02’’
S09	13/07/2023	6	S 08º 57’ 26,92’’ / E 13º 29’ 27,33’’

Figure 32: Photographic record of soil sampling.

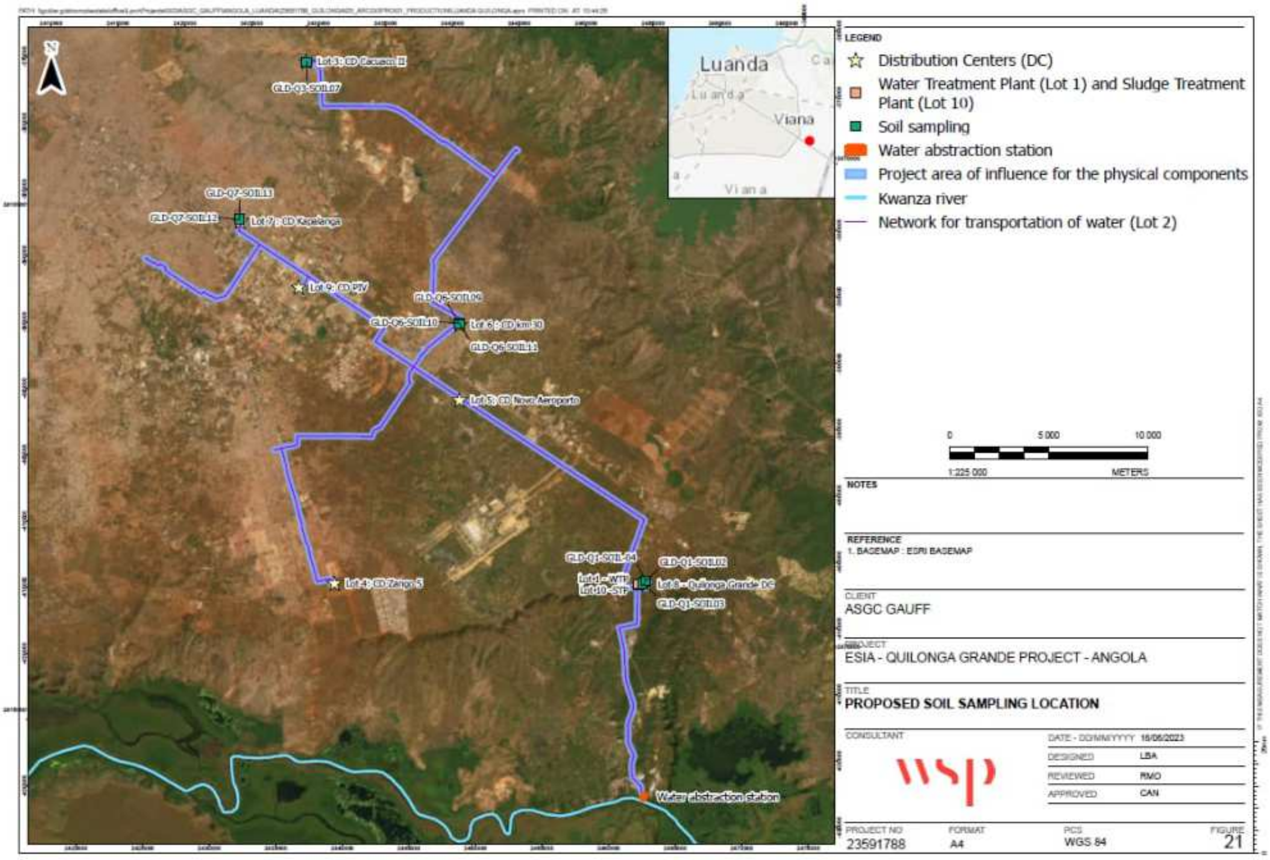

Figure 33: Soil sampling locations

Sampling technique et Equipment

Soil sampling were developed according to the NBR 9603: 2015 Standard.

After identification of the sampling location, the soil upper layer was removed (2 cm). After that, a first sample, of 50 cm^3, was collected between 2 and 10 cm deep and stored.

The soil between 10 and 20 cm was excavated and discarded.

A second sample, of 50 cm^3, was collected between 20 cm and 50 cm deep. This sample was equally mixed with the first sample, creating a composite sample.

This sample was then stored in sampling bags and sent to the laboratory in the same day, for processing.

Laboratorial analysis

Soil samples were analyzed for the following parameters:

- Metals (Fe, Hg, Pb, Mn, Cu, Cd, Ni, Zn, Al) ;
- Petroleum Hydrocarbons C<12 and C>12) ;
- Polycyclic Aromatic Hydrocarbons (PAH).

Chemical analyses were carried out by a laboratory located in Luanda (Ecosapiens, Centro de Estudos Ambientais e Tecnológicos).

5.4.1.7 Air quality

5.4.1.7.1 Desktop studies

Research aiming at collecting preliminary data on air quality in literature and previous studies was conducted in the Project's Areas of Interest.

In Angola, the only public reference report available regarding pollutant Emissions into the atmosphere is the Report on the General State of the Environment of Angola (REAA), from 2006.

Data were also obtained from existing meteorological stations, as described in chapters 7.4.1.1, to complement the data from air quality, namely in assessing dispersion processes.

There is no environmental monitoring network in the country that could provide regular data on air quality.

However, it was possible to identify some stations with operating data available in Angola, with periodic data reporting, namely :

- 1 Station associated with the Faculty of Sciences of Agostinho Neto University (FC-UAN), in the North Luanda area ;
- 3 Stations Associated with the Polytechnic Higher Institute of TUNDAVALA (ISPT):
  - 1 in the center of Lubango, in Huíla (ISPT-Lubango) ;
  - 1 at Campus Humpata, in Lubango, Huíla (ISPT-Humpata) ;
  - 1 at the ISPT-Jembas unit, in Nanguluve, Lubango, Huíla (ISPT-Jembas).
- 1 private station in the Talatona area, Luanda, in the Monte Belo urbanization (MB-L) ;
- 1 Station associated with the Academy of Fisheries and Sea Sciences of Namibe (APCM-Namibe), in Moçamedes, Namibe, still without data history ;
- 1 Benguela Higher Institute of Educational Sciences station, in Bairro Benfica (ISCED-Benguela) ;
- 1 Station at the Higher Institute of Educational Sciences in Huambo, in Xipuli (ISCED-Huambo) ;
- 1 Station at Private Polytechnic Higher Institute (ISPT – Luena).

These institutions have the equipment registered on the "OpenMap" platform, from Clarity, and Sensor Data Map, from Purple Air, which provide data from these monitoring stations. The "Air Quality Index Project" then compiles information from these sources in a single platform.

As such, through these online platforms, current hourly data and daily historical air quality data is made available and is the only identified reference of continuous air quality monitoring in the territory.

There are also several territorial air quality data obtained from satellite observations, in multiple projects developed by NASA and with data made available on the NASA EarthData – Worldview portal, such as the MERRA 2 data and the Global 3-Year Running Mean Ground-Level Nitrogen Dioxide (NO_2) Grids from GOME, SCIAMACHY and GOME-2 (Geddes 2017)

However, the information provided in NASA EarthData is based on modelling and long-distance observations, being best suited for large-scale studies. These tools can, however, provide a broader view of the country's general air quality and influences, and were then also considered in the desktop assessment.

Air monitoring stations managed by Clarity company provide only records for suspended particles smaller than 2.5 μm in diameter (PM2.5). These particles are the most dangerous for human health, and therefore considered as preliminary air quality indicators in the monitored areas. Air monitoring station managed by Purple Air's Monte Belo provides data for different ranges of particles, including PM2.5. For data comparison purposes, only data PM2.5 2.5 were considered.

The following Figure 34 shows the location of these stations in relation to the project.

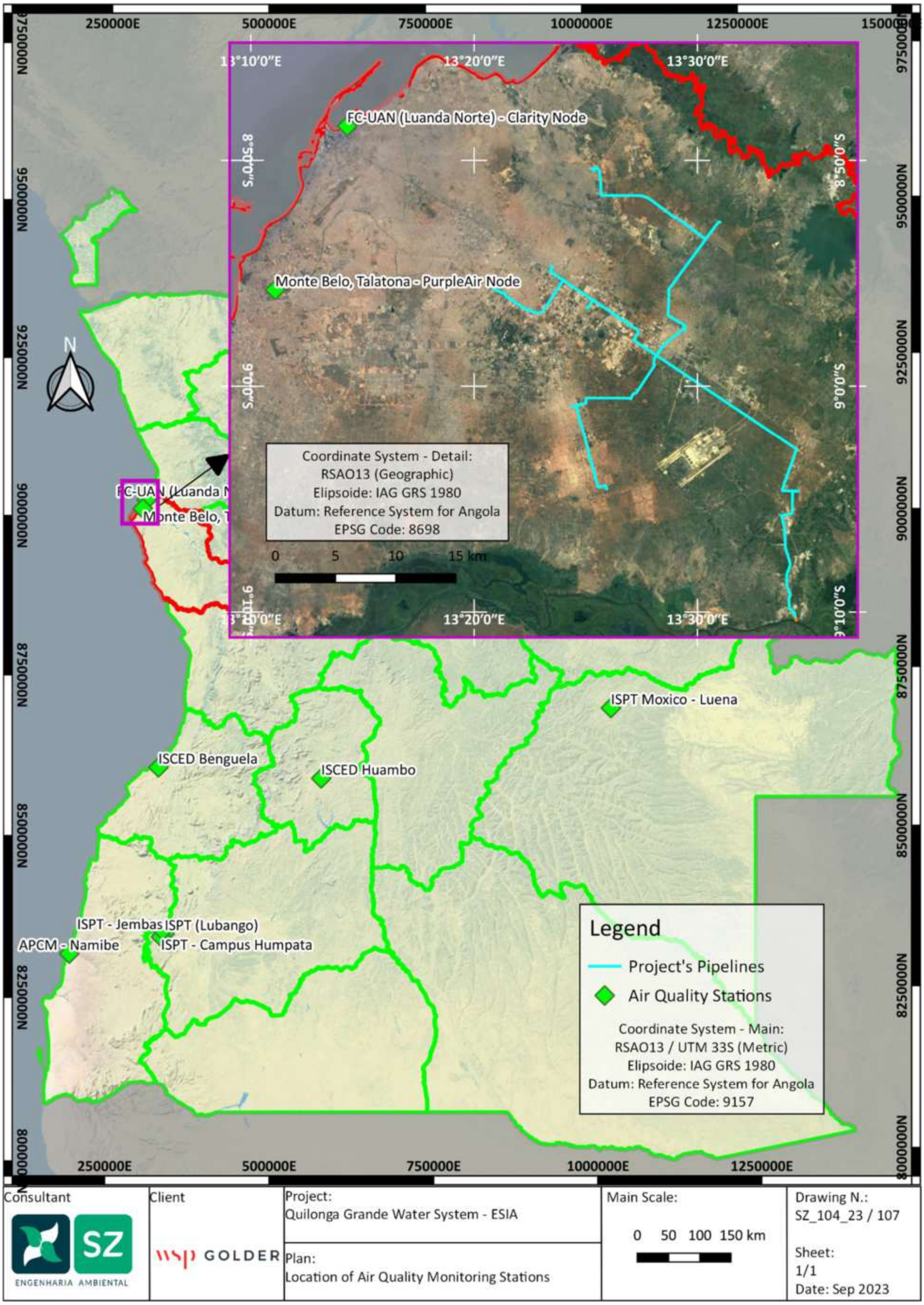

Figure 34: Location of PM2.5 Measuring Stations

Given that the project is located in Luanda Province, only the results of the two stations located in the city are considered, namely the station associated with the Faculty of Sciences of the Agostinho Neto University (FC-UAN), in the Luanda Northern area, and the private station in Talatona area, Luanda, in the Monte Belo urbanization (MB-L).

The hourly values for the main weather parameters were also obtained from the local weather stations in Luanda, for assessing potential pollutant propagation conditions during the sampling period.
It was also obtained the PM2.5 values (Daily Averages) provided by the local air quality stations, to serve as background air quality data.
It should be noted that the Monte Belo Station is offline since 6th of July, so there is no available data for the monitoring days, so it was only possible to obtain background data, for these days, from the FC-UAN station.

5.4.1.7.2 Field studies

Locations

Data from 5 monitoring points (one at each remaining Lot to build and one additional at the location of the future water extraction facility) in the field were complemented by literature and information collected during the scoping study. A total of **5** points were monitored, distributed as presented in the Figure 35 below.

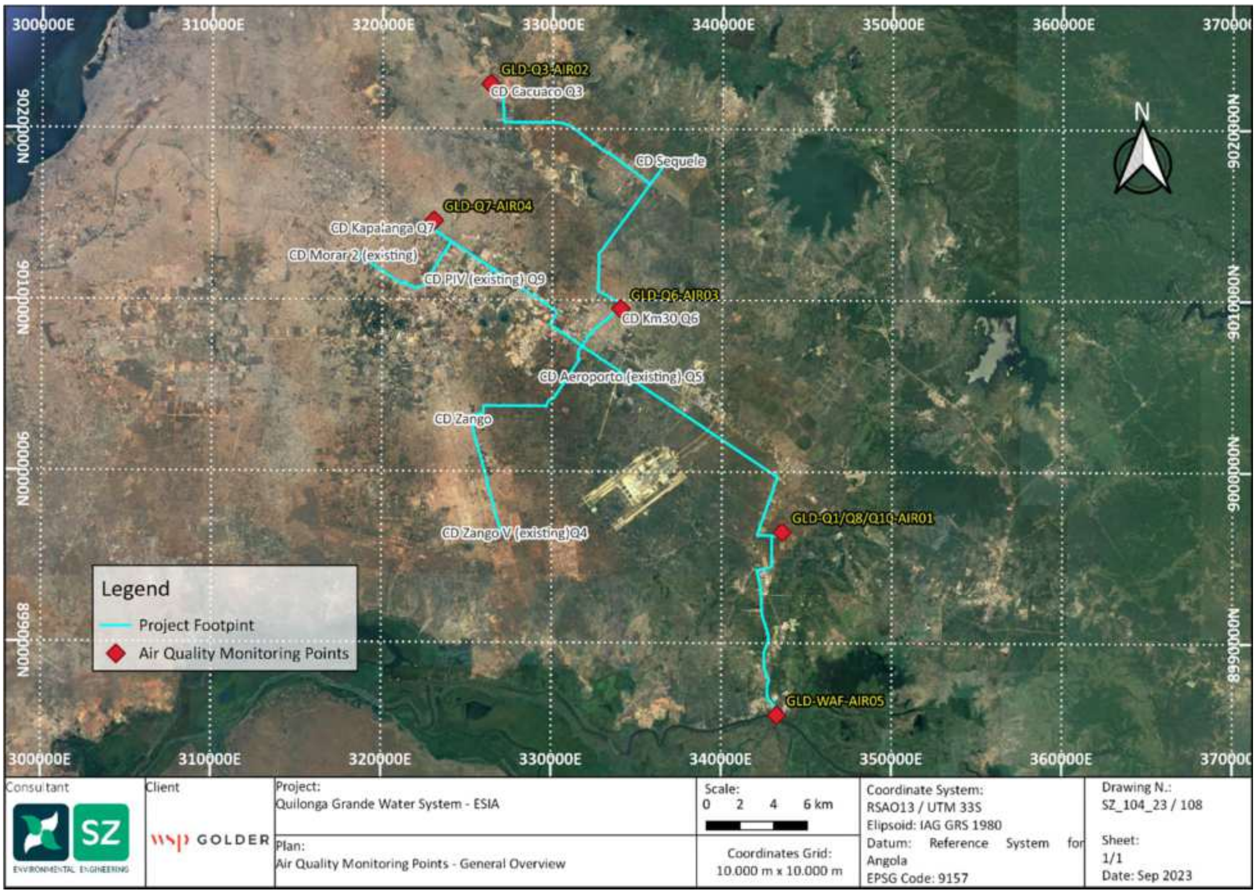

Figure 35: Air monitoring locations

Figure 36: Air Quality monitoring locations – Details – Points Air05 and Air01 (Lot 1 Water abstraction and WTP)

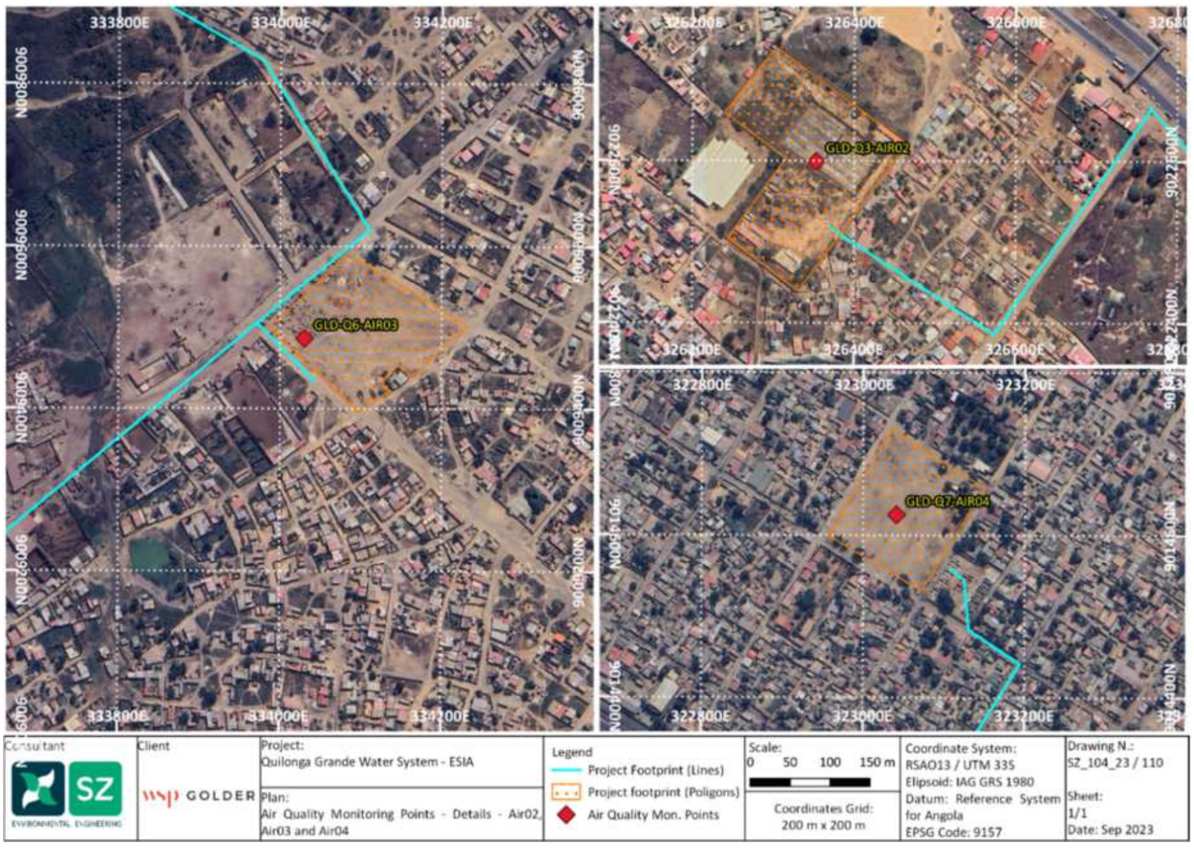

Figure 37: Air Quality monitoring locations – Details – Points Air02 (near Lot 3 Cacuaco DC), Air03 (near Lot 6 KM 30 DC) and Air04 (near Lot 7 Kapalanga DC)

The Air01 Monitoring point assesses the Air Quality near the Water Treatment Plant lot, next to the Bom Jesus Road.

The Air05 Monitoring point assesses the Air Quality near the future water extraction infrastructure, in the Bom Jesus industrial area, close to the Kwanza River.

The Air02, Air03 and Air04 are all located in lots associated with future Distribution Centers, namely Cacuaco DC, KM30 DC and Kapalanga DC respectively (Table 14).

Table 14: Air measurement data for each location.

Air monitoring stations	Coordinates				Monitoring Developed		
	RSAO13		RSAO13/ UTM 33S		Dates	Number of Samples	Total monitoring Time
Air 01 – Lot 1 Water extraction	9°04’32,19’’ S	13°34’35,39’’ E	8.996.482 N	343.554 E	13/07/2023	10	2,5 h
Air 02 – Lot 3 Cacuaco DC	8°50’19,77’’ S	13°25’15,75’’ E	9.022.599 N	326.353 E	14/07/2023	10	2,5 h
Air 03 – Lot 6 KM 30 DC	8°57’27,65’’ S	13°29’25,25’’ E	9.009.486 N	334.030 E	21/07/2023	10	2,5 h
Air 04 – Lot 7 Kapalanga DC	8°54’38,85’’ S	13°23’26,23’’ E	9.014.625 N	323.041 E	14/07/2023	10	2,5 h
Air 05 – Lot 1 WTP	9°10’19,65’’ S	13°34’24,55’’ E	8.985.807 N	343.265 E	13/07/2023	10	2,5 h

Figure 38: Air01 Monitoring Point – Near the WTP

Figure 39: Air 05 Monitoring Point – Near the Water Extraction zone

Figure 40: Air 02 Monitoring Point – Near the Cacuaco Distribution Centre

Figure 41: Air 03 Monitoring Point – Near the KM30 Distribution Centre

Figure 42: Air 04 Monitoring Point – Near the Kapalanga Distribution Centre

Monitoring technique and equipment

The air quality was determined using portable air quality monitoring stations, namely the HAZ SCANNER EPAS equipment, from SKC.

The equipment is equipped with a sample pump and uses different sensors, according to each parameter, including impactors and infrared light scattering for particles and electrochemical, nondispersive infrared (NDIR) and photoionization (PID) sensors.

This equipment was calibrated at SKC calibration laboratories, with a valid specific calibration certificate for the different parameters determined.

The equipment was positioned at the sampling location and calibrated to local conditions during a 15 minute calibration period. The sampling location was selected to try to minimize the influence of specific mobile sources and abnormal atmospheric disturbances.

The values obtained are displayed in the equipment display screen and manually registered in field data sheets.

At each point, it was acquired 15-minute average values, for each parameter, in 10 monitoring periods, for a total of 150 minutes of monitoring time. The monitoring periods were distributed in different hours, along the day period, to characterize the different air quality conditions of the monitoring day.

With the results of the 10 monitoring periods considered for each point, it was then determined the daily average values and standard deviation for each monitoring point.

The following air quality parameters were measured or sampled:

- Temperature ;
- PM2.5 ;
- PM10 ;
- O_3 ;
- SO_2 ;
- SO_X ;
- NO ;
- NO_2 ;

- NO_X.

Standards for air quality

For the purposes of evaluating results, and given the lack of applicable national legislation, the following international guidelines were considered:

- The World Health Organization (WHO) guidelines relatives to air quality (version updated in 2021) which is also referred to in the IFC EHS guidelines on air emissions and ambient air quality (2007) ;
- European air quality references (European Air Quality Standards).

The EU Air Quality Standards and the WHO Air Quality Guidelines propose specific Air Quality thresholds both for long-term exposure and for short-term exposure periods. Considering the objective of the current campaign, namely to determine the air-quality baseline, it was then considered, for result assessment, the long-term exposure limits.

Also, since Angola does not have any air quality reduction plan in place, it was considered as applicable, for result analysis, the interim target 1 values proposed by WHO.

5.4.1.8 Noise

The noise levels of Project areas have been measured in order to establish the reference baseline conditions. Regarding the nature of the project, the ambient noise might be changed by the project construction and operations and the baseline noise conditions should then be monitored.

5.4.1.8.1 Desktop studies

Preliminary data on noise was collected from literature and previous studies in the Luanda Area, including the General Environmental Status Report of Angola (REAA).

There isn't any official environmental monitoring network in Angola, with long term monitoring data and, as such, the only desktop information available, regarding noise, comes from other impact assessment studies and some specific studies.

Two main references are considered, namely the General Environmental Status Report of Angola (REAA), from 2006, developed by the Angolan Ministry of Environment, and one study published in the Angolan Sociology Magazine, namely the "Urban Noise in Central Luanda", from Wilma Fernandes and Júlio César Torres, 2014.

These noise studies were considered because they included a noise monitoring network, covering different parts of Luanda City, and not just simple point assessment. The second study mentioned ("Urban Noise in Central Luanda", also includes Noise modelling of traffic, with the presentation of a noise maps for the Central Luanda.

These studies only partly overlap with the projects area of influence, with no specific monitoring points near the main emitting sources associated with the project. However, they allow a general overview of the environmental noise levels in the great Luanda Area.

There are also available some environmental impact assessment studies for industrial projects, which include baseline noise monitoring, mainly in the Viana area. However, these EIAs consider monitoring points that are specific to each project, and not representative of the general noise levels for the influence area of the Quilonga Grande Project, and, as such, were not included in the desktop information.

The only exception was the inclusion of data from an Environmental Monitoring Report, from a central yard of Casais Angola Company. This report includes noise monitoring data from a point located at about 200 m Northwest of the PIV Distribution center, close enough to be considered representative.

The other main desktop data available relates to the one compiled in the previous ESIA, from Artelia/Ecovisão (2014), to which the current data will also be compared.

5.4.1.8.2 Field studies

Locations

A total of **11** points were selected for measuring noise conditions, distributed as in the Figure 43. Details are provided in Figure 44 to Figure 46.

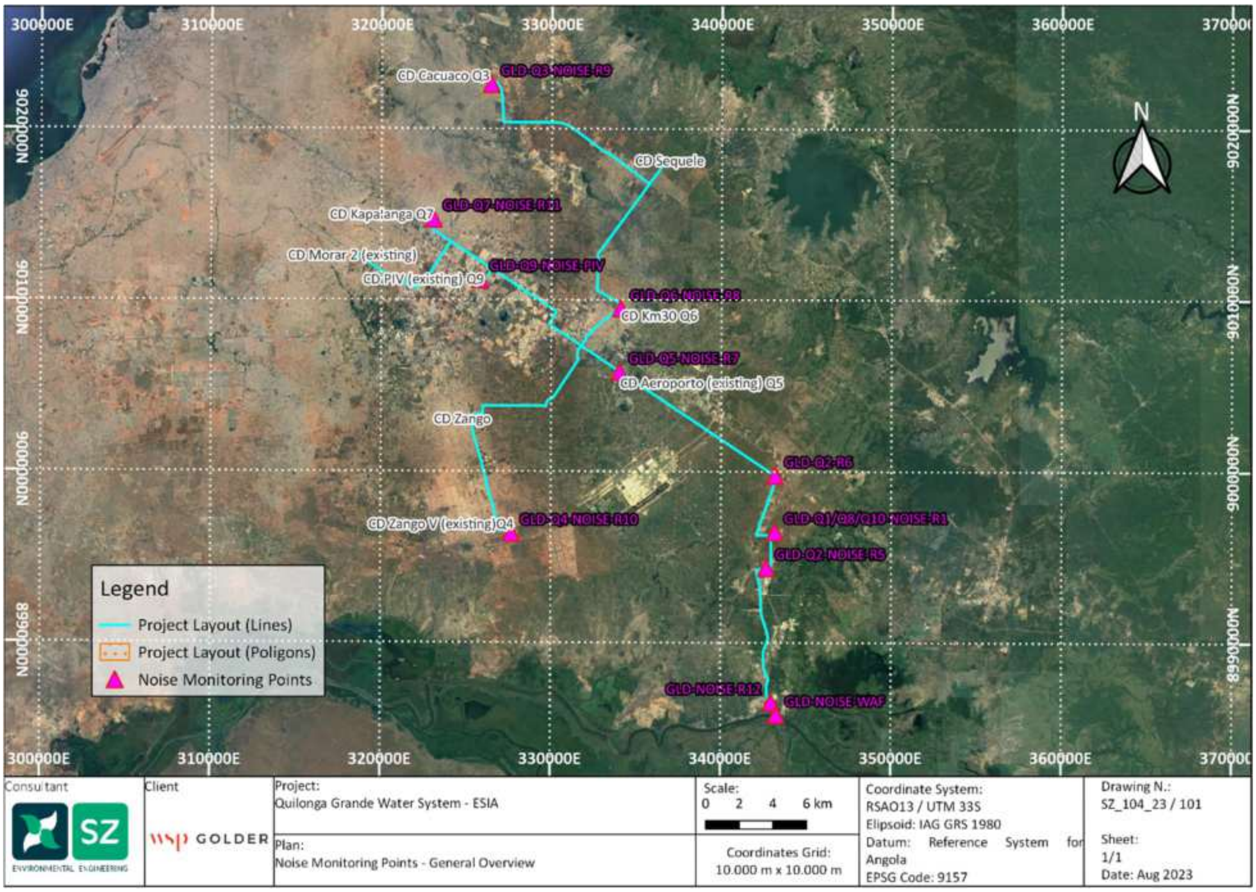

Figure 43: Noise measuring locations – Overview

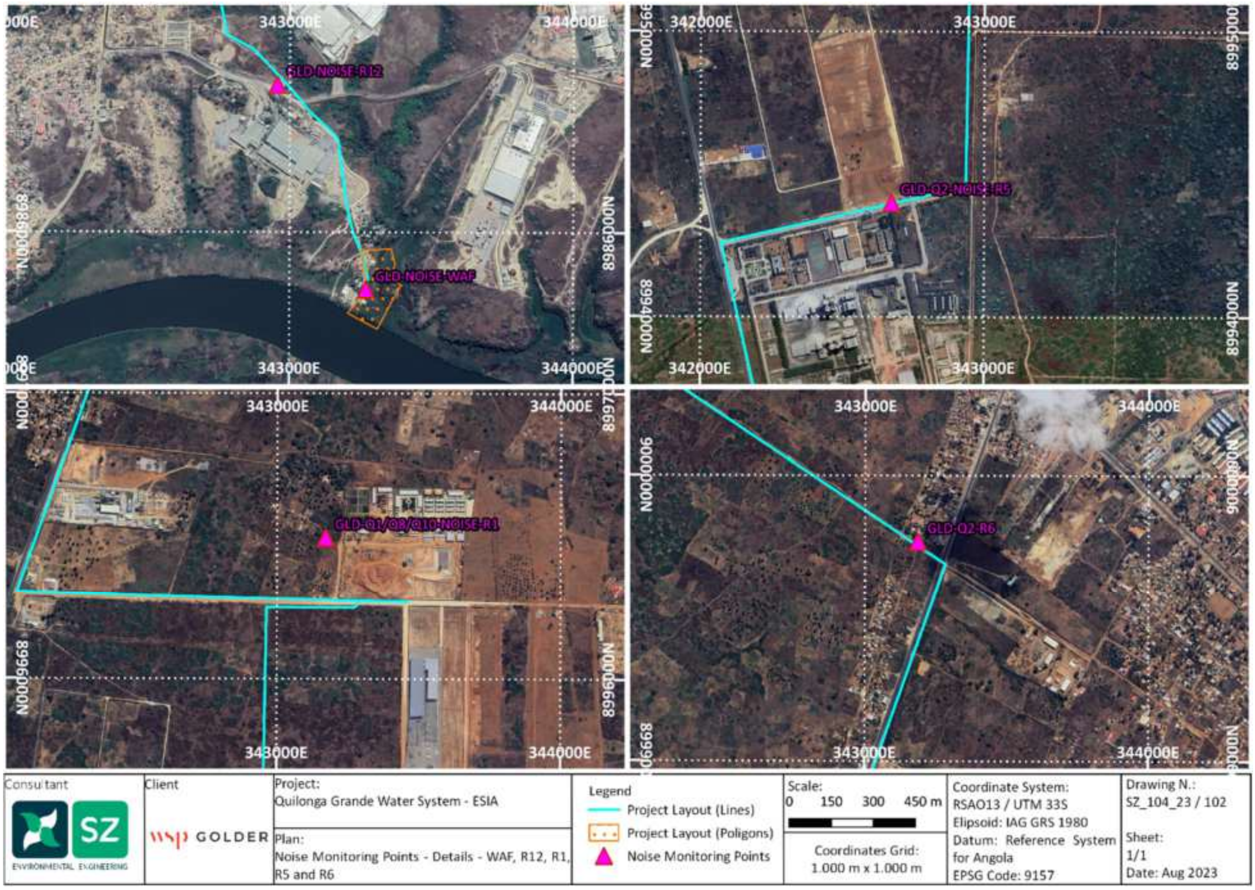

Figure 44: Noise measuring locations – Details – Points WAF (Lot 1 – WTP abstraction), R12 (Near banco Sol), R5 (Near CIF Factory), R1 (Lot 1 – WTP), and R6 (near the pipeline network from the WTP to the Distribution centres - Bom Jesus Road, near Bairro Amazónia)

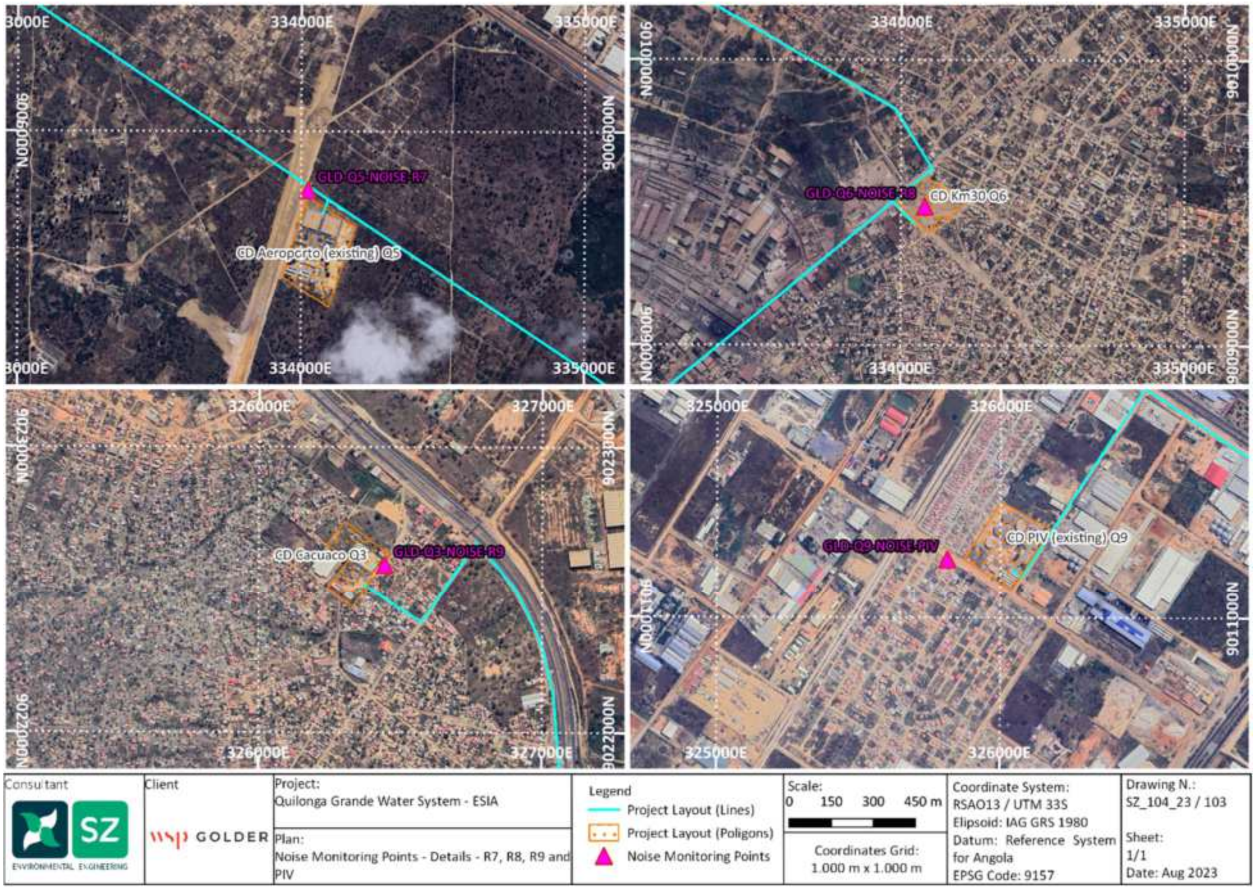

Figure 45: Noise measuring locations – Details – Points R7 (Lot 5 - DC New Airport), R8 (near Lot 6 - DC km 30), R9 (near Lot 3 - DC Cacuaco) and PIV (near Lot 9 - DC PIV)

Figure 46: Noise measuring locations – Details – Points R11 (near Lot 7 - DC Kapalanga) and R10(near Lot 4 - DC Zango 5)

The WAF Monitoring point characterizes the reference Sound Level near the future water extraction infrastructure. The point is located near existing service infrastructures, from EPAL, and the closest sensitive receivers are located to the north, with a small group of residential buildings at about 150 m, namely the Monte da Pedra Hostel.

The R12 monitoring Point is located near Sol Bank, close to the industrial plants of Purangol and Sumol+Compal bottling companies. The closest sensitive receivers, at 120 m West, are the buildings in the residential complex of Sumol+Compal, that serve as dormitory for the workers of this industrial unit. Another receiver is the Pentecostal Church of Bom Jesus, at 220 m WNW.

The R5 monitoring Point is located near a large industrial unit, namely the China International Fund (CIF) Cement Factory. This industrial unit houses a small dormitory complex, to the northeast side of the factory, and the monitoring point was located near this complex, close to the factory service entrance. There is also several temporary shops, near the wall of the CIF complex, that serve truck drivers that park in this area.

The R1 monitoring point is located near the future Water Treatment Plant (WTP) and Bom Jesus Distribution Centre, to the west of this complex. The closest sensitive uses (housing) are over 1 km to the west, near the Bom Jesus Road, and, as such, it isn't considered the existence of any sensitive receiver in this location,

The R6 monitoring point is located along the water transmission conducts, from the WTP to the Distribution centers. The point is located in the Amazonia Neighborhood, about 100 m to the West of the main Bom Jesus Road. The point is next to a residential area, which serves as sensitive receiver.

The R7 monitoring Point is located next to the existing New Airport Distribution Centre. The area is under several construction interventions, associated with the construction of the new airport and access, and the closest sensitive receivers are some disperse houses at about 300 m northwest, associated with the Km 33 Neighbourhood.

Point R8 is located in the future Km 30 Distribution Centre. Due to safety concerns, the monitoring was done inside the construction plot, and not near the surrounding houses. The plot is surrounded by residential buildings, which are sensitive receivers.

The R9 monitoring point is located near the future Cacuaco Distribution Centre. This centre is also located inside the urban matrix, with residential buildings all around.

The PIV monitoring point is near the existing PIV Distribution Centre. This Distribution center is surrounded to the East and North by industrial units. However, to the West and South we can find a large residential neighbourhood, the Kussanguluka Condominium, that is the closest sensitive area. The monitoring point is located to the West of the Distribution Centre, next to residential buildings.

The R11 monitoring point is next to the future Kapalanga Distribution Centre. This distribution center is in the urban matrix also, surrounded, in all sides, by sensitive receivers, namely residential buildings and schools (Russénio College).

The R10 monitoring point is located near the existing Zango V distribution Centre. This center is located in an urban area between the Zango IV and Zango V urban centralities. These centralities are large scale urban development projects, designed as small cities inside the greater Luanda area, focused mainly in low to medium income residential housing. The centralities also include associated services, such as schools, police stations, health facilities, commercial units, etc. As such, the Distribution Centre is surrounded, in all sides, by residential buildings of the centralities, thus being integrated in a sensitive area. The monitoring point is located to the west of the distribution center, near residential houses.

The monitoring points have the following coordinates, referenced by the geographic system RSAO13, defined in the Presidential Legislative Decree n. 9/18, of 18th of June, and by the projected metric system RSAO13 – UTM33S. These are the official coordinate systems for Angola. In addition, the monitoring effort developed is presented in the following table, with the dates and hours for each monitoring period.

Table 15: Noise measurement dates for each location.

Project sites	Coordinates				Monitoring Developed		
	RSAO13		RSAO13/ UTM 33S		Periods	Dates	Hours
R12 - Near banco Sol	9°09'56,55" S	13°34'14,52" E	8.986.515 N	342.957 E	Day	13/07/2023	12:23
						13/07/2023	12:32
						13/07/2023	12:43
						14/07/2023	16:47
						14/07/2023	16:57
						14/07/2023	17:07
					Night	13/07/2023	19:04
						13/07/2023	19:14
						13/07/2023	19:24
						14/07/2023	19:34
						14/07/2023	19:44
						14/07/2023	19:54
WAF - Abstraction Point (Lot 1)	9°10'19,91" S	13°34'24,70" E	8.985.799 N	343.270 E	Day	13/07/2023	11:27
						13/07/2023	11:40
						13/07/2023	11:51
						14/07/2023	17:24
						14/07/2023	17:34
						14/07/2023	17:44
					Night	13/07/2023	20:55
						13/07/2023	21:05
						13/07/2023	21:15
						14/07/2023	21:46
						14/07/2023	21:56
						14/07/2023	22:06
R9 - CD Cacuaco (Lot 3)	8°50'20,18" S	13°25'18,73" E	9.022.587 N	326.444 E	Day	14/07/2023	10:29
						14/07/2023	10:40
						14/07/2023	10:51
						18/07/2023	09:24
						18/07/2023	09:34
						18/07/2023	09:45
					Night	14/07/2023	21:57
						14/07/2023	21:08
						14/07/2023	21:20
						18/07/2023	21:30
						18/07/2023	21:41
						18/07/2023	21:51

Table 15: Noise measurement dates for each location.

Project sites	Coordinates				Monitoring Developed		
	RSAO13		RSAO13/ UTM 33S		Periods	Dates	Hours
R11 - CD Kapalanga (Lot 7)	8°54'35,90" S	13°23'27,31" E	9.014.716 N	323.074 E	Day	14/07/2023	12:28
						14/07/2023	12:38
						14/07/2023	12:48
						18/07/2023	11:50
						18/07/2023	12:00
						18/07/2023	12:11
					Night	14/07/2023	20:26
						14/07/2023	20:36
						14/07/2023	20:47
						18/07/2023	19:57
						18/07/2023	20:07
						18/07/2023	20:17
R8 – CD Km 30 (Lot 6)	8°57'27,62" S	13°29'27,03" E	9.009.487 N	334.085 E	Day	21/07/2023	10:12
						21/07/2023	10:22
						21/07/2023	10:32
						22/07/2023	10:53
						22/07/2023	11:03
						22/07/2023	11:13
					Night	21/07/2023	19:28
						21/07/2023	19:39
						21/07/2023	19:49
						22/07/2023	20:59
						22/07/2023	20:09
						22/07/2023	20:19
R7 – CD Novo Aeroporto (Lot 5)	8°59'27,83" S	13°29'24,57" E	9.005.794 N	334.025 E	Day	13/07/2023	17:51
						13/07/2023	18:01
						13/07/2023	18:12
						17/07/2023	08:52
						17/07/2023	09:04
						17/07/2023	09:14
					Night	13/07/2023	22:53
						13/07/2023	23:05
						13/07/2023	23:15
						17/07/2023	22:25
						17/07/2023	22:36
						17/07/2023	22:49

Table 15: Noise measurement dates for each location.

Project sites	Coordinates				Monitoring Developed		
	RSAO13		RSAO13/ UTM 33S		Periods	Dates	Hours
CD PIV (Lot 9)	8°56'30,59" S	13°24'56,51" E	9.011.205 N	325.814 E	Day	14/07/2023	13:57
						14/07/2023	14:07
						14/07/2023	14:17
						17/07/2023	08:04
						17/07/2023	08:14
						17/07/2023	08:24
					Night	18/07/2023	19:07
						18/07/2023	19:17
						18/07/2023	19:27
						19/07/2023	19:37
						19/07/2023	19:48
						19/07/2023	19:58
R10 – CD Zango 5 (Lot 4)	9°04'33,10" S	13°25'55,62" E	8.996.389 N	327.683 E	Day	17/07/2023	11:24
						17/07/2023	11:34
						17/07/2023	11:45
						18/07/2023	09:56
						18/07/2023	10:07
						18/07/2023	10:21
					Night	17/07/2023	20:28
						17/07/2023	20:38
						17/07/2023	20:51
						18/07/2023	22:31
						18/07/2023	22:41
						18/07/2023	22:52
R5 – Near CIF Factory	9°05'39,82" S	13°34'06,29" E	8.994.401 N	342.674 E	Day	13/07/2023	13:30
						13/07/2023	13:41
						13/07/2023	13:51
						18/07/2023	16:30
						18/07/2023	16:42
						18/07/2023	16:52
					Night	17/07/2023	19:24
						17/07/2023	19:36
						17/07/2023	19:46
						19/07/2023	21:02
						19/07/2023	21:13
						19/07/2023	21:23

Table 15: Noise measurement dates for each location.

Project sites	Coordinates				Monitoring Developed		
	RSAO13		RSAO13/ UTM 33S		Periods	Dates	Hours
R6 – Bom Jesus Road, near Bairro Amazónia	9°02'45,14" S	13°34'23,78" E	8.999.769 N	343.187 E	Day	13/07/2023	16:06
						13/07/2023	16:16
						13/07/2023	16:26
						14/07/2023	15:20
						14/07/2023	15:30
						14/07/2023	15:40
					Night	13/07/2023	20:19
						13/07/2023	20:30
						13/07/2023	20:41
						17/07/2023	21:18
						17/07/2023	21:29
						17/07/2023	21:40
R1 – WTP (lot 1)	9°04'31,71" S	13°34'22,86" E	8.996.495 N	343.172 E	Day	13/07/2023	09:04
						13/07/2023	09:14
						13/07/2023	09:25
						17/07/2023	16:17
						17/07/2023	16:29
						17/07/2023	16:42
					Night	13/07/2023	21:57
						13/07/2023	22:21
						13/07/2023	22:32
						19/07/2023	21:42
						19/07/2023	21:53
						19/07/2023	22:03

Figure 47: R12 Monitoring Point - Near Banco Sol

Figure 48: WAF Monitoring Point – Near Extraction area

Figure 49: R9 Monitoring Point – Near CD Cacuado

Figure 50: R11 Monitoring Point – Near CD Kapalanga

Figure 51: R8 Monitoring Point – Near CD Km 30

Figure 52: R7 Monitoring Point – Near CD Novo Aeroporto

Figure 53: PIV Monitoring Point – Near CD PIV

Figure 54: R10 Monitoring Point – Near CD Zango V

Figure 55: R5 Monitoring Point – Near CIF Cement Factory

Figure 56: R6 Monitoring Point – Near Bom Jesus Road, in Amazónia Neighbourhood

Figure 57: R1 Monitoring Point – Near the Future Water Treatment Plant (WTP)

Monitoring technique and equipment

The measurements were carried out using the following equipment:

- Sound level meter – Brüel&Kjær, model 2250 ;
- Calibrator – Brüel&Kjær, model 4231;
- Thermo-hygro-anemometer – HoldPeak, model HP-866B.

The sound level meter is of class 1 accuracy, in accordance with the IEC 61672 standard. The filters used comply with the requirements defined in IEC 61260. The measurement chain was calibrated using a class 1 acoustic calibrator, in accordance with EN IEC 60942.

Measurements were performed by sampling, with data being acquired with both Fast and Slow Time Weighting, and A-Frequency Weighting, also acquiring data in 1/3 octave band spectrum.

The equipment was calibrated before the start of the measurements, and the calibration confirmed at the end of the service.

The Sound Level Meter and Calibrator is verified at an accredited calibration Laboratory, namely ISQ – Instituto da Soldadura e Qualidade, in Portugal.

Standards for noise quality

Due to the lack of a national normative or legal reference, regarding acoustic indicators, the references of the "Environmental, Health, and Safety (EHS) Guidelines - Noise Management" of the IFC-World Bank, was considered. According to these references, the monitoring was developed for Day-time and Night-time periods, determining L_{Aeq} indicators for Day Period (L_d) and Night Period (L_n).

The Environmental, Health, and Safety (EHS) Guidelines - Noise Management" of the IFC-World Bank recommends sampling during day-time (07:00 to 22:00) and night-time (22:00 to 07:00) (**Table *16***). However, this recommendation is not fully adequate to the normal activity schedules usually observed in Angola.

In Angola, dusk is observed between 17:00 and 18:00, and most activities stop at 18:00. Dawn happens between 06:30 to 07:00, and most activities start between 06:00 and 07:00.

Considering these daylight periods and working hours, commonly followed in Angola, it was considered the day-time from 07:00 to 19:00, and the Night-time from 19:00 to 07:00.

Table 16: EHS Noise Level Guidelines

Type of Receptor		L_{Aeq} Values		Increase in Background Levels
		Day-time	Night-time	
Sensitive (S)	Residential, institutional, educational	55 dB(A)	45 dB(A)	3 dB(A)
Non Sensitive (NS)	Industrial, commercial	70 dB(A)		

data acquisition, both day and night periods were monitored by a set of 3 samples with 10 minutes duration each, as minimum acquisition time proposed in Chapters 9.1.2 and 9.3.2.2 of ISO 1996-2:2019.

The measurements were repeated in 2 different days, as independent measurements, as proposed in chapter 6.2 of ISO 1996-2:2017, for a total, in each period (day and night) of 6 samples, with a total of 60 minutes sampling time and covering 2 different independent days.

The measurement uncertainties were determined in accordance with the provisions of the NP ISO 1996-2:2017 standard and the internal procedures of the Saioz laboratory, for a confidence interval of 95 %.

Since the local streets are considered important or dominant residual sources, during the field work it was also considered the development of traffic counts, by sampling (15 minutes periods), in the main roads near the sampling points. Based on these counts, it was estimated the Average Hourly Traffic (AHT) for the Day period in each street.

5.4.2 Biological component

5.4.2.1 Terrestrial habitats and biodiversity

5.4.2.1.1 Desktop studies

Preliminary **terrestrial habitat** mapping of the AoI was conducted using satellite imagery, available local maps on habitats, forestry and/or land use, etc. The definition of habitat and vegetation types identified was done according to established and reputable classification systems for West Africa. Bibliographic references to the systems used included:

- Copernicus Global Land Cover | Dataset version: 3.0.1
- *Ecoregions 2017* *© Resolve*. Downloaded from https://ecoregions.appspot.com/ (05 august 2023)
- Burgess, N., Hales, J.A., Underwood, EOlson, D., Itoua, I., Schipper, J., Ricketts, T. and Newman, K. 2004. **Terrestrial ecoregions of Africa and Madagascar: a conservation assessment**. Island Press.

A preliminary desktop analysis to verify the potential presence of threatened or endemic **terrestrial flora and fauna** species within the AoI was carried out, based on the following literature sources:

- Baptista, N., Conradie, W., Vaz Pinto, P., & Branch, W. R. (2019). The amphibians of Angola: early studies and the current state of knowledge. *Biodiversity of Angola: Science & Conservation: A Modern Synthesis*, 243-281.
- Beja, P., Vaz Pinto, P., Veríssimo, L., Bersacola, E., Fabiano, E., Palmeirim, J. M., ... & Taylor, P. J. (2019). The mammals of Angola. *Biodiversity of Angola: Science & Conservation: A Modern Synthesis*, 357-443.
- BirdLife International. (2023). Country profile: Angola. Downloaded from http://datazone.birdlife.org/country/angola on 03/08/2023.
- BirdLife International. (2023). Important Bird Area factsheet: Quiçama. Downloaded from http://datazone.birdlife.org/site/factsheet/quiçama-iba-angola on 03/08/2023.
- BirdLife International. (2021). Gyps africanus. The IUCN Red List of Threatened Species 2021: e.T22695189A204461164.https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22695189A204461164.en on 30/07/2023.
- Branch, W. R., Vaz Pinto, P., Baptista, N., & Conradie, W. (2019). The reptiles of Angola: history, diversity, endemism and hotspots. *Biodiversity of Angola: Science & Conservation: A Modern Synthesis*, 283-334.
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- Goyder, D. J., & Gonçalves, F. M. P. (2019). The flora of Angola: collectors, richness and endemism. *Biodiversity of Angola: Science & Conservation: A Modern Synthesis*, 79-96.
- Huntley, B. J., Russo, V., Lages, F., & Ferrand, N. (2019). *Biodiversity of Angola: Science & conservation: A modern synthesis* (p. 549). Springer Nature.
- IUCN 2023. The IUCN Red List of Threatened Species. Version 2022-2. https://www.iucnredlist.org on August 2023
- Hallermann, J., Ceríaco, L. M., Schmitz, A., Ernst, R., Conradie, W., Verburgt, L., ... & Bauer, A. M. (2020). A review of the Angolan House snakes, genus Boaedon Duméril, Bibron and Duméril (1854) (Serpentes: Lamprophiidae), with description of three new species in the Boaedon fuliginosus (Boie, 1827) species complex. *African Journal of Herpetology*, *69*(1), 29-78.
- Marques, M. P., Ceríaco, L. M., Blackburn, D. C., & Bauer, A. M. (2018). *Diversity and distribution of the amphibians and terrestrial reptiles of Angola: atlas of historical and bibliographic records (1840-2017)*. California Academy of Sciences.
- Martins, António & Ferreira, Rogério. (2023). biodiversidadeangola.com on August 2023
- Mills, M. S. L., & Melo, M. A. R. T. I. M. (2013). The checklist of the birds of Angola/A Lista das Aves de Angola. *Associação Angolana para Aves e Natureza & Birds Angola, Luanda*
- Ministério do Ambiente. (2018). *Lista Vermelha de especies de Angola: Extintas, ameaçadas de extinção, vulneráveis e invasoras*. Ministério do Ambiente, Angola.
- Nielsen, S. V., Conradie, W., Ceríaco, L. M., Bauer, A. M., Heinicke, M. P., Stanley, E. L., & Blackburn, D. C. (2020). A new species of Rain Frog (Brevicipitidae, Breviceps) endemic to Angola. *ZooKeys*, *979*, 133.
- POWO. (2021). Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet. http://www.plantsoftheworldonline.org/ on August 2023

- Branch, W. R., Vaz Pinto, P., Baptista, N., & Conradie, W. (2019). The reptiles of Angola: history, diversity, endemism and hotspots. *Biodiversity of Angola: Science & Conservation: A Modern Synthesis*, 283-334.
- Org, O. G. (2015). GBIF Occurrence Download.

5.4.2.1.2 Field studies

Terrestrial habitat and flora

Field work for terrestrial flora species and habitats was conducted within the Project AoI with the aim of confirming the presence of habitats and flora species identified during the preliminary desktop study. Particular attention was paid to natural habitats and to wetland habitats, but also to areas potentially subject to greater impacts from the project.

This survey was performed in 30 survey points (FPs) for a total of 4 working days on site. The coordinates of the FPs (in WGS84 - UTM Zone 33 S coordinates system) are provided in Table 17. The location of the survey points has been defined to be representative of the different habitat and vegetation typologies identified during the desktop study and to ensure coverage of the entire study area, taking into consideration the objective of the study and the characteristics of the area according to its ecological values, physical accessibility, and safety conditions.

Table 17: Sampling points for terrestrial habitat and flora survey - coordinates

ID	Coordinates (Decimal Degrees, WGS84 – UTM Zone 33S)		Survey date
	Longitude	Latitude	
FP01	13.575261°	-9.171133°	17/07/2023
FP02	13.574236°	-9.167139°	17/07/2023
FP03	13.570778°	-9.152056°	17/07/2023
FP04	13.567097°	-9.131228°	18/07/2023
FP05	13.567917°	-9.116417°	18/07/2023
FP06	13.559972°	-9.097944°	18/07/2023
FP07	13.572889°	-9.093749°	18/07/2023
FP08	13.569297°	-9.075806°	18/07/2023
FP09	13.565594°	-9.059153°	20/07/2023
FP10	13.574674°	-9.045395°	20/07/2023
FP11	13.555625°	-9.031914°	20/07/2023
FP12	13.521917°	-9.014433°	20/07/2023
FP13	13.497943°	-8.992582°	20/07/2023
FP14	13.488124°	-8.993596°	20/07/2023
FP15	13.467336°	-8.977469°	20/07/2023

ID	Coordinates (Decimal Degrees, WGS84 – UTM Zone 33S)		Survey date
	Longitude	Latitude	
FP16	13.464533°	-8.992569°	20/07/2023
FP17	13.446819°	-9.011583°	21/07/2023
FP18	13.432897°	-9.004956°	21/07/2023
FP19	13.419622°	-9.014581°	21/07/2023
FP20	13.447199°	-8.953409°	20/07/2023
FP21	13.429642°	-8.944464°	20/07/2023
FP22	13.387571°	-8.939676°	21/07/2023
FP23	13.351917°	-8.931778°	21/07/2023
FP24	13.495931°	-8.910042°	21/07/2023
FP25	13.501147°	-8.894303°	21/07/2023
FP26	13.512050°	-8.880681°	21/07/2023
FP27	13.517167°	-8.877214°	21/07/2023
FP28	13.469436°	-8.867456°	21/07/2023
FP29	13.435619°	-8.858133°	21/07/2023
FP30	13.428222°	-8.843925°	21/07/2023

At each survey point a site reconnaissance survey was carried out to confirm the preliminary habitat mapping and classification developed through desktop analysis and to identify modified and natural habitats according to IFC PS6 definition. Natural Habitats are defined as “areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area’s primary ecological functions and species composition” (IFC 2012, PS 6.13). On the contrary, Modified habitats are defined as “areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area’s primary ecological functions and species composition” (IFC 2012, PS 6.11).

The definition of habitat and vegetation types identified remotely, as previously mentioned, was carried out based on the Copernicus Global Land Cover and *Ecoregions 2017* © *Resolve* platforms.

The main potential existing threats/disturbances (e.g., grazing, water pollution, invasive species) for Natural Habitats was identified, the disturbance level was estimated, and the conservation status defined for each identified habitat.

In addition, at each sampling station a floristic and vegetational survey was implemented and a list of the most abundant and characteristic terrestrial flora species observed was produced. For each species an estimate of coverage was provided, according to Braun-Blanquet cover-abundance scale. In addition, information on the threat status (according to IUCN assessment) and the endemism level of the observed species was provided.

For the species identified as threatened (classified as CR, EN or VU according to global or national IUCN assessment) and/or endemic, the exact location and distribution area of the populations was mapped using a GPS, their extension (m^2) and – when possible – the abundance (i.e., number of individuals) was estimated. Additionally, the percentage (%) of flowering/fruiting/seeding individuals was estimated.

Data on presence and abundance of exotic and/or invasive species was also collected. In addition, any direct observation of fauna species as well as any signs of fauna activity (e.g., tracks, droppings, nests, borrow sites, etc.) was reported.

Standard field datasheets was duly compiled for each survey point, including :

- SP ID (unique survey point code) ;
- surveyor's name ;
- date and time of the observation ;
- slope (decimal degree) ;
- aspect (N–E–S-W) ;
- Habitat type and brief description ;
- main threat/disturbance present (e.g., grazing, soil erosion, dust deposition, invasive species) ;
- disturbance/degradation level (high, medium, low, well preserved) ;
- reference number of the photos taken ;
- scientific names of the flora species observed and related cover class (or cover percentage) for each observed species ;
- if a threatened and/or endemic species was observed, the following data was collected and provided :
  - scientific ;
  - specific GPS coordinates (WGS84 system - UTM Zone 33 S coordinates system) ;
  - estimated number of individuals ;
  - extension of each population (m^2) ;
  - percentage (%) of flowering/fruiting/seeding individuals (phenology of the species) ;

Detailed photographic documentation of the landscape, vegetation, flora species, habitat characteristics, fauna presence, main disturbances etc. were collected at each sampling point.

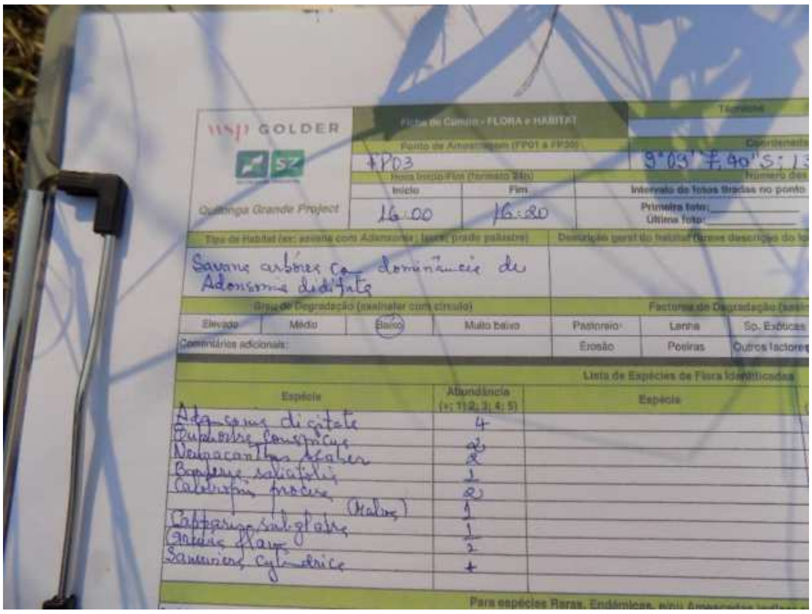

Figure 58: Field Registration Form in the study of flora and habitat

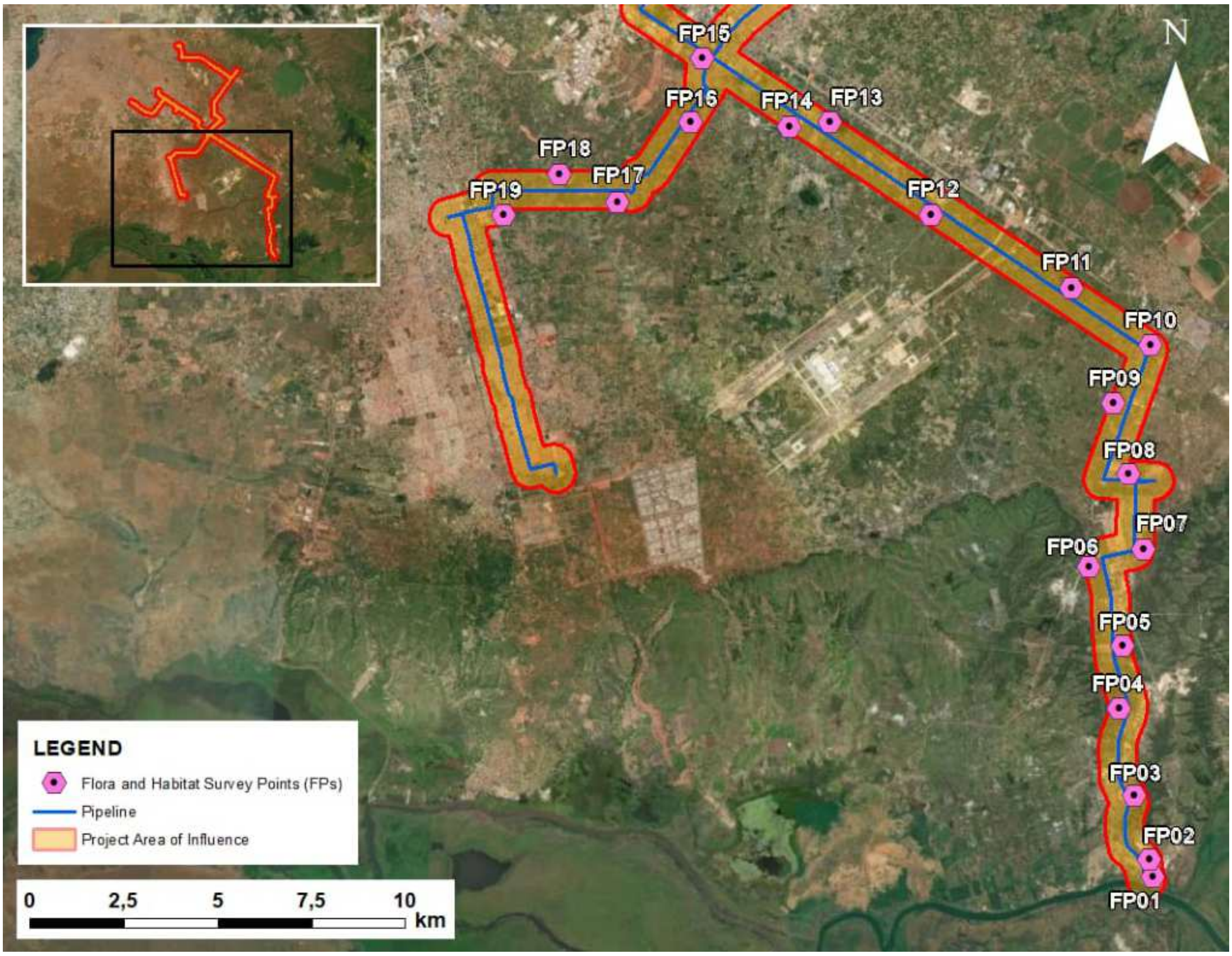

Figure 59: Flora and Habitat Survey Points (FPs) within the Project Area of Influence, for the sections of the Project including Lot Q1/Q8/Q10, Lot 5 and the section near Lot4.

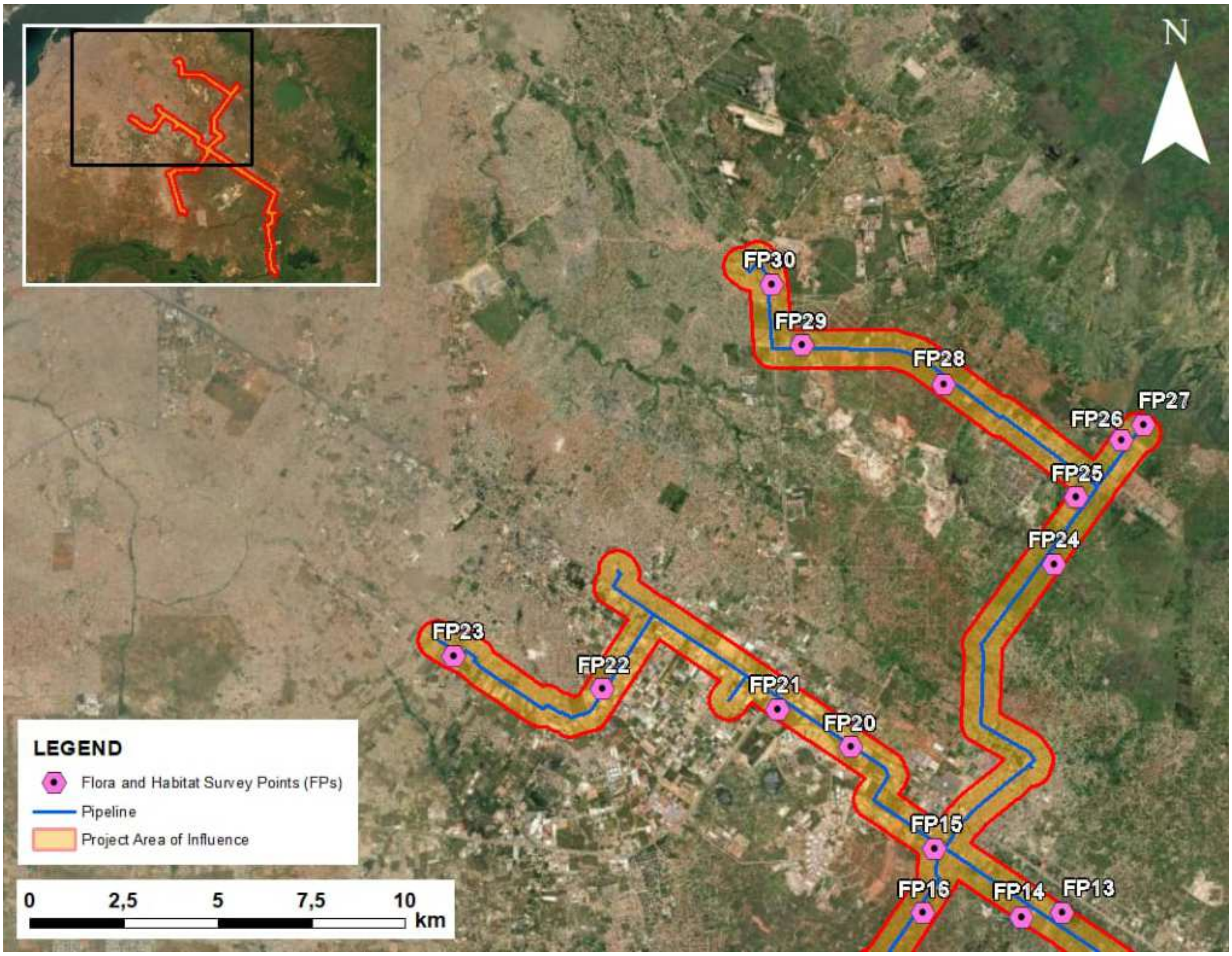

Figure 60: Flora and Habitat Survey Points (FPs) within the Project Area of Influence, for the sections of the Project near Lot3, Lot 7 and Lot 9.

Terrestrial fauna

The methodology during the field survey combined both linear transects and listening-observation points as the combination of both methods fits better with the characteristics of the habitats to be surveyed. Linear transects look more adapt to open habitats including grassy areas, while the listening-observation points are more feasible for closed habitats as dense scrubs or forested areas. The survey focused on areas near the river and on areas where a mosaic of natural habitats and urban patches is present. Observations performed during the habitat survey will help to assess the habitat suitability of certain species.

A total number of 15 survey points (BPs) and a total number of 5 survey transects (BTs) were performed within the AoI. The coordinates of the BPs and of the BTs (in WGS84 - UTM Zone 33 S coordinates system) are provided in Table 18. Those location were determined taking into consideration the objective of the study and the characteristics of the area according to its ecological values, physical accessibility, and safety conditions.

Table 18: Sampling points and sampling transects for birds – coordinates

ID	Coordinates (Decimal Degrees, WGS84 – UTM Zone 33S)		Survey data
	Longitude	Latitude	
BP01	13.569698°	-9.171133°	23/07/2023
BP02	13.574404°	-9.168739°	17/07/2023
BP03	13.570964°	-9.157010°	23/07/2023
BP04	13.566721°	-9.131105°	18/07/2023
BP05	13.570542°	-9.074207°	18/07/2023
BP06	13.532656°	-9.015784°	20/07/2023
BP07	13.500548°	-8.993617°	20/07/2023
BP08	13.488176°	-8.993598°	20/07/2023
BP09	13.464177°	-8.992199°	20/07/2023
BP10	13.433219°	-9.005250°	21/07/2023
BP11	13.430498°	-8.944772°	20/07/2023
BP12	13.352377°	-8.931911°	21/07/2023
BP13	13.519519°	-8.877698°	21/07/2023
BP14	13.467325°	-8.865979°	21/07/2023
BP15	13.435639°	-8.858522°	21/07/2023
BT01	13.575278°	-9.173278°	17/07/2023
BT02	13.570778°	-9.152056°	17/07/2023
BT03	13.570341°	-9.123718°	18/07/2023
BT04	13.442032°	-9.011194°	21/07/2023
BT05	13.493123°	-8.912913°	21/07/2023

The surveys were aimed at the identification of bird species, however other incidental observation of fauna species, including observation of signs of presence such as tracks, dens, dropping etc., were also recorded. The field ornithologists were equipped with binoculars and bird callers (for territorial species).

Standard field datasheets were duly compiled for each linear transect and listening-observation point, including:

- listening-observation point or linear transect ID ;
- GPS coordinated of the BP and BT ;
- surveyors' names ;
- day and start and end time of the observation ;
- weather conditions ;
- wind speed ;
- species and number of individuals observed ;
- species activity.

wsp GOLDER

SZ ENGENHARIA AMBIENTAL

Quilonga Grande Project

Field Survey Form - Birds	Surveyor(s)	Weather Conditions	Date
	Timóteo Júlio / Josefina Cabral	Cloudy	20/07/2023
Survey Point/Transect	**GPS Coordinates (Decimal Degrees, WGS84 – UTM Zone 33S)**		
BP07	-8.993617° | 13.500548°		

Start Time/End Time		Photos	
Start	**End**	**Photo Series**	**View points (4 pictures to N-E-S-W)**
13h33	13h53	**First:** 8044 **Last:** 8081	**N:** 8065 **E:** 8068 **S:** 8066 **W:** 8067

Habitat	Disturbing/Limiting Factors in Bird Counts				Wind Speed
Dry Shrubland	~~People~~	~~Dogs~~	~~Mist~~	Others: N/A	13 m/s

Bird Species Present

Species	Count	Activity	Species	Count	Activity	Species	Count	Activity
Merops pusillus	3	Resting						
Pycnonotus barbatus	5	Flight						
Numida meleagris	1	Feeding						
Apus affinis	10	Flight						
Urocolius indicus	3	Flight						
Estrilda astrild	5	Flight						
Spilopelia senegalensis	1	Resting						
Corvus albus	2	Resting						
Cinnyris bifasciatus	1	Feeding						
Elanus caeruleus	1	Resting						
Indicator indicator	1	Resting						

Other relevant information such as other terrestrial vertebrate fauna sighted, information obtained from locals, etc.

Gerrhosaurus* cf. *nigrolineatus

Figure 61: Field Registration Form in the bird's study

Linear transects

A total number of 5 linear transects has been defined, in order to find breeding species. A number of 3 linear transects have been chosen in the areas near the river, while the other 2 linear transect have been chosen in the areas where a mosaic of natural habitats and urban patches is present. In Table 18 the coordinates of the starting points are provided (BT01, BT02, BT03, BT04, BT05). Each transect was performed by walk for a distance of about 200 meters, starting from the starting points, and an approximate time of 20 minutes was spent for each transect. At least two observers were present. The survey was carried out between sunrise and sunset, but in the warmer hours of the day were suspended because the birds are fairly passive and partially hidden during this period. The path followed by the surveyors were straight but was adapt to the local geomorphological and ecological characteristics, focusing on the most natural micro-environments and taking into consideration the objective of the study.

Listening-observation survey

The listening and observation survey were performed in the BPs listed in Table 18. It consists in a series of watches from a fixed location to quantify the flight activity of birds potentially present within the AoI or crossing the AoI during their migration flights.

The BPs have been selected so that all together they provide insight and understanding of the flyways across the AoI. Observation in each BP will be carried out by a team consisting of at least 2 observers, who must be present simultaneously. A minimum of 20 minutes of observation was spent at each BP.

BP observations should be spread over the full daylight period available (between sunrise and sunset), and they should be taken under conditions of good ground visibility and in the absence of any noise disturbance.

In addition, the following instructions were followed:

- the surveyor spectrum will be no larger than 180 degrees in order to guarantee a reliable monitoring ;
- the observation and listening at each point will be conducted for a duration of at least 20 minutes ;
- breaks between watches are recommended to minimize observer fatigue ;
- watches will be suspended and resumed in case of any changes in visibility, e.g., fluctuations in the cloud base, passing rain shower, or for the observer to rest ;
- the survey planning will consider the time for moving from one LP to the following as well as a 10 minutes period for ‘settling in’.

Additional freshwater birds’ observations

Additional observations of birds typical of freshwater environment were taken during the survey already planned for freshwater habitats. This survey was performed on the 18th of July 2023 and lasted approximately six hours. The surveyed section of KuanzaKuanza River corresponded to the Area of Influence defined for freshwater habitat (see Figure 62).

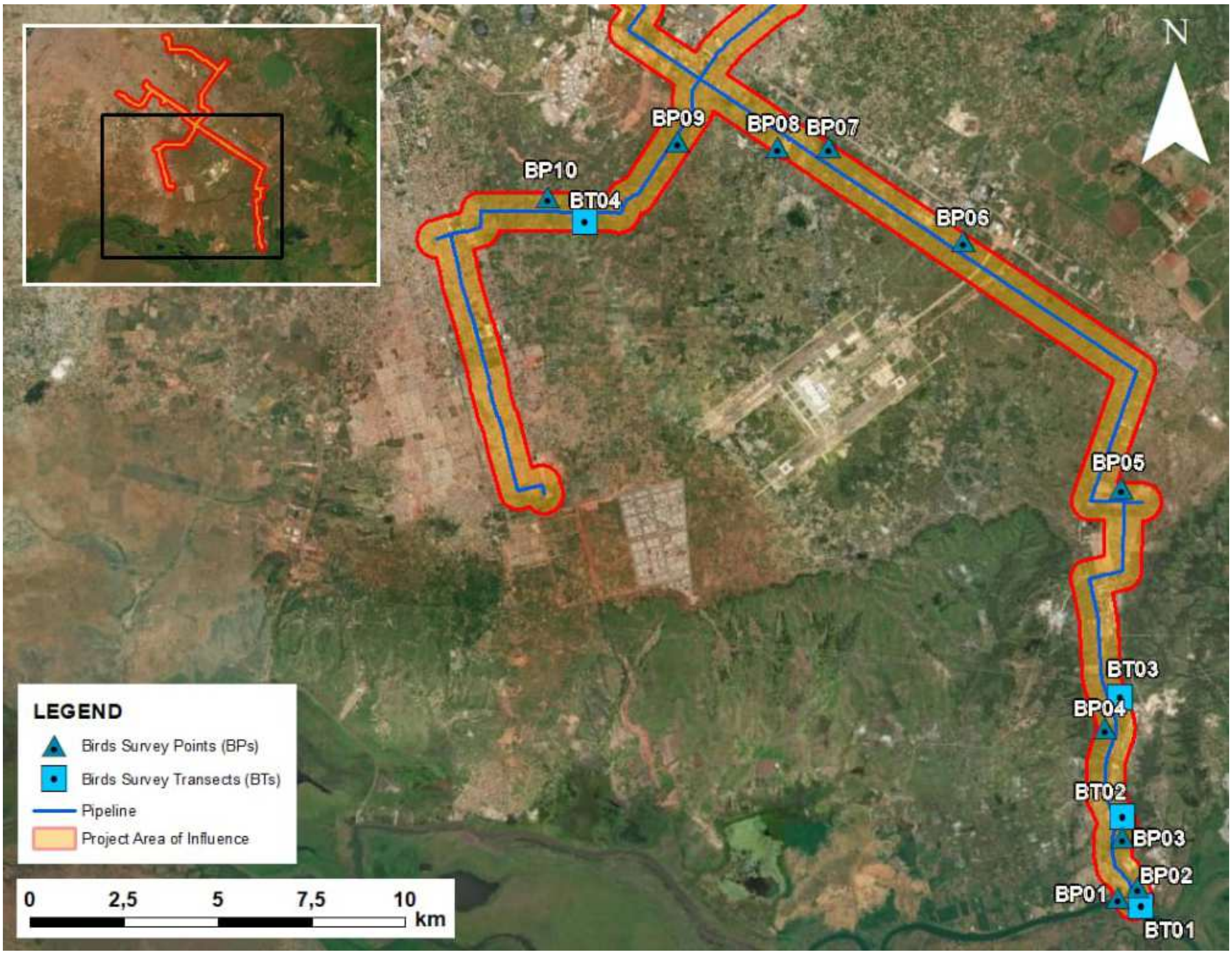

Figure 62: Bird survey points (BPs) and transects (BTs) within the Project Area of Influence, for the sections of the Project including Lot Q1/Q8/Q10, Lot 5 and the section near Lot4.

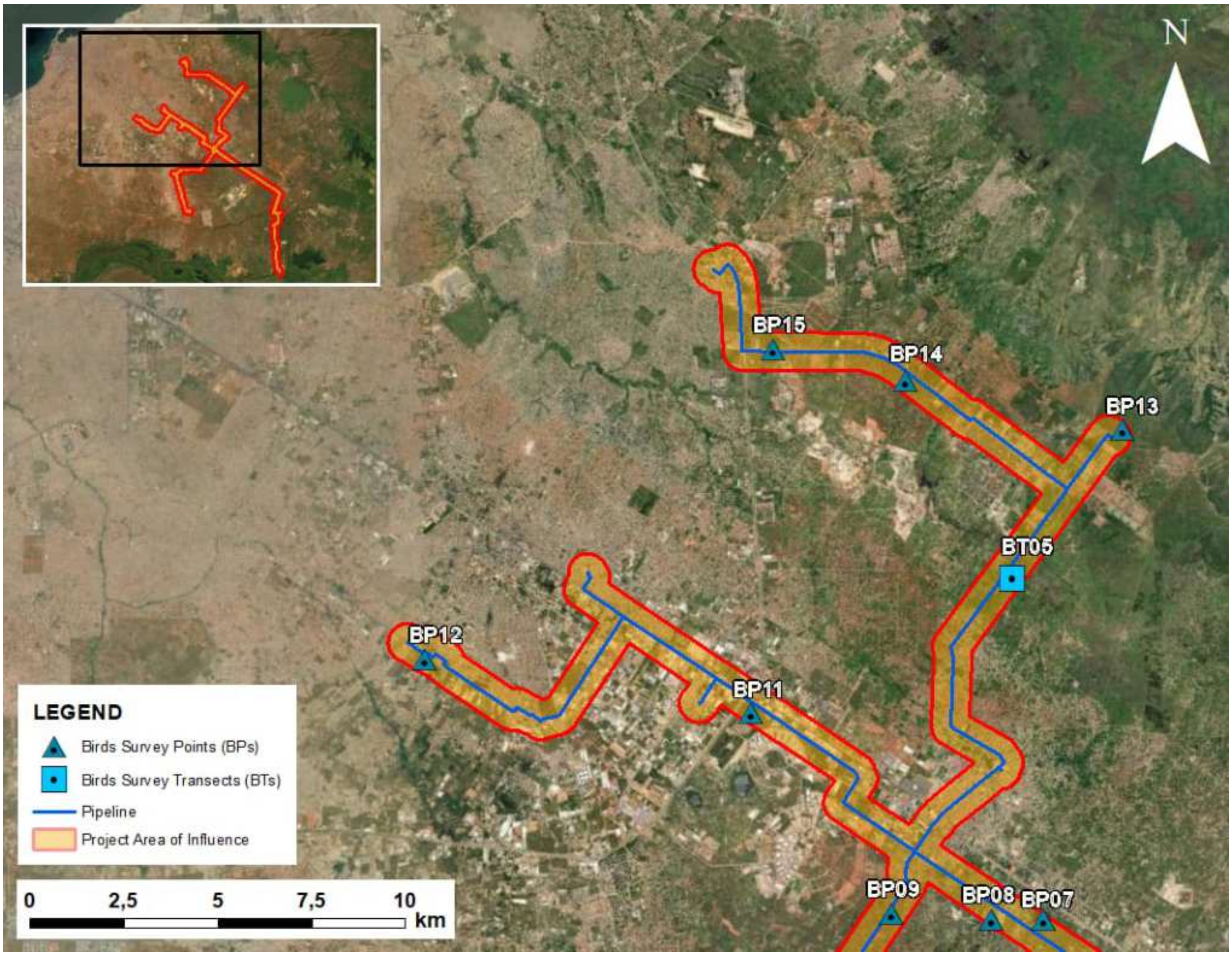

Figure 63: Bird survey points (BPs) and transects (BTs) within the Project Area of Influence, for the sections near Lot 3, Lot 7, and Lot 9

5.4.2.2 Freshwater habitat

5.4.2.2.1 Desktop studies

The Kuanza River in the area where the abstraction point is located, is wide with an open channel of approximately 200 m. The AoI was defined by 1 km upstream and 1 km downstream, with a buffer of 150 m for each bank around the central axis of the river. Thus, it was possible to identify the marginal areas in the project's AoI. Preliminary habitat mapping of the AoI using satellite imagery was done as preparation of the field work, based on Copernicus Global Land Cover and Google Earth imagery.

5.4.2.2.2 Field work

Preliminary habitat mapping generated during the desktop studies was groundtruthed and refined based on site observations. The detail of instream habitat mapped was limited due to the river conditions which comprised of deep fast flowing water. As a result, marginal habitats were mapped to obtain more information, which included bank slope and stability, light penetration and the presence of rocks or submerged logs. Fieldwork was conducted by traversing the AoI on foot and within a boat to cover the largest area possible (Figure 63). This information was used to infer the presence/absence of microhabitats for fish and other faunal groups.

Figure 64: Riparian and freshwater habitat in AoI, characterized from the banks and by boat

5.4.2.3 Aquatic biodiversity

5.4.2.3.1 Desktop studies

A list of expected species (APPENDIX H) was created based on known records and habitat using the following references:

- De Vos, L., 1995. A systematic revision of the African Schilbeidae (Teleostei, Siluriformes). With an annotated bibliography. Ann. Mus. R. Afr. Centr., Sci. Zool., 271:1-450.
- Froese, R., and D. Pauly. Editors. 2023. FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2023)
- Gosse, J.-P., 1984. Mormyridae. p. 63-122. In J. Daget, J.-P. Gosse and D.F.E. Thys van den Audenaerde (eds.) Check-list of the freshwater fishes of Africa (CLOFFA). ORSTOM, Paris and MRAC, Tervuren. Vol. 1.
- IUCN 2023. The IUCN Red List of Threatened Species. Version 2022-2. https://www.iucnredlist.org
- Poll, M. 1967. Contribution à la faune ichthyologique de l'Angola. Companhia de Diamantes de Angola (Diamang), Serviços Culturais No. 75. Lisboa.

- Risch, L. 1986. Bagridae. In: J. Daget, J.-P. Gosse & D.F.E. Thys van den Audenaerde (eds) Check-list of the freshwater fishes of Africa (CLOFFA). Volume 2, pp.2-35. Institut Royal des Sciences Naturelle de Belgique, Brussels, MRAC; Tervuren; and ORSTOM, Paris.
- Roberts, T. R. (1975). "Geographical distribution of African freshwater fishes" Zool. J. Linn. Soc. 57 pp. 249-319.
- Skelton, P.H., 2001. A complete guide to the freshwater fishes of southern Africa. Cape Town (South Africa): Struik Publishers, 395 p.
- Skelton, P.H., 2019. Chapter 11. The freshwater fishes of Angola. p. 207-242. In B.J. Huntley, V. Russo, F. Lages and N. Ferrand (eds.) Biodiversity of Angola. Science & conservation: a modern synthesis. Springer Nature Switzerland AG, Cham, Switzerland. 549 p.
- Trewavas, E. 1973. II. A new species of cichlid fishes of rivers Quanza and Bengo, Angola, with a list of the known Cichlidae of these rivers and a note on Pseudocrenilabrus natalensis Fowler. Bulletin of the British Museum (Natural History), Zoology 25(1): 27-37.
- GBIF.org (13 July 2023) GBIF Occurrence Download https://doi.org/10.15468/dl.3fv9sx

5.4.2.3.2 Field work

Fish biodiversity

Although no formal sampling of fish was conducted, fishermen’s catches and local markets were visited to gain insight into the fish diversity associated with the Bom Jesus area. Photographs of the different fish species were taken.

Environmental DNA (eDNA) sample collection

Water samples for Environmental DNA (eDNA) analysis was collected at three sampling areas within the Kwanza River. These areas included:

1. Approximately 1 km downstream of the abstraction point;
2. Adjacent to the abstraction point; and
3. Approximately 1 km upstream of the abstraction point.

Within the sampling areas, three sub-samples were collected across the width of the river, to maximize the chance of recording genetic material from different species that may utilize different habitats within the river. The three sub-samples were combined to form a single composite sample for analysis at each area.

Table 19 shows the sampling locations in relation to the abstraction point, with details of sample collection described below.

Table 19: eDNA Collection points location.

Collection Area	Subsample	Coordinates			
		RSAO13		RSAO13/ UTM 33S	
Water extraction Zone	Subsample WAF.A	9°10'22,95" S	13°34'23,34" E	8.985.706 N	343.229 E
	Subsample WAF.B	9°10'25,25" S	13°34'22,68" E	8.985.635 N	343.209 E
	Subsample WAF.C	9°10'27,26" S	13°34'21,82" E	8.985.573 N	343.183 E
Downstream Zone	Subsample DS.A	9°10'24,63" S	13°33'42,81" E	8.985.649 N	341.992 E
	Subsample DS.B	9°10'25,76" S	13°33'44,10" E	8.985.614 N	342.032 E
	Subsample DS.C	9°10'27,18" S	13°33'44,85" E	8.985.571 N	342.055 E
Upstream Zone	Subsample US.A	9°10'32,20" S	13°34'43,69" E	8.985.424 N	343.851 E
	Subsample US.B	9°10'33,90" S	13°34'42,83" E	8.985.372 N	343.825 E
	Subsample US.C	9°10'35,31" S	13°34'42,89" E	8.985.328 N	343.827 E

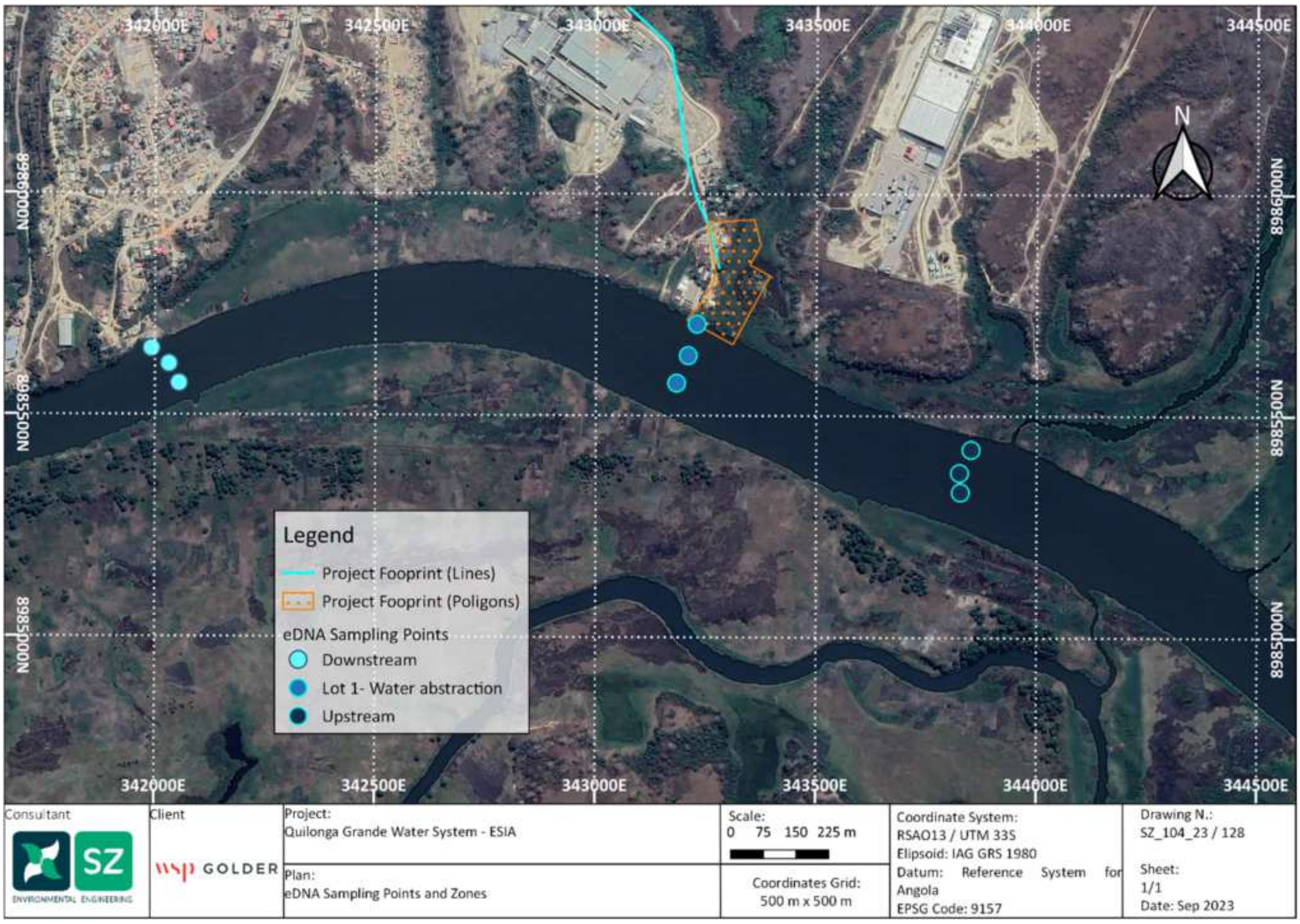

Figure 65: Location eDNA Sampling locations

At each of the sub-samples collected, approximately 1 liter of water was collected from the surface. The sub-samples were combined to make a composite sample (± 3 Liters), from which water could be filtered.

Figure 66: eDNA sample collection

The water samples were stored in the sterile bags provided by the sampling kit and transported to a laboratory facility to process the samples in a controlled environment.

Once at the laboratory, the samples were filtered according to the collection and processing protocol prescribed by Naturemetrics. The process involved pushing approximately 2.5 liters of water through a filter with a syringe. Once complete, the provided preservative was added and the filter sealed, and labeled for transportation back to the UK, where the sequencing is done.

Figure 67: Sample processing (filtering, preservation and labelinglabelling)

Subsistence fisheries

To gain further insight into the aquatic biota present at the site, and the dependency of surrounding communities on the fish stocks, informal conversations with fishermen was held. A simple list of questions was compiled to guide these discussions. Thirty-two (32) fishermen were consulted during the field assessment conducted in July 17th and 18th, 2023. The questions were:

- Where do you fish ?
- Where do you fish from ?
- How often do you fish ?
- How much time do you spend fishing ?
- How many fish do you catch per day ?
- How many different types of fish do you catch ?
- Do you keep all size fish ?
- Method of fishing ?
- What other animals do you catch by accident in nets ?

The last question related to fishing bycatch informed other discipline findings and has been included in the appropriate sections below.

Figure 68: Informal surveys carried out with fishermen

5.4.3 Social component

5.4.3.1 Review of existing documentation

As for desktop review, there was an extensive search for available information regarding all specific social component.

The main data source was the Statistical Institute of Angola (INE), which provides several periodic publications regarding different topics, and also promotes the Census data every ten years, which is the most comprehensive data collection in the country. The last census was developed in 2014, so there are many questions where the latest information available is from that year. However, there was an effort to search and complement with more recent data whenever available, either from other periodic publications from INE or other sources.

Considering the significant extent of external sources consulted, they are referenced along the baseline chapter, in each specific topic.

It was also reviewed the information available from the previous ESIA, from 2014, to assess information that needed to be updated or complemented, but also to include any valid information from that baseline.

5.4.3.2 Site activities: meetings, presentations, and surveys

For developing the social baseline, several site activities were conducted, as summarized in Table 20. They will be further detailed in the next chapters.

Table 20: Main activities developed during the social baseline

Date	Activities / Locations	Objectives
19th to 21st April 2023	Initial Project Visit, with EPAL 1st Meeting with EPAL (administration and directors)	Presentation of ESIA team and ESIA process to the Administration of EPAL Selection of Technicians from EPAL to support the fieldwork and data collection; Initial survey of the study area; Current project presentation to the ESIA team; Identification of neighborhoods and communities around the project.
31st July to 3rd August	Baseline surveys, with questionnaires on 5 communities for households (100 inquiries), farmers (20 Inquiries) and private operators and companies that work on water distribution (25 Inquiries)	Baseline data collection Project presentation in the communities Questions about Concerns, Expectations, or any doubts regarding the project.
	Initial informal contact with focus groups of fisherman and farmers alongside the questionnaires in the communities	
15th August	2nd meeting with EPAL, with broad participation of technical staff. Participation also from EASU (Uíge Public Water Company). 49 Participants	General presentation of the Project General presentation of the ESIA Process and current status Questions about Concerns and Expectations regarding the project.
21st to 24th August 2023	Delivery of letters with specific inquiries to several departments of the Provincial Government and some institutions (ZEE, PIV)	Collection of additional socio-economy data from the provincial government and project feed-back from the industry sector stakeholders (ZEE and PIV).
22nd August 2023	Public presentation meetings in the Municipalities – Ícolo e Bengo 53 participants	General presentation of the Project General presentation of the ESIA Process and current status Contact with local authorities Questions about Concerns, Expectations, or any doubts regarding the project.
23rd August 2023	Public presentation meetings in the Municipalities – Viana 79 Participants	
24th August 2023	Public presentation meetings in the Municipalities – Cacuaco 83 Participants	
28th August	Focus Group Meetings – Women	Questions about Concerns, Expectations, or any doubts regarding the project specifically for that focus group.
29th August	Focus Group Meetings – Fisherman	

5.4.3.2.1 Preparation of the field surveys and field activities

This included several meetings with AGSC, GAUFF, EPAL, Saioz and WSP; elaboration of questionnaires; bibliographical research and establishment of a program to collect field data, with the development of a Social Baseline Activity Plan.

5.4.3.2.2 Field surveys

Field surveys are one of the most commonly used methods researchers use for primary data collection. In cases where secondary data sources do not provide sufficient information, field surveys allow researchers to monitor and evaluate the impact of the Project and field experiments. The field surveys tried to collect information on the populations who would potentially be impacted by and/or benefit from the Project.

Questions included general socio-economic characterization of the household as well as perception of and knowledge on the Project.

It was developed interviews in person with the target groups of the communities through specific surveys for each group, performed in person and through questionnaires:

- A – Farmers / Land use occupants
- B – Households/residents and local workers
- C – Private water supply companies (Tanker trucks and motorbikes)

As assumed in the initial project planning, it was considered a sample survey approach, in 4 to 5 communities around the project that could be considered representative of the project's AoI.

During the scoping phase site visit, it was then identified the communities to be surveyed and selected the general area of characterization around these communities, namely :

- Community around the Km 30 DC ;
- Community around the Kapalanga DC ;
- Community around the Zango 5 DC ;
- Community around the Cacuaco DC ;
- Community of Bom Jesus.

Questionnaire A (Farmers and occupiers of land for various purposes) was developed only in the two communities located in rural areas: Bom Jesus and Cacuaco. Questionnaires B and C were developed in the five Communities.

The specific extension around the DCs wasn't pre-established, only the global survey effort, consisting of around 20 household inquiries in each community, 5 inquiries to water selling companies/individuals and, in the rural communities (Cacuaco and Bom Jesus), 10 inquiries to land users.

Before the field survey, there was an initial visit to each community to assess conditions, identify local authorities help plan de field work and limit the survey area and methodological approach. Considering the urban nature of most communities, there aren't local community leaders established. In some communities, there are neighborhood association, but it wasn't possible to obtain their assistance in proposing community members to participate in the surveys.

As such, the survey effort started near the Distribution Centers and extended along the main roads, randomly selecting households for interviews.

Also due to the urban nature of the communities, there is limited availability of the community to participate in the surveys, both because people are away at work, school, etc., or simply because they refuse to participate in any inquiry, leading to some restrictions of the survey effort to find available participants. Water companies, in the initial visit and during the household surveys, it was identified existing water operators working in the communities, who were later interviewed.

As for land users and farmers, in Cacuaco and Bom Jesus, was identified, in the initial visit, the existence of agricultural lands, that were later visited to identify farmers present.

The general area of study, used for surveys and social receiver identification, around each Lot, is presented in the Figure 70. It is also presented the location of part of the surveys developed. It should be noted that there were some issues with the coordinate registry of the household surveys (missing or incorrect coordinates), and that the surveys for land users and water companies didn't include a field for coordinates. This led to only being possible to correctly map part of the field effort developed.

For the Households and traditional authorities, the following Communities were considered:

Table 21: Communities where the field surveys were conducted

Communities	Municipality	Related to Project Lot
Bom Jesus	Icolo e Bengo	Lot 1 WTP Lot 8 CD Quilonga Grande Lot 10 STP
Belo Monte	Cacuaco	Lot 3 – DC Cacuaco
Zango 5	Viana	Lot 4 – DC Zango 5
Km 30	Viana	Lot 6 – DC Km 30
Kapalanga	Viana	Lot 7 – DC Kapalanga

In this case, the interviewers conducted fieldwork with Farmers, Households and Private Water Suppliers to collect data on farmers' productions and incomes, structure and living conditions of households and sources of water supply and quantities sold by private operators, among other aspects.

The method used was the face-to-face survey. Getting information from respondents face-to-face is much more effective than other means because respondents often trust respondents and provide honest and straightforward feedback.

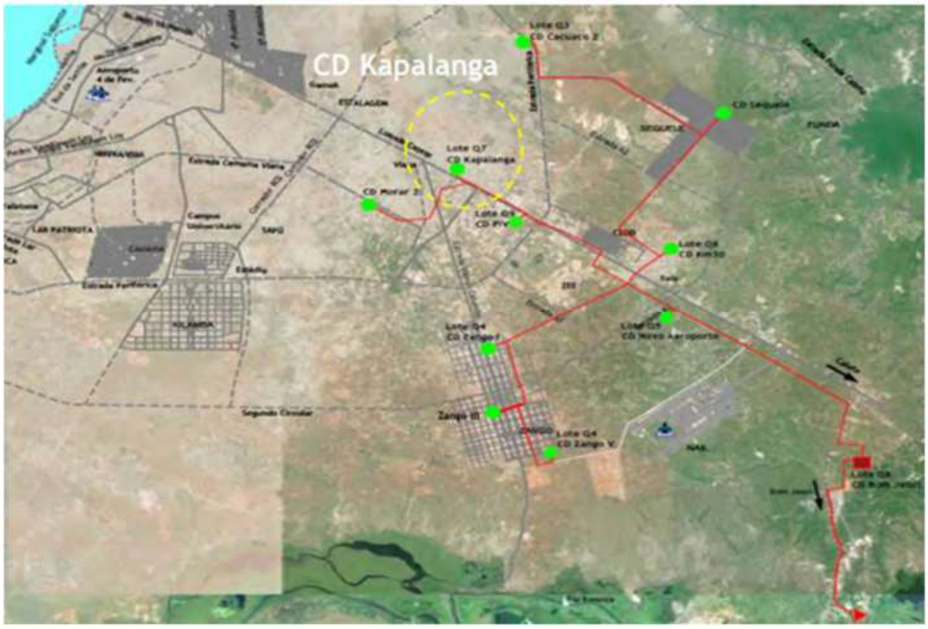

Figure 69: Surveyed communities

Table 22: Survey effort developed

Communities	Target Groups	Questionnaires Used	Number of Questionaires obtained
Lot 1 – WTP Lot 10 –STP (Bom Jesus)	Farmers and occupiers of land for various purposes	A	10
	Households/residents and local Workers	B	20
	Private water supply companies (tankers)	C	5
Lot 3 DC Cacuaco	Farmers and occupiers of land for various purposes	A	10
	Households/residents and local Workers	B	20
	Private water supply companies (tankers)	C	5
Lot 4 – DC Zango 5	Households/residents and local Workers	B	20
	Private water supply companies (tankers)	C	5
Lot 6 – DC km 30	Households/residents and local Workers	B	20
	Private water supply companies (tankers)	C	5
Lot 7 DC Kapalanca	Households/residents and local Workers	B	20
	Private water supply companies (tankers)	C	5
Total	**A – Farmers and occupiers of land for various purposes**		**20**
	B – Households/residents and local workers		**100**
	C – Private water supply companies (tankers)		**25**

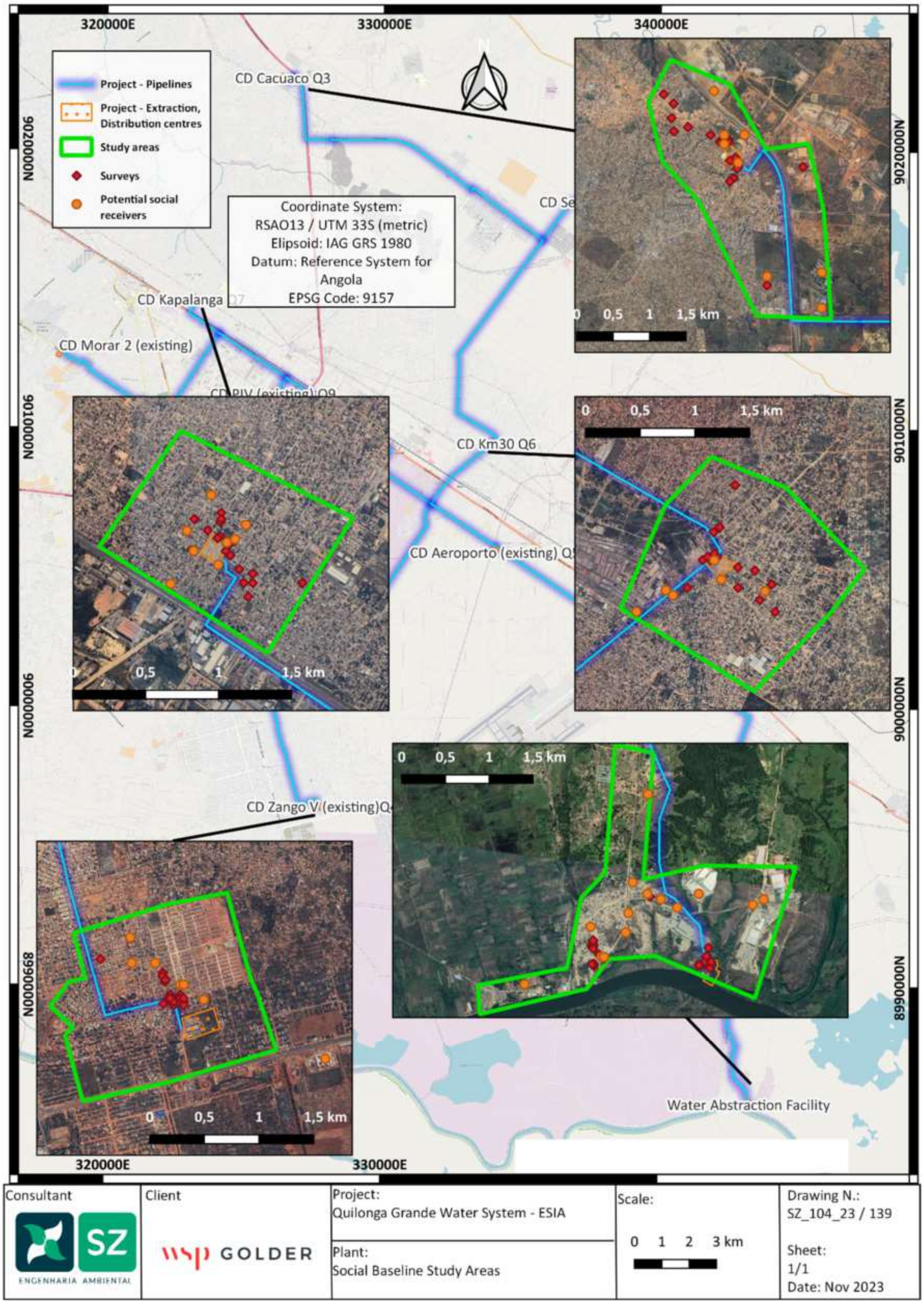

Figure 70: Location of field surveys

5.4.3.2.3 Development of Presentation Meetings

It was scheduled several Project presentations and ESIA process presentation meetings (private and public), namely one focused on EPAL staff and 3 others developed at a Municipal Level for all stakeholders, namely in Cacuaco, Viana and Ícolo e Bengo Municipalities.

5.4.3.2.4 Data Collection from Institutional and Private Entities

This included the distribution of specific questionnaires to several entities, to collect additional socio-economic data and project feed-back (concerns/expectations).

It was delivered questionnaires to the following entities:

- The National Maritime Agency (AMN) ;
- Provincial Government Agriculture, Livestock and Fishing Department ;
- Provincial Government Social Action, Family and Gender Equality Department ;
- Provincial Government Education Department ;
- Provincial Government Environment and Waste Management Department ;
- Provincial Government Transports, Traffic and Urban Mobility Department ;
- Provincial Government Culture, Tourism, Youth and Sports Department ;
- Provincial Government Health Department ;
- Viana Industrial Development Pole (PIV) ;
- Luanda-Bengo Special Economic Zone (ZEE).

Despite having delivered all letters and having stablished regular contacts (by phone and in person) with the entities, no answers from these questionnaires/letters were received. As such, the social baseline worked mainly with desktop information and field information,

5.4.3.2.5 Focus Group Discussions

During the rest of the field surveys, the main focus groups identified were women and fisherman. As such, there was a specific visit to develop 2 focus group meetings, one with women (mainly household leaders) and other with fisherman.

5.4.3.2.6 Compilation and analysis of the results

After the survey data was collected, it was analyzed to ensure that it contributes to the ultimate goal of the research.

Data privacy and anonymity

All data treatment was done in compliance of Law n.º 22/11, of 17th of June – Personal Dara Protection Law. The participants were all informed of the data use and verbally authorized the data collection. They were also informed of the entities involved in the project and it's ESIA, that could be contacted regarding data treatment questions. All physical field records are kept in a secure location in Saioz headquarters and will be kept only until conclusion and approval of the ESIA, after which they will be destroyed. As for digital records (digitation and treatment of field records), they are kept in secure servers, with restricted access, only accessible by the Saioz ESIA Team involved in the Social Baseline and WSP. These records will be kept according to the data treatment policy of Saioz and WSP, and, after the conservation time established in this policy, they will be deleted. This applies to data collected for baseline purposes as well as stakeholder engagement.

Data limitation and assumptions

An adequate baseline should incorporate assumptions about exogenous changes in the social context that may entail relevant benefits and costs (e.g., changes in demographics, economic activities, consumer preferences, and technology), industry compliance rates, other enacted regulations, government entities and behavioral responses of service providers and receptors of the proposed project.

These assumptions should guide the objectives and means to be used for the socio-economic survey of the project's direct area of incidence and its surroundings. Thus, the ESIA-addendum should objectively identify the main assumptions and limitations inherent to the study to be developed to draw the basic socio-economic framework and be able to anticipate the main impacts associated with the various phases of the project and the respective mitigation measures.

As such, the assumptions, and limitations of this ESIA are listed below :

Assumptions

The following assumptions informed the socio-economic baseline study :

- The participants in the study responded truthfully in the interviews ;
- The interviewees fully understood the questions being asked ;
- The focus group meeting facilitators accurately captured the meaning of answers and the intentions of the interviewees.

Limitations

The following limitations informed the socio-economic baseline study:

- The demographic data used in the study is largely based on the 2014 Census. Some of this data may be outdated. However, this will not have a bearing on the key findings of the Social Impact Assessment ;
- The local governing institutions (Municipalities, Communes/Districts) do not undertake regular community surveys or update baseline demographic and social data at the community level ;
- Although there was an effort to consult these local entities regarding local social date, especially the provincial government, there were no replies, limiting the available data at the local and regional level ;
- The field survey was done based on a sampling methodology, considering 5 specific communities directly involving areas of the project. It was assumed that these communities could represent the rest of the communities of the Project's AoI. However, there could be limitations on the representativeness of the samples chosen ;
- Due to the urban characteristics of the AoI, people are generally distrustful of any activity developed in the community, and there was some resistance in participating in the inquiries or in answering specific questions regarding household data and livelihood, leading to some gaps in the answers obtained to part of the questions asked ;
- The Questionnaires B were applied to communities near the DC. Due to the extent of Lot 2 (100 km) and time restriction, the social surveys did not focus on that Lot as any preliminary survey would be too limit to

provide an understanding of the social-economical living near the future pipeline. Additional surveys will need to be carried on as part of the LRP (see Chapters 8.0 and 12.0). During those additional surveys, attempts should be made to close data gaps related to low response rates ;

- In a relatively short time, it is impossible to gain an in-depth understanding of the local social, economic, and political dynamics of the area ;
- Given the limitations above, field data provided in the social baseline should be considered as anecdotal rather than proven facts.

The following steps in the analysis of the surveys are highlighted :

- Understand the most popular survey questions ;
- Filter obtained results using the cross-tabulation technique ;
- Evaluate the derived numbers ;
- Conclusion.

5.5 Impact Assessment methodology and identification of mitigation measures

The methodology is based on the premise that projects can generate both negative and positive impacts with a magnitude that can be evaluated by considering several attributes of the project activities and of the receiving environment.

The methodology is based on three main building blocks and on the identification, description, and quantification of the following key elements (Figure 71) :

- **Impact factors**: direct or indirect interferences produced by the project actions on the environment, able to influence the state or quality of one or more environmental and social valued components ;
- **Sensitivity of the valued component**: sum of the conditions which characterize the present quality and/or trends of a specific environmental and social component and/or of its resources ;
- **Impact value**: changes undergone by the environmental state or quality because of the effects caused by the impact factors on the environmental or social component ;

The three building blocks are illustrated in the Figure 71 below and described in the following paragraphs.

After impact definition, mitigations measures are defined, and residual impact value is assessed based on the mitigation measure effectiveness :

- **Mitigation measures**: actions adopted to mitigate negative impacts or to improve the effects of positive impacts on the environmental and social component.

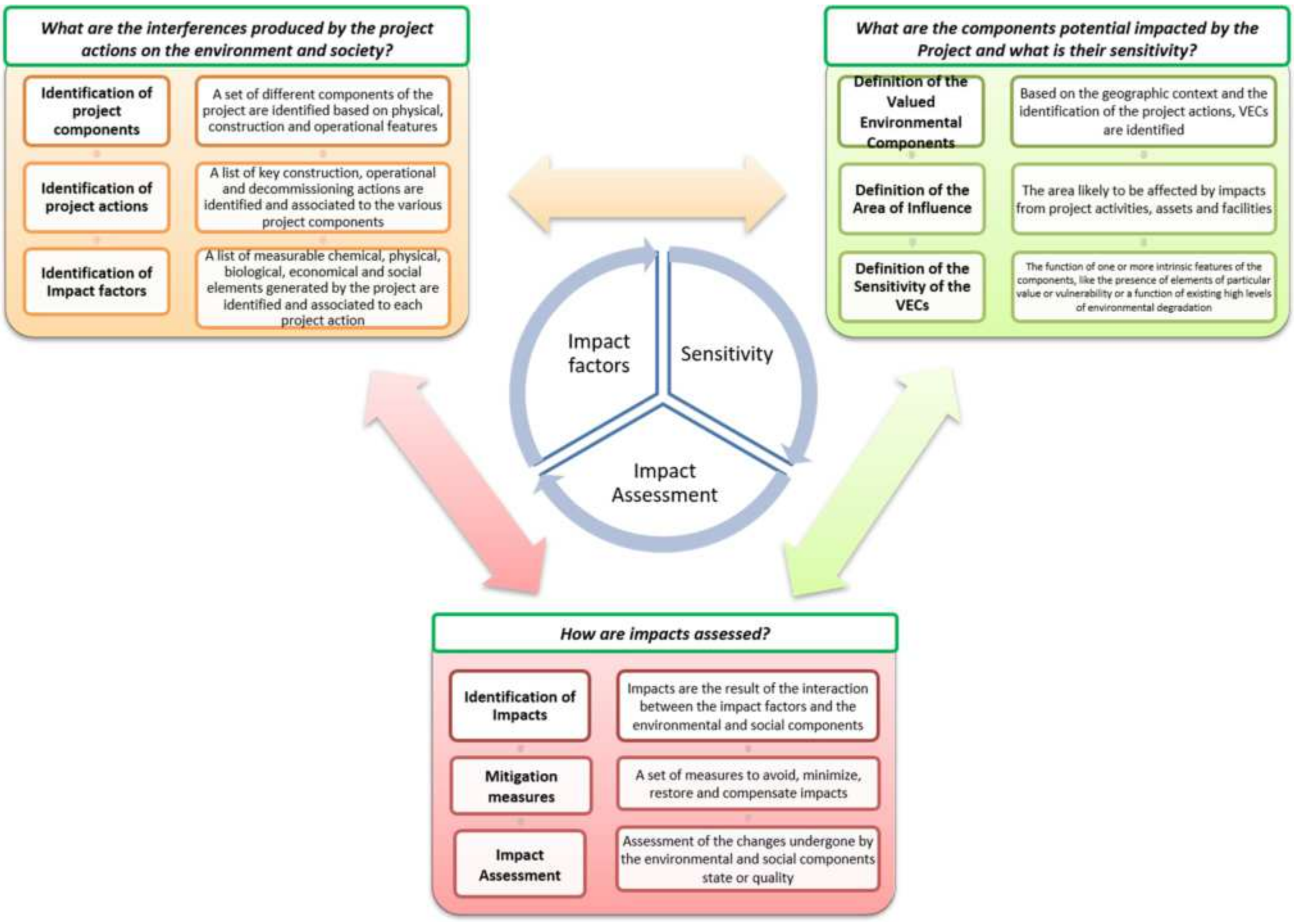

Figure 71: Impact assessment methodology

5.5.1 Impact factor definition

The impact factor is a project-specific criteria, quantified according to the following elements :

- Duration (permanent, temporary) ;
- Geographical extent (project site, local, regional) ;
- Intensity (low, medium, high).

These criteria are defined below.

Intensity

The intensity of the impact is a measure of the physical, economic, or social severity of the impact factor:

- Negligible: the impact factor is generated in quantities that might be detected or perceived but whose effects are not expected to cause tangible changes in the target environmental or social components ;
- Low: the impact factor is generated in quantities that can be detected or perceived but whose effects are unlikely to cause tangible changes in the target environmental or social components ;
- Medium: the impact factor is generated in quantities that are well within legal standards or accepted practices and/or whose effects are likely to cause tangible changes in the target environmental or social components ;

- High: the impact factor is generated in quantities that at the limit of legal standards or accepted practices and/or whose effects are likely to cause serious impairment to catastrophic damage in the target environmental or social components.

Geographical extent

This criterion corresponds to the spatial extent of the change in the element concerned. Three levels of measures are considered: regional, local and point.

- The measure is considered regional, if an impact on a component is felt over a large area (i.e. the whole region or the whole regional study area) or affects a large part of the population .
- The measure is considered local if the impact is felt in the local study area or part of its population ;
- The measure is considered to be extended to the project site if the impact is felt on a limited part of the local study area or on a small group of people.

Note that biological significance refers to the Regional Ecological Extent (REE).

Duration

An impact can be considered temporary or permanent.

A temporary impact can be spread over a few days, weeks, or months, but must be associated with the notion of reversibility. A reversible impact is one that, even without the application of mitigation measures, will recover naturally without human intervention. For example, a negative impact of dust on air quality during the construction phase will recover naturally at the end of the construction phase. This does not mean, however, that mitigation measures should not be applied while the impact is being felt.

However, a permanent impact is often irreversible and is considered permanent or very long-term. A permanent impact is one that will not recover without human intervention or the application of mitigation measures. For example, the loss of houses located within the project's right-of-way cannot be recovered without the application of an adequate compensation measure. On the other hand, if a project must deforest its right-of-way, this impact will be considered permanent if the project description does not already include a reforestation/revegetation activity for the right-of-way.

Impact factor value

The link between the criteria of duration, intensity and extent allows for an overall assessment of each impact factor. To this end, an impact assessment matrix is presented below as a guide to assessing the value of an impact factor. However, the Consultant will make an overall judgement based on the specificities of the environment. The final assessment is defined with the impact assessment matrix (Table 23) here below and is classified into the following three categories:

- Major impact factor : consequences for the environment are very strong and can hardly be mitigated ;
- Moderate impact factor : consequences are significant, but could be mitigated by specific measures ;
- Minor impact factor : consequences on the environment are reduced and could require mitigation measures ;
- Negligible impact factor : consequences on the environment are negligible and do not require mitigation measures.

Table 23: Matrix of the impact assessment

Intensity	Geographical extent	Duration	Impact factor value			
			Major	Moderate	Minor	Negligible
High	Regional	Permanent	X			
		Temporary		X		
	Local	Permanent	X			
		Temporary		X		
	Project site	Permanent		X		
		Temporary			X	
Medium	Regional	Permanent	X			
		Temporary		X		
	Local	Permanent		X		
		Temporary			X	
	Project site	Permanent		X		
		Temporary			X	
Low	Regional	Permanent		X		
		Temporary			X	
	Local	Permanent		X		
		Temporary			X	
	Project site	Permanent			X	
		Temporary			X	X
Negligible	Regional	Permanent			X	
		Temporary				X
	Local	Permanent			X	
		Temporary				X
	Project site	Permanent				X
		Temporary				X

5.5.2 Sensitivity

Each valued component of the site has a different sensitivity to the impact factors generated by the project or can pose a different level of risk to the project. The sensitivity is a site-specific criterion, typically evaluated on the basis of the presence/absence of some features which define :

- The value of the element (rarity, originality, diversity, quality of life, etc.) and its resilience to potential change ;
- The superposition of the footprint to be considered and the distribution area of the element ;
- The evolution of the element over time, based on an understanding of past evolution and a projection of its future state in the absence of the project.

As examples, for physical components the sensitivity is typically related to the presence of elements that are at the highest or lowest scale of quality or the distance of the receptor from the project footprint. For biodiversity it is related to the presence of threatened, endemic, or protected species or habitats and for social components to the presence of vulnerable elements of the community like poor, elderly, members of ethnic or religious minorities, indigenous people, etc and/or lack of essential services and basic needs i.e., limited access to water, unsustainable access to food, and limited health services.

The sensitivity could be evaluated as low, medium or high depending on the environmental and social valued component.

5.5.3 Impact value

The impact value can be either **positive** or **negative**.

The calculation of the **Impact Value** is done by multiplying the Impact Factor level for the value of the sensitivity of the target component (Table 24).

Table 24: Impact value matrix

Impact value		Impact factor			
Sensitivity		Negligible	Minor	Moderate	Major
	Low	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Major
	High	Minor to Negligible	Moderate	Major	Major

5.5.4 Residual Impact value

The following step consists in identifying and assessing the effectiveness of the mitigation measures to reduce or eliminate each negative impact or enhance the positive impact. The mitigation measures should be defined with reference to the mitigation hierarchy and be organized in a logical sequence of measures to :

- Avoid ;
- Minimize ;
- Restore ;
- Compensate.

Mitigation measures are typically addressing one or more of the key features of the impact factors identified, for example by reducing the duration, the geographic extent, and the intensity, or by increasing the resilience of the valued component.

Residual impact values are assessed according to the same methodology after mitigation measure application.

5.6 Supplementary studies

5.6.1 Impact on the hydrology of the Kwanza River

The methodology for assessment the impact on the water abstraction for the Project on the hydrology of the Kwanza River is described in the APPENDIX N .

5.6.2 GHG emission calculations

The emission calculation methods, input parameters and assumptions that are used to estimate the annual GHG emissions from each Lot of the Project, for both construction and operation phases are described in APPENDIX K. The emissions estimation methods used to quantify annual GHGs follow generally accepted practices for conducting ESIAs and, where applicable, the Regulation on Monitoring Greenhouse Gas Emissions.

5.6.3 Climate change risk assessment (CCRA)

The methodology of the climate change-related risk assessment performed in support of the Environmental and Social Impact Assessment addendum for the Quilonga Grande Project is described in APPENDIX M.

The assessment resulted in the identification of physical risks that may affect the Project at present and in the future, and in several adaptative measures that may be considered and implemented to mitigate these risks.

The CCRA was developed based on existing methodologies for the assessment of climate change risks and vulnerability as part of adaptation strategies. Guidelines and methodologies from the ISO 14091 as well as the Intergovernmental Panel on Climate Change (IPCC) and the World Bank Group were used as a guidance for defining factors that contribute to determine the risk. These methodologies consider a variety of risk components whose definitions are as follows:

- Climate-related Hazard: natural or human induced climate-related hazard, such as flood, wildfire, extreme heat, which can occur at the Project Site. The changes in intensity of hazard related events and of their probability over-time are influenced by climate change.
- Exposure: the possibility for a Project in a specific site to be adversely affected by a certain hazard because of the presence of certain Project services, resources, infrastructures, people, and other Project's intrinsic elements that are prone to be affected. A Project, depending on its intrinsic nature and characteristics, may or may not be exposed to a certain hazard that occur at the Project Site. Exposure is therefore an indicator of if the Project "can or cannot be affected" by a certain hazard.
- Sensitivity: propensity or predisposition of elements of the Project to be affected by a certain hazard. Sensitivity is a measure of "how much" a Project exposed to a certain hazard can be affected.
- Adaptive capacity: the ability of the Project to adjust to climate hazard-related events, to mitigate potential damages, to take advantage of opportunities, or to respond to the consequences.
- Vulnerability: expresses the magnitude of potential effects and consequences of climate hazard-related events on elements of the Project. Vulnerability results from the combination of Sensitivity and Adaptive capacity.
- Risk: the result of the combination of Hazard probability or intensity at a certain time and the Vulnerability.

This methodology assesses all different climate-related hazards independently, at present and in the future. Different Project components (later referred as "Lots") are treated independently as well, considering their different nature and intrinsic characteristics, and so also their distinct behaviors in case of climate-related hazards. For each hazard and for all Lots exposed to it, the Sensitivity and Adaptive Capacity are assigned a qualitative class ("i.e., "high", "medium", "low") and then combined using qualitative matrix. The result is a class of Vulnerability ("very low", "low", "medium", "high" or "very high") for each climate-related hazard considered in the analysis and all Lots potentially impacted. Vulnerability and Hazard probability or intensity are then qualitatively combined to identify the most critical risks. The following figure shows risk assessment process for a specific hazard "h" and a certain Lot exposed to it.

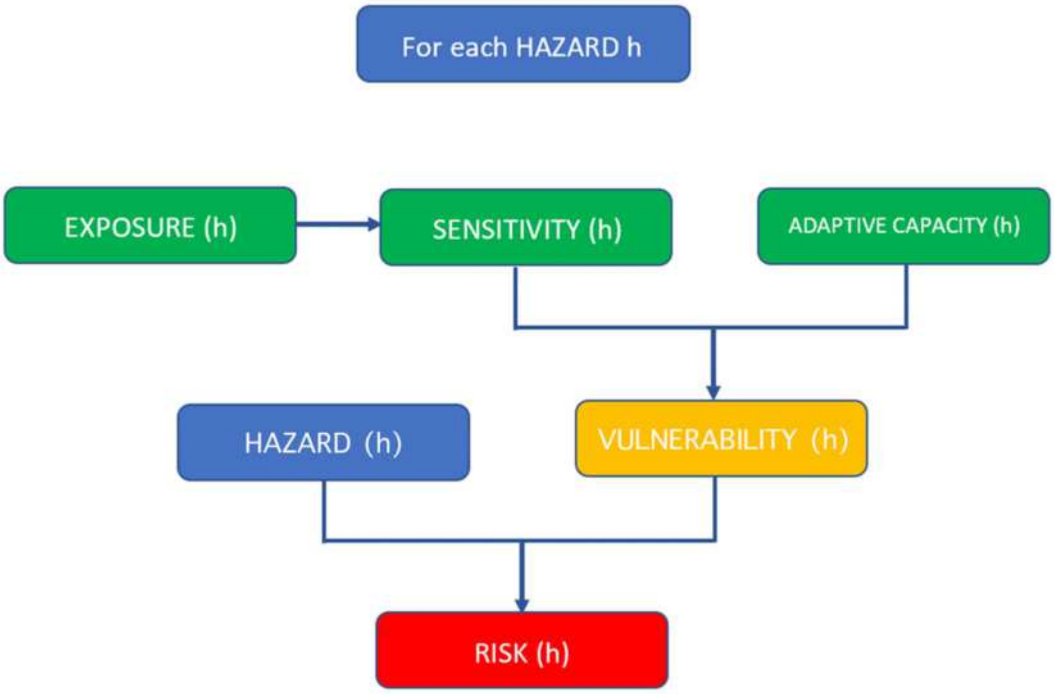

Figure 72: Workflow of the risk assessment for a specific hazard "h" the Project is exposed to, showing how different risk factors are combined across the analysis.

Both acute and chronic climate-related events have been considered to characterize the climate-related hazard levels and the climatology of the territory where the implementation of the Project is planned. Climate-related hazards, such as extreme heat, river flood, wildfires, have been characterized at present and represented through a set of maps, with the information associated to all district where the Project is located.

Predicted future climate has been added to the analysis, providing an overview of main climate variables, such as projected average temperatures and precipitations at the local scale, according to different emission scenarios.

Such an exercise has ultimately helped identifying the most critical future climate-related risks to be considered.

5.6.4 Human rights risk screening

. The objective of this human rights screening is to highlight contextual and project-specific risks at an early stage, enabling the results of the assessment to be incorporated into the environmental and social management plans for project implementation, and thus manage negative human rights risks. According to international standards, human rights aim to guarantee the dignity and equality of all human beings without discrimination.

The human rights screening was carried out to meet the expectations set by the UN Guiding Principles on Business and Human Rights and the Equator Principles, as outlined in the guidance note on implementing human rights assessments under the (Equator Principles 2020). In addition, this study fully integrates the International Labor conventions of (ILO) in order to consider all details related to working conditions of Project implementation. The methodology applied for the assessment is described in the APPENDIX L.

5.7 Impact assessment assumptions and limitations

The following was assumed during the evaluation of the impacts of Quilonga Project:

- Supply network is not part of the scope of the current ESIA-Addendum ;

- WSP assumes that all relevant project information has been provided by EPAL and the Clients and that it was correct and valid at the time it was provided ;
- The impact assessment is based on the most up-to-date information available at the time of writing ;
- The scope of this ESIA is limited to identifying the potential environmental and social impacts associated with the sections of the proposed Project areas ;
- Parts of the Project design are not yet finalized and some of the Project details of Quilonga operation are not available ;
- The precise locations for some of the project activities are not confirmed, and the trenching locations for the distribution networks must be located within an indicative Area of Interest (AoI). ESIA-addendum studies assess generic distribution network transit sites within this defined area, and the impact assessment is representative of trenching at any location within this area ;
- Some of the Lots are already constructed and therefore impacts during their construction were not evaluated in this ESIA ;
- This ESIA-addendum considers the potential impacts of the proposed additional construction activities and operation on the biophysical and social environments that have been identified within the project's AoI, which encompasses :
  - Activities and facilities that are directly owned, operated, or managed by the client (including contractors and sub-contractors) as part of the Project ;
  - Unplanned events, which are unintended but may occur as a result of accidents or abnormal operating conditions ; and In
  - Direct project impacts on biodiversity or ecosystem services upon which potentially affected communities' livelihoods are dependent.
- No significant changes to the project description or surrounding environment will occur between the submission of the ESIA-Addendum Report and implementation of the proposed project that could substantially influence findings and recommendations concerning mitigation and management

6.0 STAKEHOLDER CONSULTATION RESULTS

6.1 Introduction

Stakeholder consultation activities were carried out in the municipalities of Icolo and Bengo, Viana and Cacuaco using a participatory approach designed to involve all entities present in the project area. The objectives of these consultations were to inform and share information about the project with stakeholders, identify key stakeholders and gather their impressions of the project. Project stakeholders include local populations, administrative authorities, local authorities, civil society, private companies, water truck and motorbike operators and non-governmental organizations. Stakeholder identification and consultation are part of the activities of the project's stakeholder engagement plan, which is currently being developed to ensure transparent collaboration throughout the project lifecycle.

During the period from April to August 2023, visits were made to sites followed by public stakeholder consultations were held in the 3 municipalities, bringing together the various entities present in each municipality, and questions, suggestions and concerns were expressed by participants at the meetings. Socio-economic surveys were then carried out among the local population, targeting in particular farmers and land users, households and operators of water distribution trucks and motorbikes in the project area. This survey was used to gather information on the above-mentioned target groups and to gather their concerns and opinions on the project. Finally, in addition to these various activities, focus groups were organized with groups of local women and fishermen from the Kwanza River in the project area. The following section presents the various activities carried out and the results of the stakeholder consultation carried out in the project area.

6.2 Regulatory framework

6.2.1 Legislation of the Republic of Angola

Regarding National Legislation, the main requirements for stakeholder engagement are set in the Presidential Decree n. 117/20, of the 22nd of April, which establishes the General Regulation on Environmental Impact Assessment and the Environmental Licensing Procedure.

Article 16th of this regulation establishes the Public Consultation process, and states that all projects subject to Environmental Impact Assessment must undergo a public consultation promoted by the Environmental Ministry. The public consultation starts with the previous disclosure of a Non-Technical Summary of the EIA, which must be available for at least 5 days and for no more than 10 days straight. After the public consultation, a brief report must be developed in the following 8 days, indicating the activities done, the registered participation and the conclusions of the consultation.

Another relevant diploma is the Executive Decree n. º 87/12, of 24th of February, which establishes the Regulation for Public Consultations for Projects Subject to Environmental Impact Assessment. This diploma complements and regulates the Public Consultation process established in article 16th of the Presidential Decree n. º 117/20.

It states that Public Consultation are developed through one single session, presided by a Jury composed of three members, namely the President, Secretary and Rapporteur. It also states that the jury's presidency is assumed by a member of The National Directorate for the Prevention and Assessment of Environmental Impacts (DNPAIA), from the Environmental Ministry. This requirement is in line with Article 16th of Presidential Decree n. º 117/20, which states that the consultation is promoted by the Environmental Ministry.

Executive Decree n. º 87/12 also confirms that the Public Consultation starts with the disclosure of a Non-Technical Summary, between 5 and 10 days. Article 7th specifies that the development of the Public Consultation must be advertised, by the Environmental Ministry, in "Journal de Angola" and other mass media organizations.

Stakeholders can submit their participation though questions, suggestions, and observations, orally or by writing. The questions placed orally in the public meeting/session should be answered orally during the session. At the end of the public meeting/session, there should be developed a meeting minute, summarizing the event, and the public consultation ends with the development of a summary report until 8 days after the session.

Although the public Consultation is promoted and developed by the Environmental Ministry, the project's promoter assumes all costs associated with the process, according to the environmental tax values established in Presidential Decree n. 83/22, of 12th April.

There are also three other legal diplomas that, although not directly associated with Stakeholder Engagement, should be mentioned, namely related to Land Use Rights, since these diplomas include some requirements of stakeholder engagement.

Law number 01/21, of January 7th - Law of Expropriation by Public Utilities, Establishes the principles and rules to be observed in expropriation for public utility. In the context of the expropriation process, several general principles should be observed, and includes one chapter dedicated to protection of the affected communities, which states that it should be "guaranteed the participation of stakeholders and it's representatives" on the economic, social, and cultural compensations, while also respecting local traditions.

Presidential Decree 117/16, of May 30th, regulates the resettlement and relocation of populations. It includes provisions associated with public awareness activities (Article 13th), stipulating that the Municipal Administrations and other entities involved in the resettlement activities should promote awareness campaigns for the affected stakeholders (population) about the resettlement benefits and procedures.

Decree No. 58/07, of July 13th - General Regulation Land Concession - Establishes the legal framework for the concession of free lands within Angola. It also indicates that where there is expropriation for public use or for temporary requisition of lands, fair and adequate indemnity to the owner and to affected holders of other property rights is always owed. Article 5th establishes the right of stakeholders to be informed about any process of Land Concessions in which they are affected.

6.2.2 International Requirements

The Stakeholder Engagement Plan is developed in accordance with international standards such as the International Finance Corporation's (IFC) Performance Standards, the World Bank's Environmental and Social Standards (ESS), and the Equator Principles (EP).

International Finance Corporation's (IFC) Performance Standards:

- Performance Standard 1 (PS1) requires the Promoter to assess and manage environmental and social risks and impacts. The Promoter must ensure that affected communities are properly engaged on issues that may affect them, cultivate, and maintain a positive relationship with the communities, and establish a grievance mechanism.
- During the ESIA process, a dialogue should be established from the outset with affected communities and should include information sharing. Participation should be free from any external manipulation, interference, or intimidation, and must be carried out in a way that is relevant, understandable, and accessible. Consultation should be inclusive and tailored to the local culture. The Stakeholder Engagement Plan should be a continuous process that involves incorporating the perspectives of impacted communities into the decision-making process regarding issues that directly impact them, including proposed mitigation measures, shared benefits and development opportunities, and implementation challenges.
- Identify and facilitate the participation of individuals and groups who may be disproportionately impacted by the project due to their disadvantaged or vulnerable status.
- The project promoter must establish a mechanism for receiving and resolving environmental and social concerns and grievances from impacted communities. The grievance mechanism must be tailored to the project's risks and negative impacts, and aim to quickly resolve issues through a consultative, transparent, culturally comprehensible, and readily accessible process, without cost to the affected parties.
- The promoter must identify and engage stakeholders who may not be directly impacted by the project but maintain pre-existing ties to the local community and/or have an interest in the project such as local government officials, NGOs, and other relevant parties.

World Bank's Environmental and Social Standards (ESS) :

- World Bank's Environmental and Social Standards 1 requires the promoter will work together with stakeholders throughout the duration of the project, furnishing them with suitable information based on their interests as well as the possible environmental and social risks and impacts associated with the project.

- The promoter must engage with affected and host communities using the stakeholder engagement process outlined in Environmental and Social Standards 10 (ESS10). The provision of pertinent information is necessary, and these communities and individuals should remain engaged throughout the project's planning, implementation, monitoring, and evaluation stages.
- Environmental and Social Standards 10 (ESS10) requires the promoter will engage stakeholders throughout the project's life cycle, initiating this engagement as early in the project development process as possible and within a timeframe that permits important consultations with stakeholders regarding the project's design. Stakeholder engagement will be proportionate to the project's nature, scale, and potential impacts and risks. The frequency and scope of engagement will be adjusted accordingly.
- The promoter will conduct meaningful consultations with all stakeholders. The borrowers will furnish stakeholders with promptly delivered, pertinent, comprehensible, and convenient information and communicate with them in a culturally sensitive way, devoid of manipulation, obstructionism, force, prejudice, and intimidation.
- The promoter will maintain and disclose as part of the environmental and social assessment, a documented record of stakeholder engagement, including a description of the stakeholders consulted, a summary of the comments received and a brief explanation of how the comments have been considered, or the reasons why they are not taken into account.

Equator Principles (EP) :

- Equator Principle 5 Stakeholder participation: the promoter must carry out consultations with affected communities in a coordinated and appropriate manner to facilitate their participation in the entire project process.
- Equator Principle 6: The promotor is required to establish a mechanism for grievances which can receive complaints and aid in resolving conflicts that may arise with individuals or groups affected by the project.

6.3 Identified Project stakeholders

Comprehensive stakeholder identification is a crucial component of an effective and robust stakeholder engagement process. The project interventions are expected to contribute to improved access to water and sanitation for the residents of the municipalities of Ícolo e Bengo, Viana and Cacuaco, thus improving the city's health outcomes, the business environment and quality of life.

- Affected Parties

In this project, the affected stakeholders have been categorized at different levels from the local to the national level. At provincial governmental level of Luanda, the project will engage the target beneficiaries, members of affected communities, local leaders, as well as all the different provincial directories, which regulate local licensing, land use planning, and establish development strategies for the province. Public companies responsible for urban waste management, wastewater management and general sanitation in Luanda (i.e. Provincial Government of Luanda – Cleaning And Sanitation Company of Luanda - Elisal) and institutes, associated with the provincial Government, that establishes Urban Management instruments and Land use Planning for Luanda, Provincial Government of Luanda – Institute of Urban management and Planning of Luanda (IPGUL) will also be involved to provide technical guidance.

At the local level main identified affected parties are the beneficiary municipalities and their respective waste management units and water supply and sewerage utilities, citizens/inhabitants settled in the project area particularly those who will be involved in the project development or project implementation, local communities within the project area.

At the national level, the project will receive guidance from the steering committee and the parliamentary committee on natural resources. The line Ministry of Energy & Water will provide policy direction for the project. The line ministry will also be supported by other ministries such as the Ministry of Public Works, Urbanism & Housing, Ministry of Environment. Other government agencies which will also be engaged at national level include the Maritime National Agency (AMN).

- Other Interested Parties

Other interested parties include various individuals, institutions and organizations that have an interest in the delivery of the project at the national city/district and community levels. Some of the other interested parties which will be engaged include NGOs for best practice in the implementation of the project. Contractors, suppliers, and consultants will support the implementation of the project. Trade unions, for management of grievances, and media and social media will be engaged for information dissemination.

- Disadvantaged and Vulnerable Individuals or Groups

Also, part of the stakeholders, are the beneficiaries of the project implementation and those who can be negatively impacted by the project. Between the main beneficiaries as citizens located within the project area, are included the vulnerable groups as well. The classification of the potential vulnerable groups that may be affected from the project, were identified, and analyzed based on their exposure to risk and their inability to cope:

vulnerability = exposure to risk + inability to cope

Based on the initial screening and the inability to cope, some of the identified groups may include :

- Families with low incomes (including those living in informal settlements inhabited by households with precarious livelihoods) ;
- Single elderly people ;
- Women ;
- Youth.

Apart this preliminary evaluation of potential vulnerable groups, the mapping of this category is likely to be evolving throughout the project phases. Disadvantaged/vulnerable individuals or groups are potentially disproportionally affected and less able to benefit from opportunities offered by the project due to specific difficulties to access and/or understand information about the project and its environmental and social impacts and mitigation strategies. Such groups are also more likely to be excluded from the consultation process. It also includes groups who may be difficult to reach due to communication barriers (language, illiteracy) and those who are in the informal economy and those who are very poor and may find it hard to pay regular tariffs. Disadvantaged / vulnerable individuals or groups in the project area include “low-income households”; women; youth; women-headed households; elder-headed households (≥ pension age) without any other household member bringing in income; persons with limited mobility; or persons with disabilities; women, individuals, and habitat communities. It also includes including people living in informal settlements inhabited by households with precarious livelihoods which were identified near Lot 6. Various types of barriers may influence the capacity of such groups to articulate their concerns and priorities about project impacts.

For instance, women tend to have lower economic conditions, they are more vulnerable to any changes in water supply costs, either to supply cost reduction (positive impact) or increase (negative impact). This is especially true to women that are household leaders, which manage the monthly household budget. As such, during the baseline, it was considered a specific survey effort directed at women that are household leaders, with the development of focus group contact with these women.

The results of these meetings confirm that the main concern of this group is water cost, with expectations that the project will lead to a reduction in water supply cost, when compared with the current private companies. Women also mentioned expectations of water quality improvement, showing concerns regarding the quality of water that is currently supplied.

The elderly group is potentially more sensitive to health issues arising from poor water quality, which represents a specific vulnerability to project's impacts. Any improvement in water quality supply will reduce health risk associated with waterborne diseases, with a positive impact on this vulnerable group.

The young children are also more sensitive to health issues arising from poor water quality, with greater vulnerability to waterborne diseases. Regarding the working age youth, these are especially vulnerable to social impacts associated with labor offer, since this group tends to have higher unemployment rates, higher informal work relations and lower wages.

The expectations regarding job creating, especially for young workers, was something referenced by several stakeholders in the baseline surveys, ESIA Addendum public consultations and focus group meetings, which confirms that this is a vulnerability of this group.

In the Kwanza River, near the water extraction, the community has some fishing activity. Since the project could potentially have impacts in the river, namely on habitats and fish biodiversity, as well as restrictions on river uses, it was considered that the fishermen group could be especially vulnerable from an economic perspective, since fishing, for some households near the kwanza, is an important complement to monthly budget.

The project also includes the installation of water pipelines, these could potentially impact land uses in the area directly affected, namely through the temporary occupation of land for the pipeline installation, but also possible restrictions on future land use. Also, existing farmers in the communities around the project could be potential beneficiaries of the water supply system, by having another water source for crop irrigation. As such, it was considered there as potential vulnerable groups.

Update of Baseline conditions Vulnerable groups affected by the project will be further confirmed during the project subsequent stages, yet the consultation strategies and dedicated means, as appropriate shall be deployed early on in line with the golden principles of stakeholder engagement as defined in this SEP. The list of vulnerable groups shall be updated as needed following the ESIA Addendum stage.

In particular, following the ESIA Addendum and subsequent phases of the project, special attention will also be paid to vulnerable populations whose situation may be further weakened by losses associated with the project. A complementary socio-economic survey and data on indicators relating to various criteria such as gender, age, disability, level of expenditure, etc. will need to be collected in order to better grasp the populations most vulnerable to the project. Based on this forthcoming qualitative socio-economic analysis, the criteria will be scored and weighted to establish a scoring of vulnerable populations, who will then benefit from special attention and support. In this case, it is anticipated that special attention could be granted to women and young people who can be particularly affected by informal work in Angola. A livelihood restoration plan will be developed on this basis and the list of vulnerable groups of the SEP will be updated accordingly.

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Table 25: Stakeholder groups and their relation with the project

National Government	Governing ministries with direct influence on the project design and licensing	Ministry of Energy & Water	Stakeholders being able to influence and decide on the Project implementation
		Ministry of Public Works, Urbanism & Housing	
		Ministry of Environment	
Provincial/Regional Government	Provincial Government of Luanda and all the different provincial directories, which regulate local licensing, land use planning, and establish development strategies for the province	Provincial Government of Luanda – Governor's office	Stakeholders being able to influence and decide on the Project implementation
		Provincial Government of Luanda – Transports, Traffic and Urban Mobility Provincial Direction (Provincial Government)	
		Provincial Government of Luanda – Infrastructure and Technical Services Direction (Provincial Government)	
		Provincial Government of Luanda – Sanitation Management Technical Unit (Provincial Government)	
		Provincial Government of Luanda – Studies, Planning and Statistics Direction (Provincial Government)	
		Provincial Government of Luanda – Health Direction (Provincial Government)	
		Provincial Government of Luanda – Education Direction (Provincial Government)	
		Provincial Government of Luanda – Economic Sector Direction (Provincial Government)	
		Provincial Government of Luanda – Environmental and Waste Management Direction (Provincial Government)	

		Provincial Government of Luanda – Agriculture Livestock and Fishing Direction (Provincial Government)	
		Provincial Government of Luanda – Social Action, Family and Gender Equality Direction (Provincial Government)	
		Provincial Government of Luanda – Civil protection and Firefighting Direction (Provincial Government)	
National Authorities and Governing Bodies	Public company responsible for urban waste management, wastewater management and general sanitation in Luanda	Provincial Government of Luanda – Cleaning And Sanitation Company of Luanda (Elisal)	Stakeholders being able to influence and decide on the Project implementation
	Institute, associated with the provincial Government, which establishes Urban Management instruments and Land use Planning for Luanda	Provincial Government of Luanda – Institute of Urban management and Planning of Luanda (IPGUL)	
	National agency that regulates and supervises the naval transport and logistics in marine and river areas	Maritime National Agency (AMN)	
Local Government	Municipal Administrations and specific directories, as the intermediate local regulating and licensing governmental bodies	Municipal Administration of Icolo e Bengo	Stakeholders being able to influence and decide on the Project implementation
		Municipal Administration of Viana	
		Municipal Administration of Cacuaco	
	Communal and Urban District Administrations and specific secretariats, as the local regulating governmental bodies	Bom Jesus Commune	
		Bela Vista Urban District	
		Mulenvos de Baixo Urban District	
		Sequele Urban District	

		Cacuaco Urban District	
		Viana Urban District	
		Baia Urban District	
		Kikuxi Urban District	
		Zango Urban District	
Security Forces – Local Police	Provincial command of the National Police, as main stakeholder associated with community and local security	National Police Provincial Command	Stakeholders being able to influence
Business Associations	Public company responsible for promoting and managing the main industrial zone of Viana, representing many potential industrial users of the future water system.	Viana Industrial Development Pole (PIV)	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
	Public company responsible for promoting and managing a reserved economic zone (Luanda-Bengo), representing many potential industrial and commercial users of the future water system.	Special Economic Zone Luanda-Bengo	
Companies located in the Area of Influence	Bottled water and Beverages Industrial Companies, that also have water extraction points in the Kwanza River, close to the project's extraction location	COBEJE - Companhia Bebidas Bom Jesus	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
		SODIBA – Sociedade de Distribuição de Bebidas de Angola	
		Sumol+Compal Angola	
		BEFCO INDUSTRIA Lda – Purangol Factory	
	Private water companies and individuals, which sell water in the local communities, by	Private companies and individuals that work on direct water transport and selling	

	tanker trucks and water containers (barrels, drums, bottles), transported by car, pickups, and motorbikes.		
Host communities	Citizens of the local communities in the Area of Influence of the project that can benefit or be affected by the project	Local community	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
Local Business associations	Local businesses located in the Area of Influence of the project, which can benefit or be affected by the project	Local businesses	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
Local Opinion Leaders	Community leaders and influencers on the local communities in the Area of Influence of the project	“Sobas”, neighbourhood coordinators and others (Community Leaders)	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
Local Organizations/NGO/Associations for Environment Protection	Environmental NGOs and other Environmental Associations, which act in the project’s area of influence	Environmental NGOs and other Environmental Associations	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
Local Organizations/NGO/Associations for Social and Local Development	Social NGOs and other Social Associations that act in the project’s area of influence	Social NGOs and other Social Associations	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
Local Associations or representatives of specific interests	Local fisherman groups, which live and/or work in the Kwanza River	Local fisherman groups	Stakeholders who may be affected, either directly or indirectly, by the results of the implementation of the Project
	Local women groups, especially single/divorced household leaders	Local women groups	

	Local farmers and land users that live and/or work in the project’s area of influence	Local farmers and land users	
Contractors and Suppliers	Local, national, and international Contractors and Suppliers that will work in the project, both in the construction and operation phases	Local Contractors and Suppliers	Stakeholders that participate in the Project implementation
		National Contractors and Suppliers	
		International Contractors and Suppliers	

Table 26: Analysis and Prioritization of Stakeholder Groups Based on Level of Interest in and Influence over the Project

Categories of Stakeholders	Role	Level of Analysis (H=High, M=Medium, L=Low)	
		Interest	Influence
Affected parties			
Ministry of Energy & Water	Project Promoter/supervisor	H	H
Municipal Administration of Icolo e Bengo	Local Administration bodies	M	L
Municipal Administration of Viana	Local Administration bodies	M	L
Municipal Administration of Cacuaco	Local Administration bodies	M	L
Bom Jesus Commune	Local Administration bodies	M	L
Bela Vista Urban District	Local Administration bodies	M	L
Mulenvos de Baixo Urban District	Local Administration bodies	M	L
Sequele Urban District	Local Administration bodies	M	L
Cacuaco Urban District	Local Administration bodies	M	L
Viana Urban District	Local Administration bodies	M	L
Baia Urban District	Local Administration bodies	M	L
Kikuxi Urban District	Local Administration bodies	M	L
Zango Urban District	Local Administration bodies	M	L
Private companies and individuals that work on direct water transport and selling	Local Businesses	H	L
Local community	Citizens	H	M
Local businesses	Local Businesses	M	L
Local Contractors and Suppliers	Project's Contractors and Suppliers	H	L
National Contractors and Suppliers	Project's Contractors	M	M
International Contractors and Suppliers	Project's Contractors	M	M
Interested parties			
Ministry of Public Works, Urbanism & Housing	Regulating Government entities	M	M
Ministry of Environment	Regulating Government entities	M	H
Provincial Government of Luanda – Governor's office	Regulating Government entities	M	H
Provincial Government of Luanda – Transports, Traffic and Urban Mobility Provincial Direction (Provincial Government)	Regulating Government entities	L	L

Categories of Stakeholders	Role	Level of Analysis (H=High, M=Medium, L=Low)	
		Interest	Influence
Provincial Government of Luanda – Infrastructure and Technical Services Direction (Provincial Government)	Regulating Government entities	M	L
Provincial Government of Luanda – Sanitation Management Technical Unit (Provincial Government)	Regulating Government entities	M	L
Provincial Government of Luanda – Studies, Planning and Statistics Direction (Provincial Government)	Regulating Government entities	L	L
Provincial Government of Luanda – Health Direction (Provincial Government)	Regulating Government entities	M	L
Provincial Government of Luanda – Education Direction (Provincial Government)	Regulating Government entities	L	L
Provincial Government of Luanda – Economic Sector Direction (Provincial Government)	Regulating Government entities	M	L
Provincial Government of Luanda – Environmental and Waste Management Direction (Provincial Government)	Regulating Government entities	M	M
Provincial Government of Luanda – Agriculture Livestock and Fishing Direction (Provincial Government)	Regulating Government entities	M	L
Provincial Government of Luanda – Social Action, Family and Gender Equality Direction (Provincial Government)	Regulating Government entities	L	L
Provincial Government of Luanda – Civil protection and Firefighting Direction (Provincial Government)	Regulating Government entities	L	L
Provincial Government of Luanda – Cleaning And Sanitation Company of Luanda (Elisal)	Regulating Government entities	L	L
Provincial Government of Luanda – Institute of Urban management and Planning of Luanda (IPGUL)	Regulating Government entities	L	L
Maritime National Agency (AMN)	Regulating Government entities	L	L
National Police Provincial Command	Regulating Government entities	L	L
Viana Industrial Development Pole (PIV)	Industrial Associations	M	L
Special Economic Zone Luanda-Bengo	Industrial Associations	M	L
COBEJE - Companhia Bebidas Bom Jesus	Local Businesses	M	L

Categories of Stakeholders	Role	Level of Analysis (H=High, M=Medium, L=Low)	
		Interest	Influence
SODIBA – Sociedade de Distribuição de Bebidas de Angola	Local Businesses	M	L
Sumol+Compal Angola	Local Businesses	M	L
BEFCO INDUSTRIA Lda – Purangol Factory	Local Businesses	M	L
Local Opinion Leaders	Community Opinion Leaders	M	M
Environmental NGOs and other Environmental Associations	Civil Society NGO's and Associations	M	L
Social NGOs and other Social Associations	Civil Society NGO's and Associations	L	L
Local fisherman groups	Civil Society associations	M	L
Local farmers and land users	Local Businesses	L	L
Vulnerable groups			
Local women groups	Civil Society associations	L	L

6.4 Completed stakeholder activities

Stakeholder engagement activities were carried out at three (03) different engagement levels with all project stakeholders.

Municipal Public Presentations

One initial presentation meeting, followed by three general meetings, were organized to publicize, and present the project.

A first meeting was scheduled with the Energy and Water Ministry, the Ministry of Public Works, Urbanism & Housing, and the Luanda Provincial Government, to present the Project and the ESIA process and to collect feed-back from this central institutional stakeholder.

After that initial meeting, three more municipal presentation events served as dissemination vehicles and feed-back collection activity. These meetings were developed in each municipality (Cacuaco, Viana, Icolo Bengo), and included the presentation of the project and ESIA process to the municipal and communal/district administrations.

The material for general dissemination included the following :

- Formal invite letters to the different authorities (Ministries, Provincial Government and Municipal and District/Communal Administrations) ;
- Dissemination in Angola's newspaper ;
- Disclosure panel or banner (containing the contractor's name, execution deadlines, comprehensive locations, etc.) posted in the administrations.

Focus Group Discussions

At the end of each of the three municipal presentation meetings, an additional discussion meeting was held with target groups (fishermen, women involved in fishing, farmers, and private water companies) to deepen the discussion further on socio-economic aspects.

During this activity, the main information collected from stakeholders was on the following aspects :

- Contributions, suggestions, and concerns about the project implementation ;
- Contact (contact person, email and or phone number), in case of complaints already at the initial stage ;
- Discussion about possible resettlements (if possible, identify which houses or direct loss of ploughing or land) ;
- Contact list and signatures of all participants.

The following script of questions was used for data collection :

- Were you aware of the project before this General Presentation Meeting and where did you get information from ?
- Do you think the presentation was clear, or do you still have doubts or questions about what the project is and covers ?
- Do you think the project will impact the daily activities of the specific group that you represent? For the better or for worse ? How ?
- What are your main concerns about the project ?
- What is your expectation regarding questions that the project should address and improve, both in your activity and in the general community ?
- Do you have other suggestions/recommendations for improving the project's outcomes ?

Questionnaires and Interviews

Several interviews in person were conducted with the target groups of the communities through specific surveys for each group, performed in person and through questionnaires, as follows:

- Farmers/ land use occupants ;
- Households/residents and local workers ;
- Private water supply companies (tanker trucks).

For the Households and traditional authorities, it is considered the following Communities :

- Bom Jesus ;
- Cacuaco ;
- Zango 5 ;
- Km 30 ;
- Kapalanga.

The stakeholder's engagement activities started on the April 19th, 2023 and was completed on August 29th, 2023.

The public consultations were attended by many institutional representatives of local authorities. Community youth leaders, representatives of women's groups and other associations and NGOs also participated. Community leaders were also represented and participated in these consultations.

The table below presents a summary of dates and scope of the sstakeholder engagement activities undertaken as part of the ESIA Addendum process :

Table 27: Main Social Baseline and Engagement Activities developed

Date	Activities / Locations	Scope
19th to 21st April 2023	Initial Project Visit, with EPAL 1st Meeting with EPAL (administration and directors)	Presentation of ESIA team and ESIA process to the Administration of EPAL Selection of Technicians from EPAL to support the fieldwork and data collection; Initial survey of the study area; Current project presentation to the ESIA team; Identification of neighborhoods and communities around the project.
31st July to 6th August	Baseline surveys, with questionnaires on 5 communities for households (100 inquiries), farmers (20 Inquiries) and private operators and companies that work on water distribution (25 Inquiries)	Baseline data collection Project presentation in the communities Questions about concerns, expectations, or any doubts regarding the project.
	Initial informal contact with focus groups of fisherman and farmers alongside the questionnaires in the communities	
15th August	2nd meeting with EPAL, with broad participation of technical staff. Participation also from EASU (Uíge Public Water Company). 49 Participants	General presentation of the Project General presentation of the ESIA Process and status Questions about concerns and expectations regarding the project.
22nd August 2023	Public presentation meetings in the Municipalities – Ícolo e Bengo 53 participants	General presentation of the Project General presentation of the ESIA Process and status Contact with local authorities; Questions about concerns, expectations, or any doubts regarding the project.
23rd August 2023	Public presentation meetings in the Municipalities – Viana 79 Participants	
24th August 2023	Public presentation meetings in the Municipalities – Cacuaco 83 Participants	
28th August	Focus Group Meetings - Women	Questions about Concerns, expectations, or any doubts regarding the project specifically for that focus group.
29th August	Focus Group Meetings – fisherman and fishwives	

Figure 73: Initial Project Visit - 19th to 21st April

Figure 74: Baseline surveys and data collection

Figure 75: 2nd meeting with EPAL – 15th August

Figure 76: Ícolo e Bengo Public Presentation – 22nd August

Figure 77: Viana Public Presentation – 23rd August

Figure 78: Cacuaco Public Presentation – 24th August

Figure 79: Meeting with Women Groups – 28th August – Kapalanca local squares

Figure 80: Meeting with Fishermen and Fishwives – 29th August – Bom Jesus – in the house of a leader of a fishermen group.

The following information can be found in the APPENDIX A.

- General meetings – Attendance sheet or List of participants ;
- General Meeting - Invitation letter sample and sample of questions ;
- Newspaper announcement sample (scanned format) ;
- Public information flyer sample ;
- Presentations and flyers ;
- Disclosure panels ;
- Focus group meetings - Script of questions ;
- Focus Group meetings - Attendance Sheet ;
- Focus group meetings – summary report ;
- Formal Letter sample used for institutional and private entities ;

- Questionnaire used institutional entities sample ;
- Household Questionnaire samples ;

6.5 Consultation results

6.5.1 Municipal Public Presentations

During the public project and ESIA process presentation, developed in the 3 municipalities of the project's AoI, there were some questions, suggestions and concerns expressed by the participants.

Table 28 summarizes the main topics covered by those comments and questions, without an exact transcript of each question. Several questions, especially those related to project details (areas covered, infrastructures to be built, etc.) were already answered by EPAL during the meetings. Most of those questions are addressed in this ESIA.

Table 28: Questions, expectations and concerns raised during municipal presentations

Questions, expectations, and concerns	Within the scope and addressed in this ESIA?
Questions regarding local job creation (number of jobs and type of jobs);	Yes (Project description)
Questions about who would be supervising the construction activities;	Yes (Project description)
Concerns regarding the difficulties of passing pipelines in dense urban areas (what impacts could occur and how would the project minimize any damages to structures)	Yes (impact assessment)
Questions about plans for future wastewater collection networks, to complement the water distribution system and reduce the current problems with sanitation;	No
Questions about what the compensation mechanism would be foreseen, in case of damages or property loss during construction;	Yes (mitigation measures)
Questions about Project duration and construction methods to be used;	Yes (Project description)
Concerns about temporary measures to address the relevant failures of the existing water distribution system (was mentioned specifically the Vila Nova Neighborhood), namely if it was foreseen any immediate temporary improvements until project conclusion;	No
Doubts related to the reason associated with the project suspension since 2014 (why there was a 9 years delay in project construction);	No
Concerns about the project being developed and meeting the proposed deadline, since there were other public projects in the region that were started but not concluded;	No
Questions about who is responsible for the selection of the contractors (if EPAL is the entity that selects the contractors and suppliers);	No
Questions about details of project coverage (if it covered some specific areas/neighborhoods mentioned)	Yes (Project description)
Questions if there would be additional Distribution Centers in other locations, which lack proper water supply;	No

Questions, expectations, and concerns	Within the scope and addressed in this ESIA?
Questions about the project's managing structure (entities involved and responsibilities).	Yes (Project description and Framework ESMP)

The following suggestions were given during the meetings (but considered out of the scope of this ESIA):

- The development of technical visits in each neighborhood to assess the existing conditions and needs, to help design the future distribution network (from the Distribution Centers to the houses) in each location;
- The inclusion of the neighborhood committees in future EPAL visits to assess the specific needs of each neighborhood;
- Improvements, by EPAL, in the water billing system, namely having better control in effective billing.

6.5.2 Target Group Consultation during baseline surveys

During the baseline surveys, it was developed specific questionnaires for 3 target groups: Farmers and Land Users; Households (general population) and Private water distribution operators.

On those questionnaires, focused on collecting baseline information, **it was also included a final chapter asking for concerns, expectations, and suggestions regarding the project, with the objective of serving as an additional tool for stakeholder consultation**.

Table 29 summarizes the main results obtained on those questions.

Table 29: Questions, expectations and concerns raised during Target Group Consultations

Questions, expectations, and concerns	Within the scope and addressed in this ESIA?
Reduction in water cost;	No
Job creation;	Yes (impact assessment)
Project effectiveness (real improvements in water distribution and availability in the communities)	Yes (impact assessment)

6.5.3 Focus group meetings

During the fieldwork developed, vulnerable or minority groups were identified. The neighborhoods characterized in the baseline are in the capital city of Luanda, and have semi-urban or peripheral characteristics, with a young population considered economically active. Most of the neighborhoods assessed have some level of social vulnerability, mainly associated with the lack of social infrastructures, no adequate land use planning, low income, and precarious housing conditions. This is particularly true in the Belo Monte and km30 neighborhoods, as well as some areas of Kapalanga.

In terms of identification of vulnerable groups, the first group considered was that of single women, which act as household leaders, due to being single, separated (divorce or family abandonment) of widows. These women assume the role of head of the family, managing the monthly budget and having to ensure the family organization and structure.

As such, after developing the project's public presentation meetings, there was a specific effort in consulting women's groups with household leaders. These meetings took place on August 28th, in small local squares in the Kapalanca neighborhood, were these women usually gather for daily conversations.

There was little participation from the women, as many showed disbeliefs regarding the implementation of social consultation activities, having only obtained the participation of 11 women.

The women were satisfied with the implementation of the project, as this would significantly reduce the high costs of purchasing water from private suppliers. Another great expectation regarding the project was related to the quality of the water. Several of them considered the current water supply had questionable quality.

The concerns raised were related to whether the project will have a useful lifespan or if it will be only temporary. Another issue raised is related to the implementation of other social projects, such as more schools, hospitals, and employment for their children to help with household expenses.

The second group identified were fishermen in the Icolo and Bengo area, namely that work in the Kwanza River, near the future water extraction point. This group is mostly made up of young fishermen and women fishwives. The meeting took place on August 29th at the house of one of the leaders of a group of fishermen, with the participation of 21 fisherman.

According to them, the project will have a positive impact and they hope that jobs will be created in the project's area of influence.

The third group considered were farmers in the Icolo and Bengo area also, in Bom Jesus Commune, that work near the project's intervention area. This meeting was developed on August 29th, in the agricultural area of Bom Jesus, with the participation of 6 farmers.

The results were like the ones obtained with the fishermen, considering that the project will have general positive impacts, including job creation.

Table 30 summarizes the main results obtained on those discussion.

Table 30: Questions, expectations and concerns raised during Focus Group Discussion

Questions, expectations, and concerns	Within the scope and addressed in this ESIA?
Project duration and actual implementation	Yes (Project description)
Other projects with social impacts, such as additional schools, hospitals and job promotion activities, especially targeted for young adults (job creation)	Yes (Cumulative impact assessment)

6.5.4 Perceptions of Project

Perceptions in the Project area are measured based on consultation with stakeholders, for the most part. The survey sought to assess expectations and apprehensions in the different groups consulted, whose analysis has already been reflected in several previous chapters.

The area under study has numerous social and infrastructure needs, especially the availability and price of drinking water.

During the stakeholder engagement process, after the project was disseminated, consultations were held with the women's group. The meetings took place on August 28 in squares of the Kapalanga neighborhood (where they usually gather) for daily conversations.

There was little adherence, as many were discredited about the implementation of projects of a social nature.

The women were satisfied with the implementation of the project, as this would significantly reduce the high costs of purchasing water from private suppliers. Another great expectation regarding the project is the quality of the water, which many pointed out as waters with dubious quality.

The concerns raised were whether the project would have a lifetime or only temporary. Another issue and problem is related to implementing other social projects, such as more schools, hospitals, and employment for their children to help with household expenses.

Another group identified were fishermen in the Icolo and Bengo area. This group mainly consists of young fishermen and women fishmongers. The meeting took place on 29 August at the home of one of the heads of a group of fishermen. According to them, the project will be of added value to them, and jobs are expected to be created in the project implementation area.

As a final note, it is pointed out that the Project is common knowledge of the population. In addition to the sessions already held, the media and word of mouth convey information about the implementation and nature of this project for the distribution of piped water in areas not currently covered by the public water supply network.

Thus, the perception is high, as well as the expectations for the practical realization of this project on time.

6.5.5 Perceptions on water supply

Overall, the responses consider that the Project will positively impact the communities covered by the water distribution system.

The answers to the questions about the Project's impact on the region's environment, namely in the drainage, sanitation, hygiene, and health conditions, are diverse, and some need to meet the intended.

Some responses refer to the lack of organization of residents for cleaning, water scarcity, lack of buyers, public health and safety and police and enforcement.

One of the answers points to the decrease in cost on the part of the final consumer and another that will benefit the community with few resources. The level of non-response was significant, 15 out of 25.

In the expectations stands out the uncertainty about the realization of the Project, referring to the previous non-execution of the "Water Project for All" (The "Water for All Program", an initiative of the previous Government of the Republic of Angola 2007).

The question about what concerns and expectations for the Project (E-4) has a range of answers that focus on the following problems:

- That the Project is not a reality and that the available funds are diverted ;

- The brevity in the execution of the work ;
- The positive impact of reducing the amount spent on water and the negative effect of hindering access roads for an extended period ;
- Facilitate piped water for all ;
- The improvement in the population's quality of life and increase in youth employment ;
- Restriction on access to all homes.

Finally, some answers to how communities could be involved in implementing the Project (E-5).

About 75 per cent of respondents expressed their opinion, although some answers could be more precise. The following forms of possible community involvement are highlighted :

- Participation in the conservation of resources ;
- Involve the leaders of the neighborhoods in the supervision of the Project ;
- Involve the community in renumbered work and promote youth employment ;

7.0 UPDATE OF BASELINE CONDITIONS

The purpose of the baseline is to have a complete and overall understanding of the pre-existing physical, biological and social conditions before starting the Project, and to identify the components that may be directly or indirectly affected by the Project. The impact analysis of positives and negatives potential impacts of the project is based on the baseline conditions of the environment.

Environmental and Social Baseline and Impact Assessment were completed only for the themes were data gaps on 2014 ESIA were identified.

The results of the baseline studies are presented in the sections below organized by physical, biological, and social components, and their respective subcomponents.

7.1 Physical component

7.1.1 Meteorology and climate data

The climatic characterization of the region is important for its influence on several aspects. Local meteorological conditions, especially wind, condition the dispersion of atmospheric pollutants, thus influencing the impacts on air quality associated with a project, as well as the propagation of acoustic emissions, influencing the impacts on the sound environment descriptor. Weather conditions can also influence the hydrological cycle, namely water availability, flow regimes and soil erodibility.

The climate also conditions the type of vegetation that can be considered for future green areas of the Project, as part of and identification of mitigation measures to reduce the impact of the Project.

This characterization is based mainly on the parameters' temperature, precipitation, atmospheric humidity, wind direction and speed.

7.1.1.1 National Climatic Classification

Most of the territory of Angola is characterized as having a subtropical climate, with a rainy season and a dry season (Cacimbo).

According to the Geographical Atlas of Angola (2008 edition), the Angolan territory is divided into four climatic zones:

- Modified by altitude ;
- Tropical desert ;
- Tropical humid and ;
- Tropical dry.

The Project area fits into this last climatic zone (Figure 81).

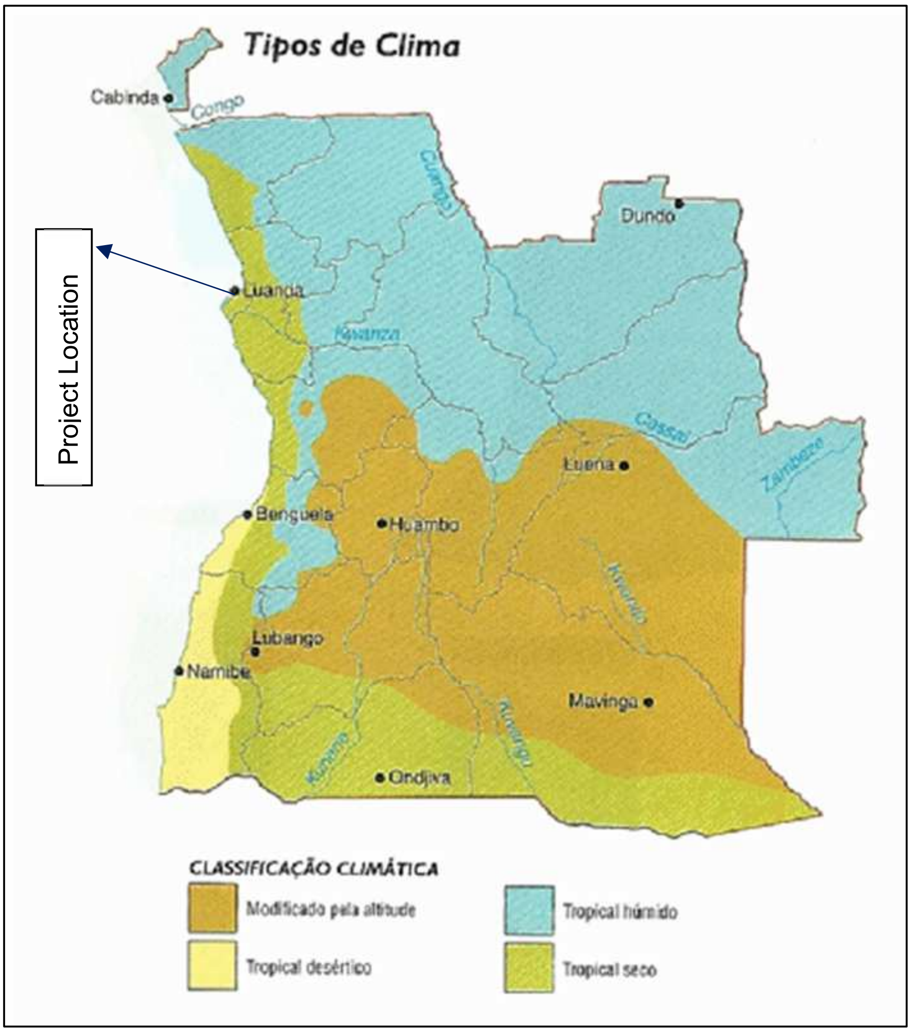


Figure 81: Climatic zones of Angola (Geographic Atlas, Education Ministry of Angola, 2008).

Among other existing classifications, the analysis of the Koppen-Geiger (Kottek 2006) climate classification for the Angolan territory was considered as an international reference widely used in climate characterization. According to this classification, the Project is located in a region classified as dry, semi-arid and hot (Classification BSh - Hot semi-arid climate), where annual evaporation levels exceed precipitation data.

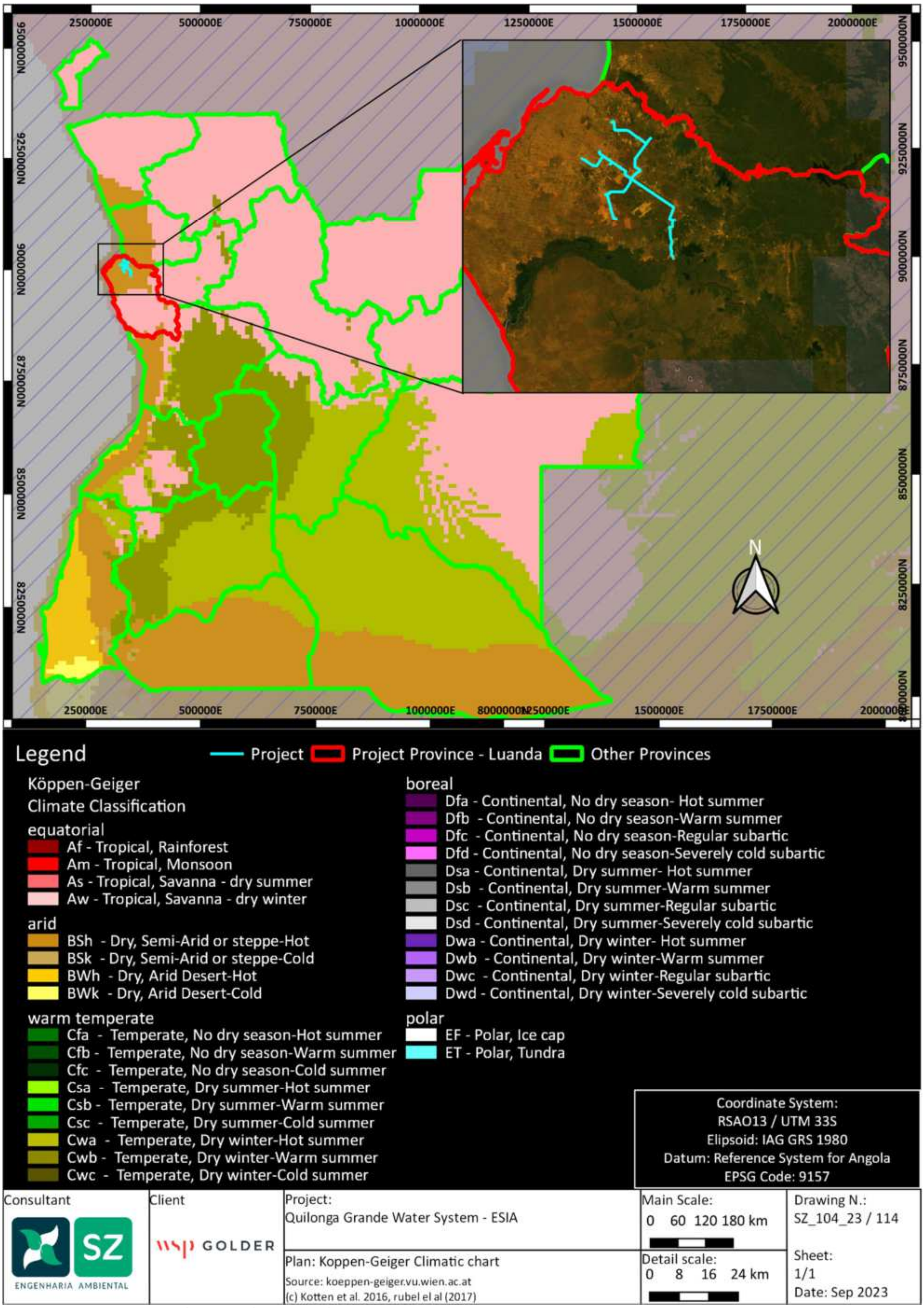


Figure 82: Koppen-Geiger Climate Chart – 2017 update.

As described in the World Bank's Angola climate data portal, Angola's rainy season lasts from October to May and is characterized as hot and humid. The intertropical convergence zone (ITCZ) controls precipitation as it moves between the equator and the tropics, bringing precipitation to Angola as it migrates southwards from the equator in October. The rains coincide with the hottest months of the year, with temperatures ranging from 22 to 23 °C. The dry season, known as the “Cacimbo” occurs from June to September and is the coldest period of the year, with temperatures between 18 and 20 °C.

Total precipitation decreases from North to South and East to West, with Northeast Angola receiving the highest amount of precipitation. Much of Angola's climate is linked to sea surface temperatures and variations in the cold Benguela current.

In terms of temperature, there has been a progressive increase since 1960, with the temperature increase rate being more pronounced in winter (June to August) and less expressive in summer (December to February).

The frequency of “hot” days and nights per year has increased significantly between 1960 and 2003, with the greatest increase being recorded in the months of September to November.

Conversely, the frequency of “cold” days and nights has reduced between 1960 and 2003, with the greatest rate of reduction in the months of March to May.

Also in terms of precipitation, average annual precipitation has decreased at a rate of 2 mm/month for each decade, with the greatest reduction recorded in precipitation from March to May, with a rate of 5 mm/month per decade.

In the second half of the 20th century, the southern part of the African continent has seen a reduction in summer precipitation, which has advanced from Namibia, through Angola to the Congo.

This progressive downward trend in precipitation is associated with an increase in sea temperatures in the tropical zone of the Indian Ocean.

There is no clear precipitation trend in the central highland’s region. However, in the highlands of Huíla and in the central-south transition zone, there are indications of a reduction in precipitation and an increase in its variability.

In terms of specific national meteorological data, namely temperature, humidity, and precipitation data for the territory, INAMET has only some official data available on its website, namely climatological precipitation normals, developed based on data from 1981 to 2010, but only for the periods from September to April.

There are alternatively multiple sources of meteorological information available internationally, typically based on extrapolation climate modelling. One of these examples is the data made available by FAO, used in the Geographical Atlas of the Ministry of Education.

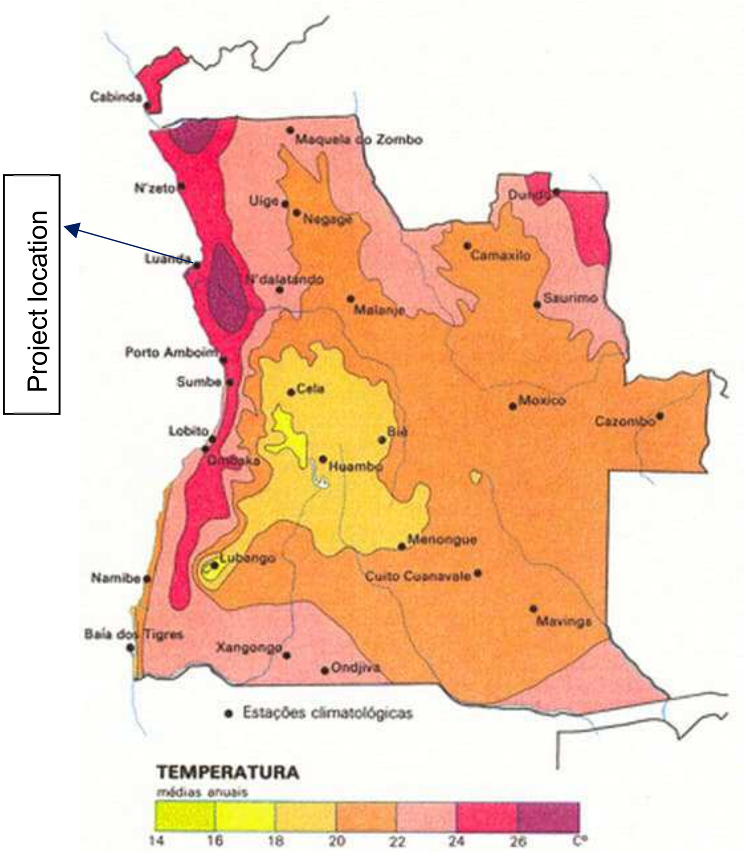


Figure 83: Representative map of temperatures in Angola (Geographic Atlas, Ministry of Education of the Democratic Republic of Angola, 2008)

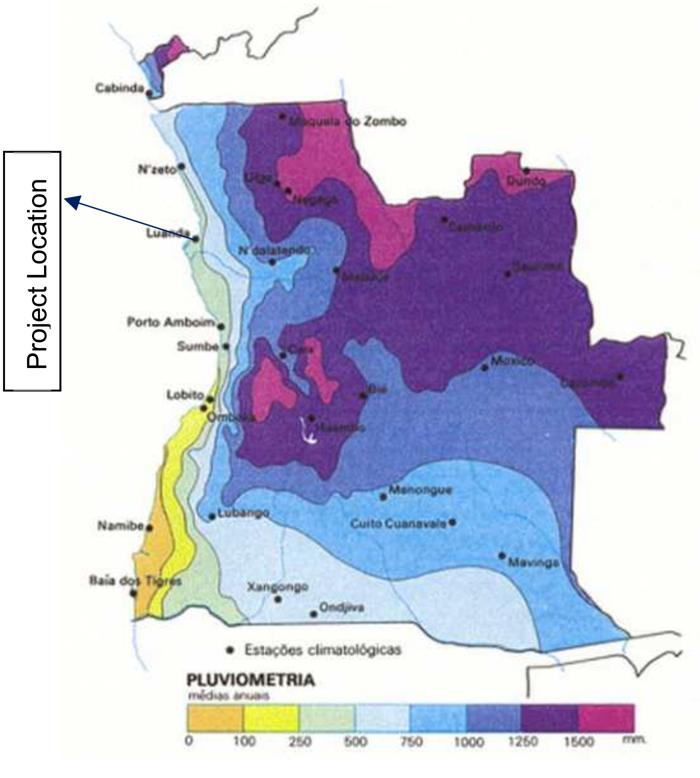


Figure 84: Representative map of pluviometry in Angola (Geographic Atlas, Ministry of Education of the Democratic Republic of Angola, 2008).

It should be noted, however, that the existing national data results from extrapolations and spatial modellingand is often based on very long historical series. As described above, the climate is undergoing progressive change, as a result of climate change, limiting the applicability of old historical data series.

Thus, more important than a general meteorological characterization of the country, for the purposes of the project, it is considered relevant to have a specific perspective of the meteorology in the project region, in this case, in the Luanda area.

For this purpose, a survey of meteorological stations was carried out with recent data from the project area, which could be assessed for data on local climate.

7.1.1.2 Local Data

7.1.1.2.1 Stations and Assessed data

In terms of local data, in the Luanda Area, there are available data from stations of the "SASSCAL WeatherNet" project, from a private meteorological station of the Clube Naval de Luanda and the TAF/METAR data from the Luanda Airport.

Under the Bali Action Plan of the United Nations Framework Conference on Climate Change (UNFCCC), Angola, Botswana, Namibia and South Africa established, together with Germany, and with the support of the African Union, the South African Science Services for Climate Change and Adaptive Soil Management (SASSCAL), a network of meteorological stations was installed in the 4 African countries, with data available at **www.sasscalweathernet.org**.

From the analysis carried out, two meteorological stations in the region of Luanda, from SASSCAL WeatherNet, were considered, namely the Benfica Station and the CAOPE Station, described in the following table.

In addition, a search was also carried out on the Weather Underground Portal for meteorological stations with accessible data in the Luanda area, identifying a private station belonging to the Luanda Nautical Club (CNL - Clube Naval de Luanda), which appears to have adequate stability and a correct correspondence with the normalized data and with the data from the stations of the SASSCAL WeatherNet project.

Regarding Luanda Airport area, historical data from the respective Meteorological Station is also available. The airport regularly uploads station data, via TAF or METAR encoding, to various traffic control services and specialty portals. There are different files available with these data, one of which is held by the National Center for Environmental Information (CEI), of the National Oceanic and Atmospheric Administration (NOAA) of the United States of America. From this data, the ESIA team has chosen to work with a 20-year history of data (2012 to current data – July 2023).

Table 31: Considered local Weather Stations

Station	Data Period Available	Equipment	Location	Altitude	Photo record
Benfica	10 Oct 2009 - 12 Jan 2018	SchiltKnecht Typ f.566.24.28 RTU Adcon A753GPRS Solar panel 540mA	Latitude: -9 Longitude: 13.091	70 m	-
CAOPE	1 Jan 2016 - 16 Apr 2018		Latitude: -8.755 Longitude: 13.423	21 m	
CNL – Luanda Nautical Club	2 Jan 2014 - Current	Davis Vantage Pro2	Latitude: -8.798 Longitude: 13.224	11 m	-
Luanda International Airport	01 Jan 2002 - Current	-	-	-	-

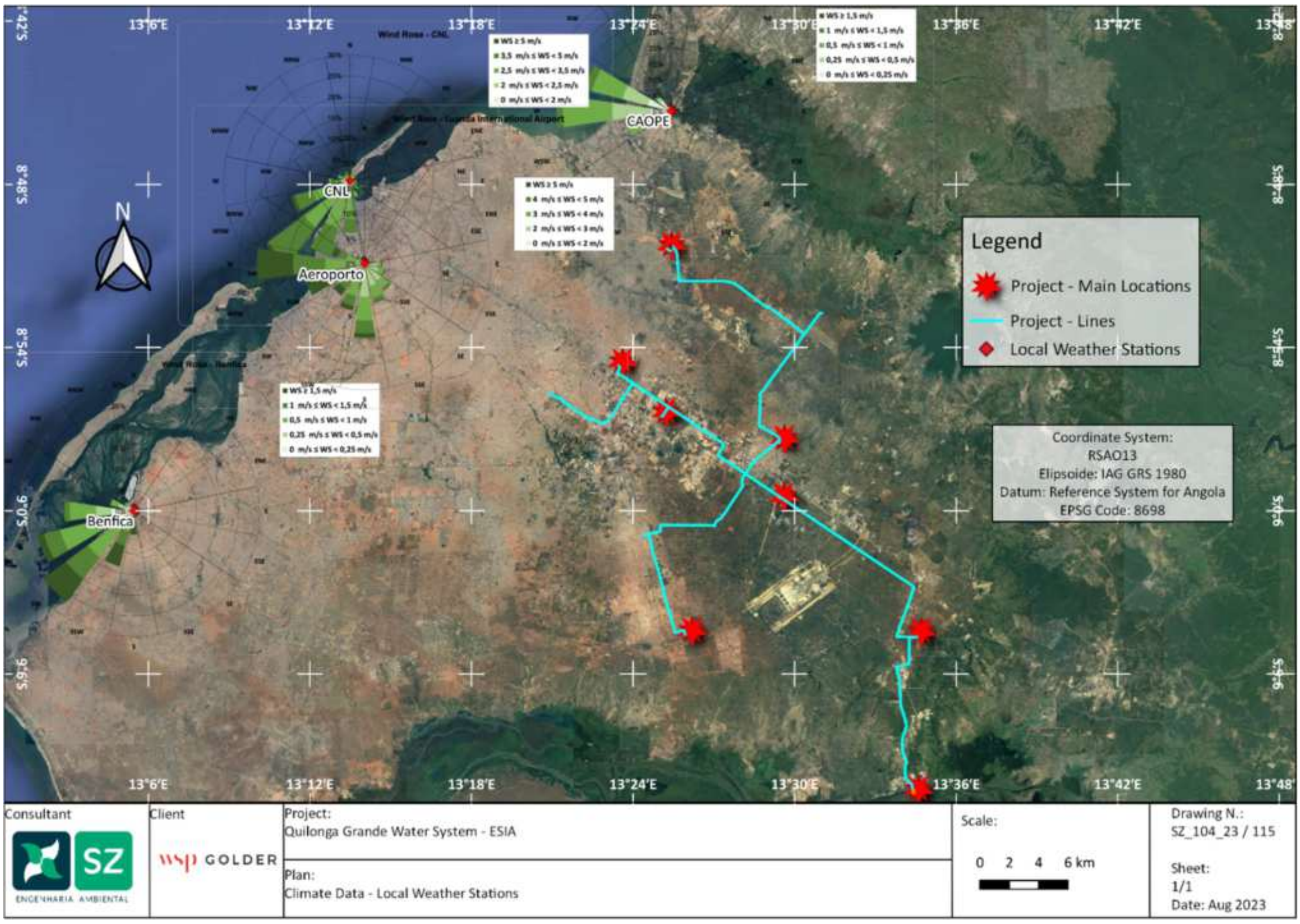


Figure 85: Considered local Weather stations.

For the purposes of comparing and validating the data obtained at these stations, a survey of historical and normalized data from the Luanda region was carried out for each of the registered parameters.

INAMET makes available, through the Meteorological Information Service on a World Scale of the World Meteorological Organization, normal temperature data for the Luanda area, based on the monthly average, in the period 1961-1990 (normal 1961-1990), thus allowing comparison data.

In terms of precipitation and wind speed, historical observation data available for the Luanda area were not identified, but only simulation/modelling data. The closest source of observation data is the meteorological station of Point Noire (Congo), with historical record data available on the MeteoBlue service.

Modelling data for precipitation and relative humidity were also taken into account (parameter where no source of historical record was identified). For this purpose, and within the various possible sources available, it was considered data, for Luanda, from the International Association for Medical Assistance to Travelers (IAMAT) namely the “24 World Climate and Food Safety Charts”.

The “Climatological Monitoring” data found on the INAMET website were also considered. In this section of the INAMET portal, monthly rainfall monitoring data, for 8 months periods, are presented.

However, the monitoring data made available on INAMET correspond to information from the CHIRPS v2.0 - Climate Hazards group Infrared Precipitation with Stations (CHIRPS) dataset (Funk 2015), developed to support FEWS-NET - Early Warning Systems Network against Hunger of the United States Agency for International Development (USAID).

Historical data from this estimation and monitoring system, used by INAMET, is available by FEWS-NET, with data since 1981. For the purposes of this characterization, the most recent monthly data were considered, that is, from January 2021 to July 2023.

Based on the daily data, monthly average values were obtained for each station for the parameters in question, which were compared with the normalized references indicated above, presented in the following subchapters.

It should be noted that precipitation and humidity data are not available for the Luanda airport station, only temperature data is presented.

7.1.1.2.2 Temperature

The following figures show the average temperature values obtained at the four stations and their comparison with normalized data for the period 1961-1990 provided by INAMET for the Luanda area.

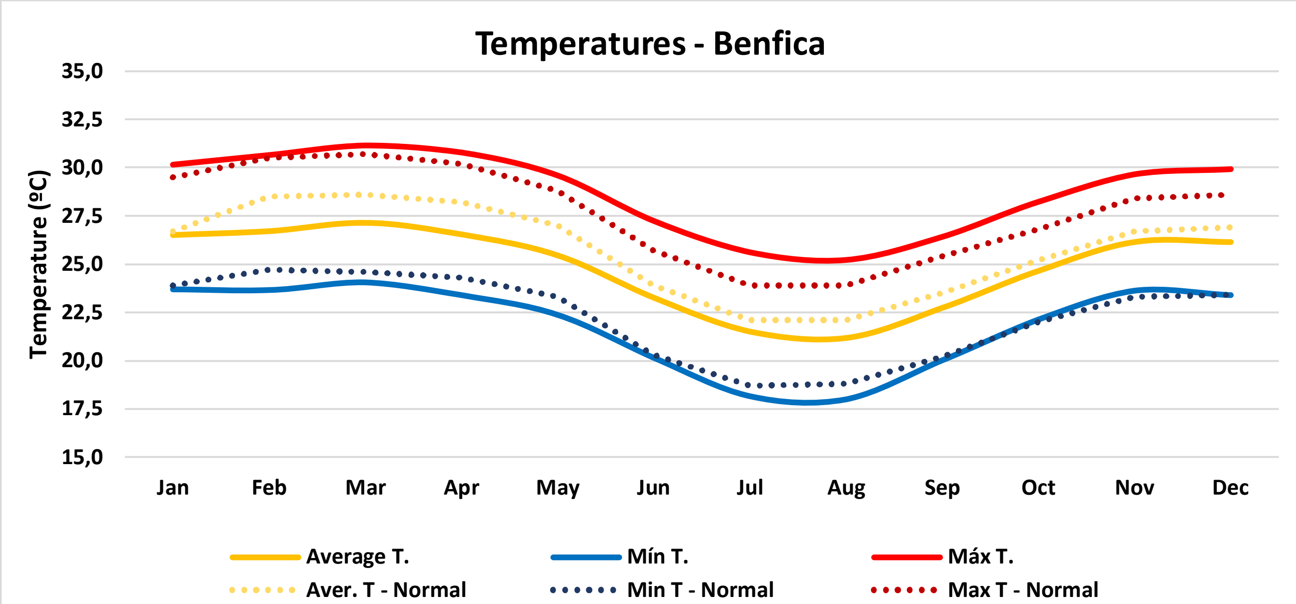


Figure 86: Monthly Temperature Data –Benfica Station

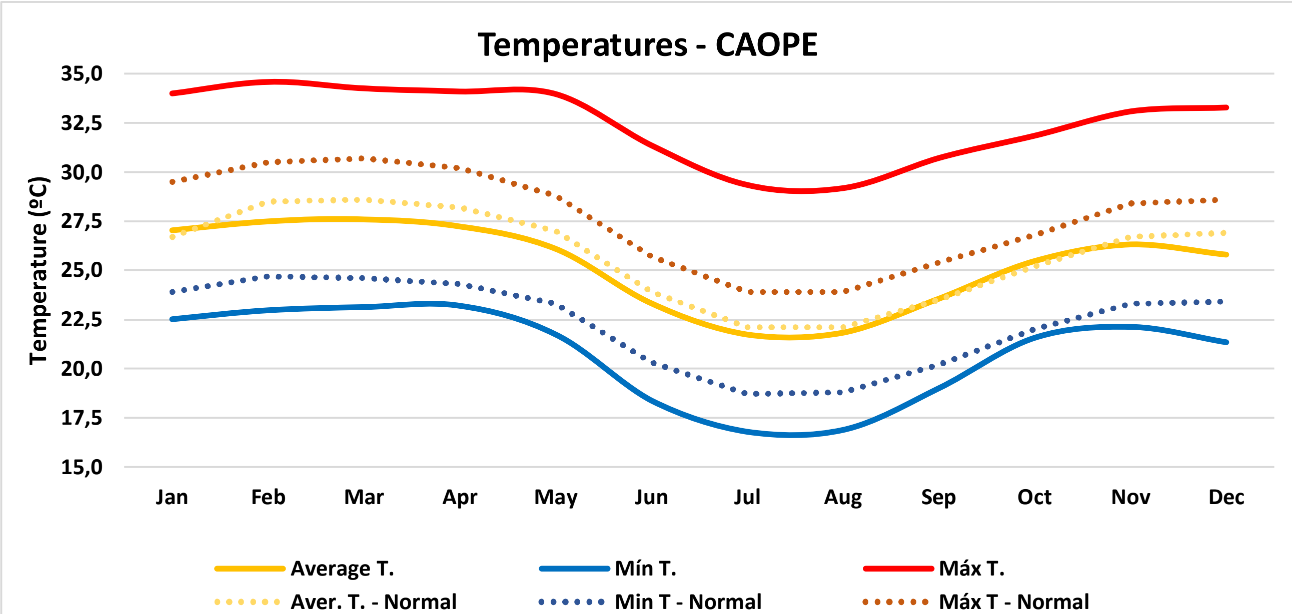


Figure 87: Monthly Temperature Data –CAOPE Station

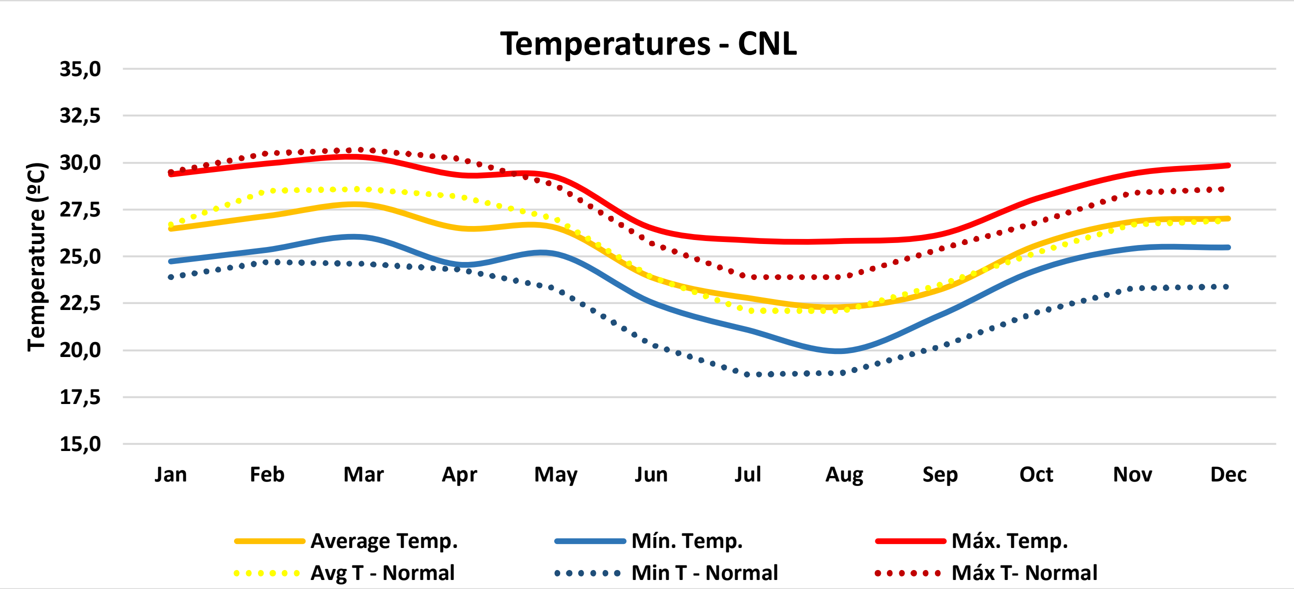


Figure 88: Monthly Temperature Data –CNL Station

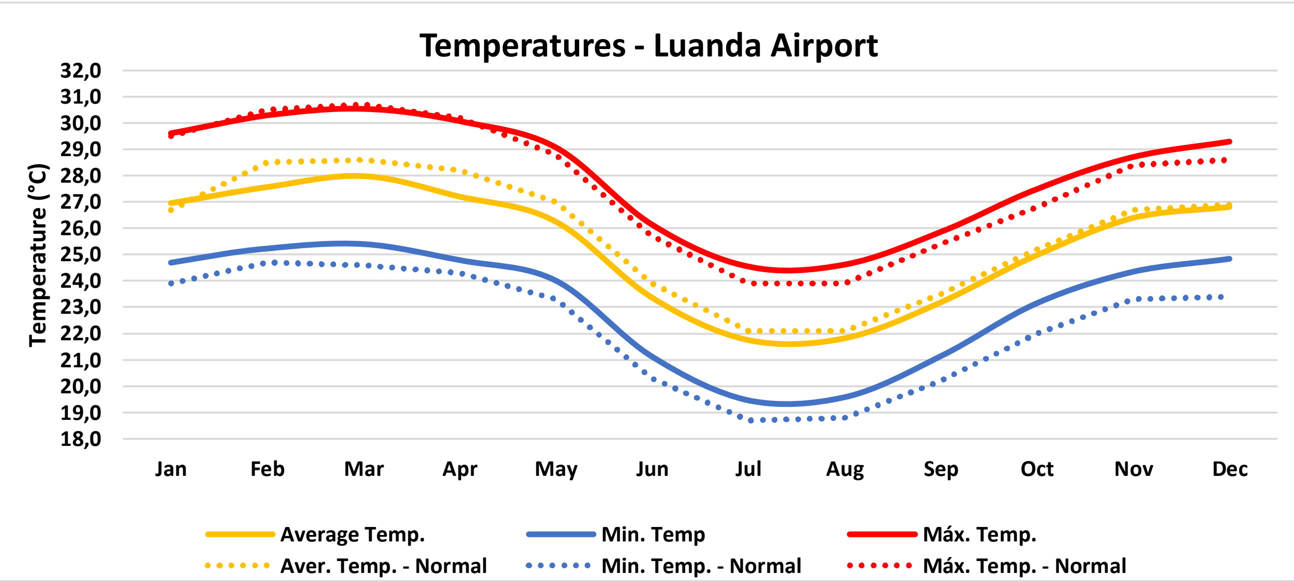


Figure 89: Monthly Temperature Data – Luanda International Airport

Analyzing the data obtained from the meteorological stations considered and the respective values of the normals in the Luanda area, it appears that the observation data have the expected behaviour, with the lowest temperatures in the months of July/August, with values of 25 to 30 °C of daily maximum temperature and 16 to 20 °C of daily minimum temperature, and with the highest temperatures in February to April, with values of 30 to 35 °C of maximum daily temperature and 22 to 26 °C of minimum daily temperature.

The differences registered between the different stations can be related to local microclimatic effects of the installation zones, as well as to the differences in installation altitude and data acquisition periods.

The results of observation at the stations show that, at the local level, the data from the 1961-1990 climate normal adequately represent the zone, even though an increase of 2 to 3 °C in maximum temperatures must be assumed compared to the values of the climate normal, as expected, because of climate change.

7.1.1.2.3 Relative Humidity and Precipitation

The following figures show the average values of relative humidity and precipitation obtained in the local weather stations. As mentioned above, they are compared with historical observation data from the Point Noire meteorological station, available on the MeteoBlue website, with modelling data from the 24 World Climate and Food Safety Charts (24 WCFSC) from IAMAT, and with data latest CHIRPS-V2.0 precipitation data.

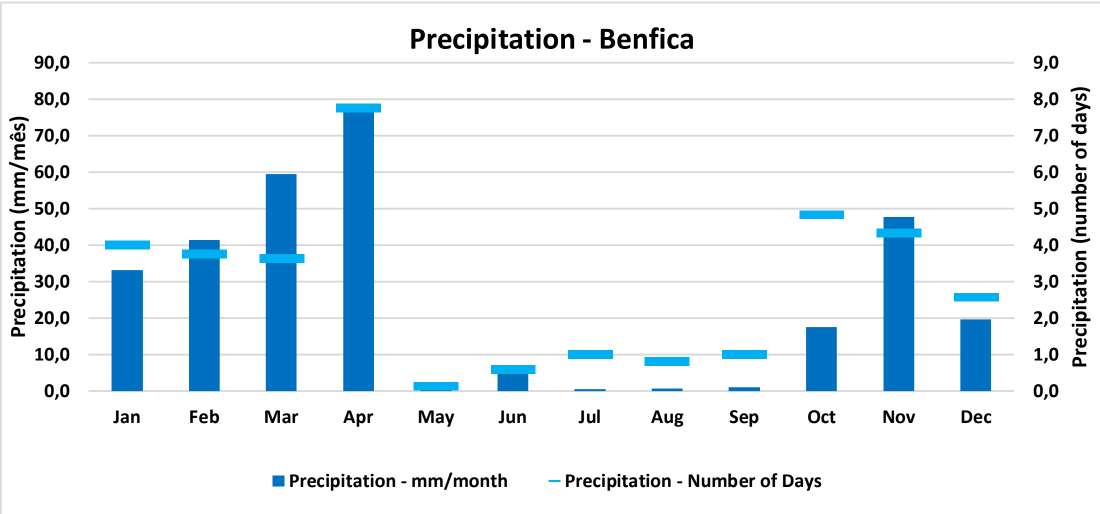
In this case, specific precipitation data for the project area, produced by the CHIRPS-V2.0 modelling since January 2021, were measured, obtaining the results in the following table.

Table 32: Average monthly precipitation Data – CHIRPS V2.0 – Project Area (mm/Month)

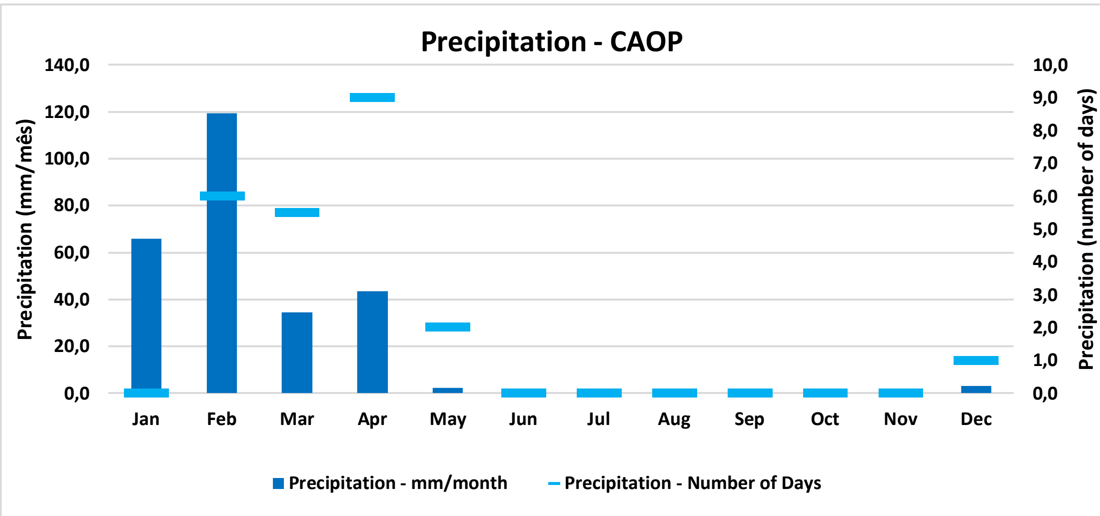
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	25	61	87	160	34	1	0	2	3	60	41	62
2022	26	28	71	141	2	1	0	1	4	34	22	35
2023	65	66	71	191	27	0	0	-	-	-	-	-
Average	39	52	76	164	21	1	0	2	4	47	32	49

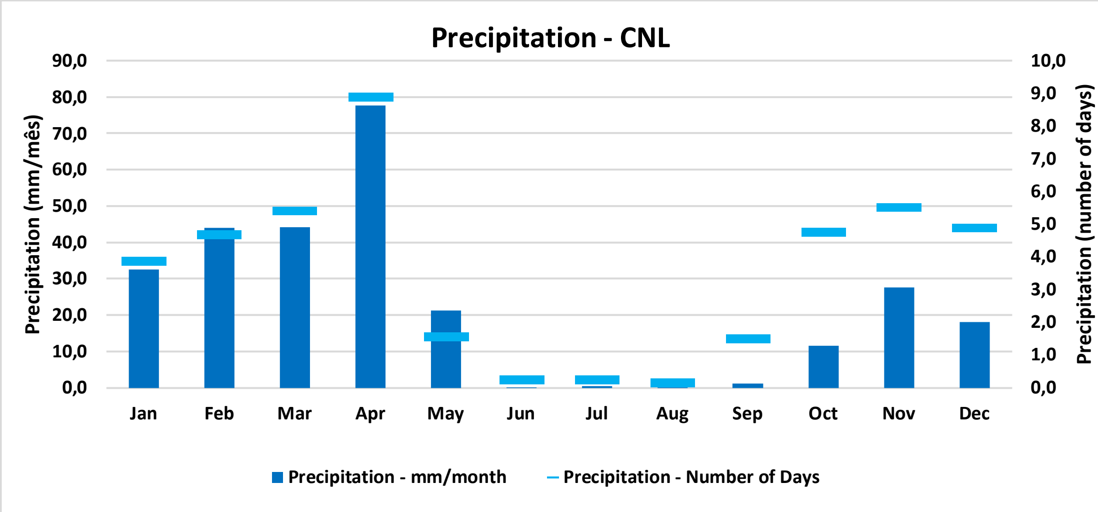
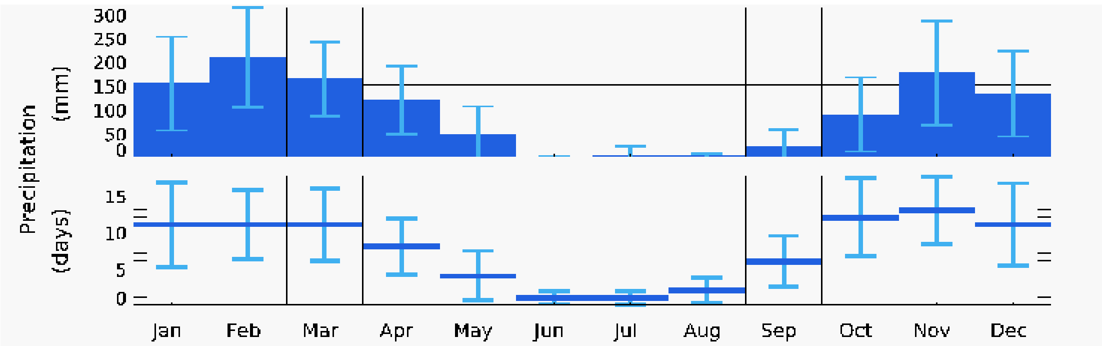
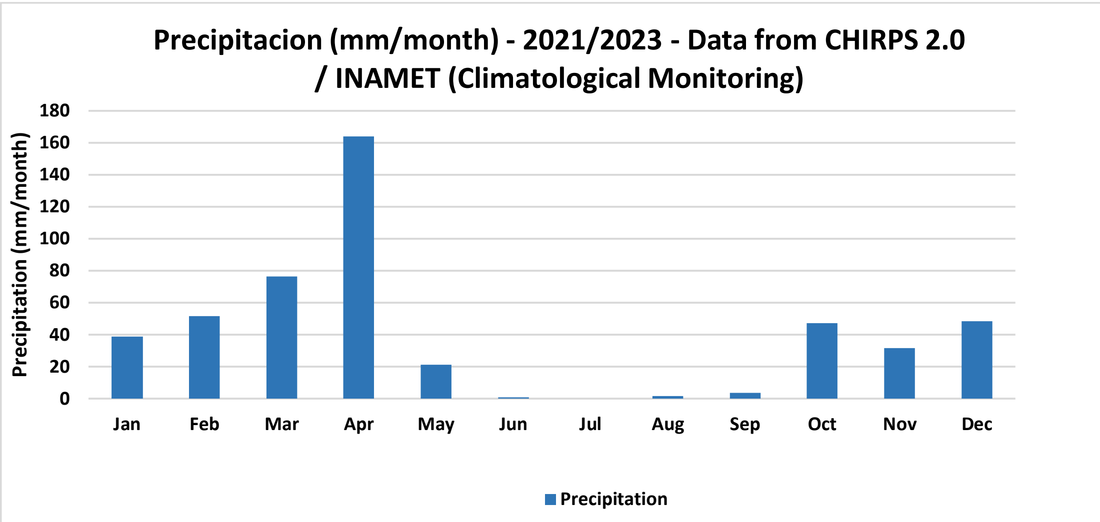
Table 33: Local Precipitation Data (mm of total precipitation per month).

Observation Data – Precipitation (total mm / Month) Benfica Station



Observation Data – Precipitation (total mm / Month) CAOPE Station



<table>
<tr><td>Observation Data – Precipitation (total mm / Month) CNL Station</td><td>
</td></tr>
<tr><td>Reference Historical Observation data - Point Noire Station</td><td>
</td></tr>
<tr><td>Precipitation data from climate monitoring of INAMET / CHIRPS 2.0</td><td>
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For reference only, the following figure shows the available data on precipitation for the month of July 2023 (most recent available – Dry Season), in Angola, according to information from the CHIRPS 2.0 project, with details of the project area, with an estimated 0.07 mm of precipitation, in the project area, in the month of December.

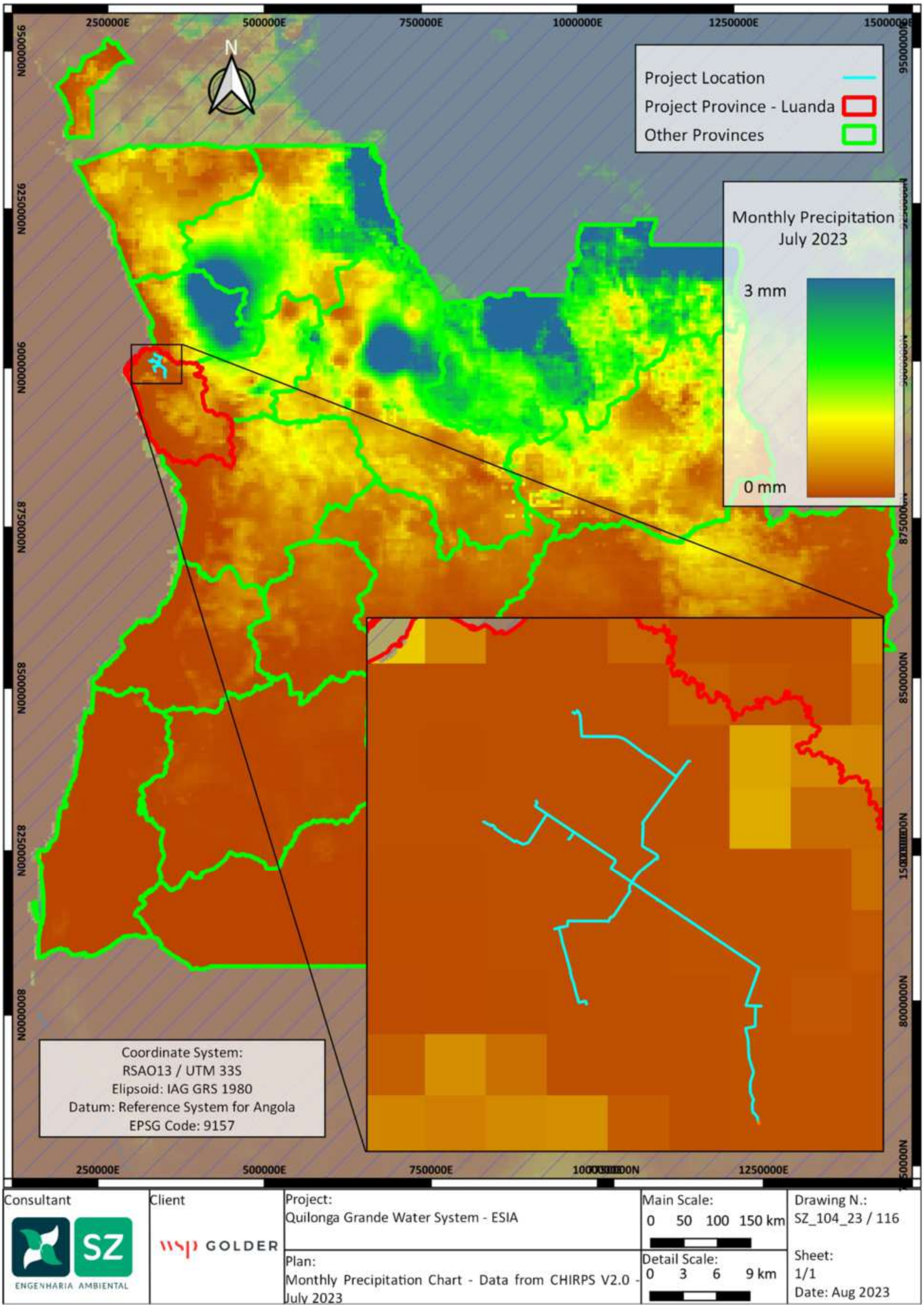
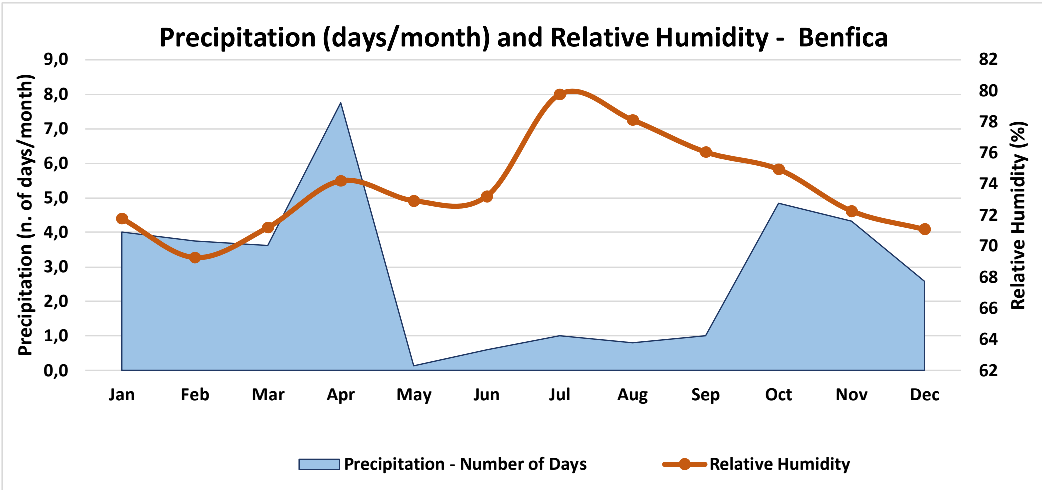
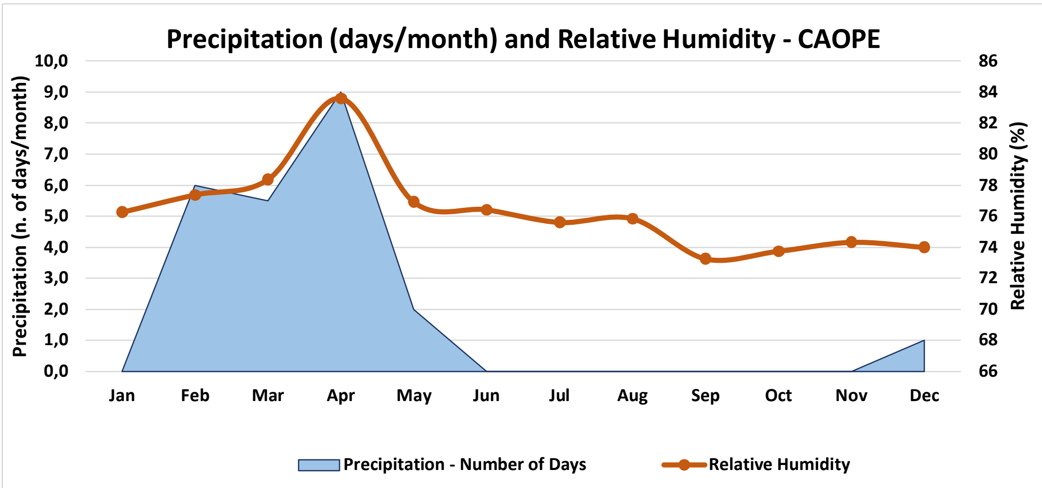
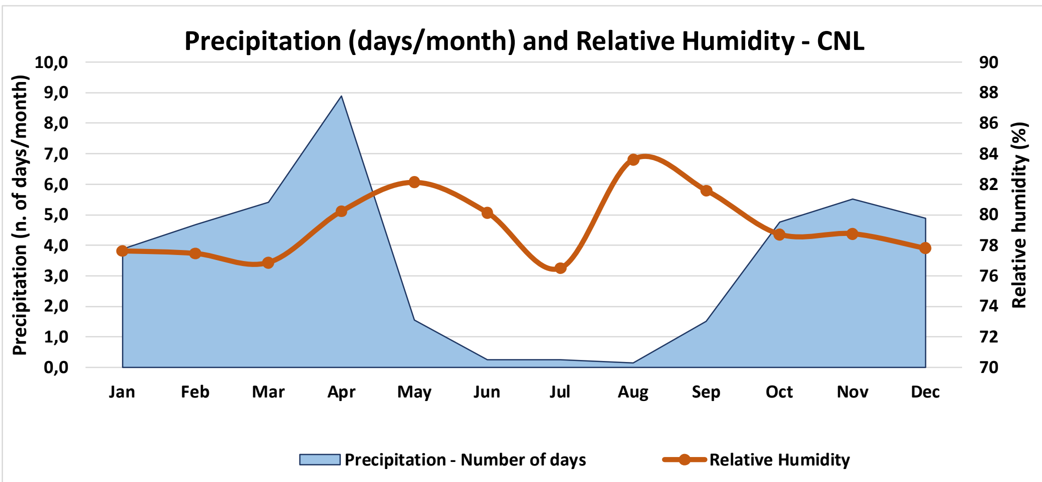


Figure 90: Precipitation Data – July 2023

Table 34: Local precipitation Data (Days/month) e Relative Humidity.

<table>
<tr><td>Observation data – Precipitation (days/ Month) and Relative Humidity Benfica Station</td><td>


</td></tr>
<tr><td>Observation data – Precipitation (days/ Month) and Relative Humidity CAOPE Station</td><td>


</td></tr>
<tr><td>Observation data – Precipitation (days/ Month) and Relative Humidity CNL Station</td><td>


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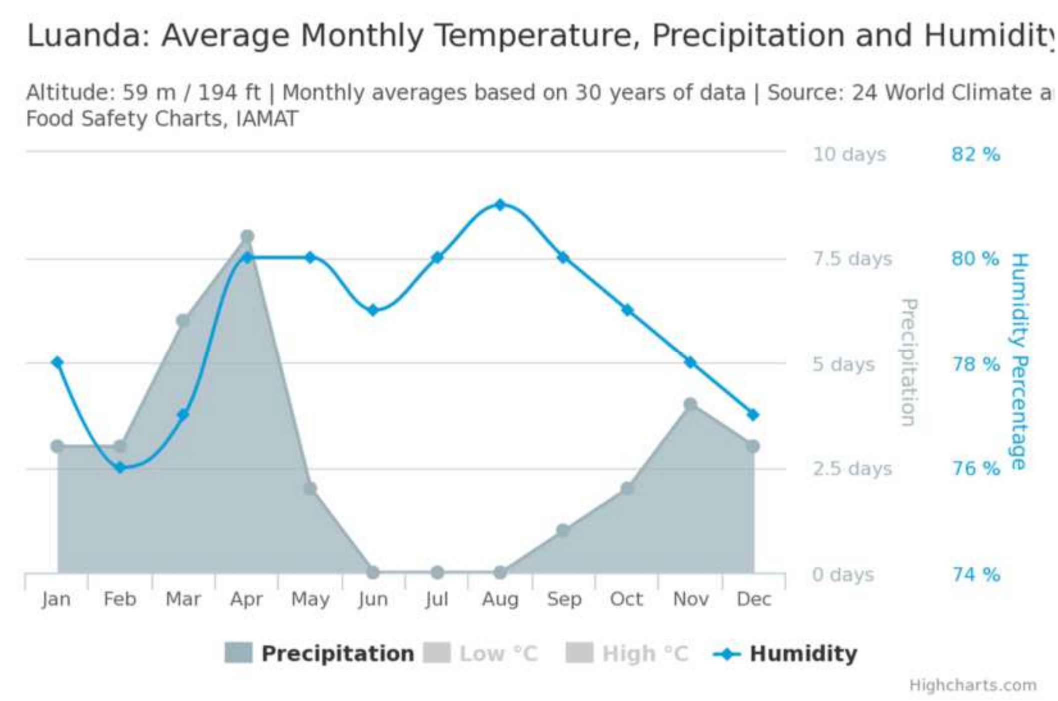
24 WCFSC da IAMAT Charts for Luanda	

From the analysis of the precipitation data, a similar general behavior is registered between the three monitored stations and consistent with the record data of the Point Noire reference station, with the data of the IAMAT charts and with the data from the Climatological Monitoring of INAMET from 2021 to 2022 (CHIRPS 2.0 charts). The data shows a period of reduced or no precipitation between May and September, and with a wet period between October and April, with a peak in this last month.

This difference between the stations may be related to the difference in the data acquisition period. Thus, for the region, precipitation peaks in the month of April are considered, with 7 to 9 days of precipitation and monthly accumulated values close to 80 mm, registering, on average, in the months usually with rain (October to April), values of about 40 mm per month and 5 days of precipitation.

Regarding Relative Humidity, the data from the Benfica and CNL stations follow a pattern similar to that considered by the IAMAT charts, with average daily relative humidity variations between 70 % and 80 %, with humidity peaks in July, August, and September, coinciding with the lowest temperature periods of the year, and minimum humidity between December and March, and with an average level of humidity in the months of April to June.

Data from the CAOPE station record relative humidity fluctuations between 72 % and 84 %, but with a peak in April and relatively stable values in the remaining months. This different behavior, once again, may be related to the shorter data acquisition period and also to possible microclimatic conditions in the area where the station is installed.

7.1.1.2.4 Wind

Regarding wind data, the average daily wind direction and speed in each of the 4 stations was assessed, developing a wind rose representative of the data obtained, identifying the percentage of hours or days that were recorded in each direction and class of wind. This data was compared with the wind rose obtained from historical observation data from the Point Noire station, available on the MeteoBlue portal.

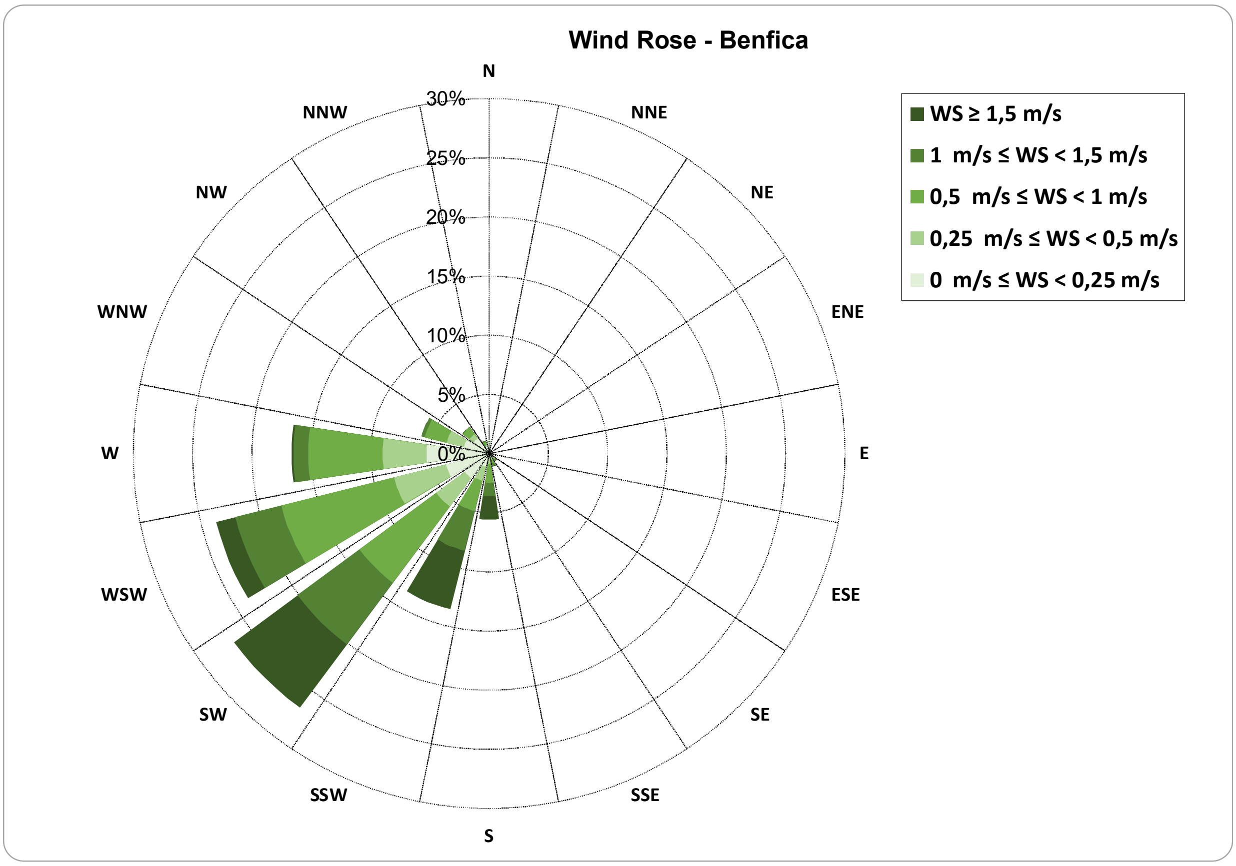


Figure 91: Wind Rose – Benfica Station

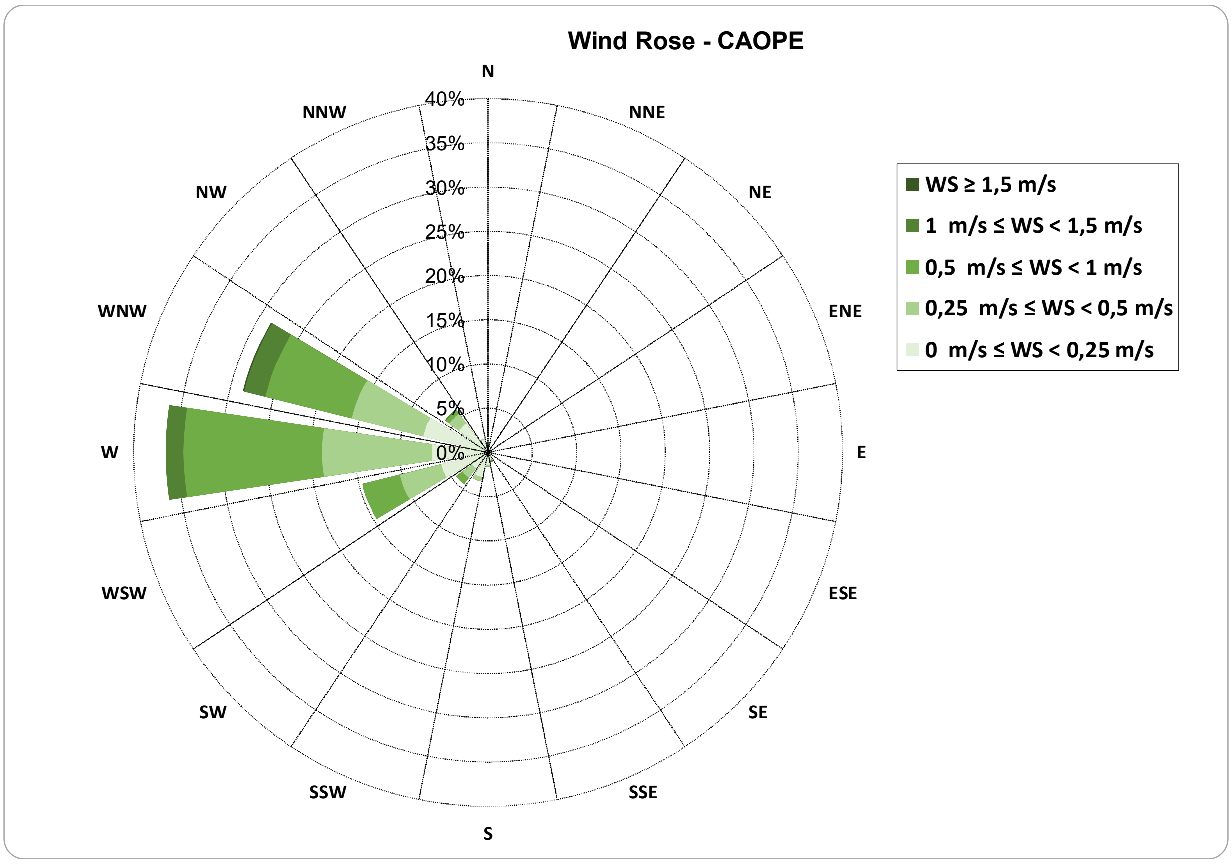


Figure 92: Wind Rose – CAOPE

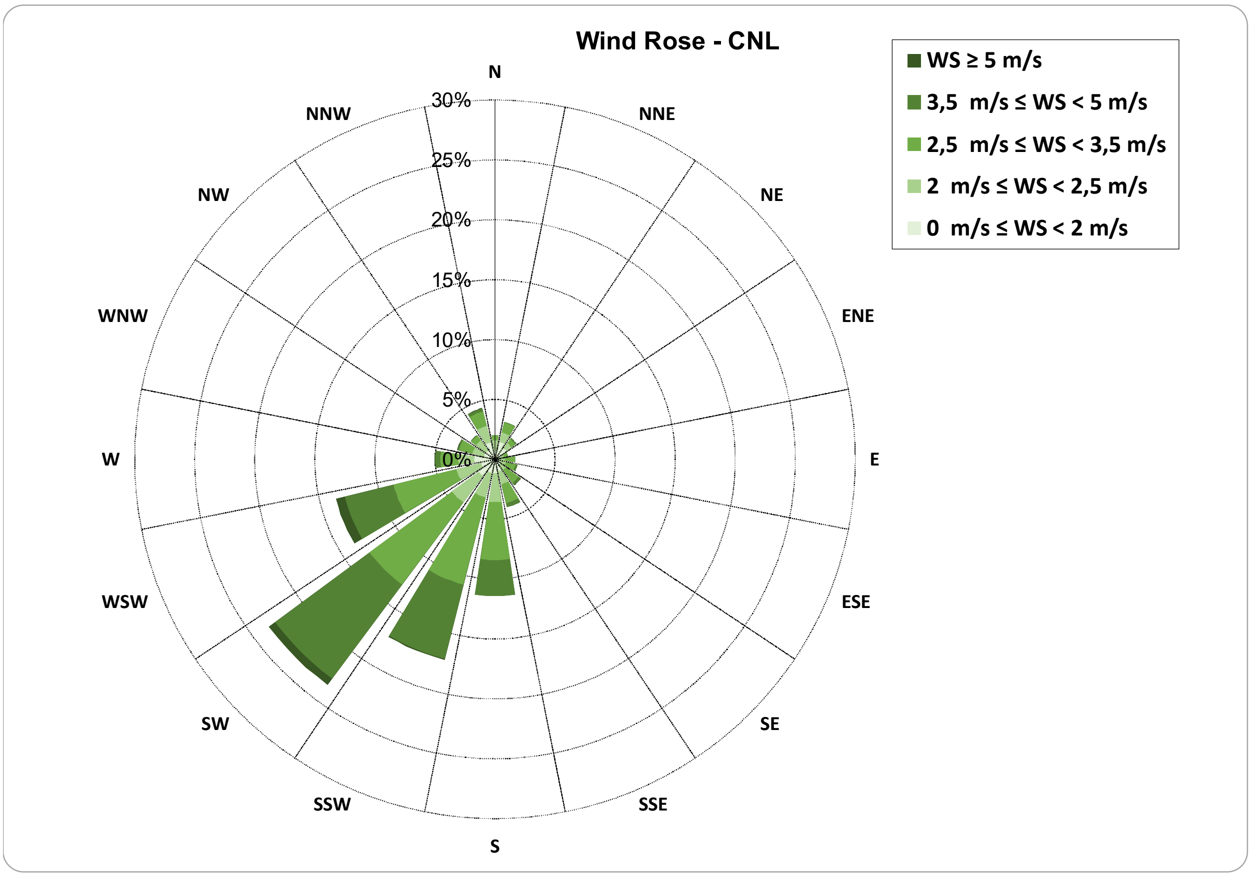


Figure 93: Wind Rose– CNL

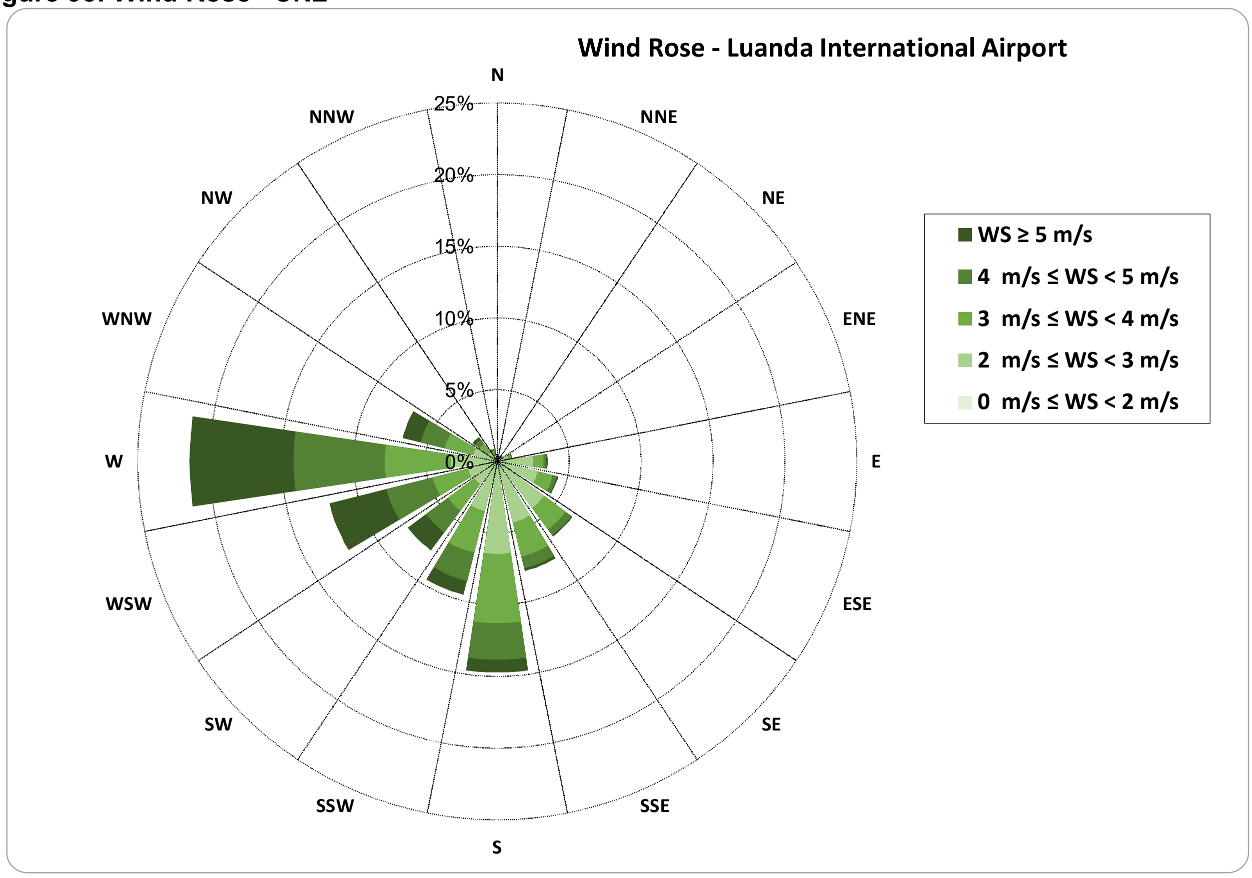


Figure 94: Wind Rose – Luanda Airport

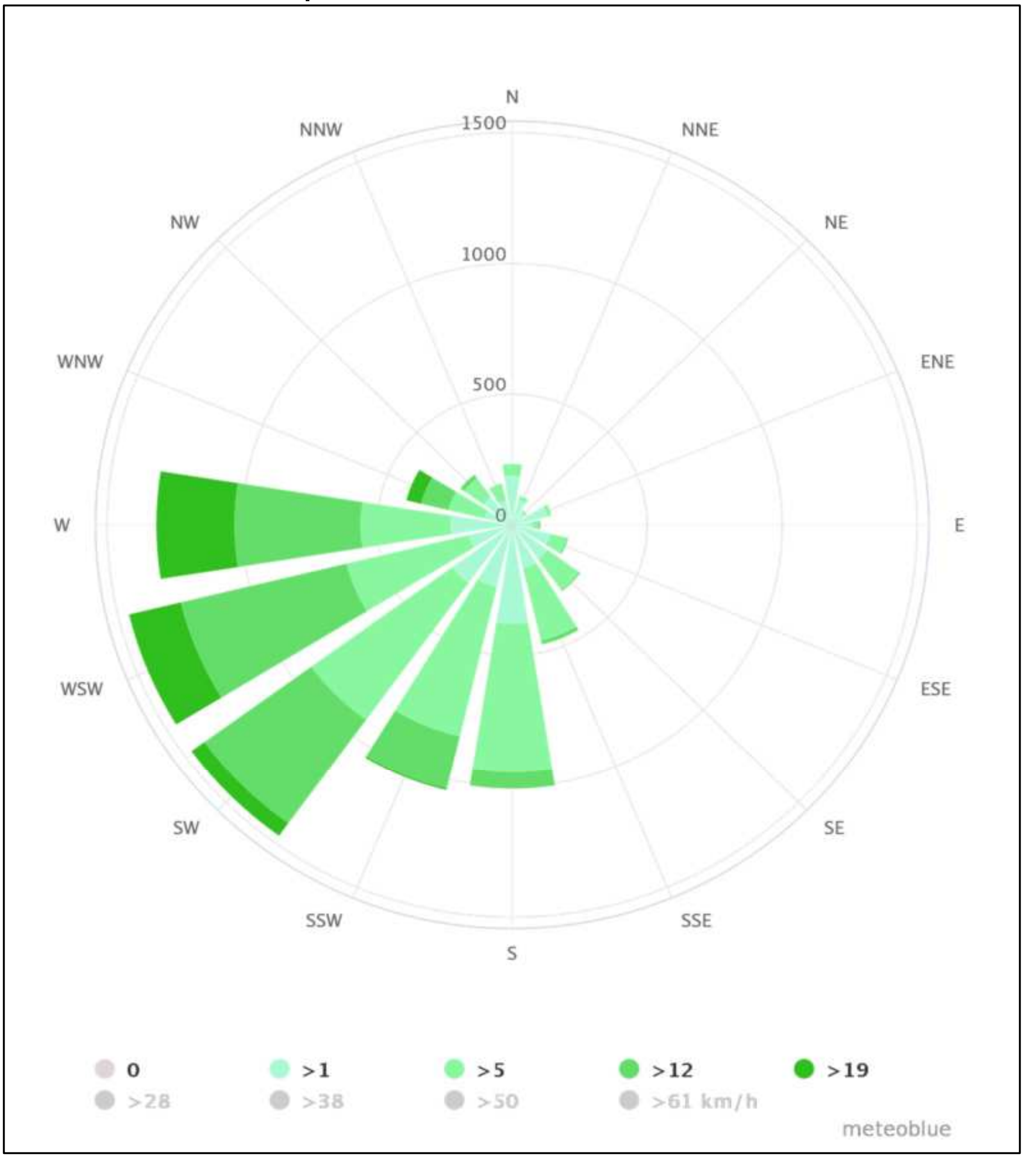


Figure 95: Wind Rose – Observation Historical Data - Point Noire Weather Station- MeteoBlue

Analyzing the data obtained, the Benfica, CNL and Airport stations are those that have similar behavior to the reference data (Point Noire), indicating predominant winds from the Southwest quadrant (S, SSW, SW, WSW, W), with a total of 71 % (CNL), 66 % (Airport) and 86 % (Benfica) of measurements.

With regard to wind speeds, there are relevant differences between stations, with Benfica and CAOPE stations tending to register light winds (average speed of less than 1 m/s (3.6 km/h)), with 67 % of the days in Benfica and 95 % of the days in CAOPE.

On the contrary, the Clube Naval station registers 99 % of the days with an average wind above this value, with the majority of days (82 %) with average wind values between 2 m/s and 5 m/s (7.2 to 18 km/h).

The Airport also registers moderate wind trends, with 60 % of the hours with winds between 2 m/s and 4 m/s (7.2 to 14.4 km/h), still registering 20 % of the hours with moderate to strong wind, between 4 m/s to 5 m/s and 17 % of the hours with strong wind, above 5 m/s (18 km/h).

The difference in average wind speeds at the CNL station and at the Airport, when comparing with the other two stations analyzed, could be related to the respective location and wind exposure characteristics.

The data obtained at the CNL and at the Airport are coherent, in terms of direction and wind speed, with the data recorded in the history of the Point Noire reference station. Benfica Station is also consistent with Point Noire data in terms of wind direction, but with lower average speeds.

In terms of wind speeds, it is then assumed that the project area will be affected by light to moderate winds, with predominant average speeds between 2 m/s and 3 m/s and predominant wind coming from the Southwest quadrant.

7.1.2 Geology and Geomorphology

7.1.2.1 Geomorphological environment

The territory of Angola is divided into two morpho-structural parts: western and eastern. The eastern part is characterized by accumulation relief, while the western part (where the Project is located) is characterized by denudation landform with intense erosion phenomena.

The western part of Angola comprises the Central Plateau with the staircase relief zone, the Maiombe denudation plains, the Kwanza-Longe plains, the Zenza-Loge plateau, the Cuango plain with the Cassanje depression, the coastal plain (where the Project is located) and the Namibe accumulation plain.

The coastal plain, which is not very rugged, was formed on the Meso-Cenozoic marine deposits of the Perioceanic Depression. It is generally no more than 15-30 km wide. Near the mouths of the Zaire and Kwanza rivers, the plain widens by 100 to 130 km, forming the coastal basins of the same name.

In the Kwanza basin, the coastline is cut by lagoons that fill tectonic faults of different orientations. The hills and ridges that appear on the plain were formed in places of rock outcrops resistant to denudation processes. The arched depressions observed in the relief probably correspond to salt dome structures. Along the coast, a step of abrasion is observed at an altitude of 20 to 50 meters. In the vicinity of the mouths of many rivers, beaches, accumulation terraces, islands, and sandbanks several meters high are observed (Araújo 1992).

With a different terminology from that of Araújo & Guimarães (1992), Figure 96 shows the geomorphological outline in the Geographical Atlas of Angola for secondary education, published in 2008. The “coastal strip” of the Geographical Atlas of Angola corresponds to “coastal plain” mentioned in Araújo & Guimarães (1992).

7.1.2.2 Geological environment

The geology of the region is dominated by sedimentary formations exclusively from the Cenozoic. According to the Geological Map Explanatory Note at scale 1: 1.000.000, coordinated by A.G. de (Araújo 1992), the formations can be characterized, from the oldest to the most recent, as follows:

- **Palaeogene**

In the Kwanza area they are represented by the Palaeocene Rio Dande formation, Eocene Gratidão and Cunga formations and Palaeocene-Eocene Rio Dande, Gratidão and Cunga formations. The Palaeogene deposits have the greatest development in the Kwanza area, where they have been recognized by a large number of drillings, and numerous outcrops are also observed in the vicinity of the Dande, Cuvo, Kwanza and Cunga rivers.

The Rio Dande formation presents the most important outcrops in the eastern part of the area. Its cross section is represented here mainly by marls and clays with sandstones and conglomerates in the lower part, and by phosphatic sandstones in the upper part. Limestone-clay deposits occur in the western sector of the zone. The thickness is about 600 m. It rests in stratigraphic discordance on the deposits of the Teba formation.

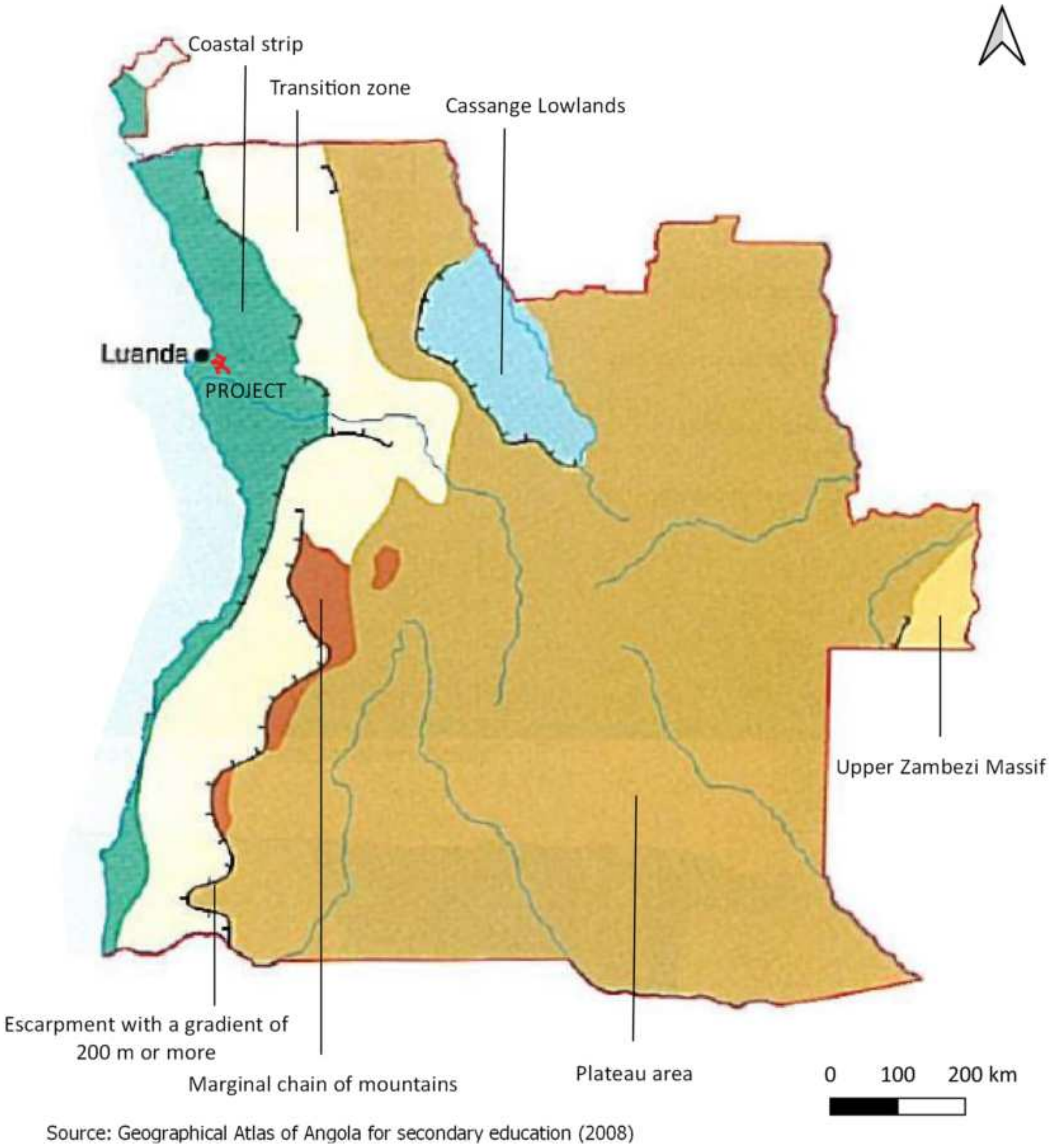


Figure 96: Geomorphological Map of Angola

The Gratidão Formation is located in the eastern and central parts of the area, and also outcrops in small patches along the coast in the southern sector. It consists of marls, limestones, sandstones, and clays. It is up to 500 meters thick. It rests concordantly on the Rio Dande formation, with discordance at its contact only in the eastern part of the area.

The Cunga formation is mainly well developed in the southern part of the area. It consists mainly of marls and clays. Its thickness is 500 meters. It rests concordantly on the Gratitude formation.

The Rio Dande, Gratidão and Cunga formations were individualized on the coast of the northern sector of the area, having been recognized only by drillings. Their differentiation was not possible due to their homogeneous lithology. They are composed of marls and limestones comprising coprolites and conglomerates. Their thickness is 200 to 300 meters. The age of the Palaeogene deposits has been established with certainty on the basis of fossils. The rocks of these formations have collecting properties and there are oil deposits in the area.

- **Palaeogene - Neogene**

The undifferentiated Palaeogene-Neogene deposits are located in the Perioceanic Depression and in the continental depressions. In the Perioceanic Depression, they are represented by the Oligocene-Miocene formation of Quifangondo, in the Kwanza area; by the Eocene-Miocene formation of Malembo and by Eocene-Pliocene and Oligocene-Miocene deposits in the Cabinda-Congo area; by Eocene-Miocene and Eocene-Pliocene deposits in the Namibe area.

In the Kwanza area the Quifangondo formation is largely developed, forming large areas in its northern, southern and central sectors. It consists of essentially sandy-clay rocks. Sometimes, in its middle part, limestone and gypsum sediments appear, as well as beds and intercalations of marl and limestone. Its thickness varies. In the depressions, it reaches up to 3013 m (Calomboloca 1 borehole, northern sector of the area), while in the old elevations and on their slopes, it ranges from zero to several hundred meters. It is based on stratigraphic discordance over the deposits of the Cunga formation.

- **Neogene**

Neogene deposits have been identified only in the Kwanza zone of the Perioceanic Depression, and are represented by the Miocene formations of Bom Jesus, Cacuaco and Luanda.

The Bom Jesus formation is of local development, filling the Mesozoic depressions in the area of the Cuvo and Kwanza rivers. It consists of marls, clays and, more rarely, limestones and sandstones. At the base, conglomeratic limestone sandstones occur. Its thickness is about 120 meters. It rests on the Quifangondo formation in stratigraphic discordance.

The Cacuaco and Luanda formations are observed only along the present coastline, in the north-western sector of the Kwanza area, and sedimentation does not appear to have taken place elsewhere. They consist of clays, marls, sometimes gypsum, limestone, and sandstone. They are up to 2,000 meters thick. They lie in stratigraphic discordance over the Quifangondo formation.

- **Neogene - Quaternary**

Pliocene-Quaternary deposits are represented by the Quelo Formation in the Kwanza area.

This formation is located in the northern sector of the area, outcropping locally south of Luanda. Its deposits constitute gently sloping surfaces of the interfluves of the coastal plain and are represented by reddish clays and sands. Sometimes lateritic levels (0.5-1.0 meters) appear at the base of the cut. Freshwater fossils of Cenozoic age are found in the deposits. Its thickness ranges from several tens of meters to 150-200 meters. It rests in concordance on the Miocene marine deposits of the Cacuaco and Luanda formations, often being covered by marine terrace sediments and other Quaternary deposits.

- **Holocene**

Modern deposits comprise beach and marine terrace deposits from 3 to 6 m above sea level and alluvium from water lines. Their age is based on geomorphological data.

Beach and marine terrace deposits are extensively represented in a narrow (few hundred meters) strip along the coast. These deposits constitute numerous sandbanks (especially in the vicinity of Luanda). They are represented by light-colored fine sands, often rich in magnetite and epidote, locally by gravels and, less frequently, by clays and muds. Their thickness is probably only a few tens of meters.

The alluvial deposits are low terraces up to 3 m, riverbeds, and marshes of all more or less important watercourses. They consist of fine and coarse sands, mostly with little clay, sometimes with pebbles, blocks, and clay layers 1.5 to 3.5 m thick. Gravels are present in the upper part. The thickness of the deposits varies between 8 and 20 meters.

Figure 97 shows the stratigraphic column of the Cenozoic sedimentary deposits in the Kwanza region, according to two different reference works. The differences observed are not relevant to the present environmental impact study.

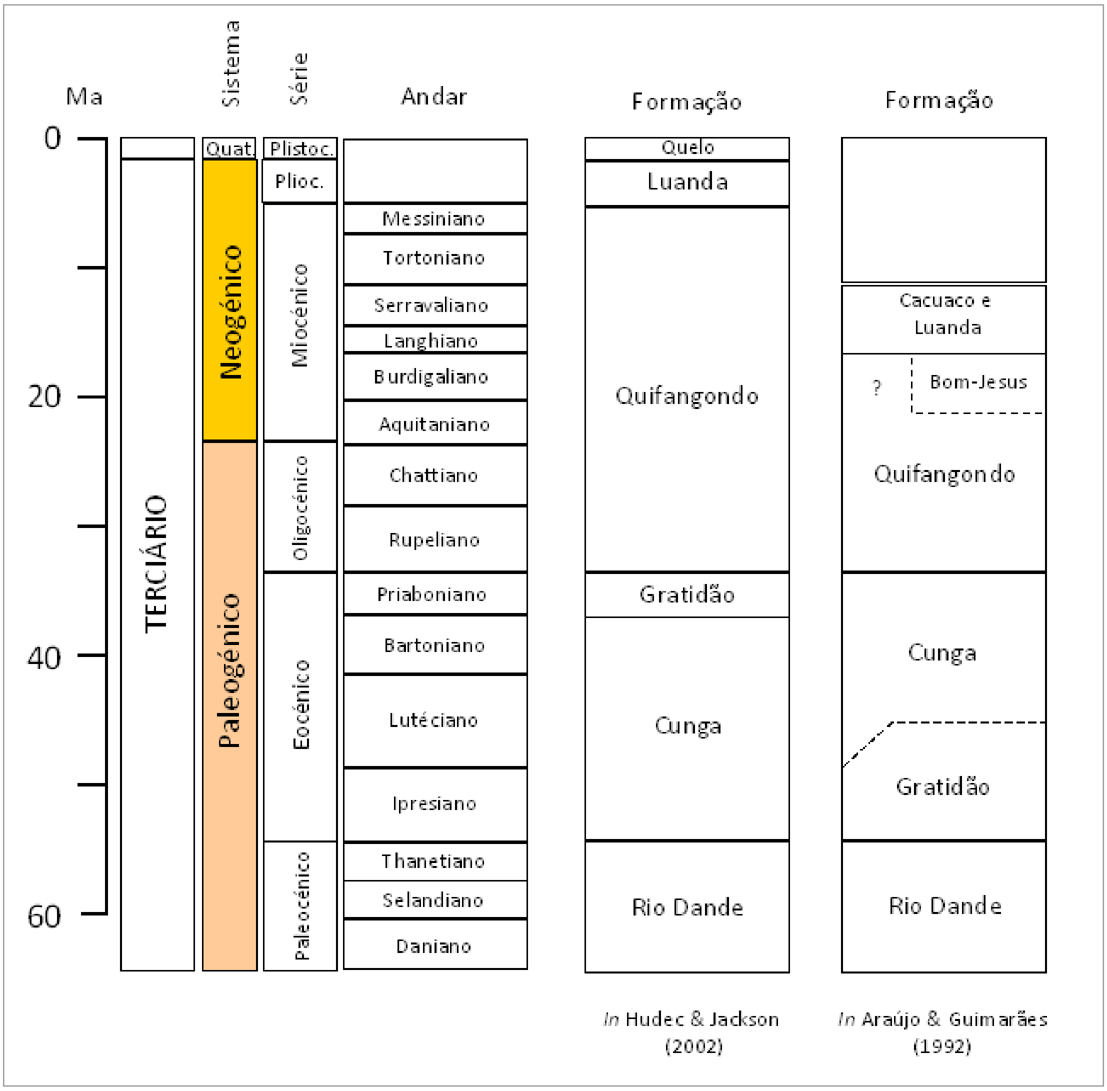
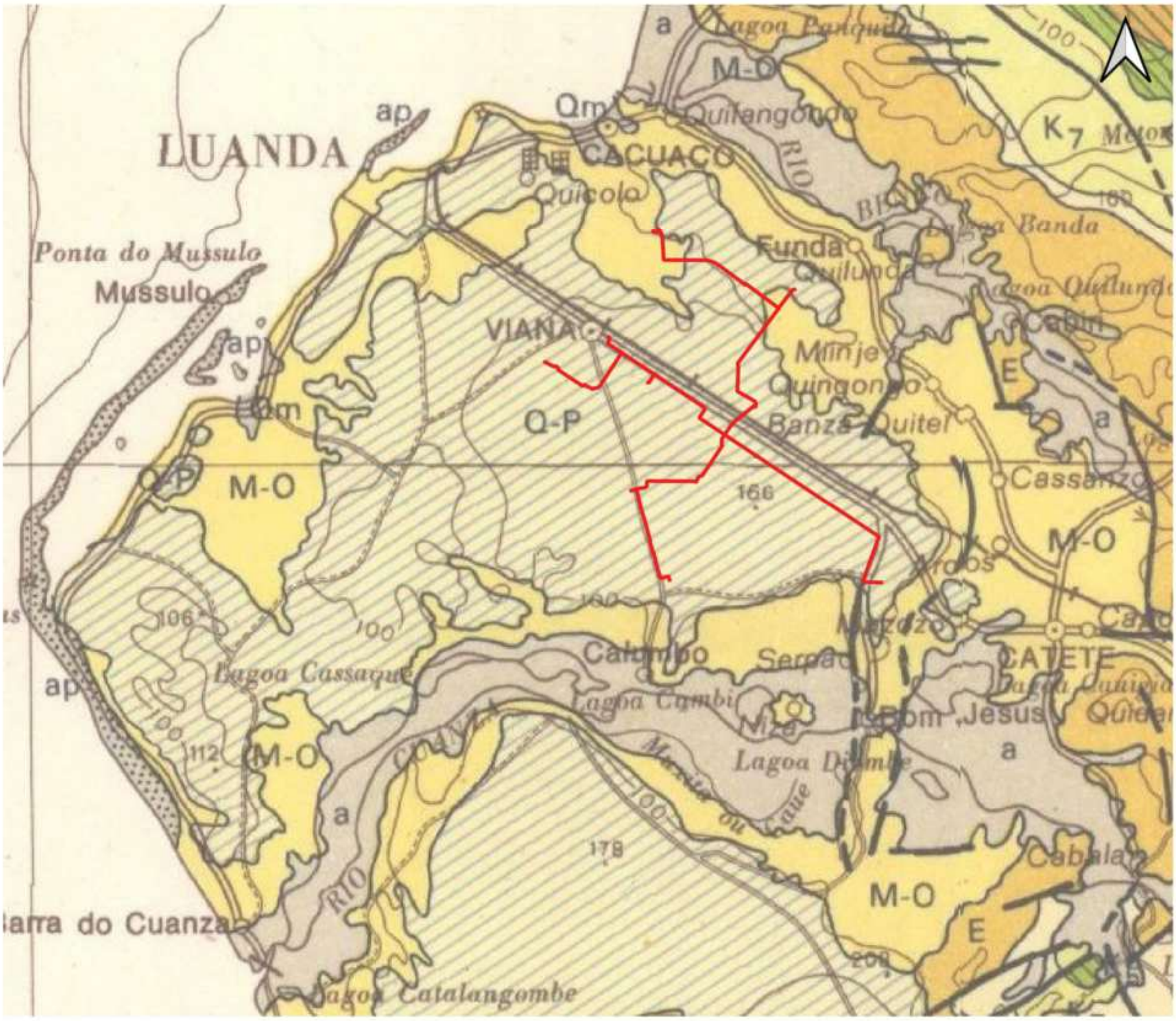


Figure 97: Stratigraphic column of Cenozoic deposits in the Kwanza region (Hudec & Jackson, 2022; Araújo & Guimarães, 1992)

For the regional geological mapping, the Geological Map of Angola at 1:1,000,000 scale, by (Heitor de Carvalho 1980) was considered. According to this chart, the Project area is located predominantly on Cenozoic sedimentary formations of the Miocene - Oligocene, lithologically composed of sands, marls, clays, sandstones and conglomerates, as well as more recent formations of the Pliocene - Quaternary, consisting of sands, laterites and clays (**Figure 98**).



0 7,5 15 km

Extract from the Geological Map of Angola at a scale of 1:1.000.000

Legend

ap - Beach sands (Holocene)
a - Alluvial fans
Q-P - Sands, laterites and clays (Pleistocene - Pliocene)
M-O - Sands, marls, clays, sandstones and conglomerates (Miocene - Oligocene)
E - Clays, limestones and marls (Eocene)

Figure 98: Regional geological setting of the Project area

The refinement of the regional geological characterization was obtained using the Geological Map of Luanda at 1:25000 scale, published by the Department of Geology of the Faculty of Sciences of the Agostinho Neto University. The outcropping lithologies in part of the Project area and its immediate surroundings are from the oldest to the most recent:

- Quifangondo Formation (Miocene age); alternation of marly clay and calcilutites with planktonic foraminifera,

- Cacuaco Formation (Miocene age): bioclastic calcarenites with bivalves, bryozoans, red algae and abundant macroforaminifera and with plantonic foraminifera;
- Luanda Formation (lower - middle Pliocene): Clay, silt, fine, medium, or coarse sand, sometimes alternating with limestone levels with marine fossils;
- Quelo Formation (Pleistocene age): medium-fine sand of red color (although with different shades), referring to more than one depositional cycle (on which a large part of the Project area is located);
- (Holocene age): floodplain and terrace alluvial deposits and sandy slope debris.

Also, according to the Geological Map of Luanda at 1:25000 scale, the sequence of stratigraphic relationships is represented as shown in **Figure 99**.

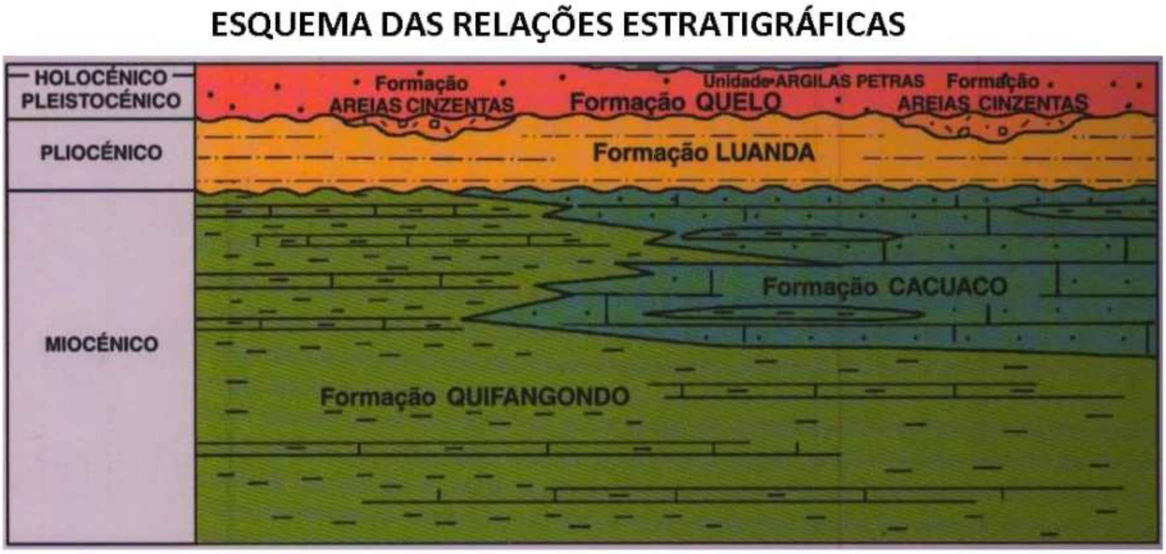


Figure 99: Stratigraphic column of the Tertiary and Quaternary formations present in the Project area (Geological Map of Luanda at 1:25000 scale).

According to the Geotechnical Map of the Luanda region - 1st Approximation (Horta da Silva & Gomes Teixeira, n.d.), the Quelo Formation (or Muceque) consists of medium and fine marine sands, very well graded. Subsequently, in the continental environment, phenomena of disturbance and alteration caused rubification of the sands at depth, developing a clay fraction consisting of kaolinite, illite and iron oxides (goethite and hematite), the latter being responsible for the reddish-brown color of the formation (**Figure 100**).

Figure 100: Outcrop of the Quelo Formation in the Project Area (Zango IV)

The Quelo formation is granulometrically composed of sandy particles (≥ 75 %), silty particles (between 1 and 5 %) and clayey particles (between 8 % and 20 %). The sandy and silty particles have identical mineralogical composition, based on quartz and feldspars. Thickness varies between a few centimeters and 17 meters in the town charter area, but according to data provided by (BROGNON.G.P. 1955) it can reach about 50 meters. It dominates the top of the Luanda plateau, thus constituting most of the city's foundations and largely covering the Tertiary formations.

The Luanda Formation is the most heterogeneous of all the Tertiary formations, comprising clayey, silty, and sandy sediments as well as calcareous rocks.

This formation begins with a clay-marl episode, consisting of brownish clays and marls, sometimes greyish, with foraminifera, which represent the lateral equivalent of the platform facies formed by the limestones of the Cacuaco Formation. This clay-marl episode then passes to a coarser sedimentation of silt and sand, with intercalations of limestone conquers (BROGNON.G.P. 1955).

The Cacuaco Formation consists of limestone formations with algae, echinids, bivalves and calcarenites rich in shell and foraminifera remains. The limestone rocks correspond to a platform facies and go through laterally to the clay and marl formations that underlie the Luanda Formation.

The limestone rocks of the Cacuaco Formation are still more or less dolomitized and locally even layers or intercalations of dolomites appear. The insoluble residue of these rocks is abundant in calcarenites and less frequent in limestones, especially the more dolomitized ones.

The Quifangondo Formation is composed at the base of black or variegated, azoic, very gypsiferous clays and black, greenish-black, and brownish marls or clays with foraminifera. This formation ends at the top by silty clays and marls rich in foraminifera, locally with calcareous and sandy-calcareous lumachelic intercalations (BROGNON.G.P. 1955).

With regard to tectonics, almost no faults are identified in the vicinity of the Project area. According to the Geological Map of Angola at 1:1,000,000 scale published by Heitor de Carvalho in 1980, the exceptions occur near the road to Bom Jesus, where two probable faults trending N-S are mapped.

The Luanda region has a very low seismic risk (less than 0.2 m/s^2 of seismic acceleration) (WHO 2010). **Figure 101** shows that almost all of Angola's territory is classified in the lowest seismic risk class.

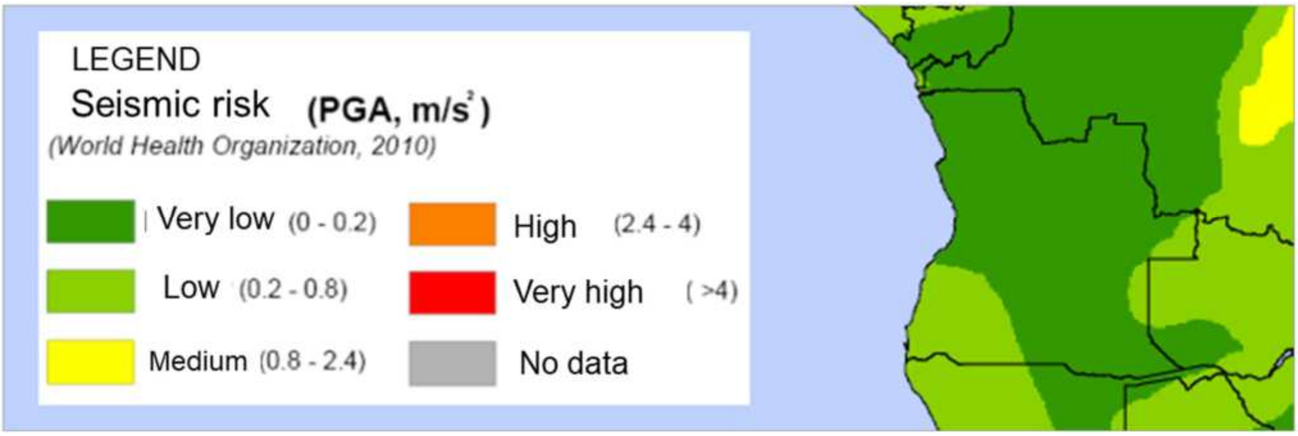


Figure 101: Excerpt from the Map of Seismic Risk Distribution in Africa (World Health Organisation)

A search carried about earthquakes occurring around Luanda, for magnitudes equal to or greater than 3 and for the time period 01-01-2000 to 09-08-2023, returned the results presented in **Erreur ! Source du renvoi introuvable.** A cartographic representation of this data is presented in **Figure 102**.

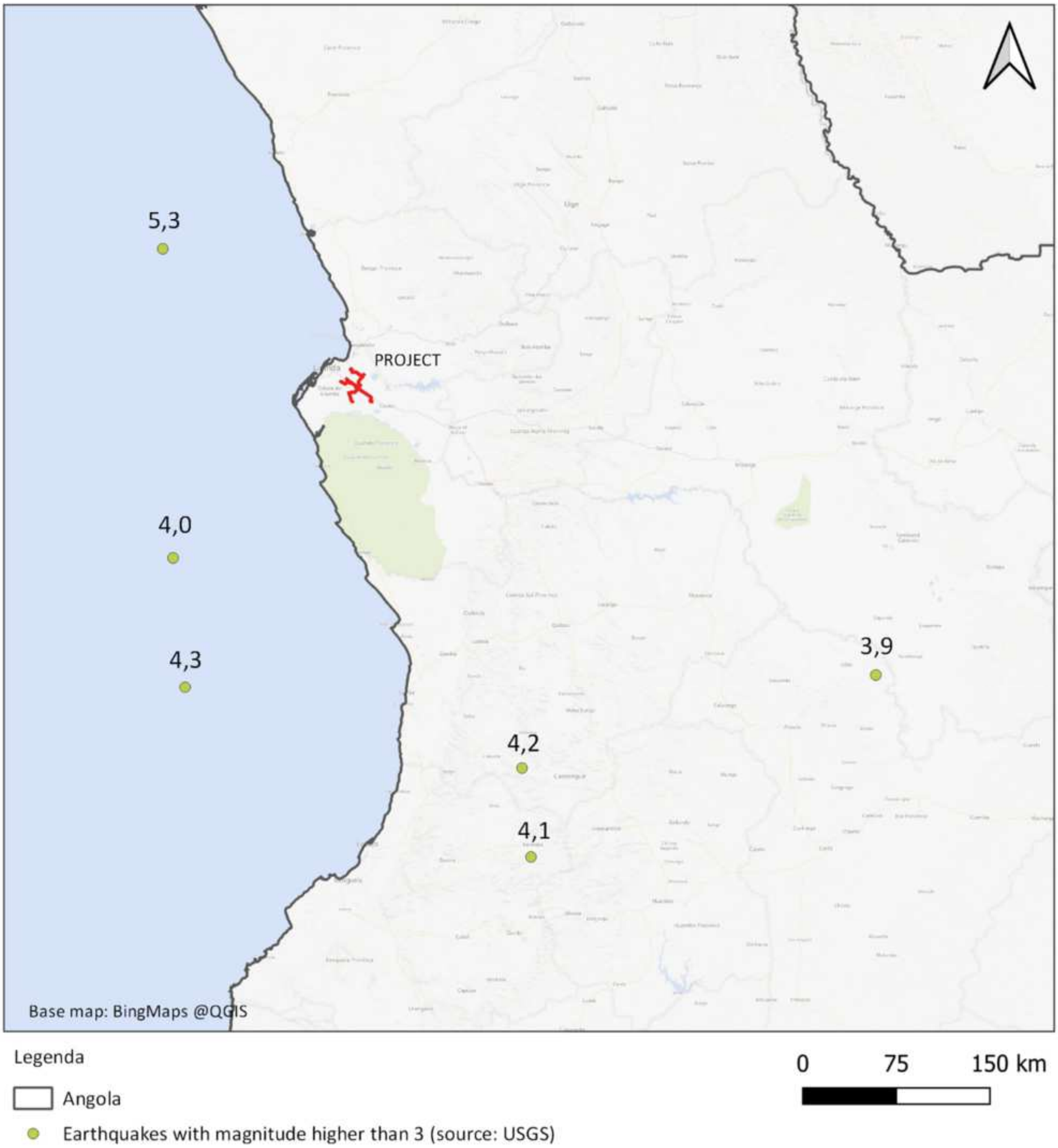


Figure 102: Location of earthquakes with magnitudes equal to or greater than 3 since January 2000.

Table 35: Localisation of earthquakes in the region around Luanda.

Magnitude	Site	Coordinates (WGS84)	Depth	Occurrence date
5,3	121 km SW of N'zeto, Angola	7,946ºS / 12,026ºE	10.0 km	19/10/2001
4,3	180 km W of Sumbe, Angola	11,194ºS / 12,192ºE	10.0 km	05/10/2018
4,2	67 km SW of Uacu Cungo, Angola	11,794ºS / 14,691ºE	15.1 km	19/11/2013

Magnitude	Site	Coordinates (WGS84)	Depth	Occurrence date
4,1	73 km NW of Longonjo, Angola	12,452ºS / 14,757ºE	15.0 km	10/11/2014
4,0	198 km SW of Luanda, Angola	10,237ºS / 12,103ºE	10.0 km	13/12/2004
3,9	102 km N of Camacupa, Angola	11,102ºS / 17,315ºE	10.0 km	08/10/2006

Regarding occurrences of outcrops, classified as geological heritage with conservation status, no occurrences are identified in the bibliography.

However, in a recent initiative, called "Seven Natural Wonders of Angola", there were three occurrences in Luanda province classified as finalists, namely: Mussulo Island, Miradouro da Lua and Quiçama National Park.

The Project area does not interfere with or overlap with any of these occurrences.

For a more detailed geological description, 33 sites were visited during a field survey carried out between 27 August and 1 September 2014. The main characteristics of these sites are summarized APPENDIX A.

7.1.2.3 Geological Resources

About 250 deposits and mineral occurrences of economic interest are known in Angola. The most important deposits are oil, gas, diamonds, iron, manganese, gold, copper, lead, crystalline quartz, muscovite, anorthosites, marbles, bitumen, fluorite, titanium, rock salt and potassium salts.

The Cretaceous, Palaeogene and Neogene formations where oil deposits accumulate are considered productive. The distribution of the deposits is mostly determined by the existence of salt domes and block and step structures of the Cretaceous-aged terrigenous-carbonate and essentially carbonate sequences. The deposits are related to anticlinal structures that are often located along tectonic accidents of sub-meridional orientation. Three oil basins are defined: Cabinda, Congo and Kwanza. Industrial oil reserves have been detected at depths of up to 3000 meters.

In the Kwanza basin there are 10 oil and gas fields (Benfica, Mulenvos, Bento, Quenguela, Galinda, Tobias, among others). The most productive layers are located in the organogenic limestones of the Binga, Tuenza and Catumbela formations and, with less importance, in the Eocene, Oligocene and all typeslower Miocene marls (Araújo & Guimarães, 1992).

The same paper, now more than 30 years old, stated: "The exploitation of most of these deposits is already at an end. However, if more sophisticated methods of extraction are used, it can still be continued profitably".

According to the Geographical Atlas of natural Angola - Secondary Education (2008) the following geological resources (still unexploited in 2008) occur in the province of Luanda: petroleum and urbanized environments encountered in limestone. In this same document only limestone appears as a resource with active exploitation (although in the north of Luanda), at about 15 km north of the closest project area (Kapalanca DC).

According to information provided by the ANPG, there are several blocks (e.g. KON5) in the AOI that have recently been tendered but are not yet being exploited (Figure 23). In a few days, "Sonangol Pesquisa & Produção" will begin oil and gas exploitation at the Tubias well in the Kwanza onshore block (KON-11), located in the Cabo Ledo commune, Luanda province and south of the project area.

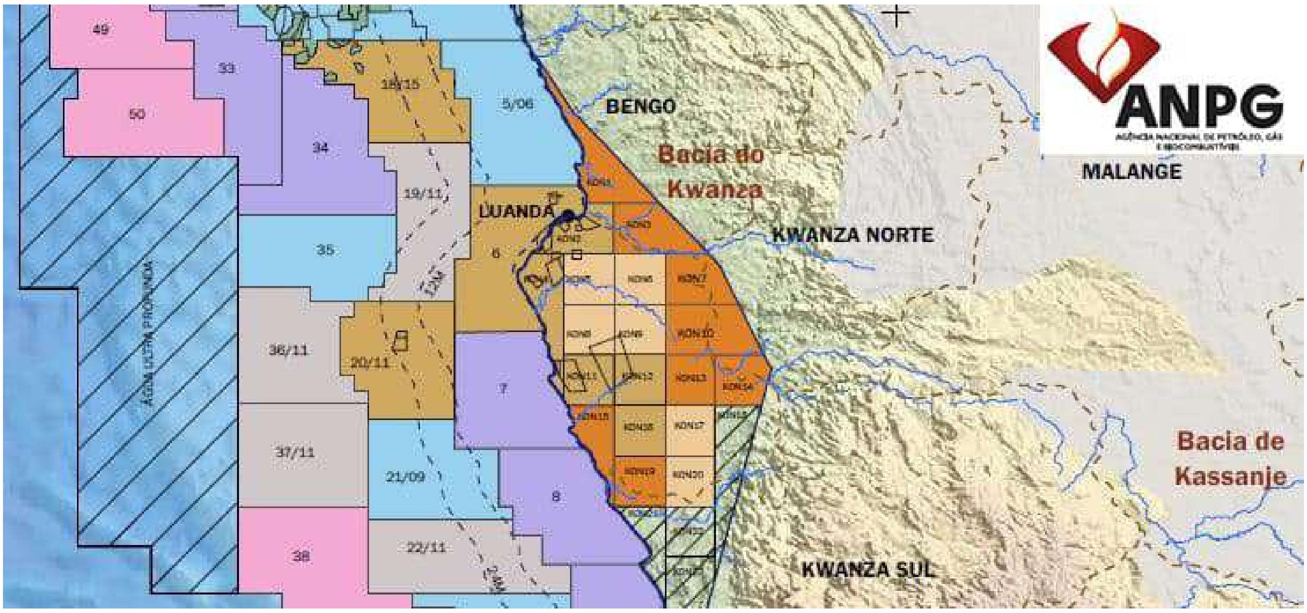


Figure 103: Concessions for hydrocarbon exploitation in the province of Luanda and neighboring provinces (ANPG).

7.1.3 Hydrogeology and Groundwater

The project area is based on the Quelo-Luanda aquifer system. This detrital aquifer system covers an area of 1900 km^2 and lies between parallels 8º 45' S and 9º 21' S and between meridians 13º 02' E and 13º 37' E (Luís Miguel *et. al.*, 2003).

The Quelo-Luanda aquifer system is hosted in detrital materials, of stratigraphically ages between the lower Pliocene and the Holocene.

Permeability is in the range of 1 to 3 m/day, contrasting with the low permeability of the underlying Miocene Quifangondo formation.

Luís Miguel *et. al.* (2003) advocate that the whole of this system can function as a "multilayer" system in which, due to the numerous lateral and vertical variations in facies, heterogeneity plays an important role.

As a conceptual model of the aquifer system, the same authors present the diagram in **Figure 104**, highlighting the geometric irregularity of the system as a consequence of tectonic activity (it is observed a major normal fault, with significant vertical rejection, to the east). The thickness of the system varies from less than 100 m for the Quelo, Luanda and Cacuaco formations (around Luanda) to more than 500 m in the southern sector of the region.

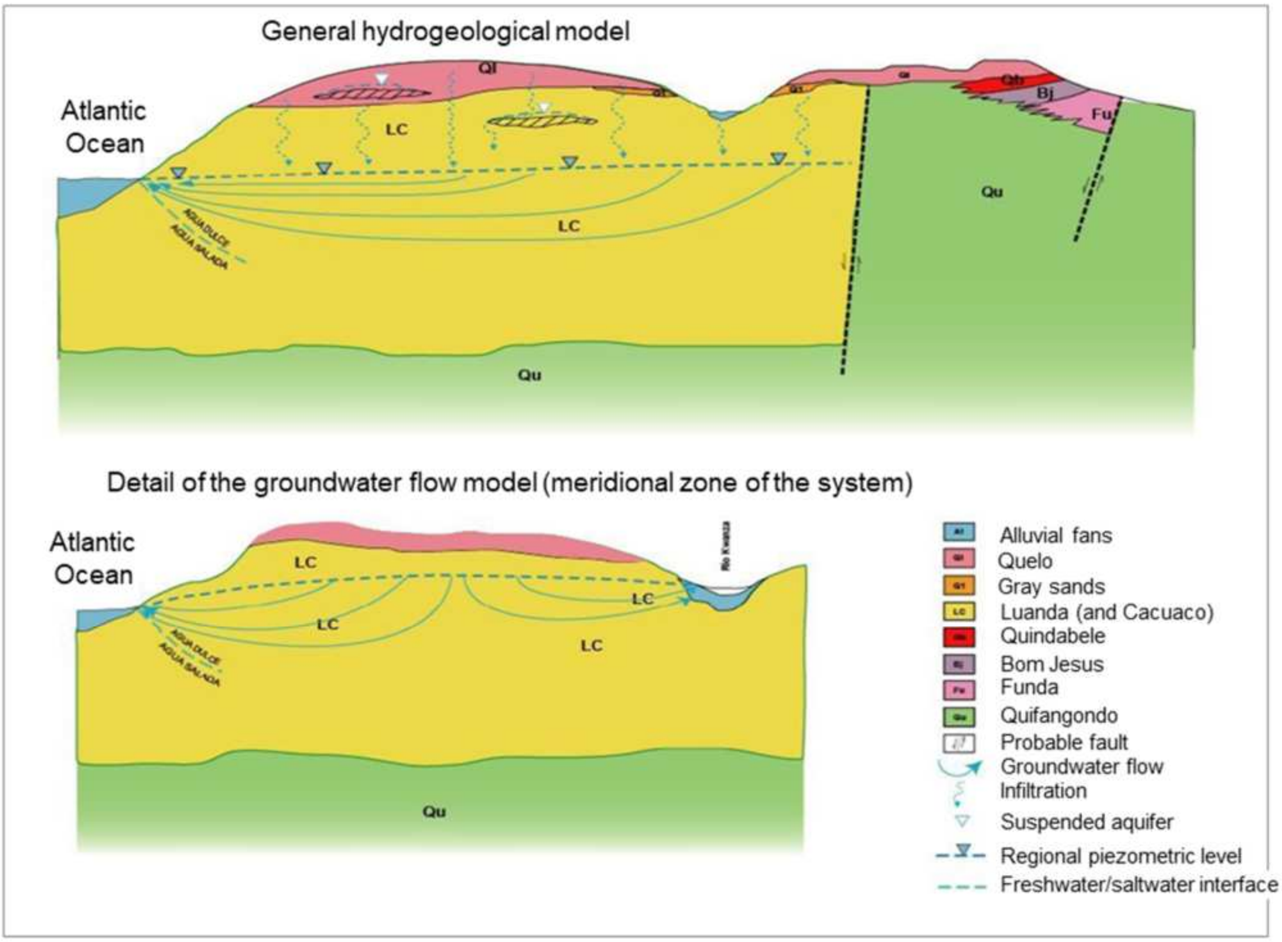


Figure 104: Conceptual (preliminary) model of the Quelo-Luanda aquifer system [adapted from Luís Miguel et. al. (2003)].

The system's regional groundwater level is generally found between 60 and 100 m depth, although on a local scale there are some suspended aquifers (related to the lithological heterogeneity of the Luanda Formation, namely more clayey levels).

According to (M.Pereira & G.Miguel 2019) for a set of 53 groundwater abstractions the piezometric levels are around 63 meters deep.

In the projects Lots, Sinohydro developed an extensive work of geotechnical surveys between August 2018 and November 2020 mainly focused on the section between the water abstraction facility and the WTP/STP. It was also developed a search for other available geotechnical surveys in the Luanda area, and it was possible to consult several reports from Geosol and Techansol companies, with data from May 2016 to May 2020.

Of a set of 173 boreholes, from Sinohydro, Geosol and Technasol, with the spatial distribution shown in **Figure 105** only 13 had an intersected water table. In these boreholes, the water table was between 0.30 and 12.00 meters deep, corresponding to suspended aquifer levels. One of these boreholes is located near the PIV DC (lot09). None of these boreholes are in the area of the WTP/STP.

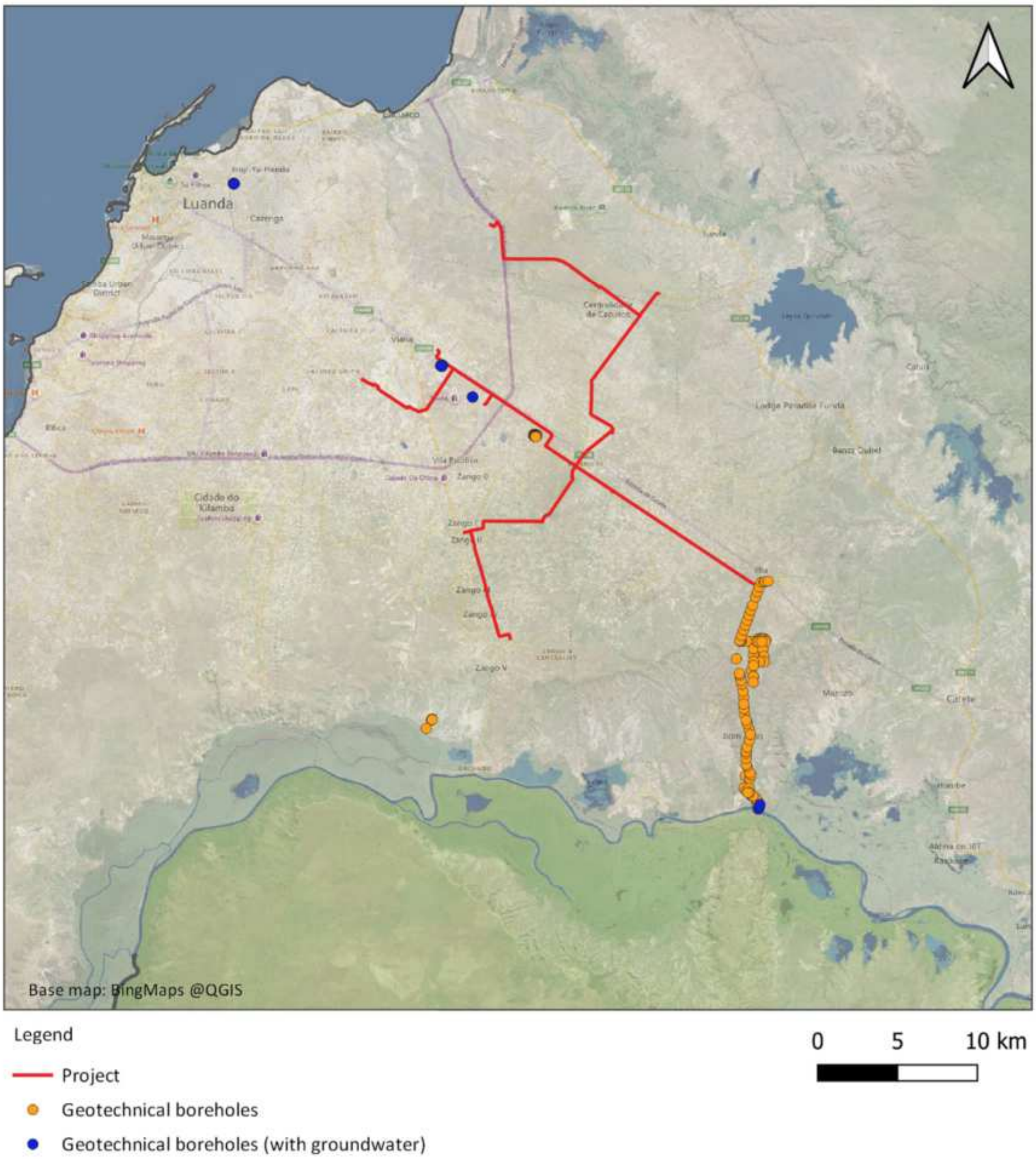


Figure 105: Location of Geotechnical boreholes (Sinohydro).

Underground water flows predominantly in an E-W direction, with very low velocities in most of the system, as a result of the small hydraulic gradient and moderate permeability. With an effective porosity of 20 %, a permeability between 0.14 and 5.3 m/day and a hydraulic gradient between 1×10^{-3} and $4,5 \times 10^{-3}$, the maximum velocity in the system is 0.12 m/day and the minimum at the productive levels is around 1 mm/day.

This order of magnitude of groundwater velocity allows for a longer residence time in the aquifer system, generally providing significant electrical conductivity values even if the system is fundamentally made up of detrital materials.

In terms of groundwater to surface water hydraulic relation, it is assumed that the River Kwanza predominantly receives a small part of the system's groundwater discharge. Occasionally, and in extreme flood situations, the hydraulic conditions can be reversed, with water from the River Kwanza entering the aquifer system.

The hydrogeochemical characterization of the aquifer system indicates a functioning that broadly follows the scheme proposed by Chebotarev for large sedimentary basins; this is characterized by a progressive dominance of ions with a higher solubility product, particularly chloride ion, in the discharge zones, although other factors that may also intervene in this phenomenon are also present in the region (Luís Miguel *et. al.*, 2003).

According to the same authors, the electrical conductivity values of groundwater measured in various wells located more than 7 km from the coastline are in the order of 1200 µS/cm.

According to Pereira & Miguel (2019), for a set of 53 groundwater abstractions, and for sampling campaigns carried out between 2003 and 2008, the following results were obtained:

- Average water temperatures between 26.3 and 26.9 ºC;
- pH between 6.3 and 7.6;
- Electrical conductivity of less than 6000 µS/cm, with the exception of groundwater points located in A. Matos.
- There is a prevalence of calcium bicarbonate, sodium bicarbonate, calcium chloride and sodium chloride facies.
- There is also saline intrusion in some sectors of the aquifer system.

It should be mentioned that, for the social baseline, surveys (inquiries) were conducted at households (100 surveys) in the communities around the project. None of the households interviewed mentioned the use of groundwater, and no hand dug well or borehole were identified near the households.

The Angolan National Institute of Water Resources also provided no information on licensed groundwater abstraction in the region. Despite this apparent lack of groundwater use in the region, it is expected that some industries, especially associated with the beverage sector, especially in the Bom Jesus Area, use some groundwater extraction points for process water. However, it wasn't possible to obtain specific data, either directly from the companies or though the Angolan National Institute of Water Resources (INRH).

The (Geological Institute of Angola (IGEO) s.d.)(IGEO) also has, in its Hydrogeology cartography catalogue, a mapping of water wells/boreholes, but with data available only for the southwest part of the country, thus not providing any data for Luanda.

Only one groundwater borehole initially built for sweet water supply was identified in the vicinity of the project area (5 km NE of Bom Jesus: 9,141º S / 13,600º E). However, according to locals, the water became salty and the borehole was filled in and abandoned few years ago (**Figure 106**).

Figure 106: Abandoned and filled in borehole.

7.1.4 Hydrometric conditions of the Kwanza River

7.1.4.1 The Kwanza Watershed

The Kwanza river watershed covers an area of over 148,000 km^2, or approximately 12 % of the national territory. The boundary of the watershed draining the study site was determined by analyzing the altitudes provided by a Digital Terrain Model (30-meter SRTM, NASA).

Despite the low gradient of the study catchment, the boundaries were precisely defined using the digital terrain model analysis method.

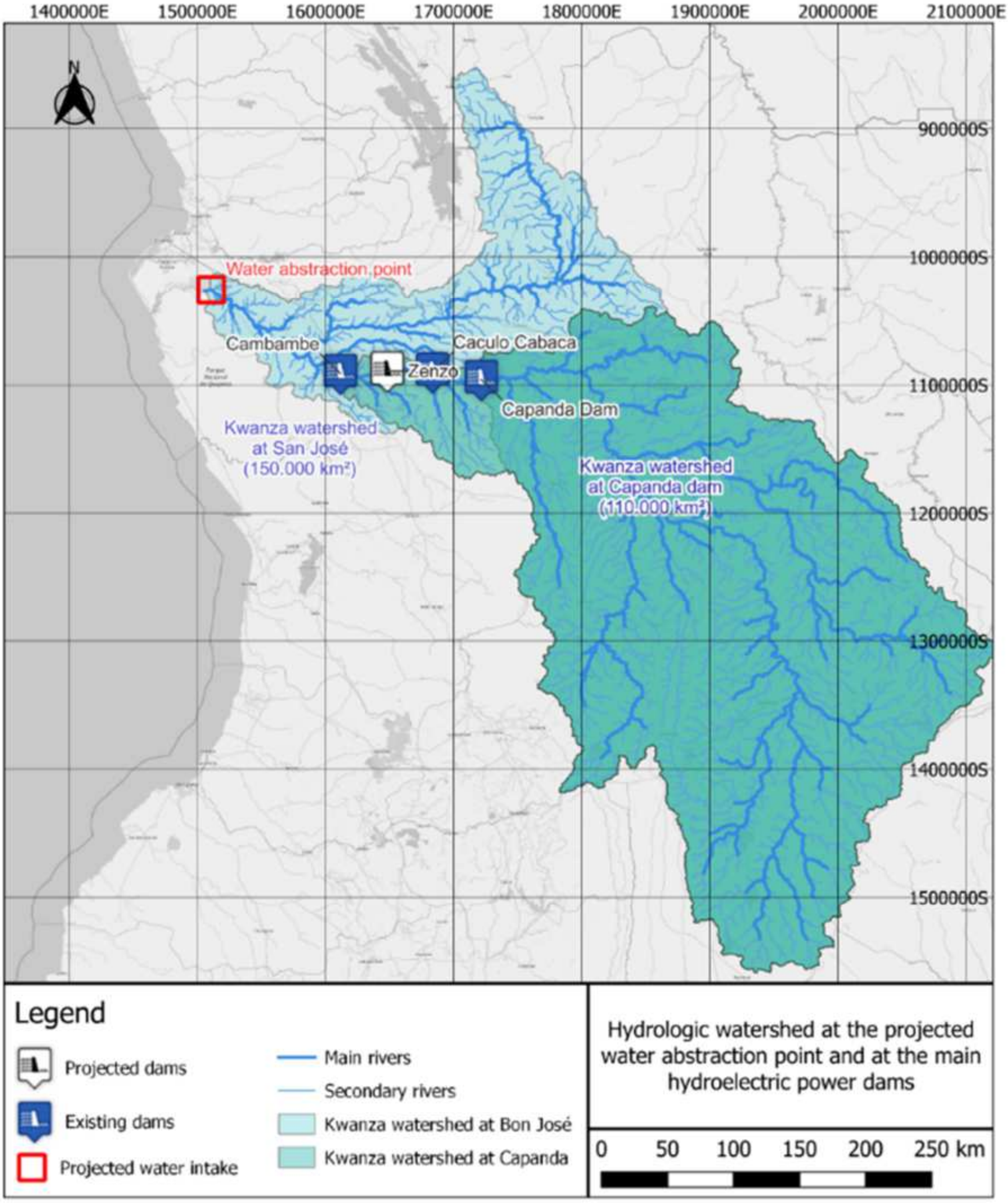


Figure 107: Hydrological watershed at the projected water abstraction point and at the main hydroelectric power dams

7.1.4.2 Hydrometric data

Data from three hydrometric stations managed by the Institute of Water Resources of the Angolan Ministry of Water and Energy, active over the period 1950 - 1980, were identified and constitute good reference stations for the study of Kwanza hydrology, due to their geographical proximity and similarity to the study watershed.

The following Table 36 also shows the characteristic flows calculated from daily data for these stations.

Table 36: Characteristic flows observed at historical hydrometric stations near the Water Abstraction Point

Reference	Name	River	Annual mean	Specific flow rate	Minimum monthly mean (QM)	QMNA5	Observation period
			m³/s	l/s	m³/s	m³/s	[Start ; End]
601908	CAMBAMBE	Kwanza	539,50	4,66	201,41	169,30	[1951 ; 1972]
			561.4	4.85	194.46	170.2	[1951 ; 1956]
			484.9	4.19	213.1	164.0	[1971 ; 1972]
601944	CANGANDALA	Kwanza	616,20	6,37	184,25	143,27	[1967 ; 1982]
			679.5	7.0	199.3	156.5	[1967 ; 1973]
			510.7	5.3	159.07	143.3	[1979 ; 1982]
601930	LUCALA	Lucala	132,54	5,86	45,42	40,43	[1967 ; 1974]

The following graph shows observed rainfall in the Kwanza watershed over the period 1901 - 2021), the 3 stations operating periods and Kwanza dam construction periods. The diagram reveals that meteorological histories and projections present a relatively stable climate and hydrometeorological regime in the Kwanza watershed over recent decades.

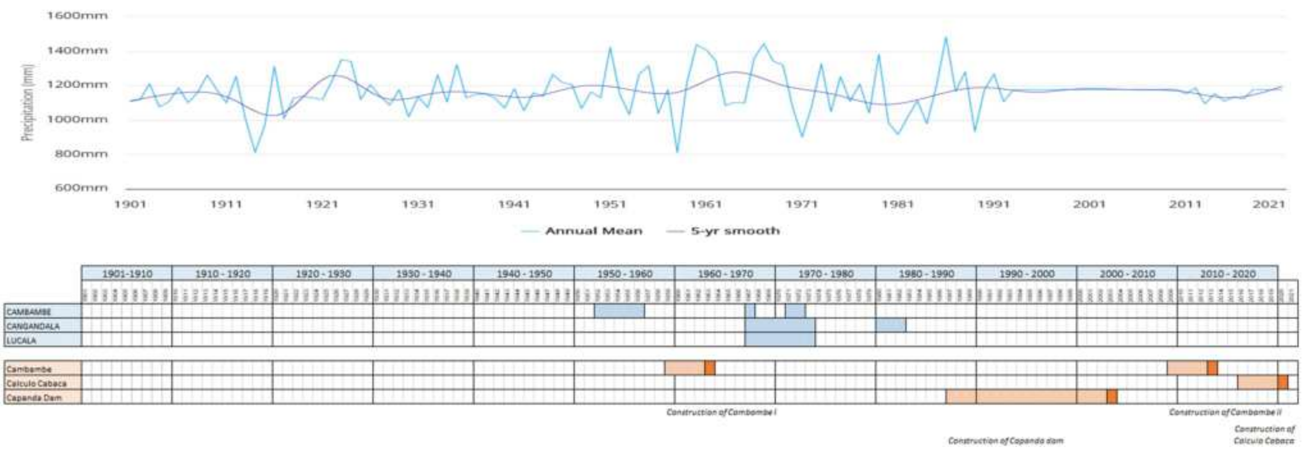


Figure 108: Observed rainfall in the Kwanza watershed over the period 1901 - 2021), station operating periods and Kwanza dam construction periods

In April 2018, two flow surveys were carried out on the River Kwanza near the location of the catchment planned for this project. The flow rates obtained are between 390 and 395 m^3/s, corresponding to water velocities between 0.43 and 1.09 m/s (SINOHYDRO, 2018)."

7.1.4.3 Hydrological analysis

The aim of the analysis is to :

- identify the specific flows applicable to the study catchment area,
- multiply the latter by the surface area of the catchment area drained by the site under study.

The three selected stations allow describing the hydrology of the Kwanza Watershed at the water abstraction point:

- Station 601944 CANGANDALA characterizes the hydrology of the median Kwanza upstream of the hydroelectric facilities.
- Station 601930 LUCALA is used to characterize the hydrology of the Lucala tributary, which has little influence on the river's hydrology and constitutes a natural inflow for al Kwanza downstream of the hydroelectric facilities.
- Station 601908 CAMBAMBE characterizes the hydrology at the power station of the same name, the first of three hydroelectric power stations along the river. The historical chronicles available for this station allow also to characterize the natural hydrology of the river during the 1950s. Considering relatively stable climate and hydrometeorological regime in the Kwanza watershed over recent decades and a limited land use change upstream of the Study area, these chronicles can be considered relatively representative of the present natural hydrology of the Kwanza (the hydrology that the Kwanza would present in the absence of hydroelectric works). For this reason, the CAMBAMBE station was selected for carrying out the reconstruction of the hydrology of the Kwanza River at the water abstraction point.

The CAMBAMBE station present the following flow characteristics:

- Average flow rate : 561 m^3/s
- Specific flow rate 4.8 l/s/km2
- QMNA5 170 m^3/s

The hydrology at the water abstraction point can therefore be determined by simply applying a ratio reflecting the difference in drained surface between the reference station and the study site (1.28) or using the specified flow rate and the following formula :

$$\textbf{Average flow rate}_{\textbf{abstraction point}} = \text{WSsurface}_{\text{abstraction point}} \times \text{Specifc flow rate}_{\text{référence station}}$$

$$= 148{,}222\ km^2 \times 4.85\ l/s/km^2 / 1000 = \mathbf{719\ m^3/s}$$

$$\textbf{QMNA5}_{\textbf{abstraction point}} = \text{WSsurface}_{\text{abstraction point}} \times \text{specificQMNA5}_{\text{référence station}}$$

$$= 148{,}222\ km^2 \times 1.47\ /s/km^2 / 1000 = \mathbf{218\ m^3/s}$$

Detailed hydrological analysis is presented in APPENDIX N

7.1.5 Surface water quality

7.1.5.1 Regulatory Framework

The regulation on water quality (which contains the national water quality standards) was published in the Official Gazette in the form of Presidential Decree No. 261/11 of October 6, 2011. This decree establishes water quality standards and criteria, with the aim of protecting the aquatic environment and improving water quality, depending on its main uses. The provisions of the law apply to inland waters, both surface and groundwater, as well as waters for aquaculture, livestock, agricultural irrigation, and bathing. This law also regulates the rules for controlling the discharge of wastewater into national water bodies and the soil, with the aim of preserving the quality of the aquatic environment and protecting public health.

For the quality parameters set out in that law, the following have been defined:

- maximum admissible values (MAV), which indicate the quality standard values that must not be exceeded;
- maximum recommendable values (MRV), which indicate the quality standard values that must be respected or not exceeded; and
- emission limit values (ELV), which indicate the concentration value of certain substances that may not be exceeded by discharge into the aquatic environment and soil.

The quality standards for drinking water are presented in Annex I and the minimum quality standards for surface water are in Annex IX. The wastewater discharge quality limits, into the receiving aquatic environment, is established in Annex VI of Presidential Decree No. 261/11.

The quality objectives for the effluent treated and released into the environment include the concentrations shown in **Table 37**.

Table 37: Effluent quality objectives after primary treatment.

Parameter	Characteristics of the effluent entering the system	Characteristics of the effluent leaving the system (after primary treatment)
Total suspended solids (TSS)	300 mg/L	200 mg/L
BOD5	300 mg/L	100 mg/L
pH	6 - 9	7 – 9
Total coliforms	108 – 1010 UFC/100mL	0 MPN
Fecal coliforms	106 – 108 UFC/100mL	0 MPN
Total nitrogen	50 mg/L	50 mg/L
Total phosphorus	15 mg/L	15 mg/L
BOD5 - Biochemical oxygen demand; CFU - Colony forming units; MPN - Maximum Probable Number		

Water quality is a critical issue in the more densely populated parts of Luanda, and has been for some years now, as a direct result of the sudden increase in population in the capital. However, near a significant part of the Project area (the closest to the abstraction site and the WTP), this issue is considered not critical, due to the substantially lower population density.

The sanitation of the Quimbos in the Bom Jesus region consists of individual septic tank systems (such as the one shown in **Figure 109**) that collect effluent from individual houses or groups of houses.

Figure 109: Individual septic tank, under construction.

7.1.5.2 Data from public institutions

In Luanda province, water quality is monitored by EPAL's water analysis laboratory. EPAL has provided the data in the table below (**Table 38**), relating to sampling carried out in 2013 and 2015.

Table 38: Concentration ranges in water samples (without treatment) from the Kwanza River (source of data: EPAL).

Parameter	Samplings (year 2013)	Samplings (year 2015)	Acceptable limit for treated water
Turbidity (NTU)	8.0 – 34.3 (#12)	5.5 – 48.0 (#12)	5
pH	6.5 – 7.2 (#12)	6.3 – 7.5 (#12)	6,5 – 8,5
Electric conductivity (□S/cm)	55.0 – 65.7 (#12)	12.0 – 57.0 (#12)	500
Hardness (ºF)	2.3 – 5.9 (#12)	2.0 – 5.4 (#12)	30
Oxidisability (mg/L O_2)	1.4 – 3.5 (#11)	1.4 – 3.4 (#12)	2,0
Calcium (mg/L)	7.1 – 10.9 (#12)	7.2 – 14.2 (#11)	75
Magnesium (mg/L)	0.6 – 4.6 (#9)	0.1 – 8.8 (#11)	30
Hydrogen carbonates (mg/L HCO_3)	18.9 – 31.7 (#12)	6.1 – 26.7 (#12)	-
Total coliforms (/100mL)	2.2 x 104 - 8.8 x 104 (#4)	1.0 x 105 (#1)	0
Fecal coliforms (/100mL)	19 – 120 (#4)	46 (#1)	0
Faecal streptococci (/100mL)	2 – 26 (#4)	25 (#1)	0
Sulfite-reducing clostridia (/20mL)	2.4 x 102 - 6.8 x 102 (#4)	2.2 x 102 (#1)	0

7.1.5.3 Data from the previous ESIA (2014)

With a view to strengthening the data of Angolan public institutions, the characterization of water quality in the Project area (along the Kwanza River) and its immediate surroundings was reinforced with *in situ* measurements (28/08/2014 to 01/09/2014) and sampling for laboratory analysis. The location of the sampling points is shown in **Figure 110**. Approximately 18 km were covered by boat between the most upstream sampling point ("RHid10") and the most downstream sampling point ("RHid12").

In situ measurements (water temperature, pH, redox potential, electrical conductivity, dissolved oxygen, and turbidity) were carried out at ten surface water sites (predominantly on the Kwanza River). **Table 39** shows the results.

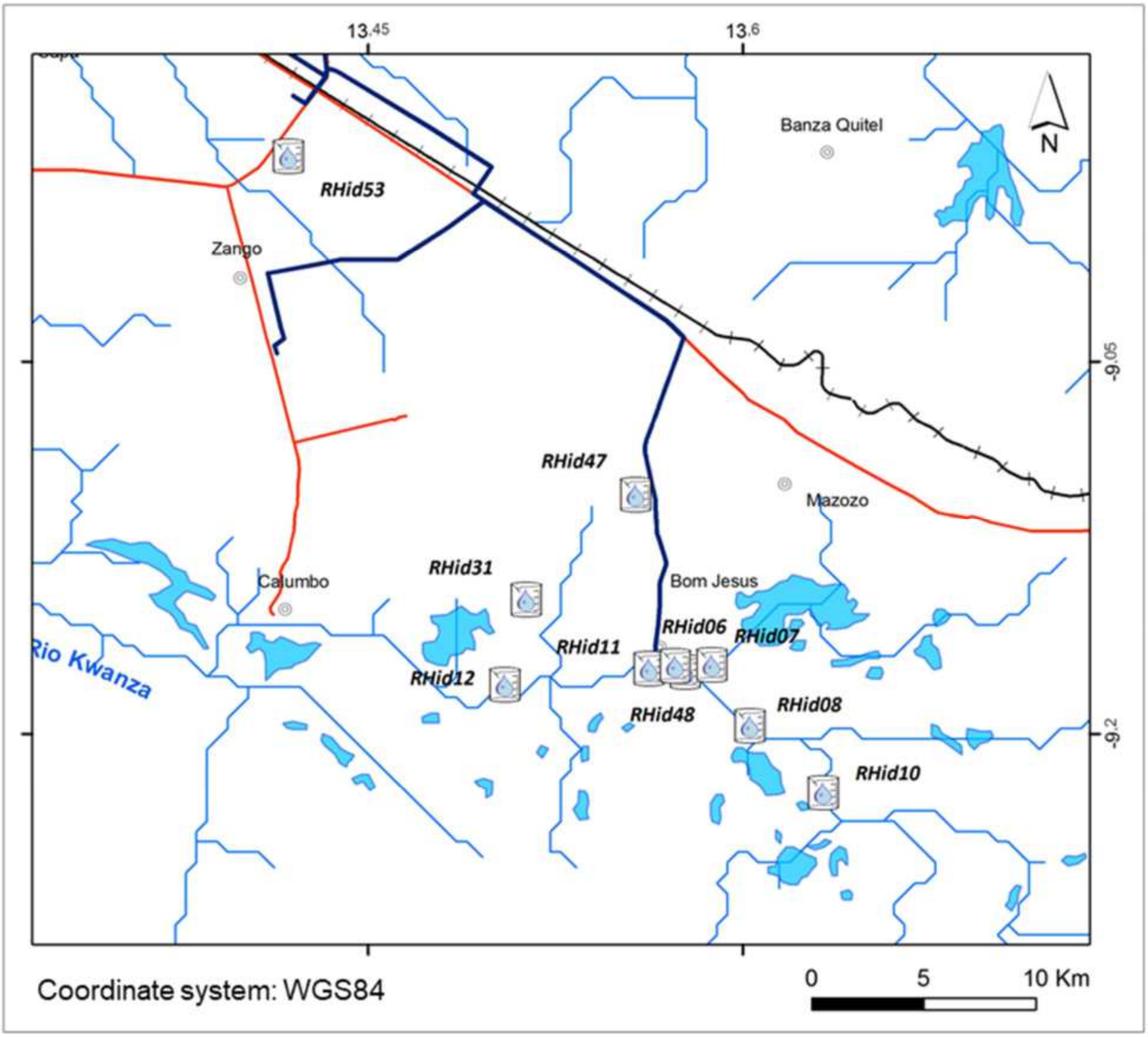


Figure 110: Geographical location of surface water quality monitoring points (ESIA, 2014).

Table 39: Results of in situ measurements of water quality parameters (ESIA, 2014).

Sampling point reference	Water temperature (ºC)	pH	Eh (mV)	Electrical conductivity (□S/cm)	O_2 (mg/L)	O_2 (% sat.)	Turbidity (FNU)
RHid06	24.7	7.66	-24.0	41.4	8.13	97.5	-
RHid07	24.6	7.67	-24.9	41.6	7.76	92.9	9.35
RHid08	24.7	7.80	-32.1	41.6	8.05	97.3	9.05

Sampling point reference	Water temperature (ºC)	pH	Eh (mV)	Electrical conductivity (µS/cm)	O_2 (mg/L)	O_2 (% sat.)	Turbidity (FNU)
Rhid10	25.0	8.11	-48.9	41.5	8.18	99.0	9.82
Rhid11	25.1	8.22	-54.7	41.5	8.13	98.6	6.92
Rhid12	24.7	7.93	-39.0	41.5	8.08	97.5	6.20
Rhid48	24.1	7.46	-13.1	41.9	7.30	86.2	8.63
Rhid53	27.2	7.77	-30.3	124.8	7.64	97.8	32.6
Rhid31	23.5	7.25	-1.6	107.3	4.92	58.0	21.5
Rhid47	22.9	8.09	-47.5	272.0	1.88	22.1	30.3

The measurements taken in the Kwanza riverbed are highlighted.

From the results presented in **Table 39**, the high homogeneity of the values measured at different locations on the Kwanza River stands out (24,1 < T < 25.0 ºC; 7.5 < pH < 8.1; -55 < Eh < -13; 41.4 < CE < 41.9 µS/cm; 7.3 < O_2 < 8.2 mg/L; 6.2 < turbidity < 9.8 FNU).

These values, particularly with regard to the electrical conductivity parameter, are perfectly comparable with the values obtained in another study developed by Ecovisão Angola in March 2013 on the same Kwanza River, albeit a few kilometers downstream (as referenced in the 2014 ESIA from Ecovisão/Artelia). In this complementary study, developed in 2013 by Ecovisão Angola, the electrical conductivity of the water in the Kwanza River was between 37 and 48 µS/cm. The water temperature was between 27.9 and 29.0 ºC (slightly higher than now measured) and the pH showed slightly more acidic values, i.e. between 6.6 and 7.0.

The electrical conductivity and dissolved oxygen concentration of the "Rhid47" sample (less than 1km from the CIF cement plant) strongly suggest that it is an effluent from this industry[1].

The values presented in the previous table were obtained in-situ, along the Kwanza River, using portable meters. A more detailed characterization of the water quality in the Kwanza River was developed, by samples collection ("Rhid48" sample), and laboratory analysis, with the results presented in **Table 40**.

Table 40: Results of laboratory analysis of water quality parameters (ESIA, 2014).

Parameter	RHid48	VMR	VMA
pH	7.7 (23.7ºC)	6.5 - 8.5	-
Electrical conductivity (µS/cm)	50	1000	-
Color (mg/L, scale Pt-Co)	< 10 (LQ)	10	20
Smell (Dilution Factor at 25 ºC)	1	3	-
Arsenic (mg/L As)	< 0.002 (LQ)	0.01	0.05
Cadmium (mg/L Cd)	< 0.0002 (LQ)	0.001	0.005
Chlorides (mg/L Cl-)	40	200	-
Sulphates (mg/L SO_4^{2-})	11	150	200
Total nitrogen (mg/L N-tot)	< 1.0 (LQ)	-	-

[1] This situation, recorded in 2014, has not been confirmed recently.

Parameter	RHid48	VMR	VMA
Calcium (mg/L Ca)	4	-	-
Aluminum (mg/L Al)	0.2	-	-
Total hardness (mg $CaCO_3$/L)	18	-	-
COD13F2 (mg O_2/L)	8	-	-
Chromium VI (mg/L Cr_6^+)	0.02	-	0.05
Total Alkalinity (mg $CaCO_3$/L)	20	-	-
Nitrates (mg/L NO_3^-)	1	25	50
Nitrites (mg/L NO_2^-)	< 2	-	-
Bicarbonates (mg $CaCO_3$/L)	20	-	-
Phosphates (mg/L P_2O_5)	< 0.02 (LQ)	0.4	-
Dissolved Iron (mg/L Fe)	0.1	0.1	0.3
Manganese (mg/L Mn)	0.05	0.05	-
Lead (mg/L Pb)	< 0.005 (LQ)	-	0.05
Cyanides (mg/L CN)	0.03	-	0.05
Magnesium (mg Mg/L)	3	-	-
Nickel (mg/L Ni)	< 0.006 (LQ)	-	-
Potassium (mg/L K)	1.6	-	-
E. Coli and Total Coliforms (u.f.c /100 mL)	> 300	50	-
Fecal streptococci (u.f.c /100 mL)	> 300	20	-
Fecal Coliforms (u.f.c /100 mL)	> 300	20	-
No. of colonies at 22ºC (u.f.c /mL)	77	100	-
No. of colonies at 37ºC (u.f.c /mL)	118	10	-

LQ - Limit of quantification. The limit values indicated are in accordance with Presidential Decree No. 261/11 - Annex I (Class A1). VMR - Maximum Recommended Value / VMA - Maximum Allowable Value.

From reading the Table 8, the following conclusions stand out:

- The water of the Kwanza River is very poorly mineralized, with a pH close to neutral. This low mineralization gives the water little buffering power, making it vulnerable to physical and chemical contamination phenomena;
- In physicochemical terms, the water does not present any significant contamination or alterations. Only the iron and manganese parameters are at the limit established by the "VMR" quality standard for drinking water;
- The microbiological results show non-compliance with the drinking water criteria (normative values from EPAL, WHO, EU, etc.). Some of the causes of this non-compliance are presented in the next section about Polluting Sources.

[2] Chemical Oxygen Demand (COD)

7.1.5.4 Additional field data (July 2023)

In order to refine and update the characterization of the Kwanza River's water quality, in 2023 an additional sample was collected (reference WR01), on 13 July 2023, for subsequent laboratory analysis. The analytical results are shown in **Table 41**.

Table 41: Water quality results (water sampled 13 July 2023).

Parameter (units)	WR01	Guidelines
pH	6.9	6.5 – 8.5 (*) (**)
Electrical conductivity (μS/cm)	56.4	500 (*); 1000 (**)
Water temperature (ºC)	17.2	22 (**)
Dissolved oxygen (mg/L)	4.8	-
Total suspended solids (mg/L)	13.4	25 (**)
Total dissolved solids (mg/L)	128.9	-
ORP (mV)	224.5	-
Total petroleum hydrocarbons (mg/L)	≤ 0.02	0.05 (***)
BOD_5 (mg/L)	**26.9**	3 (**)
COD (mg/L)	105.6	-
Magnesium (mg/L)	8.2	30 (*)
Calcium (mg/L)	67.3	75 (*)
Sodium (mg/L)	15.9	-
Potassium (mg/L)	1.5	-
Fluoride (mg/L)	0.81	1.5 (***)
Chloride (mg/L)	182.9	200 (**)
Hydrogen carbonates (mg/L)	117.5	-
Sulphate (mg/L)	31.6	150 (**)
Silicate (mg/L)	7.9	-
Cyanide (mg/L)	≤ 0.1	0.05 (***)
Ammoniacal nitrogen (mg/L)	0.0	0.05 (**)
Nitrate (mg/L)	0.8	25 (**)
Nitrite (mg/L)	0.02	-
Phosphate (mg/L)	0.09	0.4 (**)
Silver (mg/L Ag)	≤ 0.005	-
Arsenic (mg/L As)	≤ 0.003	0.01 (**)
Aluminum (mg/L Al)	≤ 0.005	-
Chromium (mg/L Cr)	0.008	0.050 (***)
Lead (mg/L Pb)	≤ 0.003	0.050 (***)
Zinc (mg/L Zn)	**3.8**	0.5 (**); 3 (***)

Parameter (units)	WR01	Guidelines
Nickel (mg/L Ni)	0.005	-
Mercury (mg/L Hg)	≤ 0.005	0.001 (***)
Cadmium (mg/L Cd)	≤ 0.005	0.005 (***)
Copper (mg/L Cu)	≤ 0.005	0.02 (**)
Iron (mg/L Fe)	**0.19**	0.10 (**); 0.30 (***)
Manganese (mg/L Mn)	0.026	0.050 (**)
Total coliforms (CFU/100mL)	**893**	50 (**)
Fecal coliforms (CFU/100mL)	**274**	20 (**)
E. Coli (CFU/100mL)	1482	-
Fecal streptococci (CFU/100mL)	151	20 (**)
Germs @ 22ºC (CFU/100mL)	1392	10000 (**)
Germs @ 37ºC (CFU/100mL)	727	1000 (**)

‘(*) Acceptable limit for treated water; (**) VMR (Maximum Recommended Value) @ Presidential Decree No. 261/11 - Annex I (Class A1); (***) VMA (Maximum Allowable Value) @ Presidential Decree No. 261/11 - Annex I (Class A1)

Concentrations above reference criteria were measured for the following parameters: biochemical oxygen demand (BOD_5), zinc (Zn), iron (Fe); total and fecal coliforms.

Compared to previous sampling performed during the ESIA baseline of 2014, these recent analytical results confirm a notable and constant microbiological contamination of the Kwanza river.

7.1.5.5 Polluting Sources

For some years now, the Luanda region, like much of the country, has seen intense construction activities (residential, industrial, various infrastructures). However, with a few exceptions, this dynamic has not been accompanied by growing environmental concerns, particularly with regard to preserving water quality.

In and around the project area there are a number of infrastructures and/or economic activities that can potentially release pollutants to the water environment, both surface water and groundwater.

The following aspects, mentioned in 2014 (ESIA, 2014), are noteworthy:

- Uncontrolled open dumping of various types of waste ;
- Extractive activity (particularly of sandy materials) with little or no environmental concern ;
- Intensive and irrigated agriculture, in which large quantities of chemically synthesized fertilizers and phytopharmaceuticals are usually used, causing water eutrophication ;
- Using the Kwanza River or its tributaries for bathing, washing cloths and kitchenware/tableware, using detergents and/or soaps ;
- Discharge of liquid industrial effluents ;
- Discharge of fine-grained aggregates (silts and clays) in an abandoned sandpit ;
- Selling of fuel, lubricants, additives, and oils on the roadside, without any containment of spills ;
- Settlements (without any pits or with poorly constructed pits).

Stagnant, eutrophied water can also be observed in some places, sometimes with a pronounced smell and color.

7.1.6 Soil Quality

According to the Geographical Atlas of Angola (1982), the Luanda region is characterized by the presence of chromopsamic soils, which are part of the psammitic soil class, defined as poorly evolved soils made up of more or less coarse and loose sandy detrital materials. These soils have little or no differentiation, and their texture is extremely light, with a low organic matter content and a moderately acid pH.

According to (C.Diniz 2006,)the project area overlaps four different types of soil. Thus, from south to north (from the water catchment on the Kwanza River to the different Distribution Centers) there are the following soil types:

- River alluvial soils;
- Lithosols associated with rocky outcrops;
- Black clays and brown clays;
- “Musseque” soils.

A brief description of each soil type includes:

Fluvial alluvial soils - Recent alluvial deposits occupy extensive areas, corresponding to or, more precisely, within the limits of the Kwanza Sedimentary Basin. The soils on the lower surfaces show a certain heterogeneity, directly related to the mineralogical composition of the sediments and their dimensions. Medium and fine-textured fluvial alluvial soils predominate. Extensive areas subject to prolonged or even permanent flooding occur here. The best-drained and most fertile alluvial soils are generally distributed in the strip adjacent to the river course, whose altitude is slightly higher than that of the rest of the alluvial plain.

Figure 111: Fluvial alluvial soils in the studied area.

Lithosols associated with rocky outcrops - Thin soils based on rocky substrate at a depth of 20 cm or less (lithosols), often associated with stony material.

Figure 112: Lithosols in the studied area.

“Barros negros” and “barros pardos” - Heavy-textured soils are well represented, particularly between Kwanza and Dande, in correspondence with Oligo-Miocene formations, especially when clayey marls or marly limestones outcrop, often enriched with gypsum materials. They are clayey soils, very sticky and plastic, made up essentially of montmorillonitic clays. Well supplied with nutritional elements, especially calcium and magnesium, with a high usable capacity for water and a very high degree of saturation, factors which give them a high productive capacity. They nevertheless have, due to their physical characteristics, marked limitations in terms of agricultural use.

Figure 113: Clayey soils in the studied area.

“Musseque” soils - This major pedological unit includes the soils that correspond to the raised surfaces of quartz sediments from the Pleistocene, known by the regional name of "musseque", a vernacular term meaning sandy soil. The soils are generally coarse-textured, fairly deep, structureless, pale or brightly colored and also characterized by their excessive permeability, low usable capacity for water, low mineral nutrient content, very low compactness, and consistency. If the underlying horizons are medium-textured, which is more often the case when there is less quartz sedimentary mantle, these soils can be of great agricultural interest, provided they benefit from irrigation.

Figure 114: "Musseque" soils in the studied area

In the absence of bibliographic information, regarding specific local chemical data, nine soil samples were taken for characterizing the soil quality in the project area.

The analytical results are presented in **Table 42**. In the same table are presented the reference values for urban soils without groundwater use, considered in the (Portuguese Environment Agency 2022,)for contaminated soils of the Portuguese Environment Agency. All parameter, in all sampling points, register values compliant with the reference criteria.

Table 42: Analytical results of the soil samples.

Parameter (units)	S01	S02	S03	S04	S05	S06	S07	S08	S09	Reference values
Aluminium (mg/kg)	0.07	0.06	0.15	0.08	0.05	0.07	0.12	0.16	0.20	-
Lead (mg/kg)	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	120
Zinc (mg/kg)	12.2	17.8	14.3	9.1	15.5	20.8	10.5	18.2	3.5	340
Nickel (mg/kg)	0.09	0.06	0.05	0.11	0.08	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	130
Cadmium (mg/kg)	0.06	0.08	0.05	0.07	0.04	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	1.2
Copper (mg/kg)	≤ 0.03	≤ 0.03	0.08	0.05	0.13	0.07	0.08	0.15	0.10	180
Iron (mg/kg)	23.6	19.5	23.4	6.8	15.3	13.2	7.3	9.1	15.8	-
Manganese (mg/kg)	11.1	13.2	19.5	13.2	17.1	26.4	14.6	11.8	13.7	-

For the following parameters, all results are below the respective limits of quantification: mercury (≤ 0.03 mg/kg). hydrocarbons fraction C<12 (≤ 0.02 µg/kg), hydrocarbons fraction C>12 (≤ 0.003 µg/kg), PAH (≤ 0.003 µg/kg).

To summarize, for all the samples, the concentrations observed are in the following ranges:

- 0.05 < Aluminium < 0.20 mg/kg
- Lead < 0.03 mg/kg
- 3.5 < Zinc < 20.8 mg/kg
- Nickel < 0.11 mg/kg
- Cadmium < 0.08 mg/kg
- Copper < 0.15 mg/kg
- 6.8 < Iron < 23.6 mg/kg
- 11.1 < Manganese < 26.4 mg/kg.

No soils were identified as contaminated soils. In addition, the results show significant homogeneity, with no hotspots being identified.

It should be mentioned that the previous study (Artelia/Ecovisão, 2014) did not include any soil sampling, so there are no results available, from that study, for comparison.

7.1.7 Air quality

As the main international reference documents on this subject emphasize, ambient air quality is an essential environmental component, in particular for public health and for the citizens. Atmospheric pollution has direct impacts on human health and ecosystems, particularly in densely populated urban areas, such the present project.

In addition to human activity, many natural phenomena (volcanic eruptions, forest fires, sandstorms) release pollutants into the atmosphere, which are sometimes transported over long distances, depending on atmospheric dispersion conditions.

Pollutant concentrations in the ambient air depend mainly on the emitted quantities and the meteorological conditions that influence their distribution, as well as the physical-chemical reactions between the different pollutants. Emissions of air pollutants result from almost all socioeconomic activities. These include :

- Road traffic, especially in urban areas, as a source of nitrogen oxides (NO_x), carbon monoxide (CO), particulate matter (PM), benzene (C_6H_6) and other volatile organic compounds (VOCs)
- Industrial sources, with regard to emissions of sulphur dioxide (SO_2), Nox and Particulate Matter.

Pollutants have different residence times in the atmosphere and different impacts whether on human health, ecosystems, or the climate. This results in both chronic and acute air pollution. Acute effects are synonymous with high concentrations of a given pollutant which, when reached, can rapidly have repercussions on receptors. Chronic effects are related to longer exposure and lower concentration levels. Although this level is lower, exposure takes place over a prolonged period, effects may still occur.

In addition to direct exposure to atmospheric pollutants, indirect impact is characterized by the accumulation of certain heavy metals or persistent organic pollutants in the environment or food chain.

Atmospheric emissions generate problems on different scales. On a local scale, for example, it is mainly transport and industry that emit carbon monoxide (CO), carbon dioxide (CO2), nitrogen and sulfur oxides (Nox and Sox), which influence climate change on a global scale.

7.1.7.1 Main Pollutants and Effects

7.1.7.1.1 Particulate Matter

Particulate matter (PM) is the atmospheric pollutant that causes the greatest damage to human health. Depending on their chemical composition, particles can also affect the climate. Typically, at the level of suspended particles, two main classifications are considered based on the size of the pollutant particles, namely:

- PM < 10 µm – attach to the bronchial wall
- PM < 2.5 µm – settle in the lung alveoli

7.1.7.1.2 Ozone

Tropospheric Ozone is a secondary pollutant that results from complex chemical reactions between precursor gases, by the action of solar radiation. Elevated levels of ozone can damage materials, buildings and living tissue. At plant level, in addition to reducing photosynthetic capacity, it has negative effects on reproduction and growth. The impacts of ozone can also manifest themselves in human health, through inflammation of the lungs and bronchi.

7.1.7.1.3 Nitrogen Dioxide

Nitrogen dioxide, NO_2, is a reactive gas that results from the burning of fossil fuels at high temperatures, especially in industrial units and motor vehicle engines. The effects of NO_2 on human health are reflected in increased susceptibility to respiratory diseases. With regard to ecosystems, NO_2 contributes to soil and water acidification and eutrophication, leading to changes in species diversity.

7.1.7.1.4 Methane

With regard to methane (CH_4), damage to health can only be considered in situations of confined environments and high concentrations, not being typically a pollutant assumed to be of concern, in terms of human health, in ambient air or in terms of damage to ecosystems. The main effect of Methane is related to its potential in terms of climate change. Sixty per cent (60 %) of methane emissions in the world are the result of human action, coming mainly from agriculture and livestock, but also from the waste management sector (uncontrolled landfills, effluent treatment, etc.).

7.1.7.1.5 Carbon Monoxide

Carbon monoxide is formed when fuels (gas, petroleum products, solid fuels, and solvents) are not completely burned. It is also produced both by natural sources and by anthropic sources. In terms of risk to human health, it is also considered a risk at high concentrations, usually in confined spaces or areas with high pollution, typically not being a relevant pollutant at normal concentrations of outdoor ambient air.

7.1.7.1.6 Other Pollutants

There are several other important pollutants, such as polycyclic aromatic hydrocarbons (PAH) with potential carcinogenic effects, present in fine particles emitted by biomass combustion processes and road vehicles, particularly diesel, which are also responsible for other effects on humans, but also heavy metals present in the breathable particulate matter, that can have multiple health effects, dependent of the compounds present.

7.1.7.2 Angolan Characterization

As is the case in developing countries starting the industrialization process, Angola has also seen a strong influx of population into urban centers. The growth of unplanned urban areas and the anarchic development of various industrial sectors have contributed to rising air pollution levels.

The only public reference report available, regarding pollutant Emissions into the atmosphere, is the Report on the General State of the Environment of Angola (REAA), from 2006. According to this document, the predominant pollutant Emissions in the country come from the combustion of fossil fuels, originating from:

- Vehicles in circulation ;
- Generators used to supply energy ;
- Torches from oil production, and
- Fires.

Road transport is responsible for most CO (carbon monoxide), NMVOC (non-methane volatile organic compounds) and lead emissions. CH_4 (methane) emissions come almost entirely from the final disposal of urban solid waste, while water treatment plants can be considered significant sources of NH_3 (ammonia) and NO_2 (nitrous oxide).

The large geographical area, existing water masses and meteorological factors also influence air quality.

7.1.7.2.1 Vehicles

The number of vehicles in circulation in Angola has increased significantly in recent years, in terms of private transport vehicles and the fleets of trucks and buses for state transport and private companies. However, this increase did not match with an expansion of road infrastructure.

This situation causes major traffic jam, mainly in the urban centers of major cities, such as Luanda, forcing vehicles to move at reduced speeds.

Simultaneously, fuel consumption (gasoline and diesel) has risen to very high levels, which are manifested, for example, by queues of vehicles at fuel supply pumps.

At the same time, air contamination by small particles, or dust, particularly particles smaller than 10 microns (PM10) from diesel-powered trucks and buses has also increased. Dust emissions have been considered a public health risk, especially for people residing along roadsides (REAA, 2006).

In REAA 2006, it was also considered that vehicles using diesel engines released large amounts of lead into the atmosphere, which is inhalable when mixed with dust, and quite harmful to human health.

It should be noted, however, that since 2006, there has been a downward trend in this type of emission, linked to the introduction of unleaded petrol and the renewal of the vehicle fleet, particularly in the case of petrol vehicles, with better combustion technology, which is also leading to a reduction in other emissions, namely CO and NMVOCs.

7.1.7.2.2 Electric generators

Currently, not all residential areas in Angola are connected to the electricity grid and, even in those areas that do have access, there are still occasional power outages, which explains why a large part of the population and companies use gasoline or diesel generators as an alternative source of supply, even if only for occasional failures of the public network. Although REAA 2006 also considered this source of emission to be major, it is worth noting a significant improvement in the reliability of the public power grid in recent years, resulting in fewer power failures, particularly in major urban areas such as Luanda, leading to a reduction in the use of emergency generators and a lower impact from these sources of emissions.

7.1.7.2.3 Oil Platform Flares

Another emission source considered by REAA 2006 are the oil exploration platforms and rigs, especially the gas flares/torches, which emit high volumes of greenhouse gases, specifically at the different burning points, which can be several in each block.

This emission source has also seen improvements in recent years, with several natural gas units being implemented, which capture the gas instead of flaring it.

7.1.7.2.4 Biomass burning

REAA 2006 considered that the main source of air pollution in Angola and neighboring countries was biomass burning, which is carried out mainly during the dry season – between May and August. Fires occur for three main reasons:

- Obtaining coal for cooking and as a source of domestic heating;
- Hunting, and

- Agricultural and livestock purposes.

The result of the combustion of this biomass is the emission of carbon monoxide (CO), nitrogen oxides (NO_x), nitrous oxide (NO_2), methane (CH_4), non-methane hydrocarbons, particles, in addition to carbon dioxide (CO_2).

This continues to be a major source of air pollution in Angola, but with significant differences within the country, still being the most relevant source in rural Areas.

However, in urban areas, such as Luanda, where the current project is located, biomass burning will be a less relevant source of pollution, when compared to traffic and industrial emissions, which are predominant in the larger Luanda region.

7.1.7.2.5 Summary

Thus, in terms of the main effects of air pollutants, it is worth considering:

- Damage to human health
  - Direct exposure to atmospheric pollutants (inhalation);
  - Ingestion of airborne pollutants, which were deposited in the soil and accumulated in the food chain.
- Environmental Damage:
  - Acidification of ecosystems;
  - Eutrophication of terrestrial and aquatic ecosystems;
  - Damage and loss of productivity of agricultural crops, forests, and other vegetation due to exposure to tropospheric O_3;
  - Environmental toxicity and bioaccumulation of heavy metals or toxic metalloids and persistent organic pollutants in ecosystems;
- Weather Damage:
  - Contribution to changes in the radiative balance and indirect effects on the climate;
  - Reduction of atmospheric visibility;
  - Damage to materials and buildings due to exposure to acidifying pollutants and O_3.

In addition to the direct effects of each pollutant, there are also interactions between the different pollutants that result in the potentiation of their adverse effects.

The following table outlines the main interactions and impacts of the various pollutants (*Extracted from Portuguese ENAC 2020 – National Strategy for the Adaptation to Climate Change 2020*)

Table 43: Interactions and impacts caused by air pollutants in a multi-pollutant / multi-effect approach (ENAC 2020 Portugal)

Impacts	Traditional Pollutants						Green House Gases Effect			
	PM	SO_2	Nox	COV	NH_3	CO	CO_2	CH_4	N_2O	PFCs HFCs SF_6
Health Impacts										
PM										
O3										
Vegetation Impacts										
O3										
Acidification										
Eutrophication										
Climate Impacts										
Direct and Long Term effects										
Indirect and Short Term Effects										

As described above, and referenced in the REAA 2006, several factors indicate the existence of high amounts of suspended particles and other pollutants in the country, namely:

- Unpaved roads ;
- Land without vegetation ;
- Prolonged dry seasons ;
- High temperatures ;
- Fires ;
- Diesel generators ;
- High number of vehicles in circulation ;
- Factories and industries with uncontrolled atmospheric emissions.

7.1.7.3 Available National and Local Data

7.1.7.3.1 Local Air Quality Stations

As mentioned in the baseline methodology chapter 5.0, there is no official air quality monitoring network in Angola, but it was possible to identify some stations with operating data available in Angola, with periodic data reporting.

The following figures show the data on PM2.5 Values, in µg/m^3 from the air quality stations identified in Luanda, already presented in Chapters 5.4.1.7.

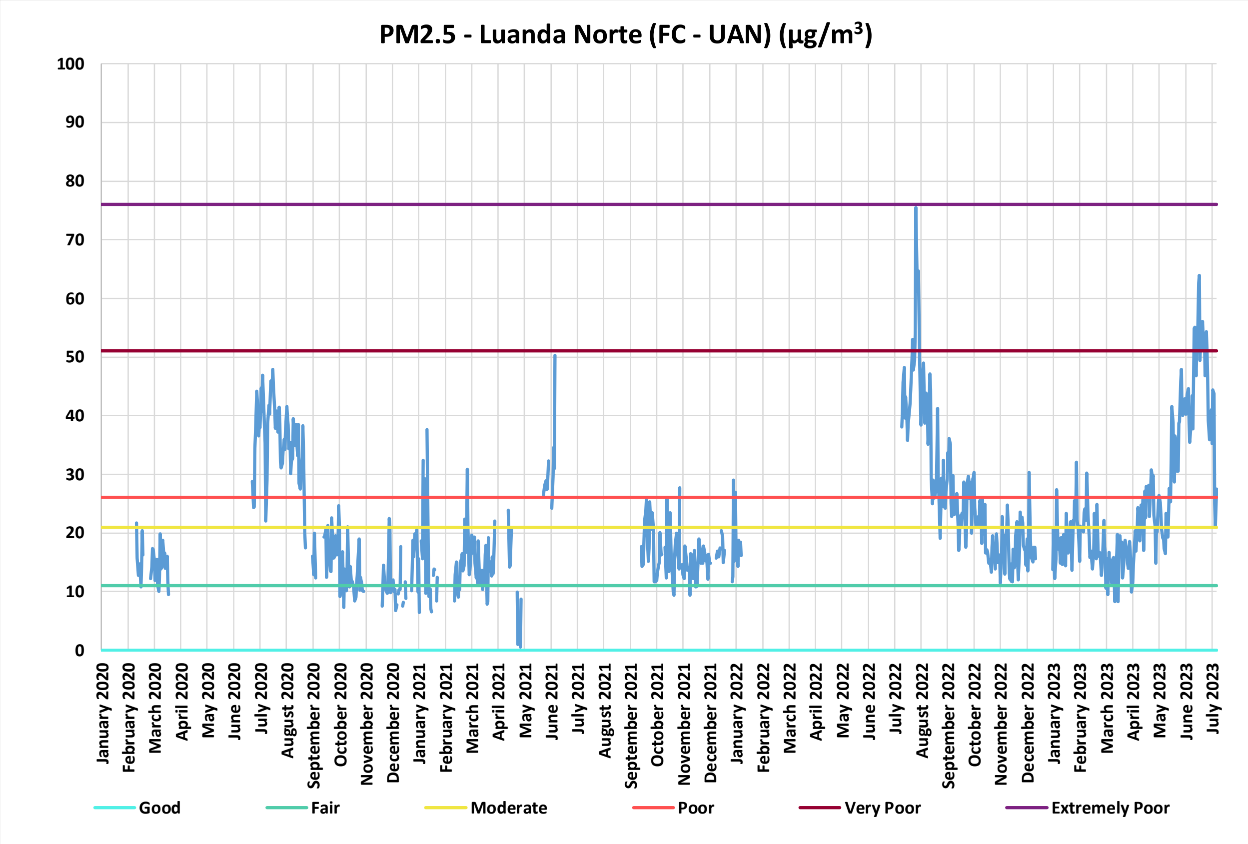


Figure 115: PM2.5 data obtained in the FC-UAN station

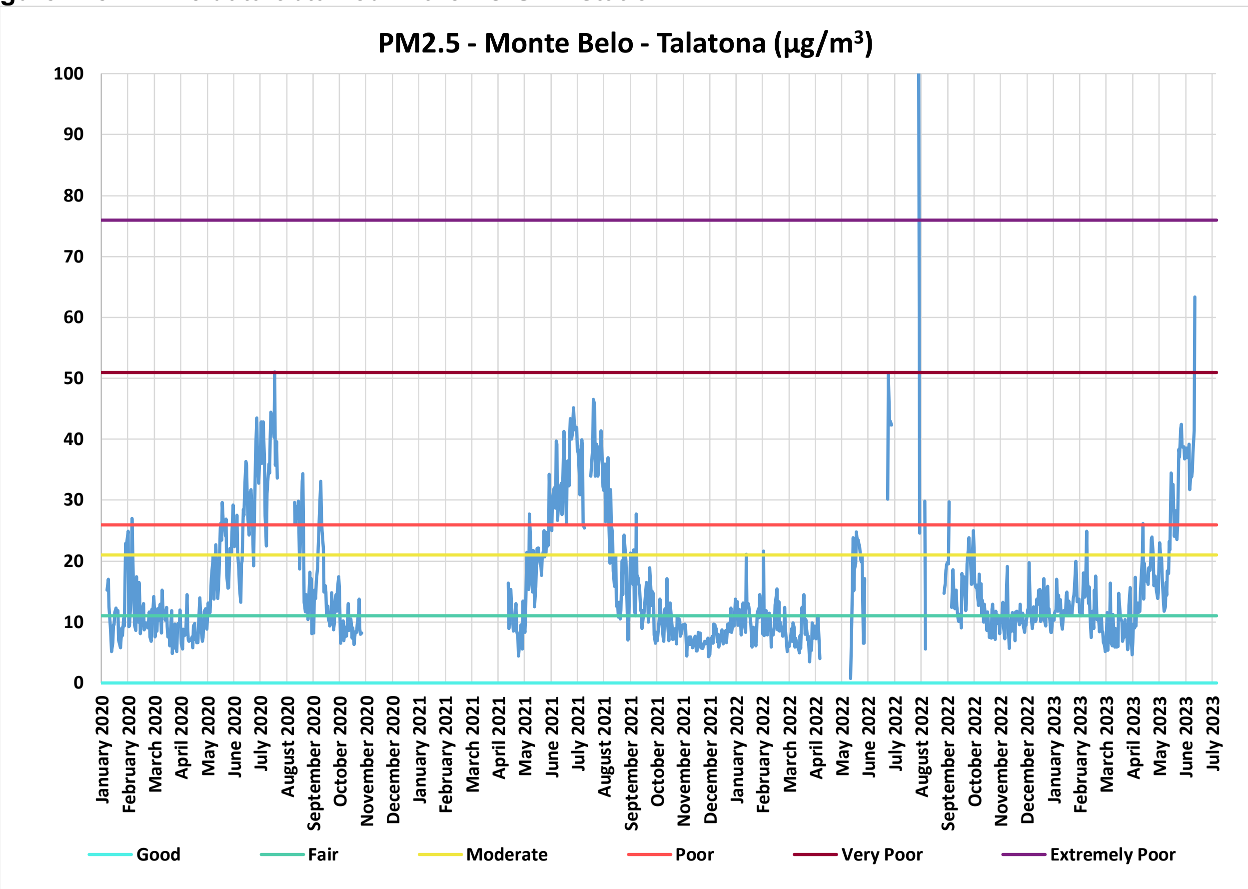


Figure 116: PM2.5 data obtained in the MB-L station

It was decided to evaluate the results based on the European Air Quality Index Scale. This index takes into account the most recent knowledge on the effects of pollutants on health and also changes in the reference values recommended by the World Health Organization (WHO).

This Index considers six levels of air quality, namely Good, Fair, Moderate, Poor, Very Poor and Extremely Poor.

The graphs presented above show that air quality follows a seasons-based pattern, with air quality levels ranging from "Good" to "Moderate" during the wet period, between October and April, and an air quality between "Moderate" and "Poor", including some days with "Very Poor" quality during the dry period between May and September.

These results are consistent with what was expected, demonstrating a worsening of particles pollution during the dry period, possibly associated with the raising of dust on bare soils, but also with a lesser effect of "washing" the air, by entrainment of particles during events of precipitation.

Below are the daily PM2.5 results, in µg/m^3, obtained at the stations, by semester.

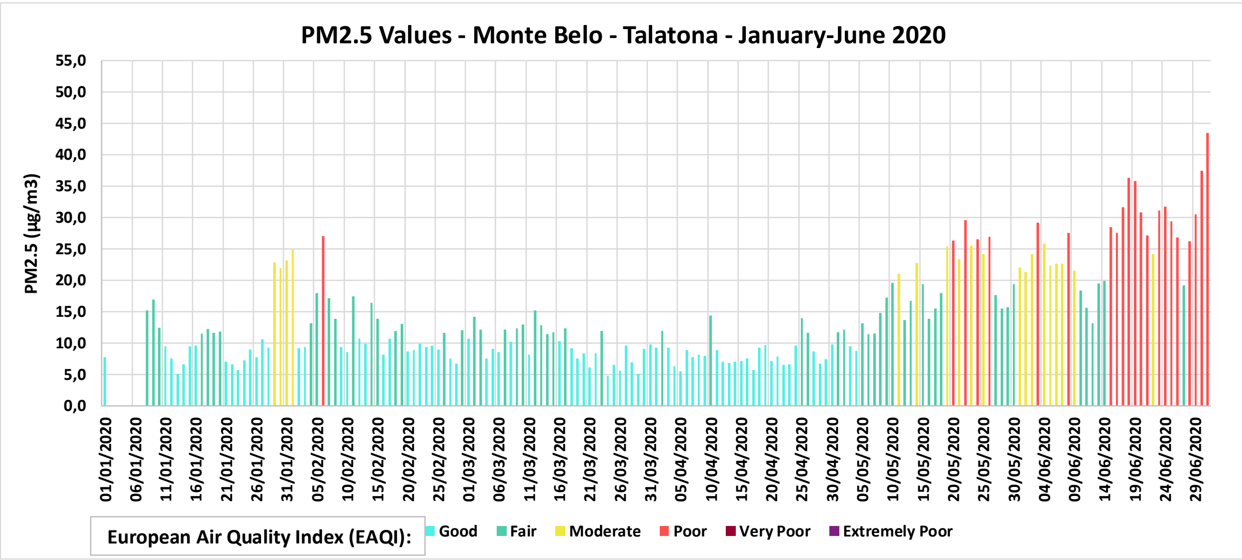


Figure 117: PM2.5 Data – Monte Belo Urbanization Monitoring Station – 1st Semester 2020

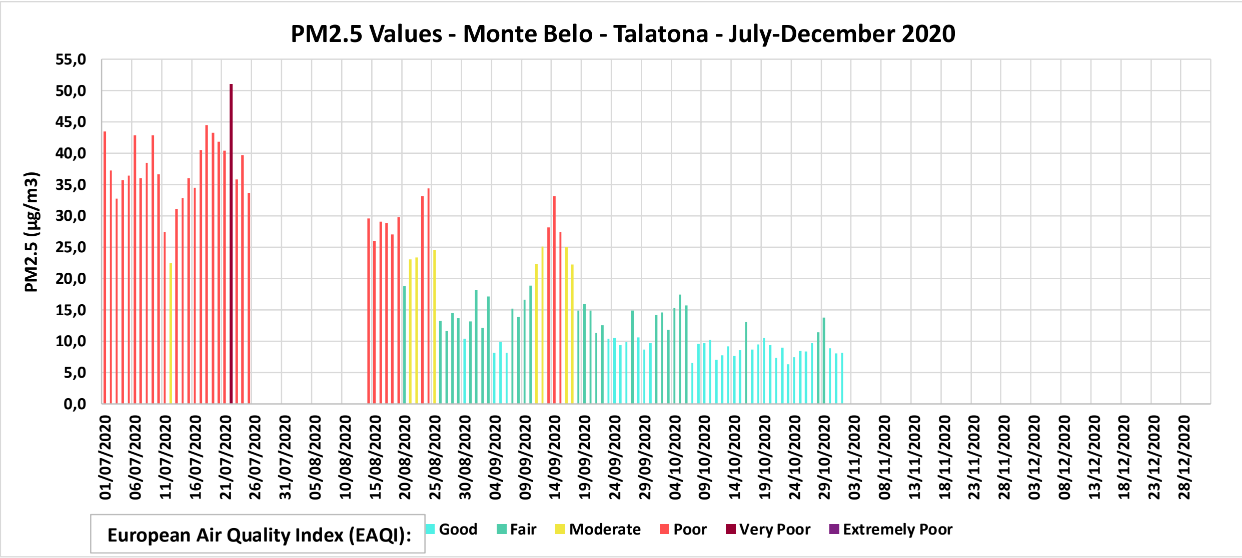


Figure 118: PM2.5 Data – Monte Belo Urbanization Monitoring Station – 2nd Semester 2020

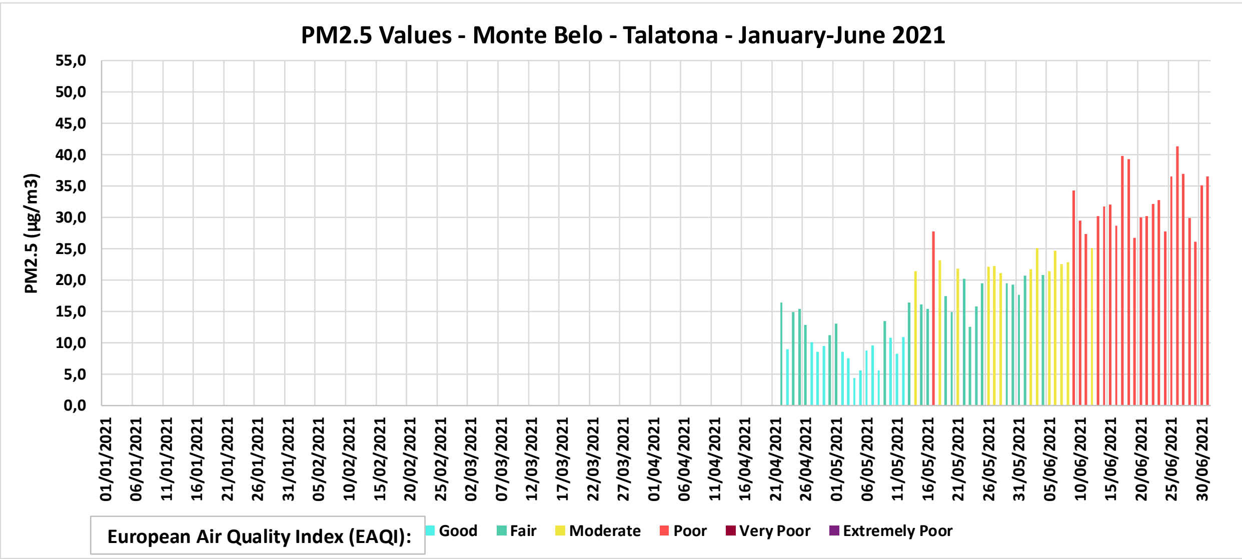


Figure 119: PM2.5 Data – Monte Belo Urbanization Monitoring Station – 1st Semester 2021

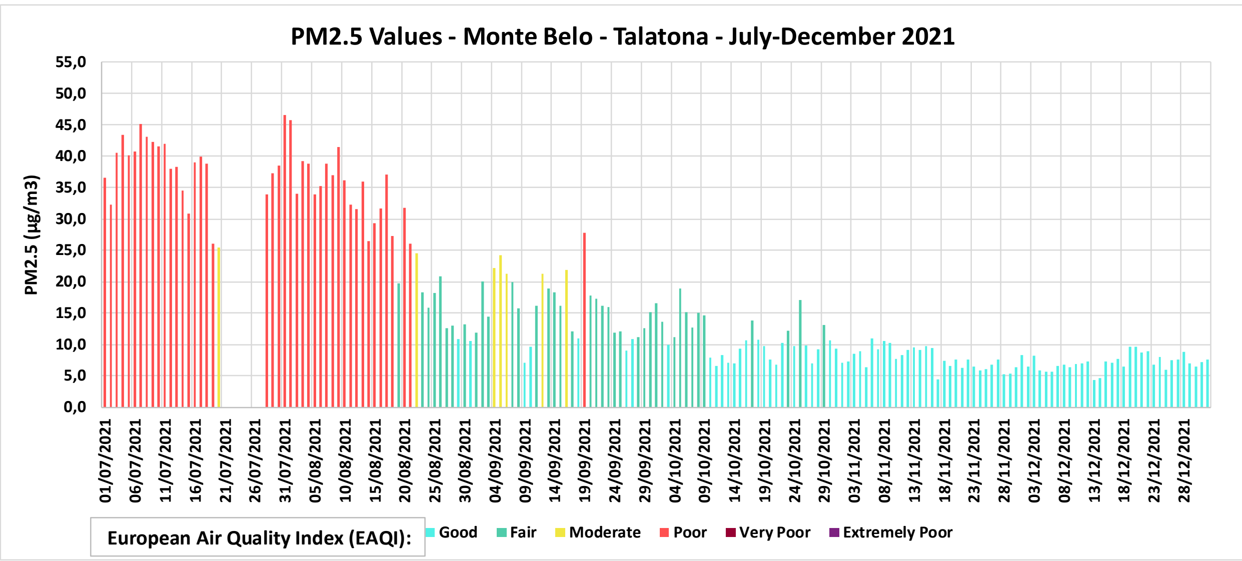


Figure 120: PM2.5 Data – Monte Belo Urbanization Monitoring Station – 2nd Semester 2021

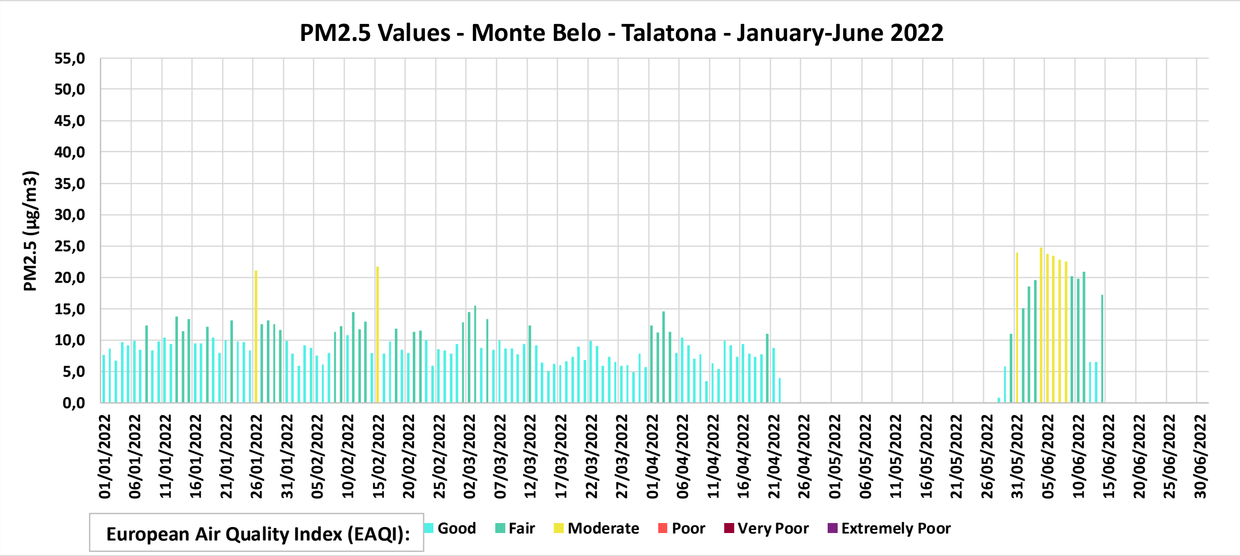


Figure 121: PM2.5 Data – Monte Belo Urbanization Monitoring Station – 1st Semester 2022

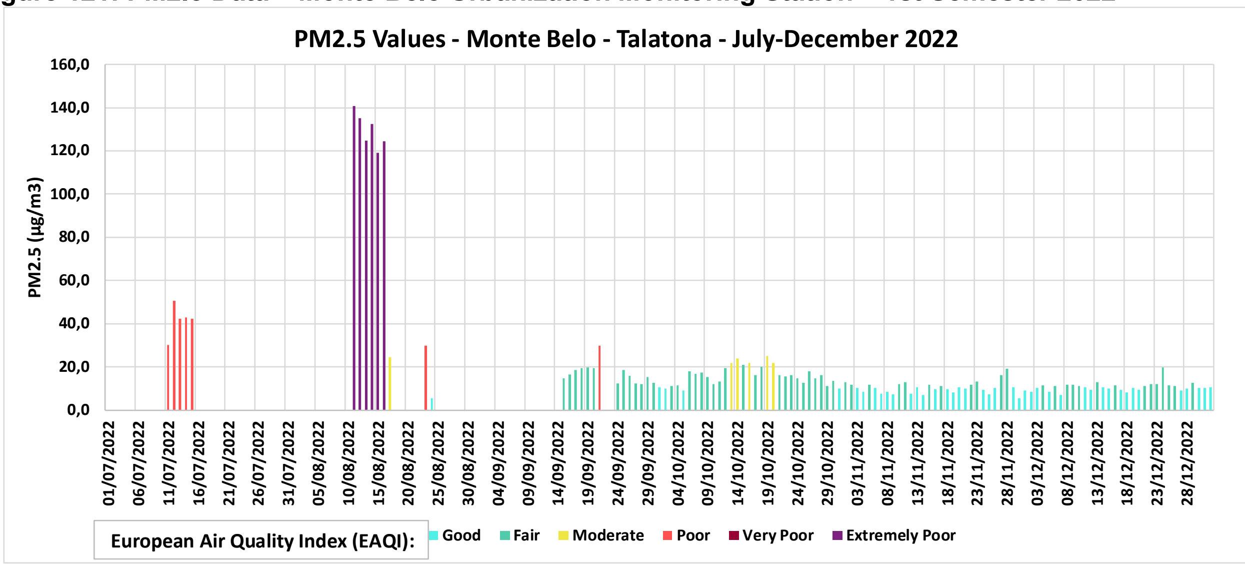


Figure 122: PM2.5 Data – Monte Belo Urbanization Monitoring Station – 2nd Semester 2022

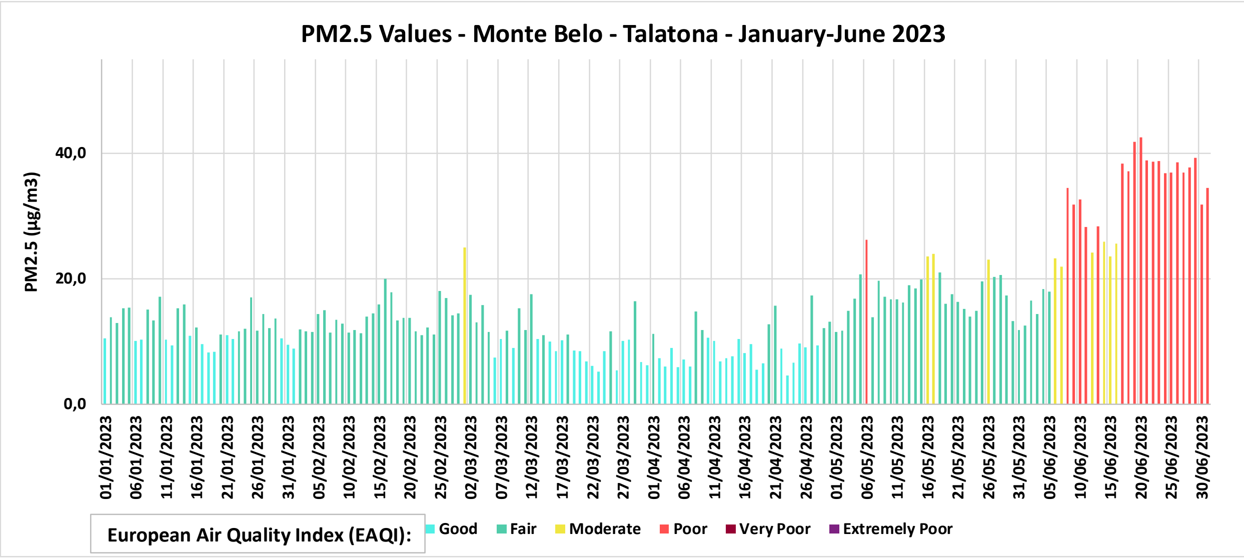


Figure 123: PM2.5 Data – Monte Belo Urbanization Monitoring Station – 1st Semester 2023

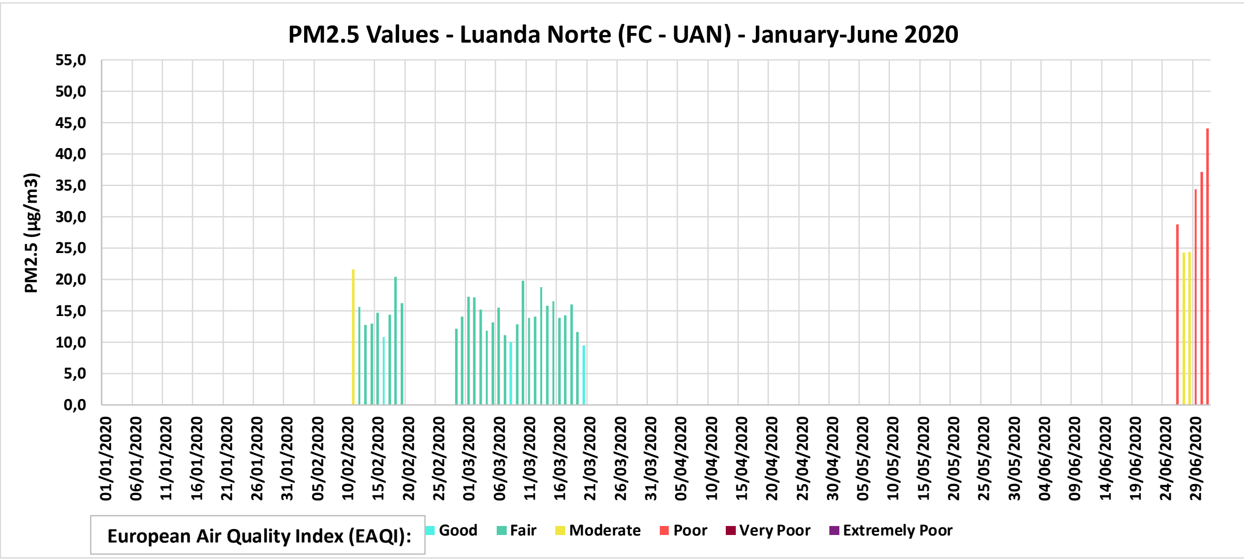


Figure 124: PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station – 1st Semester 2020

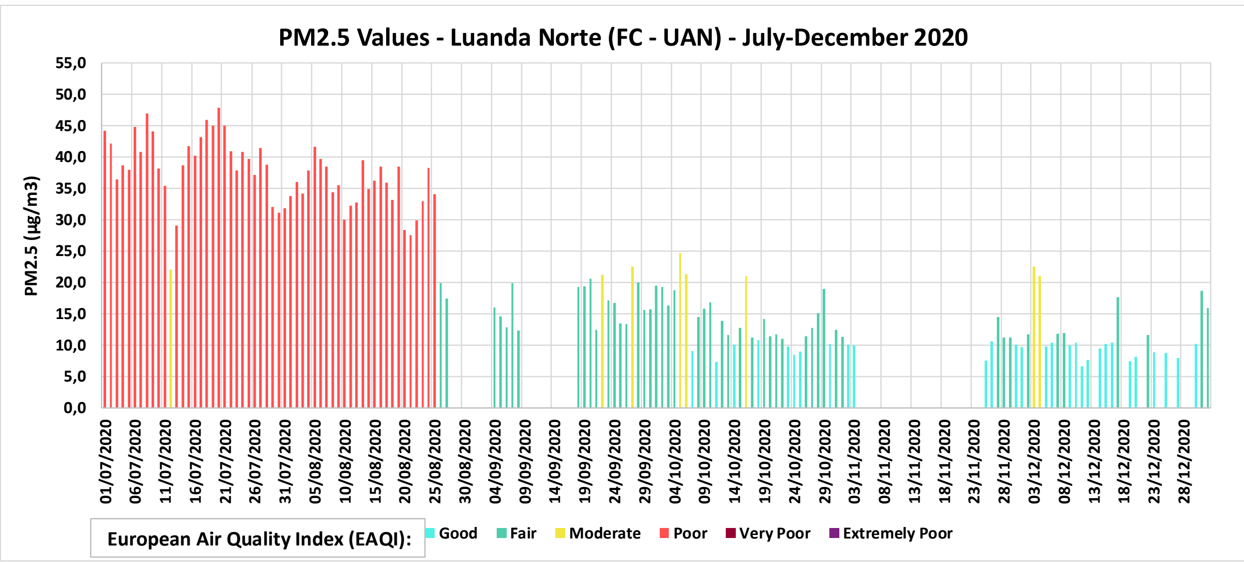


Figure 125: PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station – 2nd Semester 2020

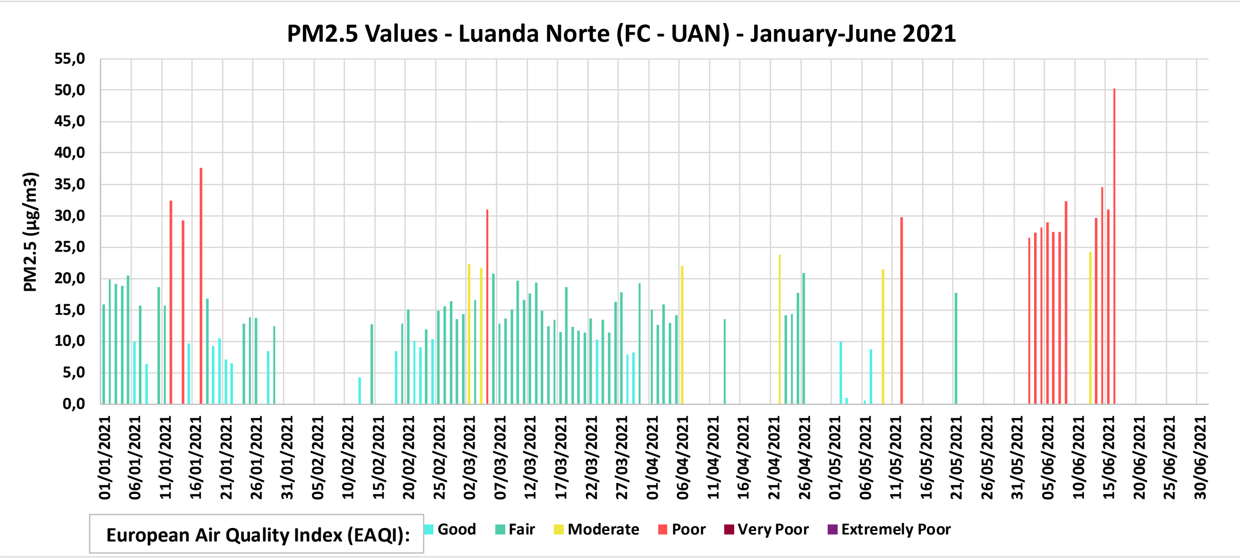


Figure 126: PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station – 1st Semester 2021

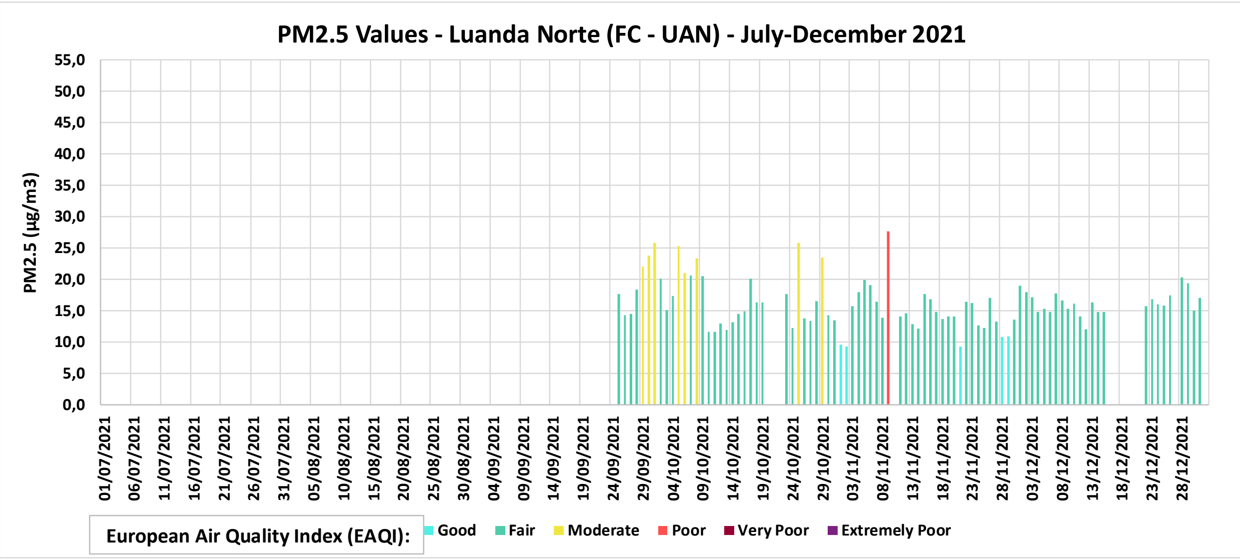


Figure 127: PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station – 2nd Semester 2021

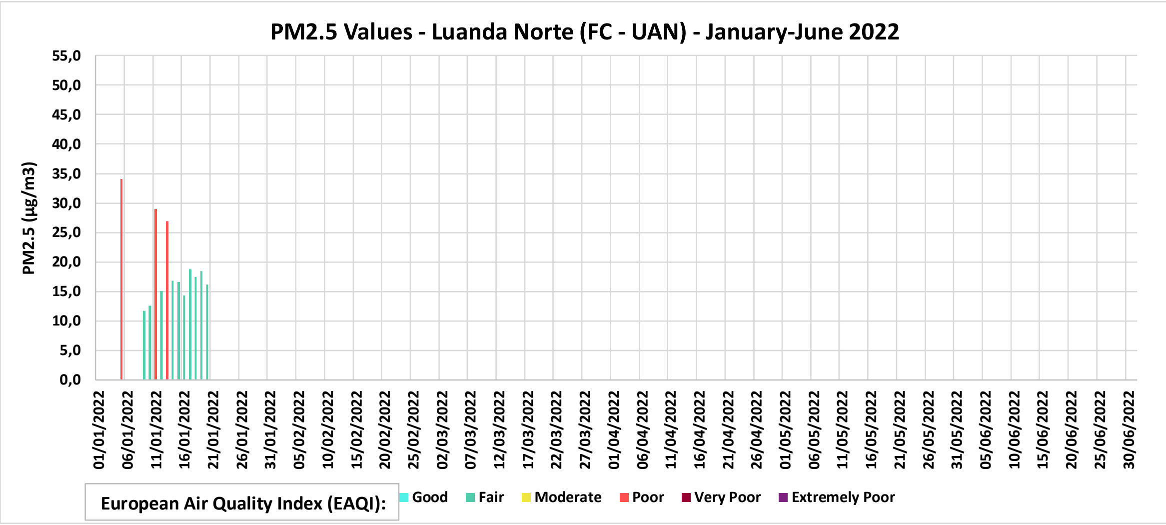


Figure 128: PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station – 1st Semester 2022

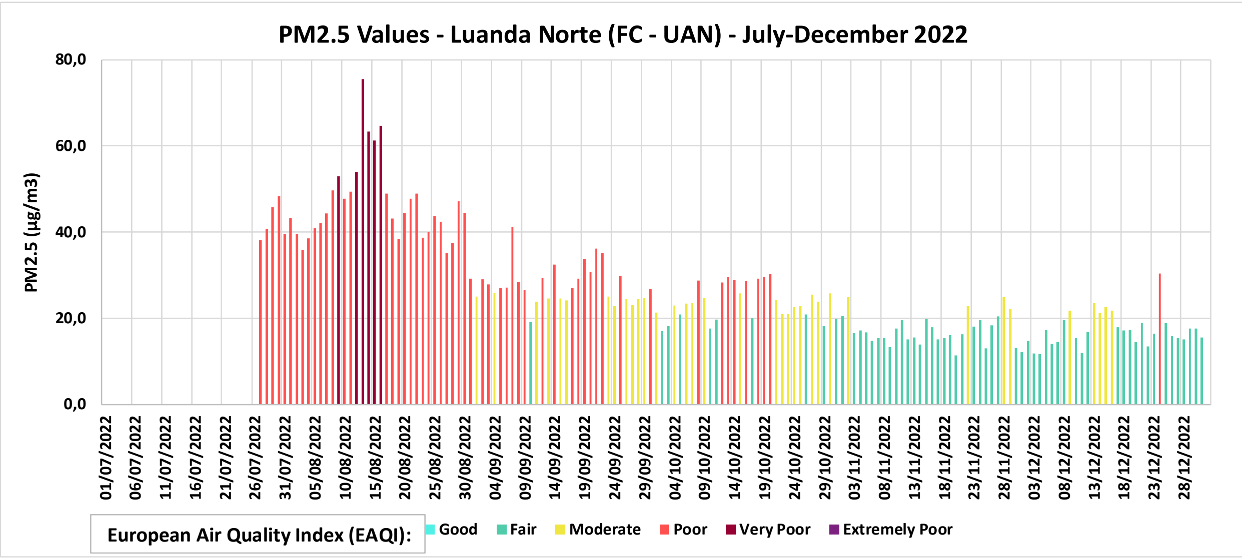


Figure 129: PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station – 2nd Semester 2022

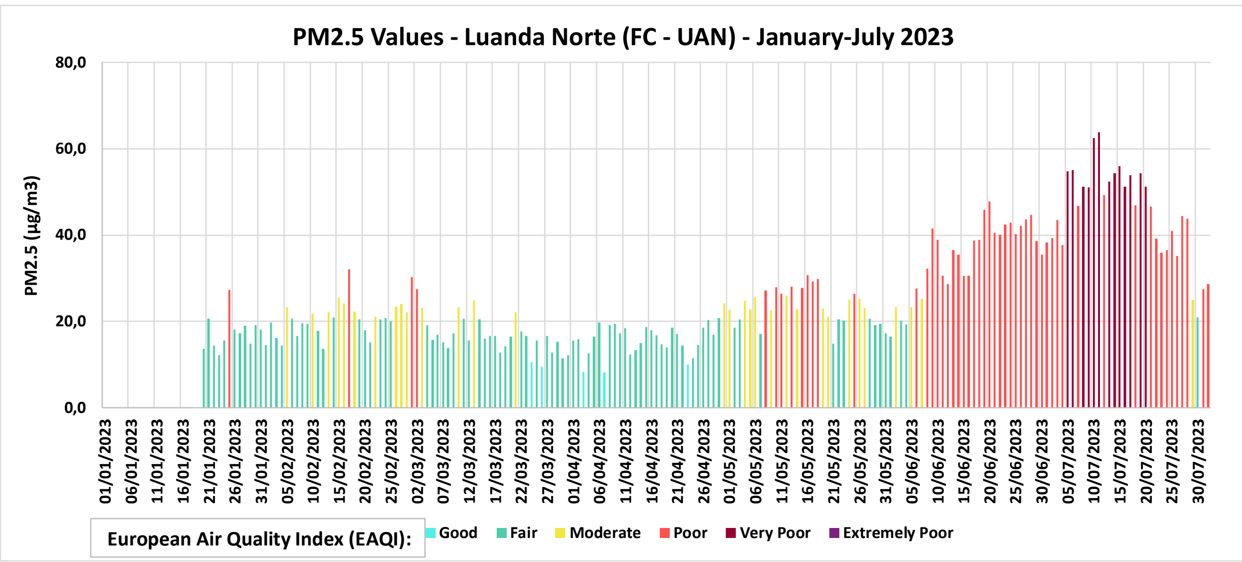


Figure 130: PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station – 1st Semester 2023 (extended to July)

The daily results of each station show what was already mentioned above, of a worsening of the air quality in the dry period, with an air quality between “Good” to “Moderate” between September and April (with some specific days of worse quality) and worsening to quality levels between “Moderate” to “Very Poor” between May and August. It should be noted the existence of an anomalous period of data in August 2022 at both stations, with abnormally high values, which are linked to some specific situations that occurred in the Luanda area during that period and that affected both stations, with higher incidence in the Monte Belo station.

The World Air Quality Index Project also provides some recent hourly historic data for additional parameters registered by the FC-UAN (Faculty of Science – Agostinho Neto University) Monitoring Station. This station started providing hourly values for several particle parameters (PM10, PM2.5 and PM1.0) but also for Nitrogen Dioxide (NO_2), with data starting 15 May forward.

The following figure present the hourly values obtained at this station for PM10, PM2.5 and NO_2 pollutants.

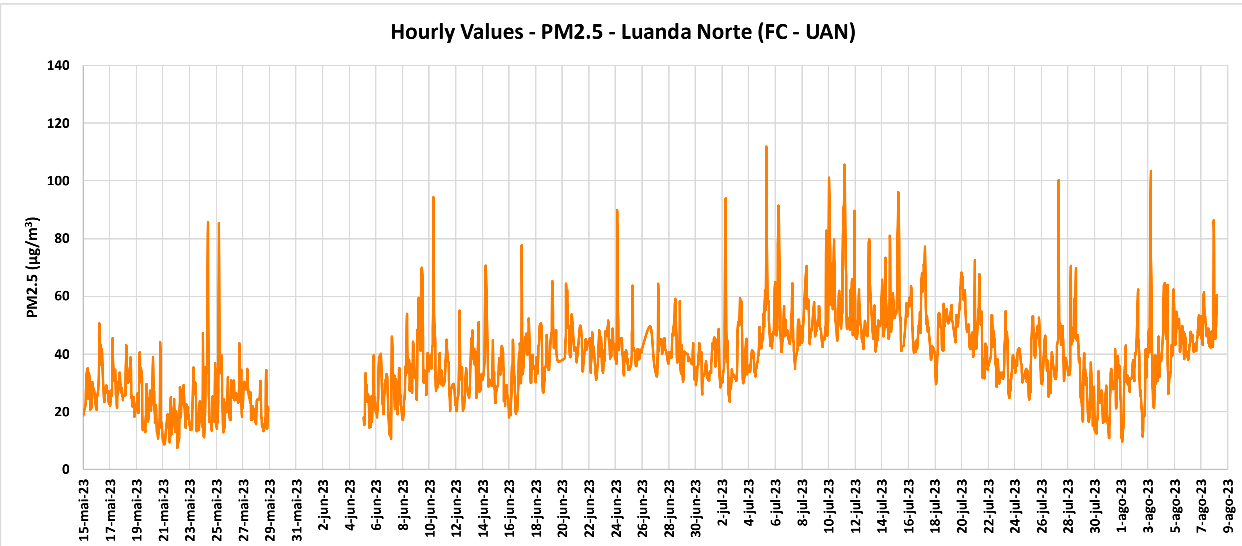


Figure 131: Hourly PM2.5 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station

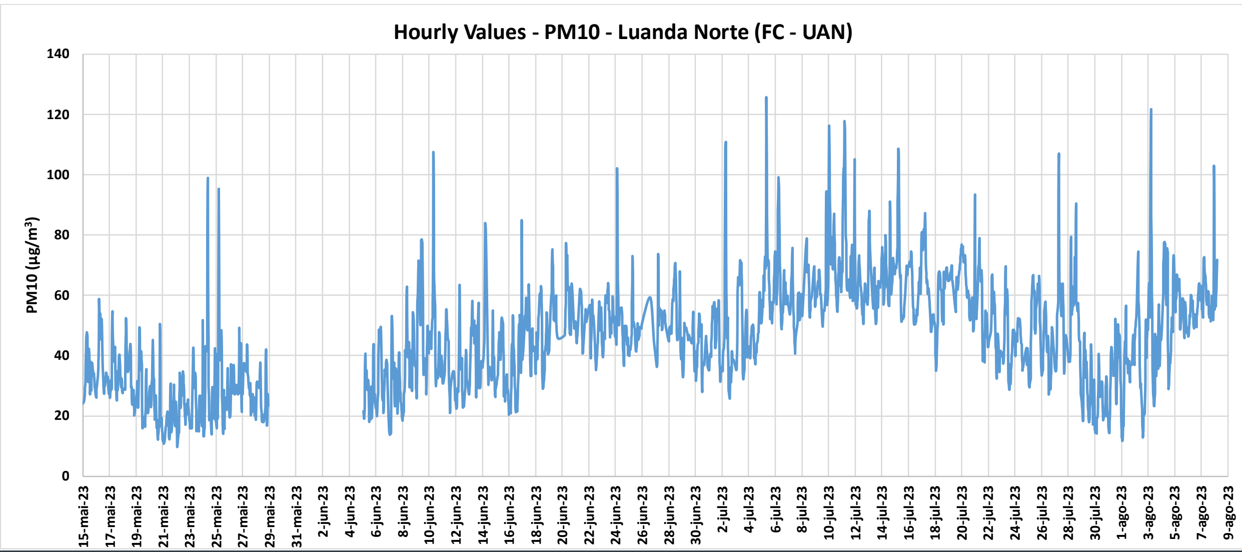


Figure 132: Hourly PM10 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station

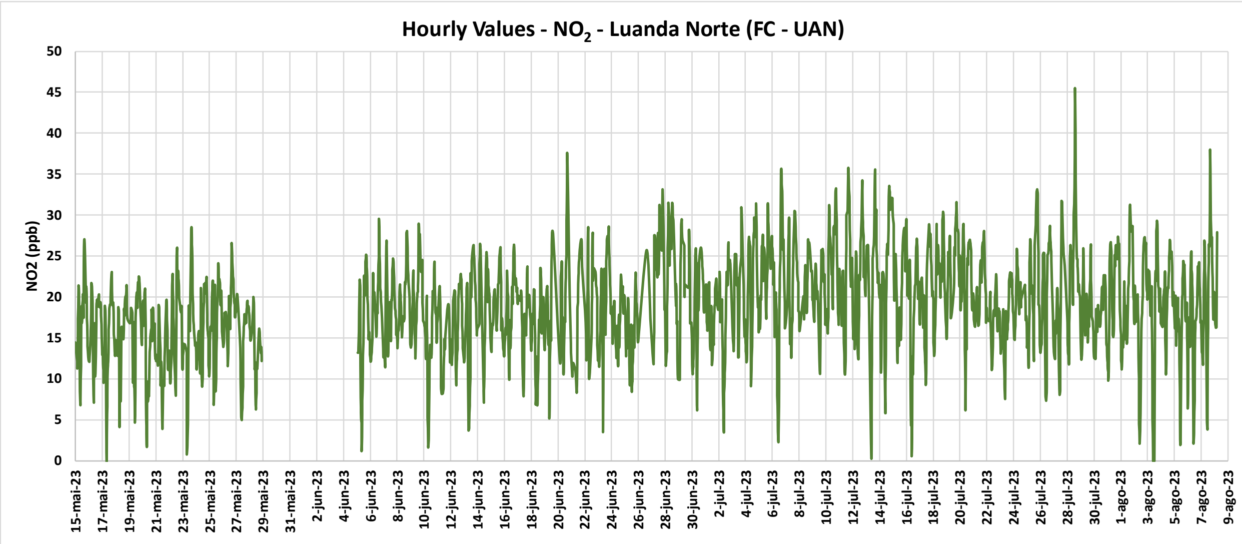


Figure 133: Hourly NO2 Data – FC-UAN Norte – Agostinho Neto University Monitoring Station

The period covered by the available hourly data (15th May to 8th of August) show that the Luanda area was subject to PM concentrations (both PM2.5 and PM10) ranging from 20 µg/m^3 to 80 µg/m^3 (around 90 % of hourly values). The data also shows a clear increase of PM concentration in July, going from 20-60 µg/m^3 in May and June (moderate to poor air quality, according to European Air Quality Index standards), to 40-80 µg/m^3 in July and August (poor to very poor air quality, according to European Air Quality Index standards).

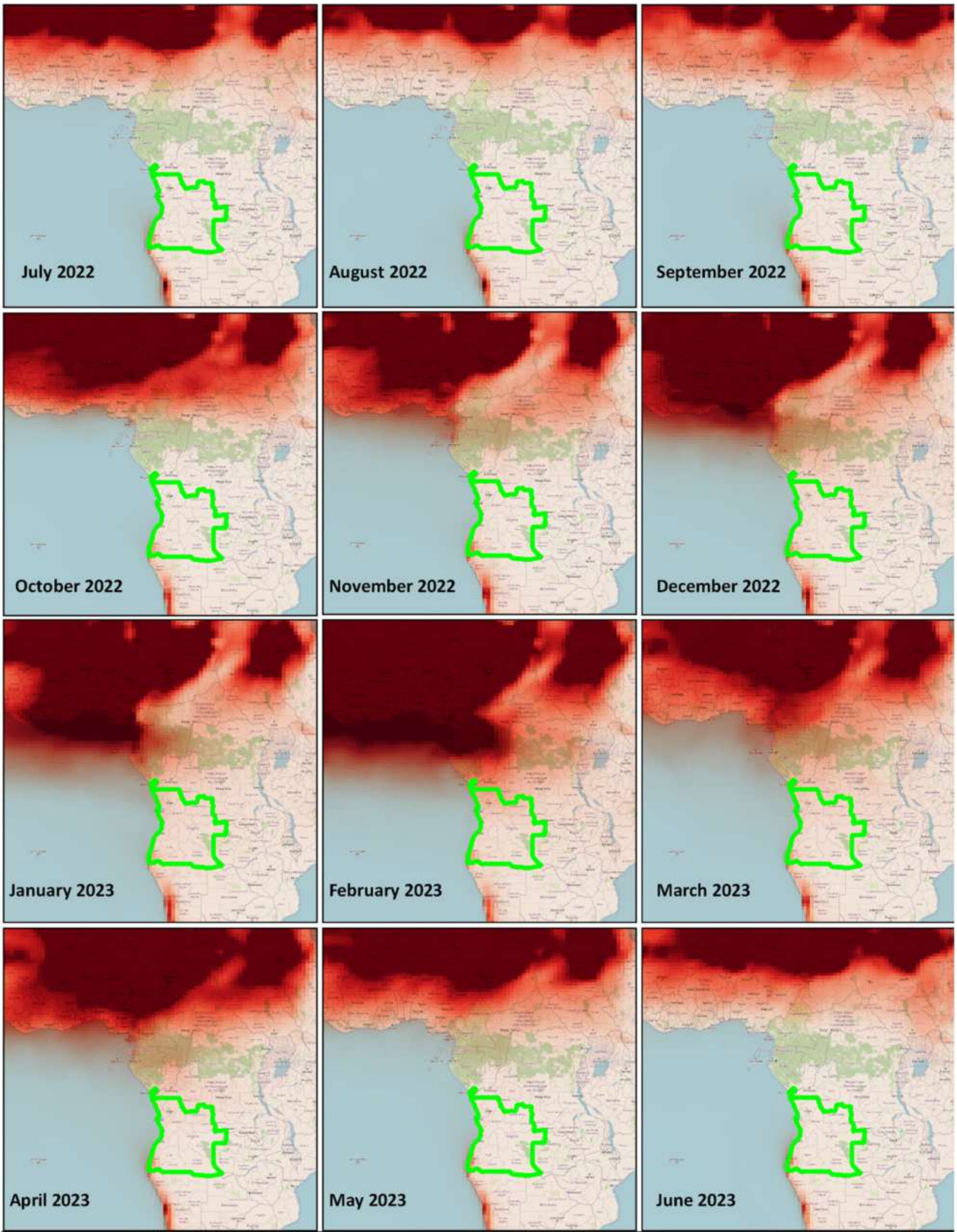
The Nitrogen Dioxide varies mainly between 10 and 30 ppb (90 % of registered hourly values), which represent a good air quality level, according to European Air Quality Index standards.

7.1.7.3.2 Satellite Observation Data

7.1.7.3.2.1 Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2)

There are several territorial air quality data sources, based in satellite observations, developed by NASA and made available on the NASA EarthData – Worldview portal. One of these databases is associated with the Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2), that provides data beginning in 1980. MERRA-2 is the first long-term global reanalysis to assimilate space-based observations of aerosols and represent their interactions with other physical processes in the climate system.

A Monthly mean, Time-averaged, Single-Level data for dust (PM2.5) at surface level, was obtained from this database covering the African continent. A one-year period data set was considered for the current assessment, from July 2022 to June 2023, with a total of 12 raster matrixes with PM2.5 values, in kg/m^3, as shown in the following figure.



Consultant	Client	Project: Quilonga Grande Water System - ESIA	Scale:	Drawing N.: SZ_104_23 / 111
SZ ENGENHARIA AMBIENTAL	wsp GOLDER	Plan: Dust (PM2.5) - Monthly Values - Modern-Era Retrospective analysis for Research and Applications version 2 (MERRA-2) - 2022/2023	0 500 1 000 1 500 km	Sheet: 1/1 Date: Aug 2023

Figure 134: 2022 Monthly Average PM2.5 surface raster maps from MERRA-2

As observed in the above map, Angola seems to be partly influenced by the dust originating in the Sahel region northward, and also by the Namib Desert in the south. The Sahel influence extends to the northern side of Angola from November to February, with a lesser influence of the other months.

Despite the information provided by this data source, when assessing the local observation data registered by the existing monitoring stations (Monte Belo and FC-UAN), the increase in dust particles from November to February, predicted by the Satellite observation data, was not registered.

As such, it is considered that, in the Luanda region, the local air quality is mostly conditioned by the dry and wet seasons and also by the wind conditions, especially the influence from the Atlantic, without relevant influence from the Sahel.

The MERRA-2 database also provides a country based monthly mean values of pollutants from 1980 to 2020. The following figures present the monthly mean values provided by the MERRA-2 database for Angola.

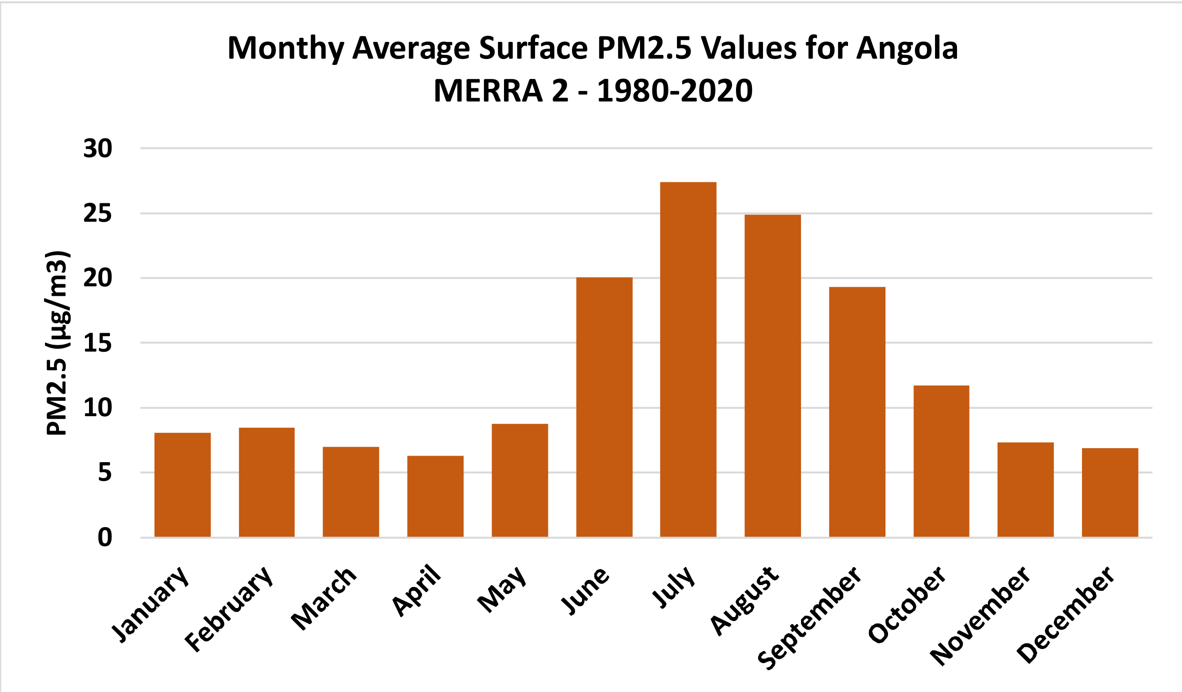
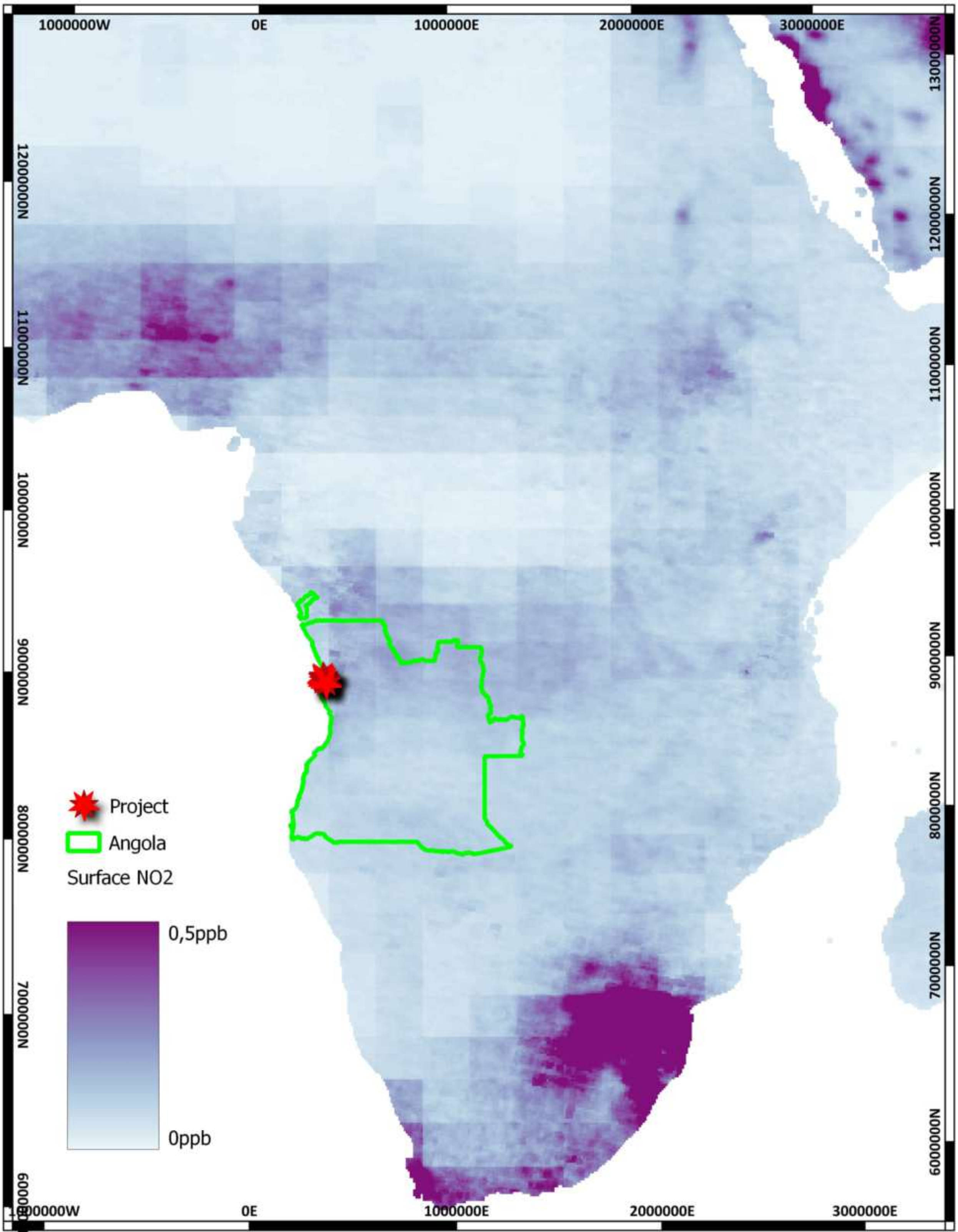


Figure 135: Monthly Average PM2.5 surface values for Angola from MERRA-2, from 1980 to 2020 – Nasa EarthData

The mean results obtained by the MERRA 2 values, above, are consistent with the observed data in the Luanda local air quality stations considered, with a better air quality during the wet season, between October and April, and with worse air quality levels during the dry season, between May and September.

7.1.7.3.2.2 Global 3-Year Running Mean Ground-Level Nitrogen Dioxide (NO2)

Another database available in the NASA EarthData portal, associated with air quality at the surface level, is the Global 3-Year Running Mean Ground-Level Nitrogen Dioxide (NO_2) Grids from GOME, SCIAMACHY and GOME-2, whose data for the African region is presented in the following figure.



Consultant	Client	Project:	Scale:	Drawing N.:
SZ ENGENHARIA AMBIENTAL	wsp GOLDER	Quilonga Grande Water System - ESIA	0 200 400 600 km	SZ_104_23 / 112
		Plan: Global 3-Year Running Mean Ground-Level Nitrogen Dioxide (NO2) Grids from GOME, SCIAMACHY and GOME-2		Sheet: 1/1 Date: Aug 2023

Figure 136: 3-Year Running Mean Ground-Level Nitrogen Dioxide (NO2) at surface level – Nasa EarthData

The above map shows low expected values of Nitrogen Dioxide in all of the Angolan Territory. It should be noted that this tool has a large mapping area and does not have the necessary detail to take into account the local emissions and sources. Considering the dense industrial areas of Luanda, with several sources of industrial emissions, it should be expected a higher concentration of several pollutants, including NO_2, in some specific areas, that are not necessarily mapped by the large scale of the GOME, SCIAMACHY and GOME-2 studies.

However, the expected low values of NO_2 in Luanda area are consistent with the hourly values obtained from the Air Quality Station of the Agostinho Neto University (FC-UAN), presented above.

7.1.7.3.2.3 Country Trends in Major Air Pollutants data set

Another relevant information provided by the Nasa EarthData is the Country Trends in Major Air Pollutants data set (Wolf 2022).

This data set is considered a framework of public-health-focused air quality indicators that quantifies over 200 countries trends in exposure to the main air quality pollutants:

- Particulate Matter (PM2.5) ;
- Ozone (O_3) ;
- Nitrogen Oxides (Nox) ;
- Sulphur Dioxide (SO_2) ;
- Carbon Monoxide (CO) ; and
- Volatile Organic Compounds (VOCs).

The data set is based on pollutant concentration data derived from the European Center for Medium-Range Weather Forecast’s (ECMWF) Atmospheric Composition Reanalysis 4 (EAC4) data sets.

The following figures present the available spatial average data, from the period 2003 to 2018, for Angola, for these pollutants.

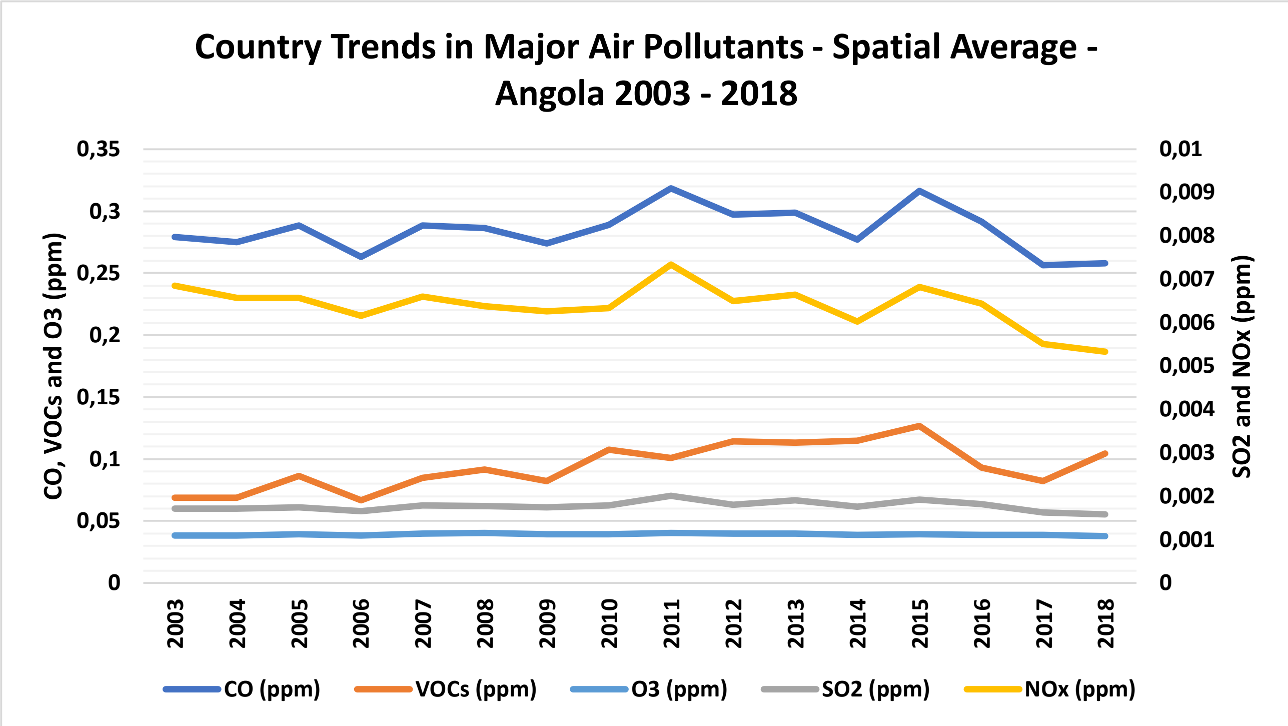


Figure 137: Country Trends in Major Air Pollutants data set – Angola – 2003/2018– Nasa EarthData

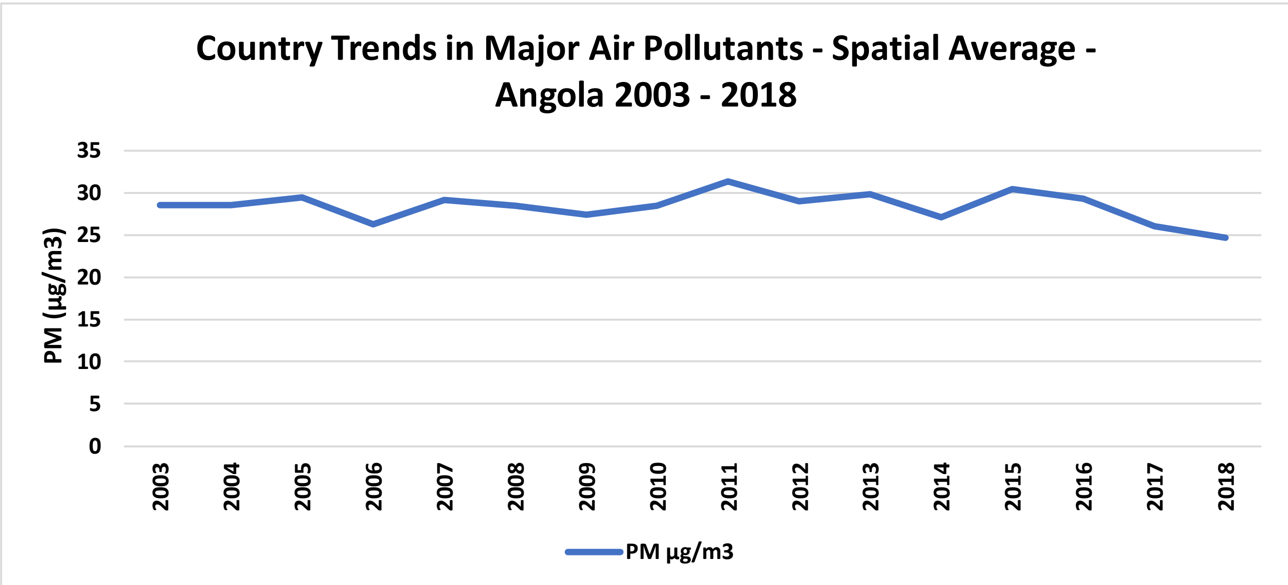


Figure 138: Country Trends in Major Air Pollutants data set – Angola – 2003/2018 – PM– NASA EarthData

The above figures show a slight increased tendency for major air pollutants in the country until 2015, with a reduction in the years 2017 and 2018, except in VOCs, which registered a new increase in 2018.

7.1.7.4 Local Conditions

In the Project Area of Interest, the main air pollutant emissions identified during the field survey were the following:

- Road traffic and respective exhaust emissions, including both light and heavy vehicles, with special emphasis on the main roads that serve the region, the Catete Road, the Bom Jesus Road, the Zango road and the Via Expresso Avenue, but also the rest of the local roads that serve all the residential and industrial areas;

- Several industrial area, with punctual (chimneys) and diffuse emissions, especially in the Viana Region (PIV, ZEE and along the Catete Road) and also in the Bom Jesus area, near the future WTP, the CIF Factory and several industries, mainly in the beverage sector, near the Kwanza;
- Some commerce and service units with potential diffuse emissions (car repair shops, restaurants, others) distributed on the urban matrix;
- Generators for electrical production, present in many residential buildings and almost all industrial and commercial projects, used to compensate for occasional failures of the public electrical network of to complement that supply.

According to the Meteorology and Climate data baseline (chapter 5.4.1.1), in Luanda the predominant winds are from the Southwest. As such, the sensitive uses in the project's area of influence will be affected, most of the time, by emissions of pollutants from industrial, commercial, and service units, as well as road traffic emission, located to the west and southwest of the receptors.

In terms of air pollution, it is considered, in general, that the following areas represent the main sensitive receptors:

- Areas with residential uses, even if including mixed uses (commercial/services), due to possible health impacts on residents;
- Natural areas and forest areas with dense vegetation, due to impacts on vegetation growth and habitat pollution deposition.

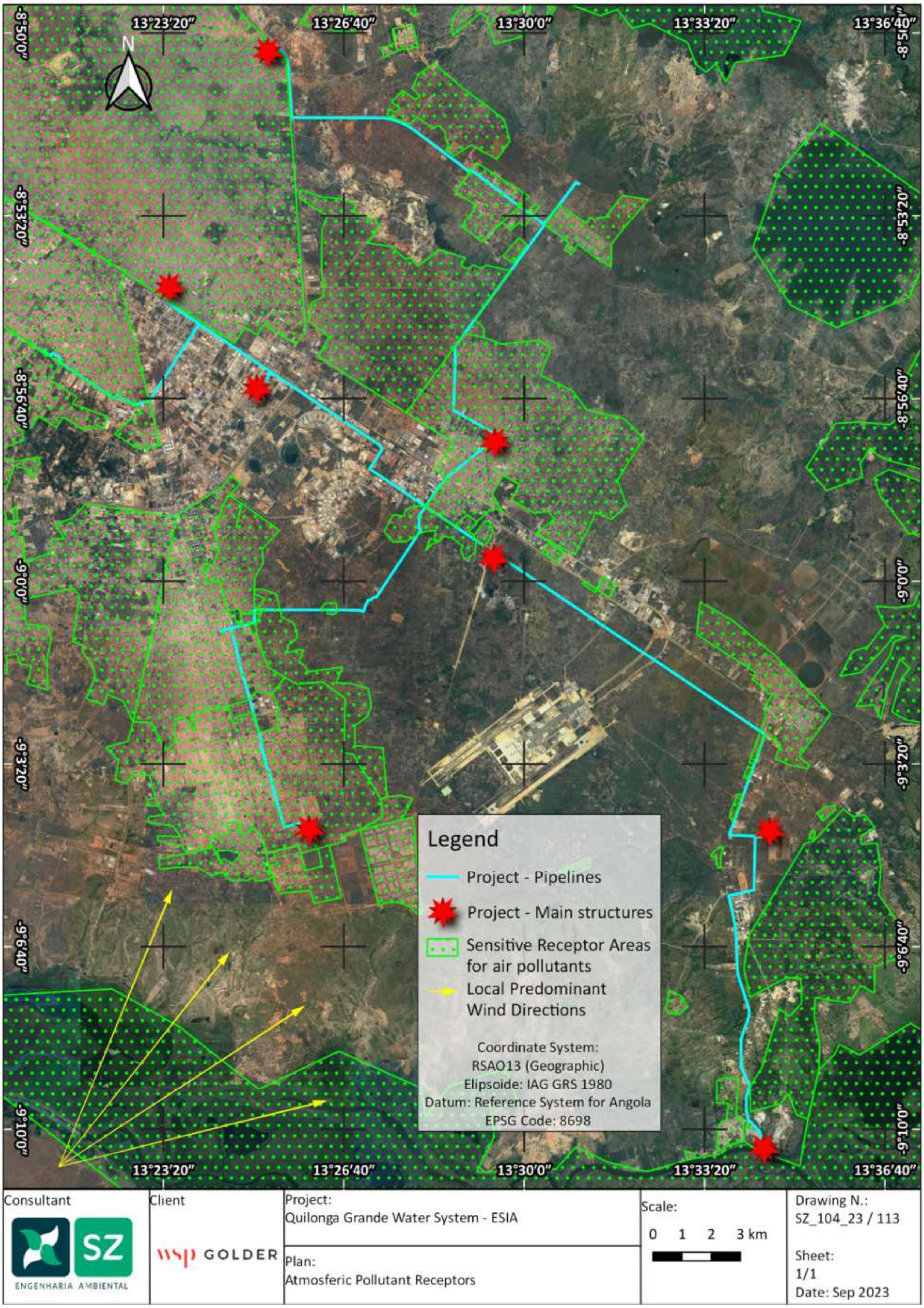


Figure 139: Sensitive Areas to Air Pollution in the project's region.

7.1.7.5 Air quality monitoring campaign

For establishing the air quality baseline, a monitoring field campaign was developed, as described in the baseline methodology presented in chapter 5.4.1.7.

This monitoring included 5 monitoring points, covering the Water Extraction area (Air05), the WTP (Air01), as well as the Cacuaco (Air02), km30 (Air03) and Kapalanga (Air04) distribution centers.

To complement the field monitoring data, it was also obtained from the local weather stations in Luanda, the hourly weather parameters for the monitoring period. This data allow an assessment of the existing propagation conditions (wind speed, direction, and temperatures) during the monitoring campaign.

It was also obtained the hourly air quality values from the air quality station of the Science Faculty of Agostinho Neto University – Northern Luanda (FC-UAN). These values can serve as background air quality data for the Luanda region, during the monitoring campaign.

This data is then presented in following figures.

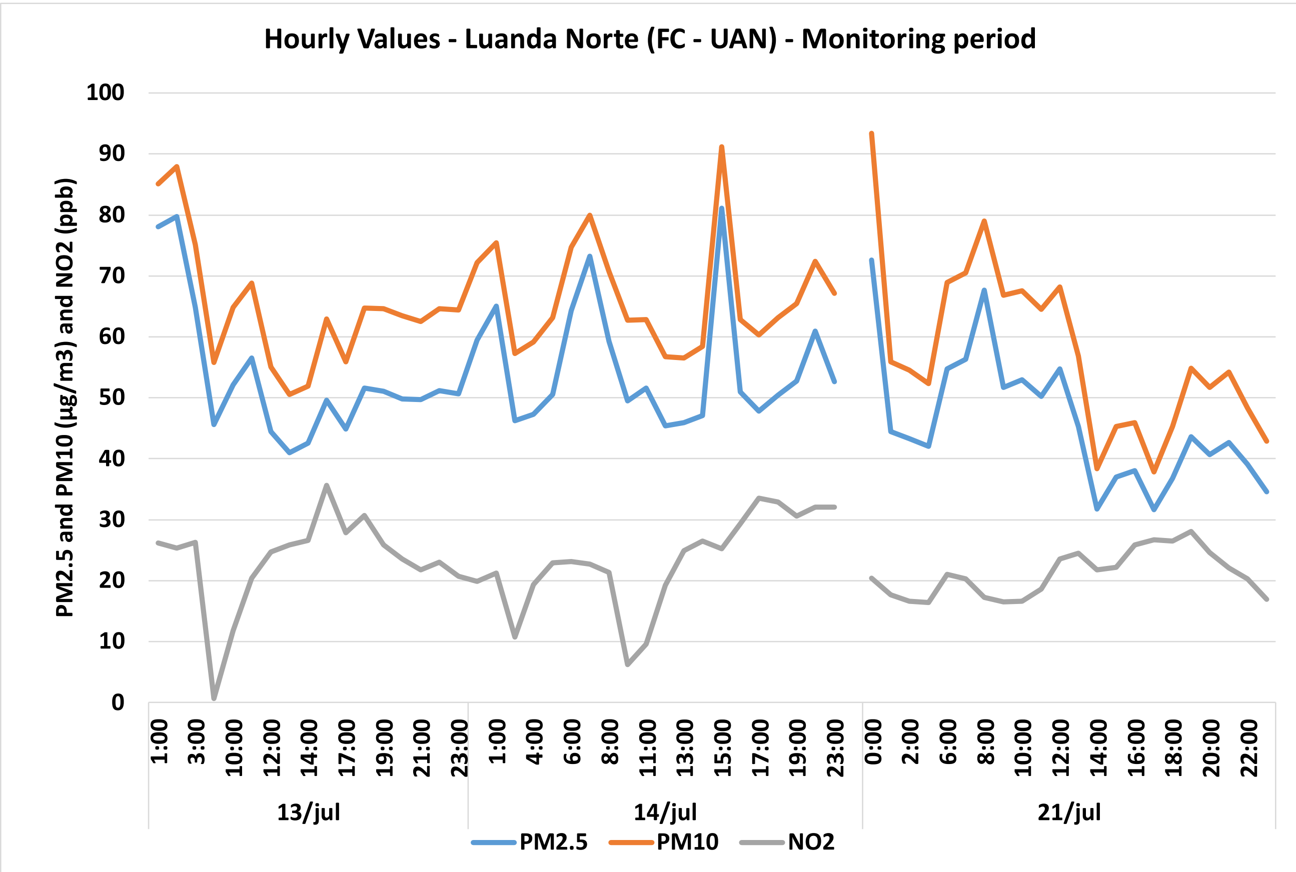


Figure 140: Hourly values for PM2.5, PM10 and NO2 from the local Air Quality Station of Agostinho Neto University (FC-UAN) during the monitoring period (13, 14 and 21 July).

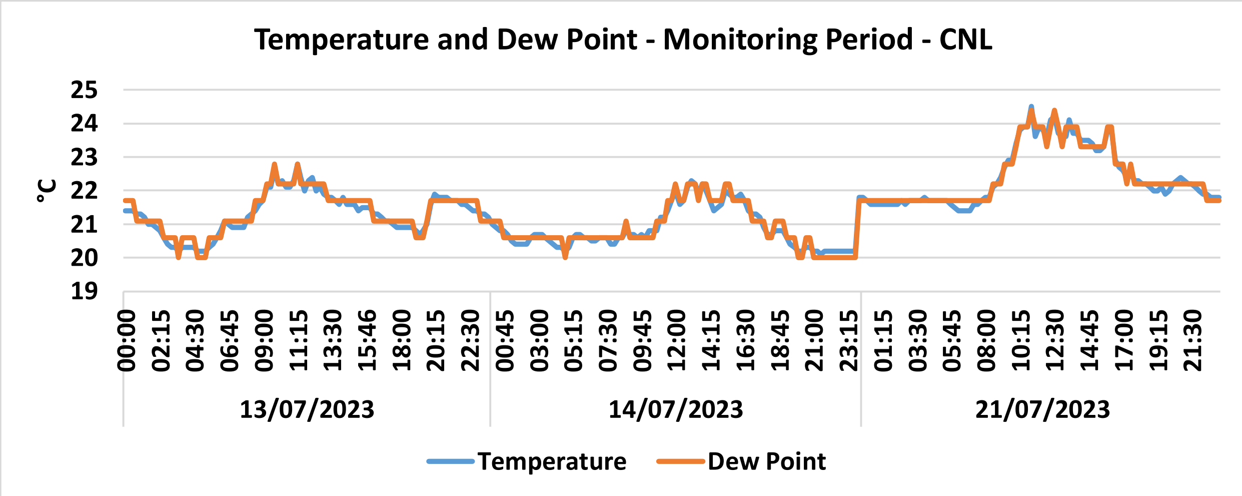


Figure 141: Temperature Records for the Monitoring Period – Nautical Club of Luanda (15 minutes data) Weather station.

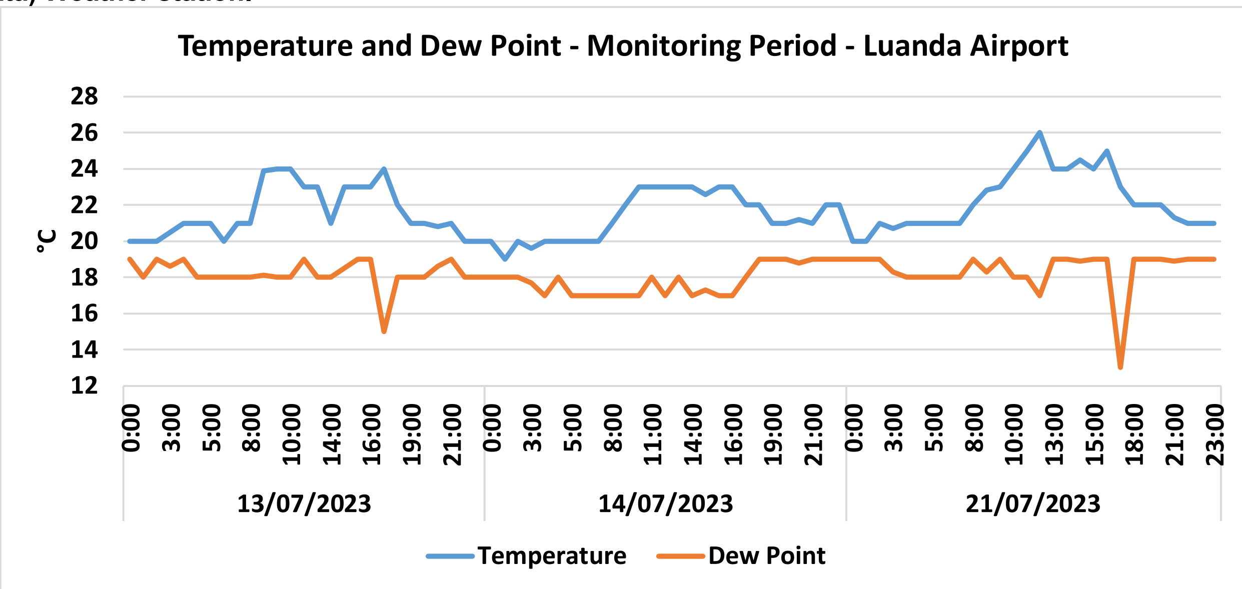


Figure 142: Temperature Records for the Monitoring Period – Luanda Airport (Hourly Data) Weather station

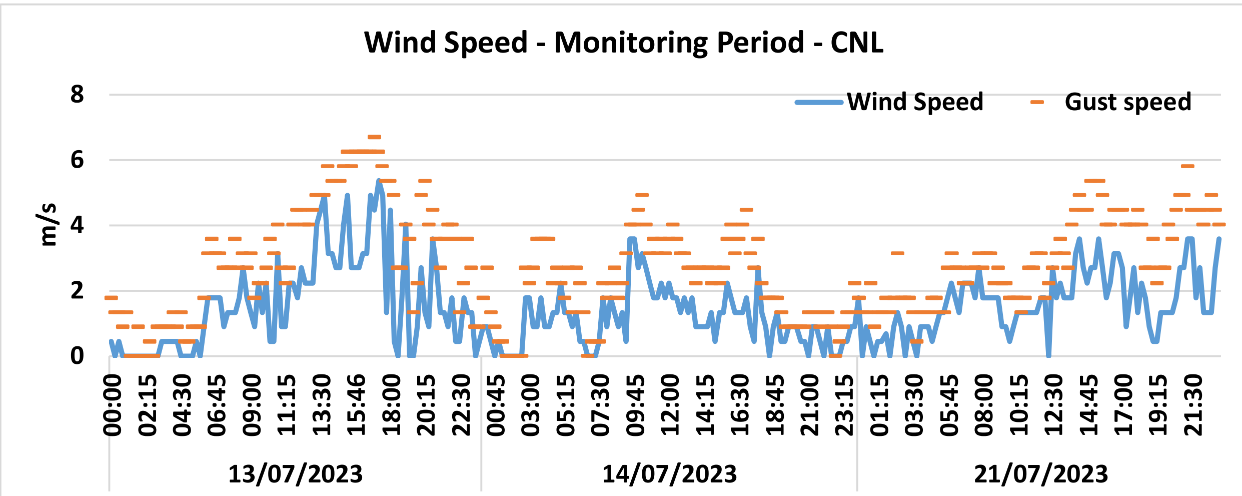


Figure 143: Wind Velocity Records for the Monitoring Period – Nautical Club of Luanda (15 minutes data) Weather station.

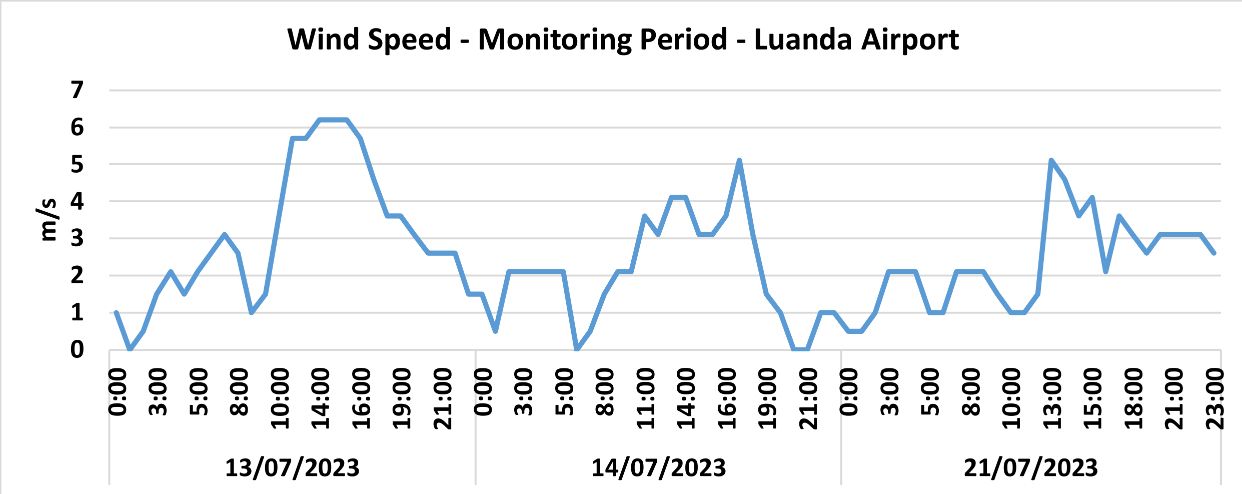


Figure 144: Wind Velocity Records for the Monitoring Period – Luanda Airport (Hourly Data) Weather station.

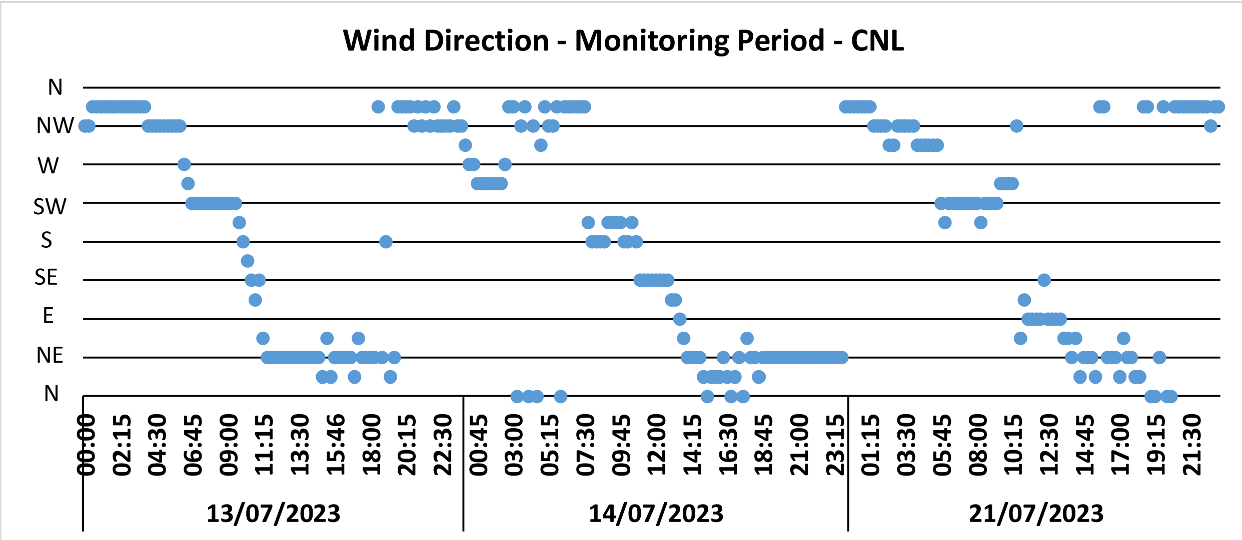


Figure 145: Wind Direction Records for the Monitoring Period – Nautical Club of Luanda (15 minutes data) Weather stations.

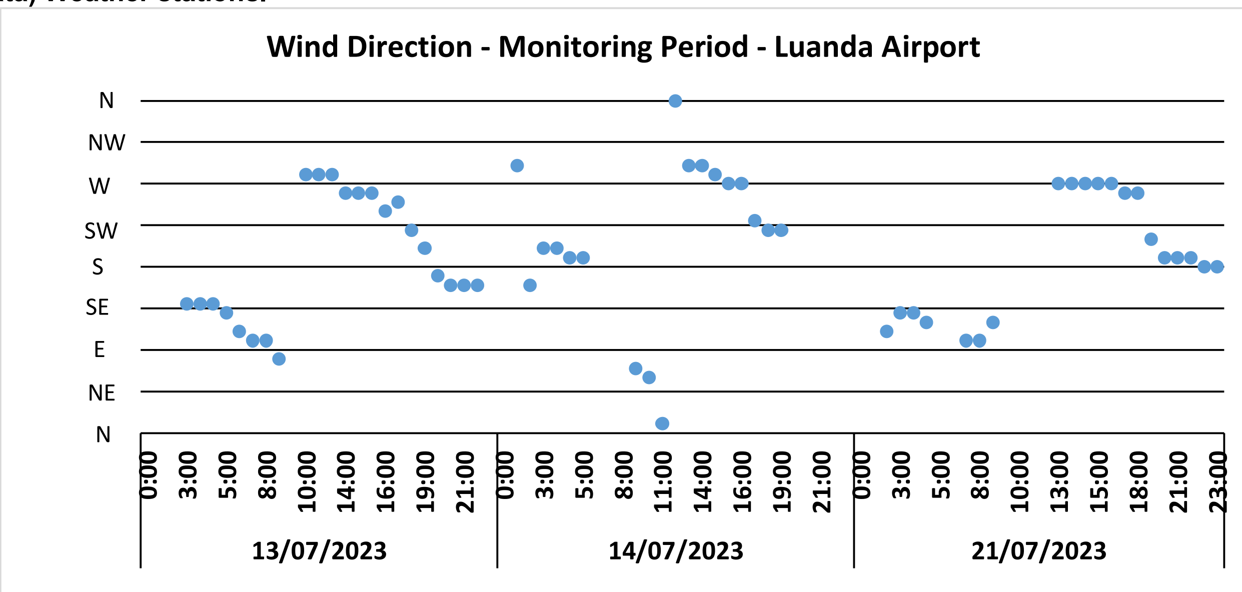


Figure 146: Wind Direction Records for the Monitoring Period - Luanda Airport (Hourly Data) Weather station.

The results obtained in the field monitoring campaign are then presented in the following table.

Table 44: Air Quality Results obtained in the Monitoring Campaign

Locations		Parameters							
		Temperature °C	PM2.5 µg/m3	PM10 µg/m3	O3 µg/m3	SO2 µg/m3	SOx ppb	NO µg/m3	NO2 µg/m3
Results	Air01 – WTP (Lot 1)	22	76	137	395	73	31	15	12
	Air02 – Cacuaco DC (Lot 3)	21	100	204	188	116	50	14	36
	Air03 – KM30 DC (Lot 6)	33	72	196	157	182	83	5	14
	Air04 – Kapalanga DC (Lot 7)	24	128	240	66	55	29	≤ 1.25	4
	Air05 – WAF (Lot 1)	26	99	187	42	59	23	5	4
Background Station (UAN-FC) (Average value from 13, 14 and 21 July)		24	51	63	-	-	-	-	42
Guidelines retained	EU Air Quality Standards	-	20	40	120	125	-	-	40
	WHO Guidelines	-	35	70	100	125	-	-	40
			Annual IT 1	Annual IT 1	Peak S. IT 1	24 h IT 1			Annual IT 1

The results obtained indicate high levels of particles in all sampling points and also Ozone in points Air01, Air02 and Air03. Point Air 03 also registers high levels of Sulphur Dioxides, above the retained guidelines.

It should be noted that, according to the data from the local weather stations, there was some variability of wind directions along the sampling days and even within the region, with different wind conditions near the coast (CBL Station) and inside the urban territory (Airport station), with low to medium wind velocities, around 2-3 m/s, that result in different propagating conditions along the day.

There were some periods, on the sampling days, with average wind speeds over 3 m/s and gust velocities over 6 m/s. These periods, of higher wind velocities, could have contributed to an increase on dust emission from unpaved roads and other areas with uncovered soil.

The values obtained for Particles, Ozone and Sulphur Dioxides are likely associated with the emission sources present in the region, especially road traffic, generators, and industrial zones.

High levels of particles and ozone are usually associated with "smog" pollution, characteristic of dense urban areas with intense traffic and other urban sources. In all Monitoring Points there are also dirt roads nearby, which result in high levels of dust associated with passing vehicles.

Another relevant source of particle emissions is associated with quarry activities in the Bom Jesus area and also Cacuaco.

All these sources were mentioned in the baseline of the 2014 ESIA from Ecovisão/Artelia, and are still present, contributing to poor air quality over the entire project's area.

7.1.8 Noise

From a human point of view, exposure to ambient noise and vibrations may have harmful consequences on health, on the behavior of individuals and on human activities, as well as psychological and social effects. It can then be considered that noise constitutes a cause of discomfort, an obstacle to verbal and sound communication, and may cause general fatigue and, in extreme cases, auditory trauma and extra-auditory physiological alterations.

These aspects should be addressed in view of the direct impacts caused and resulting economic costs that their correction may imply. The main objectives of controlling ambient noise are to protect the population from intruding disturbances that affect their daily activities and to prevent the growing increase in ambient noise, which will later translate into a decrease in quality of life.

Noise is then assumed as a very sensitive component of the environment, potentially negatively affecting people's quality of everyday life.

7.1.8.1 Previous Information and Studies

As mentioned in the Methodology chapter, there isn't any environmental monitoring network implemented in Angola, that can provide long term noise monitoring data. This limits de amount of information available on sound level characterization in Angola, including for the Luanda Area and for the area of influence of the project.

One of the main references, on general environmental characterization in Angola, is the General Environmental Status Report of Angola (REAA), produced in 2006 by the Ministry of Urbanism and Environment. Although this report is based in data from 18 year ago, there isn't any other recent publication of this type, and this report remains the broadest environmental characterization of the country.

This report presents data from the characterization of 2 cities in Angola, namely Luanda and Cabinda.

This report assumed the division of the day in 2 periods, namely the Day Period, from 06:00 to 18:00, and the Night Period, from 18:00 to 06:00, with measurements developed in both periods in September and October 2005.

The measurements were done in places with high traffic load, commercial areas, residential areas, discotheques, and near airports. In Luanda, this report considered measurements in 9 points/zones, namely:

- São Paulo ;
- 1.º de Maio ;
- Catete Road ;
- Samba Road ;
- Américo Boavida Road, in Kinanga ;
- Alvalade Neighborhood ;
- Bairro Azul Neighborhood ;
- One construction site (unspecified) ;

- Luanda Airport.

The report does not present individual values for each site, and only assess general environmental noise according to the use type. According to these results, the areas with high traffic load are subject to noise values of over 70 dB(A), with the quiet residential areas registering values of 50 dB(A). In the night period the report indicated values from 30 to 50 dB(A) dependent on location.

It should be noted that most of the monitoring points mentioned in this report are located in the center on Luanda, outside the area of influence of the current project and the only assessed area near the project is the Catete Road.

Another previous study available is the “Urban Noise in Central Luanda”, from researchers Wilma Fernandes and Júlio César Torres, published in the Angolan Sociology Magazine in 2014.

This study included noise monitoring in the day period in 18 points and in the night period in 7 points distributed in Central Luanda. The study also includes noise simulations for both periods, with the presentation of noise maps.

The Day period values range from 59,8 dB(A) to 72,2 dB(A), with an energetic average of 69,4 dB(A). The night period values range from 65,2 dB(A) to 74,4 dB(A), with an energetic average of 71,0 dB(A). This study then presents very high levels of environmental noise, significantly higher than those registered in REAA 2006, especially in the night period, indicating strong noise disturbances in Luanda. A special note should be made about the Night period values presented in this study, since they are usually higher than those presented for the day Period, even for similar monitoring areas.

As mentioned above, this study also presents Noise Simulation values for both periods, with the Day Period registering a maximum of -4.6 dB(A) difference between Monitored and Simulated values, for an average of – 1.0 dB(A) offset between both data sets.

For the night period, the study presents a maximum of -13.4 dB(A) between monitoring and simulation values, with an average of -4.9 dB(A) offset. The differences obtained between monitored and simulated values, in the night period, indicate that the noise levels, presented for this period, could be less representative.

It should also be noted that this study is focused only in central Luanda, near the Luanda Bay (old town), without any monitoring points near the project’s areas of influence.

During the research done, it was also found a recent monitoring report that included noise values from an area close to one of the project’s area, namely the PIV Distribution Center. There is an industrial yard, from Casais Angola, located northwest of PIV Distribution Center, which is subject to periodic environmental monitoring. In the Monitoring Report coded SZ-161/18-RMA.ALX.04.1S2021, from September 2021, associated with this facility and submitted to the National Institute of Environmental Management of Angola (INGA), it was included a Noise Monitoring Bulletin. This Bulletin contains noise values from a monitoring point located near the Kussanguluka Condominium, next to the PIV Distribution center, with values of 55 dB(A) for the Day Period.

The other desktop reference to be considered is, of course, the previous ESIA for the Quilonga Grande Water Distribution Project, developed in 2014 by Artelia and Ecovisão.

This ESIA included Noise monitoring in 11 points around the project, characterizing the noise levels around the main project structures (according to the 2014 project design). This monitoring was developed only for the day period and with one monitoring session only in each point.

Table 45: Noise monitoring points from the 2014 Ecovisão/Artelia ESIA

Point	Location	Coordinates (RSAO 13)		L_{day} (dB(A) values obtained
R1	WTP and Bom Jesus Distribution Center	9°4,'39,23" S	13°34'31,93" E	43
R5	Pipeline – Bom Jesus Road	9°5,'05,13" S	13°33'37,69" E	81
R6	Pipeline - Junction between the Bom Jesus Road and the Viana/Catete road	9°2,'35,40" S	13°34'30,14" E	74
R7	Site of the New Airport DC and intermediate pumping station	8°59'41,16" S	13°31'04,68" E	46
R8	km 30 Distribution Center	8°57'25,08" S	13°29'25,92" E	58
R9	Cacuaco Distribution Center	8°50'46,02" S	13°25'53,76" E	55
R10	Zango V Distribution Center	9°4,'47,08" S	13°26'07,31" E	67
R11	Kapalanga Distribution Center	8°54'37,50" S	13°23'28,38" E	59
R12	Pipeline - Near the Abstraction point of Coca-Cola Factory	9°9,'56,71" S	13°34'11,14" E	60
R13	Pipeline near the abstraction point of the beer factory	9°9,'53,82" S	13°34'41,10" E	67
R14	Pipeline - Bom Jesus Road	9°9,'52,86" S	13°33'54,60" E	65

On the following figure is presented a comparison between the sampling points assessed in the 2014 ESIA Baseline and the monitoring points considered in the current study, described in the Methodology Chapter (5.4.1.8).

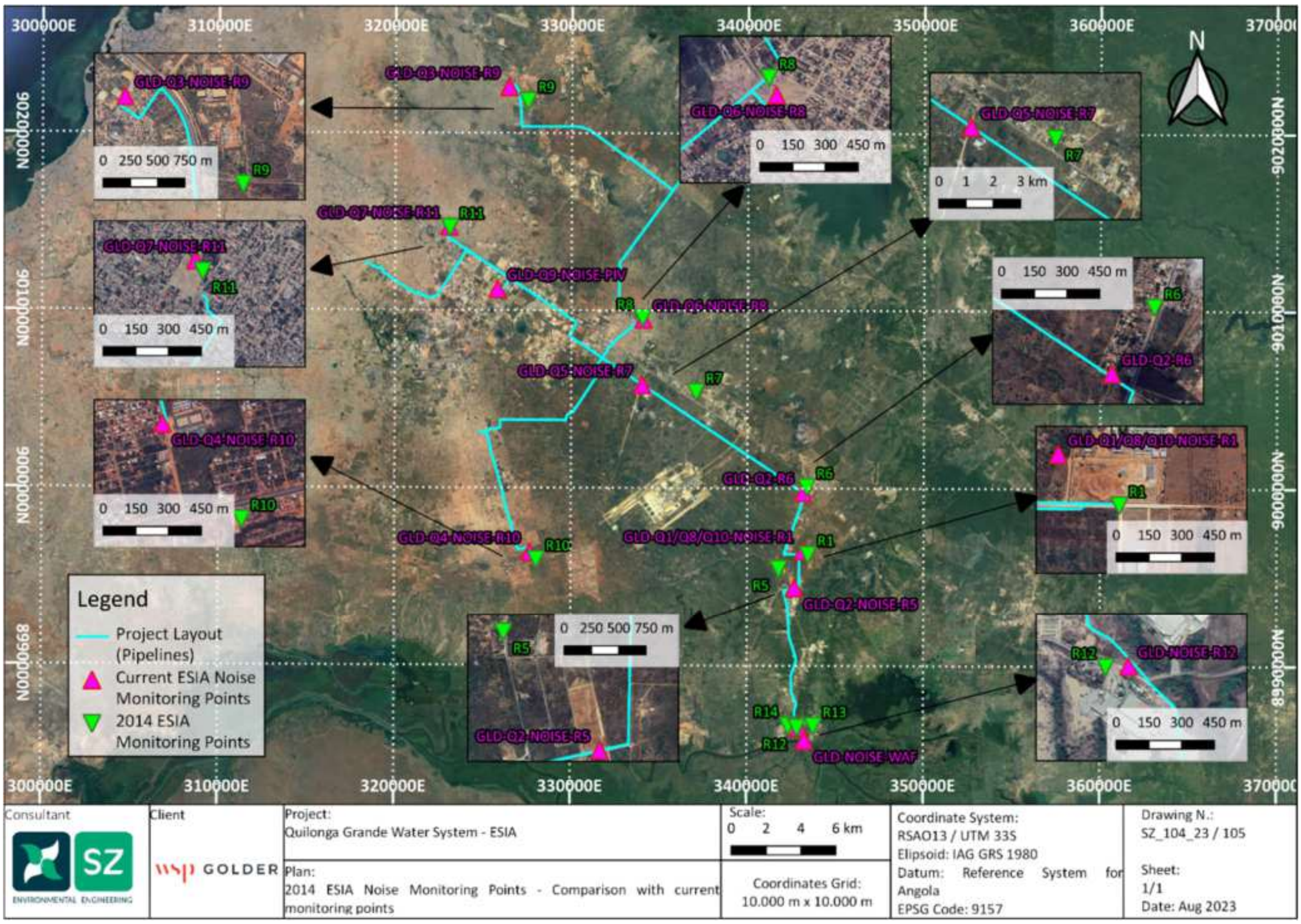


Figure 147: Comparison of Noise measuring locations between the 2014 ESIA from Artelia/Ecovisão and the current study

As can be seen from the comparison above, points R12, R1, R8 and R11, assessed in 2014, are similar to the ones considered in the present baseline, representing the same monitoring area.

As for the rest of the monitoring Points, the mains changes considered were the following:

- R5 and R6, near the water pipeline
  - the project layout was changed, and the 2014 points are offset to the current project layout.
  - R5 is offset from the current monitoring location by 1,400 m and represents significantly different noise conditions, not enabling any comparison between results;
  - R6 point from 2014 is offset by 360 m from the current point. Both are located in the Amazonia neighborhood . However the 2014 monitoring was done next to the Bom Jesus Road, while the 2023 monitoring was done inside residential area, with less influence from the Road Traffic of the main road.
- R7 – Near the New Airport Distribution Center
  - The ESIA from 2014 considered a different location for the New Airport Distribution Center
  - As such, the R7 monitoring point is in a completely different location, over 3 km apart from the current site.
- R9 – Cacuaco Distribution Center:
  - The ESIA from 2014 considered a different location for Cacuaco Distribution Center
  - The monitoring point differ in over 1,300 m between both studies
- R10 – Zango V distribution Center:
  - The ESIA from 2014 considered a different location for the Zango V Distribution Center
  - The monitoring point differ in over 500 m between both studies

7.1.8.2 Noise monitoring Campaign

For the characterization of the current noise environment, in the Project's Area of Influence, discrete short-term noise measurements were carried out, at locations around the different project areas, characterizing the pre-existing sound levels.

The selected measurement points are described in the baseline methodology chapter (5.4.1.8).

In the following tables, it is then presented, for the considered monitoring points, the values obtained in the monitoring Campaign.

Since the local streets are considered important or dominant residual sources, it was also included, during the fieldwork, the development of traffic counts on the nearest roads. It was then obtained an estimate for the Average Hourly Traffic for Day period, as also included in the following table.

Table 46: Noise Baseline Results

Points	Measurement Results (dB(A))		Type of receptor	Guideline Levels	Assessment	Average Hourly Traffic – Day Period (nearest roads)			
						Road	Motor-cycles	Light Vehicles	Heavy Vehicles
R1 – WTP	L_{night}	44	Non Sensitive	70	Compliant	-	144	240	168
	L_{day}	56		70					
WAF - Extraction Point	L_{night}	52	Non Sensitive	70	Compliant	-	60	54	90
	L_{day}	56		70					
R5 – Near CIF Factory	L_{night}	54	Non Sensitive	70	Compliant	-	0	30	156
	L_{day}	58		70					
R6 – Bom Jesus Road, near Bairro Amazónia	L_{night}	43	Sensitive	45	Compliant	-	168	192	246
	L_{day}	53		55					
R7 – CD Novo Aeroporto	L_{night}	48	Non Sensitive	70	Compliant	-	24	66	54
	L_{day}	58		70					
R8 – CD Km 30	L_{night}	59	Sensitive	45	Non-Compliant	-	264	24	42
	L_{day}	65		55					
R9 - CD Cacuaco	L_{night}	53	Sensitive	45	Non-Compliant	Monte Belo	282	42	0
	L_{night}	60		55		Via Expresso	55	465	385
R10 – CD Zango 5	L_{night}	46	Sensitive	45	Non-Compliant	-	318	254	46
	L_{day}	54		55	Compliant				
R11 - CD Capalanga	L_{night}	53	Sensitive	45	Non-Compliant	-	150	30	6
	L_{day}	56		55					
CD PIV	L_{night}	59	Sensitive	45	Non-Compliant	-	220	290	190
	L_{day}	67		55					
R12 - Near banco Sol	L_{night}	59	Sensitive	45	Non-Compliant	-	97	148	92
	L_{day}	64		55					

The areas where the project's facilities will be built present the following characteristics:

- Project's development areas R12 (transmission line between the water extraction and the WTP), R9 (Cacuaco DC), R11 (Capalanca DC), R8 (KM30 DC) and PIV (PIV DC) are located near sensitive receptors (residential areas) and present average background noise above thresholds defined by IFC guidelines, ranging from 53 dB(A) to 59 dB(A) during the night and from 56 dB(A) to 67 dB(A) during the day (IFC Guidelines thresholds defined to 45 dB(A) during the day and 55 dB(A) during the night). These measurements reveal already high noise levels which could increase with the noise generated by the future construction works.
- Areas around R6 (Transmission live between the WTP and the DC) are also located near sensitive receptors (residential areas), but present background noise (L_{night} = 43 dB(A) and L_{day} = 53 dB(A)) compliant with thresholds defined by IFC guidelines, indicating less noise disturbance, with noise levels compatible with sensitive uses;

- Areas around R10 (Zango V DC) also register sensitive receptors (residential areas). The Background noise in this area is near the thresholds defined by IFC guidelines, with the L_{night} levels being 1 dB(A) above those thresholds and the L_{day} levels 1 dB(A) below. As such, any increase in environmental noise levels originating from the future construction or operational phases, even if below the recommended 3 dB(A) increase limit mentioned in the IFC Guidelines, will likely lead to non-compliance with the day and night threshold limits for sensitive areas (45 dB(A) and 55 dB(A).
- As for the project areas around R1 (WTP), WAF (water extraction), R5 (transmission line between the extraction and the WTP) and R7 (New Airport DC), it is considered that there are no sensitive receivers in the proximity of the sampling points, being considered only non-sensitive uses. All points register noise levels compatible with these uses, with noise levels ranging from 44 dB(A) to 54 dB(A) during the night and from 56 dB(A) to 58 dB(A) during the day.

When comparing the values obtained with those referenced in the General Environmental Status Report of Angola (REAA) and the “Urban Noise in Central Luanda” study, the day period values are generally consistent with the conclusions of the REAA. However, the Night Period values were, in general, higher than those obtained in 2006 on the REAA. However, all values measured are, in general, below those mentioned in the “Urban Noise in Central Luanda” study, in both periods.

As mentioned in the previous chapter it is only possible to compare noise data, between the previous 2014 ESIA and the current baseline, in points R12, R1, R8 and R11.

It is presented, in the following table, a comparison of the values obtained in 2014 (ESIA from Artelia and Ecovisão), and the values obtained in the current study.

The 2014 ESIA only obtained values in the Day Period, having assumed an estimate for the Night Period (a direct reduction of 10 dB(A)). Because of that limitation, the following table only compared the values obtained in the Day Period for both monitoring campaigns.

Table 47: Comparison of values between 2014 (ESIA Artelia/Ecovisão) and 2023 (Current study)

Point	Lday values obtained (dB(A))	
	2014	2023
R12 - Near banco Sol	60	64
R11 - CD Capalanga	59	56
R8 – CD Km 30	58	65
R1 – WTP	43	56

As can be seen from the table above, there are some differences between the values obtained in each monitoring campaign.

These differences can result mainly from two different aspects, namely:

- Natural changes in the residual noise emitting sources from 2014 to 2023 and noise propagation conditions
- Different monitoring protocols between the two campaigns.

Regarding the monitoring protocols, the 2014 ESIA only considered a single short duration monitoring in each point, without repetition in different days (as such, without “independent monitoring”, as proposed in ISO 1996-2:2017), and assuming a shorter monitoring period. Those values could, then, have larger influence from specific noise emitting events, being less representative of the noise baseline.

As for the natural changes in residual noise emitting sources, the Bom Jesus area has seen, since 2014, an increase in industrial units, as the Sodiba Plant, which also leads to additional road traffic in the local roads, such as the one near the R12 monitoring point. This increase in industrial plants and associated traffic could then lead to an increase in noise values.

Figure 148: Evolution of noise sources around R12 (Bom Jesus) monitoring point between 2014 and 2017 (marked in blue the industrial plants that have started operation of have expanded operations between 2014 and 2017).

Regarding the KM 30 Distribution center (point R8), there has been a significant urban development since 2014, with the construction of new buildings on all sides of the plot, including several commercial units, with relevant noise emissions. In addition, the project's area has recently been used for some informal market activities, which can contribute to an increase of noise levels. The local roads have also been renovated, allowing greater traffic flow and speed.

Figure 149: Evolution of noise sources around R8 (Km30 DC) monitoring point since 2014.

As for the WTP (Point R1), in 2014 the construction plot had only some forest and agricultural uses, with no relevant noise emitting sources present.

In 2023, there are already, inside the plot that will include the WTP, several buildings in operation. There are also other industrial uses around. The road system was completely redone, going from small dirt tracks in 2014, to large open roads in 2023. These roads serve the communities in the region, but also the industrial sites around, and the improvement in road conditions led to significant increase in road traffic flow and speed.

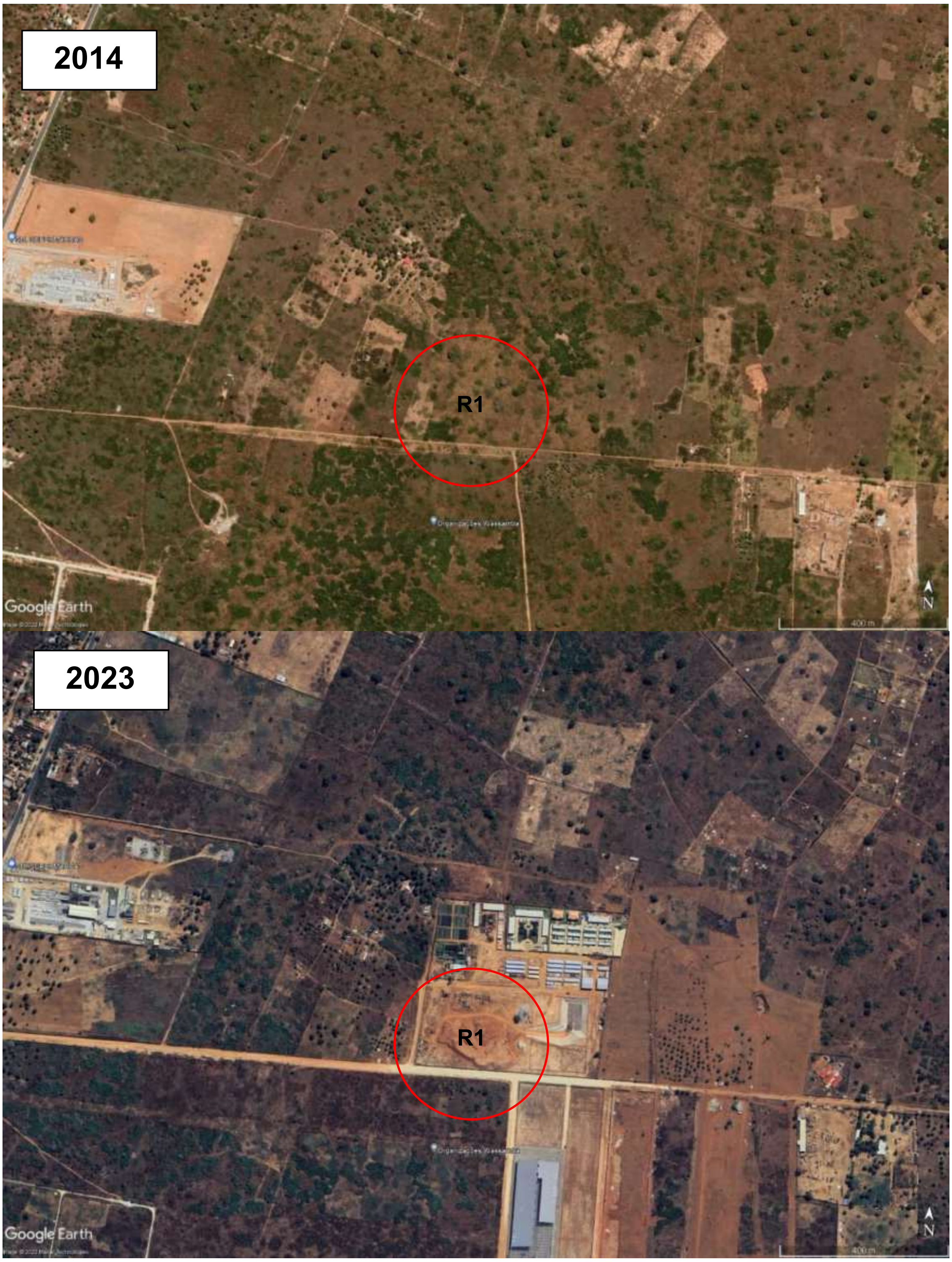


Figure 150: Evolution of noise sources around R1 (WTP) monitoring point since 2014.

7.1.8.3 Emitting Sources and Sensitive Receivers

The 2014 ESIA from Artelia and Ecovisão included an assessment of the main noise emitting zones and sensitive receptor zones, presenting a general mapping of these areas.

During the field work and desktop work, there was an effort to update and complement this information, identifying the main noise emitting sources that currently exist, the main residential areas in the region as well as other sensitive uses (educational and health services) surrounding the project.

The project extends to a very wide area, covering all types of land uses, including:

- industrial sites/zones ;
- residential urban areas ;
- large scale commercial areas ;
- public services zones, including sensitive uses such as schools and health care units ;
- the future new Luanda International Airport ;
- a transport network with very high traffic load and associated noise emissions, including the Catete road, the Bom Jesus Road, the Via Expresso Road and also the Luanda railroad.

The main noise sources and receptor zones, existing in the project's surroundings, are summarized in the following figure.

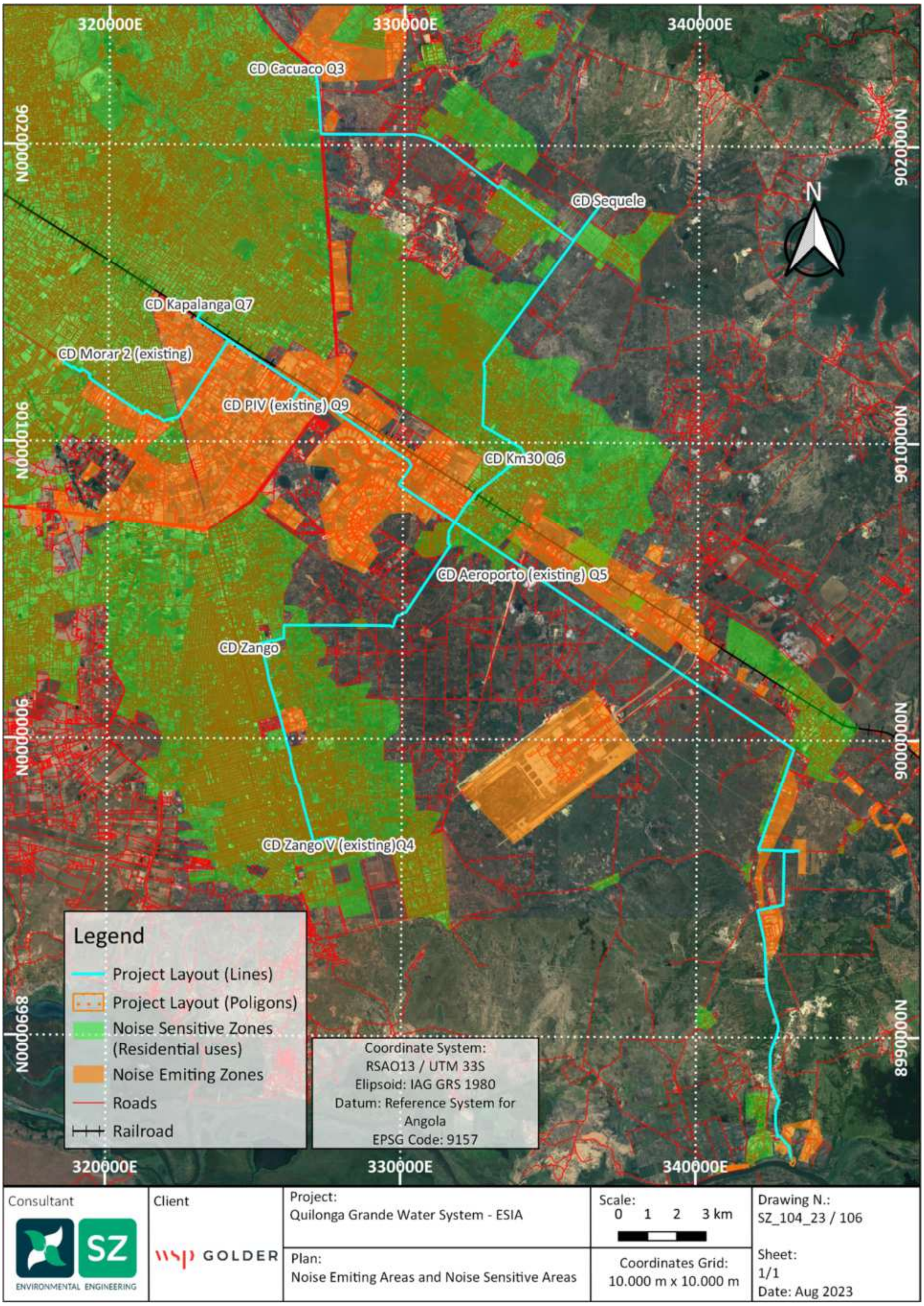


Figure 151: Identification of main noise emitting areas and sensitive receiving areas

When comparing the sensitive receptor areas and the project layout, the most relevant zones will be located around the distribution centers. Since the Distribution Centers are located inside the Luanda urban matrix, they have habitational housing around, and already register some background noise disturbances. As such, these are the areas' most sensitive to any increase in noise levels, that could lead to additional noise disturbances to the surrounding receptor.

The only exception, for now, is the New Airport Distribution center since there aren't any relevant sensitive uses around this facility. The noise sensitivity of this location will depend on the future evolution of land use, associated with the start of operations of the new airport, namely the potential construction of new sensitive uses.

There are also some sensitive areas near the Bom Jesus Road, with some communities living next to this road, as is the case of the Amazónia Neighborhood . The areas around the extraction and the water treatment plant are not considered sensitive, and the main uses around are non-sensitive, such as industrial plants.

7.2 Biological component

7.2.1 Natural and Modified Habitats

As mentioned in Methodology Chapter, preliminary mapping of the habitat in AoI was carried out, based on the Copernicus Global Land Cover and *Ecoregions 2017* *© Resolve* platforms.

In terms of phytogeography, there is no current mapping of Angola's vegetation, based on field surveys, updated taxonomy, and remote sensing and modeling. Thus, the reference classifications at the level of the country's vegetation units continue to be the Phytogeographical Map of Angola (Angola. 1970) and the Vegetation Chart of Africa (UNESCO/AETFAT/UNSO) compiled by White (White 1983) which generalizes the 32 types of vegetation in Barbosa in just 14 types, introducing in parallel continuity with the vegetation of adjacent countries.

According to the Phytogeographical Map of Angola (Barbosa, 1970), the Province of Luanda features a vegetation typically comprised of a mosaic of savannas, steppes, and xerophytic woodland, sublittoral on clayey and sandy soils, dominated by *Adansonia*, *Acacia welwitschii*, *Dichrostachys* sp., *Guibourtia* sp., *Combretum* sp., *Strychnos* sp., and *Setaria welwitschii*. White (1983) places the study region in Vegetation Unit 29C - Undifferentiated woodland of the North Zons. In this work, the nine biomes of the three biogeographical divisions of the African continent were identified, which in turn were divided into ecoregions.

According to these authors, the study area falls within the ecoregion N.º 81 - Savanna and Forest of the Escarpment of Angola.

As mentioned in the Bio and Phytogeographic Framework, there is no systematization or standardization of nomenclature in Angola, despite being the country with the greatest diversity of biomes in Africa, having 7 of the 9 accepted for the continent, and the second country in Africa with largest number of ecoregions, right after South Africa, in accordance with what was proposed by Burgess *et al.* (2004).

As mentioned by (Huntley B. 2019) despite the different classifications and terminologies used throughout the 20th century, regarding the Phyto and Biogeography of Angola, these did not result in a formal nomenclature of its biomes, habitat, among other hierarchical levels of ecological organization. This fact makes comparison between different studies and publications difficult and can even lead to dubious interpretations.

Based on what above reported, in the characterization of habitat types presented below, taking into account that it is focused on a relatively small area, the AoI was subdivided into biotopes, which can be considered as areas with uniform environmental conditions and their phytocenoses. A descriptive and perceptible nomenclature of the types of vegetation cover/habitat present was used, in line with many of the latest reference publications (Commission. 2016) (Huntley 2023) that address various biological and ecology studies of the ecoregion.

Next, the AoI habitat mapping is presented, duly validated after field surveys in the predefined flora points (from Figure 152 to Figure 157), with the nomenclature adopted as previously mentioned.

In accordance with the habitat maps (from Figure 152 to Figure 157), the extension of the areas occupied by the different identified Natural and Modified Habitat and the relative percentage on the total surface of the AoI were calculated and are presented in the Table 48 below. As can be seen from the description made of the habitats present in the AoI, although there are some relatively well-preserved habitats, most of the study area corresponds to Modified Habitat, with medium to high disturbed nature, characteristic of a peri-urban area of Luanda city, having several millions of inhabitants.

The results of this habitat classification are coherent with what reported in the ESIA promoted in 2014 by Artelia/Ecovisão, revealing that throughout these almost ten years there has been a general worsening of the conservation conditions of natural communities, as a result of urban and industrial expansion.

Based on the above, the ecological sensitivity and the conservation value of the AoI are assumed as **low**.

Table 48: habitat types present in the AoI and relative area occupied

Habitat Type	Total AoI	
	ha	%
Natural habitats		
Dry *Adansonia* Woodland	1088	11
Dry Shrubland	1257	13
Floodplain Grassland	19	<1
River Kwanza	18	<1
Subtotal	*2382*	*25*
Modified habitats		
Small-scale Farming	852	9
Ruderal	1478	16
Artificialized/Built-up Areas	4775	50
Subtotal	*7104*	*75*
Total	***9486***	***100***

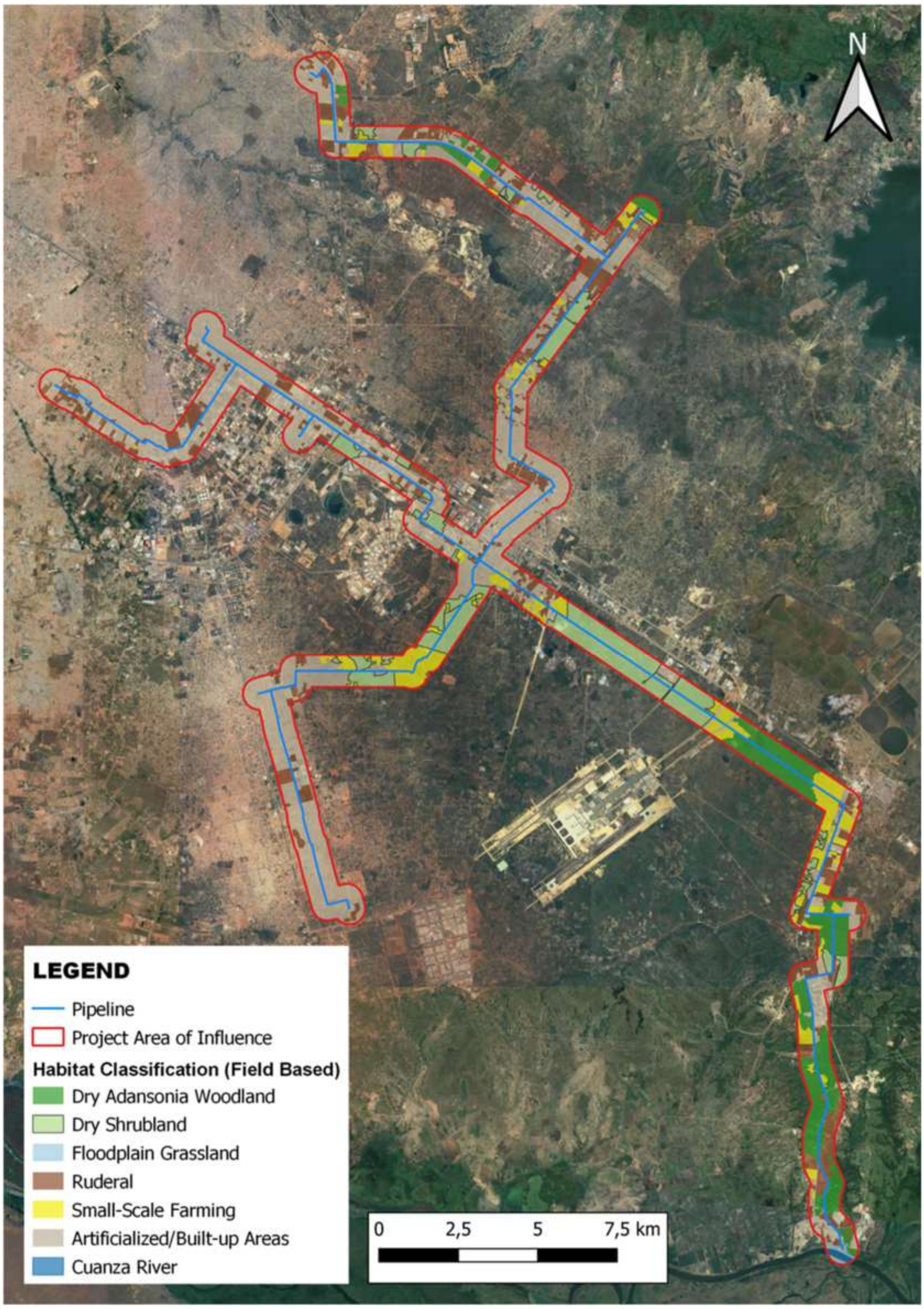


Figure 152: Habitat within the Project Area of Influence (overall)

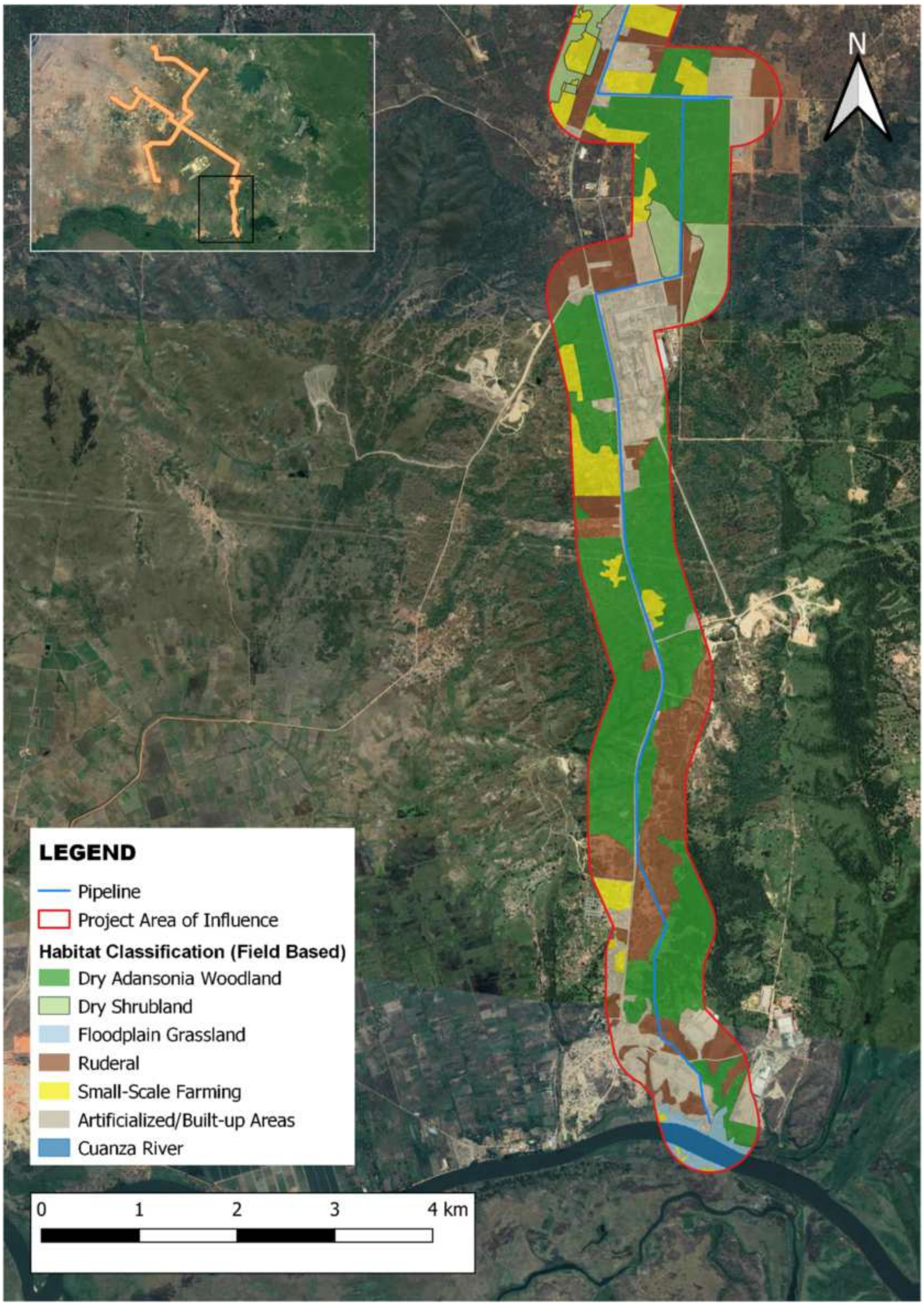


Figure 153: Habitats within the Project Area of Influence, for the section of the Project including Lot Q1/Q8/Q10

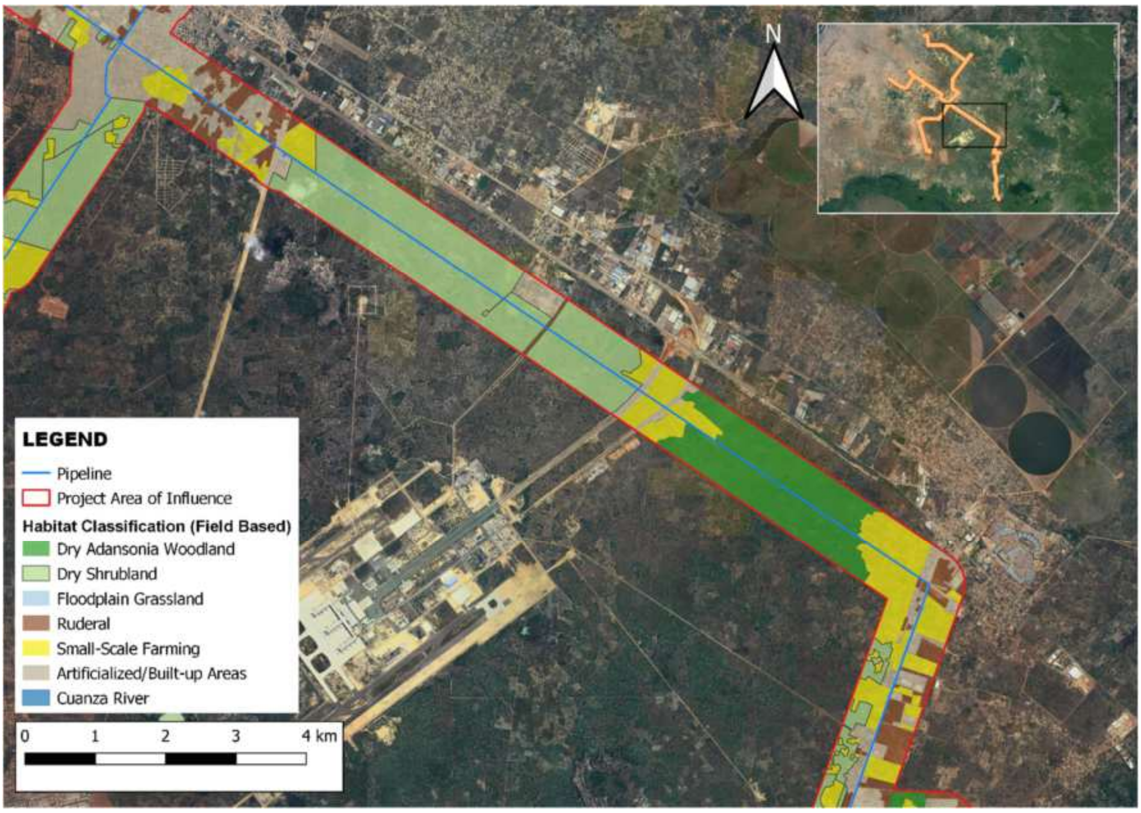


Figure 154: Habitats within the Project Area of Influence, for the section of the Project including Lot 5

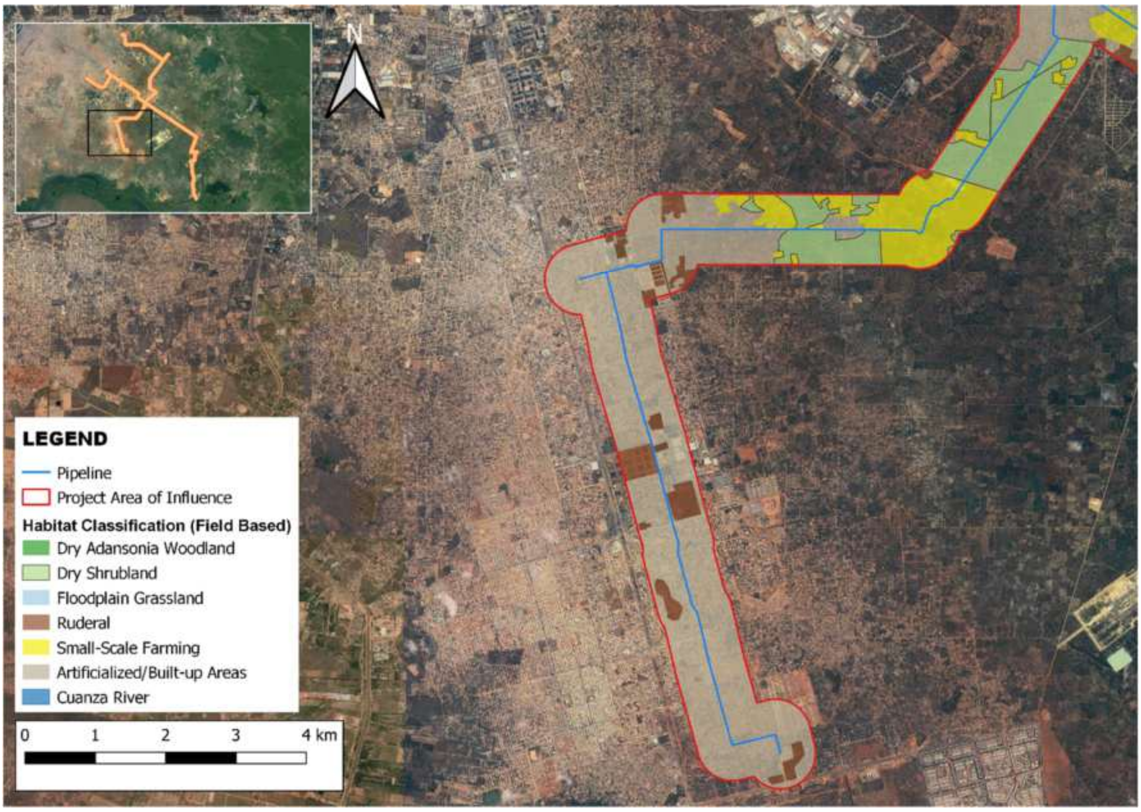


Figure 155: Habitats within the Project Area of Influence, for the section of the Project near Lot 4

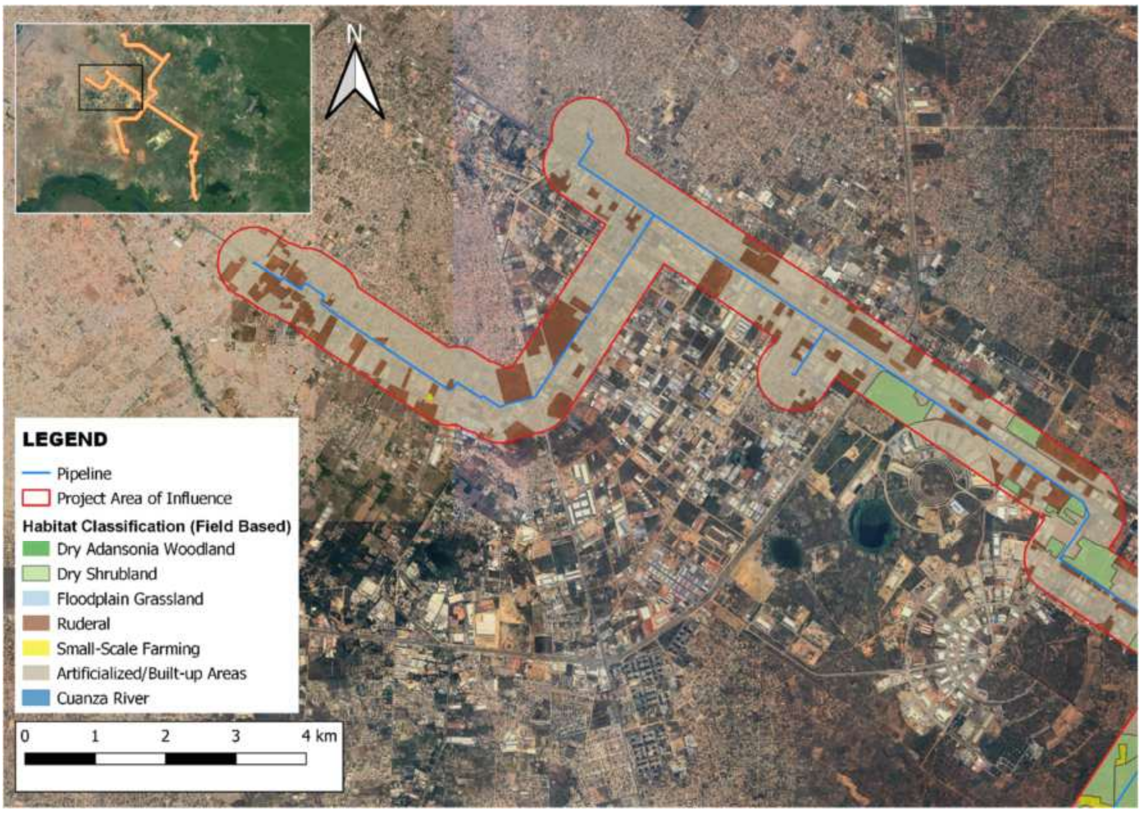


Figure 156: Habitats within the Project Area of Influence, for the section of the Project near Lot 7 and Lot 9

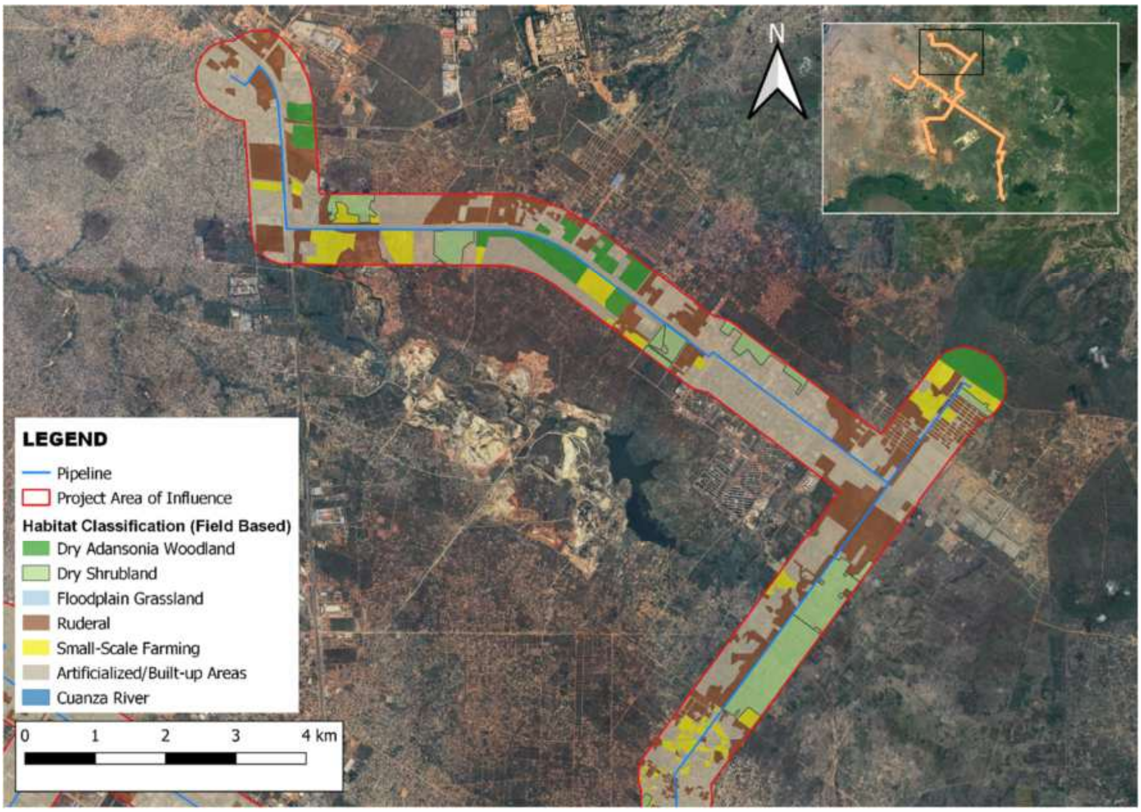


Figure 157: Habitats within the Project Area of Influence, for the section of the Project near Lot 3

Below is a characterization for the natural habitats present in the AoI. For a more exhaustive analysis of the characteristics of all sampling points, including humanized, ruderal, or agricultural areas, as well as other data such as the relative abundance of each species (Braun-Blanquet), the field survey forms should be viewed, as well as the photographic documentation for all the survey points.

Dry Adansonia Woodland

This habitat corresponds to a dry savannah dominated by trees and developed on sandy to clayey soils. The soil is sometimes cracked. The cracks in the soil are a sign of erosion happening in certain areas, possibly evolving into ravines. The relief is generally highly variable in terms of slope and exposure, alternating depressions and small valleys, characterized by dark clayey soil, with bands at a relatively higher elevation characterized by sandy soil. The edaphic conditions represent an important factor in determining the plant distribution within this habitat. Indeed, the density of plant communities is much higher in the depressions with clayey soils, which are the ones with the higher concentration of humidity. On the contrary, relatively elevated places have a pronounced aridity, which is reflected in the vegetation.

The degree of degradation in this habitat ranges between low to medium. The main degradation factors are represented by agriculture, grazing, cutting and/or burning of shrubs and trees for construction activities and for the production of charcoal. Another important degradation factor is represented by invasive alien species. The main invasive alien plant species present is *Chromolaena odorata*, which grows in the patches with a high moisture concentration in the soil.

This habitat shows a well-developed tree layer, with a considerable density (**Figure 158**). Vegetation is dominated by baobabs (*Adansonia digitata*), which is included in the LVA (Lista Vermelha de espécies de Angola - Angolan Species Red List) in the Vulnerable (VU) category. *Adansonia digitata* is accompanied by *Euphorbia conspicua* and *Sterculia setigera*. The shrub layer is often developed and dense and it forms sometimes impenetrable communities, characterized by the presence of *Capparis subglabra*, *Maerua angolensis*, *Alantsilodendron pilosum*, *Azima tetracantha*, *Gymnosporia senegalensis*, *Bridelia cathartica*, *Commiphora angolensis*, *Grewia carpinifolia*, *Abutilon mauritianum*. The subshrub layer is dominated by *Neuracanthus scaber* and *Barleria salicifolia*. The herbaceous layer is less developed and dominated by various grasses, the most common being *Heteropogon contortus*, *Eragrostis superba*, *Andropogon gayanus*, and *Digitaria* sp.

Approaching residential areas, the level of degradation increases, and tree and shrub densities decrease, because of increased human activities.

Figure 158: Photos of Dry Adansonia Woodland taken at FP03 (on the left) and at FP04 (on the right).

Dry Shrubland

This habitat corresponds to a dry savannah dominated by shrub plants and developed on sandy to clayey soils. The relief is generally homogeneous and not so highly variable in slope and exposure. The level of degradation ranges between low to medium, and the main degradation factors are represented by agriculture, grazing, periodical human-induced fires to convert natural lands into cassava crops or for the cultivation of fruit trees, or to produce charcoal. Another important degradation factor is represented by invasive alien species, with the main invasive alien plant species being *Chromolaena odorata*.

The shrub layer is the one with the highest level of development (**Figure 159**) and it consists of *Strychnos cocculoides*, *Combretum camporum*, *Boscia urens*, *Abutilon mauritianum*, *Pentarrhinum insipidum*, and *Hoslundia opposita*. The herbaceous layer is made up of several grasses, the most common being *Heteropogon contortus* and *Eragrostis superba*. The tree layer is not very expressive, probably due to human action. Scattered individuals of *Adansonia digitata*, *Mangifera indica*, and *Azadirachta indica* are present.

Some areas are under process of urbanization or partially used by local population for subsistence agriculture, with main crops being corn and cassava.

Figure 159: Photos of Dry Shrubland taken at FP13 (on the left) and at FP18 (on the right).

Floodplain Grassland

This habitat corresponds to a grassland located in proximity to the dry banks of Kwanza River (**Figure 160**), also covering part of the humid area. The degree of degradation is low, with the main degradation factors being invasive alien species, the cutting and burning of trees for the production of charcoal, and wastewater spills from a beverage factory located upstream. The main invasive alien plant species are *Pistia stratiotes* and *Pontederia crassipes*.

The dry banks of the River, whose altitude is estimated at approximately 10 meters from the riverbed, are dominated by trees, especially *Adansonia digitata* and *Ceiba pentandra*, as well as the introduced *Spondias mombin*. Several species grow in the shrub layer, in particular *Grewia carpinifolia*, *Capparis subglabra*, *Maerua angolensis*, *Bridelia cathartica*, *Cordia africana*, *Gymnosporia senegalensis*, *Azima tetracantha*, and *Ximenia americana*. Some palm trees (*Elaeis guineensis* and *Phoenix reclinata*) are sometimes present. The subshrub layer is dominated by *Neuracanthus scaber* and *Barleria salicifolia*. The herbaceous layer is dominated by various grass species, especially *Heteropogon contortus* and *Eragrostis superba*.

The areas of the grassland which are in direct contact with the river (palustrine meadow) are made up of an extensive strip of *Echinochloa pyramidalis*, *Typha domingensis*, *Cyperus papyrus*, *Cyclosorus interruptus*, *Pistia stratiotes*, *Pontederia crassipes*, *Mimosa pigra* and other plants adapted to the floodplain wetlands.

Figure 160: Photo of Floodplain Grassland taken at FP01.

Kwanza River

This habitat corresponds to the watercourse of the Kwanza River and to its banks, in the range corresponding to the land/water interface, therefore covering the submerged and emerging banks. The hydrological characteristics of the river are described in greater detail in the chapters relating to hydrogeology and freshwater habitats; however, a brief description is presented below.

The river, in the stretch considered as freshwater AoI, has an average width of 200 m. The average depth of the river in the area of future water abstraction is in the order of 4 m, falling in some places to 6 to 8 m. Regarding the emerging bank, the right bank has an abrupt, ravine slope, up to 8 m, although there are some flattened, vegetated or bare soil/artificialized areas, due to anthropic use as commercial areas and stopping areas for small boats. The left bank presents a distinct typology, since after an abrupt slope of approximately 2 m in the water/land interface, it is flat for hundreds of meters. This bank is heavily flooded during the rainy season.

The river's flow regime is lentic, with velocities between 0.43 and 1.09 m/s (SINOHYDRO, 2018). The banks and the riverbed are made up of a mixture of clay, sand and silt, with a large percentage of organic matter which gives the characteristic high turbidity and which conditions the penetration of light to a maximum depth of 30 to 50 cm.

The wetland areas, whose extent varies depending on the characteristics of the margin, are covered by floodplain grasslands and small marshy areas, consisting essentially of *Echinochloa pyramidalis*, *Echinochloa crus-pavonis*, *Cyperus papyrus*, *Phragmites mauritianus*, *Oryza longistaminata*, *Megathyrsus maximus*, *Thelypteris interrupta, Cyclosorus interruptum*, *Persicaria madagascariensis* among others. In the lagoons formed on the marshy banks, several floating aquatic macrophytes develop, such as the invasive *Pontederia crassipes*, *Pistia stratiotes*, *Azolla pinnata* and others with floating leaves, such as *Nymphaea lotus*.

Even though there is no true riparian forest or gallery, in some places on the banks there are large trees, such as *Ceiba pentandra*, *Adansonia digitata*, *Spondias mombin*, *Ficus thonningii*, as well as fruit trees of anthropogenic origin, such as *Mangifera indica*, *Annona muricata*, and many *Elaeis guineensis*.

The main degradation factors found correspond to trampling of vegetation on the banks, proliferation of exotic and invasive species, and destruction of sections of flooded grasslands during the dry season, for the implementation of small-scale farming in areas adjacent to the river. In addition, the banks of the River are particularly vulnerable to water erosion in the rainy season and to the colonization by invasive species.

Figure 161: Photo of the River Kwanza in the area of the future water abstraction point and detail of the river bank surrounding Point FP01, with high coverage of the exotic and highly invasive Pontederia crassipes.

7.2.2 Flora species

According to literature review, a total of 175 flora taxa was identified as potentially present in the region where the AoI is located. The complete list of species is reported in APPENDIX B The field survey conducted on August 2023 by the expert botanist Amândio Gomes, revised and compiled by Pedro Martins, confirmed the presence of 85 species within the AoI.

Among the flora species identified as potentially present within the AoI, “species of conservation concern” were defined by considering the species classified as Near Threatened (NT), Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) at a global or regional level according to IUCN Red List of Threatened Species, and by also considering the locally or regionally endemic species present or potentially present within the AoI. These species are listed in **Table 49** (photos are reported in APPENDIX A).

None of the 175 potentially present species has an unfavorable threat status, although the threat status has not yet been assessed according to IUCN Criteria for a large proportion of species. For all these species no assignment of threat status exists, and they are classified as Not Evaluated (NE) or Data Deficient (DD).

Table 49: **Flora species of conservation concern identified as present or potentially present within the AoI**

Species	Global IUCN Status	National / Local IUCN Status	End./ RR	Lit./ Obs.	Station Code	Lot
Adansonia digitata	LC	VU	/	O	FP1, FP2, FP3, FP4, FP5, FP6, FP8, FP9, FP11, FP13, FP14, FP15, FP21, FP22, FP26, FP28, FP29, FP30	Lot 1-WTP & WAF, 8, 10, Lot 2 Lot 3
Croton angolensis	NE	NE	Endemic	O	FP12, FP16,	
Euphorbia conspicua	NE	NE	Endemic	O	FP1, FP2, FP3, FP5	Lot 1-WAF
Neuracanthus scaber	NE	NE	Endemic	O	FP1, FP2, FP3, FP4, FP5, FP13, FP27	Lot 1-WAF
Pycnocoma dentata	LC	NE	Endemic	L	-	

Among the 175 flora species identified as potentially present, 18 are exotic species The species were considered Invasive/exotic according to the information from the Plants of The World Online (POWO) database but also referenced against the Angolan Red List of Species (category D - Exotic / Invasive). *Pontederia crassipes* and *Chromolaena odorata* have high invasive capacity. Complementarily, 12 species are introduced and correspond essentially to agricultural crops or forestry species.

Regarding the exotic species, the table below shows the identification of possible species in each monitoring point for baseline flora/habitat surveys. All sampling points were located near the Lots 1/8/10 and along the pipelines (and Lot2) where natural habitats found. The species that are referenced by literature, but also the other species that were identified in specific survey points, have wide distribution on the region, and will probably be found along the project's AoI.

Table 50: Invasive species observed in the AoI of the Project

			Lots 1, 8 and 10								Lot 2																					
Species	**Status (POWO)**	**Status Angolan Red List***	**FP01**	**FP02**	**FP03**	**FP04**	**FP05**	**FP06**	**FP07**	**FP08**	**FP09**	**FP10**	**FP11**	**FP12**	**FP13**	**FP14**	**FP15**	**FP16**	**FP17**	**FP18**	**FP19**	**FP20**	**FP21**	**FP22**	**FP23**	**FP24**	**FP25**	**FP26**	**FP27**	**FP28**	**FP29**	**FP30**
Boerhavia	Exotic	N/A																														
Cajanus	Exotic	N/A																														
Calotropis	Exotic	N/A		x	x																					x					x	x
Chromolae	Exotic	Category D	x	x	x																											
Cissus	Exotic	N/A																														
Coriandru	Exotic	N/A																														
Eclipta	Exotic	N/A																														
Lantana	Exotic	Category D																x														
Mimosa	Exotic	N/A	x																													
Neptunia	Exotic	N/A	x																													

Opuntia		Exotic	N/A	x	x																												
Persicaria		Exotic	N/A	x																													
Pontederia		Exotic	Category D	x																													
Ricinus		Exotic	Category D																							x							
Senna		Exotic	N/A																														
Senna		Exotic	N/A																						x								
Waltheria		Exotic	N/A																														
Panicum		Exotic	N/A																														

Note

*Angolan Red List**	*Decreto Executivo n.º 252/18, de 13 de julho*
Category D	*Exotic / Invasive*
	Bibliographic occurrence (not recorded in the field)

7.2.3 Amphibian species

Based on literature review, 7 species of amphibians were identified as potentially present in the region where the AoI is located. The list of species is reported in APPENDIX B None of these were observed within the AoI during the performed field survey.

Among the species of amphibians identified as potentially present within the AoI, “species of conservation concern” were defined by considering the species classified as Near Threatened (NT), Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) at a global or regional level according to IUCN Red List of

Threatened Species, and by also considering the locally or regionally endemic species present or potentially present within the AoI. These species are listed in **Table 51**.

Table 51: amphibian species of conservation concern identified as present or potentially present within the AoI

Species	Global IUCN Status	National/ Local IUCN Status	End./ RR	Lit./ Obs.
Breviceps ombelanonga sp. nov.	NE	NE	Endemic	L
Hildebrandtia ornatissima	DD	NE	Endemic	L
Phrynobatrachus brevipalmatus	DD	NE	Endemic	L

Note: Data Deficient (DD) or Not Evaluated (NE)

Among the amphibian species identified as potentially present in the region, no species having an unfavorable threat status were identified. 4 species are classified as Least Concern (LC), while the remaining 3 species do not have a precise assignment of their threat status, being classified as Data Deficient (DD) or Not Evaluated (NE).

7.2.4 Reptile species

Based on literature review, 42 species of reptiles were identified as potentially present in the region where the AoI is located. The list of species is reported in APPENDIX B The presence of 2 species within the AoI was confirmed thanks to the performed field survey. The two observed species are *Gerrhosaurus* cf. *nigrolineatus* (LC) and *Gerrhosaurus multilineatus* (LC).

Among the reptile species identified as potentially present within the AoI, “species of conservation concern” were defined by considering the species classified as Near Threatened (NT), Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) at a global or regional level according to IUCN Red List of Threatened Species, and by also considering the locally or regionally endemic species present or potentially present within the AoI. These species are listed in **Table 52**.

Table 52: reptile species of conservation concern identified as present or potentially present within the AoI

Species	Common name	Global IUCN Status	National/ Local IUCN Status	End./ RR	Lit./ Obs.
Agama mucosoensis	Mucoso Agama	LC	NE	Endemic	L
Boaedon bocagei sp. nov.	-	NE	NE	Endemic	L
Boaedon variegatus	-	NE	NE	Endemic	L
Hemidactylus bayonii	Barboza's Leaf-toed Gecko	LC	NE	Endemic	L
Monopeltis luandae	-	LC	NE	Endemic	L

Namibiana rostrata	Angolan Beaked Thread Snake	LC	NE	Endemic	L
Sepsina copei	Cope's Reduced-limb Skink	LC	NE	Endemic	L
Trachylepis bocagii	Bocage's Skink	LC	NE	Endemic	L

Note : Least Concern (LC), Not Evaluated (NE), L = Literature

Among the reptile species identified as potentially present within the region, *Trionyx triunguis* is the only species classified as Vulnerable (VU). No other reptile species with an unfavorable threat status were identified. 36 species are classified as Least Concern (LC), and the remaining 5 species have not yet been assessed according to IUCN Criteria, therefore they are classified as Not Evaluated (NE).

8 endemic species were identified, which correspond to the species of conservation concern listed in **Table 52**.

7.2.5 Mammal species

Based on literature review, 32 species of mammals were identified as potentially present within the region where the AoI is located. These species are listed in APPENDIX B Among these species, only 3 were directly recorded during the field survey: *Chlorocebus cynosuros* (LC), *Grandmoms* cf. *dolichurus* (LC), and *Heliosciurus gambianus* (LC). None of the directly recorded species has an unfavourable threat status.

On the opposite, among species identified as potentially present but not observed during the field survey, the following species having an unfavourable threat status were identified: *Cephalophus silvicultor* (NT), *Cercopithecus mitis* subsp. *mitis* (VU), *Equus quagga* (NT), *Hippopotamus amphibius* (VU), *Hydrictis maculicollis* (NT), *Loxodonta africana* (EN), *Syncerus caffer* (NT), and *Trichechus senegalensis* (VU).

In addition, *Cercopithecus mitis* subsp. *mitis* is a subspecies endemic to the Angolan Escarpment area.

Hydrictis maculicollis and *Trichechus senegalensis* inhabit the banks of Kwanza River and the main threat has been demonstrated to be bycatch in fishing nets.

For *Cercopithecus mitis* subsp. *mitis*, *Hippopotamus amphibius*, and *Loxodonta africana*, the occurrence is confirmed at regional level, but especially southern than Kwanza River, while the probability of occurrence within the AoI is practically minimal or even zero.

Among the species identified as potentially present, 2 exotic species were identified: *Oryx gazella* (LC) and *Rattus rattus* (LC).

Among the mammal species identified as potentially present within the AoI, “species of conservation concern” were defined by considering the species classified as Near Threatened (NT), Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) at a global or regional level according to IUCN Red List of Threatened Species, and by also considering the locally or regionally endemic species present or potentially present within the AoI. These species are listed in **Table 53**.

Table 53: mammal species of conservation concern identified as present or potentially present within the AoI

Species	Common name	Global IUCN Status	National/ Local IUCN Status	End./ RR	Lit./ Obs.

Cephalophus silvicultor	Yellow-backed Duiker	NT	NE	-	L
Equus quagga	Plains Zebra	NT	NE	-	L
Hydrictis maculicollis	Spotted-necked Otter	NT	VU	-	L
Syncerus caffer	African Buffalo	NT	NE	-	L
Trichechus senegalensis	African Manatee	VU	AEx (EN)	-	L

Note: Near Threatened (NT), Vulnerable (VU), Endangered (EN), L = Literature, AEx (“Especies Ameaçadas de *Extinçao*”)

7.2.6 Bird species

Based on the performed literature study, a total of 139 bird species was identified as potentially occurring at a regional level. The complete list of bird species is reported in APPENDIX B Among these, the presence of 60 species within the AoI was confirmed during the field study. Considering the low sampling effort implemented, which is not representative of an annual cycle, it is possible to state that the present detection of almost half of the species identified through desktop analysis corroborates this compilation exercise.

Among the bird species identified as potentially present within the AoI, “species of conservation concern” were defined by considering the species classified as Near Threatened (NT), Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) at a global or regional level according to IUCN Red List of Threatened Species, and by also considering the locally or regionally endemic species present or potentially present within the AoI. These species are listed in **Table 54**. *Gyps africanus* (CR), *Polemaetus bellicosus* (EN), and *Terathopius ecaudatus* (EN) are the only potentially present species with an unfavorable threat status. None of these three species was currently observed in the AoI during the field study. *Gyps africanus* was detected in 2014 in the field study promoted by Artelia/Ecovisão. Literature suggests that the record of these species in the region is occasional (GBIF, 2023) therefore the observed individuals should be considered as vagrant, and no stable populations of these three species should be considered as present in the AoI.

Euplectes aureus (LC) is endemic at a national level , as it is distributed along a coastal strip from Luanda to the South.

Regarding the remaining species, 134 are classified as Least Concern (LC), and for other 2 species no IUCN threat assessment has been realized, therefore they are classified as Not Evaluated (NE).

Table 54: Bird species of conservation concern identified as present or potentially present within the AoI

Species	Common name	Global IUCN Status	National/ Local IUCN Status	End./ RR	Lit./ Obs.
Euplectes aureus	Golden-backed Bishop	LC	NE	Endemic	O
Gyps africanus	White-backed Vulture	CR	NE	-	O 2014
Polemaetus bellicosus	Martial Eagle	EN	NE	-	L

Terathopius ecaudatus	Bateleur	EN	NE	-	L

Note: Endangered (EN), L = Literature, O = observed

As observed for amphibians, reptiles and mammals, a higher number of species was listed in the present study compared to the 2014 study. This increase is due to the evolution of knowledge and available information.

Like for the study promoted by Artelia/Ecovisão, it is possible to conclude that the AoI has habitat suitability for common and widespread species, reasonably tolerant or even dependent on human presence, whit the most important areas for bird species being the areas associated with Kwanza River.

7.2.7 Aquatic diversity

The aquatic fieldwork was completed in July 2023, which falls within the dry season and a period in which the water level (discharge) is relatively low. September and October typically have the lowest flow, while April and May have the highest.

7.2.7.1 Freshwater habitat

As mentioned above in chapter 7.1.2.2 Freshwater habitat, ground-truthing of the AoI was carried out to refine the desktop findings. The assessed AoI was a river stretch of approximately 2,600 m with an average width of 150 – 200 m and included the marginal habitats up to 150 m from the rivers' centerline. The updated mapping is presented below in **Figure 77**.

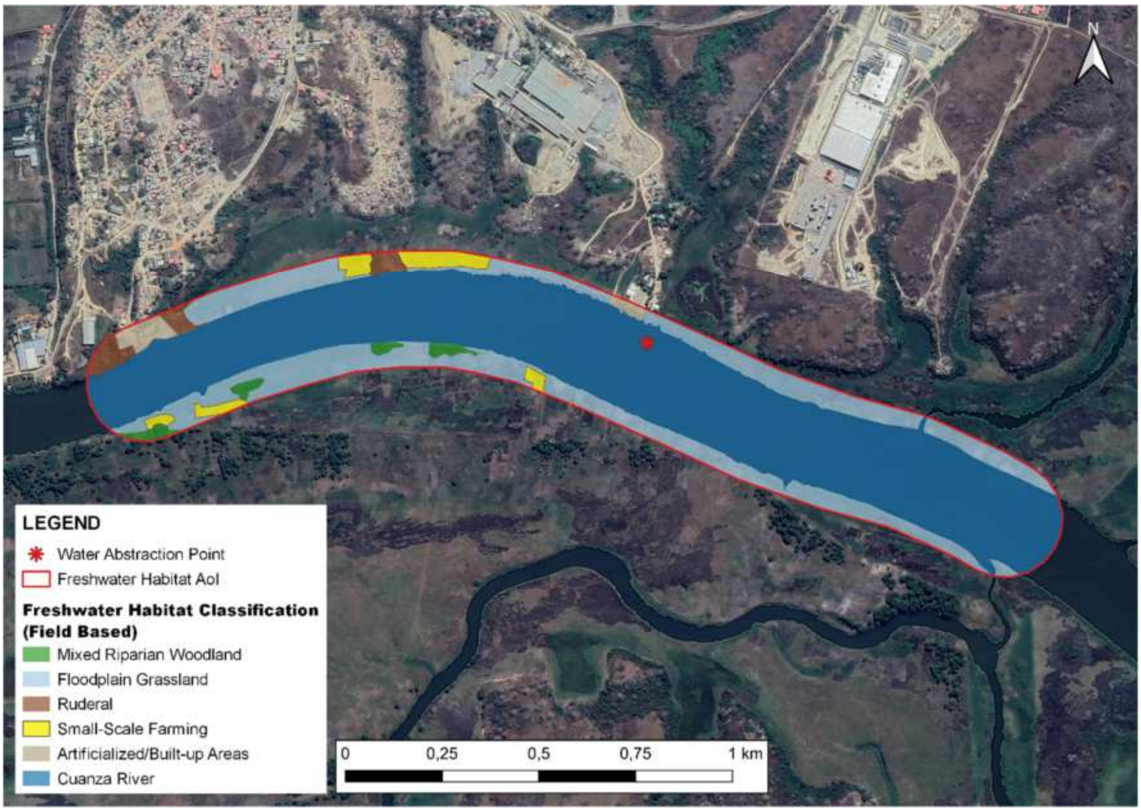


Figure 162: Freshwater habitat in AoI around the Water Abstraction Point, found during the field survey

Freshwater habitats presented in **Figure 162**, align with those characterized within the scope of terrestrial habitats (Section 7.2.1 – Kwanza River). The habitats found within the Study Area are relatively homogeneous and common in the lower sections of the Kwanza River, with anthropogenic impacts present within the Bom

Jesus area. Just upstream from the AoI, extensive backwater swamp are present, with abundant reeds and sedges.

Within the AoI, the only sections of riverine forest are small patches that are located exclusively on the south bank. These patches are not a pure riverine forest, since in addition to some riverine species, there are distinctly terrestrial species and fruit trees such as mango and palms, especially *Elaies guineensis*.

The vegetation cover on the emerged banks is abundant, especially on the banks without erosion, consisting of a diverse stratification of tree, shrub and, above all, herbaceous vegetation.

The wetland areas, whose extent varies depending on the characteristics of the margin, are covered by floodplain grasslands and small marshy areas, consisting essentially of *Echinocloa pyramidalis*, *Echinocloa crus-pavonis*, *Cyperus papyrus*, *Pragmites mauritianus*, *Oriza longistaminata*, *Panicum maximum*, *Cyclosorus interruptum*, *Persicaria mauritianum* among others. In the lagoons formed on the marshy banks, several floating aquatic macrophytes develop, such as the invasive *Pontederia crassipes*, *Pistia stratiotes*, *Azolla pinnata* and others with floating leaves, such as *Nymphaea lotus*. During the survey period, large masses of *P. crassipes* and *P. stratiotes* were observed being dragged towards the mouth, which will allow them to colonize backwater areas downstream.

The emerged banks on the southern side (left bank) have patches of large trees (mixed riparian woodland), such as *Ceiba pentandra*, *Adansonia digitata*, *Spondias mombin*, *Ficus thonningii*, as well as fruit trees of anthropogenic origin, such as *Mangifera indica*, *Annona muricata*, *Elaies guineensis* (oil palm) among others.

In the section analyzed, the river has a lentic flow (slow moving), and was approximately 150 to 250 meters wide. In areas where sediment accumulates, the depth is often less than 2 meters, especially during low flow times. However, the normal depth in the channel can reach up to 7 meters in places where there is no large accumulation of sediment.

The geometry and material of the banks are practically constant throughout the entire area covered, although the presence of submerged rocks and logs is occasionally observed in some places, thus creating favorable microhabitat conditions. The banks have an average height of between 2 and 2.5 m and the slope angles are high, whereas in flooded areas, this difference is minimal, allowing water flows in both directions. The material on the banks is made up of a mixture of clay, sand and silt, with a large percentage of organic matter which gives the characteristic dark tone and which conditions the penetration of light to a maximum depth of 30 to 50 cm.

From the above, there is the presence of a significant set of aquatic micro-habitats. The areas of still waters with high vegetation cover, areas of abundant floating vegetation, as well as areas of shallow waters and sandy beds, provide breeding and nursery areas for fish and many other groups of fauna, including invertebrates.

Although the river generally has a slow flow, there are small areas with rapid flow, as well as areas with a larger water column that alternate with shallow areas, on the banks but also in sedimentation areas in the center of the channel, which in addition to the presence of submerged rocks and logs results in the existence of a mosaic of aquatic habitats compatible with the ecological requirements of benthic and pelagic fish, including top predators.

Throughout the study area, subsistence agriculture along the riverbanks was common. Crops included cassava, corn, beans, sweet potatoes, and various vegetables. In addition to this, the existence of houses or other businesses along the riverbanks, has resulted in habitat modification and has increased the potential for erosion.

The typical erosion mechanism of banks along the analyzed section corresponds to the removal of the base material from the bank. The continuous removal of material tends to form unstable undercut banks along the bottom of the bank which, under the continuous action of flow, fail when the weight of the suspended material exceeds the resistance capacity of the bank material, leading to its collapse, usually in blocks.

The erosion of the banks at certain points is enhanced and amplified by the removal of the vegetation near the base of the bank, as shown below.

Near the town of Bom Jesus, the riverbanks were noted to be highly modified, devoid of natural vegetation and with several water abstraction points. At the same time, there are discharges of untreated wastewater.

Compared to the study produced by Artelia/Ecovisão in 2014, it appears that there has been an increase in the built area and human settlement on the north bank of the river. An increase in seasonal agriculture in the floodplains, in the dry season, was also noted. Furthermore, in the dry area immediately to the north, a new factory has been constructed.

Overall, the flooded grasslands and marginal habitats provide a diverse mosaic of aquatic habitat, providing areas of refuge, feeding and reproduction/nursery for a variety of species.

7.2.7.2 Aquatic biodiversity

Desktop studies

Ichthyofauna is one of the taxonomic groups in Angola, about which numerous gaps in knowledge persist, with the reference publication being dated 1967 (Poll, 1967). In fact, given the inaccessibility of some rivers and the increased difficulty of aquatic research, they lead to a much lower availability of information than for other vertebrate groups.

Skeleton reports more than 100 species for the Kwanza River (Kwanza), however this will probably be for the river basin and not exclusively for the river itself and may have at least 50% endemism (Abell R. et al. 2008). At the same time, the Kwanza River presents very different habitat typologies throughout its course, as is the case of the study area, which is located within the lower reaches, immediately before entering the estuarine area.

Based on the available bibliography, as well as the GBIF and FISHBASE platforms, 65 species of fish have the potential to occur within the study area (APPENDIX H). Of these, 13 are considered endemic, and of these the presence of *Marcusenius angolensis* and *Schilbe bocagii* was confirmed (**Table 55**).

Oreochromis macrochir, *Oreochromis mossambicus* and *Sardinella maderensis* are listed as VU – Vulnerable, while *Brycinus humilis*, *Chrysichthys furcatus*, *Labeobarbus boulengeri*, *Labeobarbus stenostoma*, *Neochelon* *falcipinnis* and *Petrocephalus cunganus*, are listed as DD – Deficient Data. *Hemichromis angolensis* and *Microphis aculeatus* are not yet evaluated.

It is important to note that *Oreochromis mossambicus* is a species native to East Africa, which was introduced into the Kwanza River through the many aquacultures that exist there. Therefore, the species is considered to be exotic and can generate considerable ecological imbalances.

Oreochromis niloticus has also been introduced as it is native to areas of northern, western, and eastern Africa.

Following the eDNA results (see further below), a further 5 species were added to the expected species list, these include the coastal (estuarine) *Neochelon falcipinnis, Sardinella maderensis* and *Pseudotolithus elongatus*, as well as *Labeobarbus caudovittatus* and *Pellonula leonensis.*

Table 55: Endemic fish species

Species	IUCN Global Category	Angola Red List (2018/23)	Occurence in Angola	Previous confirmed regional occurrence	Recorded in the field studies	Bibliographic Occurrence in the Region
Alestes ansorgii	*LC*	*NE*	*Endemic*	-	*No*	*FISHBASE | IUCN*
Brycinus humilis	DD	NE	Endemic	-	No	IUCN | Skelton, P.H., 2019
Chrysichthys ansorgii	LC	NE	Endemic	GBIF	No	FISHBASE | IUCN
Chrysichthys bocagii	LC	NE	Endemic	GBIF	No	FISHBASE | IUCN
Chrysichthys furcatus	DD	NE	Endemic*	-	No	IUCN | Risch, L. 1986
Enteromius musumbi	LC	NE	Endemic	IUCN	No	FISHBASE | IUCN
Hemichromis angolensis	NE	NE	Endemic	GBIF	No	Skelton, P.H., 2019
Heteromormyrus pauciradiatus	DD	NE	Endemic	-	No	IUCN | Skelton, P.H., 2019
Hippopotamyrus pappenheimi	LC	NE	Endemic	-	No	IUCN | Gosse, J.P., 1984 | Skelton, P.H., 2019
Marcusenius angolensis	LC	NE	Endemic	-	Yes (River Kwanza)	FISHBASE
Oreochromis angolensis	LC	NE	Endemic	GBIF	No	IUCN | Trewavas, E. 1973 | Skelton, P.H., 2019
Petrocephalus cunganus	DD	NE	Endemic	-	No	IUCN | Poll, M. 1967 | Gosse, J.P., 1984
Schilbe bocagii	LC	NE	Endemic	-	Yes (River Kwanza)	Poll, M. 1967 | De Vos, L., 1995 | Skelton, P.H., 2019

*** Presence Uncertain in Congo and The Democratic Republic of Congo.**

eDNA

The analysis of eDNA from water samples collected within the project area, identified 26 species of fish, from 10 Families. Of these 26 species, there was an overlap of 2 species as identified in the field, and a further 5 that could be identified down to species level. The remaining 19 species could only be identified to Family or Genus level, and in the case of one, only to Class.

Considered analysis of the results, species identified in the field and distributions, provided enough information to assume that the:

- Claroteidae could be *Chrysichthys ansorgii* as observed on site.
- Hemichromis could be *Hemichromis fasciatus* as observed on site.
- Labeo could be *Labeo ansorgii* as observed on site.
- Oreochromis could be *Oreochromis niloticus* as observed on site.
- Marcusenius could be *Marcusenius angolensis* as observed on site.
  - It should be noted a second Marcusenius species was noted, but based on literature, only one species was expected in the Project Area. This is likly a new species as based on distribution, the next 'closest' species, *Marcusenius moori* occurs within Lower and Central Congo River basin.
- A second Pellonula species was identified. As only one was expected within the project area, this species has been narrowed down to *Pellonula leonensis* based on distribution.

Further to this list, the eDNA results at a Genus level were compared to the expected species list, from this, it was summarized that:

- A second Clarias species could be *Clarias ngamensis* or *Clarias angolensis*.
- Coptodon could be *Coptodon guineensis* or *Coptodon rendalli*.
- Syngnathidae could likely be *Enneacampus ansorgii* or alternatively *Enneacampus kaupi.*
- Hippopotamyrus could be *Hippopotamyrus ansorgii* or *Hippopotamyrus pappenheimi.*
- Labeobarbus could be *Labeobarbus boulengeri* or *Labeobarbus stenostoma*.
  - It should be noted that *Labeobarbus caudovittatus* as identified by the eDNA samples was not on the original expected species list based on its distribution within the Congo River system. It is likely that nomenclature of the Labeobarbus Genus at a genetic level requires further work.
- In addition to *Oreochromis mossambicus*, 4 further species were noted (2 at the Family level and 2 at the Genus level). As *Oreochromis niloticus* was observed on site, it is likely that one of these records would identify as that. The other species could be *Oreochromis angolensis, Oreochromis macrochir*, or *Oreochromis schwebischi.*
- Petrocephalus could be *Petrocephalus cunganus* or *Petrocephalus simus*.

Based on the eDNA results and field observations, 32 species of fish have been recorded within the Study Area (Table 56).

Sardinella maderensis was the only native fish species recorded (and confirmed) with a designation of Vulnerable. The Madeiran Sardinella is widespread, with its geographic range extending from Spain and Gibraltar and southward along coastal West Africa, from Morocco to at least Luanda. This is a pelagic, oceanodromous species that forms schools in coastal waters. It shoals at the surface or at the bottom down to at least 50 m. It is tolerant of fairly low salinity and juveniles sometimes enter estuaries.

Field Investigation

During the July 2023 field survey, at total of fourteen (14) fish species were recorded from fishermen catches, and identified to species level were possible. Within these samples, *Marcusenius angolensis* and *Schilbe bocagii* were noted, as well as *Oreochromis niloticus*. It should be noted that 12 of these species were not detected in the eDNA results as detailed below. Based on photo identification, the Genus and in some case, species could be verified, eliminating the concern for misidentification (i.e., fish observations on site remain relevant even though eDNA did not detect them in the water samples).

It is important to note that there were some species observed whose identification was not possible in a timely manner, given the existence of numerous taxonomic gaps associated with the local ichthyofauna.

Table 56: Fish species within the Study Area

#	Class	Order	Family	Genus	Species	Common Name	IUCN Global Category	Occurrence in Angola	Recorded in the field studies	eDNA
1	Actinopterygii	Characiformes	Alestidae	Brycinus	*Brycinus* sp.				Yes	
2	Actinopterygii	Perciformes	Cichlidae	Coptodon	*Coptodon guineensis / Coptodon rendalli*	Guinean Tilapia Redbrest Tilapia	LC / LC			Yes
3	Actinopterygii	Perciformes	Cichlidae	Hemichromis	*Hemichromis fasciatus*	Banded Jewelfish	LC	Native	Yes	Yes
4	Actinopterygii	Perciformes	Cichlidae	Oreochromis	*Oreochromis mossambicus*	Mozambique Tilapia	VU	Exotic		Yes
5	Actinopterygii	Perciformes	Cichlidae	Oreochromis	*Oreochromis angolensis / Oreochromis schwebischi*	Angolan Tilapia Schwebisch's Tilapia	LC / LC			Yes
6	Actinopterygii	Perciformes	Cichlidae	Oreochromis	*Oreochromis niloticus*	Nile Tilapia	LC	Exotic	Yes	Yes
7	Actinopterygii	Perciformes	Cichlidae	Pelmatolapia	*Pelmatolapia cabrae*	"Tilapia"	LC	Native	Yes	
8	Actinopterygii	Perciformes	Cichlidae	Unknown	Unknown					Yes
9	Actinopterygii	Perciformes	Cichlidae	Unknown	Unknown					Yes
10	Actinopterygii	Siluriformes	Clariidae	Clarias	*Clarias gariepinus*	African Sharptooth Catfish	LC	Native	Yes	Yes
11	Actinopterygii	Siluriformes	Clariidae	Clarias	*Clarias ngamensis / Clarias angolensis*	Blunt-toothed African Catfish / Angolian walking catfish	LC / LC			Yes

#	Class	Order	Family	Genus	Species	Common Name	IUCN Global Category	Occurence in Angola	Recorded in the field studies	eDNA
12	Actinopterygii	Siluriformes	Claroteidae	Chrysichthys	*Chrysichthys ansorgii*		LC	Endemic	Yes	Yes
13	Actinopterygii	Clupeiformes	Clupeidae	Pellonula	*Pellonula vorax*	Bigtoothed Pellonula	LC	Native	Yes	Yes
14	Actinopterygii	Clupeiformes	Clupeidae	Pellonula	*Pellonula leonensis*	Smalltoothed Pellonula	LC	Out of known extant		Yes
15	Actinopterygii	Clupeiformes	Clupeidae	Sardinella	*Sardinella maderensis*	Madeiran Sardinella	VU	Coastal / Estuaries		Yes
16	Actinopterygii	Cypriniformes	Cyprinidae	Enteromius	*Enteromius* sp.	"African Barb"	LC	Native	Yes	
17	Actinopterygii	Cypriniformes	Cyprinidae	Labeo	*Labeo ansorgii*	Cunene Labeo	LC	Native	Yes	Yes
18	Actinopterygii	Cypriniformes	Cyprinidae	Labeobarbus	*Labeobarbus caudovittatus*	"Yellowfish"	LC	Out of known extant		Yes
19	Actinopterygii	Cypriniformes	Cyprinidae	Labeobarbus	*Labeobarbus boulengeri / Labeobarbus stenostoma*	"Yellowfish"	DD / DD			Yes
20	Actinopterygii	Cypriniformes	Cyprinidae	Unknown	Unknown					Yes
21	Actinopterygii	Perciformes	Eleotridae	Eleotris	*Eleotris vittata*	Senegal-sovekutling	LC	Native	Yes	Yes
22	Actinopterygii	Perciformes	Gobiidae	Awaous	*Awaous lateristriga*	West African freshwater goby	LC	Native	Yes	

#	Class	Order	Family	Genus	Species	Common Name	IUCN Global Category	Occurence in Angola	Recorded in the field studies	eDNA
23	Actinopterygii	Osteoglossiformes	Mormyridae	Hippopotamyrus	*Hippopotamyrus ansorgii / Hippopotamyrus pappenheimi*	Slender stonebasher / "Elephantfish"	LC / LC			Yes
24	Actinopterygii	Osteoglossiformes	Mormyridae	Marcusenius	*Marcusenius* sp.					Yes
25	Actinopterygii	Osteoglossiformes	Mormyridae	Marcusenius	*Marcusenius angolensis*	"Elephantfish"	LC	Endemic	Yes	Yes
26	Actinopterygii	Osteoglossiformes	Mormyridae	Petrocephalus	*Petrocephalus cunganus / Petrocephalus simus*	"Elephantfish"	DD / LC			Yes
27	Actinopterygii	Mugiliformes	Mugilidae	Mugil	*Mugil cephalus*	Flathead Mullet	LC	Native	Yes	
28	Actinopterygii	Mugiliformes	Mugilidae	Neochelon	*Neochelon falcipinnis*	Sicklefin Mullet	DD	Coastal / Estuaries		Yes
29	Actinopterygii	Siluriformes	Schilbeidae	Schilbe	*Schilbe bocagii*	"Schilbe Catfish"	LC	Endemic	Yes	
30	Actinopterygii	Perciformes	Sciaenidae	Pseudotolithus	*Pseudotolithus elongatus*	Bobo Croaker	LC	Coastal / Estuaries		Yes
31	Actinopterygii	Syngnathiformes	Syngnathidae	Enneacampus	*Enneacampus ansorgii / Enneacampus kaupi*	"Freshwater Pipefish"	LC / LC			Yes
32	Actinopterygii	Unknown	Unknown	Unknown	Unknown					Yes

Informal surveys

As previously mentioned, 32 informal surveys were carried out seeking to obtain information regarding local fishing practices, species fished and bycatch, with great importance in terms of characterizing biodiversity, but also at a socioeconomic level. The following table presents an analysis of the results obtained.

Table 57: **Fishermans Surveys Results**

Question	Option	Relative Percentage
1. Where do you Fish?	Site (<1km)	34.38 %
	Local (1km - 5km)	31.25 %
	Regional (>5km)	34.38 %
2. Where do you fish from?	River Bank	46.88 %
	Boat	37.50 %
	Both	15.63 %
3. How often do you Fish?	< once a day	3.13 %
	once a day	59.38 %
	> once a day	37.50 %
4. How much time do you spend fishing?	Morning	34.38 %
	Evening	18.75 %
	Both	43.75 %
5. How many fish do you catch per day?	<10	28.13 %
	10 a 50	43.75 %
	>50	28.13 %
6. How many different types of fish do you catch?	<3	21.88 %
	3 a 5	71.88 %
	>5	6.25 %
7. Do you keep all size fish?	Yes	15.63 %
	No	84.38 %
8. Method of fishing?	Rod	6.25 %
	Fishing net	37.50 %
	Both	56.25 %
9. What other animals do you catch by accident in nets? (Bycatch)	"Turtle" = prob. *Trionyx triunguis* and *Pelusios castaneus* "Snake" = prob. *Philothamnus angolensis*	

	"Jibóia" = prob. *Python* sp. "Sengue/Lizzard" = *Varanus niloticus* "Crocodile" = *Crocodylus niloticus* "Otter/Seal" = prob. *Hydrictis maculicollis* Manatee/"Peixe-boi" = *Trichechus senegalensis*

It appears that the majority of fishermen (65 %) fish on a highly local scale, not moving more than 5 km away from their village. At the same time, around 47 % fish from the bank. Both characteristics demonstrate subsistence fishing, highly artisanal. Only 34 % of fishermen go more than 5 km away, probably only those who have an engine on their boat. This percentage is in line with the 37.5 % of fishermen who fish from boats and who use fishing nets (mainly gill nets and seine nets), which indicates fishing for economic purposes, even if artisanal.

43.75 % of fishermen estimate they catch between 10 and 50 fish, with only 28 % catching more than 50 fish per trip. In turn, 72 % of fishermen surveyed say they fish 3 to 5 different species.

56 % say they fish with nets and rods, while 37.5 % fish exclusively with nets. The difference will be in the type of net, which in some cases is a gillnet or seine net and in others it is a cast net.

The majority of fishermen (84 %) state that they are selective regarding the size of their fish, however it was not possible to determine whether juvenile fish or those with no food interest are returned to the water or simply discarded.

With regard to bycatch, important data was collected, starting with confirmation of the capture and therefore the presence of the African Manatee (*Trichechus senegalensis*), a Vulnerable species with a tendency to worsen its threat status.

The capture of juvenile *Crocodylus niloticus* was also answered in several surveys, which corroborates what was observed in the 2014 study by Artelia/Ecovisão. No contacts with adult crocodiles are reported, however the presence of juveniles suggests that the swampy area of the river is used as a nursery.

Freshwater Insects

Due to the deep waters, and inaccessibility for effective sampling of freshwater insects, the analysis of eDNA from water samples collected within the Project Area was used. Results indicated 118 species (9 Orders) within the AoI, comprising of individuals from the Orders: Anthoathecata (Hydrozoa), Coleoptera (Beetles), Diptera (Flies), Ephemeroptera (Mayfly), Haplotaxida (Worms), Hemiptera (Bugs), Rhynchobdellida (Leeches) and Spongillida (Sponges), as well as general Insecta (Insects),

The most dominant Order recorded were Chironomidae (Non-biting Midges), with a high prevalence of Chaoboridae (Phantom Midges) at the downstream site (P1). Overall, the site adjacent to the abstraction point (P3) showed the highest species richness with the highest ‘Operational Taxonomic Unit’ count.

Of interest was the lack of Odonata (Dragonflies) diversity, which one would expect to be abundant along the floodplain grassland. Furthermore, the absence of Trichoptera (Caddisflies) and Plecoptera (Stoneflies), both of which are very sensitive to pollutants in the stream environment. It should be noted that both of these Orders do prefer riffles (cobbles and boulders) over fine substrates.

7.2.8 Critical Habitat Assessment

7.2.8.1 Criterion 1 - Habitat of significant importance to Critically Endangered and/or Endangered species

The presence of species having Endangered (EN) or Critically Endangered (CR) conservation status according to global IUCN criteria was considered. In the absence of a Global IUCN assessment (e.g., Not Evaluated NE, or Data Deficient DD), local assessments were considered (e.g., Red List of species of Angola).

As a result of the biodiversity baseline assessment, 4 species were identified as potentially triggering CH based on this criterion. These species include:

- Three bird species : *Gyps africanus* (CR), *Polemaetus bellicosus* (EN), and *Terathopius ecaudatus* (EN);
- One mammal species: *Loxodonta africana* (EN).

However, Gyps africanus, *Polemaetus bellicosus*, and *Terathopius ecaudatus* were excluded from the Critical Habitat assessment, since literature suggests that no established populations of these three bird species exist in the AoI, therefore the species could be present only as vagrant individuals. In addition, *Loxodonta africana* was also excluded from the Critical Habitat assessment, since the ecological requirements of this species do not match with the habitats identified within the AoI. Therefore these species were excluded from the screening

All the Vulnerable species listed as potentially present have a wide distribution range, therefore it is excluded that they could meet the thresholds for Criterion 1b: "Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72".

No areas containing nationally/regionally-important concentrations of an IUCN Red-listed EN or CR species was identified within or around the study area, therefore criterion 1c was not applied.

Therefore, no species triggering Critical Habitat were identified according to Criterion 1.

7.2.8.2 Criterion 2 – Habitats of significant importance to endemic or geographically restricted species

The presence of endemic or restricted-range species (EOO lower than 50,000 km^2 for terrestrial vertebrates and plants; global range of less than or equal to 500 km linear geographic span for coastal, riverine, and other aquatic species that do not exceed 200 km width at any point) was considered.

As a result, 4 species were identified as potentially triggering CH based on this criterion. These species include:

- One flora species: *Pycnocoma dentata*;
- Two amphibian species: *Phrynobatrachus brevipalmatus* and *Breviceps ombelanonga* sp. nov.;
- One reptile species: *Monopeltis luandae*.

None of the above species were observed in the AoI during field studies, however they are considered to be potentially present based on literature review.

To assess the importance of the AoI for these species, the following threshold was applied (Guidance Note 6, GN75, IFC 2019):

a) areas that regularly hold ≥ 10 % of the global population size AND ≥ 10 reproductive units of a species.

An "Ecologically Appropriate Area of Analysis" has been identified for flora, amphibian, and reptile species to apply the threshold identified in criterion 2a:

- for flora species: since *Pycnocoma dentata* is the only flora species identified as potentially triggering CH, in absence of clear geographical boundaries, the EAAA has been defined as the crossing between the areas of the river basins where the AoI is located and the EOO of the species, obtained from IUCN. The defined EAAA reaches an extension of 5 028 km^2 (**Table 58**).
- for amphibian and reptile species, in absence of clear geographical boundaries, the EAAA has been defined as the sum of the areas of the river basins where the AoI is located. The defined EAAA reaches an extension of 13,516 km^2 (Figure *163*).

The results of the critical habitat assessment for Criterion 2 are summarized in **Table 58**. Species that could trigger critical habitats but that are considered only potentially present based on literature information and/or species for which not sufficient data are available are identified as triggering "Potential Critical Habitat".

The ecology of the species identified as triggering CH is briefly described in detail in section 7.2.8.6.

Table 58: Species with a restricted range that can Potentially trigger a Critical Habitat (PCH)

Taxon	Scientific name	IUCN Status*	National/ Local IUCN Status*	Lit./ Obs.	EOO (km2)	EAAA (km2)	Is EAAA ≥ 10% of EOO?	PCH/CH
Flora	*Pycnocoma dentata*	LC	NE	L	40 836	5 028	Yes	PCH
Amphibian	*Breviceps ombelanonga* sp. nov.	NE	NE	L	17 234	13 516	Yes	PCH
	Phrynobatrachus brevipalmatus	DD	NE	L	11	13 516	Yes	PCH
Reptile	*Monopeltis luandae*	LC	NE	L	600	13 516	Yes	PCH

*IUCN status: Ne (Non Evaluated), DD (Data Deficient), LC (Least Concern)
L = Literature

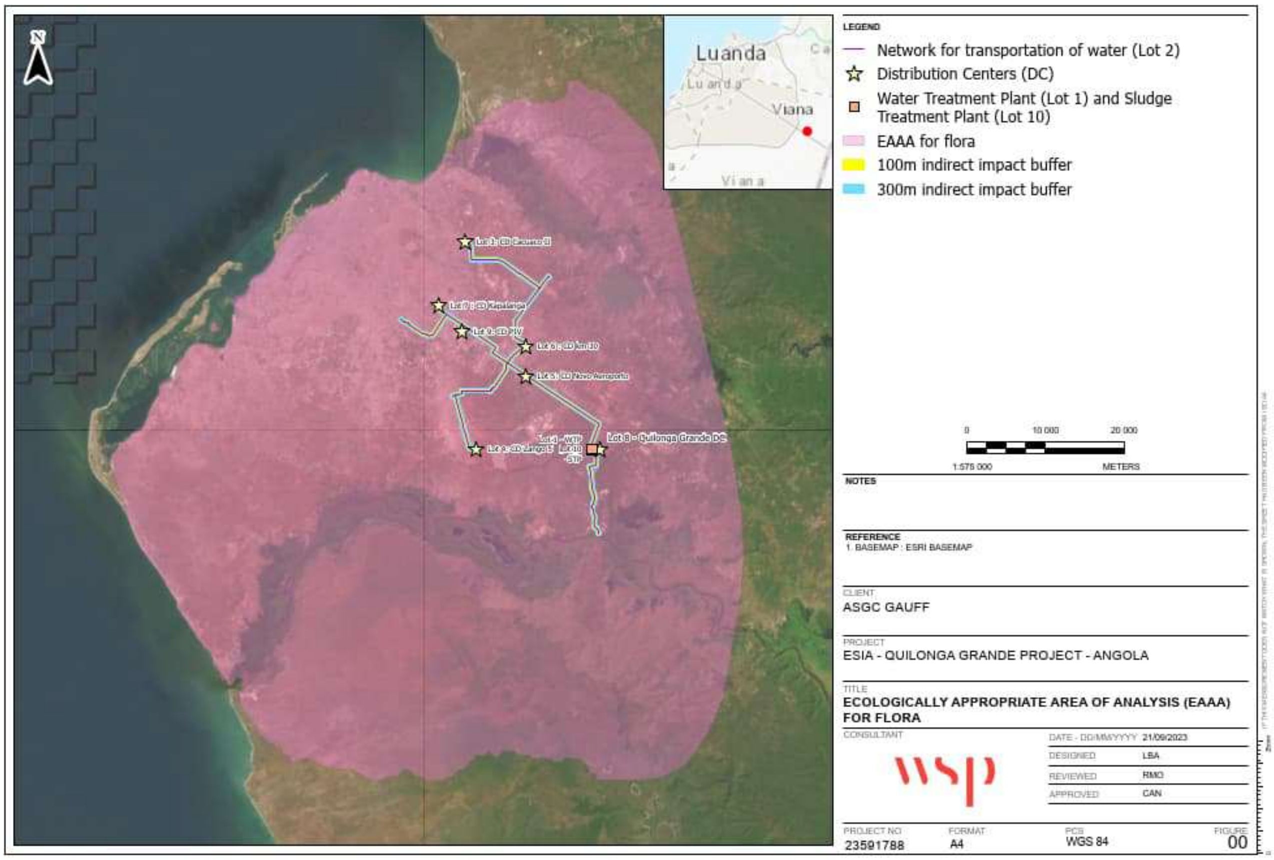


Figure 163: ***Ecologically Appropriate Area of Analysis defined for flora species.***

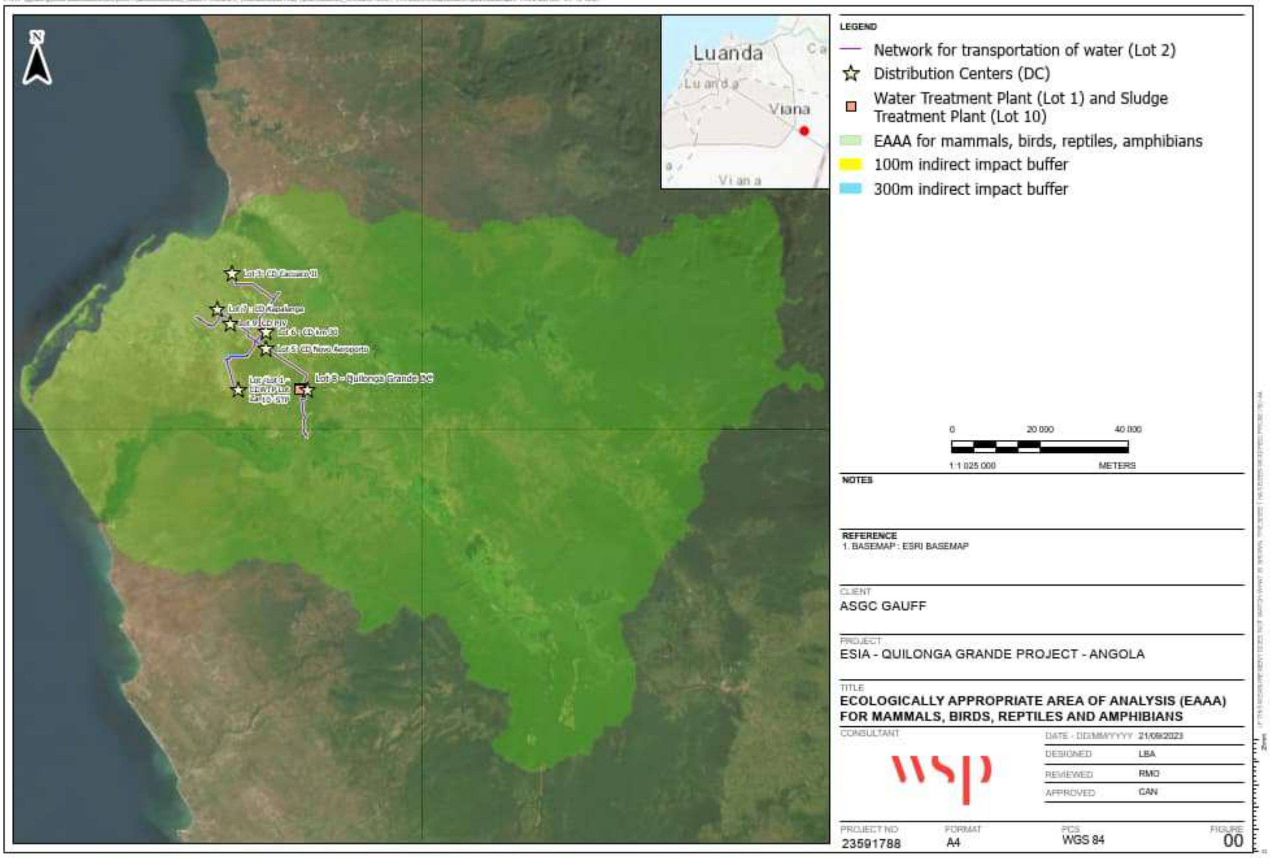


Figure 164: Ecologically Appropriate Area of Analysis defined for terrestrial fauna species.

7.2.8.3 Criterion 3 - Habitats supporting globally significant migratory or congregatory species

The presence of Key Biodiversity Areas (KBAs) and Important Bird Areas (IBAs) identified for congregatory species and of Wetlands of International Importance designated under criteria 5 or 6 of the Ramsar Convention was considered. In addition, the presence of migratory and congregatory species was also considered.

The Project is not located within any internationally recognized area. Two IBAs have been identified in the area surrounding the AoI, one located at less than 5 km from the Bom Jesus point, and the second located at less than 25 km from the Project Site. However, the habitat characteristics present within these two IBAs strongly differ from those identified within the AoI. Therefore, the species triggering the IBA criteria for these two IBAs were not considered in the present assessment.

Using a precautionary approach, all the migratory and/or congregatory species identified as present or potentially present within the AoI based on desktop analysis and literature review were assessed according to Criterion 3a (GN6, IFC 2019).

In order to assess the importance of the AoI for these species, the following thresholds were applied (Guidance Note 6, GN78, IFC 2019):

- a) areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.
- b) areas that predictably support ≥ 10 percent of the global population of a species during periods of environmental stress.

An "Ecologically Appropriate Area of Analysis" has been identified for bird, fish, and mammal species to apply the threshold identified in criterion 3a:

- for bird and mammal species, in absence of clear geographical boundaries, the EAAA has been defined as the sum of the areas of the river basins where the AoI is located. The defined EAAA reaches an extension of 13,516 km^2 (Figure 164).
- for fish species and freshwater mammal species (*Trichechus senegalensis*), the EAAA has been identified as the extension of the basin of Cuanza River. The defined EAAA reaches an extension of 6 686 km^2 (Figure 165).

Since a numerical estimation of the individual of the species does not exist, the EAAA is then compared with the extent of occurrence (EOO) of each species, which represents the global population estimate, in order to identify if that area could potentially meet Criterion 3 threshold: if the EAAA is ≥ 1 % of the EOO, the area is defined as potentially triggering Critical Habitat (GN78, IFC 2019). The results of the CH screening are discussed below and reported in Table 59.

Species that could trigger critical habitats but that are considered only potentially present based on literature information and/or species for which not sufficient data are available are identified as triggering "Potential Critical Habitat".

As a result of the CH screening, two species were identified as potentially triggering CH according to Criterion 3: Blunt-toothed African Catfish (*Clarias ngamensis*) and African Manatee (*Trichechus senegalensis*).

The ecology of the species identified as potentially triggering CH is described in detail in section 7.2.8.6.

Table 59: Screening of migratory and congregatory species potentially triggering Critical Habitat according to Criterion 3 (IFC, 2019)

Taxon	Scientific name	IUCN Status*	National/ Local IUCN Status*	Migration	Lit./ Obs.	EOO (km2)	EAAA (km2)	Is EAAA ≥ 1%of EOO?	PCH/CH
Bird	*Acrocephalus arundinaceus*	LC	NE	Full Migrant	L	22 200 000	13 516	No	-
Bird	*Anastomus lamelligerus*	LC	NE	Full Migrant	O	22 800 000	13 516	No	-
Bird	*Apus affinis*	LC	NE	Full Migrant	O	60 600 000	13 516	No	-
Bird	*Apus caffer*	LC	NE	Full Migrant	L	33 500 000	13 516	No	-
Bird	*Ardea alba*	LC	NE	Full Migrant	L	346 000 000	13 516	No	-
Bird	*Ardea cinerea*	LC	NE	Full Migrant	O	136 000 000	13 516	No	-
Bird	*Ardea goliath*	LC	NE	Full Migrant	O	30 800 000	13 516	No	-
Bird	*Ardea melanocephala*	LC	NE	Full Migrant	O	26 000 000	13 516	No	-
Bird	*Ardea purpurea*	LC	NE	Full Migrant	O	131 000 000	13 516	No	-
Bird	*Ardeola ralloides*	LC	NE	Full Migrant	L	54 300 000	13 516	No	-
Bird	*Arenaria interpres*	LC	NE	Full Migrant	L	399 000 000	13 516	No	-
Bird	*Bubulcus ibis*	LC	NE	Full Migrant	L	355 000 000	13 516	No	-
Bird	*Butorides striata*	LC	NE	Full Migrant	O	305 000 000	13 516	No	-
Bird	*Caprimulgus fossii*	LC	NE	Full Migrant	O	7 430 000	13 516	No	-
Bird	*Cecropis abyssinica*	LC	NE	Full Migrant	O	23 200 000	13 516	No	-
Bird	*Cecropis semirufa*	LC	NE	Full Migrant	L	16 600 000	13 516	No	-
Bird	*Cecropis senegalensis*	LC	NE	Full Migrant	L	19 100 000	13 516	No	-
Bird	*Chrysococcyx caprius*	LC	NE	Full Migrant	L	30 000 000	13 516	No	-
Bird	*Circaetus cinereus*	LC	NE	Full Migrant	L	23 300 000	13 516	No	-
Bird	*Dendrocygna viduata*	LC	NE	Full Migrant	L	75 400 000	13 516	No	-
Bird	*Egretta garzetta*	LC	NE	Full Migrant	O	151 000 000	13 516	No	-

Taxon	Scientific name	IUCN Status*	National/ Local IUCN Status*	Migration	Lit./ Obs.	EOO (km2)	EAAA (km2)	Is EAAA ≥ 1%of EOO?	PCH/CH
Bird	*Glareola pratincola*	LC	NE	Full Migrant	L	21 300 000	13 516	No	-
Bird	*Halcyon senegalensis*	LC	NE	Full Migrant	O	20 100 000	13 516	No	-
Bird	*Hieraaetus wahlbergi*	LC	NE	Full Migrant	L	20 000 000	13 516	No	-
Bird	*Himantopus himantopus*	LC	NE	Full Migrant	L	302 000 000	13 516	No	-
Bird	*Hirundo angolensis*	LC	NE	Full Migrant	L	4 940 000	13 516	No	-
Bird	*Hirundo smithii*	LC	NE	Full Migrant	O	54 600 000	13 516	No	-
Bird	*Merops apiaster*	LC	NE	Full Migrant	L	12 800 000	13 516	No	-
Bird	*Merops superciliosus*	LC	NE	Full Migrant	L	12 500 000	13 516	No	-
Bird	*Milvus migrans*	LC	NE	Full Migrant	L	135 760 673	13 516	No	-
Bird	*Neophedina cincta*	LC	NE	Full Migrant	L	12 300 000	13 516	No	-
Bird	*Oena capensis*	LC	NE	Full Migrant	O	17 900 000	13 516	No	-
Bird	*Pelecanus onocrotalus*	LC	NE	Full Migrant	O	54 800 000	13 516	No	-
Bird	*Petrochelidon rufigula*	LC	NE	Full Migrant	L	1 920 000	13 516	No	-
Bird	*Phalacrocorax carbo*		NE	Full Migrant	O	323 000 000	13 516	No	-
Bird	*Porphyrio alleni*	LC	NE	Full Migrant	L	24 100 000	13 516	No	-
Bird	*Rhinoptilus chalcopterus*	LC	NE	Full Migrant	L	20 600 000	13 516	No	-
Bird	*Spilopelia senegalensis*	LC	NE	Full Migrant	O	64 400 000	13 516	No	-
Bird	*Streptopelia capicola*	LC	NE	Full Migrant	O	15 100 000	13 516	No	-
Bird	*Streptopelia semitorquata*	LC	NE	Full Migrant	O	26 000 000	13 516	No	-
Bird	*Tringa stagnatilis*	LC	NE	Full Migrant	O	120 000 000	13 516	No	-
Bird	*Turtur afer*	LC	NE	Full Migrant	L	19 100 000	13 516	No	-
Bird	*Upupa epops*	LC	NE	Full Migrant	O	104 000 000	13 516	No	-

Taxon	Scientific name	IUCN Status*	National/ Local IUCN Status*	Migration	Lit./ Obs.	EOO (km2)	EAAA (km2)	Is EAAA ≥ 1%of EOO?	PCH/CH
Fish	*Awaous lateristriga*	LC	NE	Full Migrant	O	924 530	6 686	No	-
Fish	*Chelon dumerili*	LC	NE	Full Migrant	L	1 107 543	6 686	No	-
Fish	*Chrysichthys nigrodigitatus*	LC	NE	Full Migrant	L	1 640 747	6 686	No	-
Fish	*Clarias ngamensis*	LC	NE	Full Migrant	L	654 172	6 686	Yes	PCH
Fish	*Eleotris vittata*	LC	NE	Full Migrant	O	1 757 722	6 686	No	-
Fish	*Enteromius eutaenia*	LC	NE	Full Migrant	O	1 272 398	6 686	No	-
Fish	*Enteromius radiatus*	LC	NE	Full Migrant	L	1 790 918	6 686	No	-
Fish	*Hemichromis fasciatus*	LC	NE	Full Migrant	O	4 214 648	6 686	No	-
Fish	*Nematogobius maindroni*	LC	NE	Full Migrant	L	1 180 640	6 686	No	-
Fish	*Pellonula vorax*	LC	NE	Full Migrant	O	685 236	6 686	No	-
Fish	*Periophthalmus barbarus*	LC	NE	Full Migrant	L	934 036	6 686	No	-
Fish	*Petrocephalus simus*	LC	NE	Full Migrant	L	1 485 520	6 686	No	-
Fish	*Tilapia sparrmanii*	LC	NE	Full Migrant	L	1 921 062	6 686	No	-
Mammal	*Connochaetes taurinus*	LC	NE	Full Migrant	L	3 545 638	13 516	No	-
Mammal	*Equus quagga*	NT	NE	Full Migrant	L	4 180 000	13 516	No	-
Mammal	*Trichechus senegalensis*	VU	AEx (EN)	Full Migrant	L	480 142	6 686	Yes	PCH

* IUCN status: LC (Least Concern), NT (Near Threatened), VU (Vulnerable), NE (Not Evaluated)
L = Literature, O = Observed

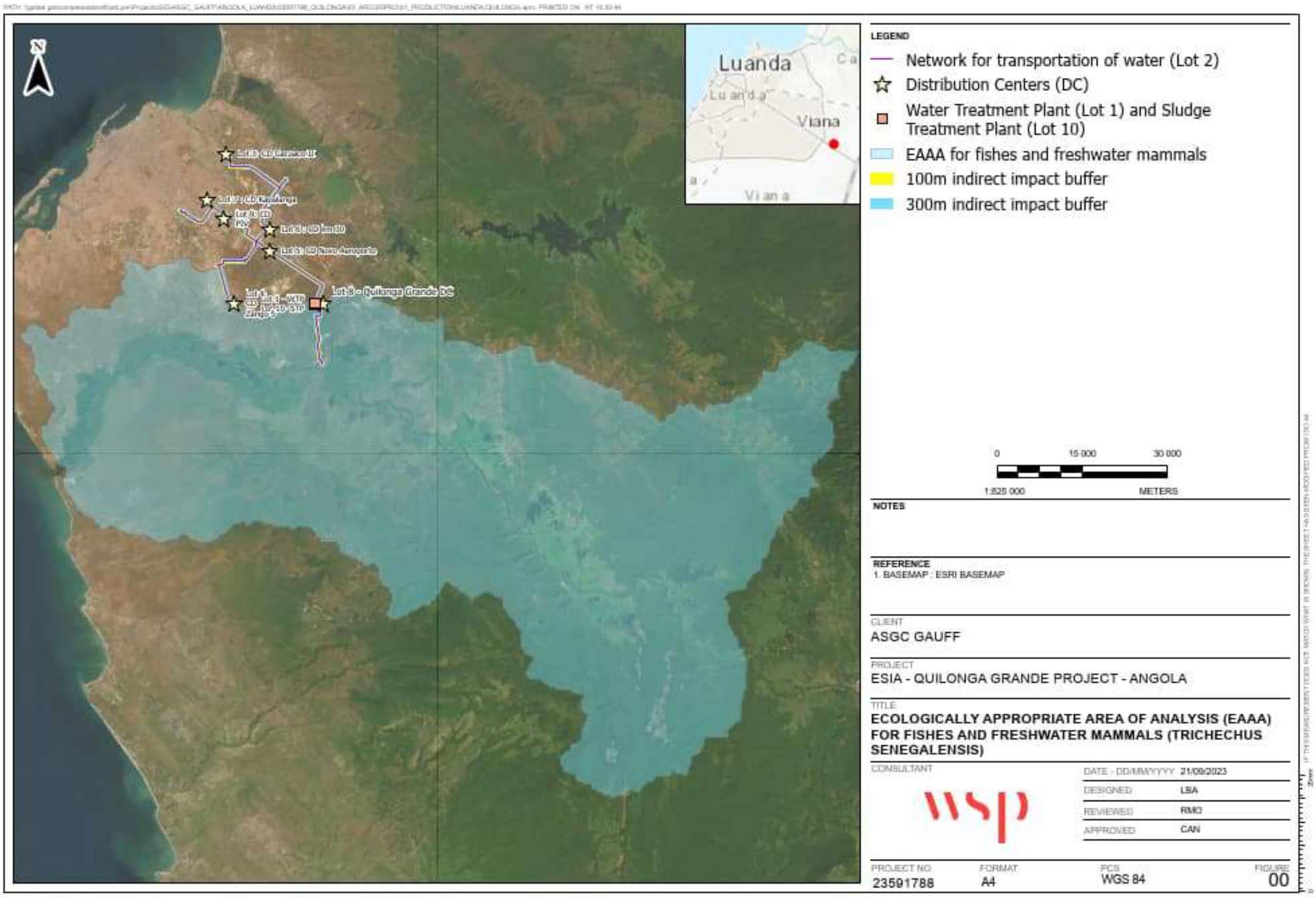


Figure 165: Ecologically Appropriate Area of Analysis defined for fish freshwater mammal species.

7.2.8.4 Criterion 4 - Highly threatened or unique ecosystems

IFC Guidance Note 6 defines highly threatened or unique ecosystems as “at risk of significantly decreasing in area or quality with a small spatial extent; and/or containing unique assemblages of species including assemblages or concentrations of biome-restricted species.”

The Criterion 4 application (GN79, IFC 2019) foresees the use the “Red List of Ecosystems (RLE)” where formal IUCN assessments have been conducted. However, no evaluation was performed in Angola as shown in the IUCN RLE Database. Therefore, this system cannot be used at present.

The Natural Habitat identified in the AoI include:

- Dry Adansonia Woodland ;
- Dry Shrubland ;
- Floodplain Grassland ;
- River Kwanza.

These habitats are characterized by different levels of anthropogenic pressure (from Low to High) and are not determined to be of high priority for conservation by regional or national systematic conservation planning.

Therefore, no Critical Habitat is expected to be present in the AoI according to this criterion.

7.2.8.5 Criterion 5 - Areas associated with key evolutionary processes

This criterion includes presence of areas with landscape features that might be associated with evolutionary processes or species populations that are especially distinct and may be of special conservation concern given their distinct evolutionary history was considered.

The study area is not known to contain landscape features that may influence evolutionary processes, giving rise to regional configurations of species and ecological properties. In fact, no species and/or subpopulations of species is characterized by a particular level of isolation, spatial heterogeneity, and wealth of environmental gradients or edaphic interfaces. Moreover, the area is not considered to be of demonstrated importance as to climate change adaptation or as biological corridor. These considerations suggest that the study area does not support any key evolutionary processes.

Therefore, no Critical Habitat is expected to be present in the AoI according to this criterion.

7.2.8.6 Ecology of confirmed species triggering Critical Habitats

The table below summarize the flora and fauna species identified as triggering Critical Habitats (CHs) and the criteria for which they were considered. Species that could trigger CH but that are considered only potentially present based on literature information and/or species for which insufficient data are available are identified as triggering “Potential Critical Habitat” (PCH). The ecology of the species identified as potentially triggering CH is described in detail below.

It should be noted that there is no legal framework for the protection of specific species in Angola. The existing legal framework is done through the establishment of protection areas (Natural Parks, Natural Reserves, etc.), where there are specific legal restrictions inside that protection area for the existing species. The only diploma that identifies specific species is the Angola Red List of Species, established through Executive Decree No. 252/18, of 13th of July. This diploma lists Endangered or Vulnerable Species. Although not directly establishing a legal protection mechanism, it identifies species in danger. Then, the Angola Penal Code, in article 282 states that it is a crime to create the danger of extinction of any species of animals or plants. So, indirectly, it could be considered that the species listed in the Red List are under protection by the Penal Code.

Out of the species listed in Table 59**: Screening of migratory and congregatory species potentially triggering Critical Habitat according to Criterion 3 (IFC, 2019)** only *Trichechus senegalensis* is included in the red list published by Executive Decree No. 252/18, of 13th of July.

Table 60: Flora and fauna species identified as triggering or potentially triggering Critical Habitats

Taxon	Scientific name	Common name	IUCN Status	National/ Local IUCN Status*	End./ RR	Migratory Status	Lit./ Obs.	PCH/CH	IFC Criteria
Flora	*Pycnocoma dentata*	-	LC	NE	RR	-	L	PCH	2a
Fish	*Clarias ngamensis*	Blunt-toothed African Catfish	LC	NE	-	Full Migrant	L	PCH	3a
Amphibian	*Breviceps ombelanonga* sp. nov.	-	NE	NE	RR	-	L	PCH	2a
	Phrynobatrachus brevipalmatus	-	DD	NE	RR	-	L	PCH	2a
Reptile	*Monopeltis luandae*	-	LC	NE	RR	-	L	PCH	2a
Mammal	*Trichechus senegalensis*	African Manatee	VU	AEx (EN)	-	Full Migrant	L	PCH	3a

FLORA

Pycnocoma dentata is a shrub or tree species, growing primarily in the wet tropical biome. It can reach a maximum height of approximately 4 m, and the trunk branches from the base. It is found in dry *Adansonia digitata* savannah and in similar dry savannah lowland vegetation, including *Colophospermum mopane* savannah. During the performed field survey no individuals of this species were observed. The species was considered as potentially present in the AoI based on literature review.

FISHES

Clarias ngamensis is a demersal, potamodromous fish species designated a conservation status of LC (IUCN, 2023-1). This species prefers vegetated habitats in swamps and estuaries and the lower reaches of rivers. It lives over muddy substrates in swampy areas and feeds on molluscs, terrestrial and aquatic insects, shrimps, crabs, and other fish species.

Clarias ngamensis was initially included into this assessment as a precautionary approach, as the freshwater EAAA has the potential to host >1% of the global population based on area (1.02 %), and therefore could host >1% of the global population. It should be noted that the species is widespread within the southern half of Africa and its distribution is described as:

> *A wide-ranging species in the southern half of Africa, from Democratic Republic of Congo (DRC) to South Africa. It is a swamp/floodplain specialist that is widespread in southern African and common where such habitats occur. It ranges from southern Congo catchments through to the Phongolo System in KwaZulu Natal, South Africa. In Zambia it is known from the Lualaba and Luapula Rivers, Lakes Mweru and Bangweulu. In the DRC it is recorded from the upper Kasai system. In Malawi it has been recorded from Lake Malawi but is extremely rare there, although it is common in the Elephant Marsh in the Lower Shire.*

> *In South Africa and Swaziland it has been recorded from the lower sections of the Pongolo River. In the upper Zambezian systems floodplains (Okavango, Kunene and Zambezi) it is common in Angola, Namibia, Botswana and Zambia (Skelton 2001). There are almost no records from coastal southern Mozambique but it would be expected there in the lower sections of large rivers*.

Although confirmed, the only documented occurrence of *Clarias ngamensis* in the catchments is within the Capanda Dam, which is a hydroelectric dam on the Kwanza River in Malanje Province, Angola, and This further supports the notion that the EAAA is unlikely to sustain >1 % of the global population.

Clarias ngamensis breeds during the summer rainy season when it moves into shallow flooded drainage channels to spawn, similar to that of *C. gariepinus*. This species is considered to be a locally migrating species, and therefore is not dependent on the ±200 km of Kwanza River flowing through the EAAA .

Based on the information above, the EAAA would not be considered CH for *Clarias ngamensis,* as;

- The EAAA will unlikely sustain >1 % of the global population, as the figure is based on area and not population.
- The EAAA is not a migration corridor necessary for the species to complete their lifecycle, as this is done locally in suitable floodplain habitat.
- The species is listed as Least Concern.

Based on the above information, no further assessment of *Clarias ngamensis* is warranted.

AMPHIBIANS

Breviceps ombelanonga is an amphibian species, distributed from the typical western Angolan savannah, with sandy soils and vegetation dominated by *Adansonia digitata*, *Euphorbia conspicua*, *Acacia welwitschii* and *Combretum* sp., together with a considerable grass coverage, to dense Angolan wet miombo woodland in the east.

Phrynobatrachus brevipalmatus sp. nov. is an amphibian species strongly connected to freshwater marshes and intermittent freshwater marshes.

REPTILES

Monopeltis luandae is a burrowing reptile species. It can be found in deep Pleistocene red sandy soil in small farm plots (fruit trees) mixed with natural vegetation (*Euphorbia conspicua* and *Adansonia digitata* mainly) and near the banks of the Cuanza River.

MAMMALS

Trichechus senegalensis is a freshwater mammal species whose distributional range occurs in West and Central Africa. This species is present in large and small rivers, coastal estuaries, freshwater and saltwater lagoons, shallow quiet coastal bays, lakes, and reservoirs. Its ecological requirements are strongly connected to sheltered water with access to food and freshwater. Literature reports that molluscs and fishes represent approximately 10 % of the lifetime diet in Gabon, and 50 % of diet in both freshwater and marine systems in Senegal. Manatees are mostly solitary, with mothers and calves forming the principal social unit. They usually rest during the day in water that is 1–2 m in depth and sometimes in the middle of a watercourse or hidden in mangrove roots or under natant vegetation.

7.3 Social component

This section of the report will analyze primary and secondary data to portray the baseline socioeconomic conditions in Angola, Luanda, and the Quilonga Grande Project System 5 area of influence.

Primary data will include information from a preliminary site survey, key informant interviews and a high-level social survey. Secondary data, such as peer-reviewed articles, data from the World Bank and other reliable sources, will help to establish the socioeconomic conditions in the North and Northeast of Luanda, including the municipalities of Viana, Icolo Bengo and Cacuaco.

Fieldwork being carried out locally consisted of general surveillance of the three municipalities and respective communes within the scope of the study in structured questionnaires/interviews made to the target groups of the communities through specific surveys for each group (A – Farmer's land use occupants; B – Households; C – Private water supply companies). Given the limitations of data acquisition (See Chapter 5.4.3), field data provided in the social baseline should be considered as anecdotal rather than proven facts.

7.3.1 Administrative Framework

Angola is administratively divided into 18 provinces, led by province governors nominated by the President of the Republic, the Head of Government. With the publication of the new Constitution of the Republic of Angola in February 2010, a new chapter named "Local Power" was introduced. Here, the existence of autonomous local authorities is determined, and the possibility for the setting up of municipalities is established.

The Constitution determines that the organization and functioning of municipalities and the competence of its governing bodies are regulated by the law under the principle of administrative decentralization.

Local government of the State arises within the framework of administrative devolution. The CRA establishes that the local administration of the State is exercised by devolved organs of the central administration to ensure, at the local level, the accomplishment of the attributions and specific interests of the State Administration in the respective administrative district, without prejudice to local autonomy, as provided for in article 201 paragraph 1 of the CRA. It is, in essence, the constitutional principle of bringing the central administration closer to the populations in the pursuit of their respective attributions without clashing with the constitutionally recognized mission of local government.

The principles and norms of organization and functioning of the Local Government Bodies of the State to which it is applicable in the Province, Municipality and Inframunicipal levels are established in the Law of Local Administration of the State (Law n.º 15/16 of September 12).

The provincial Government is a devolved organ of the central State Administration that aims to ensure the accomplishment of the functions of the Executive Power in the Province. In the execution of his powers, the Provincial Governor is accountable to the PR for his activity before the PR. It is up to the central administration body that supervises the Local Administration of the State to coordinate the efforts of the related ministerial departments to stimulate and evaluate the implementation of the policy of the Executive Power related to the said areas. For this purpose, the Provincial Government shall send periodic reports on the political, administrative, economic, social and cultural development of the Province.

The Municipal Administration is presided over by a Municipal Administrator appointed by the Provincial Governor and is assisted by a Deputy Municipal Administrator.

The Communal Administration is the devolved organ of the State Administration in the Municipality that aims to ensure the accomplishment of the functions of the State in the Commune or equivalent territorial entities, whose attributions it is responsible for pursuing; guide economic and social development and ensure the provision of public services in the respective geographical area.

The **Figure 166** shows the administrative chain from the provincial to the sub-municipal levels (elaborated from the Law of Local Administration of the State).

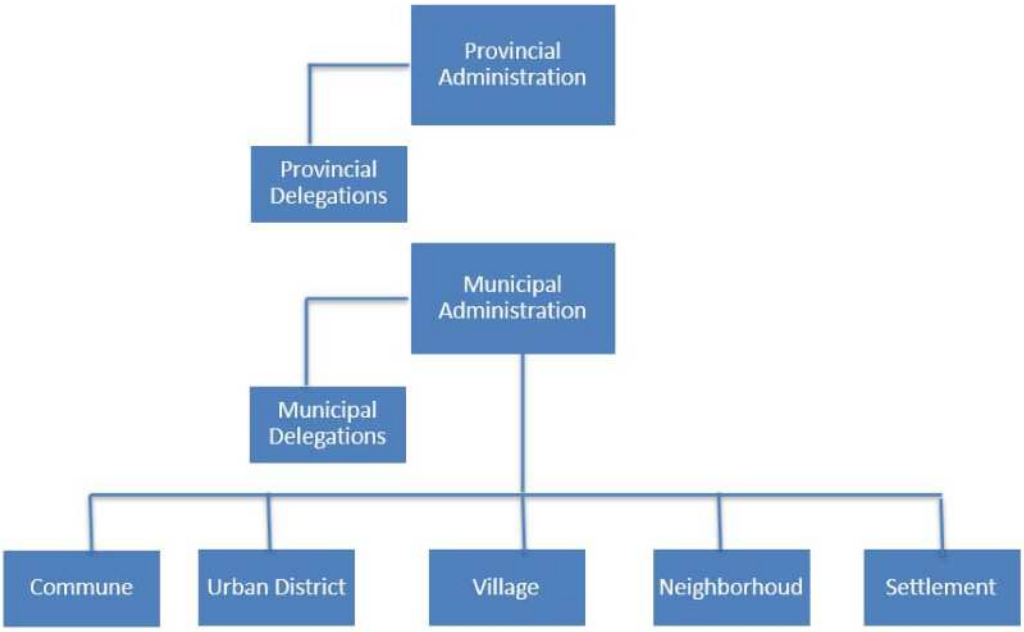


Figure 166: Administrative Chain (Law n.º 15/16 of September 12)

The traditional authorities are entities that personify and exercise power within the respective traditional political-community organization, under customary values and norms and with respect for the Constitution and the law" (Article 224).

They are given competence, organization, control regime, the responsibility, and the heritage of the institutions of traditional power, relations institutions of these with the organs of the local administration of the State and the municipal administration, as well as the typology of the Traditional Authorities, are regulated by law" (Article 224).

7.3.1.1 Project Insertion Area

The Quilonga Grande Project System 5 area is contained solely in Luanda. Luanda is subdivided into nine municipalities: Luanda, Icolo e Bengo, Quiçama, Cacuaco, Cazenga, Viana, Belas, Kilamba Kiaxi and Talatona. However, these municipal borders have changed several times in recent years.

Pre-2011, nine municipalities differed slightly in name or location from the current divisions, as illustrated in **Figure 167**. This was then updated by the Ministry of Territorial Administration in 2011 to merge some of the municipalities in central Luanda and add Quiçama to the south of the Province, resulting in seven municipalities (**Figure 168**).

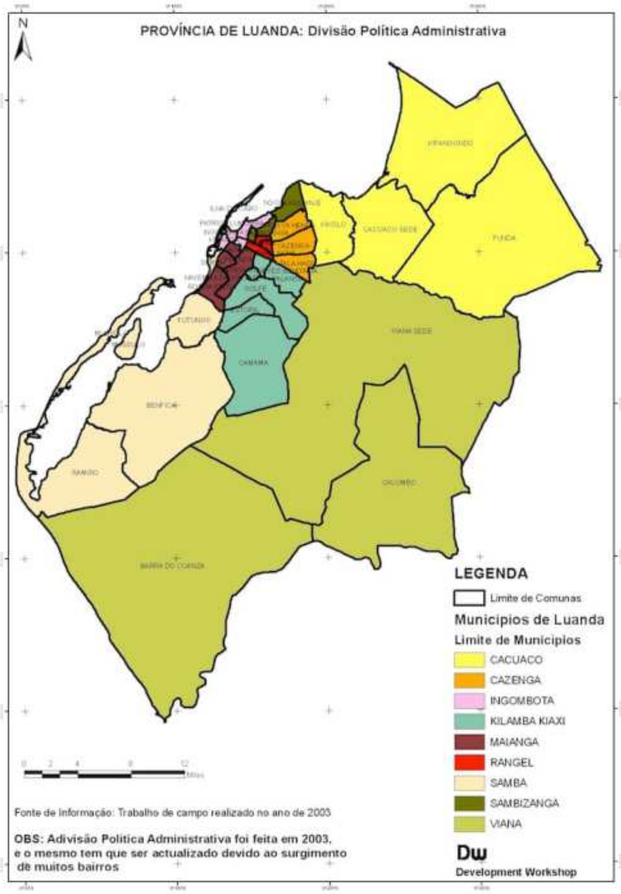


Figure 167: pre-2011municipality divisions in the Province of Luanda

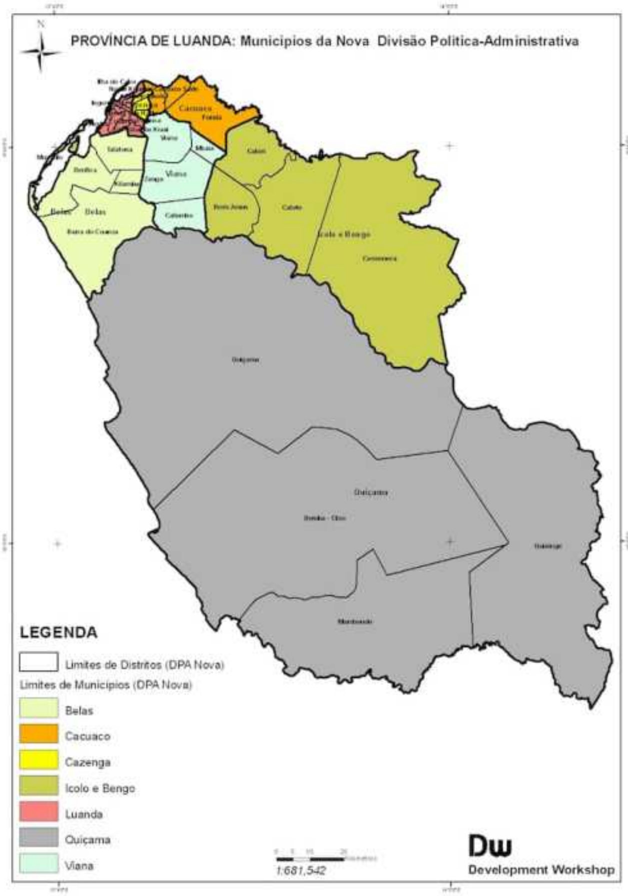


Figure 168: 2011-2016 municipality divisions in the Province of Luanda

Administratively, the Province of Luanda was divided into Luanda and Icolo and Bengo in 1980. Luanda was further divided into nine municipalities (Kilamba Kiaxi, Rangel, Maianga, Sambizanga, Viana, Ingombota, Cacuaco, Samba and Cazenga). In 2011, increasing population expansion and density were sought accommodated by incorporating Icolo and Bengo and the 9,000 km^2 park of Quiçama and reducing/reorganizing the number of municipalities to seven (Cacuaco, Belas, Cazenga, Icolo and Bengo, Luanda, Viana and Quiçama). The Municipality of Luanda coincides with the former limits of the city of Luanda, which was further subdivided into six urban districts (Ingombota, Kilamba Kiaxi, Viana, Rangel, Samba and Sambizanga) (**Figure 169**).

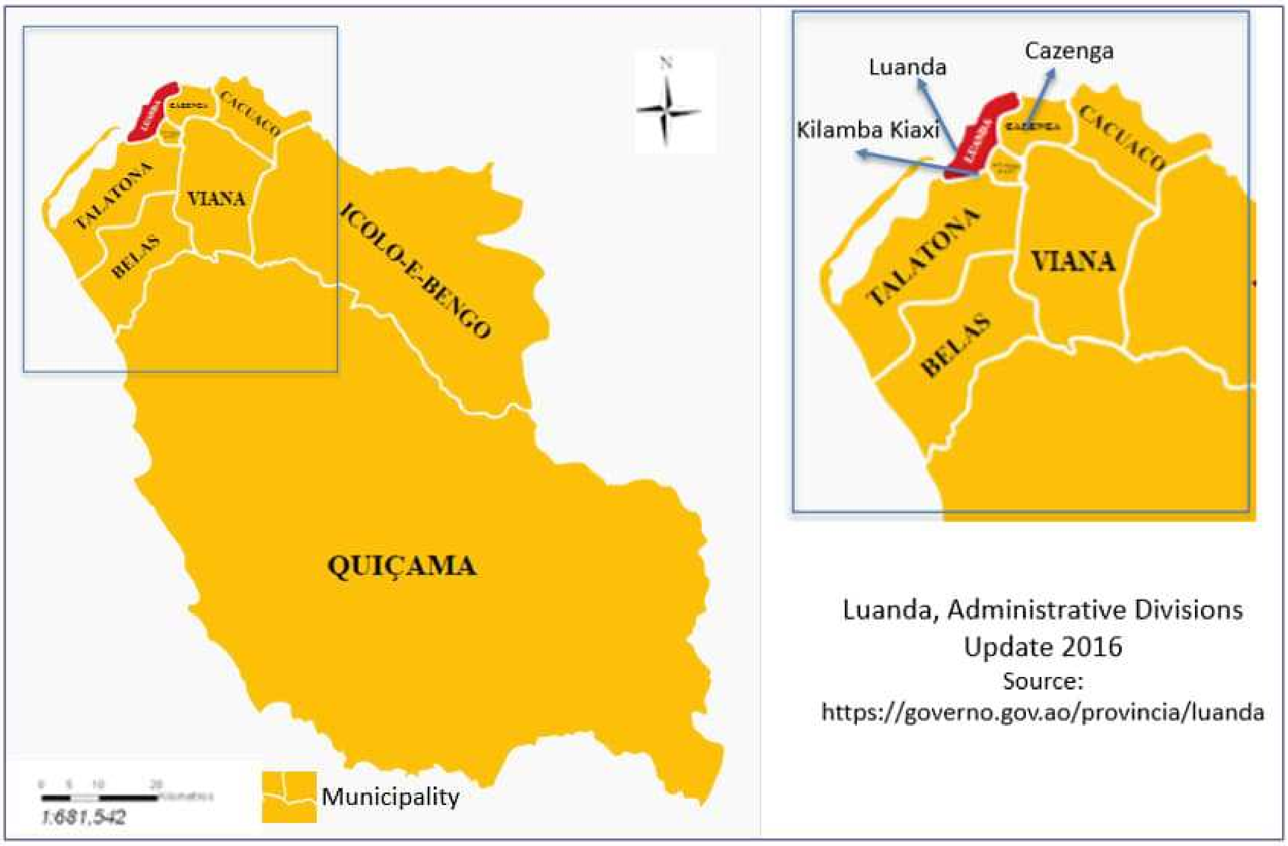


Figure 169: Municipality divisions in the Province of Luanda since 2016

Municipalities are further divided into Communes and Urban Districts. The Quilonga Grande System 5 area is spread across three Municipalities, Cacuaco, Icolo & Bengo and Viana, and six communes/districts. **Table 61** shows the administrative division of the Province of Luanda based on the 2014 Census.

Table 61: Number of the Municipalities, Communes and Localities of Luanda, 2014 (INE, Censos 2014)

Province Municipality	Commune	Locality		Total
		Urban	Rural	
Luanda	**32**	**292**	**296**	**588**
Luanda	6	98	0	98
Cazenga	3	28	0	28
Cacuaco	3	35	17	52
Viana	3	39	14	53
Belas	7	76	29	105
Icolo e Bengo	5	14	114	128
Quissama	5	2	122	124

Note: There are not 3 (Three) localities registered as reserves because they constitute uninhabited areas

Today, with the new political and administrative division of Luanda, according to Law no. 18/16 of October 17, 2016, the Province of Luanda, headquartered in the City of Luanda, has nine (9) Municipalities. Among them: Municipality of Luanda, Icolo and Bengo, Quiçama, Cacuaco, Cazenga, Viana, Belas, Kilamba Kiaxi and Talatona.

Table 62: Number of the Municipalities, Communes and Localities of Luanda Province, 2023 (Law n.º 18/16, October 17).

Province Municipality	Commune	District	
		Urban	Rural
Luanda		**41**	**14**
Belas	Barra do Kwanza, Quenguela, Morro dos Veados, Ramiros, Vila Verde, Cabolombo, Kilamba	6	1
Cacuaco	Funda, Cacuaco, Kikolo, Mulenvos de Baixo, Sequele	4	1
Cazenga	Cazenga, Hoji ya Henda, 11 de Novembro, Kima Kieza, Tala Hadi, Kalawenda	6	0
Icolo e Bengo	Cassoneca, Cabiri, Bom Jesus, Caculo Cahango, Quiminha, Catete, Bela Vista	2	5
Luanda	Sambizanga, Rangel, Maianga, Ingombota, Samba, Neves Bendinha, Ngola Kiluanje	7	0
Quiçama (Quissama)	Muxima, Demba Chio, Quixinge, Mumbondo, Cabo Ledo	0	5
Kilamba Kiaxi	Golfe, Sapú, Palanca, Nova Vida	4	0
Talatona	Mussulo, Benfica, Futungo de Belas, Lar do Patriota, Talatona, Camama, Cidade Universitária	6	1
Viana	Calumbo, Viana, Estalagem, Baia, Kikuxi, Zango, Vila Flor	6	1

Figure 170 shows the Quilonga Grande System 5 Project administrative implantation area, municipalities and communes.

Figure 170: Quilonga Grande System 5 Project Area, Municipalities and Communes

7.3.2 Demographic profile

The Angolan territory has an enormous diversity in terms of physical and human occupation. The following Table systematizes a brief characterization of the Angolan provinces regarding surface and population. The Province of Luanda, with 2,418 km^2, represents only about 0.2 % of the territory of Angola and about 27.5 % of the total population (see Table 63).

Table 63: Territory, Administrative and Settlement Indicators of the Provinces of the Republic of Angola (INE, 2014 Census and others)

Province	Capital	Surface (km^2)	Total Projected Population - 2023	Population Density Inhab/km^2	Municipalities	Communes
Bengo	Caxito	31.371	515.917	15.9	6	23
Benguela	Benguela	39.827	2,820.137	69	10	38
Bié	Kuito	70.314	1,944.538	26.8	9	39
Cabinda	Cabinda	7.270	917.916	123	4	12
Cuando Cubango	Menongue	199.049	697.397	3.4	9	31
Kwanza Norte	N' Dalatando	24.190	570.385	22.9	10	31
Kwanza Sul	Sumbe	55.660	2,441.152	42.6	12	36
Cunene	Ondjiva	89.342	1,311.824	14.2	6	20
Huambo	Huambo	34.274	2,736.159	77.2	11	37
Huila	Lubango	75.002	3,282.968	42.5	14	52
Luanda	Luanda	2,418	9,359.552	3,755.1	7	32
Lunda Norte	Lucapa	102.783	1,121.715	10.6	10	25
Lunda Sul	Saurimo	45.649	711.130	15.1	4	14
Malange	Malange	97.602	1,284.855	12.8	14	52
Moxico	Luena	223.023	994.053	4.3	9	30
Namibe	Namibe	58.137	672.086	11.2	5	14
Uíge	Uíge	58.698	1,922.673	31.8	16	47
Zaire	Mbanza Congo	40.130	789.570	19.1	6	25
Total		**1,254.739**	**33,086.278**	**26.4**	**162**	**558**

In 2023, the highest concentration of population continues to occur in Luanda Province, estimated to concentrate 27.5 % of Angola's population, followed by Huíla Province (9.6 %), Benguela Province (8.3 %), Huambo Province (8.0 %) and Kwanza Sul (7.2 %).

Except for the provinces of Lunda Norte and Zaire, the proportion of the female population is higher than that of the male population in 2014. The masculinity index translates the number of men per 100 women, ranging from 106.1 in the Province of Lunda Norte to 87.5 in Cunene, with the country's average of 94. In the Province of Luanda, this ratio was 96 men for every 100 women.

The following two figures show the breakdown of the total population by gender and Province and their projection for 2023.

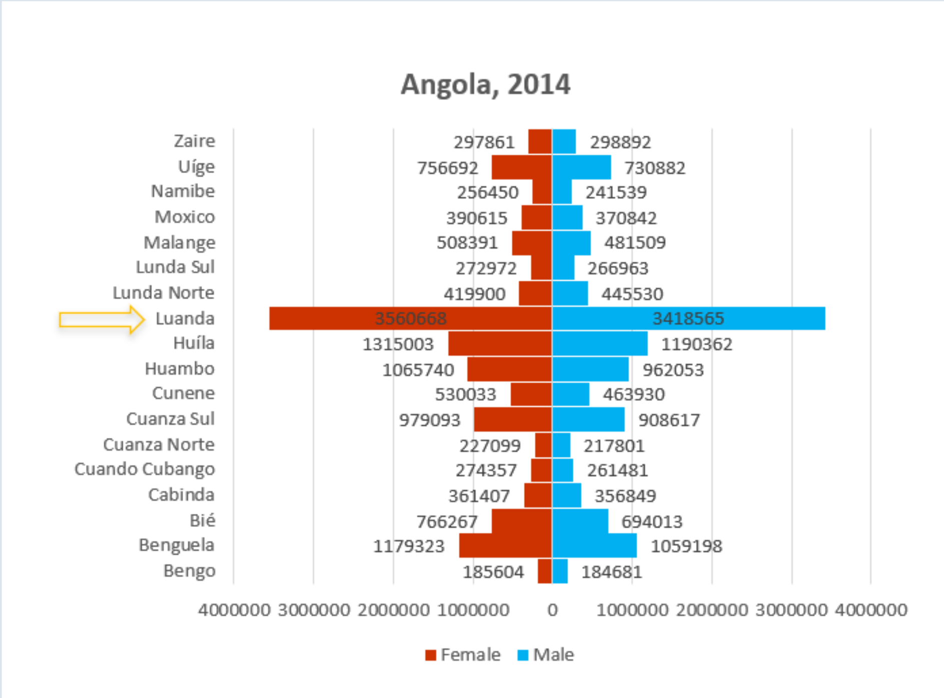


Figure 171: Population Breakdown of the Republic of Angola by Province and Gender, 2014 (Source INE, 2014 Census)

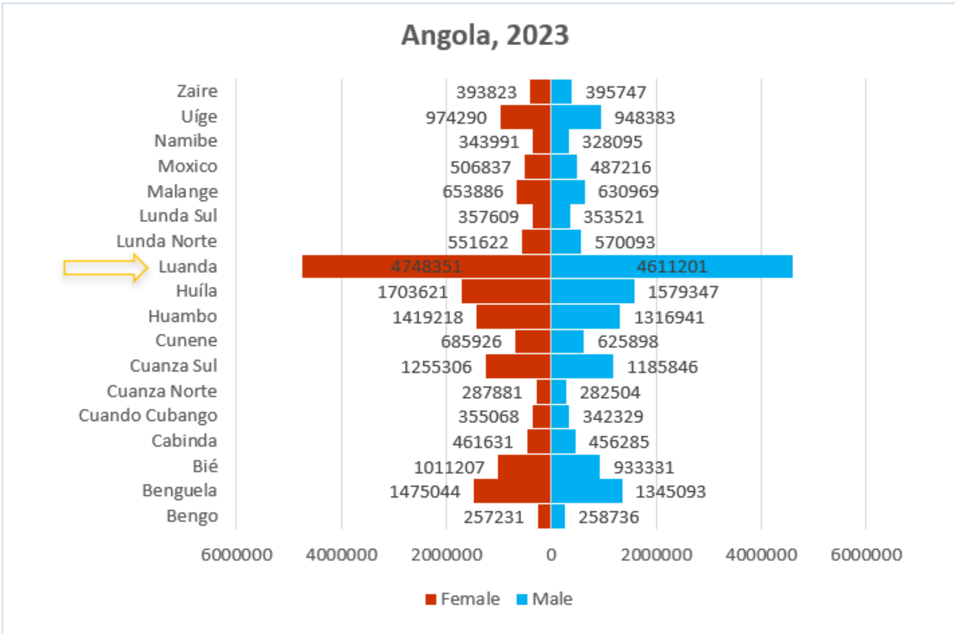


Figure 172: Population Breakdown of the Republic of Angola by Province and Gender, Projection 2023 (Source INE, 2014 Census)

In 2022, the World Bank estimated that Angola's population was just under 35.6 million, a 117 % increase from its 2000 population. This growth is mainly attributed to the urban centers of Angola, such as Benguela, Huambo, Lobito and the most populous of them all, Luanda.

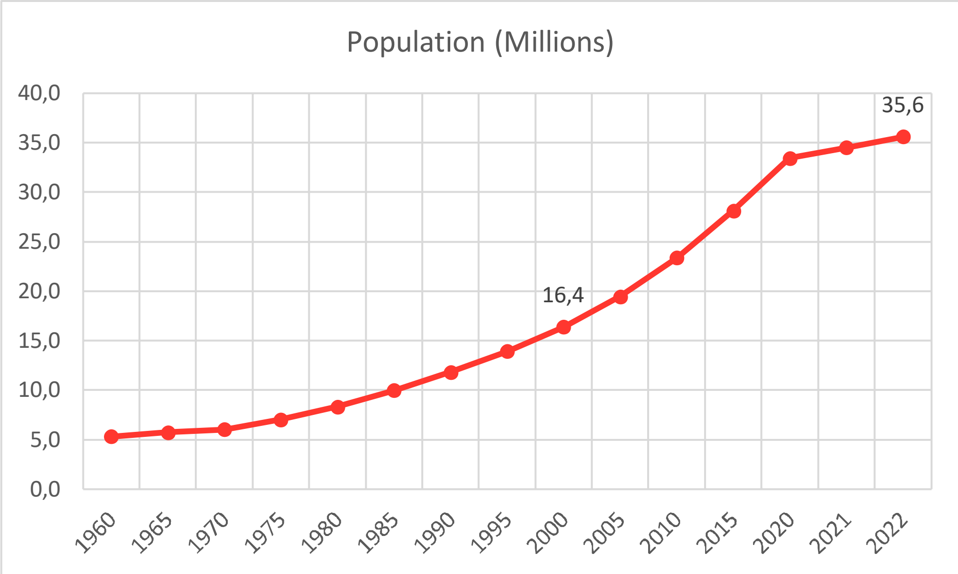


Figure 173: Population of Angola 1960-2022 (The World Bank Data, August 16, 2023)

At Independence in 1975, the population of Luanda stood at approximately 500,000 (Jenkins et al. 2010). Since then, following decades of war and the rural exodus, the population has increased from 1 million in 1980 to 4 million in 2000. The population continued to grow at an unprecedented rate after the peace agreement of 2002 to 6.5 million in 2014, with continued urban migration and very few returning to their rural areas of origin. Considering only the central municipalities, it is estimated that in 2023, Luanda will have a population density of 23.307 per km^2 – among the highest on the African continent (The World Bank Data, August 16, 2023).

During the Civil War (1975-2002), many people moved from the outlying provinces, where most of the fighting took place, to the relative safety of the capital. This mass movement of Internally Displaced Peoples (IDPs) to Luanda accelerated the city's population growth and, as the country was at civil war, social and physical infrastructure could not accommodate growing demand. The violence and unstable atmosphere associated with a civil war reversed any progress made until that point.

In the first fifteen years of the millennium and after the Peace Treaty in 2002, the city's economic growth consolidated, which led to the continuous influx of the rural population. Despite the inequality and social and spatial differentiation, the hinterland population continued to see Luanda as a place that offered better opportunities and made it easier to become rich, attracting the rural population more and more. With no resources to access urbanized areas, these new city dwellers moved to the old and the new musseques, where access to essential urban services was insufficient and where the majority of the population of the country's capital still lives.

The population doubled again in the first fifteen years of the 21st century, reaching, in the 2014 census, about 6,945 million (in the Province of Luanda).

Since then, and despite the country's economic crisis in the past years, the population has continued to increase at a fast pace, and the population of Luanda is estimated at more than 11 million. Most of the population continues to live in the vast self-built "urban fringes" (África Habitat 2018) that are called musseque in Luanda: they are "informal settlements", or they are "self-produced neighborhoods" that are lacking in infrastructures.

In the forty-six years of Independence, these self-built settlements have become more populated and have expanded beyond the old borders, now home to about 8 million people, i.e., the population living in the musseques is now 20 times higher than the 352,000 inhabitants in 1970.

The Metropolitan Plan for Luanda (PDGML), undertaken by the Provincial Government in ((PDGML) 2015) found that the capital had a population of just over 5.5 million. The PDGML plans for 2015/2030 when the Province's population reaches 12.9 million inhabitants.

Luanda has been one of the world's fastest-growing urban areas, and the growth is expected to continue over the next decade. By 2030, a population of 12.9 million is projected for the Province.

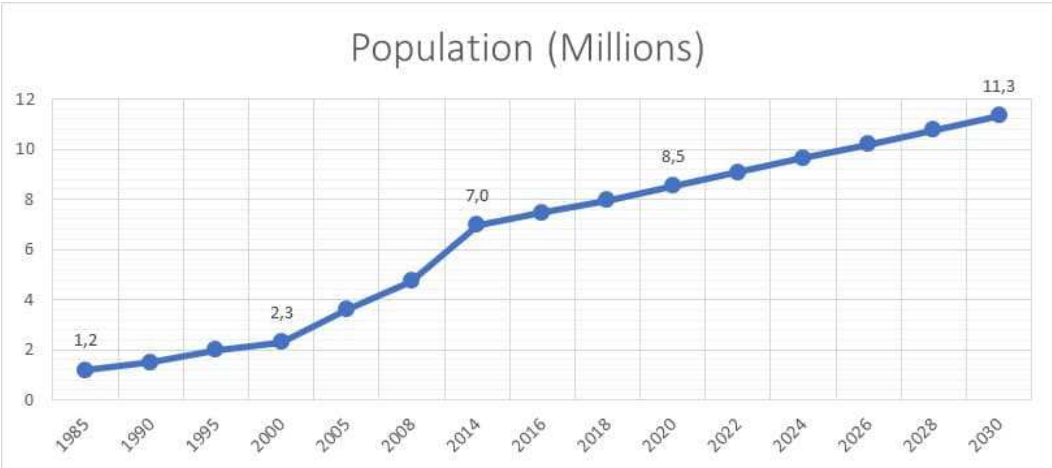


Figure 174: Population of Luanda Province 1985-2030 (INE 2016)

According to the Definitive Results of the 2014 Census, the population in Luanda, as of the census date, May 2014, is 6,945,386 people.

Considering the 18 Provinces of Angola, the population distribution by zones has significant differences, as shown in the following figure (**Figure 175**). Luanda Province has about 97 % of the population residing in urban areas and only about 3 % in rural areas. This distribution will be reflected in several aspects of society.

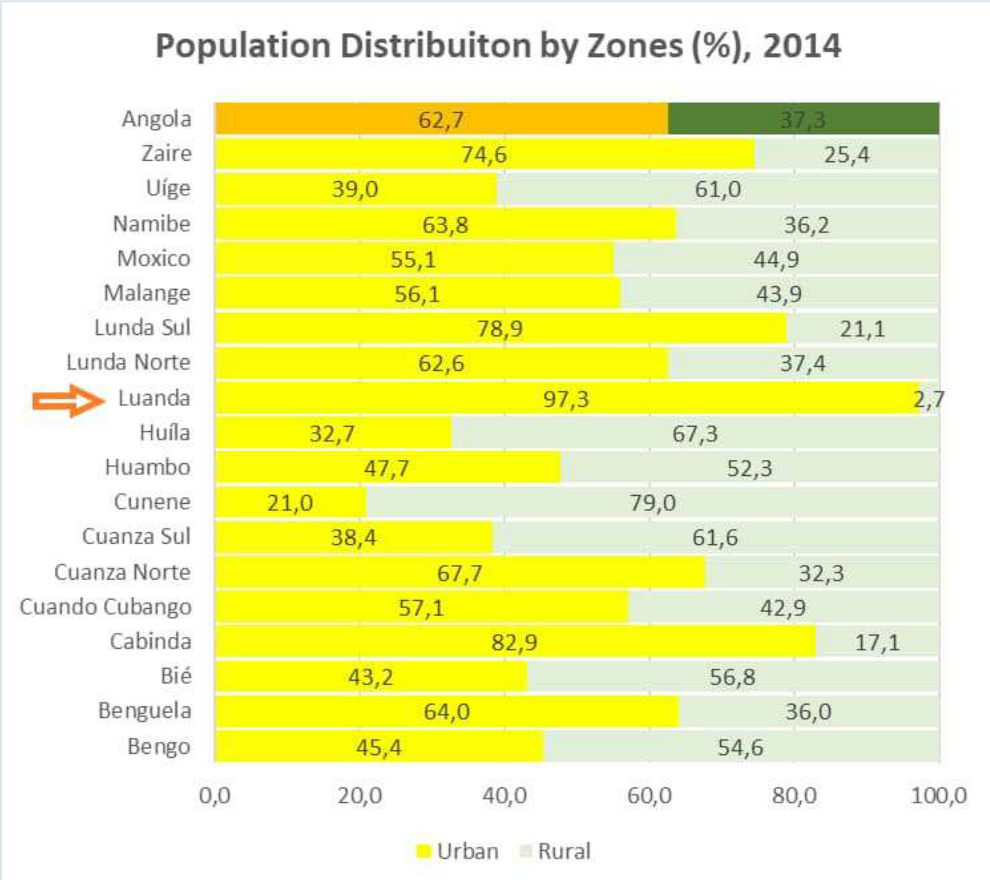


Figure 175: Partition of Urban and Rural Population by Province (INE, 2014 Census)

The Municipality of Luanda is the most populous, with 2,194,747 people, representing about a third of the Province's population (32 %). With less than 100 thousand inhabitants, the municipalities of Icolo and Bengo (81 144 inhabitants) and Quissama (26 546 inhabitants) appear (Figure 174).

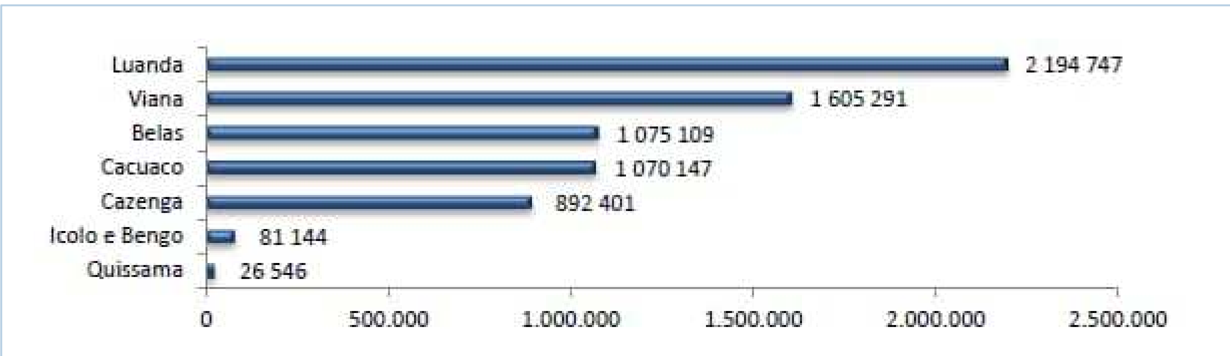


Figure 176: Population by municipalities, 2014 (INE, Censos 2014)

The district of Luanda has the highest population density, including the communes Ingombota, Rangel, Samba, Sambizanga, Kilamba Kiaxi and Maianga, of which Catambor is a part. The Luanda district is the city's most diversified in terms of formal/informal areas and poor/wealthy population groups.

The Table below presents the population data by commune for the three municipalities in the project area, referring to the 2014 Census. The communes in the project area are highlighted in colour.

Table 64: Population by Municipalities and Communes of Project Area, 2014 (INE, Censos 2014)

Municipality / Commune	Total	Male		Female	
		Number	%	Number	%
Cacuaco	**1,070.147**	**521.882**	**48.8**	**548.266**	**51.2**
Cacuaco	259.161	126.140	48.7	133.021	51.3
Funda	209.387	103.099	49.2	106.287	50.8
Kikolo	601.599	292.642	48.6	308.957	51.4
Viana	**1,605.291**	**785.351**	**48.9**	**819.940**	**51.1**
Viana	1,382.854	675.437	48.8	707.418	51.2
Zango	198.538	97.242	49.0	101.296	51.0
Calumbo	23.899	12.673	53.0	11.226	47.0
Luanda	**2,194.747**	**1,074.957**	**49.0**	**1,119.790**	**51.0**
Ingombota	103.260	50.494	48.9	52.766	51.1
Maianga	598.613	292.907	48.9	305.706	51.1
Rangel	136.453	66.097	48.4	70.356	51.6
Sambizanga	367.038	180.427	49.2	186.611	50.8
Kilamba Kiaxi	841.411	412.738	49.1	428.674	50.9
Samba	147.972	72.295	48.9	75.677	51.1
Icolo e Bengo	**81.144**	**41.865**	**51.6**	**39.279**	**48.4**
Catete	23.284	11.731	50.4	11.553	49.6
Bom Jesus	21.798	11.492	52.7	10.306	47.3
Cabiri	17.551	8.953	51.0	8.598	49.0
Calomboloca	15.454	8.046	52.1	7.408	47.9
Caculo Cahongo	3.058	1.643	53.7	1.415	46.3

7.3.2.1 Gender and Age Structure – Urban and rural

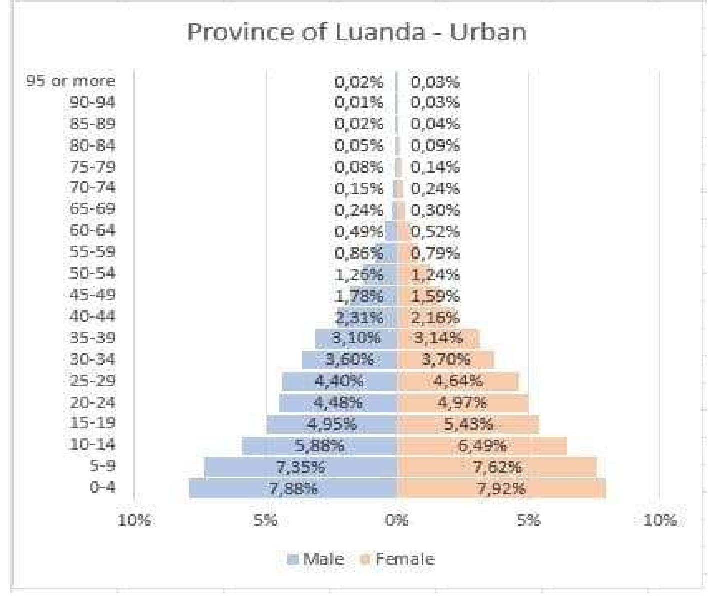
The municipalities of Cacuaco and Viana, like the municipality of Luanda, are primarily urban, as already mentioned. On the other hand, the municipality of Ícolo e Bengo is predominantly rural. The territory's characteristics are reflected in the population distribution between rural and urban areas and breakdown by gender and age groups.

The following figures characterize the population by age groups and gender, based on the age pyramids of the **urban population** and masculinity indices for the three municipalities of the project, regarding the Province of Luanda and the municipality of Luanda.

The masculinity index represents the number of men per hundred women and shows some differences in the distribution by age groups, as illustrated below.

At the provincial level, only the groups between 40 and 59 years of age have a higher proportion of men than the female population.

Overall, the Province has a young and balanced population structure between the female and male populations, with no sharp drops in the spreading by age group. Only the 50-54 age group has a masculinity index below 100 in the rural population.



Age Group	Total	Urban	Rural
95 or more	63.6	63,6	64.2
90-94	48.3	48,3	48.6
85-89	46.7	46,5	50.0
80-84	48.6	48,5	52.4
75-79	56.4	56,3	57.1
70-74	65.1	64,7	71.8
65-69	79.2	78,9	85.9
60-64	94.7	94,8	92.8
55-59	108.5	108,7	101.8
50-54	101.9	102,3	90.0
45-49	111.4	111,6	106.2
40-44	107.3	107,2	114.3
35-39	99.4	98,8	121.6
30-34	97.6	97,3	110.2
25-29	95.0	94,8	106.6
20-24	90.6	90,2	110.7
15-19	91.5	91,2	107.9
10-14	91.1	90,6	101.9
5-9	96.6	96,5	98.6
0-4	99.6	99,6	98.5
Province	**96.0**	**95.8**	**102.9**

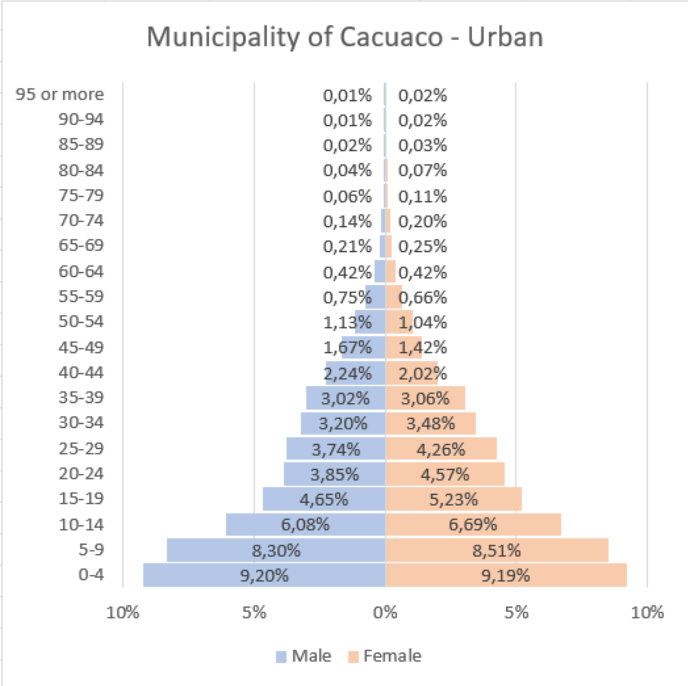
Figure 177: Luanda Province Population Pyramid and Masculinity Index (%), 2014 (INE, Luanda Censos 2014 - elaborate)

The municipality of Cacuaco has a broader base of the pyramid than the Province, reflecting the highest proportion of young people of both sexes.

The Masculinity Index shows some differences from the provincial pattern, and the highest proportion of men is found in the age groups between 35 and 69 years in the rural population.

The 0-4-year-old group also has a higher ratio of male and female children, which aligns with the world standard.

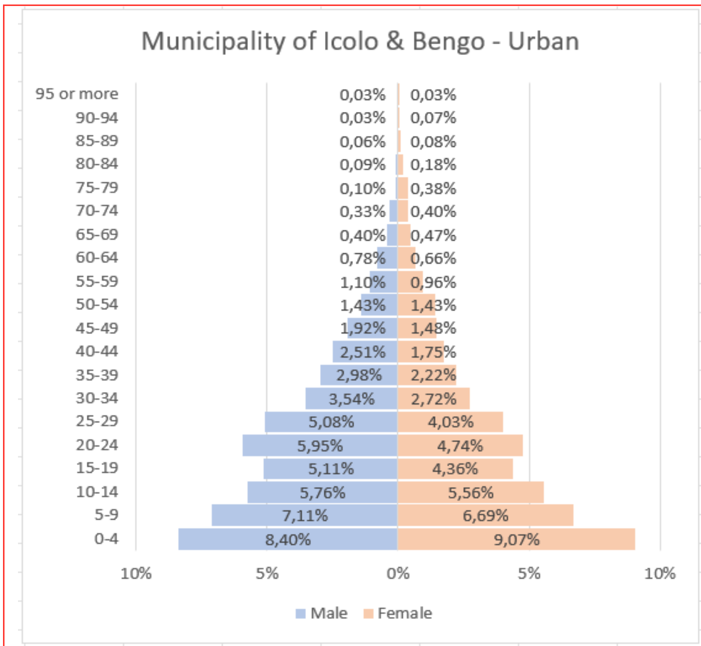
It is estimated that for every 105 boys who come into the world, 100 girls are born. While there is no absolute certainty, some theories explain. "In the human species, the ratio between the birth of girls and boys is tilted in favour of the male sex," says the World Health Organization (WHO).



Age Group	Total	Urban	Rural
95 or more	65.4	61,1	162.5
90-94	53.5	51,9	90.0
85-89	52.5	52,6	54.5
80-84	56.6	56,9	50.0
75-79	60.6	59,5	91.9
70-74	70.6	69,3	96.7
65-69	86.7	85,7	103.7
60-64	100.2	100,5	94.9
55-59	113.4	112,8	126.8
50-54	108.5	108,8	101.7
45-49	117.8	117,6	122.0
40-44	111.1	110,9	116.4
35-39	99.3	98,9	108.6
30-34	92.1	92,1	90.7
25-29	87.7	87,8	84.5
20-24	84.2	84,2	84.1
15-19	89.1	89,0	90.8
10-14	90.8	90,9	89.6
5-9	97.4	97,5	94.4
0-4	100.2	100,1	102.4
Province	**95.2**	**95,1**	**96.2**

Figure 178: Cacuaco Municipality Population Pyramid and Masculinity Index (%), 2014 (INE, Luanda Censos 2014 - elaborate)

The pyramid of ages of Icolo & Bengo also has a broad base and narrows towards the top but with an irregular distribution. Three hollow age classes were observed: the 10-14- and 15-19-years groups in men and the 15-19 years group in women. The concept of hollow class means that the next age group or groups have higher values than the previous ones, so the groups in question must have experienced some problems in their normal evolution — for example, lower number of births or higher mortality.



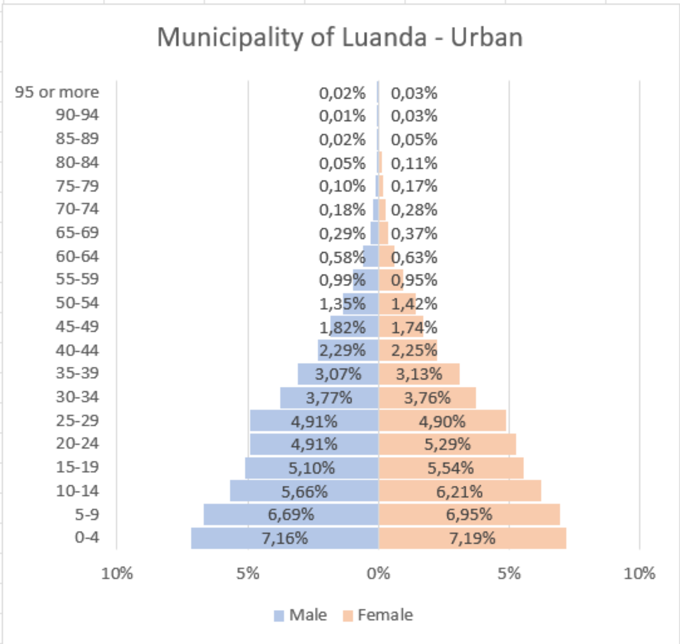
Age Group	Total	Urban	Rural
95 or more	40.0	85,7	32.6
90-94	44.9	42,9	44.6
85-89	61.3	75,0	59.0
80-84	45.7	51,4	44.6
75-79	43.0	27,3	47.0
70-74	72.2	82,7	70.6
65-69	87.1	86,3	87.2
60-64	97.4	117,9	93.9
55-59	94.9	113,8	91.1
50-54	83.0	99,7	79.5
45-49	99.8	130,4	92.6
40-44	113.5	143,8	105.0
35-39	124.1	134,5	121.0
30-34	121.2	129,9	118.1
25-29	124.2	126,2	123.5
20-24	133.8	125,5	137.4
15-19	119.0	117,2	119.8
10-14	109.9	103,5	112.5
5-9	101.5	106,3	100.1
0-4	95.9	92,7	97.0
Province	**106.6**	**111,5**	**105.0**

Figure 179: Icolo & Bengo Municipality Population Pyramid and Masculinity Index (%), 2014 (INE, Luanda Censos 2014 - elaborate)

The age pyramids of the municipality of Luanda have the narrowest base, showing lower birth rates in the primarily urban population.

The masculinity index is higher in the age groups between 25 and 59 years, except in the 35-39 and 50-54 age groups.

According to the 2014 Census, this municipality has only five residents classified as rural population, two male and three female. Hence, the rural male ratio is 66.7 miles per hundred females.



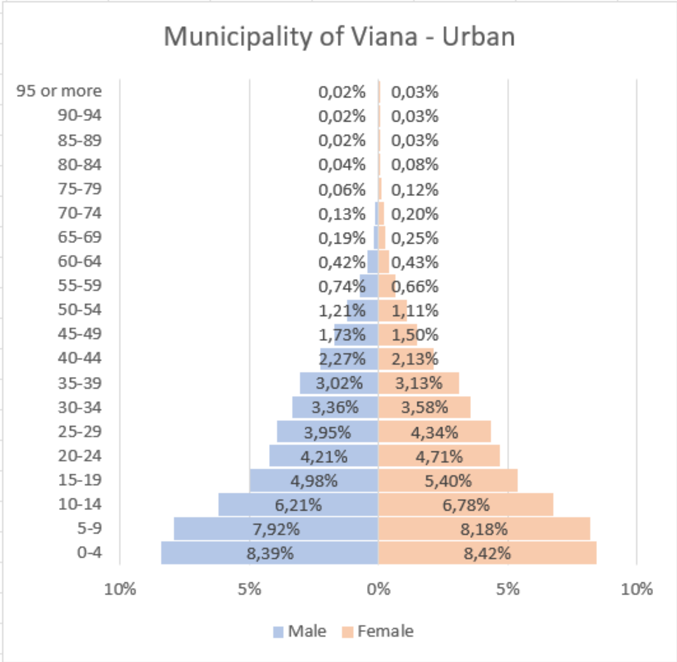
Age Group	Total	Urban	Rural
95 or more	60.7	60,7	0.0
90-94	44.1	44,1	0.0
85-89	45.5	45,5	0.0
80-84	47.0	47,0	0.0
75-79	57.8	57,7	0.0
70-74	65.0	65,0	0.0
65-69	78.6	78,6	0.0
60-64	92.3	92,3	0.0
55-59	103.5	103,5	0.0
50-54	95.2	95,2	0.0
45-49	104.7	104,7	0.0
40-44	101.8	101,8	0.0
35-39	98.2	98,2	0.0
30-34	100.3	100,3	0.0
25-29	100.2	100,2	0.0
20-24	92.7	92,7	0.0
15-19	92.1	92,1	0.0
10-14	91.0	91,0	0.0
5-9	96.2	96,2	0.0
0-4	99.6	99,6	0.0
Province	**96.0**	**96,0**	**66.7**

Figure 180: Luanda Municipality Population Pyramid and Masculinity Index (%), 2014 (INE, Luanda Censos 2014 - elaborate)

In the municipality of Viana, the age pyramid has a broad base. It narrows towards the top, with a structure similar to that observed in the other two municipalities in the Project area.

The breakdown of age groups by gender shows a higher masculinity ratio in the age groups between 40 and 59 years in the total and urban populations.

The masculinity ratio in the rural population is different, with the highest proportion of men among the 5-49 age groups, except in the 10-14 age group.



Age Group	Total	Urban	Rural
95 or more	70.3	69,2	150.0
90-94	58.8	58,6	66.7
85-89	49.1	49,4	38.9
80-84	47.9	47,5	58.5
75-79	48.4	48,3	52.6
70-74	64.6	64,3	71.4
65-69	76.4	76,5	73.9
60-64	95.9	96,5	81.9
55-59	111.5	112,0	95.6
50-54	109.4	109,7	97.2
45-49	115.2	115,3	113.1
40-44	106.9	106,7	113.6
35-39	97.1	96,7	117.3
30-34	94.2	93,8	111.5
25-29	91.2	91,0	104.2
20-24	89.6	89,4	101.1
15-19	92.5	92,3	104.4
10-14	91.7	91,5	99.7
5-9	97.0	96,9	101.5
0-4	99.6	99,6	99.6
Province	**95.8**	**95,7**	**102.1**

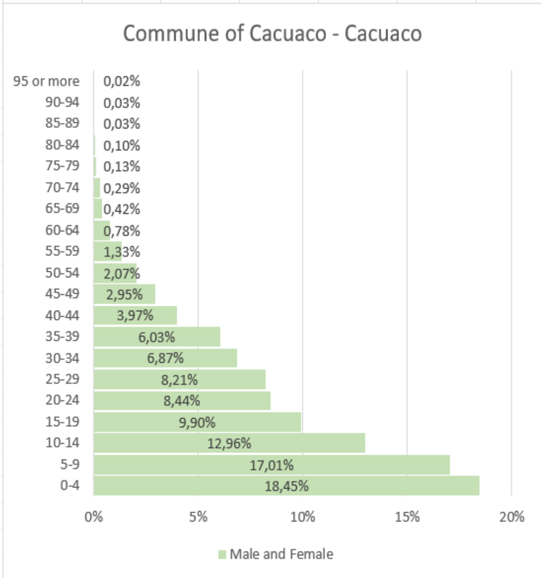
Figure 181: Viana Municipality Population Pyramid and Masculinity Index (%), 2014 (INE, Luanda Censos 2014 - elaborate)

At the Commune level, the 2014 Census does not disaggregate the population by gender and age groups.

The following figure shows the female and male population distribution for the three communes where the water distribution project will be implemented.

The Bom Jesus Commune has the smallest resident population and is predominantly rural. The respective pyramid is an "anomaly" in the age groups 10-14 and 15-19 years old, whose numbers are below the reference values of the other communes under study.

Resident Population	
Cacuaco Municipality	1,070,147
Cacuaco Commune	259,161
Icolo & Bengo Municipality	81,144
Bom Jesus Commune	21,798
Viana Municipality	1,605,291
Zango Commune	198,538



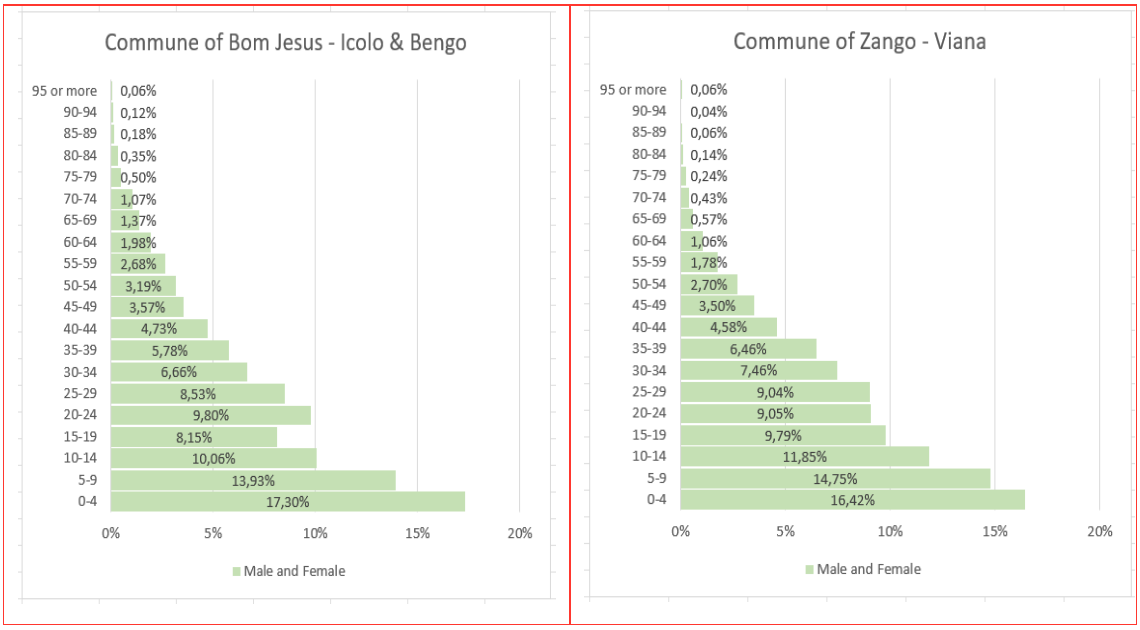


Figure 182: Population total (women and men) by age groups, Municipality and Commune, 2014 (INE, Luanda Censos 2014 - elaborate)

7.3.2.2 Population in the Project area

The social field survey in the project area was carried out in five locations. The following tables and figures present the most significant characteristics of the population per household, based on Survey B - Domestic conducted with 100 families, 20 per locality.

Initial visits were made to each municipality/bairro to establish contacts with relevant authorities and secure accessibility/permission to carry out fieldwork.

Belo Monte community (neat Lot 3)

The Belo Monte neighborhood or bairro, located in the Municipality of the Cacuaco, is bordered to the south by the municipalities of Viana and Cazenga, to the west by the Atlantic Ocean and the Municipality of Luanda and to the north and east by the Municipality of Dande in the Province of Bengo.

Belo Monte is a peripheral neighborhood, poorly urbanized and structured by secondary roads in poor condition, which hinders circulation. The district lacks public services, including piped water, sanitation, and other services such as education and public health.

The Belo Monte neighborhood, one of the most critical in terms of health and population density in the municipality of Cacuaco in the province of Luanda, does not have any health unit to meet the population's needs. Due to the lack of a health unit, the people of Belo Monte are forced to travel long distances to the medical centers of neighboring neighborhoods, such as Vila Paz, Mulenvos and the Municipal Hospital of Cacuaco.

On average, a family comprises five people: the husband, the wife and the children, and the average age of the Head of the family is 44 years. In the group of 20 families interviewed, 103 people lived.

Figure 183: Surveys in the neighborhood of Belo Monte – Cacuaco (Lot 3 CD)

The father is considered the head of the family, and he is the one who seeks subsistence through formal and informal jobs. The woman has the role of caregiver of the house and the children. In some cases, they are farmers or merchants in the markets.

The majority of the population in Cacuaco survives from the street sale and marketing of agricultural products from other provinces such as Malange and Uíge, and the neighborhood has a stop for the flow of farm products.

In Belo Monte, there is a lot of unemployment; young people are mainly dedicated to selling small services such as car washes, transporting goods and shoe shoes. The family income is primarily obtained daily in informal services and varies between 500 and 12,000.00 kwanzas (Field Survey).

According to the Law amending the political-administrative division of Luanda and Bengo (Law 29 / 11) and the creation of the Municipality of Belas (Law 16 / 11), the current geographical limits of the Municipality of Viana are to the North, the Municipality of Cacuaco, to the South the Municipality of Quissama, to the East the Municipality of Icolo e Bengo and to the West the Municipality of Belas.

Viana has a territorial area of 1,344 km², being the country's capital's most populous and densely populated municipality. Founded on December 13, 1963, and due to its proximity to Luanda, Viana was chosen to host the Industrial Reserve, inserted in the Luanda-Bengo Special Economic Zone (ZEE-LB), where many of the capital's enterprises exist.

In 1975, within the framework of Angolan independence and territorial reform of the new country, the province of Luanda was restricted to three municipalities, suppressing the capital, Luanda, leaving Ingombota, Viana and Cacuaco. The sum of the three municipalities formed the area of the "city of Luanda".

In 1976, with the subdivision of Ingombota to form Kilamba Kiaxi, the Vianense territory ceased to be one of the components of the city of Luanda, returning to be a city.

In the post-independence period, the African National Congress (ANC) implants in the city one of the main external military bases of the armed wing, "Spear of the Nation”.

After the 1980s, the municipality of Viana experienced an intense transformation from a traditional rural landscape to a dynamic urban one. The period culminated with Viana's integration into the Master Plan of the Metropolitan Region of Luanda in 2011. The Municipality of Viana is densely populated, and it is estimated that the current population is around 2.2 million inhabitants (INE, projection for 2023).

The rate of illegal occupation of land and the sale of lots is another of the significant problems of the municipal administration of Viana, which blames some citizens for the behaviour of less good practices and proceeds to occupy the land of others. The most conflicting areas concerning this issue have been the urban districts of Kikuxi, Zango, Vila Flor, and Baia. He said the headquarters village, in the Kapalanga area, is quieter in this sense, as well as the Inn. "We often have cases that are resolved only in court."

Kalanga community (near Lot 7)

The Kapalanga neighborhood is one of the 54 neighborhoods of the Municipality of Viana. Kapalanga is an urbanized neighborhood structured by linear and orthogonal roads facilitating circulation. In Kapalanga are located several school facilities and the Kapalanga Hospital. The railway line and the main street of Catete serve the locality.

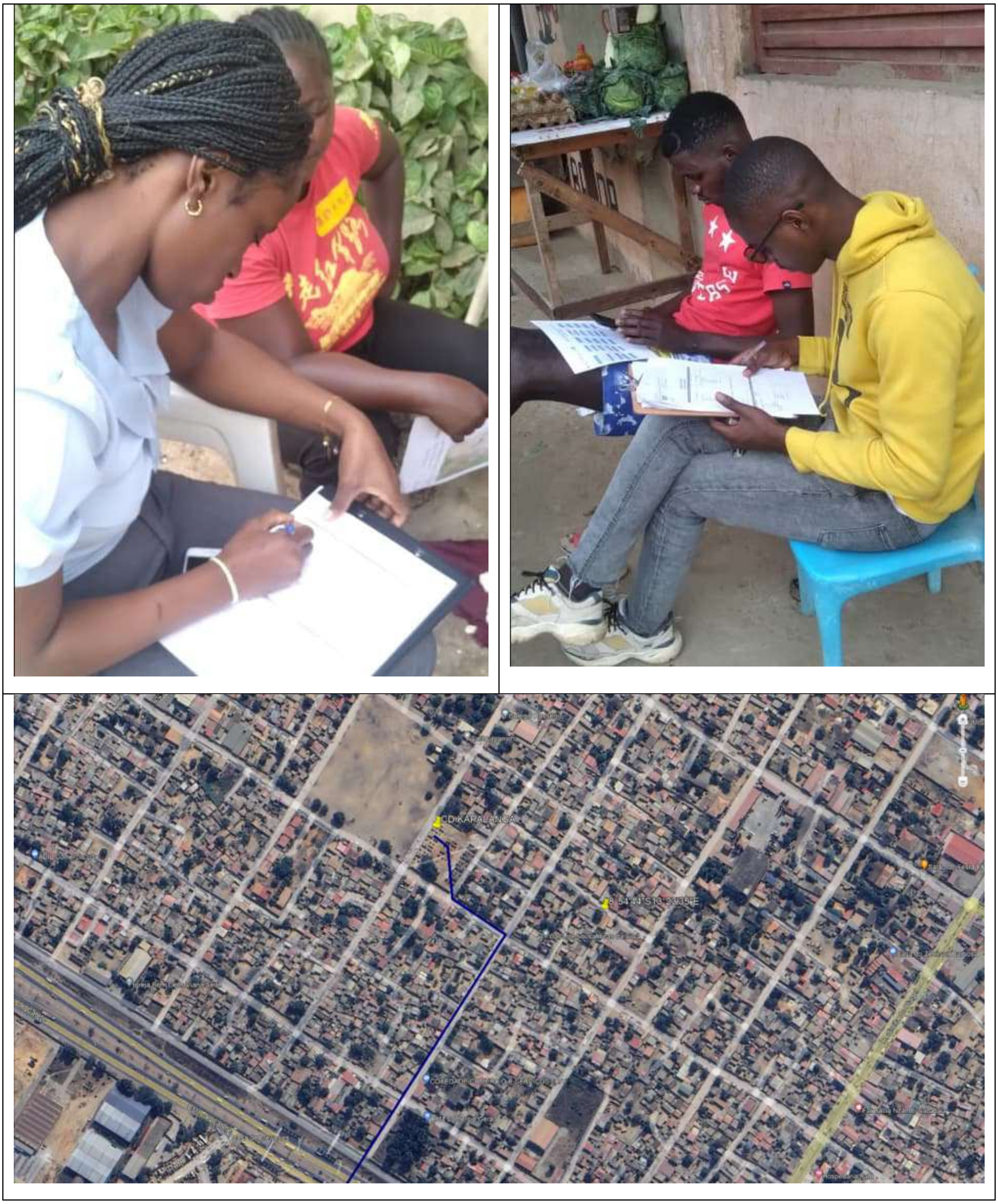


Figure 184: Surveys in the neighborhood of Kapalanga (Lot 7 CD)

The population of Bairro Kapalanga is considered young. More than 70% of the population is under 30 years old. On average, a family comprises six people: the husband, the wife and the children, and the average age of the Head of the family is 56 years. In the group of 20 families interviewed, 128 people lived.

The father is the head of the family. Being an extremely young population, most fathers seek subsistence and formal employment to support their families.

The woman usually has the role of caregiver of the house and the children. In some cases, they are merchants, and they place small benches in front of their homes where they sell fruits, agricultural products, and other products of first necessities when they do not move the city's artillery for the street sale. Many others are maids in the Sequele, Kilamba and other centers (Field Survey).

The neighborhood lacks public services, including piped water, sanitation, and other services such as education and public health.

Km 30 community (near Lot 6)

The km 30 neighborhood is one of the 54 neighborhoods of the Municipality of Viana. Km 30 is an urbanistically poorly structured neighborhood served by dirt roads that hinder circulation.

The km 30 is an urbanized neighborhood structured by linear and orthogonal roads facilitating circulation. In the vicinity of the district is located the KM30 market, currently considered one of the largest employment centers, direct and indirect, in Angola, given the movement of people and registered goods from Tuesday to Sunday.

On average, a family comprises five people: the husband, the wife and the children, and the average age of the Head of the family is 39 years. In the group of 20 families interviewed, 94 people lived.

The neighborhood lacks public services, including piped water, sanitation, and other services such as education and public health.

Figure 185: Surveys in the neighborhood of km 30 (Lot 6 CD)

Zango 5 community (near Lot 4)

The Bairro of Zango is located in the expansion zone of Luanda beyond the outer ring, the Expressway (ring road) that delimits the urban center of the capital of the country, similar to the new Centrality of Cacuaco (Municipality of Cacuaco) and the City of Kilamba (Municipality of Belas).

Zango V is the fifth in the series of urbanizations along the Viana-Calumbo road. Zango is divided into six centers: Zango I, Zango II, Zango III, Zango IV, and Zango 8000, and the object of this proposal is Zango V.

Located in the Municipality of Viana (35 km from the center of Luanda, 6 Km from the New International Airport of Angola and 5 km from the Kwanza River), Zango V is bordered by the Viana-Calumbo road, which in turn connects the expressway and the future peripheral highway.

The new Airport is a fundamental infrastructure in the macro-region of development of Luanda (Luanda, Bengo and Kwanza-Norte), being part of the West-East logistics axis for national and regional integration according to the strategic document "Angola 2025".

On average, a family comprises three people: the husband, the wife and the children, and the average age of the Head of the family is 40 years. In the group of 20 families interviewed, 56 people lived.

The father is considered the head of the family, and he is the one who seeks subsistence through formal and informal jobs. The woman has the role of caregiver of the house and the children. The majority of the population of Zango 5 has formal jobs selling agricultural products in the markets of Calumbo and Zango 4 as a means of subsistence. The unemployment rate is very significant (Field Survey).

This new centrality lacks public services, namely water and sanitation problems and urban and hospital waste collection.

Figure 186: Surveys in the neighborhood of Zango 5 (Lot 4 CD)

Bom Jesus community (near lot 1, 10 and 8)

Bom Jesus do Kwanza is an urban district and commune in the Municipality of Ícolo e Bengo in Luanda Province, Angola. It is located on the right bank of the Kwanza River, about 60 kilometers southeast of Luanda. There is a former sugar factory and a factory of the transnational Coca-Cola. In addition, Luanda's new international Airport is being built on the margins of the community.

On average, a family comprises five people: the husband, the wife and the children, and the average age of the Head of the family is 42 years. In the group of 20 families interviewed, 103 people lived.

The father is considered the head of the family, and he is the one who seeks subsistence through formal and informal jobs. The woman has the role of caregiver of the house and the children. In some cases, they are farmers or merchants in the markets. The majority of the population of Bom Jesus has as a means of subsistence agriculture, fishing, and sale of agricultural products. Few have a formal job, and the unemployment rate is very significant. On average, households have an income ranging from 35,000.00 to 230,000.00 (Field Survey).

Figure 187: Surveys in the neighborhood of Bom Jesus (Lot 1 WTP and Lot 10 STP)

7.3.2.3 Age and gender

In Angola, particularly in Luanda, the population is very young; 48 % of Angola's population is under 15 years old, and the average Luanda is 21 years old (2014), both male and female. This young population profile can be attributed to several factors including, but not limited to:

- a relatively low life expectancy (61 years (2021));
- the highest birth rate in the world (44.2 live births/ 1,000 population);
- a high fertility rate (6.16 children/ woman- second highest in the world), and ;
- a high population growth (annual %) 3,1 (2022).

This young population is the main contributing factor to a high dependency ratio. For every 100 working-age people (15-64) in Angola, 97 people are not of working age (i.e. under 14 or above 65) and are, therefore, economically dependent on someone else.

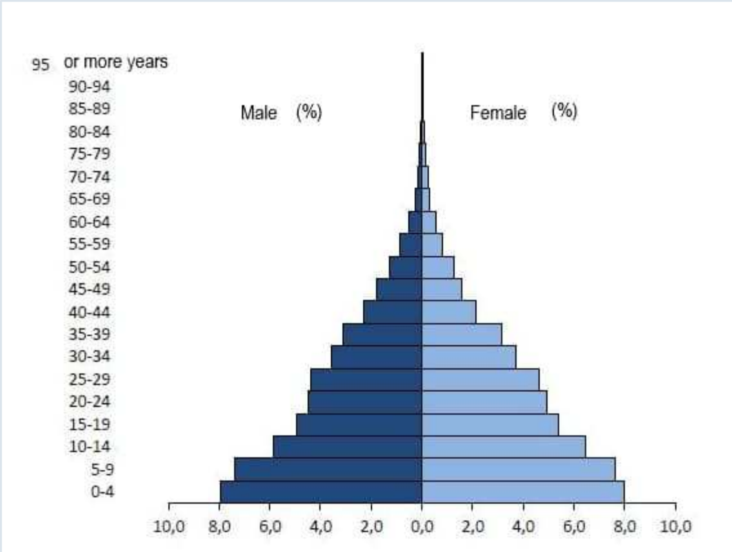


Figure 188: Age structure by gender (%), Luanda Province, 2014 (INE, Censos 2014)

Even though this age structure is typical of many developing countries, especially those in sub-Saharan Africa, Angola's case seems to be one of the extremes. The combination of a predominantly young population and a lack of sufficient social infrastructure, particularly schools and job opportunities, means that not only is education and, therefore, employment of limited supply but also that there are vast inequalities in their provision (discussed further in Sections 9.2.1.5 and 9.2.3).

A young population characterizes the age structure of the population. The population aged 0-14 years is 3.000.284, representing 43 % of the total resident population. The people of 0-24 years of age correspond to about 63 % of the resident population, which means that the Province of Luanda consists mainly of a highly young population. The gap between young and old is vast; only 102,982 people are 65 or older (about 2 % of the Province's population).

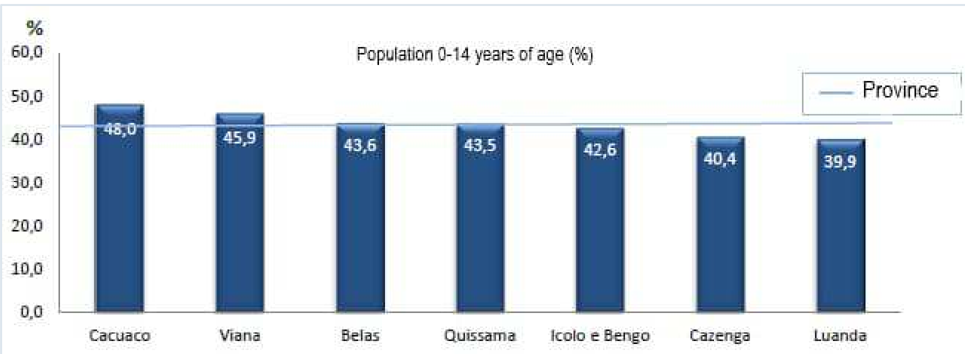


Figure 189: Population 0-14 years by the Municipality (%), Luanda Province, 2014 (INE, Censos 2014)

The working-age population (population aged 15-64) is 3,842,120 people, representing 55 % of the Province's population.

The population aged 65 years or more corresponds to less than 2 % of the people of Luanda province (1.5 %). The municipalities with the highest proportion of elderly are Icolo Bengo and Quissama.

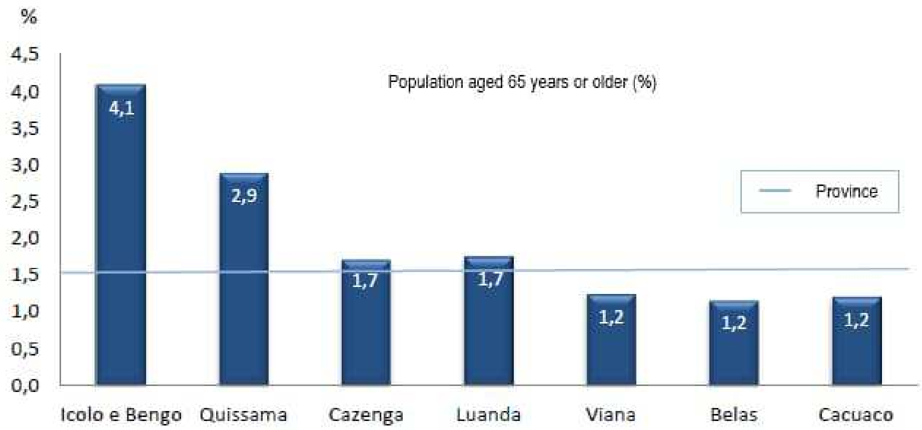


Figure 190: Population aged 65 years or older by the Municipality (%), Luanda Province, 2014 (INE, Censos 2014)

Based on the 2014 Census, in the Province of Luanda, 3,543,390 of the resident population are women, corresponding to 51 % of the total, while the male population is 3,401,996, representing 49 % of the total resident population in Luanda.

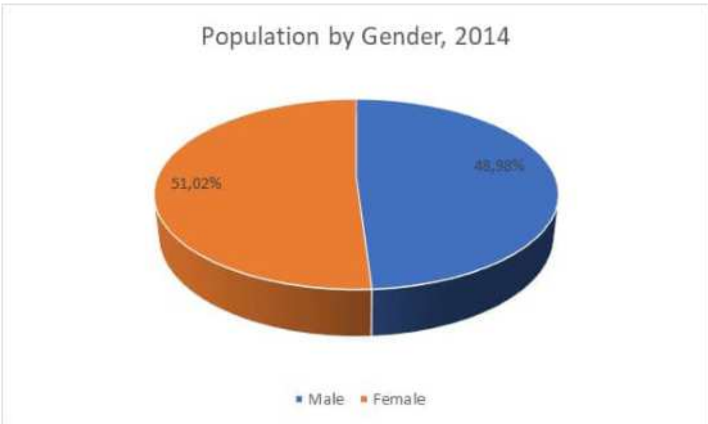


Figure 191: Population by gender (%), Luanda Province, 2014 (INE, Censos 2014)

The following Table presents the breakdown of respondents across the five locations by gender and age group.

Table 65: Gender and age group of the respondents by Locality / Bairro (INE, Censos 2014)

Bairro	Gender		Age groups (N.º)					
	Male	Female	18-25	26-35	36-45	46-55	55-60	61 or more
Cacuaco	10	10	3	6	5	1	0	5
Kapalanga	11	9	2	4	2	2	3	7
Km 30	10	11	0	5	10	3	1	1
Zango 5	13	6	0	5	9	3	1	2
Bom Jesus	11	9	3	5	9	2	0	1
Total (n.º)	55	45	8	25	35	11	5	16

7.3.2.4 Ethnicity and Religion

Angola is home to a large diversity of ethnolinguistic groups. Most are African, while a small minority are Portuguese, or mestizo, a Portuguese term for a person of mixed African and Portuguese heritage. Three ethnic groups dominate Angolan life and are called:

- the Ovimbundu,
- the Kimbundu and
- the Bakongo.

The Ovimbundu is the largest ethnic group, constituting around 37 % of the population. The Ovimbundu were traders for centuries, managing trade routes between other African groups and, eventually, the Portuguese. Under colonial rule, the Ovimbundu people gained several positions of authority from the Portuguese. They were also one of the significant groups that pushed for independence.

The Kumbundu is the second largest ethnic group in Angola, comprising approximately 25 % of the nation. This group is also known as the Mbundu or Northern Mbundu. Many Kimbundu today are farmers, but they, too, had a significant role in the independence movement and civil war.

The Bakongo is the smallest of the three groups, comprising around 13 % of the population. Most of the Bakongo people reside in the northern Angola province of Cabina. The mestiço make up about 2 % of the population. Europeans, mostly of Portuguese extraction, constitute 1 % of the people; other groups account for the remaining 22 % (Angola: Country Profile Report 2020-21. Cross Border).

Portuguese is spoken by more than half of the population (89 %), with more significant predominance in urban areas, where 89 % of the population speaks Portuguese, against only 85 % in rural areas.

Kimbundu is the second most spoken language, with 9 %, followed by Kikongo and Umbundo, with 8 % and 7 % respectively.

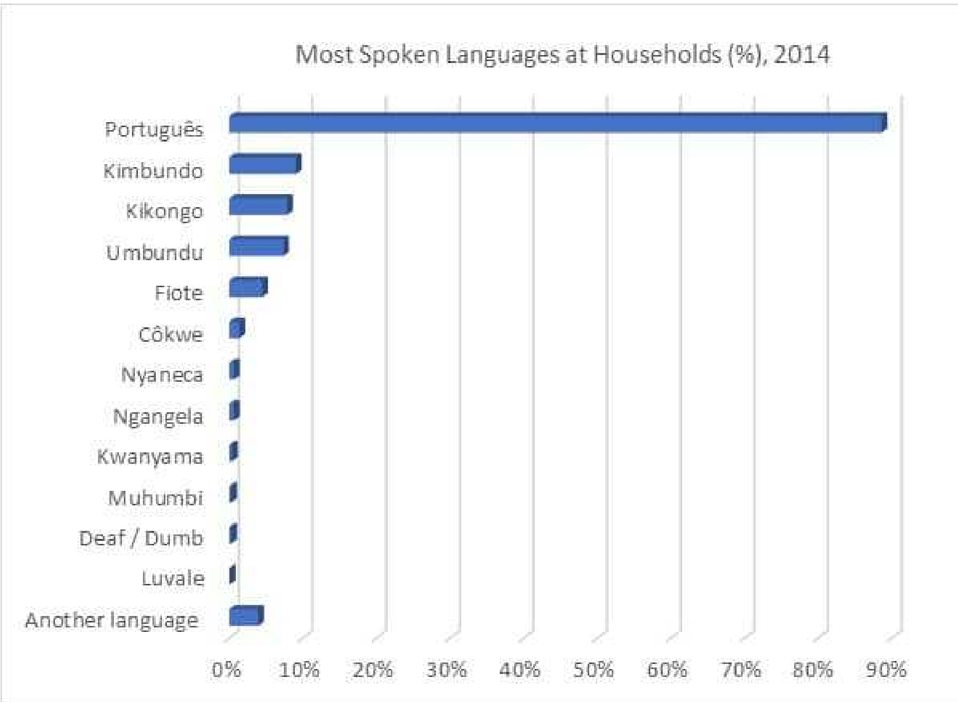


Figure 192: Most Spoken Languages at Households (%), Luanda Province, 2014 (INE, Censos 2014)

Angola is a conservative country when it comes to religious groupings. As such, there is a propensity for intolerance regarding other religious organisations and sects (e.g. extremist groups) that don't align with their own national identity. Angola's population is overwhelmingly Christian. About two-fifths of the population is Roman Catholic, about two-fifths is Protestant, and some one-tenth adheres to traditional beliefs or other religions. (https://www.britannica.com/place/Angola/People).

According to the 2014 census, Protestantism is the predominant religion in the Province of Luanda, practised by 39% of the resident population, followed by the Catholic faith with 31 %.

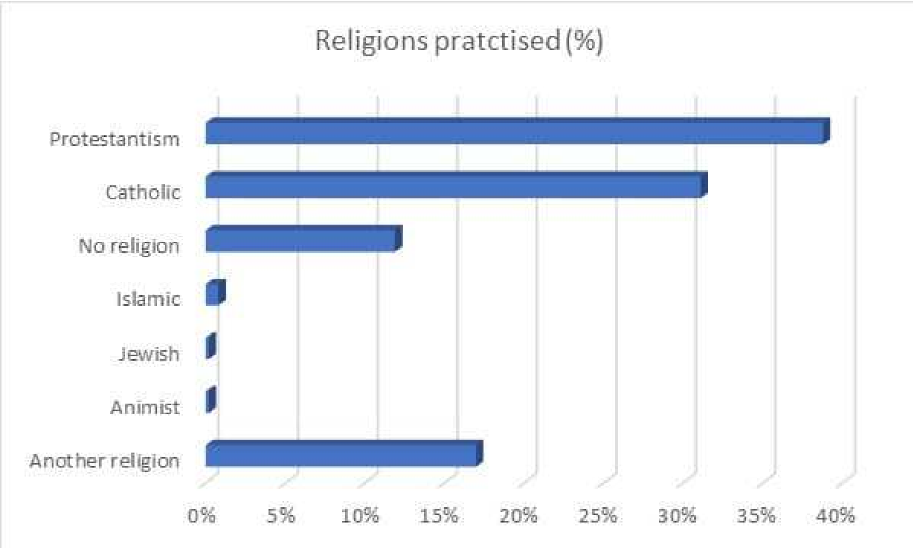


Figure 193: Religions practised (%), Luanda Province, 2014 (INE, Censos 2014)

7.3.2.5 Family structure

In the 2014 Census, 6,945,386 residents were registered in Luanda Province, of which 6,919,613 lived in family dwellings, 23,460 lived in collective housing (such as nurseries, nursing homes, orphanages, and religious units), and 2,313 people had no housing. Among people without homes, 28 % are children under 15.

Table 66: Resident population by housing type, according to age groups, 2014 (INE: Censos 2014 Luanda).

Province and typology of housing	0-4 years		5-14 years		15-64 years		65 or more years	
	N.º	%	N.º	%	N.º	%	N.º	%
Luanda	1,103,079	100.00	1,897,205	100.00	3,842,120	100.00	102,982	100.00
Family dwellings	1,102,601	99.96	1,896,100	99.94	3,818,199	99.38	102,713	99.74
Collective house	225	0.02	706	0.04	22,284	0.58	245	0.24
No housing	252	0.02	399	0.02	1,637	0.04	24	0.02

At the provincial level, 18 % of households comprise seven members, and 12 % of homes are made up of a single person, with the average number of people per household at the provincial level being 4.7 people. The Luanda household structure does not differ slightly from the typical Angolan family. For example, the average household size in Luanda is 4.7 (urban 4.7 and rural 3.9), and Angola's is 4.6 (urban 4.8 and rural 4.4).

Table 67: Households by area of residence, according to size and the average number of people, 2014 (INE: Censos 2014 Luanda).

Province Residence area	Household size (Average number of persons)							Average number of people per household
	One	Two	Three	Four	Five	Six	Seven or more	
Luanda	12.1	10.5	12.8	14.4	14.0	17.9	18.4	4.7
Urban	11.8	10.3	12.8	14.5	14.0	18.0	18.6	4.7
Rural	22.1	14.5	12.0	12.6	12.2	14.7	11.8	3.9

Regarding the number of members per household, there are no significant differences between the municipalities of Cazenga, Cacuaco, Viana, Luanda and Belas. However, the municipalities of Icolo, Bengo, and Quissama have, on average, less than four members per household (3.8 and 3.9, respectively).

Next, the systematized data collected in the survey in the five locations where the Fieldwork occurred are presented to complete the characterization of the family structure in the Project area.

The total number of people living per household ranges from 53 in Zango 5 to 128 in Kapalanga. In the 100 families interviewed, 471 people were divided into various age groups.

Table 68: Total people living in the household and repartition by age group, by locality (Field Survey, Question C4

Locality	Total people living in the household	People who habitually live in the home (total per household)					
		Adult men (+18 years)	Adult women (+18 years)	Own children (age 5-18 years)	Other children (5-18 years)	Own children (under 5 years old)	Average of household
Cacuaco	102	34	34	29	5	0	5.1
Kapalanga	128	46	48	21	8	5	6.4
Km 30	98	17	15	48	17	1	4.9
Zango 5	53	17	15	10	3	8	2.7
Bom Jesus	90	19	25	45	1	0	4.5

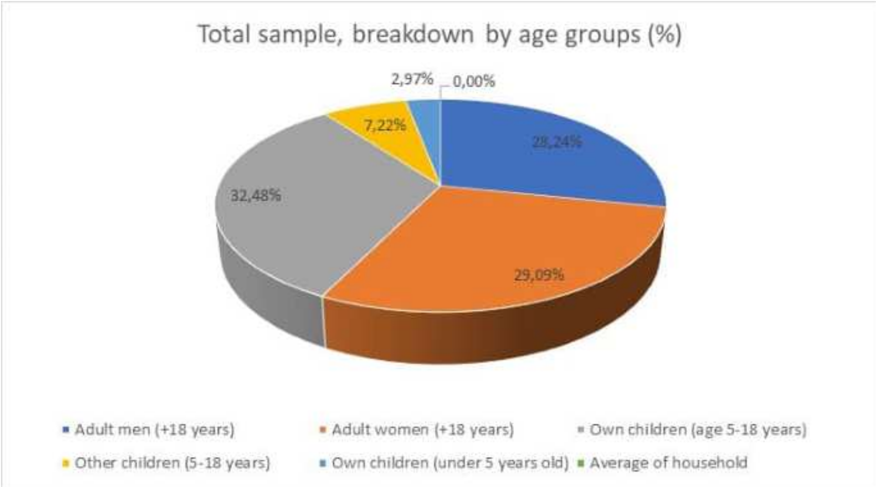


Figure 194: Number of people living in households, total sample breakdown by age groups (Field Survey, Question C4

The Domestic questionnaire determined the ownership regime of the houses of the interviewed households. The following table shows the results by location and gender of the head of the household.

The level of valid answers to this question was 100 per cent, which allows us to establish a standard of occupation regime by gender.

Table 69: Households by Housing Ownership and Gender of Head Household (Field Survey, Question C9).

Locality	Ownership Regime.					
	Home Ownership		Rented		Other	
	Male	Female	Male	Female	Male	Female
Cacuaco	17	2	1			
Kapalanga	9	9	1		1	
Km 30	14	5	1			
Zango 5	11	8	1			
Bom Jesus	18	1	1			
Total	69	25	5	0	1	0

Sixty-nine of the seventy-five households (92 %) headed by a man live in their own home, while only five live in rented housing. On the other hand, the twenty-five households headed by a woman live in their own homes.

7.3.2.6 Education level

The Angolan educational landscape still presents many deficiencies at the infrastructural and personnel levels. Education levels across the country and provinces mainly are Primary Schools, but the population without education remains high. Angola currently (2021) registers a literacy rate of a total adult of 72 % (% of people ages 15 and above).

The literacy rate in Luanda province is 86 %, with 87 % in the urban area and 63 % in the rural area. At the gender level, it is observed that 94 % of men can read and write, compared to 78 % of women (Census, 2014).

The analysis by municipalities indicates that at the level of the Province of Luanda, the lowest rate is found in the Municipality of Icolo e Bengo, where only 6 out of 10 people can read and write (60 %).

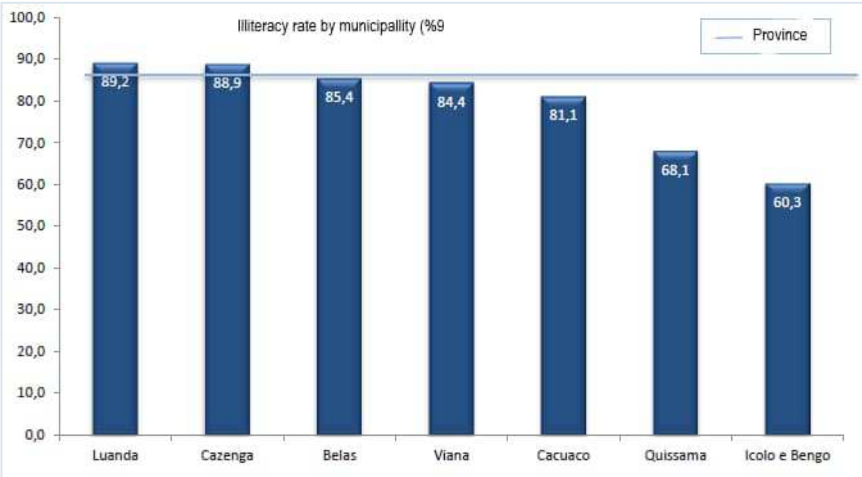


Figure 195: Illiteracy rate by Municipality (%), Luanda Province, 2014 (INE: Censos 2014 Luanda)

As discussed in Section 7.3.2.3, Angola's population growth is inconsistent with its social infrastructure and service provision, particularly schools. Unfortunately, the civil war destroyed many of Luanda's school network, meaning that in 2019, the Province had 3.565 (INE, (Educação 2019). Edição de 2022).

In 2019, about 1.7 million students were enrolled in non-higher education in Luanda Province. The gross ratio of students per school in non-tertiary education is approximately 485 students per school. In 2022, the GoA spent 6.6 % of its state budget on education.

In 2014, only 23 % of the population aged 18 and over had completed the second cycle of secondary education (had completed the 12th or 13th grade). On the other hand, 24 % of the population aged 18 and over had completed primary education (had completed Grade 6). According to the results of the 2014 Census, 13 % of the population aged 5-18 years was outside the education system.

Table 70: Population aged 18 years or older, according to the level of education completed (%), 2014 (INE: Census, 2014)

Province	No level	Primary education	I Cicle of secondary education	I Cicle of secondary education	Higher education
Angola	47.9	19.9	17.1	13.2	2.0
Luanda	16.5	24.0	23.9	22.8	4.2

In Luanda Province, in 2014, the proportion of the population aged 24 or over with completed higher education represented 5 %. Men hold the lead with 6 per cent, versus 5 per cent for women.

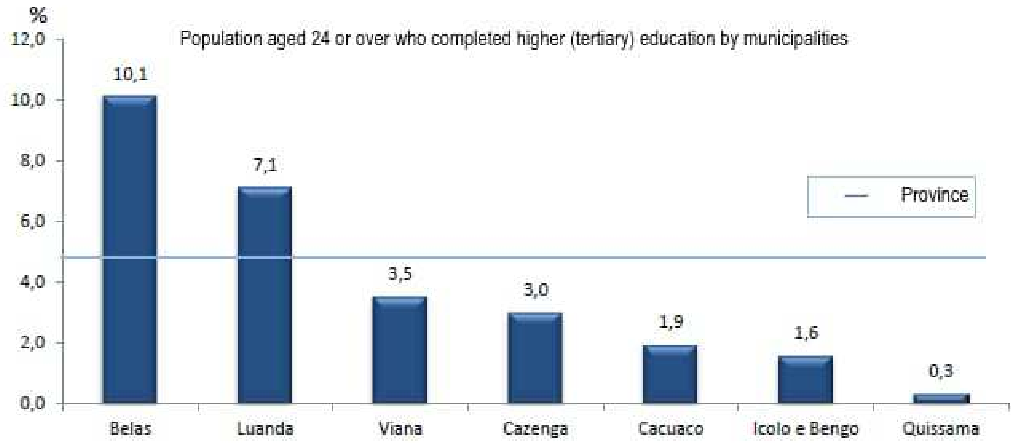


Figure 196: Population aged 24 or over who completed higher (tertiary) education by municipalities (%), Luanda Province, 2014 (INE: Censos 2014 Luanda)

Next, the systematized data collected in the survey in the five locations where the Fieldwork occurred are presented to characterize the family level of complete education in the Project area (Table 71).

Table 71: People living in the household and highest level of a complete education, by locality (INE: Censos 2014 Luanda)

Locality	Highest level of complete education (%)									
	Self-contained (1-4)		First cycle (grade 5-8)		Second cycle (grade 9-10) and Preparatory (grade 11-12)		College University		Technical/Professional	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Cacuaco	3		2		10		2	2	1	
Kapalanga	1	1	2	1	4	4	2	4		
Km 30	2		5	3	7	1				
Zango 5			4	4	5		3	2		1
Bom Jesus	1		2	1	12		3		1	
Total	**7**	**1**	**15**	**9**	**38**	**5**	**10**	**8**	**2**	**1**

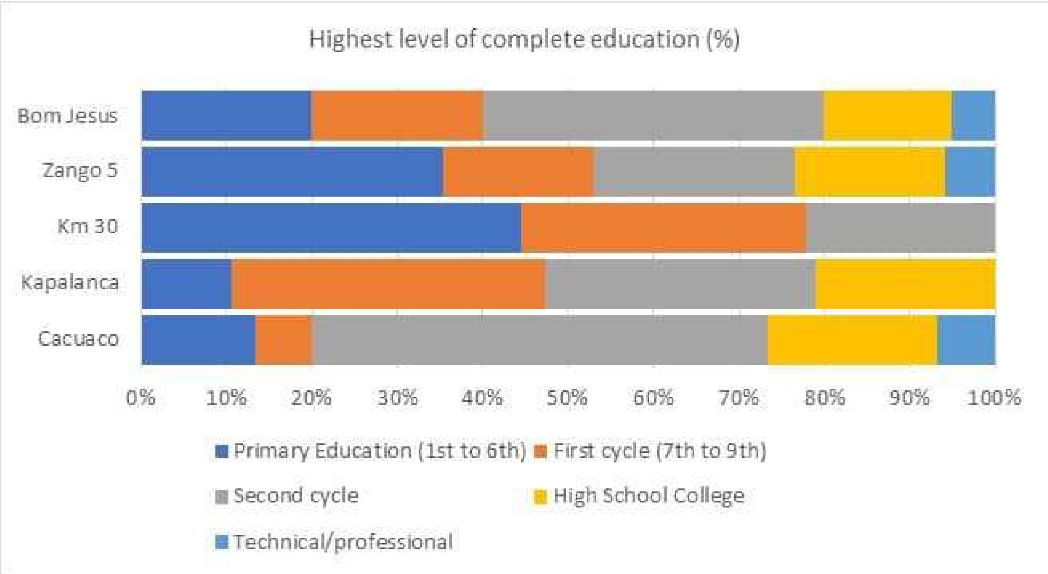


Figure 197: Households people by the highest level of complete education (%) by localities (Field Survey

Capalanca
Private School - Primary Education and I Secondary Cycle

Bom Jesus
Primary Education School

Cacuaco
School Equipment

Km 30
School Equipment

Figure 198: Examples of School Infrastructures in the Project Area of Influence (PAI).

7.3.3 Women’s Empowerment and Gender Equality

As described by the United Nations Development Program (UNDP) in Angola (https://www.undp.org/pt/angola/gender), women's rights and participation and the gender perspective remain a challenge due to patriarchal customs and practices. Gender-based violence is widespread, reported by 8 % of women between 15 and 49 years old and 35 % of married women, who report having suffered some type of sexual violence. Women represented, in 2021, 29.5 % of seats in parliament, with an increase to 33,6 % in 2023. Gender barriers remain inherent in the context of HIV, such as inequality in the age of consent to marriage and gaps in sexual and reproductive health rights.

The Angolan Government approved several legal instruments that aim to promote Gender Equality and Equity. This includes the following diploma:

- Law 25/11 of July 14, 2011 - legal framework for preventing domestic violence
- Presidential Decree No. 124/13 of August 28, 2013 - Regulation of the Law Against Domestic Violence
- Presidential Decree No. 222/13 - National Policy for Gender Equality and Equity
- Law 38/20 of November 11, 2020 – Penal Code

The country has governing structures that cover Women’s Empowerment and Gender Equality, especially the Ministry of Social Action, Family and Promotion of Women (MASFAMU), which includes the National Directorate of Women's Rights, Equality and Gender Equity, which is specifically focused on promoting policies associated with these topics.

The government has developed several activities focused on promoting gender equality and equity, including the development of a Gender Observatory, with support from UNDP, and the creation of a Digital Information Platform on Gender-Based Domestic Violence (GBV), in www.violenciadomestica.ao, with a dedicated contact line and a reporting form.

Regarding information on Women’s Empowerment and Gender Equality, there are two main resources available, namely from the United Nations, through the UN Development Programme (UNDP), and from the European Union, through the EU-Angola Dialogue Facility, which are partner entities for Angola in promoting sustainable development programs.

The UNDP and UN Women published, in July 2023, the document “PATHS TO EQUAL - Twin indices on women’s empowerment and gender equality”, which includes the most recent global statistical data, including for Angola. This data was compared against the average values for the Human Development main groups (VHHD – Very High Human Development, HHD – High Human Development, MHU – Medium Human Development and LHD – Low Human development), as well as the average values for the Sub-Saharan Africa, the Least Developed Countries and the global World values, as presented in the following tables.

Table 72: Twin indices on women’s empowerment and gender equality – Life and Good Health Indices

			SDG 3.7		
			Life and good health		
	Women’s Empowerment Index (WEI)	Global Gender Parity Index (GGPI)	Women of reproductive age whose need for family planning is satisfied with modern methods	Adolescent birth rate	Fraction of life expectancy at birth spent in good health
	Value	Value	(% ages 15–49)	(births per 1,000 women ages 15–19)	(%)

Data Period	2022	2022	2022	2022	2019	
					Female	Male
Angola	n.a.	n.a.	35.4	135.8	85.8	88.2
			LHD	LHD	-	-
Human development groups						
Very high human development	0.734	0.793	77.7	13.5	85.4	87.9
High human development	0.641	0.733	85.7	27.6	86.5	89.3
Medium human development	0.533	0.629	73.2	37.4	84.5	87.4
Low human development	0.432	0.603	50.3	88.0	85.6	88.2
Sustainable Development Goal regions						
Sub-Saharan Africa	0.498	0.697	53.5	99.4	85.8	88.3
Least developed countries	0.459	0.649	56.9	92.4	85.7	88.2
World	0.607	0.721	74.8	41.9	85.1	87.6

Table 73: Twin indices on women's empowerment and gender equality – Education and Labour Indices

			SDG 8.6				SDG 8.10	
	Education, skill-building and knowledge				Labour and financial inclusion			
	Population with completed secondary education or higher		Youth not in education, employment or training		Labour force participation rate among prime-working-age individuals who are living in a household comprising a couple and at least one child under age 6		Account ownership at a financial institution or with a mobile-money-service provider, female	
	(% ages 25 and older)		(% ages 15–24)		(% ages 25–54)		(% of population ages 15 and older)	
Data Period	2022		2012–2022		2012–2022		2021	
	Female	Male	Female	Male	Female	Male	Female	Male
Angola	12.3	22.7	22?6	20.8	88.2	97.2	22.3*	36.1*
	LHD	LHD	HHD	MHD	VHHD	-	LHD	LHD
Human development groups								
Very high human development	75.8	76.9	14.0	11.4	65.5	94.3	92.5	93.2
High human development	40.4	43.4	24.7	15.0	62.2	96.7	72.7	76.9
Medium human development	27.2	37.7	39.6	14.5	34.5	96.4	65.8	70.3
Low human development	14.5	22.9	42.5	21.6	57.9	94.9	26.4	38;7
Sustainable Development Goal regions								
Sub-Saharan Africa	20.2	31.5	33.9	22.5	70.9	93.0	40.8	51.7
Least developed countries	15.0	22.9	37.7	19.6	57.6	93.8	33.2	43.7
World	43.5	48.1	31.7	15.6	54.2	95.9	69.8	74.2

*Data from 2014

Table 74: Twin indices on women's empowerment and gender equality – Decision-Making and Violence Indices

	SDG 5.5			SDG 5.2
	Participation in decision-making			**Freedom from violence**
	Share of seats held by women - In parliament	Share of seats held by women - In Local Government	Share of managerial positions held by Women	Ever-partnered women and girls subjected to physical and/or sexual violence by a current or former intimate partner in the previous 12 months
	(%)	(%)	(%)	(% ages 15–49)
Data Period	2023	2015–2022	2012–2022	2018
Angola	33.6	n.a.	15.4	25.0
	VHHD	n.a.	**LHD**	**LHD**
Human development groups				
Very high human development	29.4	34.2	36.8	6.6
High human development	26.0	30.3	32.9	9.2
Medium human development	22.4	41.6	22.5	17.2
Low human development	25.2	n.a.	24.3	20.2
Sustainable Development Goal regions				
Sub-Saharan Africa	26.5	n.a.	38.0	20.6
Least developed countries	25.3	n.a.	29.8	22.2
World	26.3	35.5	31.2	12.9

This report from UNDP presents the most updated information available. It confirms the tendency mentioned in the UNDP Angola portal, with several indices below the average of the “Low human development” group of countries.

Regarding Life and Good Health, Angola has a very high Adolescent birth rate, clearly above the average of the sub-Saharan Africa and the “Low human development” group. It also presents low access, by women, to Family Planning Methods,

As for education, it registers low values of secondary or higher education, with a clear distinction between men (22,7 %) and Women (12,3 %). This is in line with the values from the “Low human development” group of countries. As for youth inactivity (not in education, employment or training), it has low inactivity, near the average of high human development countries, and without large differences between men and women.

Regarding the Labour Force Participation Rate, Angola has a high level of active workers, even above the Sub-Saharan average results. There are some differences in gender, with women having a 88,2 % activity rate against 97,2 % in men.

However, the indices considered for financial inclusion show low results in account ownership, with relevant differences between Women and Men. These results are aligned with the averages of the “Low Human Development” group of countries.

As for participation in decision-making, there are clear differences between governmental and private institutions, with a high women participation rate in the parliament, above the averages of the Very high human development countries, but with low participation in managerial positions, with only 15,4 %.

The indices for sexual violence also place Angola in a Low human development class, with 25 % violence rate registered, above the values of Sub-Saharan Africa and the Least Developed Countries.

As mentioned above, the EU-Angola Dialogue Facility also published a recent report on Gender Equality, namely the “Angola Gender Equality Diagnosis 2022”, from March 2022.

This report updates the first Diagnosis Report Published in 2014, and compiles information from several sources.

From the different indices included in this document, it was considered the presentation of some complementary information not addressed in the UNDP report, namely associated with Informal Employment but mainly with the role of women in decision making.

The following figures then present some indices obtained from the Angola Gender Equality Diagnosis 2022, from the EU-Angola Dialogue Facility.

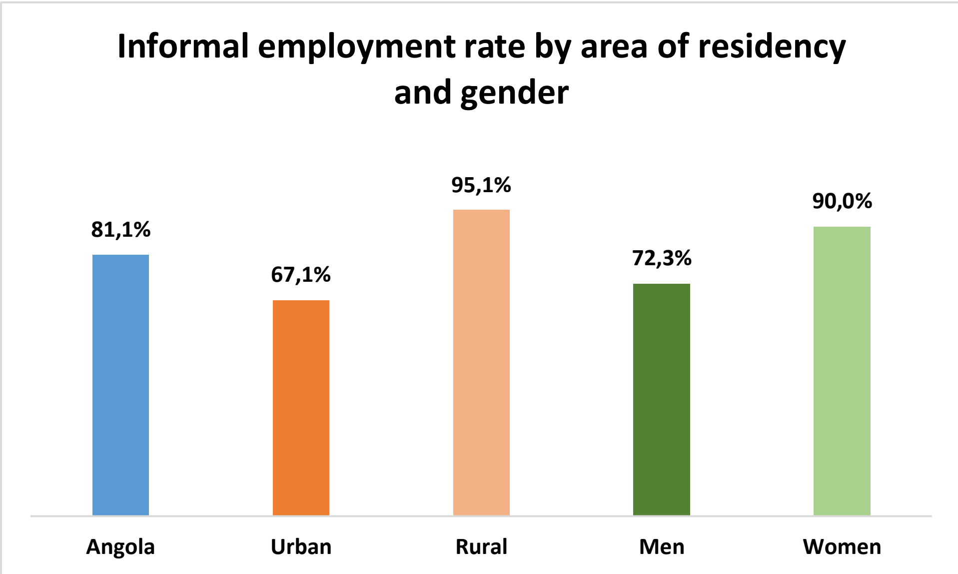


Figure 199: Informal Employment rate

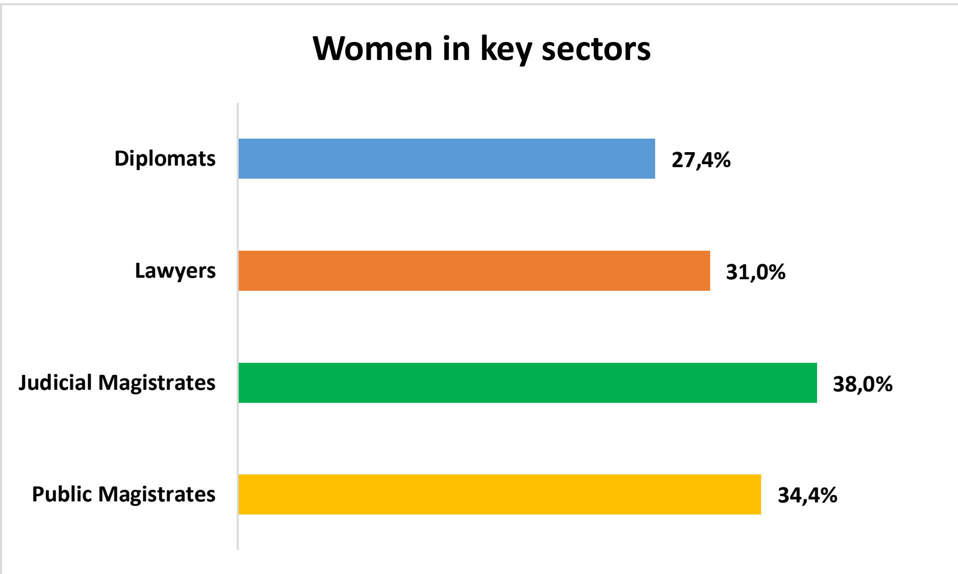


Figure 200: Participation of Women in Key sectors of the society

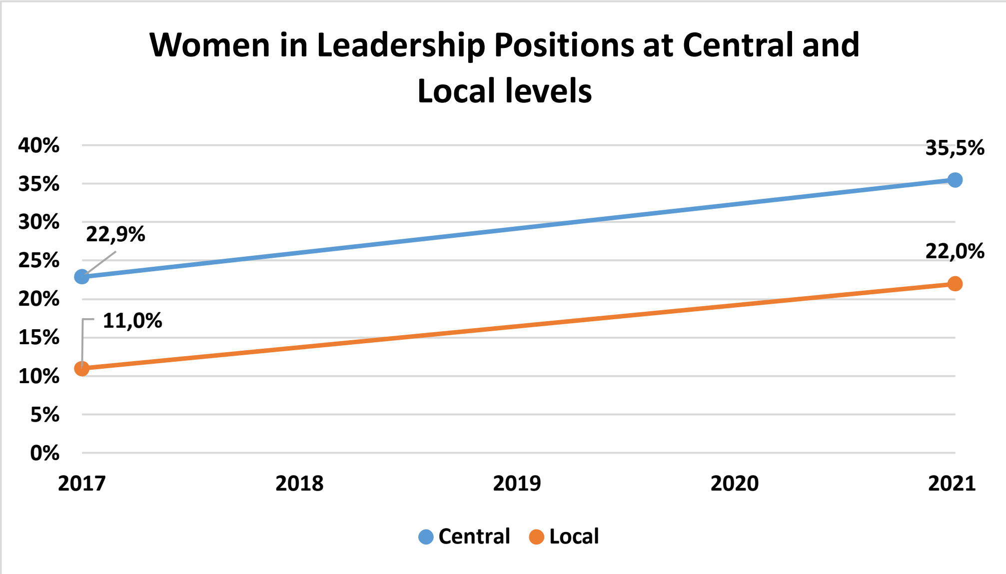


Figure 201: Evolution of Women participation in Leadership Positions at Central and Local levels.

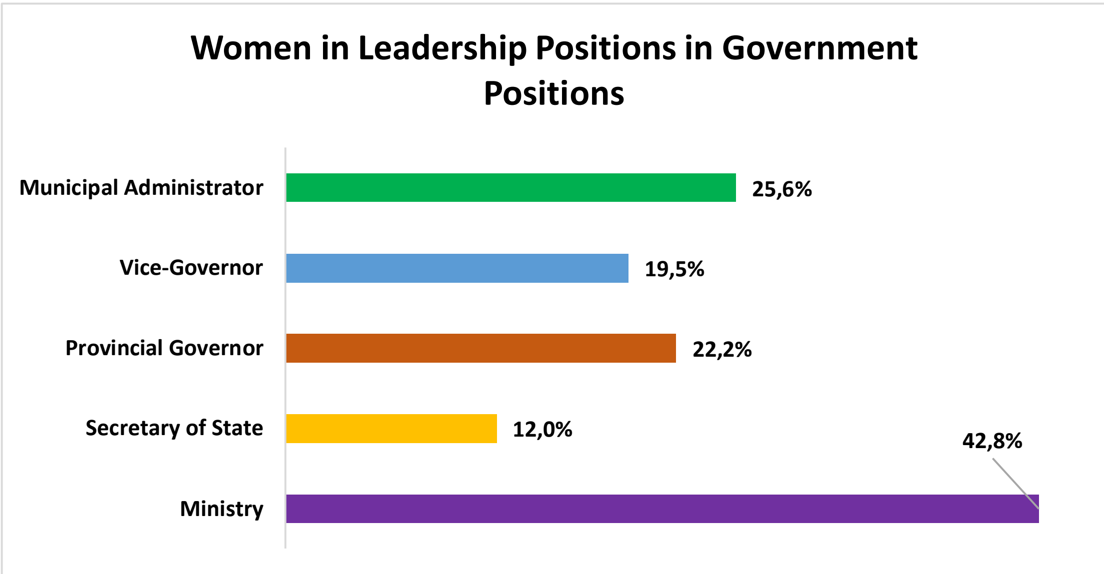


Figure 202: Women Participation in Government positions

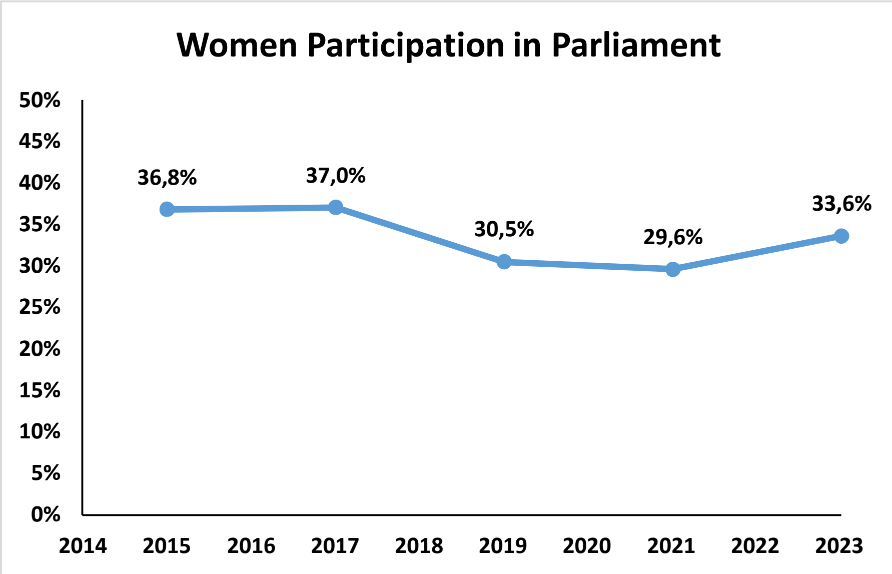


Figure 203: Evolution of Women Participation in Parliament

As summarized in the conclusions of this report (Angola Gender Equality Diagnosis 2022), Angola has adopted various agreements and conventions, as well as published national legislation, which has allowed for increasing equivalence, in legal terms, between men and women. However, there are still various levels of discrimination in terms of opportunities, and, in cultural terms, customary law persists, which is often discriminatory to the detriment of the woman.

The economic crisis has exacerbated gender inequalities at an economic and social level, with repercussion in the school professional and family context.

Although it is possible to see more significant equity between the number of boys and girls who attend the first years of schooling, as their progress in the academic career, the disparities between the two genders increase, with lower participation of women in the secondary school of higher education.

This report also stresses that, due to cultural reasons, women have low participation in areas recognized as jobs of “male dominance”, such as sciences, technologies, engineering, and mathematics, with low presence of women in professions linked to industry and engineering.

Women mostly work in the areas of education, health, or informal professions, such as selling products and domestic work, with the Angolan labor market quite marked by this professional division based on gender. The report also identifies a lack of professional progression, with lower presence of women in positions of higher responsibility.

Women also have low participation in other areas of social life, such as decision-making positions regarding conflicts and natural disasters or militarized and peacekeeping forces.

It is also clear that gender-based violence continues to be an issue critical for Angolan women. The report also highlights several restrictions on access to sexual and reproductive health services.

Regarding specifically the WASH Sector, there is another report with some available data related to Gender Equality, namely the “Diagnosing Angola’s WASH Sector - An Urgent Call to Action - DIAGNOSTIC REPORT”, from GWSP / World Bank Group (Lombana Cordoba 2021).

When analyzing the status of the WASH services in Angola, it takes into account some assessment of gender differences, including water collection responsibilities by Gender in houses lacking connection to piped water, as presented in the following figure.

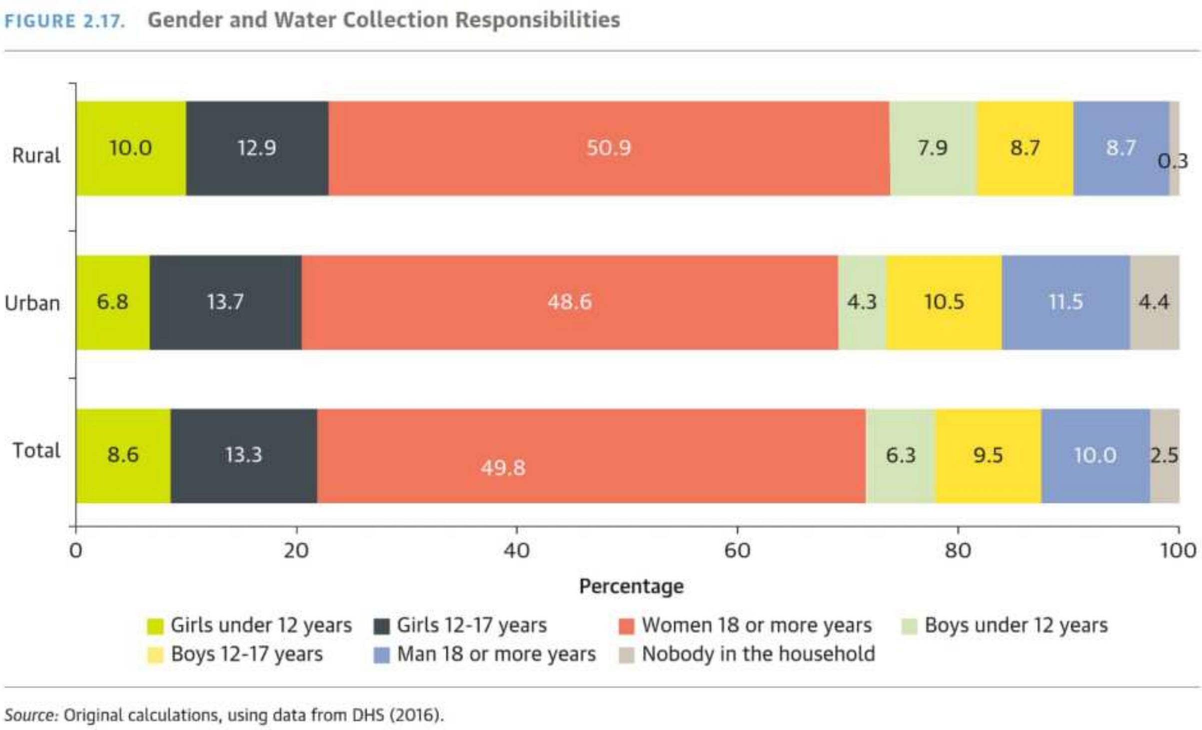


Figure 204: Gender and Water Collection Responsabilities

As can be seen from the above graph, there are clear inequalities in gender responsibilities regarding water collection, with women and girls being responsible for this task in 73,8 % of the households in Rural Areas and 69,1 % in the urban areas. However, this scenario is only applicable in households that lack connection to piped water and should be considered relevant only when there is no source of water in the premises of the households.

As shown in the following figure, in Angola, in the urban areas, 51,4 % of the households have water available on the premises, with 26,4% with water at a distance of less than 30-minute walks.

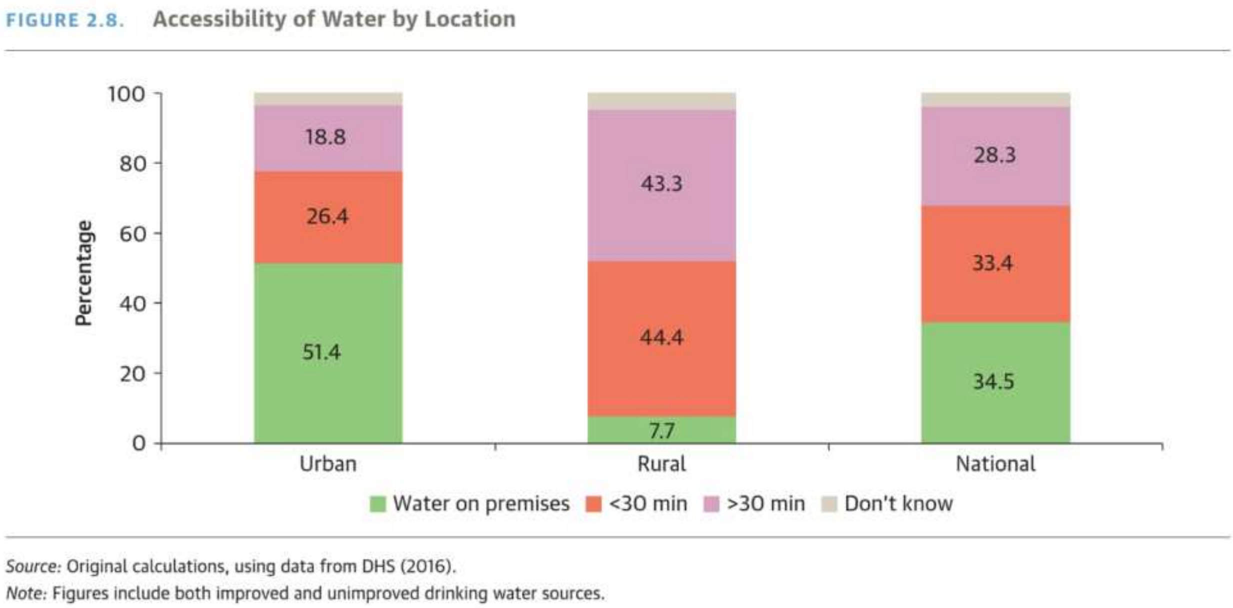


Figure 205: Accessibility to Water in Angola

Despite the data from the graph above, Luanda has an even higher percentage of water availability on premises, with 75 % to 82 % of households with access to at least basic water on the premises, as shown in the following figure.

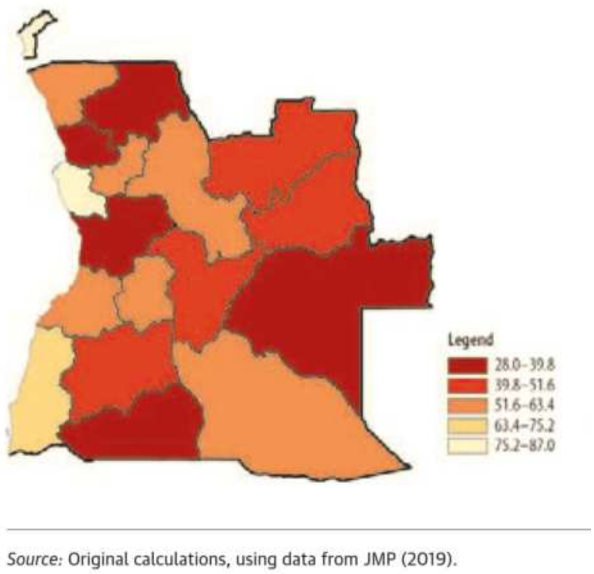


Figure 206: Accessibility to Water (ate least basic water) by province

As described in the chapter related to Infrastructure and Services, in the AoI of the project, namely in the Cacuaco, Viana and Ícolo e Bengo Municipalities, there are relevant differences regarding water availability.

In fact, in the urban municipalities (Cacuaco and Viana), the majority of households is supplied by Tanker Truck, which delivers the water on premise of the households, followed, in Viana, by direct connections to the public network.

Base on the information provided by the 2014 Census, 82,6 % (in Viana), 61 % (in Cacuaco) and 30,7 % (in Ícolo e Bengo) of the househols have water available on premises. These households, supplied by tanker trucks and faucets connected to the public network, are then less susceptible to the gender inequalities originating in water collection responsibilities.

However, public fountains still represent an important water supply in these municipalities, especially in the mode rural areas, with 32.9 % of the households in Cacuaco, 19,9 % in Ícolo e Bengo and 9,3 % in Viana using public fountains for supply.

Usually these fountains are distributed between the communities, close to the surrounding households, being then assumed that they represent a water supply close (under 30 minutes travel time) to the households.

Regarding local data, there are no reports available with information desegregated at local levels (Municipal, District/Commune of communities). Also, the inputs obtained during the field surveys and stakeholder engagement activities do not provide significant inputs on gender equality data for the project's surrounding communities. However, the AoI of the project is mostly urban, and the communities should have similar social characteristics as the rest of the Luanda city, so it is expected that the project area has results similar to those presented, at a national level, for urban areas.

The only available indicator that can be assessed for the AoI of the project relates to decision-making, namely regarding leadership positions in government.

The Luanda Provincial Government is led by a male Governor, Manuel Gomes Homem. All Vice-Governors are also male (Manuel Gonçalves, Jorge Augusto, Cristino Ndeitunga). Regarding the heads of different cabinets and structures of the Provincial Government, there are 12 men and 7 Women (37 %).

As for Municipal Administration, namely the 3 municipalities where the project is located, we have 2 male administrators (Auzílio de Oliveira Martins Jacob – Cacuaco and Demétrio António Brás de Sepúlveda – Viana) and 1 Female (Isabel Kudiqueba – Ícolo e Bengo) (33 %).

When assessing the 9 Communes and Urban Districts where the project is located, namely Bom Jesus, Bela Vista, Mulenvos de Baixo, Sequele, Cacuaco, Viana, Baía, Kikuxi and Zango, we have 8 male administrators and 1 female (11 %).

7.3.4 Distribution of settlements and housing conditions

Angola has a very high rate of urbanization compared to other countries in sub-Saharan Africa at 63 per cent – and of the total population of 25.8 million, as many as 6.9 million or 27 per cent live in the capital, Luanda alone (INE 2016). Luanda's official consumption-based poverty rate stands at 11.5 per cent, considerably lower than the national urban average of 19 per cent (INE 2013, Tvedten, Lázaro et al. 2017).

Urban and rural poverty are recovering from the deep economic crisis in Angola following a sharp fall in the price of oil, which has had immediate effects on access to and prices of essential commodities, including housing and construction materials.

This has also affected relations between urban and rural areas. From a long period of near unilateral migration from rural areas to Luanda in particular, due to war and better opportunities, there are indications that this is in the process of changing with the current economic crisis in many ways hitting urban areas harder than rural and agricultural ones (INE 2016).

The combination of unregistered construction and demolitions affecting hundreds of thousands of people in the poor bairros or musseques– where an estimated 80 per cent of Luanda's inhabitants reside (World Bank 2011) – continued at an unabated pace. With most of them still lacking even the most basic infrastructure (formal land rights, water, sewage, Electricity, proper roads etc.) and with grossly inadequate social services (police/security, education, health, social protection etc.), construction is based mainly on peoples' material within the structural constraints and massive poverty of the musseques.

The dual city is also reflected in Luanda's socioeconomic characteristics. The distinctions are visible when visiting the city's formal and informal parts: The former have high-rise buildings and villas, (apparently) well-functioning infrastructures and commercial areas, parks and other symbols of the modern city.

The informal city, on its part, is overcrowded, with poor sandy roads, narrow alleyways, and markets/small commercial outlets, and they are littered with garbage. Statistically, problems related to unemployment, dwellings, water, school attendance, etc., are also primarily associated with the informal settlement areas.

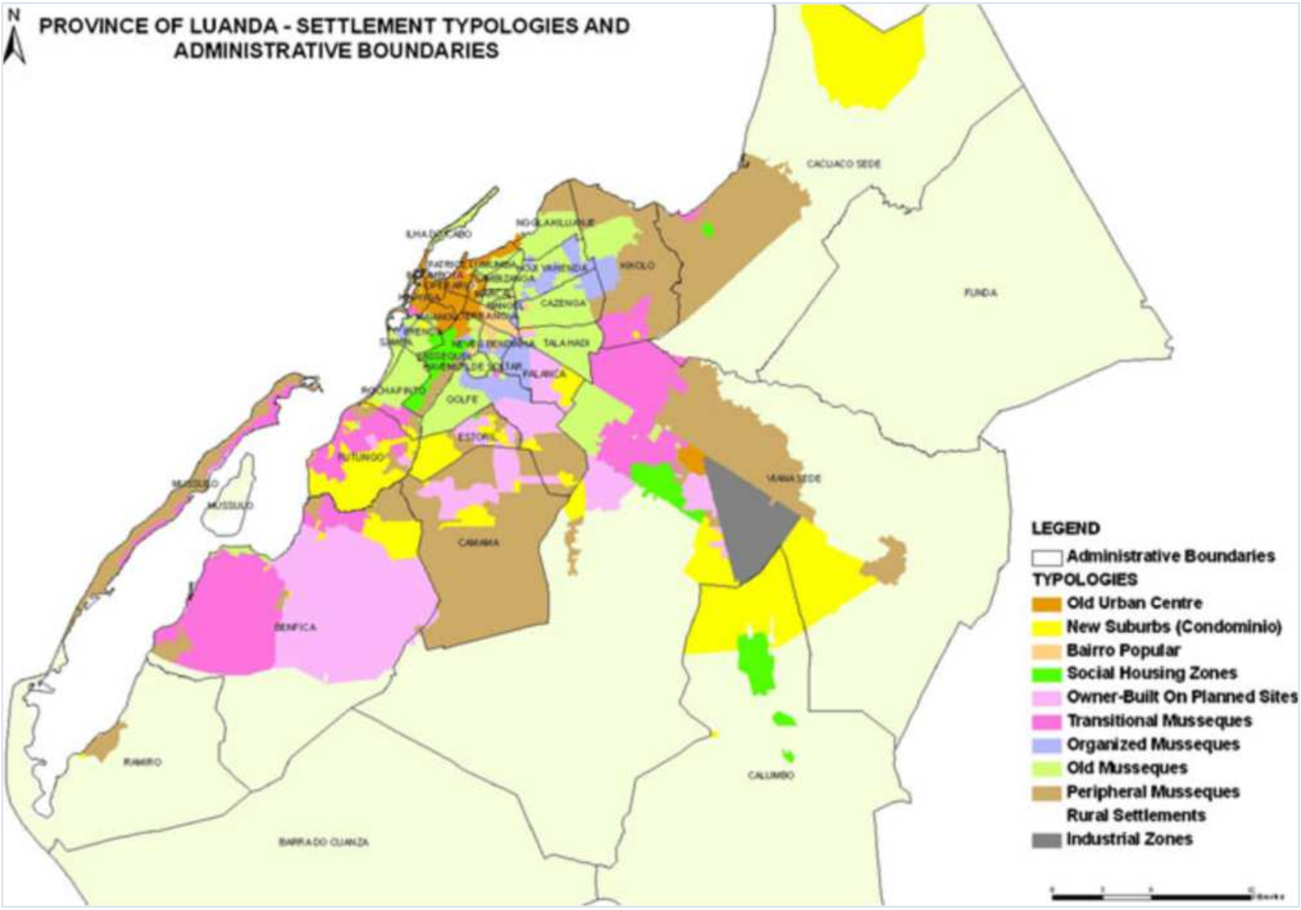


Figure 207: Map of Luanda showing the distribution of settlement typologies (Development Workshop 2011)

The masterplan for Luanda (PDGML) – Plano Director Geral Metropolitano de Luanda (AMADO, coord., 2015: 216, 226) –presents a classification based on the possibility for renewal of the musseques, which are divided into three types:

- structured (with about 1.5 million inhabitants, 21 % of the total population of Luanda);
- unstructured (with about 3.2 million or 46 % of the total); and
- scattered (about 5 %).

The PDGML defines a complex refurbishing, but primarily based on the demolition of the existing buildings and the rehousing of a large percentage of the population of Luanda (5.9 million inhabitants or 86 % of the total). The assumptions of the PDGML comply with the objectives of the national program on housing – Programa Nacional de Urbanismo e Habitação -, launched in 2008, and other legal and urban planning tools of the new millennium, which include demolishing the self-built peri-urban settlements, considered illegal, and their replacement with new public housing (BRAZ, Osvaldo; RAPOSO, Isabel, 2021).

This Project was suspended because of the severe economic crisis and the influence of the new urban agenda – Nova Agenda Urbana -launched in 2016, within the scope of Habitat III by UN-Habitat.

According to the results defined in the General Census of Population and Housing of Angola 2014, 87.2 % of the occupation regime is self-construction, 57.0 % of households are in urban areas with access to drinking water sources, 81.8 % have access to adequate sanitary facilities, 50.9 % have access to Electricity. Only 37.5 % have an appropriate solid waste management system (UN-HABITAT, 2017, p13).

Globally, eight out of ten households in Luanda Province live in homes. This proportion reaches 87 % in urban areas and drops to 73 % in rural areas, where the more characteristically rural construction, the cubatas or cabanas, comes to 24 %. The proportion of households living in apartments and annexes is negligible, practically not reaching, on the whole, 10 %.

Self-construction and illegal occupations revealed an expansion in the period 2004-2009. The proportion of houses ceded by the state also reaches its value higher in this period (26 %) than in other periods age. In 2009, self-construction and illegal occupation revealed little difference; the lease reached 3 %, and the purchase did not exceed 2 %.

Except for cubatas or cabanas, where the quality is considered not universally appropriate, the houses occupy the second position of the dwellings built with inappropriate materials (89 %). Self-built homes have the highest percentage of unsuitable construction (96 %). The best quality of construction (30 %) is found in the houses purchased or in the process of being purchased. The high costs of building materials, the population's low purchasing power, and the limited access to housing credit may be the basis of this situation.

The national average per division is 1.7 people/division, with no significant variation between urban and rural areas. The Luanda Province's average per house is 2.9 division/house, with considerable variation between urban and rural areas, respectively 2.9 and 2.1 (INE, Census 2014).

Concerning the number of people per bedroom, this average rises to 3 people/division, and 42.5 % of households live in a situation of overcrowding, revealing a housing deficit in the country. Luanda has between 40-50 % of overcrowded housing.

Table 75: Households by area of residence, municipalities, and communes, according to the average of divisions, average of people per room, average of rooms to sleep, and the average of people per room only to sleep in the dwelling (Census 2014 – Luanda) (INE: Censos 2014 Luanda)

Province (rural/urban) Municipality Commune	Number of households	Divisions by dwelling		Sleep-only rooms	
		Average divisions by dwelling	Average number of people by dwelling	Average number of sleep-only rooms per dwelling	Average number of people in sleep-only rooms
Luanda	**1 484 350**	**2.9**	**1.6**	**1.7**	**2.7**
Urban	1 437 302	2.9	1.6	1.8	2.7
Rural	47 048	2.1	1.8	1.2	3.2
Cacuaco	**222 989**	**2.6**	**1.9**	**1.6**	**3.0**
Cacuaco	53.034	2.7	1.8	1.7	2.8
Funda	46 102	2.2	2.0	1.3	3.4
Kikolo	123 853	2.6	1.9	1.6	3.0
Icolo e Bengo	**21 061**	**2.2**	**1.7**	**1.3**	**3.0**
Catete	6 244	2.3	1.4	1.4	2.6
Bom Jesus	5 088	2.2	1.8	1.3	3.3
Cabiri	4 509	2.0	1.9	1.2	3.2
Calomboloca	4 369	2.0	1.7	1.1	3.1
Caculo Cahongo	851	2.0	1.7	1.3	2.7
Viana	**331 860**	**2.9**	**1.7**	**1.8**	**2.7**
Viana	280 520	2.9	1.7	1.8	2.8
Zango	46 036	3.1	1.4	2.1	2.1
Calumbo	5 303	2.3	1.9	1.4	3.0

Around 43 % of households nationally live in their homes between one and five years. Only 7 % of households have lived in their homes for over 20 years, most of which are in urban areas (8 %). In the last year, all provinces recorded percentages of more than 10 % of households residing there less than a year.

The housing regime is, in 61 % of cases, that of homeownership, revealing a strong construction initiative on the part of the population. Apartments are the type of housing that presents the highest percentages of rental (31 %) and acquisition (34 %), evidencing a flourishing real estate market in urban areas, higher than that of houses (Plano Diretor Municipal de Viana. Volume II. Caracterização do Território. Maio 2014).

Population growth, house prices, rent, inflation, income, the availability of housing credit, and construction costs influence the formation of the housing framework. The financial possibilities of Each individual or family are a determining factor in the choices of housing adopted by each. Thus, the higher the purchasing power of a given household, the more comprehensive the range of options for strategies Housing.

As the schooling of the Head of the household, illegal schemes translated into simple occupation are replaced by the legalization of occupation. Rural areas have the highest situations of unlawful occupation and the highest number of self-construction (85 %). Acquisitions are only 14 % in cities and 2 % in Countryside. The lowest %

of self-construction corresponds to the population that migrated after the Peace Accords in 2002, the latter group of migrants being the lease reaches its highest values.[3]

In the area of the Project, there is an enormous diversity of typologies, although the predominance of dwellings in the masonry of cement blocks, sheet metal cover, and, usually, on a single floor. Most are not plastered or painted and are mainly found in peri-urban areas.

It is also possible to find permanent family houses in Viana, especially in the center of Viana. There are also situations of collective housing, Although in a tiny percentage, in recent spaces, where the cercia dominant are the six floors and often correspond to private condominiums. Finally, there are gated communities of single-family and multi-family housing, where the Dominant cercea varies between 1 and 2 floors. These condominiums exist in more significant numbers than the previous ones.

In the Municipality of Viana, the main problems at this level are the illegal occupation of land and informal construction, occupying a significant part of the municipal territory, in the image that happens in other localities of Luanda. About 80% of Luanda's population is estimated to live in Musseques or informal settlements. The situation of the occupations of illegal genesis is thus quite complex and broad since it affects much of the municipal territory, except for standardized urban areas and Consolidated.

According to the Project, the elements of the water abstraction (WTP), water treatment (STP) and distribution center (DC) will be built on land unimpeded by buildings, in particular dwelling houses. This component will be detailed and evaluated in the chapter on environmental and social impacts.

In the neighborhood is covered by the fieldwork, the dwellings are built mainly with cement blocks and covered with zinc sheets. Some houses have a surrounding space with annexes, namely water tanks and sanitary facilities.

Some localities in the Project areas still have houses built before the Independence of Angola, contrasting with precarity houses and new and modern buildings, as illustrated in photographs obtained during the Fieldwork.

Figure 208: Lot 1. WTP area / Lot 10 STP. Icolo e Bengo – Bom Jesus (Obtained, Field Survey).

[3] Adapted from: Plano Diretor Municipal de Viana. Volume II. Caracterização do Território. Maio 2014.

Figure 209: Lot 1. WTP area / Lot 10 STP. Icolo e Bengo – Bom Jesus (Obtained, Field Survey).

Figure 210: Lot 3 DC area. Cacuaco – Cacuaco (Obtained, Field Survey).

Figure 211: Lot 4 DC area. Viana – Zango 5 (Obtained, Field Survey).

Figure 212: Lot 6 DC area. Viana – km 30 (Obtained, Field Survey).

Figure 213: Lot 7 DC area. Viana – Kapalanga (Obtained, Field Survey).

7.3.4.1 Characteristics of heads of households

A household is a person or a group of people, with or without kinship relations, who usually live under the same roof and share food expenses and other vital needs.

The Head of the household is the person responsible for the home or the person who, for the purposes of the census, is indicated as such by the other members.

The heads of households at the Luanda Province level were primarily men (67 %), as illustrated in Figure 214and aged 25-34 (32 %), as presented in Figure 215 (INE: Censos 2014 Luanda).

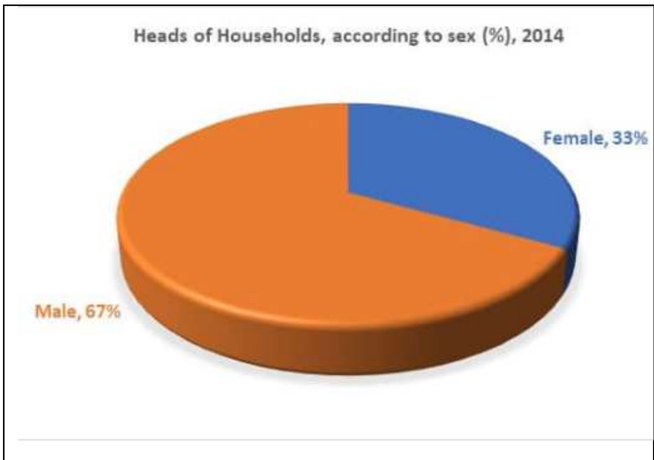


Figure 214: Heads of Households, according to sex (%), Luanda Province, 2014

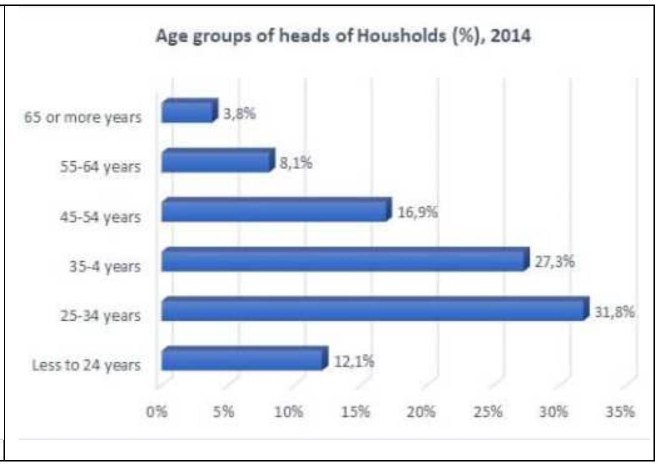


Figure 215: Age groups of Heads of Households (%), Luanda Province, 2014

In the Province of Luanda, it is estimated that in the population aged 12 or over, about 1.5 million people have the status of Head of Family. The following Table presents the situation of the heads of families concerning marital status by commune (INE, Census 2014 Província de Luanda).

At the commune level, married heads of households account for about 50% of the total population aged 12 or over, followed by single marital status, which accounts for nearly a quarter of the total, and widower status.

Table 76: Population aged 12 years or older and heads of household concerning marital status by area of residence (INE: Censos 2014 Luanda)

Province Commune	People aged 12 and over	Marital status					
		Single	De facto union	Married	Divorced	Separate	Widower
Province	**4438009**	**51.2**	**15.3**	**29.1**	**0.2**	**1.9**	**2.2**
Head	**1485478**	**27.6**	**22.3**	**41.8**	**0.4**	**3.5**	**4.4**
Male	**1001825**	**19.5**	**28.3**	**49.9**	**0.2**	**1.3**	**0.8**
Female	**483653**	**44.3**	**9.9**	**25.1**	**0.9**	**8.0**	**11.9**
Cacuaco	631862	46.9	11.4	37.2	0.2	2.1	2.3
Head	223094	24.7	15.9	51.4	0.3	3.7	4.0
Viana	986415	49.5	13.9	32.6	0.1	1.7	2.0
Head	331972	26.1	20.1	46.3	0.3	3.3	4.9
Icolo e Bengo	51002	41.3	11.5	40.5	0.1	2.4	4.2
Head	21075	27.8	12.1	47.9	0.1	3.9	8.2

The survey (Question C.1) showed that a man heads 75 households interviewed at the local level, while a woman heads the remaining 25. The following Table presents the relationship with the respective Head of family regarding the interviewee.

Of the 100 interviewed, 61 % were their head of household, 30 % were their wife or husband, 6 % were children, and 2 % were parents (Question B. 3).

Table 77: Relationship of the interviewee with the Head of the family (Field Survey, Questions B3 and C1)

Locality	Gender of the Head of Household		Relationship of the interviewee with the Head of the family					
	Male	Female	Head of household	Spouse	Parent	Son or daughter	Brother or sister	Other
Cacuaco	18	2	10	9		1		
Kapalanga	11	9	14	2	2	2		
Km 30	15	5	14	5		1		
Zango 5	12	8	13	5		1		1
Bom Jesus	19	1	10	9		1		

The following figure shows the condition of the heads of families concerning the marital status for the localities of the field survey, based on the 100 household surveys carried out.

In the localities of the Project area, the heads of families in the condition of single are more significant compared to the respective communes.

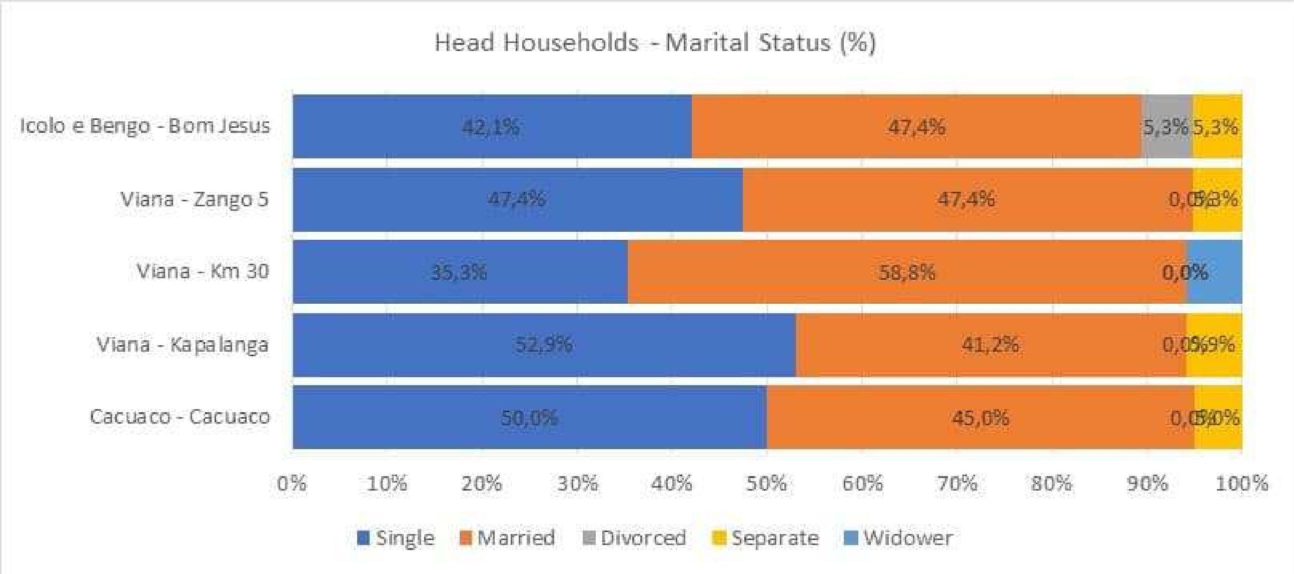


Figure 216: Distribution of the Heads of Households according to marital status in the localities of Project Área (Field Survey, Question C3)

The following table answers Question C3 of the Survey regarding the marital status of the Head of Household. The answers make it possible to differentiate the situation in terms of gender.

Table 78: àMarital status of the Head of the family by gender (Field Survey, Question C3)

Locality	Single		Married		Other Situation / Non-Response		Total
	Male	Female	Male	Female	Male	Female	
Cacuaco	10	1	8	1	0	0	20
Kapalanga	5	4	5	2	2	2	20
Km 30	4	2	9	1	2	2	20
Zango 5	4	5	6	3	2	0	20
Bom Jesus	6	1	13	0	0	0	20
Total	**29**	**13**	**40**	**8**	**6**	**4**	**100**

Women in the single condition make up 50 per cent of the female sample, while men make up about 39 per cent. Women in married status make up about 31 per cent of the female sample, while men in this situation make up about 54 per cent.

The answers in “Other / n.r.” correspond to the non-answer to this question, the situation most observed in the female population and separated or widowed in the case of men.

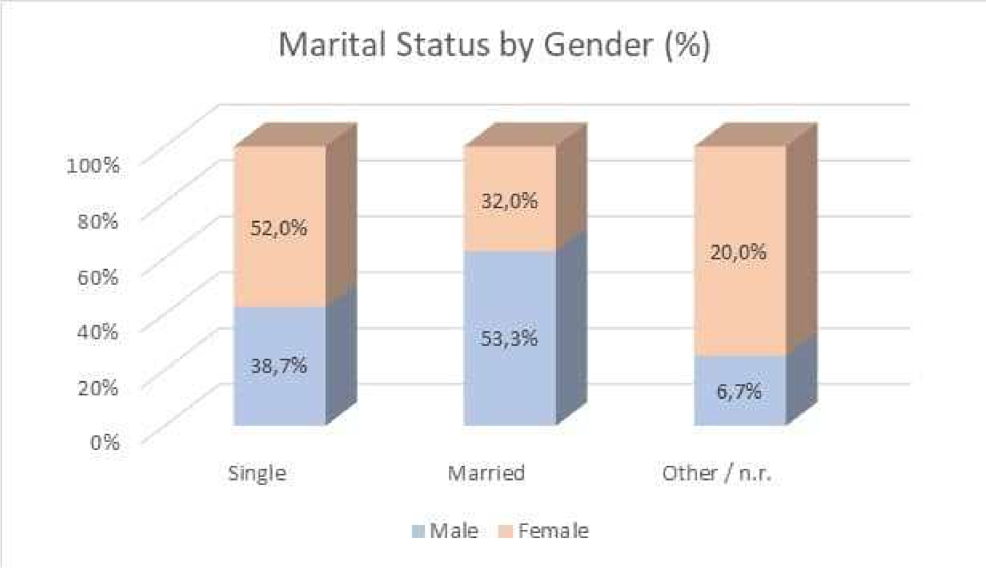


Figure 217: Marital status of the Head of the family by gender (Field Survey, Question C3)

The predominant ethnicity of the 20 interviewees in each of the five locations is also shown in the following figure (Figure 118). Kimbundo ethnicity is dominant in the five localities of the Project area. Of the 100 respondents, 61% are ethnic Kimbundo, followed by Bakongo (16 %) and Umbundu (16 %).

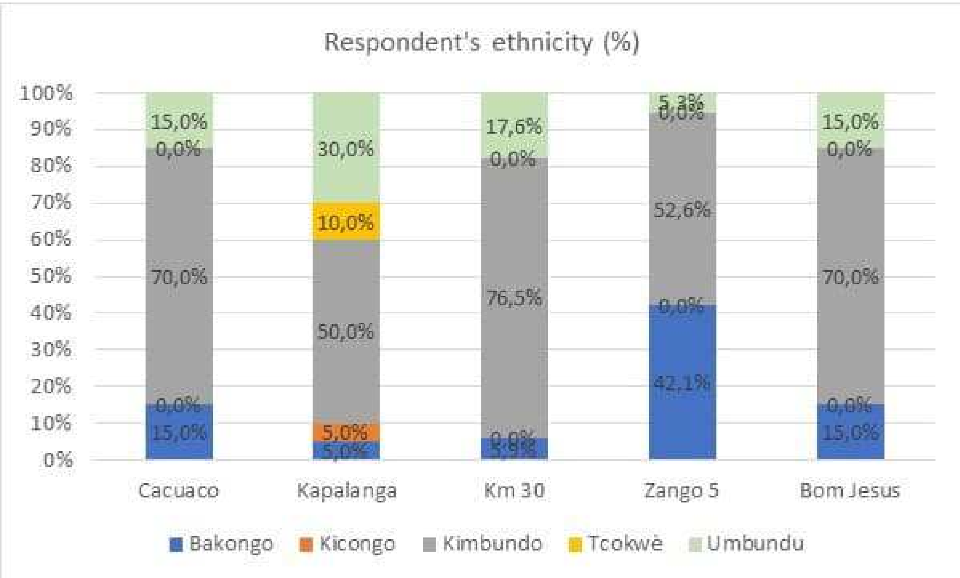


Figure 218: Respondent´s ethnicity (%) in the localities of the Project Area (Field Survey, Question C11)

7.3.4.2 Main activity of heads of households

Primary data on the Head of the household's principal occupation and income are scarce. The data gathered in the Fieldwork are insufficient to detail this topic locally in the Project area.

Like much of the male population, the main activities are divided into formal and informal renumbered occupations. Agriculture remains one of the main occupations in rural areas, with the sale in street markets of surplus production or products bought elsewhere and then sold on the street.

Table 79: Means of family sustainability of the head of the household (Field Survey).

Locality	Means of family sustainability of the head of the household						
	Own business	Employer Salary	Family Support / Neighbors	Market Sell	Pension	No income	No response
Cacuaco Belo Monte	7	11	1			1	
Kapalanga	2	7	2	1	1		7
Km 30	7	8					5
Zango 5	1				1		18
Bom Jesus	6	8					6
Total	23	34	3	1	2	1	36

From the analysis of the answers to the question about the main activity in the previous seven days, the following occupations stand out (Table 79):

- Employer salary (34 %);
- Income from own business (23 %);
- Family /Neighbours support (3 %);
- Pensión (2 %);
- Market sell (1 %);
- Without any income (15).

Thirty-one per cent of respondents did not indicate what form of family support they have.

The following figures illustrate some economic activities practiced in the project area. Part of the financial activities are based on informal practices, such as selling agricultural surplus.

Figure 219 shows women selling on the street products purchased elsewhere and resold on the street . It is a form of informal economy and household support.

Figure 220 illustrates another type of sale. In this case, it was selling vegetables and eggs in a stall in your home. It is also a form of informal economy.

Figure 221 and **Figure 222** exemplify a business of its own, with the confection of clothing and sale on the spot. This small business typically employs family members.

Figure 219: Women selling products on the street. Cacuaco – Cacuaco.

Figure 220: Sale of food in the house itself. Kapalanga – Viana.

Figure 221: Small autonomous domestic unit of confection and sale of clothing. Km 30 – Viana.

Figure 222: Small retail sale. Bom Jesus – Icolo e Bengo.

7.3.5 Occupational profile

The breadth of Angola's informal sector – and its pervasive role in the lives of most Angolans – cannot be overstated. Throughout the vast urban "musseques" (informal settlements) of peri-urban Luanda, where approximately half of the city's population currently resides, essential services – such as water and food distribution – are provided for the overwhelming majority through a private initiative in the informal sector. Luanda's informal economy grew during the conflict years before 2002 when it was estimated to employ 37% of the entire country's labor force (Allan Cain. 2018).

Most people have a precarious employment situation and work as "biscateiro", street vendors (zungueiro/a, matocheiro and lotador),[4] teachers, security guards, bricklayers, luggage porters or transport in wheelbarrows (roboteiros).[5]

The income for households headed by men and women mentioned above is too low, considering the price level in Luanda – and it is likely not to reflect all real income, given the level of expenditure reported by households (see below). However, the responses testify to a complicated economic situation and what is difficult to be poor and marginalized in the dense and tense context of the musseques.

The large number of households claiming to have no income reflects poverty and poverty. There is a sense of marginalization among some of the most impoverished families. During the Fieldwork, we observed several households with members sitting inside or outside their dwelling/tent, apparently apathetic and seeming to have given up – reflecting a 'culture' of poverty.'

The following is a summary of the occupation profile and weaknesses for each of the five-neighborhoods covered by the fieldwork in late July and early August 2023.

This local characterization results from the formal and non-formal interviews conducted in the fieldwork and the analysis of the ten questions in Section H – Economic status of the questionnaire.

Belo Monte – Cacuaco (Lot 3 – DC Cacuaco)

Most of the population in Belo Monte survives from the street sale and marketing of agricultural products from other provinces such as Malange and Uíge, and the neighborhood has a stop for the flow of farm products. In Belo Monte, there is a lot of unemployment; young people are mainly dedicated to selling small services such as car washes, transporting goods and shoe shoes.

Kapalanga – Viana (Lot 7 – DC Kapalanga)

Most of the population of Kapalanga has, as a means of subsistence, informal activities. Men develop the activities of mechanics, car washers, small merchants, motorcycle taxis, and other informal activities. Due to the minor technical qualifications, few get formal jobs, of which are some teachers, nurses, and attendants of commercial establishments.

Zango 5 – Viana (Lot 4 – DC Zango 5)

The majority of the population of Zango 5 has formal jobs selling agricultural products in the markets of Calumbo and Zango 4 as a means of subsistence. The unemployment rate is very significant.

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[4] "Matocheiro" is a person who identifies as an intermediary. In the informal market, they will arrange customers for shopkeepers/merchants. Crowders (or callers) are individuals who work at taxi/bus stops calling passengers and instigating them to get in (or, more appropriately, to fill the car with passengers).

[5] A "Roboteiro" worker works in the informal market and transports goods with a wheelbarrow. Robotists can also pick fish from the beach and transport it to markets.

Most of the inhabitants of the Zango 5 neighborhood are unemployed. The main form of subsistence is informal trade, such as street vending. Although some companies, small industries, and commercial establishments exist, unemployment within Zango 5 is a reality.

Km 30 – Viana (Lot 6 – DC Km 30)

The population of Bairro Km 30 has as its primary source of income the commercialization and various services provided in the market of 30 because it is a very requested market by the citizens of Luanda.

The Km 3o market, located in the district of Baia, can currently be considered one of the largest employment centers, direct and indirect, in Angola, given the movement of people and goods registered from Tuesday to Sunday.

Bom Jesus – Icolo e Bengo (WTP/CD Quilonga Grande /STP)

Most of the population of Bom Jesus has as a means of subsistence agriculture, fishing, and sale of agricultural products, and few have a formal job. The unemployment rate is very significant.

Bom Jesus belongs to a commune where fishing is an essential economic and family activity along the Kwanza River.

Many of the households are engaged in fishing. Men as fishermen and women as fishmongers (treatment and marketing of fish). Another activity has to do with the creation of animals for commercialization and consumption.

7.3.5.1 Main sources of income

The National Statistics Institute (INE) of Angola carried out the Expenditure and Revenue Survey (IDR) and the Expenditure and Revenue and Employment Survey in Angola (IDREA) from March 2018 to February 2019.

IDR was designed to estimate the poverty trend from 2008/9 to 2018/9. For this reason, it uses the diary method, which consists of visiting the household every other day for seven days to record its expenses. This method is similar to the Integrated Survey on the Welfare of the Population (IBEP) 2008/2009 method.

As previously discussed, the IDR defines the Head of household as the person whom the other household members recognize as such. It can be a man or a woman. If there is any doubt, the person with the household's most significant economic responsibility will be considered the Head and ultimately the most advanced age.

The average monthly income per person in Angola is Kz 15,454 per month. Significant differences exist between the areas of residence: in urban areas, the average revenue per person is almost double that of the rural area, with 19,090 kwanzas and 9,149 kwanzas, respectively (see Table 80).

Table 80: Mean income per person by the type of income (Kwanzas – Kz) (IDR. INE, December 2019)

	Total	Labor Income	Non-labor Income	Own consumption and from own stock
Angola	15,454	9,735	2,751	2,968
Urban Area	19,090	12,680	3,691	2,719
Rural Area	9,149	4,629	1,120	3,400

In urban areas, labor income from employment accounts for about 48 % of average incomes, followed by transfers, with around 15 %. In rural areas, the most considerable revenue comes from self-consumption (33 %) and self-employment (30 %).

The household composition shows that the average monthly income is three times higher in childless households than in households with three or more children. Families with fewer members have higher earnings than households with seven or more members, with 35,065 kwanzas versus 12,151 kwanzas, Table 81

Table 81: Income sources by characteristics of the household head (Kwanzas) (IDR. INE, December 2019)

	Labor Income	Non-labor Income	Own consumption and from own stock	Total
Angola	9,735	2,751	2,968	15,454
Households without dependent children	24,660	8,939	5,756	39,355
Households with dependent children				
One child	14,250	4,624	4,039	22,913
Two children	10,925	3,278	3,281	17,485
Three or more children	7,711	1,904	2,544	12,159
Household size				
1-2	22,029	7,553	5,483	35,065
3-4	11,495	3,445	3,313	18,253
5-6	9,589	2,447	2,703	14,739
Seven or more	7,451	,027	2,672	12,151

Table 82 shows that the population living with an unemployed head of household has an income per capita about three times lower than those living with a head of household employed in the labor market. People living with a head of household, not in the labor market, that is, inactive, have a higher per capita income than the unemployed. This is explained by the large amount of earned non-work income, mainly of transfers these families receive. Heads employed in the public sector have a higher income, almost twice as much as the private sector and about three times as much as the self-employed and family employees.

Table 82: Income sources by employment status (Kwanzas) (IDR. INE, December 2019)

	Labour Income	Non-labor Income	Own consumption and from own stock	Total
Angola	9,735	2,751	2,968	15,454
Employment status				
Employed	11,124	2,134	3,036	16,294
Unemployed	1,471	2,677	1,924	6,071
Inactive	4,329	5,934	2,839	13,101
Sector of employment				
Public sector	22,200	3,020	3,580	28,800
Private sector	14,966	2,277	2,768	20,011
Self-employed	6,012	1,803	2,972	10,787
Family / Other	5,653	1,832	2,119	9,604

Looking at the sector of economic activity of the Head of the household, the per capita income of those working in agriculture is lower. In comparison, those working in the extractive industry and mines have higher income per capita, followed by those working in providing services.

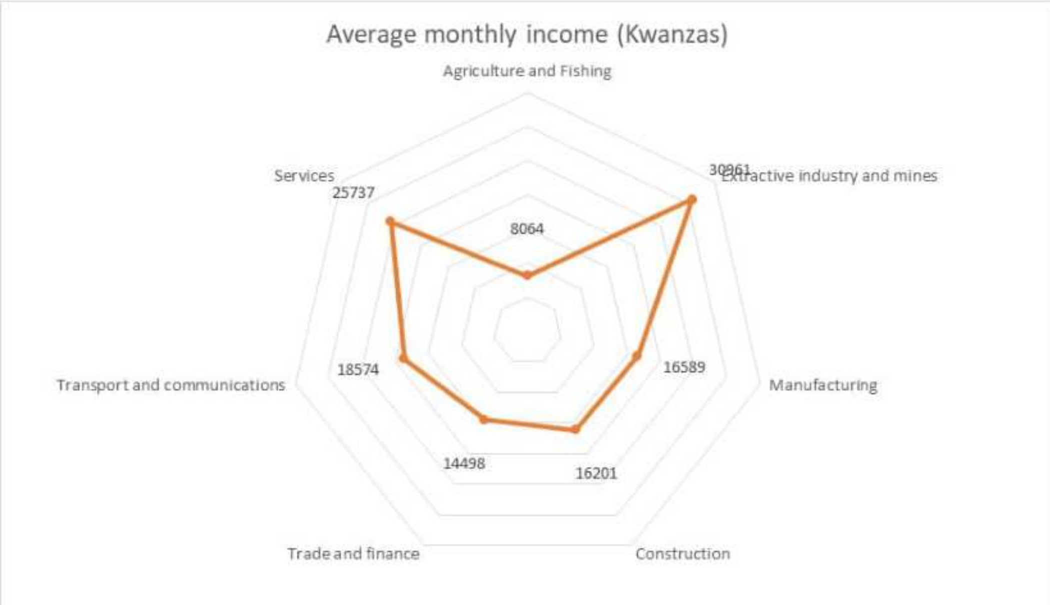

Figure 223: Average monthly income by economic activity of the household head (IDR. INE, December 2019)

Responses to the household income study generally fall between the less reliable: people may not know the exact remuneration, particularly in the case where the interviewee is the wife of the Head of the household; the couple may have trouble assessing the average yield over a specific period (in this case, a month), in a context where it can vary significantly from day to day; or may want to reduce their income in the expectation that it might bring them some support. The following Table shows the income declared in the localities of the Project area.

In the fieldwork, we tried to assess the existence of inequalities in income in households headed by men or women. Question H10 - What is the average total monthly income of the household? This question includes income earned by all members of the household and all sources (income from employment, own production, received from other family members, etc.).

The level of non-response was high, with only 26 % of valid responses, especially in households headed by women. Even so, the following table systematizes the calculation of the answers and crosses the average income per household headed by a woman or a man. Of the one hundred interviewees, only twenty-six responses were obtained, of which twenty were from men and six from women.

Table 83: Determination of valid answers to the question on total income by gender of the Head of the Household (Field Survey, Question H10)

Locality	Gender of Head Household		Number of valid responses		
	Male	Female	Male	Female	Total
Cacuaco	18	2	5	0	5

Kapalanga	11	9	1	1	2
Km 30	15	5	6	2	8
Zango 5	12	8	3	2	5
Bom Jesus	19	1	5	1	6
Total	75	25	20	6	26

Based on the answers, it can be seen that, on average, households headed by men reported higher average earnings than those reported by women. Kapalanga is one exception to this rule, but the result stems from only one male response and one female response. The same is true for Zango 5, whose average results from the value of 200,000 Kz reported by a female head of household.

The highest average incomes are 230,000 Kz in Cacuaco and Bom Jesus, in households headed by one man.

In addition to the results of the surveys, the impression gathered by the interviewers who visited the study area is relevant.

The interviewees and the people contacted informally showed reluctance to declare their income due to a lack of adequate knowledge or fear.

The perception transmitted by the field team reinforces the conviction of inequalities in social conditions and income in households according to the gender of the head of the household. They confirm our overall impression of the differences in poverty and well-being between the five-neighborhoods.

Table 84: Average income per household per district of residence in the Project area (in Kwanzas) (Field Survey, Question H10)

Locality	Gender of Head Household – Average Income per Household (Kz)					
	Male			Female		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Cacuaco	230,000	80,000	146,000	-	-	-
Kapalanga	20,000	20,000	20,000	40,000	40,000	40,000
Km 30	130,000	60,000	90,000	70,000	60,000	65,000
Zango 5	120,000	40,000	76,667	200,000	70,000	135,000
Bom Jesus	230,000	120,000	172,000	80,000	80,000	80,000

7.3.5.2 Level of expenditures

The responses to household spending were reduced overall, only 11 per cent in health expenses, 56 per cent in domestic fuel expenses and 45 per cent in total household expenses.

Many of the answers seem incoherent, so some reservation is recommended in the reading and interpretation of the values presented for the localities of the Project area.

Table 85 shows that Angola's average monthly consumption per person is estimated at 17,569 kwanzas. Urban areas have higher consumption than rural areas.

Table 85: Average monthly consumption per capita (in Kwanzas) (IDR. INE, December 2019)

	Total	95% confidence interval	
Angola	17,569	16,349	18,790
Urban area	22,117	20,117	24,117
Rural area	10,606	10,064	11,147

Luanda has the highest average consumption per capita at Kz 26,528/month, followed by the Province of Lunda Norte, with a consumption of 23,286.

At the local level, consumption was estimated by calculating total household consumption, composed of the value of all food and non-food goods and services consumed by the family.

Table 86: Average monthly consumption expenses per district of residence and household (in Kwanzas) (Field Survey, Question H2)

Item	Cacuaco	Kapalanga	Km 30	Zango 5	Bom Jesus	Total average
Average total consumption	92,571	103,000	75,000	56,900	88,000	83,094
The number of respondents (%)	70	25	30	50	75	50

The official documents (IDR. INE, December 2019) show that the average monthly expenditure per capita on drinking water is 1,079 Kwanzas in Angola (Urban 1,737 and rural 57). In comparison, in Luanda Province, the spending is 3,572 Kwanzas, substantially much higher than the value of the other provinces.

Also, according to that document, the average monthly per capita expenditure on the rent of houses is 1,462 Kwanzas in Angola (urban 2,225 and rural 278) and in Luanda 2,847 Kwanzas. Benguela is the Province with the highest value, 3,065 Kwanzas.

7.3.6 Livelihoods

Communities in Angola have traditionally made extensive use of natural resources as a central part of their livelihoods. While they use relatively small areas for agriculture, natural resources are often collected over a large area; many households collect, process and/or market natural resources as a significant livelihood activity or as part of a diversified portfolio of livelihood activities.

Sobas (traditional leaders) are responsible for managing the community land in their areas, including setting rules regarding communal land and its resources, adjudicating land disputes, and allocating lands to individuals or households who may not have land access. In rural areas, families and individuals access land via inheritance and allocations by the soba. In contrast, in most peri-urban areas, land access depends on land markets as much as inheritance.

Many poor rural households continue to depend on natural resources for their livelihoods. However, resource depletion has occurred in many areas, affecting community resources. Major threats to the sustainability of traditional resource use systems are mainly occurring in places where access to outside commercial markets has opened up (e.g. for charcoal along major transport routes to urban centers, bushmeat in areas with access to local towns, and live wild animal and wildlife trophy trade in areas with access to international borders). Community controls and incentives are inadequate in this open-access situation. Expansion of agriculture and population growth are also major factors in the loss or overuse of the resource base.

In recent years, the GoA, especially technical staff and policymakers in the Ministry of Agriculture and Rural Development (MINADERP), have been introduced to livelihood methods and analysis for assessing populations at risk of food insecurity. Through the RVAA Programme (Regional Vulnerability Assessment and Analysis Programme), the SADC Secretariat has provided introductory livelihood training sessions and ongoing technical advisory support. In November 2011, an initial livelihood zoning exercise was carried out by the SADC RVAA program in partnership with the GoA, particularly the MINADERP. However, this pilot exercise was only undertaken in the Province of Kwanza Sul. A total of three livelihood zones were identified and defined within the Province (ANGOLA Livelihood Zones and Descriptions, November 2013).

HEA (Household Economy Approach) defines a livelihood zone as a geographic area where households obtain their basic survival needs, notably food and cash income, in relatively similar ways. This means they also typically have similar socioeconomic groupings, asset bases, and somewhat identical consumption patterns.

More than 85-90 % of the rural populations in Angola rely on subsistence agriculture as the primary source of livelihood, except in the coastal area where irrigation is practiced by commercial farmers and, to some extent, the tuber-producing northern provinces. However, most rural agriculture has fallen to a subsistence level, with little or no marketable surplus. (WFP/VAM Angola, June 2005). These similarities apply to good and bad years in that coping strategies in response to shocks within the same livelihood zone are also relatively similar.

Apart from agro-ecological factors that have shaped livelihood patterns in most of rural Angola, increased access and better linkages to markets and trading opportunities following the end of the 27-year civil war continue to influence rural livelihoods, particularly between the agriculturally productive interior and the strategic and lucrative coastal food markets in areas such as Benguela, Lobito and Luanda. There has been improved infrastructure development of main national roads and the reconstruction of the Benguela railway line, which follows the ancient trading routes through Benguela, Huambo and Bié.

The other significant economic activity that has shaped rural populations' livelihoods is the expanding construction industry, a product of the fast-growing economy. This has provided work opportunities through housing, road, airport, railway, and social infrastructure projects in rural parts of the country. The above background information and the expert judgment of participants regarding livelihood activities in rural parts of Angola led to the identification of thirteen broad livelihood zones (see Figure 224):

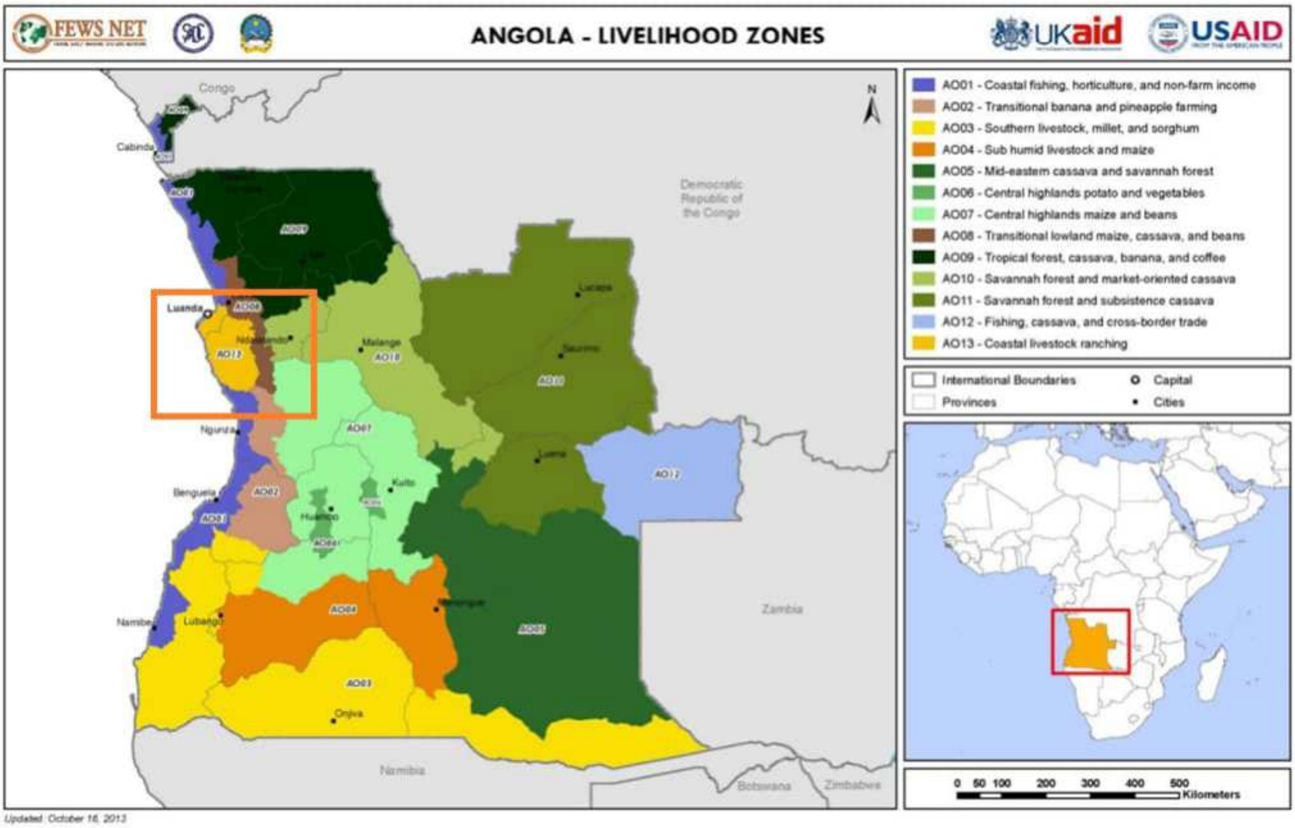

Figure 224: Angola – Livelihood Zones (Adapted from FEWS NET – Angola Livelihood Zones and Descriptions).

In general, food insecurity is most significant in areas with a high risk of production failure due to semi-arid climatic conditions, frequent occurrence of natural hazards, where the poorest groups have limited opportunities to obtain income, and the most significant difficulties in accessing markets.

Coastal livestock ranching (livelihood zone 13)

This livelihood zone lies along the coastal plain. It is concentrated in the rural parts of Luanda Province and stretches into Ilhéu dos Pássaros Natural Reserve,[6] an area covered by mangroves and a habitat for marine birds. It is dominated by flatland plains with low-lying areas. The primary vegetation is savannah grassland and bush shrubs, suitable for rearing livestock. The Kwanza River and its tributaries, such as the Luando Reserve and Luasso, flow across the one. Other natural resources include grasses, fish, and inland oil reserves.

The better-off have landholdings of around 2 hectares; these are generally local inhabitants settled outside the commercial ranches. Low-income people have landholdings of approximately 0.5 hectares and are mainly retail farm workers with limited access to land in commercial ranches. Hand-tilling is the primary means of land

[6] Ilhéu dos Pássaros has an area of 1.7 km2 and is located in the bay of Mussulo, outside the Project área. Due to its status as an Integral Reserve, any and all human activity is prohibited. However, scientific works may be permitted. The Bird Islet, unlike the other Integral Reserves, has the particularity of being an island, thus allowing the observation of birds from tourist boats. The avifauna consists of resident waterfowl, as is the case of pelicans, or migrants as is the case of pink flamingos. More details at: https://flyway.waddensea-worldheritage.org/sites/default/files/2022-07/PLANO%20DE%20GEST%C3%83O%20DA%20RESERVA%20NATURAL%20ILHEU_2020.pdf

preparation among the poor group, although owners of commercial livestock ranches also carry out mechanized and irrigated crop production.

The main food crops grown are maize and vegetables. This is possible through access to water provided by the commercial ranch owners. Livestock is only kept by the exceptionally well-off, primarily as commercial ventures. The principal livestock reared are cattle, goats and, to a lesser extent, pigs.

For rural households, in particular, keeping livestock plays a crucial economic and socio-cultural role in maintaining the well-being of farm families by providing food security, nutrition, income, soil productivity, transport, agricultural traction, and diversification. In urban areas such as Luanda, the dependence on livestock is slightly less significant and is generally on a smaller subsistence scale but remains essential.

The poor and better-off groups consume crops, fish, wild foods and some milk from commercial farms and the market. They depend heavily on the market purchase of staple foods for more than half the year.

Income opportunities for the poor group are minimal and include wages from commercial farm employment, vending of vegetables and retail trade (household items). The better-off group relies on semi-skilled non-farm work in urban areas such as Luanda, the sale of construction materials (sand and stones) and retail trade (household items) to a lesser extent.

Compared with neighboring zones, this area has excellent access to lucrative markets (Luanda and other coastal areas), especially for local products such as vegetables, construction materials and unskilled labor.

The main hazards in this zone are livestock diseases such as dermatitis, anthrax, scabies and trypanosomiasis, coupled with drought and dry spell conditions. In years of poor rainfall, people experiencing poverty maximize food access through migratory labor to gain income for staple food items; the better-off usually use this income to purchase livestock drugs (FEWS NET – Angola Livelihood Zones and Descriptions).

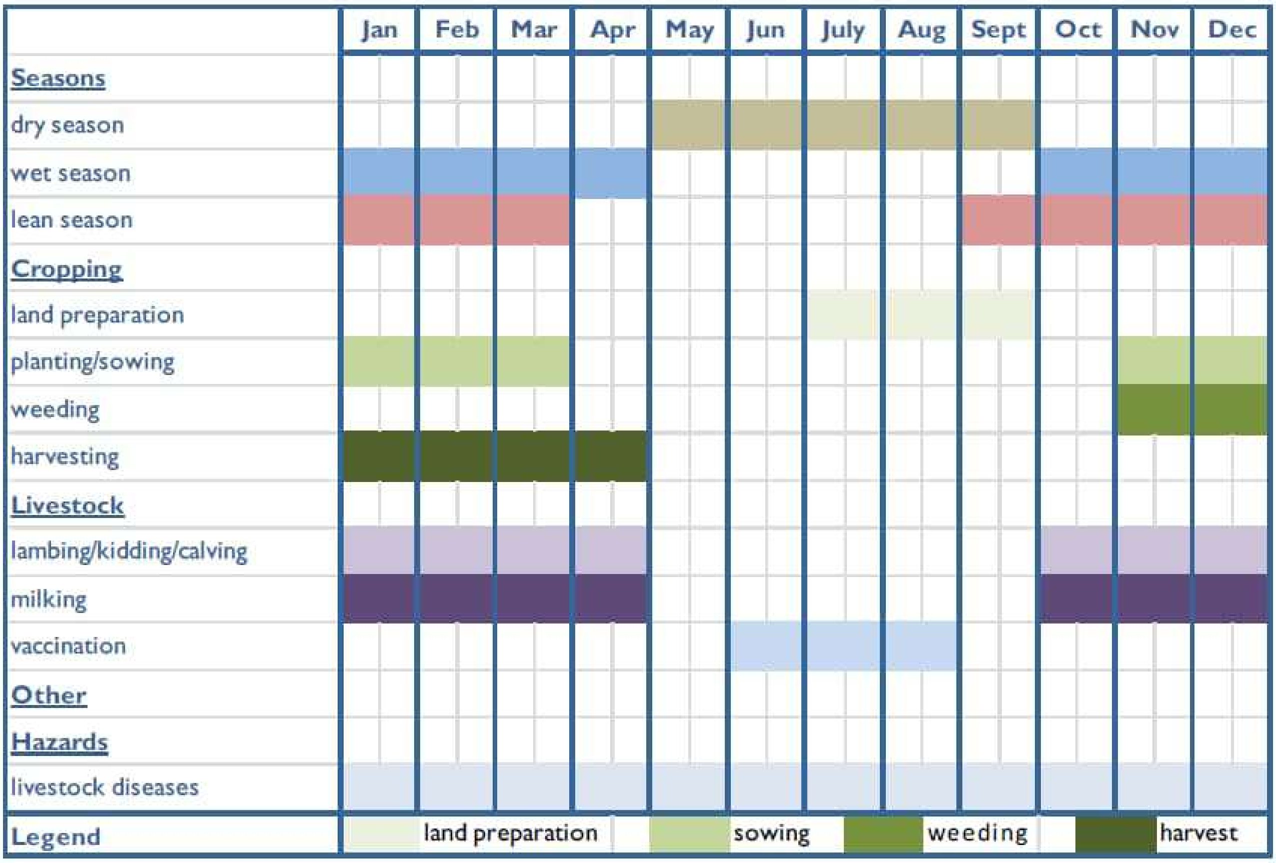

Figure 225: Seasonal Calendar, Zone 13 (FEWS NET – Angola Livelihood Zones and Descriptions)

The rainy season lasts from October until the end of April. The dry season starts in May and continues until September. The lean season usually is from December to February, before the start of green consumption in February.

The agricultural season starts with land preparation from July to September. This is mainly for maize and vegetables. This is followed by planting and sowing from November to December. Weeding takes place from November to December, providing employment opportunities for people experiencing poverty. Green consumption starts in January. The main harvest of maize and other cereal crops takes place in June.

Other activities include lambing, kidding, and calving during the rainy season and vaccination of livestock from June to September.

Due to Luanda's rising population and associated urban sprawl, open space for grazing livestock and larger animals such as cattle is in short supply.

At the Project area level, the following paragraphs complement the current livelihood framework.

In the project area, no family collects products in the forest or hunts; only in the locality of Bom Jesus, ten respondents practice fishing on the Kwanza River for their food and sale of surpluses.

The localities Belo Monte (Cacuaco) and Bom Jesus (Icolo and Bengo) are inserted in rural areas. The remaining three localities are located in the so-called urban peripheries of Luanda.

In the rural localities, a survey was conducted with ten families with rural activity per locality.

The families surveyed developed agricultural activities, namely cultivating vegetables and some cereals and raising domestic animals (pigs and chickens) for their consumption and sale.

Based on the data of the Project, the infrastructures of the Quilonga Grande System on the surface (namely the distribution centers and the water treatment plant) are located on land without current human occupation or agricultural use.

7.3.6.1 Employment

The civil war disrupted education for many generations of students and meant that the population had little opportunity to learn new skills and trades or pursue education; as a result, much of Angola's working-age population was unemployed.

The census data consider the economically active population to be those aged 15 or over who were employed or unemployed on 16 May 2014.

National Level - Angola

The labor force (employed and unemployed individuals aged 15 years and over) was estimated at 13,651,042 people, of which 6,636,561 were men and 7,014,481 were women. The labor force participation rate among the population aged 15 and over was estimated at 86.9 % overall, 90.7 % in rural areas and 84.6 % in urban areas. Men's labor force participation rate is slightly higher than women's in nearly all age groups (ILO 2021).

The population in employment was estimated at 9,690,373 individuals, of which 4,819,435 were men and 4,870,937 were women. The employment rate among the population aged 15 and over was 61.7 % overall, 64.2 % among men and 59.3 % among women. The rural employment rate is 75.2 %, and the urban employment rate is 53.8 %, a difference of 21.4 percentage points.

The agriculture, animal husbandry, hunting, forestry, and fishing sector employs the highest number of workers (4,455,516 individuals), representing 46.0 % of employees, followed by the service sector (4,367,031 individuals or 45.1 % of employees) and industry, construction, energy and water (785,863 individuals or 8.1 % of employees). Women comprise 51.4 % of individuals employed in agriculture, animal husbandry, Hunting, forestry and fishing. Nearly half of all employed people (48.3 %) work on their accounts (with or without employees), and 18.5 % work in the private sector.

Regarding employment and unemployment, official figures (G. d. Angola 2018) show that most adults participate in the labor force. The employment rate is higher among men than among women. Among those employed, most men work in the formal sector, while most women are self-employed/work in the informal sector. In formal employment, most people work in the private sector, followed by the public sector/state companies.

Activity rates peak in the 35-49 age group, 76 % and 55 % for men and women, respectively. The lowest activity rates are usually found in the younger age groups, with 27.2 % and 54.8 % for men aged 15-19 and 20-24 years and 24.9 % and 42.6 % for women, respectively.

In 2009-2014, and until the outbreak of the oil crisis, the employment generated by the Angolan economy evolved at a high pace of 3.3 %, not deviating from the target of 3.5 % set in the ELP Angola 2025 for 2005-2015.

Luanda and Local Level

The following Table frames the resident population of Luanda Province concerning the condition before the activity and employment, referring to 2014.

Table 87: Population aged 15 years or more by area of residence, according to the situation concerning economic activity, 2014 (INE, Censo 2014. Resultados Definitivos do Recenseamento Geral da População e da Habitação de Angola 2014 2016)

Province and residence area	Working-age population		Economically active population		Employed population		Unemployed population	
	N.º	%	N.º	%	N.º	%	N.º	%
Luanda	3,945,102	100.0	2,065,839	100.0	1,393,190	100.0	672,649	100.0
Urban	3,843,256	97.4	2,010,334	97.3	1,353,584	97.2	656,750	97.6
Rural	101,846	2.6	55,505	2.7	39,606	2.8	15,899	2.4

The activity rate makes it possible to assess the relationship between the economically active population (employed and unemployed) and those aged 15 and over. In 2014, the activity rate in Luanda was 52 %, with 63 % for men and 42 % for women.

The municipality of Quissama has the highest rate, with 62 %, followed by the municipality of Icolo e Bengo, with 56 %. The municipalities of Cacuaco and Viana have the lowest rates, with 48 % and 51 %, respectively.

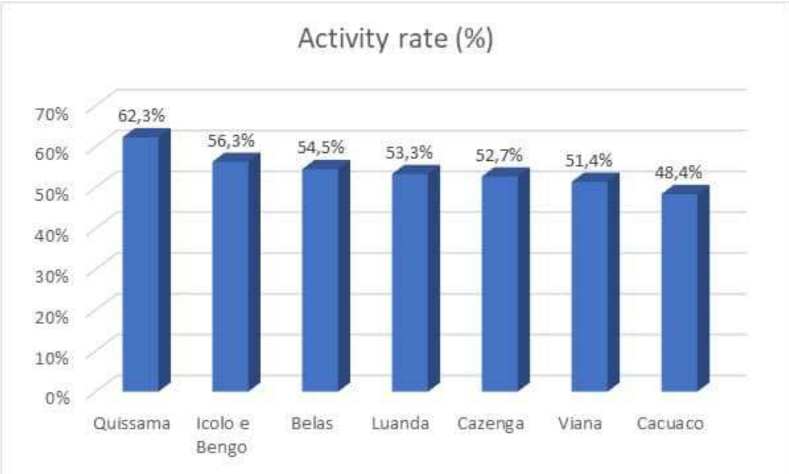

Figure 226: Activity rate by municipality (%), 2014 (INE, 2016)

Table 88: Working-age population, economically active population and activity rate by area of residence, municipalities and communes, by sex, 2014 (INE, 2016)

Province (rural/urban) Municipality Commune	Working-age population			Economically active population			Activity rate (%)		
	Total (N.º)	Male (%)	Female (%)	Total (N.º)	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)
Luanda	**3945102**	**49,0**	**51,0**	**2065839**	**59,1**	**40,9**	**52.4**	**63.2**	**42.0**
Urban	3843256	48,9	51,1	2010334	59,0	41,0	52.3	63.1	42.0
Rural	101846	51,4	48,6	55505	61,4	38,6	54.5	65.1	43.3
Cacuaco	**556913**	**48,4**	**51,6**	**269484**	**60,8**	**39,2**	**48.4**	**60.8**	**36.8**
Cacuaco	133664	48,4	51,6	68083	59,7	40,3	50.9	62.9	39.7
Funda	106411	49,3	50,7	52212	62,6	37,4	49.1	62.3	36.2
Kikolo	316838	48,1	51,9	149189	60,6	39,4	47.1	59.3	35.7

Province (rural/urban) Municipality Commune	Working-age population			Economically active population			Activity rate (%)		
	Total (N.º)	Male (%)	Female (%)	Total (N.º)	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)
Icolo e Bengo	**46573**	**52,6**	**47,4**	**26223**	**67,7**	**36,1**	**56.3**	**68.4**	**42.9**
Catete	13132	50,7	49,3	7844	61,1	38,9	59.7	71.9	47.1
Bom Jesus	12799	54,6	45,4	7039	69,5	30,5	55.0	70.0	37.0
Cabiri	9640	51,3	48,7	4764	63,3	36,7	49.4	61.0	37.2
Calomboloca	9285	53,4	46,6	5507	61,2	38,8	59.3	68.0	49.3
Caculo Cahongo	1716	55,0	45,0	1079	63,6	36,4	62.9	72.7	50.9
Viana	**868227**	**48,8**	**51,2**	**446651**	**59,3**	**40,7**	**51.4**	**62.6**	**40.9**
Viana	741689	48,6	51,4	379997	59,3	40,7	51.2	62.4	40.6
Zango	113121	49,0	51,0	59915	59,2	40,8	53.0	63.9	42.4
Calumbo	13418	54,8	45,2	6738	64,2	35,8	50.2	58.8	39.8

The employment rate is the ratio of the employed population aged 15 years or older to the total population aged 15 years or older. This vital indicator measures the ability of a province's economy to engage its population growth. In 2014, the employment rate in Luanda was 35 %, with men being higher than women.

The municipalities of Quissama and Icolo e Bengo have the highest employment rates, with 48 % and 43 %, respectively. At the opposite extreme is the municipality of Cacuaco, with 27 %.

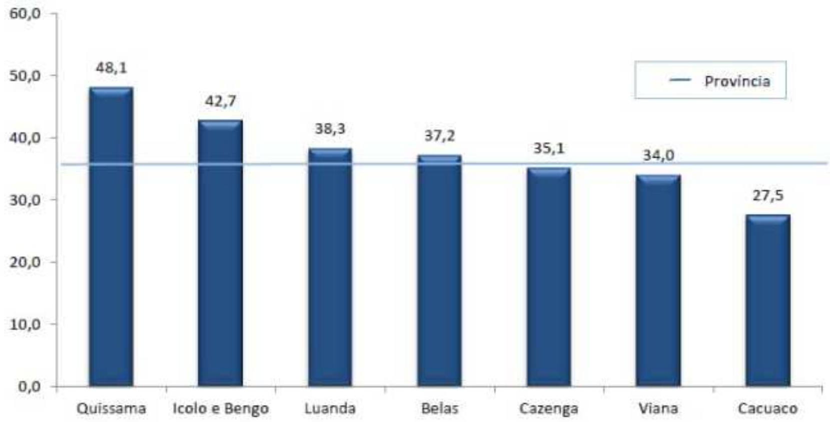

Figure 227: Employment rate by municipality (%), 2014 (INE, 2016)

The unemployment rate is the ratio of the number of unemployed to the number of economically active people. This indicator represents the breadth of the available and unused workforce.

In 2014, the number of unemployed covered 672,649 individuals, corresponding to a provincial unemployment rate of 33 %. It can be seen in the table and graph above that unemployment affects mainly the young population between 15-24 years old and women.

The highest unemployment rates were found in the municipalities of Cacuaco and Viana, with 41 % and 33 %, respectively. On the other hand, the municipalities of Icolo e Bengo and Quissama have the lowest unemployment rates, with 24 % and 23 %, respectively.

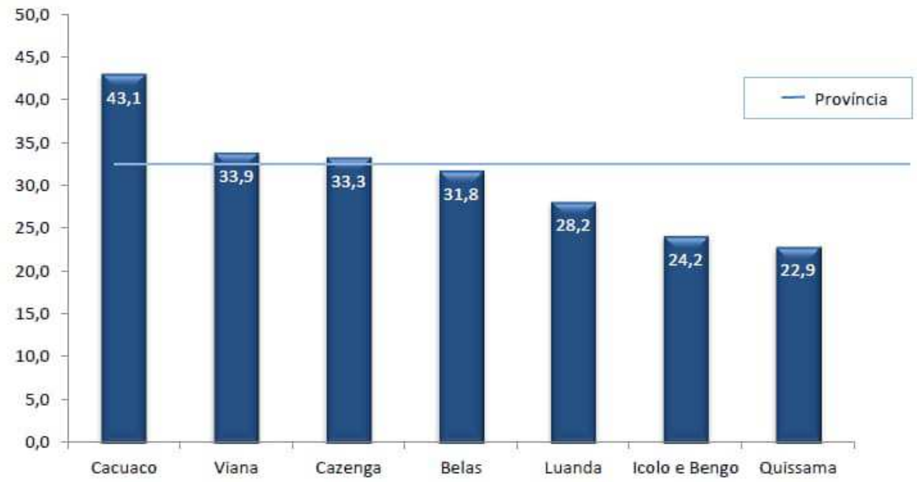

Figure 228: Unemployment rate by municipality (%), 2014 (INE, 2016)

Based on the fieldwork, it was found that eight of the hundred respondents in the question about what had been the main job in the previous seven days (G.9) said they had no job. By localities, six in Kapalanga, and one in Km 30 and Zango 5.

The following table and figure show the distribution of the population aged 15 years and over employed by municipalities and sectors of activity.

Table 89: Population aged 15 years or more employed by municipalities, according to the branch of economic activity, 2014 (INE, 2016)

Municipality Economic Activity	Cazenga	Cacuaco	Viana	Luanda	Belas	Icolo e Bengo	Quissama	Province Luanda
Agriculture, animal production, hunting, forestry and fishing	1,566	8,673	6,517	6,173	3,266	9,733	4,269	40,198
Industry	7,486	6,245	8,732	17,220	6,996	626	59	47,365
Construction	9,315	11,975	21,246	30,253	17,833	843	323	91,788
Wholesale and retail trade; repair of motor vehicles and motorcycles	22,437	20,001	26,769	50,176	15,274	652	180	135,487
Transport, storage and communication	11,963	10,688	16,422	29,710	12,232	543	96	81,653
Administrative and support services activities	14,749	12,206	20,654	42,798	21,476	976	175	113,034
Public administration and defence; compulsory social security	12,999	10,877	28,980	43,046	24,028	581	655	121,165
Education	4,644	4,149	6,972	12,673	5,183	137	78	33,836
Other activities and services	20,334	11,182	27,700	67,074	28,256	779	275	155,621
Undeclared	81,3679	57,379	131,090	206,217	90,891	5,028	1,073	573,044
Total	186,861	153,374	295,080	506,339	225,435	19,897	7,203	1,393,190

From the reading of these elements, the proportion of undeclared activity stands out, which accounts for 41 per cent of the total employed population.

Wholesale and retail trade is among the most represented economic activities in the province, concentrating about 10 per cent of the activity declared.

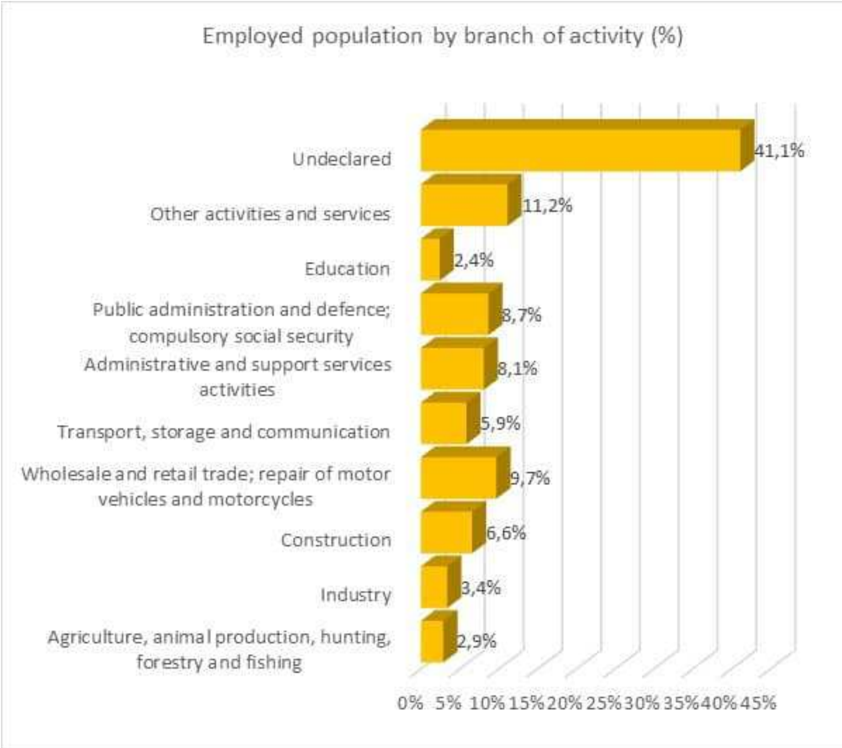

Figure 229: Population aged 15 years or more employed by municipalities, according to the branch of economic activity, Luanda, 2014 (INE, 2016)

The most recent available data indicate that in 2020, the employed population aged 15 years or older was estimated at 10,254,736 people, of which 5,074,051 were men and 5,180,685 women (INE, Recenseamento Agro-Pecuário e Pescas (RAPP 2019-2020). Resultados do relatório Comunitário. 2022).

In Angola, 60.8 % of the aged 15 and over were absorbed into the labor market. The employment rate of men (62.8 %) was higher than that of women (58.9 %).

The difference between the employment rate in the rural and urban areas is quite significant, 79.8 % and 48.0 %, respectively, presenting a difference of 31.8 percentage points, more than twice in favor of the rural area.

In 2020, Luanda province had the lowest total employment rate among the 18 provinces, as shown in the figure below.

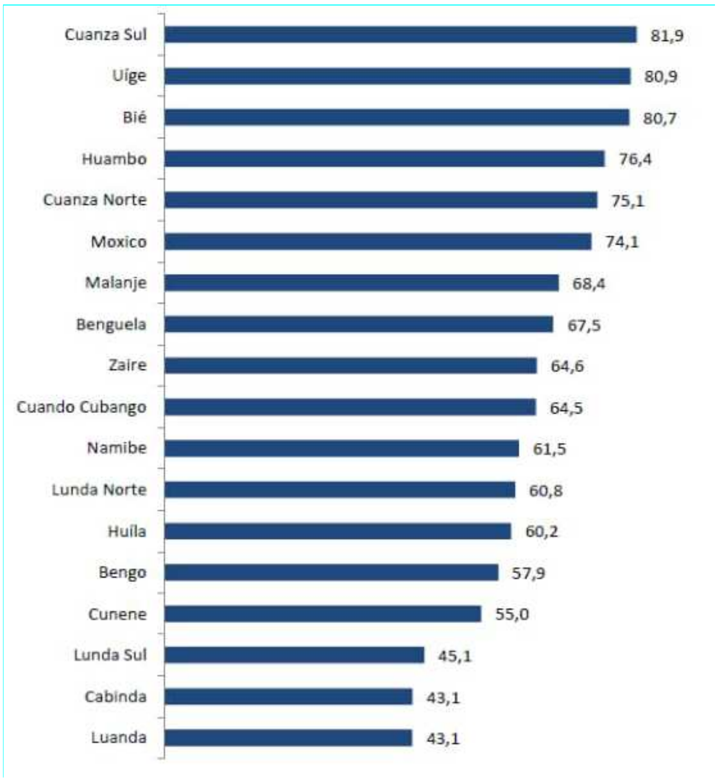

Figure 230: Employment rate by Province 2020 (INE 2022). IEA 2020)

In 2020, underemployment affected 10.0 % of the employed population. The Lunda Sul and Bengo provinces had the highest underemployment rates, 48.1 % and 42.3 %, respectively. The province of Huíla has the lowest rate of underemployment, with values below 1 % (0.1 %).

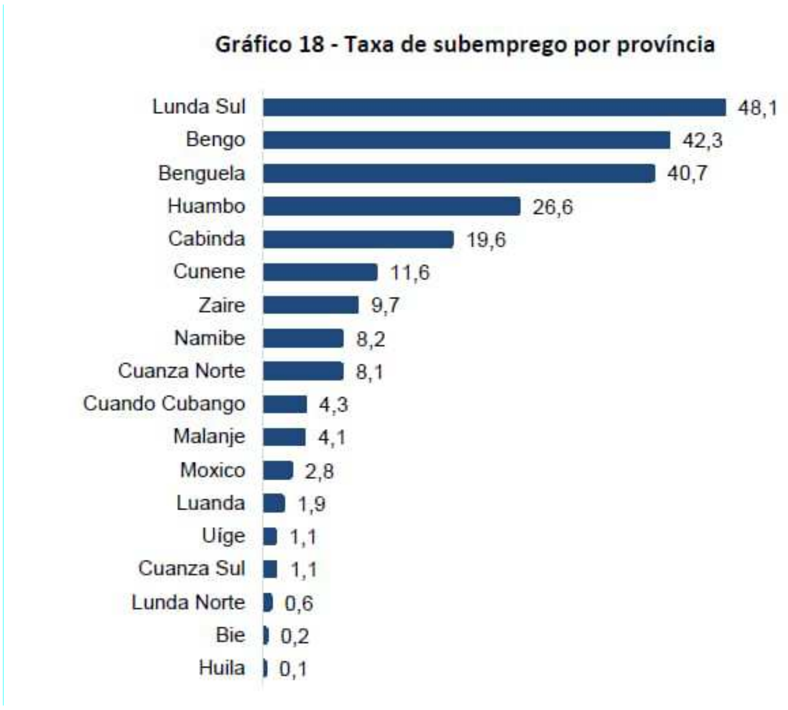

Figure 231: Underemployment rate by Province 2020 (INE 2022. IEA 2020).

The unemployed population aged 15 years or over was estimated at 4,866,025 people, 2,219,859 males and 2,646,166 females.

The unemployment rate of the aged 15 years or older was estimated at 32.2 %, 30.4% for men and 33.8 % for women.

The unemployment rate in the urban area was 44.4 %, 2.8 times higher than in the rural area (15.5 %), with a difference of 28.9 percentage points.

The province of Lunda Sul recorded the highest unemployment rate, with 53.1 %, and Kwanza Sul and Uíge's areas had the lowest unemployment rates (11.9 %).

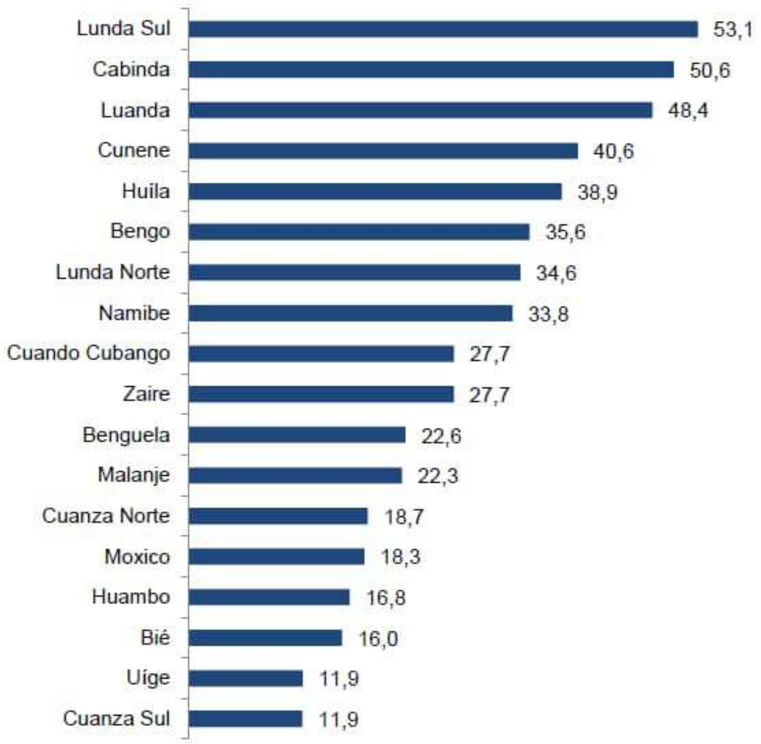

Figure 232: Unemployment rate of population aged 15 and over by Province 2020 (INE 2022. IEA 2020).

7.3.6.2 Farming

Agricultural land refers to the share of land area that is arable under permanent crops and pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. This category includes land under flowering shrubs, fruit trees, nut trees, and vines but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops.

Agriculture is a significant sector of the Angolan economy, although the country's abundant resources remain underutilized. The total area of Angola is approximately 124 million hectares. With a potential agricultural area of about 58 million hectares (FAO, 2010), Angola used about 4.9 million hectares in agriculture in 2009/10

(MINADERP, 2010). Approximately 97 % of this area was occupied by the seven main food crops: maize (37.6 %), cassava (24.1 %), beans (17.3 %), peanuts (7 %), massango/massambala (4.1 %), sweet potatoes (3.9 %) and potatoes (2.5 %). Coffee accounted for only 0.6 % of this area (FAO, 2010).

Agricultural output declined dramatically after Independence and during the Civil War, shifting toward subsistence agriculture and away from cash crops. Angola's cultivated area (physical area) at the level of the whole country is 4,236,018 hectares. The middle area cultivated by the family farm is 1.85 ha.

Huambo is the Province with the most significant amount of cultivated area, with 804,815 ha (about 19 % of the total cultivated area of the country) and with an average cultivated area of 2.6 hectares per family farm that practices agricultural production, followed by Huíla with 776,865 hectares and with an average size of 2.3 ha (INE, RAPP 2019-2020. Setembro de 2022).

Agriculture accounted for roughly 12 per cent of Angola's GDP in 2016; in 2014, it was estimated that almost 68 per cent of the country's economically active adults worked in the sector. The country has abundant land and water and the diverse climatic and soil conditions needed to produce many foods. The main crops include cassava, corn, beans, potatoes, sweet potatoes, soy, and bananas, with other agricultural products being livestock, coffee, manioc, rice, vegetables, and fruits.

The Gross Value Added of Agriculture and Livestock grew 3.9 % in the fourth quarter of 2022, about the same quarter of the previous year, contributing positively by 0.15 p.p. in the total variation of GDP. This variation was due to the increase in the production of crops, as well as the excess rainfall throughout the country, which contributed to the high output of the different crops. (INE 2023).

The total value of exports of agricultural products in the first quarter of 2023 was 2,458 million Kz, while imports in the same period were 60,537 million Kz (INE 2023).

The GDP in the last four quarters of 2022 grew by 3.0 % in relation to the same period of 2021. This positive variation is mainly attributed to the activities of Agriculture and Forestry 3,8 %; Fisheries 4.2 %; Oil extraction and refining 0.5 %; Diamond extraction 0.5 %; Products of manufacturing 2.5 %; Electricity and water 4.7 %; Construction 5.5 %; Trade 1.0 %; Transport and storage 32.8 %; Public administration 7.5 % and Real estate and rental services 3.0 % and Others Services 4.0% (INE, 2023)

The following paragraphs briefly characterize the agricultural and fisheries sector based on the Agricultural and Livestock and Fisheries Census – RAPP 2019-2020 (INE 2022)

The total number of Family Agricultural, Fishing and Aquaculture Farms in Angola is 2,364,880, of which 1,625,892, representing 69%, are headed by men, and 738,988 EF,[7] or 31 %, are headed by women. The total number of household members and family producers in Angola is 13,770,718, of which 51 % are women and 49 % are men.

About 91 % of the heads of producer households (2,152,041) practice farming as their primary activity, about 1 % engage in fishing as the main activity, and about 8 % do not practice any of the activities as an activity primary.

Concerning fishing or communal aquaculture (small scale) as the main activity by the producer households, find-if the provinces of Luanda with 19 %, Namibe with 7 % and Zaire with 6 %.

Table 90: Distribution of agricultural and livestock households by Province, according to the farming activity and sex of the head of the household (RAPP 2019-2020, Volume III)

[7] EF – Agricultural Holdings, Fishing and Family Aquaculture.

Country Province	Households Total	Households Producing Agriculture				
		Total	Men (N.º)	Men (%)	Women (N.º)	Women (%)
Angola	2 364 880	2 289 644	1 569 370	68.5	720 274	31.5
Luanda	53 409	40 944	29 932	73.1	11 012	26.9
Livestock households						
Angola	2 364 880	1 430 606	1 037 632	72.5	392 974	27.5
Luanda	53 409	25 359	20 272	79.9	5 087	20.1

Table 91: Distribution of households producing agriculture and fisheries/aquaculture by Province, according to the sex of the head of the household (RAPP 2019-2020, Volume III)

Country Province	Households Producing Agriculture-Livestock and Fisheries/Aquaculture				
	Total	Men (N.º)	Men (%)	Women (N.º)	Women (%)
Angola	2 364 880	1 625 892	68.8	738 988	31.2
Luanda	53 409	40 738	76.3	12 671	23.7

The level of education of the heads of producer households is relatively low: 32 % have primary education, 14 % have the 1st cycle of secondary education, and less than 1 % have some professional training. On the other hand, about 28 % of the heads of the producing households have no level of education.

Concerning agrarian training, only 1 % of the heads of producing households in the country have agricultural training. When analyzed by provinces, it is verified that the Province of Luanda presents a value slightly above the national average, with 1.7 % of the heads of producer households with agricultural training.

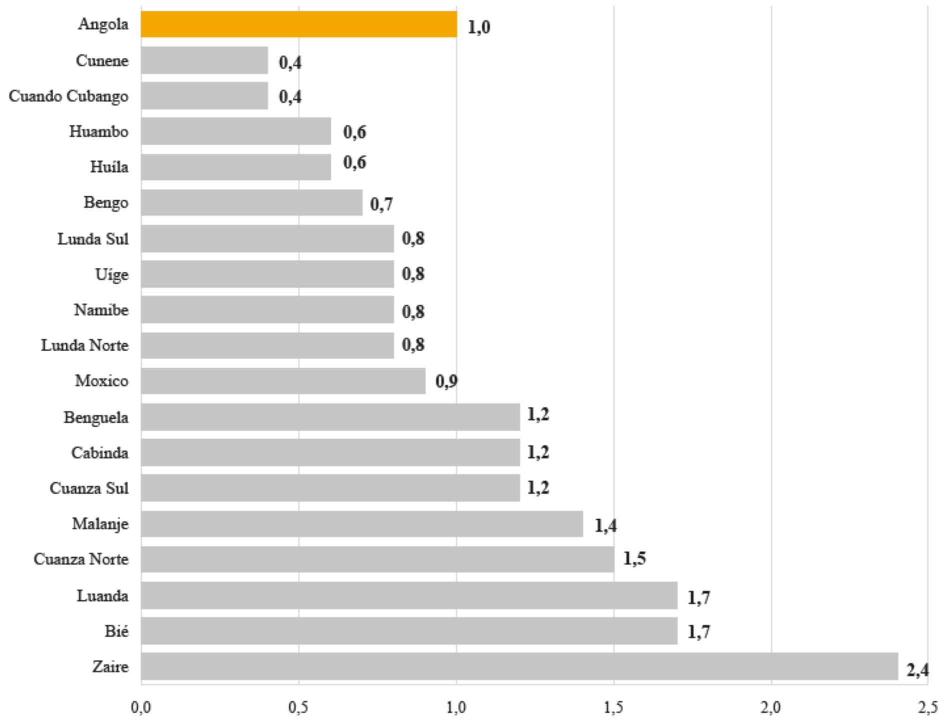

Figure 233: Heads of producer households, according to the frequency of agrarian training by Province (%) (RAPP 2019-2020, Volume III)

Most people engaged in agricultural activities in Luanda are subsistence farmers, as there isn't much open land for commercial farming. The main crops produced in Luanda province include:

- Com ;
- Cassava ;
- Sweet potatoes ;
- Legumes; and,
- Oilseeds

Based on the field survey, the most relevant aspects of the occupation and agricultural activity are presented below.

Of the five-neighborhoods that were part of the sample, only agricultural surveys were carried out in two locations: Cacuaco and Ícolo e Bengo. The remaining three localities are primarily urban areas.

Lot 3 CD 3 area - Cacuaco

The majority of the population in Cacuaco survives from the street sale and marketing of agricultural products from other provinces such as Malange and Uíge, and the neighborhood has a stop for the flow of farm products.

In Belo Monte, there is a lot of unemployment. Young people are mainly dedicated to selling small services such as car washes, transporting goods and shoe shoes.

The family income is mainly obtained daily in informal services and varies between 500 and 12,000.00 kuanzas.

The enclave of Cacuaco produces diverse crops such as cassava, corn, tomatoes, onions, eggplant, and cabbage, among other vegetables, for self-consumption and sale, mainly in the areas of Funda and Quifangondo for the benefit of the population of the Municipality and other points of the Province of Luanda.

The fieldwork covered ten farmers from the **Belo Monte neighborhood** with the following profile:

- Gender – 50 % male and 50 % female ;
- Middle ages – 46 years ; 33 % aged between 46 and 55 years ;
- The average value of persons residing in the household – 5.6 (between 1 and 12);
- Land ownership – 100 % provided by the owner for cultivation;
- Most cultivated products - Kale, lettuce, gimboa, tomato, onion and jindungo;
- The main destination of the products – consumption and sale (100 %);
- Average travel time between housing and farmland (on foot) – up to 30 minutes (20 %), between 30 minutes and an hour (30 %), up to 2 hours (50 %);
- Main obstacles to the development of agricultural activity :
  - Lack of land (one in ten) ;
  - Lack of fertilizers (five out of ten) :
  - Transport for the disposal of products (one in ten) ;
  - Lack of power and water supply (nine in ten).
- What are the main concerns and expectations about the proposed project? - Improvement in water distribution to improve the quality of life.

Lettuce plantation.

Kale plantation.

Figure 234: Angola – Example of crops in the area surrounding the survey - DC 3, Bairro Belo Monte - Cacuaco.

Lot 1 WTP area – Ícolo and Bengo

Most of the population of Bom Jesus has as a means of subsistence agriculture, fishing, and sale of agricultural products, and few have a formal job. The unemployment rate is very significant. On average, households have an income ranging from 35,000.00 Kz to 230,000.00 Kz per month (Survey Field).

Most of the inhabitants of Bairro Bom Jesus own the land they occupy. Most of them are inheritances of their ancestors, and a number are considered to occupy the ground without any administrative intervention.

The developed agriculture is the family's most significant cultivation destined for own consumption and sale on small scales.

The Good Jesus is considered a neighborhood of a commune where the fishing activity is quite significant. Fishing is developed along the Kwanza River. Many of the households are engaged in fishing. Men as fishermen and women as fishmongers (treatment and marketing of fish). Another activity has to do with the creation of animals for commercialization and consumption.

The neighborhood does not have land reserve areas, areas of natural conservation, or traces of war. There is the practice of family farming; it is possible to identify crops along the neighborhood , and in some cases, the fields are found inside the residences or in the back.

The primary natural resources of the Municipality are substantiated in continental and marine fishing, arable land with the capacity to develop agricultural and livestock products and giving rise to light and heavy processing industries.

The Kwanza River, located a few kilometers from the neighborhood , is the largest natural water resource, originating from water lines along the commune and the Municipality.

The fieldwork covered ten farmers from the **Bom Jesus neighborhood** with the following profile:

- Gender – 40 % male and 60 % female;
- Middle ages – 38 years; 33 % aged between 36 – 45 and between 46 – 55 years;
- The average value of persons residing in the household – 4.8 (between 2 and 9);
- Land ownership – Land ceded by the State (10 %) / Inherited land (90 %);
- Most cultivated products – okra, tomato, onion, cucumber, gindungo, mangoes, guava, cassava, corn, banana ;
- The leading destination of the products – processing and sale (10 %) / sale (90 %);
- Average travel time between housing and farmland (on foot) – up to 30 minutes (50 %), between 30 minutes and an hour (10 %), up to 2 hours (40 %);
- Main obstacles to the development of agricultural activity :
  - Lack of fertilizers (four out of ten) :
  - Transport for the disposal of products (six in ten) ;
  - Lack of power and water supply (three in ten) ;
  - Others - Motorcycle pumps and hoses (two in ten).
- What are the main concerns and expectations about the proposed project? – Enough water for cultivation, improvement in water distribution, and the project being carried out.

Animals' creation.

Cassava plantation.

Figure 235: Angola – Example of animal creation and crops (Cassava) in the area surrounding the survey – Lot 1 WTP are Bom Jesus – Icolo e Bengo.

7.3.6.3 Commerce

The services, or tertiary sector, employed most people in Angola and still uses over 40 % of the labour force today. One of the primary industries in the tertiary sector is tourism and hospitality.

The Gross Value Added of Trade had an increase of around 2.5 % in the first quarter of 2023 compared to the same quarter of the previous year, contributing positively by 0.46 p.p. in the total variation of GDP. In real terms, there have been increases in both imported and domestically produced goods (INE, 2023).

The Gross Domestic Product in the first quarter of 2023 totaled 13,521,227 million kz, of which 165,818 million kz to Taxes on Products net of Subsidies.

Considering the Value Added of some activities in the quarter, Agriculture recorded 1,256,036 million Kz, Fisheries 711,481 million Kz, Oil extraction and refining 3,034,141 million Kz, Extraction of diamonds, Metallic and other non-metallic minerals 133,903 million Kz, Manufacturing 983,868 million Kz, Electricity and water 132,436 million Kz, Construction 916,666 million kz and **Trade 3,741,882 million Kz**.

The value added to commercial activities represents about 28 per cent of the total gross product added in the first quarter of 2023.

The commercial activity in Luanda and the municipalities of the project area is done in establishments of different nature and size, markets, such as the market of Km 30, and along the roads in a disorderly way. The Government of Luanda is working to end uncontrolled trade on public roads, assigning places to vendors in the various local markets.

This practice of selling along public roads has several negative aspects, namely road and pedestrian safety, the accumulation of garbage along the streets and hygiene and public health issues. The official authorities estimate that there are close to 200 markets and more than 57,000 stalls in the municipalities of Luanda Province.

By reordering trade, the Provincial Government of Luanda (GPL) does not intend to end street vending in the Province. The itinerant sale is a legal activity enshrined in the Law, based on article 1/07 of 14 May, referring to Ambulatory Trade.

The Trade Reorganization Plan carried out by the LPG has awareness as a primary element to reorganize this activity, especially for the vending machines that are installed in inappropriate places, such as sidewalks and berms, among others, which constitute a danger to those who sell and to those who buy, as well as to public health.

The more than 300 warehouses closed in Luanda dedicated to marketing wholesale and retail products have already secured new establishments, about 200, according to information provided by the GPL. These new establishments will be distributed throughout Cacucaco, Viana and Cazenga municipalities.

According to news published in the Angolan media, within the scope of the reorganization of trade "There are, in the municipality of Luanda, 13 markets, with 2800 vacancies; **in Cacuaco, 21 markets, with 14,262 vacancies**; Cazenga, 12 markets, with 39,479 vacancies; **Icolo and Bengo, three markets, with 750 vacancies**; Belas, 22 markets, with 7,683 vacancies, Quiçama, 08 markets, with 386 vacancies, Kilamba Kiaxi, 16 markets, with 3,397 vacancies; Talatona, 16 markets, with 3,846 vacancies; **and Viana, with 33 markets and 4,100 vacancies**, making a total of 144 markets and 76,800 vacancies available," he said, noting that LPG has created all the conditions to welcome the zungueiras with dignity in the markets where they can trade smoothly".

In the municipality of Viana, namely in the localities of Calumba and Km 30, there are 12 official markets called municipal and neighborhood and ten informal, according to the 2013 Report of the Administration of Viana and information from the Municipal Bureau of Commerce. The largest markets are Km30, Regedoria and Viana 2. Each market registers a large turnout, with more than 2,000 people.

The following figures illustrate some forms of formal trade and street vending obtained in the field survey conducted between 31 July and 4 August 2023.

Figure 236: Formal and street trade. Area of Lot 3 CD - Cacuaco

Figure 237: Formal and street trade (waste left on the ground). Area of 4 CD – Zango 5

Figure 238: Formal and street trade in the area of Lot Lot 6 CD – Km 30

Figure 239: Formal and street trade in the area of Lot 1 and Lot 10 – Bom Jesus

7.3.6.4 Livestock and Hunting

For rural households, in particular, keeping livestock plays a significant economic and socio-cultural role in maintaining the well-being of farm families by providing food security, nutrition, income, soil productivity, transport, agricultural traction, and diversification. In urban areas such as Luanda, the dependence on livestock is slightly less significant and is generally on a smaller subsistence scale but remains essential.

About 80 % of all livestock in Angola is cattle, and the remaining 20 % comprises poultry, pigs, sheep, and goats. Livestock is mainly farmed in the southern provinces of Huíla, Cunene, Benguela, Huambo and Namibe. Due to Luanda’s rising population and associated urban sprawl, open space for grazing larger animals such as cattle is in short supply.

Several pieces of legislation offer entry points for community-based natural resource management, particularly regarding land rights, land-use planning, forest management (logging), use of forest products (e.g. wild fruits, charcoal, and firewood), artisanal fisheries, and water. Legislation on forest, fishing and water explicitly enables the management of natural resources explicitly by communities through establishing associations and/or cooperatives. This marks an attempt to move from strict protection of natural resources to a more sustainable management of resources by communities. The Environmental Framework Law of 1998 has a largely protectionist approach (rather than sustainable utilization). The Wildlife and Conservation Areas Law is being revised, and it is unclear to what degree it will cover the rights of people living inside or near conservation areas.

Due to the long civil war, the colonial-era network of conservation areas and its physical infrastructure was severely damaged through the direct impacts of war, extensive Hunting, and, in many cases, agricultural encroachment (UNDP, 2017). Since Independence, the national conservation area network has been expanded, but it faces challenges, including weak administration and is characterized today by degraded infrastructure and low capacity.

The core causes of the poaching and illegal wildlife trade are related to poverty and the consequences of the long-armed conflicts and post-conflict impacts, including unemployment and lack of alternative livelihoods; ex-combatants with no other skills; loss of respect for old traditions; high demand and relatively good income in bushmeat and wildlife trade; and existence of cross-border illegal wildlife trade networks. Angola’s conservation areas are shown in Figure 240.

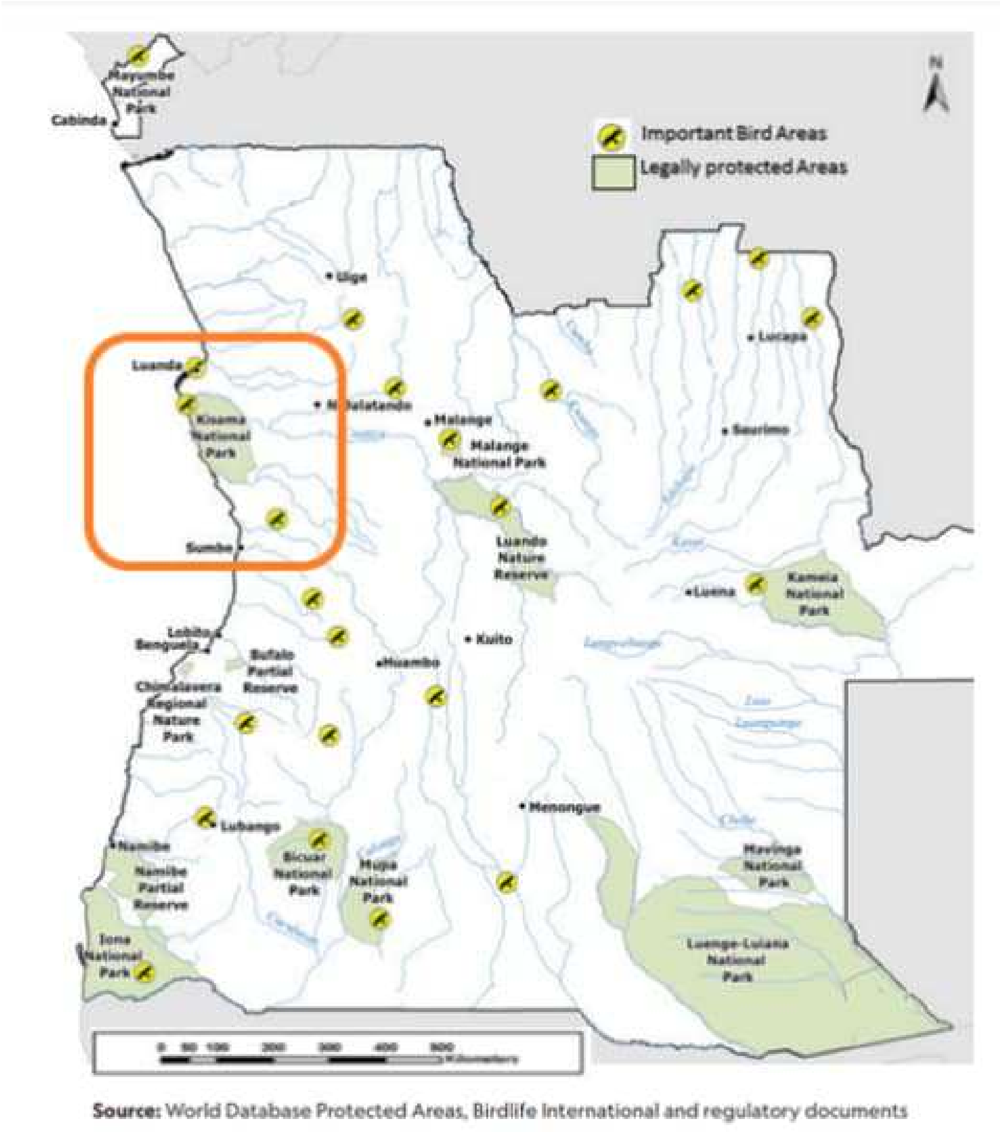

Figure 240: Angola´s Conservation Areas and Important Bird Areas (Angola´s Conservation Areas and Important Bird Areas s.d.)

Communities are living inside most of Angola's conservation areas. National parks such as Quiçama, Cameia and Mupa have thousands of people inside, while others, such as Cangandala and Iona, have smaller numbers.

Human-wildlife conflict is also a severe concern in the zones adjacent to conservation areas and where communities live within the boundaries of conservation areas (including Iona, Quiçama, LuengueLuiana, Maiombe and Mavinga National Parks). Elephants, in particular, cause damage to crops and homes, injuring or even killing community members, provoking a negative attitude towards the parks and the authorities, and resulting in retaliatory killing of animals (UNDP, 2017).

7.3.6.5 Fishing

Fishing in Angola is an important socioeconomic activity that contributes to food security. This is particularly true of coastal communities. However, despite having plentiful fishing resources, Angola still imports horse mackerel from Namibia and South Africa to ensure food security for those inland. This is because a poor transport network inhibits the movement of goods, including fish, from the coast to inland areas.

In Luanda, artisanal fisheries are an essential source of income and food for communities along the coastline and riverside areas of the Kwanza. Apart from the food component, the fishing industry in the province of Luanda is of considerable economic value, occupying important fringes of the population, which depend on fishing as a source, almost exclusively, to generate income.

The Development of Fishing Activities and Fish Processing is essential to meet the needs of this population group, increase production levels, improve the population's fish supply, improve and operate the infrastructure and equipment to support the activity, reactivating the Luandaners shipyards, as well as the structures of the vocational training sector and improve the living conditions of the nuclei of artisanal fisheries, particularly in areas of Barra do Bengo, São Pedro da Barra and Samba/Mussulo.

Artisanal fishing also contributes as a source of income for the population of Luanda, especially that found along the coastline and in the riverine areas of Bengo and Kwanza. The development of inland fisheries extends the municipalities of Viana over the Kwanza River, including the Cacuaco Kilunda Lagoon, to the Bengo River. The fisheries sector in Luanda is currently characterized by seven significant areas of activity: fisheries production, processing, marketing, business maintenance, repair and shipbuilding, aquaculture, and supervision. Aquaculture is one of the activities that has recently begun to earn interest, becoming implanted in Luanda with the help of big investors.

The main fishing port in Luanda is Porto da Boa Vista, but Porto Commercial and the coal pier are also used when necessary.

Fisheries Program 2018-2022

This initiative is included in the National Development Plan of Angola 2018–2022 (Ministério da Economia e Planeamento, 2018), the country's second medium-term development plan. The plan aims to promote socioeconomic and territorial development nationwide, in synchrony with the Angola Long Term Strategy (Angola um País com Futuro 2007) which plans to go beyond economic dependence on oil and gas. The inland fisheries part of the Fisheries Program aims to increase fisheries production by 13 % yearly.

Aquaculture is also foreseen in this program, with 260 existing tanks in the Province that can link food security to economic diversification.

In 2018, 2019 and 2020, 4,745 were registered fishermen; 3,842 and 4,226 respectively engaged in industrial and semi-industrial fishing. However, as of 2019, continental and sea artisanal fishing reported 70,788 fishermen and 25,849 women fish processors.

In those years, it licensed 271 fishing vessels (industrial and semi-industrial). As for artisanal fishing, until 2019, it registered 17,506 ships, of which 7,912 are from artisanal maritime fishing, of which 4,965 have licenses and 9,594 from continental artisanal fishing.

Table 92 shows the number of fishermen registered in the different years, of which most of these workers are located in the Province of Luanda and assigned to industrial fishing.

Table 92: Population working in fishing by segment, according to Province 2018-2020 (INE, Anuário Estatístico das Pescas 2020, Edição 2021)

Province	2018		2019		2020	
	Industrial	Semi-industrial	Industrial	Semi-industrial	Industrial	Semi-industrial
Luanda	2919	420	2037	420	2016	420

Luanda (%)	75.1	48.8	68.3	48.8	61.5	44.2
Total Angola	3885	860	2982	860	3276	950

Regarding the fishermen registered in artisanal maritime and continental fishing, until the end of the year 2019, there was a record of 96,637 workers distributed at the level of the various provinces, of which 70,788 (73.3 %) are fishermen and 25,849 (26.7 %) are women fish processors. The provinces of Benguela (16.7 %), Luanda (17.3 %) and Moxico (21.9 %) concentrate more than half of the workers in artisanal maritime and continental fishing in both sexes.

The activity of small-scale continental fishing has a total record of 49,540 workers (Graph 8), of which 40,665 (82.1 %) are fishermen, and 8,875 (17.9 %) are Women fish processors (Graph 9) and (Graph 10). The Province of Moxico has the most significant number of fishermen (52.1 %) engaged in inland fishing, followed by the Provinces of Cunene (14.0 %), Luanda (11.1 %), Bié (12.2 %) and Bengo (9.9 %). Women fish processors have the highest incidence in the provinces of Cunene (21.0 %), Luanda (17.0 %), Moxico (14.0 %) and Bié (14.0 %).

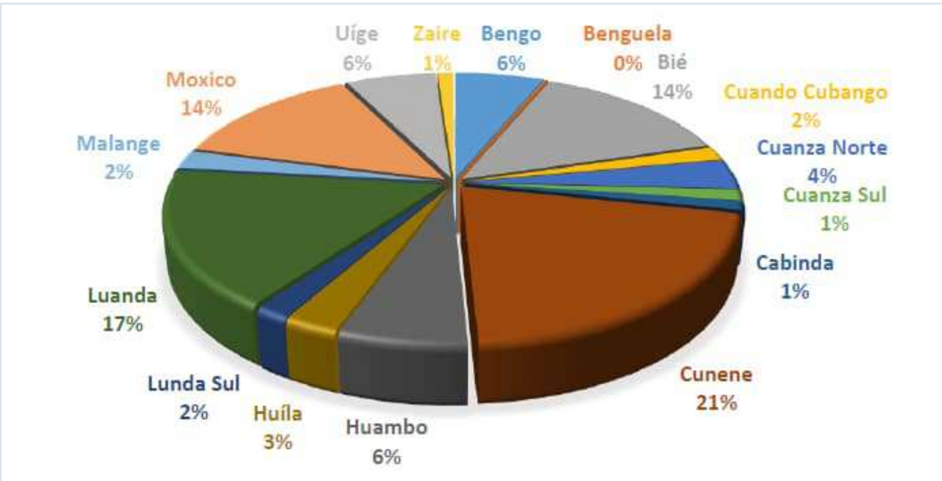

Figure 241: Percentage distribution by Province of women fish processors in continental artisanal fisheries (INE, Anuário Estatístico das Pescas 2020, Edição 2021)

The fisheries industry generates a significant portion of Angola's non-oil exports, but production for the domestic market needs to be expanded. The sector accounted for 3.5 per cent of GDP in 2015, with 96.2 per cent of that contribution coming from marine fisheries. The primary marine resources include sardinella, horse mackerel, shrimp, crabs, sea breams, swordfish, squid, and octopus.

Fishing is a significant source of livelihood for Angolans, with 150,000 people working in the sector, including jobs in fishing, gathering, processing, and selling.

Angola's formal fish exports were estimated at $81 million in 2018, mainly consisting of high-end shrimp, crab, and tuna, but it can vastly increase the value of its exports. Nearly half of the population in many coastal areas relies on fisheries for livelihoods, and women account for up to 80 % of the people involved in artisanal fish processing and marketing (UNCTAD 2023).

Export earnings in the last three years were 105,679 tons of fishery products; this export was valued at Kz 105,561.88 billion, and there was the most significant volume (63.7 %) of exports of Crustaceans followed by fish (30.2 %) (INE, 2021).

The Gross Value Added of Fisheries decreased by 6.5 % in the first quarter of 2023 compared to the same quarter of the previous year, contributing negatively by 0.23 p.p. to the total variation in GDP. This decrease was due to the low catch of sea fishing in the same period in question, as This is associated with climatic factors (migration of species from one site to another (INE, 2023).

Fish are an important food resource for Angola, accounting for roughly 25 per cent of the total animal protein intake in the country. A lack of processing and storage facilities hampers domestic and international trade in fish and fish products. Products from artisanal fisheries are consumed locally, with little infrastructure and poor hygiene and handling conditions in landing sites.

In the localities of the project area, only in Bom Jesus, 10 of the interviewees declared to practice fishing activity.

7.3.6.6 Mining

Angola has considerable non-diamond mineral resources, but they are poorly exploited. Subsoil resources in the country include iron, gold, copper, zinc, lead, manganese, and phosphate. Despite this wealth of deposits, Angola's non-diamond mining products include only quarried building materials and manufactured cement.

After crude oil, diamonds have traditionally been the category with the most significant weight in Angolan exports, although, in recent years, they have been supplanted by natural gas. Lunda Norte and Lunda Sul are the central mining provinces in Angola. In 2022, diamond exports yielded US$1,945.5 million, for a volume of 8,745.5 thousand carats and a price of US$222.5/carats. The cost of oil and the price of diamonds maintain some uniformity throughout the series analyzed, with a significant increase in the last two years.

The Gross Value Added of Diamond grew 22.9 % in the first quarter of 2023, concerning the same quarter of the previous year, contributing positively by 0.32 p.p. to the total variation in GDP. This significant increase was due to industrial diamond production in the quarter from the Luaxe and Tchegi mines (INE, 2023).

7.3.6.7 Harvesting and Local Communities

Commercial use of timber and other forest resources by communities is possible through community forests with cooperatives. Under Presidential Decree nº 171/18 of July 23rd, which approves the Forest Regulation and the National Policy on Forest, Wildlife and Conservation Areas (Resolution nº 1/10 of January 14th), commercial logging operators are required to support the local communities in the areas of their concessions.

They do have to follow the recommendations expressed in the Forest Regulation approved by Presidential Decree nº 171/18 of July 23 on community consultation about logging operations. Since logging concessions are only for five years, companies have little incentive to make longer-term investments apart from a legal obligation to establish plantations, which are likely to be fast-growing exotic species. Some could cause harm if planted in sensitive areas (e.g., Eucalyptus species could lower the water table and affect community water supplies, possibly increasing vulnerability to climate change; exotics could become invasive).

In the direct incidence of the Project areas, no significant harvesting activity was identified.

7.3.7 Community Health, Safety and Security

7.3.7.1 Health Conditions

The health system in Angola is composed of a large public system, managed by the State, called the National Health System (SNS), which serves the majority of the population, and also by the private sector, managed by private health insurance funds and private entities, and non-profit entities.

The health system in Angola is basically divided into 3 levels: primary, secondary, and tertiary. The primary network includes health posts/centers and municipal hospitals. The secondary network contains provincial and regional hospitals (these two networks are administered by provincial governments). The tertiary network is made up of reference and national hospitals, cardiac surgery centers, ophthalmological centers, haemodialysis centers and cancer treatment centers. This network depends on the Ministry of Health (MINSA).

While access to health services does not reach certain regions, it is replaced by clinics that work in a complementary way to the main public health institutions. Public health care in Angola is free and mandatory, and the private network is obliged to provide first aid care, regardless of the patient's purchasing power. The SNS is made up of close to two thousand facilities, of which eight central hospitals, 32 provincial or general hospitals, 228 municipal hospitals and health centers and 1,453 health posts. Health care in Angola is complemented by the private sector, which has 319 clinics across the country (https://www.jornaldeangola.ao/ao/noticias/hospitais-publicos-de-luanda-atendem-casos-ligeiros/ accessed in February 2023).

The coverage of municipalities in Angola with primary health units grew from 25 % in 2017 to 60 % in 2022, according to government data released. According to the analysis, the increase is the result of significant state investments in the last five years for the expansion and modernization of large, medium, and small infrastructures.

Regarding epidemiological data, the **2015-16 Multiple Indicator and Health Survey**, implemented from October 2015 through March 2016, is designed to provide data for monitoring the population and health situation in Angola. It is the first Demographic and Health Survey and the fourth Multiple Indicator Cluster Survey conducted in Angola.

The objective of the 2015-16 IIMS is to provide current information concerning the demographic and health situation of women, men, and children, including fertility levels, marriage, sexual activity, fertility preferences, family planning methods, childhood and maternal mortality, maternal and child health, breastfeeding practices, nutrition, malaria, HIV/AIDS, domestic violence, and child wellbeing.

A nationally representative sample of 14,379 women aged 15-49 in 16,109 households and 5,684 men aged 15-54 in half of selected households were interviewed in the 2015-16 IIMS. This represents a response rate of 96 % for women and 94 % for men. The sample design for the 2015-16 IIMS provides estimates at the national and provincial levels and for urban and rural areas.

Considering the information available, the main health problems considered in the study area include:

- **Typhoid:** the bacteria Salmonella Typhi is spread when someone comes into contact with the excreta of an infected person.
- **Trachoma:** can be contracted via contact with an infected person but also, particularly in developing countries, via eye-seeking flies. The main risk factors for developing this disease include poverty, crowded living conditions and poor sanitation.
- **Dengue Fever:** similar to malaria and yellow fever, dengue fever is spread via mosquitoes which are attracted to stagnant, dirty water and often congregate around municipal waste.
- **Leptospirosis:** spread via the urine of infected animals. This is a problem in the study area because there is limited knowledge and practice of hygienic behaviors.

In addition to the health issues mentioned above, the following are also highlighted, with some prevalence in the suburbs of Luanda.

Child Undernutrition - Undernutrition is defined as "the outcome of insufficient food intake and repeated infectious diseases. It includes being underweight for one's age, too short for one's age (stunting), dangerously thinking for one's height (wasting) and deficient in vitamins and minerals (micronutrient malnutrition)".

Malaria: is a parasitic disease spread by mosquitoes and is most common in the following groups in Angola:

- Children under five;
- Pregnant women; and,
- Patients with other health conditions (e.g. HIV/AIDS or Tuberculosis).

While diarrheal diseases are the most deadly across Angola, malaria is the principal cause of mortality in Luanda's informal musseque areas, due to a combination of poor drainage, flooding and a lack of sanitation.

Tuberculosis – Tuberculosis (TB) is a communicable, airborne disease that can pass from one person to another when an infected individual coughs, sneezes or speaks. TB is still a major concern for Angola.

Angola ranks among the countries with the most TB cases per year. TB remains the third leading cause of death among people aged 15-49. Health service coverage is low, especially among lower-income people in rural areas, with 60 % of TB services located in Luanda, the capital. In 2020, GeneXpert machines used to detect TB were diverted for COVID-19 testing, which met urgent needs during the pandemic but may have contributed to limiting TB case reporting.

But Angola is seeing progress. In 2022, the Government of Angola, UNDP and Global Fund partnership to fight TB **reached 95 % of its target for case reporting**, a significant indication that patients are being found. Among those cases, **80 % were cured of TB**.

Angola's neonatal and infant mortality rates for the five years before the survey were 24 and 44 deaths per 1,000 live births, respectively. The under-5 mortality rate is 68 deaths per 1,000 live births. This means that 1 in every 15 children dies before their fifth birthday.

Mortality rates differ by residence, province, and household wealth for the ten years before the survey. Children in rural areas are more likely to die before their fifth birthday (98 deaths per 1,000 live births) than children in urban areas (68 deaths per 1,000 live births). The under-5 mortality rate is 2.5 times higher among children in the lowest two wealth quintiles than among children in the highest quintile (102 and 103 deaths per 1,000 live births in the first two quintiles versus 39 in the highest quintile).

Eight in ten (82 %) women aged 15-49 received antenatal care (ANC) from a skilled provider (doctor, nurse or midwife). Although coverage of ANC is 92 % in urban areas, it is only 63 % in rural areas. Eighteen per cent of women in Angola did not have any ANC visits.

Less than half (46 %) of births in Angola take place in health facilities (primarily in the public sector). Conversely, 53 % of births occur at home. Half (50 %) of births are assisted by a skilled provider.

Health facility births are more common in urban areas than in rural areas (65 % vs. 17 %). Women in the wealthiest households are much more likely to give birth in a health facility than women in the poorest households (86 % vs. 12 %). Provincially, health facility births range from 17 % in Bié to 86 % in Zaire.

The 2015-16 IIMS asked women about the deaths of their sisters to determine pregnancy associated with pregnancy and childbearing. The pregnancy-related mortality ratio is 239 deaths per 100,000 live births (confidence interval of 164 to 313). In other words, for every 1,000 live births in Angola during the seven years before the 2015-16 IIMS, approximately two women died during pregnancy, during childbirth, or within two months of childbirth.

Malaria is ten times more prevalent among children from the poorest households (greater than 20 % in the first two quintiles) than among children from the wealthiest households (2 %). Prevalence is also greater in rural areas (22 %) than in urban areas (8 %). By province, malaria prevalence ranges from <1 % in Cunene to 40 % in Moxico.

Having multiple sexual partners increases the risk of contracting HIV and other sexually transmitted infections (STIs). A small percentage of women (2 %) and 18 % of men had two or more sexual partners in the year before the survey. Among women and men with two or more partners in the past year, 24 % of women and 30 % of men used a condom at the last sexual intercourse. Men in Angola have more sexual partners in their lifetime than women (6.7 vs. 2.0).

As for the Project's AoI, there are available two documents with Municipal Data, namely the Municipal Sanitary Development Plan for Viana (PDDS 2013-2017 – November 2014) and Cacuaco (PDDS 2013-2017 – October 2014), that include specific information for the epidemiological status of these municipalities.

According to these reports, in the 2009-2013 period, the main diseases registered in the region were Acute Malaria, Diarrheal Disease, Acute Respiratory Disease, Typhoid fever, Dysentery, sexually transmitted infections, Acute Malnutrition, HIV-AIDS, Schistosomiasis, Xerophthalmia, Tuberculosis and others.

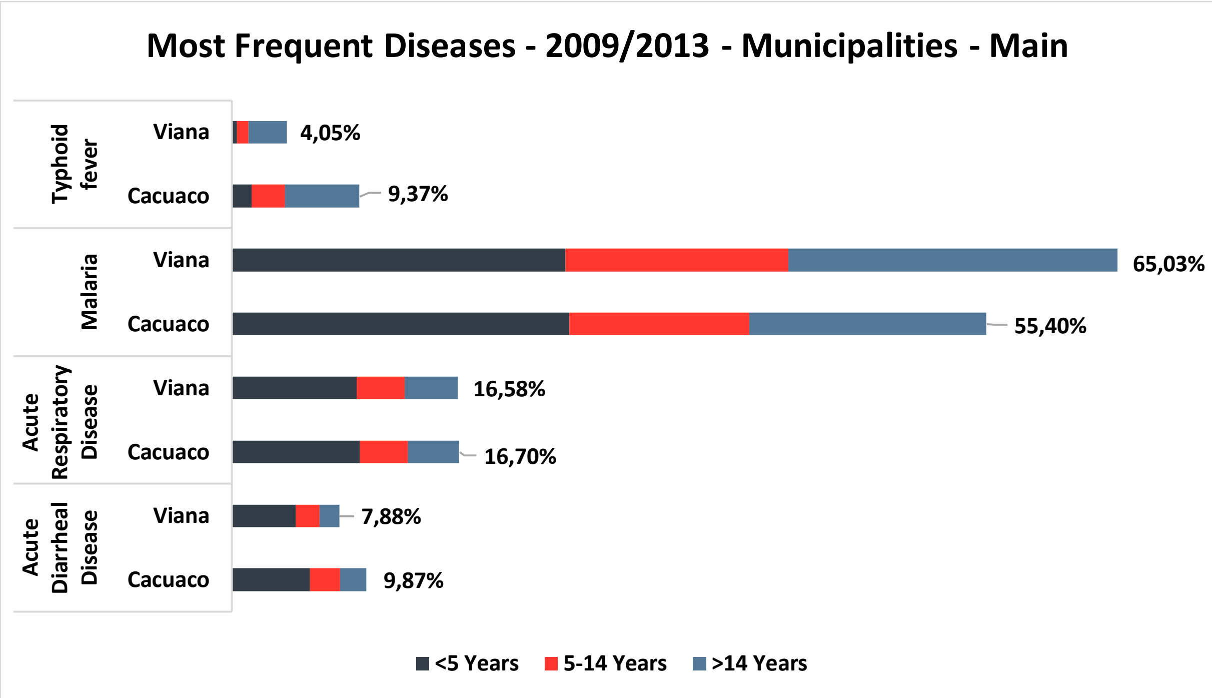

Figure 242 : Most frequent diseases in Viana and Cacuaco Municipalities (PDDS Viana and Cacuaco)

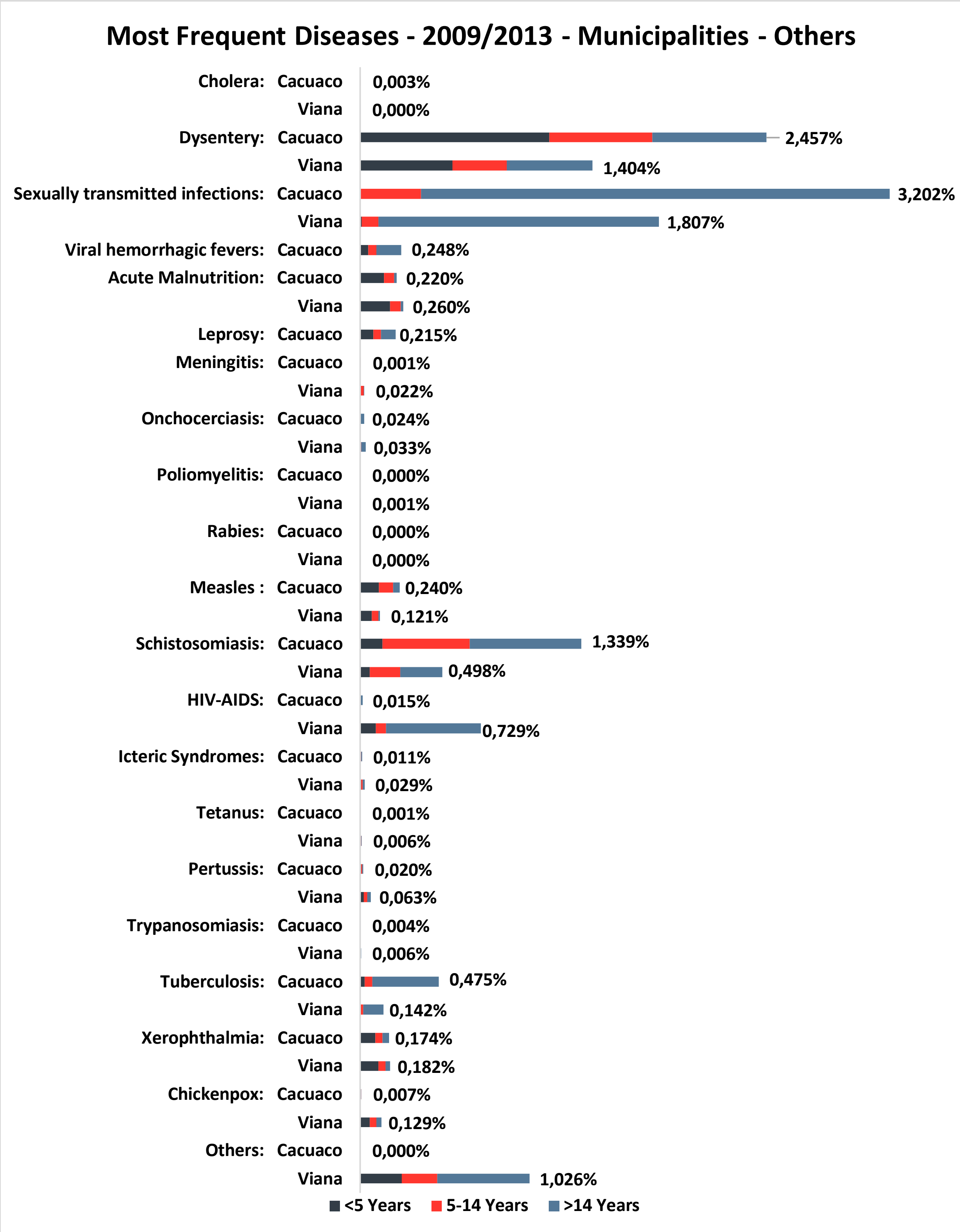

Figure 243: Other diseases registered in Viana and Cacuaco Municipalities (PDDS Viana and Cacuaco)

7.3.7.2 Domestic Violence

According to the data from the 2015-16 (IMS 2017) almost one-third (32 %) of women aged 15-49 have experienced physical violence since age 15. In the past year, 22 % experienced physical violence. Experience of physical violence after age 15 is greater among women who are employed and paid in cash (37 %) than among unemployed women (29 %) and women who are employed but not paid in cash (28 %).

Among ever-married women who have experienced physical violence since age 15, nearly three-quarters (73 %) reported that their current husband/partner committed the violence. Among never-married women, the most common perpetrator of physical violence is their mother/stepmother (31 %).

Eight per cent of women aged 15-49 have ever experienced sexual violence. Experience of sexual violence is greater in urban areas than in rural areas (9 % vs. 6 %). Five per cent of women experienced sexual violence in the last 12 months.

One-third (34 %) of ever-married women aged 15-49 experienced spousal violence, whether physical or sexual. Experience of spousal violence ranges from 11 % in Cuando Cubango to 57 % in Malanje. One-quarter (26 %) of ever-married women experienced spousal violence within the past year.

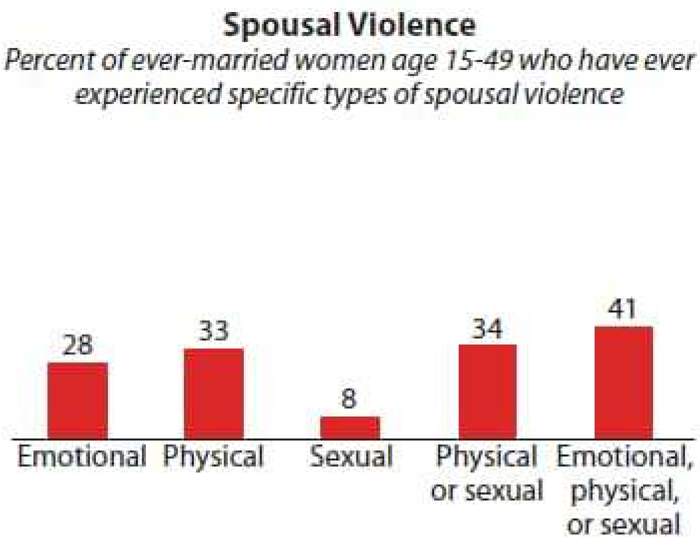

Figure 244: Spousal Violence (Key Findings of the 2015-16 Angola IIMS)

7.3.7.3 Prevalence of Disabilities

According to the United Nations Convention, a person is considered to have a disability if he or she has physical, intellectual or sensory impairments, which, in interaction with various barriers, may obstruct his or her full and effective participation in society like other people.

In 2014, the prevalence of disability in the population residing in the province of Luanda was 2.2 %, corresponding to 154,727 persons with disabilities, of which 86,718 are male, representing (56 %) and 68,010 female, representing (44 %).

Among people with some kind of disability, 16 % reported having a mental disability, 16 % are paralyzed and 11 % have their lower limbs amputated, 8 % are blind, 8 % have their upper limbs amputated, 4 % are deaf and 4 % are mute.

The following figure summarizes the data regarding disabilities for the population living in the province, municipalities and communes covered by the study area, by type of disability (Luanda Census Report 2014)

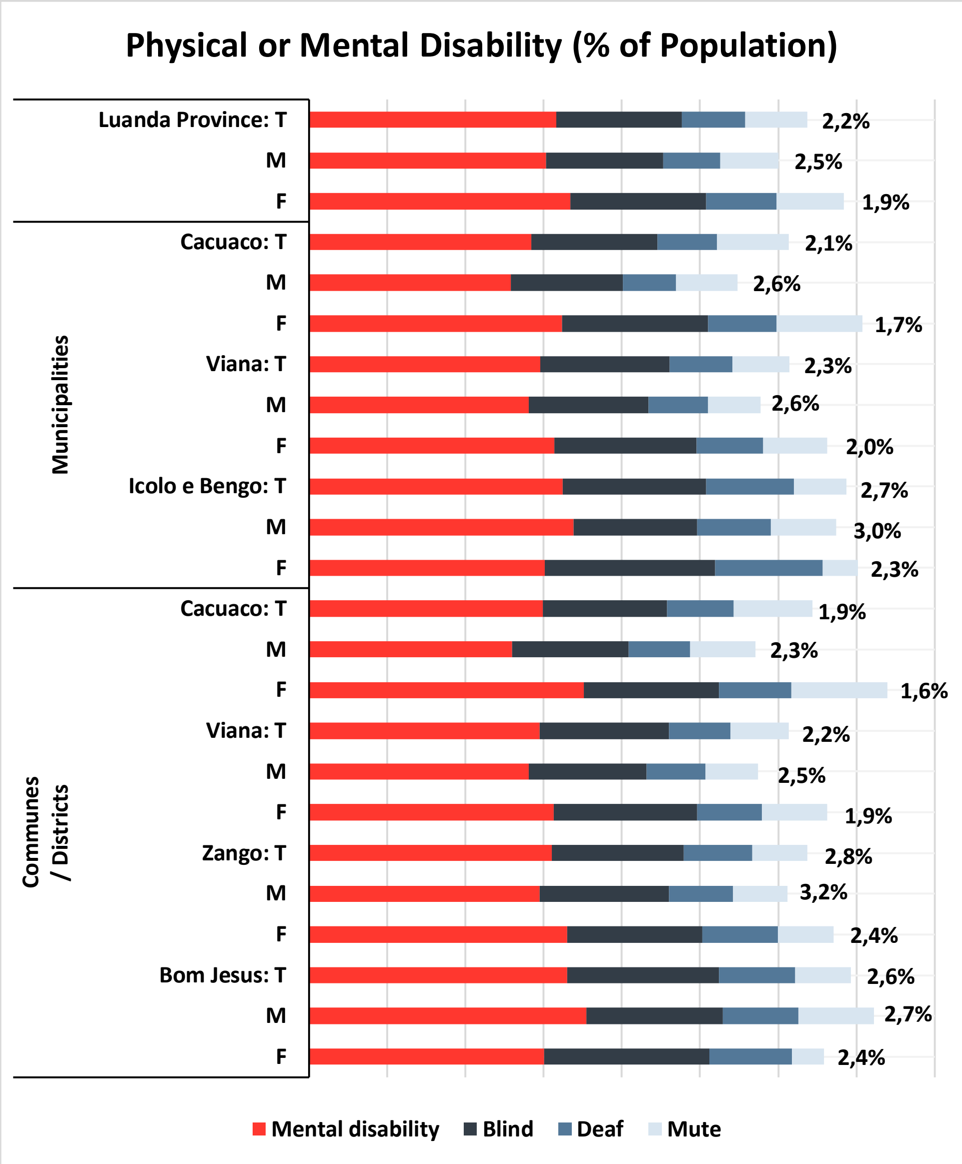

Figure 245: Disability Rates (2014 Census)

7.3.7.4 Public Safety

7.3.7.4.1 Land Mine Safety

During the civil war land mines were used by all parties, including foreign actors in the conflict. As a result, Angola is thought to be the most heavily mined country in Africa (Land Mine Monitor s.d.) Her Royal Highness Princess Diana of Wales visited Angola in January 1997 and drew international media attention to the issue. Later that year "The Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction", commonly referred to as the Mine Ban Treaty was adopted and formally enforced in March 1999 (The Guardian 2018).

NGOs such as the Mines Advisory Group and The Hazardous Area Life-support Organisation (HALO) Trust have been working to demine Angola for 23 years and have so far succeeded in destroying more than 125,000 weapons, 2.9 million bullets and 1,480 metric tonnes of degraded ordnance. However, progress is slow and, in a day, one demining team can cover about 30 m^2, which is not enough to meet the country's target of being mine-free by 2025, at current funding levels, it may take until 2046 for Angola to be completely mine-free (State of Play. s.d.)

The exact number of land mines in Angola is not known, estimates range from the conservative 500,000 to the exaggerated 20 million. As mentioned previously, much of the fighting took place in the countryside away from urban centers such as Luanda.

The southern Provinces are the worst affected, whereas Luanda, like many of Angola's urban centers, is widely believed to be mine-free. According to the survey by province, in 2023 in Luanda Province, there were still 9 Confirmed Hazardous Areas (CHA) that contained anti-personnel mines (Convention on the prohibition of the use, stockpiling, production and transfer of anti-personnel mines and on their destruction article 7 report 2022).

Table 93: Anti-personnel Mine Contamination by province on 12 April 2023

Province	Number of remaining Confirmed Hazardous Areas (CHA) containing anti-personnel mines	Square meters of CHA remaining (m^2)	Number of remaining Suspected Hazardous Areas (SHA) containing anti-personnel mines	Square meters of SHA remaining (m^2)	Total number of remaining Hazardous Areas (CHA & SHA) containing anti-personnel mines	Total square meters remaining (m^2)
Cuando Cubango	262	16,805,804			262	16,805,804
Moxico	203	11,789,031	40	1,458,846	243	13,247,877
Cuanza Sul	104	8,664,509	1	35,000	105	8,699,509
Lunda Sul	48	7,430,262	21	1,009,799	69	8,440,061
Bié	135	5,160,762	-	-	135	5,160,762
Huíla	36	3,339,594	-	-	36	3,339,594
Bengo	44	3,024,891	-	-	44	3.024.891
Cunene	42	2,325,517	-	-	42	2,325,517
Lunda Norte	48	1,672,480	10	143,913	58	1,816,393
Cuanza Norte	16	1,204,361	-	-	16	1,204,361
Cabinda	27	1,188,151	-	-	27	1,188,151
Luanda	9	1,121,211	-	-	9	1,121,211
Benguela	19	960,959	-	-	19	960,959
Zaire	1	315,000	-	-	1	315,000
Uige	1	206,350	-	-	1	206,350
Namibe	3	155,100	-	-	3	155,100
Malange	-	-	-	-	-	-
Huambo	-	-	-	-	-	-
Total	**998**	**65,363,982**	**72**	**2,647,558**	**1,070**	**68,011,540**

The project area of influence is unlikely to have any undetonated land mines as roads are well travelled and off-road areas have been explored and built on. The latest public available data from the HALO trust-CARTO maps is from 2016, and considered 3 confirmed minefields, namely:

- Centro de Emissão do Satélite, Village of Camicuto I – Code: CHA-6239 – At 8 km East of Cacuaco DC;
- KM44, Village of km44 – Code CHA-4691 – At 6 km North-Northeast of the WTP;
- Morro Cawe – Village of Kindongo – Code CHA-6206 - At 7.5 km North-Northeast of the WTP.

However, it should be noted that there has been significant efforts in demining in Angola, and the data from 2016 is probably outdated. Currently, the National Database (IMSMA) is managed by ANAM and its access is restricted to demining operators.

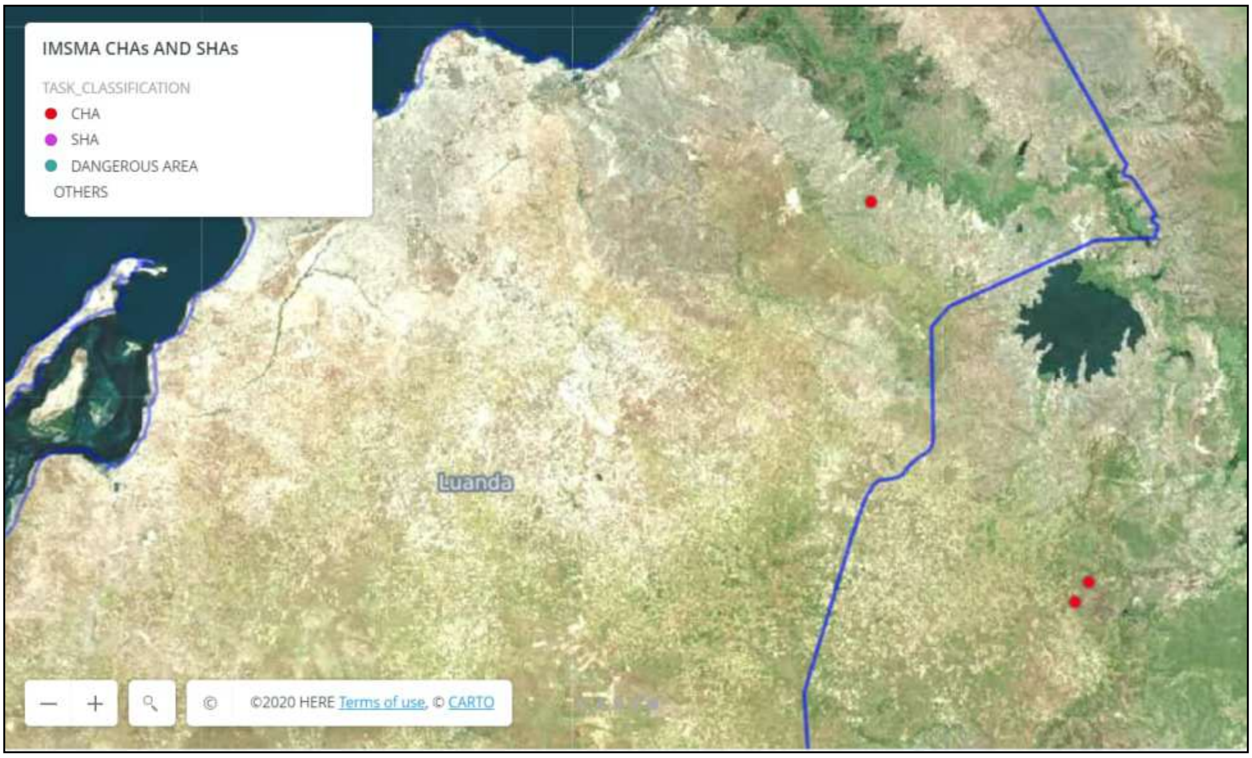

Figure 246: 2016 Angola IMSMA extract map, from Hallo Trust / CARTO

7.3.7.4.2 Road Safety

Generally, roads toward the west of Angola, on and near the coastline, are paved as they were the first to be rebuilt after the war. However, the majority of roads in the eastern half of the country are still unpaved. This can be a problem during the rainy season when sudden floods can wash away roads, and bridges and even dislodge undetonated ordnance.

Road accidents in Angola are currently one of the major causes of death in the country. Particularly Luanda, the capital, is the province that shows the highest rate in terms of accidents, deaths and injuries. However, in recent years there has been a decrease in the accident rate, with average growth rates of -6.73%, 0.19% and -2.54% for accidents, deaths and injuries respectively.

In 2022, according to data from the National Police, Angola recorded 2999 deaths and 15,693 injuries from a total of 13,360 road accidents, which means an average of eight deaths and 43 injuries per day.

Poor maintenance of roads and vehicles as well as unskilled drivers are blamed for the number of road traffic accidents. Compounding the situation further there is a lack of suitable pedestrian crossings and road safety awareness among Angolans. In Luanda footbridges are crossing main highways such as *Via Expresso* however many pedestrians opt to cross the road without using these, instead waiting for a gap in the traffic and running across. This behaviour is encouraged by the presence of zebra crossings on busy highways where such facilities are dangerous and ill-advised.

7.3.7.4.3 Crime

According to the Global organized Crime Index 2023, Angola registers a 5.58 criminality score, in a 70th position from a total of 193 countries assessed. It is considered in the 20th position of all 54 African Countries, and in the 4th position of the 11 Central African Countries.

Figure 247: 2023 Global Organized Crime Index – Criminality Score

The 2023 Angola Profile report from the Global Initiative Against Transnational Organized Crime, presents the following main conclusions:

- <u>People</u>: Angola is both a source of and destination for human trafficking, with both Angolan and foreign citizens targeted. In recent years there has been an increase in reports of human trafficking, suggesting a growing awareness of this market in the country. It is likely that human smuggling activities are increasing in parallel with the increase in trafficking. Foreign nationals seeking labor opportunities in Angola often solicit the services of smugglers, particularly from the neighboring Democratic Republic of Congo (DRC) and Namibia;
- <u>Trade:</u> The increased reporting of arms seizures from criminal networks lead to the assumption that firearms are easily accessible and widely used in the country, specifically by criminal actors involved in a variety of activities, including robbery. Most of the trade in counterfeit goods is related to pharmaceutical and electronic products such as cell phones, computers, tablets and their parts. There are large informal markets in the country, which are extremely difficult to monitor and manage. Angola mainly acts as a country of origin of and destination for the illicit trade in tobacco and alcohol.

- Environment: Illegal logging in Angola is carried out by both unauthorized fellers and concession holders exceeding their quotas or failing to replant trees illegally cut down. This has resulted in the loss of tree cover, which was at its highest ever in 2021. Angola is increasingly becoming a source country for illicit wildlife products. Angola is also a transit country for the illegal trade in pangolin scales, gorillas and wild birds, and recent reports identify the country as a potential transit point for the illegal lion and leopard trade. Conservation areas are poorly policed and hunting is inadequately regulated. Angola is rich in minerals and oil and, as a result, there is extensive trafficking of illicit diamonds and cross-border fuel and gold smuggling activities.
- Drugs: The heroin market has very little influence in the country. However, evidence suggests that the country is becoming a growing transit state for Afghan heroin moving towards Europe. Conversely, Angola is a cocaine trafficking hub, acting as a trans-shipment country for South American cocaine, mostly originating from Brazil and destined for Southern and West African countries as well as markets in Europe and the Middle East by sea and air. Cannabis, grown locally and also sourced from South Africa and Namibia, is the most consumed and commercialized illicit drug in the country. There is little evidence to indicate a substantial presence of synthetic drugs, apart from synthetic cannabis. However, the country is reportedly a transit point for methamphetamine manufactured in Nigeria and destined for South Africa
- Cyber-Crime: There are growing concerns about the vulnerability of the country to cyber-dependent crime – Angola is the African country most targeted by cyber criminals. In recent years, there has been an increase in such crimes, with estimated losses of USD$2.3 million in 2022
- Criminal Actors: State-embedded actors continue to constitute a major threat to the country despite the anti-corruption efforts of the government. Private sector actors, including but not limited to private banks and oil companies, are mainly involved in the financial crime market. The most pervasive foreign criminal actors are nationals from the DRC, who are involved in the illegal diamond mining industry. Chinese and Vietnamese criminal groups are also known to be involved in illegal logging, wildlife trafficking and human trafficking in the country, mostly through collaboration with Angolan nationals. There is evidence suggesting the slow emergence of mafia-style groups in the form of gangs in the urban centers, principally in Luanda, with a fixed territory usually defined by a neighborhood or municipality. The weak police presence in poor urban neighborhood s may account for the emergence of these groups and levels of gang violence and homicide are extremely high. Multiple small mafia-style groups were dismantled by the Angolan authorities in 2021 and 2022.

This profile report also presents the country's Resilience Score, which places Angola with a 4.50 Resilience score, on the 114th position on 193 Countries, 19th position on 54 African Countries and 3rd Position on 11 Central African Countries.

Figure 248: 2023 Global Organized Crime Index – Resilience Score

Regarding Resilience, the Profile report, presents the following main conclusions:

- Leadership and Governance: Despite the government's continued strong stance against organized crime and corruption and the efforts made in this respect, there is opposition to a comprehensive transformation of the country's political and economic systems and their practices. While many Angolans report a decline in corruption, most classify the government's performance in the fight against it as weak. They also believe the president is using the efforts against corruption as a political weapon rather than as a means of eradicating corruption. Government transparency and accountability are poor. Although there is greater transparency in the public procurement process, other areas remain opaque, including, for example, some high-profile appointments to positions within the government. Another key challenge is a lack of transparency in the extractive industries.
- Criminal Justice and Security: The judiciary is not independent and suffers from inappropriate executive control as the president nominates judges for each court and the executive rewards compliant judges with favourable paid positions as chairs of committees. The judicial system also lacks human and financial resources. Prisons are overcrowded and many inmates are denied basic human rights, living in unsanitary conditions and subject to sexual abuse. Law enforcement efficacy is impeded by corruption and a lack of resources and training. There are also concerns about police impunity, especially in light of an increase in arbitrary arrests and extra-judicial killings by law enforcement officials, especially of political activists and protesters. In 2022, there were increasing reports of battles between the Angolan armed forces and the armed group Frente de Libertação do Enclave de Cabinda, which fights for the independence of the province. Increasing pirate attacks along the western coast of the country also pose a new security threat in the region. Finally, although there is an increasing number of cyberattacks in the country there is a lack of capacity to address the situation adequately.
- Economic and Financial Environment: Despite achieving a number of high-profile prosecutions of former officials for money laundering, these do not necessarily reflect significant increases in the government's capacity to counteract the crime, to which Angola continues to be acutely vulnerable. Doing business in Angola presents substantial challenges, stemming from poor land and property rights alongside high levels of institutionalized corruption. The government has begun efforts to restore investor confidence by prioritizing anti-corruption and calling for the restructuring of state-owned enterprises.
- Civil Society and Social Protection: Government support for human trafficking victims continues to be ineffective and the country has not reported referring any identified victims for care. Although it did

launch a new hotline to receive reports of trafficking it has neither the staff nor the resources to investigate claims. Despite improvements made by the current leadership, freedom of the press is still limited, with criminal defamation laws as well as cyber-attacks used to censor journalists. There are also cases of physical persecution and intimidation of various journalists as well as academics and youth organizations and members of the public who protest against the government. Although civil society has been granted more leeway in recent years it remains weak, its protest actions are often suppressed and it has an antagonistic relationship with the Angolan government

The NUMBEO web portal (https://www.numbeo.com/), has some available crime data for Angola and specifically for Luanda. The latest available data is from December 2023, and is based on 68 inquiries for Angola, with 64 of them in Luanda City.

The NUMBEO portal considers the following assessment scale (both for Crime and Safety indicators):

- 0-20 – Very Low Crime Rate / Very Low Safety Rate
- 20-40 - Low Crime Rate / Low Safety Rate
- 40-60 – Moderate Crime Rate / Moderate Safety Rate
- 60-80 – High Crime Rate / High Safety Rate
- Over 80 – Very High Crime Rate / Very High Safety Rate.

Angola is considered as Having a High Crime Rate (66.45) and Low Safety Rate (33.55), with Luanda registering similar values (67,14 Crime Rate and 32,86 Safety Rate), with the following indicators.

Table 94: Crime and Safety Indicators - NUMBEO

Indicator	Angola		Luanda	
Level of crime	74.75	High	75.53	High
Crime increasing in the past 3 years	68.59	High	68.17	High
Worries home broken and things stolen	64.41	High	64.12	High
Worries being mugged or robbed	72.00	High	72.64	High
Worries car theft	58.07	Moderate	57.76	Moderate
Worries theft of car items	71.10	High	71.26	High
Worries being attacked	63.80	High	65.14	High
Worries being insulted	50.42	Moderate	51.34	Moderate
Worries being subject to a physical attack because of your skin colour, ethnic origin, gender or religion	37.92	Low	37.50	Low
People using or dealing drugs	52.05	Moderate	53.95	Moderate
Property crimes, such as vandalism and theft	71.16	High	72.17	High
Violent crimes, such as assault and armed robbery	75.13	High	76.83	High
Corruption and bribery	90.98	Very High	92.98	Very High
Safety walking alone during daylight	47.00	Moderate	46.80	Moderate
Safety walking alone during night	23.20	Low	22.26	Low

7.3.7.4.4 Police Structure

The National Police (PN) is the main public security force in Angola. The PNA, as a security force, is directed by the President of the Republic as Commander-in-Chief of the Angolan Armed Forces, and the Ministerial Department responsible for internal order and public security (Ministry of the Interior) is responsible for assisting the President of the Republic in driving and directing the PNA.

The PN concentrates all main functions of police structure, from customs, border control, road patrol, crime and terrorism control, public safety and others, with the exception of Criminal Investigation, which was, in 2014, attributed to an independent organization, namely the Criminal Investigation Service (SIC).

The PN is governed by a Central Command, located in Luanda, led by a General Commander, and Provincial Commands, in each Province, led by Head-Commissionaires.

The National Police publishes, on it's website, daily security statistics (from the previous day). However, there is no available historic data or detailed publications, with statistics by province, municipality, or others.

The available data consulted was from 17th of December, and it registered the following national data:

- 71 Police Interventions;
- 22 Micro-operations;
- 80 Arrests;
- 145 Vehicle apprehensions;
- 3611 Mounted Patrols;
- 23848 Members (contracted) of the Police Forces.

The Provincial Command in Luanda is divided in Municipal Commands. As such, regarding police cover, the Project's AoI is mainly managed by the Cacuaco, Viana and Ícolo e Bengo Municipal Commands of PNA:

The police cover is distributed in Police Stations (Esquadras) and Police Posts, while also having some mobile units and Service Counters. For example, in Icolo e Bengo municipality, there are 2 Police Stations (Catete and Belavista), 3 police posts (Bom Jesus, Cassoneca and Cabiri), one mobile unit, in Caculo Canhanga and 2 service counters, in Cabala and Caxicane. It wasn't possible to obtain detailed information regarding police cover in Cacuaco and Viana Municipalities, but it is expected a significant number of Stations and Police Posts distributed in all communities.

7.3.8 Vulnerable Groups

After assessing the project's description and characteristics, for the construction and operational phases, and during the Stakeholder Identification, during the Scoping Phase, it was considered an indication of potential vulnerable groups for the project's expected impacts.

Since the vulnerability of potential stakeholder groups is dependent on which are the project's impacts, which are assessed only during ESIA development, this initial assessment, done to support the establishment of the ESIA scope, is a preliminary work, to be further developed on the future Stakeholder Engagement Activities and project E&S management.

This chapter then presents this preliminary identification of potential vulnerable groups, as part of the project's Social Baseline.

The most common vulnerable groups were assessed and considered, namely Women, Elderly and Youth, since they are usually assumed as vulnerable groups to any project that has impacts on local livelihood conditions, such as is the case of a water distribution system.

However, it was also considered the assessment of other groups with special interest in the project, that could be considered vulnerable.

7.3.8.1 Women

As mentioned in the chapter related to Women's Empowerment and Gender Equality, there are still significant challenges, in Angola, for gender equality, despite some improvements in most recent years, a robust legal and institutional framework and the development of several project's and activities promoted by the government.

As such, in Angola, women tend to have a lower economic condition, with a larger percentage working in informal work, lower wages, lower qualifications and less representatives in decision-making process.

Regarding the project's impacts, it is expected to introduce, during operation, changes in water supply costs and water quality. As assessed during the social baseline, water supply is mainly provided by private companies, and has a relevant cost in the monthly household budget.

Since women tend to have lower economic conditions, they are more vulnerable to any changes in water supply costs, either to supply cost reduction (positive impact) or increase (negative impact). This is especially true to women that are household leaders, which manage the monthly household budget.

As such, during the baseline, it was considered a specific survey effort directed at women that are household leaders, with the development of focus group contact with these women.

The results of these meetings, presented in the Stakeholder Engagement Plan, confirm that the main concern of this group is water cost, with expectations that the project will lead to a reduction in water supply cost, when compared with the current private companies. Women also mentioned expectations of water quality improvement, showing concerns regarding the quality of water that is currently supplied.

7.3.8.2 Elderly

The population of Luanda, and specifically the Municipalities around the project's AoI, have a young demographic profile, with very low percentage of elderly population.

This leads to a scenario where the elderly are usually integrated in a larger household, with children and working-age adults. As such, usual vulnerability factors, such as social isolation, reduced economic conditions and lower education, are minimized by this factor.

Since the current water supply is provided mainly by private companies, in water tankers and through containers transported by motorbikes and cars, the question of travel time and distance to obtain water, which could be a vulnerability to the elderly, is not relevant in these communities, since water distribution is done locally, near each house., with reduced travel times. During the baseline, it wasn't identified specific economic vulnerabilities associated with this group, that could be important to impacts associated with water supply cost.

However, the elderly group it potentially more sensitive to health issues arising from poor water quality, which represents a specific vulnerability to project's impacts. Any improvement in water quality supply will reduce health risk associated with waterborne diseases, with a positive impact on this vulnerable group.

Considering the possible vulnerabilities of this group, and the low percentage of elderly in the population, it was considered that the baseline assessment would be based only on the general household surveys and general stakeholder engagement activities.

7.3.8.3 Youth

Regarding youth, this group should be considered in 2 sub-groups, namely young children and working age youth, since the vulnerabilities are different according to each sub-group.

The young children can be considered as having similar vulnerabilities as the elderly group. This group is also more sensitive to health issues arising from poor water quality, with greater vulnerability to waterborne diseases.

Regarding the working age youth, these are especially vulnerable to social impacts associated with labor offer, since this group tends to have higher unemployment rates, higher informal work relations and lower wages.

The expectations regarding job creating, especially for young workers, was something referenced by several stakeholders in the baseline surveys, public consultations and focus group meetings, which confirms that this is a vulnerability of this group.

As considered for the elderly, due to the type of vulnerabilities of this group, it was considered that the baseline assessment would be based only on the general household surveys and general stakeholder engagement activities.

7.3.8.4 Private Water Supply Companies

Currently, many of the communities around the project are supplied by private water operators. These operators usually transport water from the public water system in other parts of Luanda, namely fountains and distribution points (“Girafas), and distribute it to the communities, using water tankers and containers (bottles, drums, others) transported by motorbikes and cars. These operators can be independent workers or can be part of a larger company with several workers.

It should be noted that the water origin is not always known and there aren’t regular practices of cleaning and disinfecting containers and tanks, which could pose risks of degraded water quality.

The introduction of a public water supply system, with water quality control, could directly impact the economic activity of these operators since it could become a competing water supply system. As such, they were considered a potentially vulnerable group, and it was considered to have a specific questionnaire to interview these operators in each community.

7.3.8.5 Fisherman

In the Kwanza River, near the water extraction, the community has some fishing activity. Since the project could potentially have impacts in the river, namely on habitats and fish biodiversity, as well as restrictions on river uses, it was considered that this group could be especially vulnerable to project’s impacts in the Kwanza River.

To complement the baseline data, it was then considered a focus group meeting with fisherman on this area, to assess expectations and concerns. During this work, it was identified that none of the fisherman interviewed had this as their exclusive economic activity. Fishing in the kwanza was mostly done for self-consumption in the household, or to complement the household income, but all had also other economic activities. So this group is considered vulnerable from an economic perspective, since fishing, for some households near the kwanza, is an important complement to monthly budget.

It should be noted that the fishing activity is restricted to a small number of households, close to the Kwanza river, and not a common activity in all of the Bom Jesus Community.

7.3.8.6 Farmers and Land Users

Since the project includes the installation of water pipelines, these could potentially impact land uses in the area directly affected, namely through the temporary occupation of land for the pipeline installation, but also possible restrictions on future land use. Also, existing farmers in the communities around the project could be potential beneficiaries of the water supply system, by having another water source for crop irrigation. As such, it was considered there as potential vulnerable groups.

Although it wasn't possible to confirm, when planning the baseline, if there would be any direct use of crop land of disturbances to farming activities, it was still considered relevant to have a survey effort directed at Farmers and Land Users in the rural communities around the project, to assess expectations and concerns.

It was then considered the use of a specific survey questionnaire, and also a focus group meeting, to complement the baseline effort.

7.3.9 Human rights

The assessment of human rights at the national levels including land tenure security, civil rights, freedom, and workers' rights is presented in APPENDIX L. No specific data was found for the 3 municipalities in the AoI.

7.3.10 Land management

Land Law (Law N.º 9/04 of November 9) states that rural community lands are those occupied by households of local rural communities for housing, activities or other purposes recognized by custom or by this Law and its Regulations. Indicates that rural community land is the land used by a community based on the customary use of land, including, as appropriate, areas for temporary cultivation (usually less than 2 hectares), transhumance corridors for cattle (cattle passageways) to access water sources and pasture, and lands used to access water or to travel to urban centers. The law does not cover activities inside conservation areas and notes that no occupation or use is permitted in total reserves except for conservation, scientific or management purposes.

7.3.10.1 Land acquisition

Land in Luanda has a commercial value, although it is officially owned and managed by the state. Both formal and informal land markets exist in Luanda. Formal markets deal in legally titled land that falls within one of the government-designated housing reserves (reserves fundiarias—Ministry of Urbanism and Environment (MINUA) 2008), while informal markets prevail in the remaining untitled land. However, market valuations span both these markets in an almost seamless manner.

A set of conditions determines land values, the most important being the location of the land concerning the central business district, new investment opportunities or employment opportunities. Land demand, and therefore its value, is influenced by the population density, the presence of infrastructure and essential services, the legal status of the land, evidence of ownership, access to social services (schools and health), access roads and public transport and the level of environmental risk such as flooding. End-user financing for families who want to purchase land and build housing is also primarily acquired from informal sources.

A GIS-based land values model based on field and media research was developed to extrapolate land values projected for the different settlement typologies across Luanda (Cain, Allan. 2012).

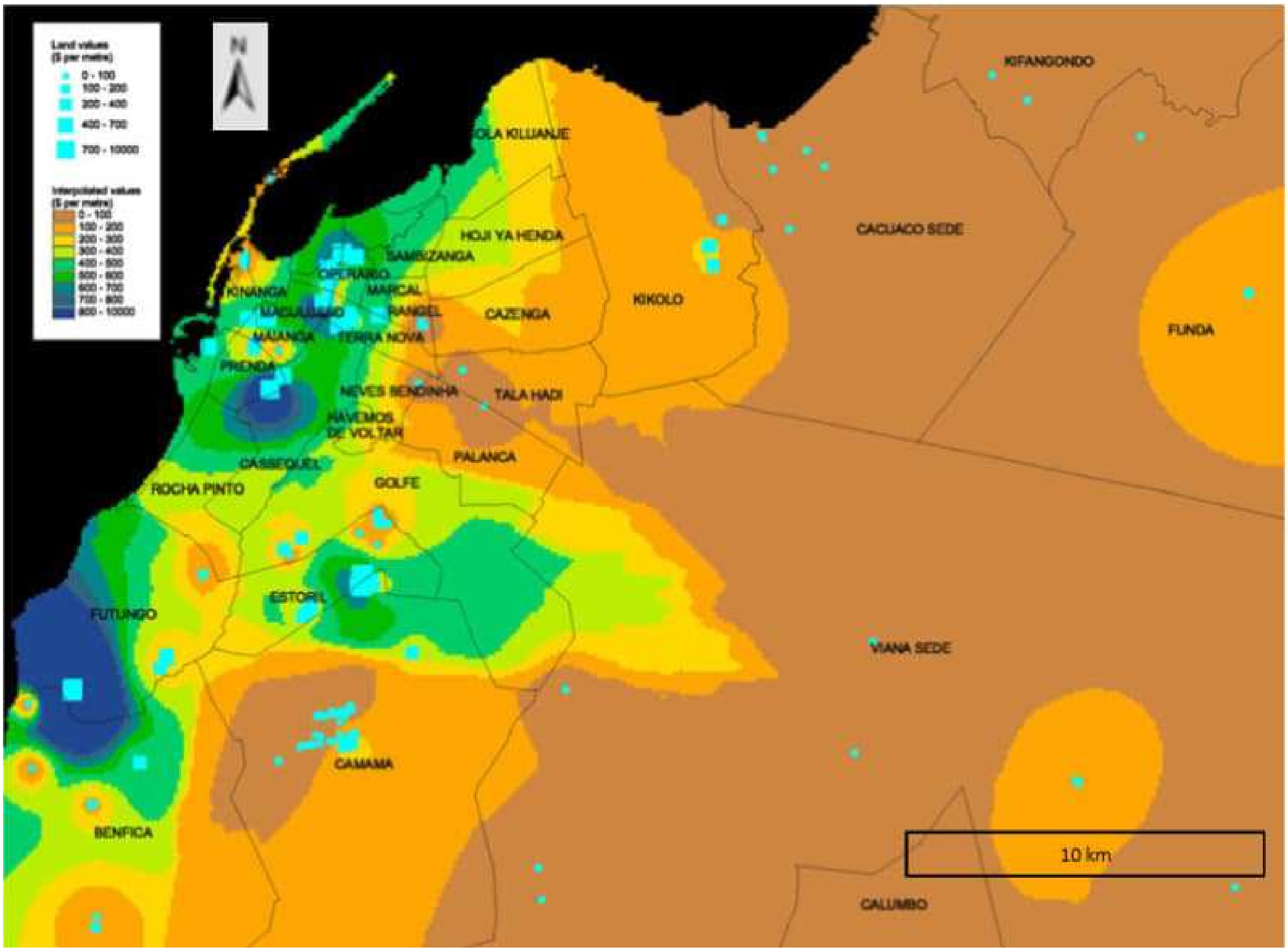

Figure 249: Map of Luanda showing the distribution of settlement typologies (Adapted from Cain, Allam. Development Workshop 2012)

7.3.10.1.1 Access to land

In Angola, rural communities are increasingly vulnerable to losing their land, especially now that the government has established agriculture as the primary practice to diversify the economy. FAO is working to help communities gain land rights. It has developed a methodology for this, which includes documenting a historical timeline of the community's use of the land, assessing natural resources and community resource use, creating a resource management plan, and delimitating the community area (often involving the participation of neighboring communities in this process). Communities use the land for various purposes, focusing on women.

Community land (when less than 1,000 ha) is approved and registered to the community at a provincial level, and the Angolan Institute for Geodesy and Cartography undertakes land demarcation. FAO has been working in several provinces and intends to scale this process to the whole country.

At the local level, there is little information. However, in the Project area, the forms of access and ownership of land follow the pattern identified for the national and provincial levels.

The land is mainly used to build household dwellings and annexes. The annexes consist of many situations in sanitary facilities and, in rural areas, small spaces for cultivation and rearing of domestic animals.

Based on the interviews, some households inherited the land where their homes are. In other situations, the land was occupied by the owners.

This occupation occurred with the arrival of large contingents in Luanda, which gave rise to the appearance and growth of suburbs without any structuring, as in the case of the Belo Monte neighborhood in the municipality of Cacuaco.

7.3.10.1.2 Ownership and tenancy

Two-thirds of all Angolans still live in rural areas and earn their living from agriculture. However, there has been an enormous movement of people from rural to urban areas, and many peri-urban areas were rural/agricultural only a decade or so ago.

The increasing urban population is generating a strong demand for land and housing in the cities. Most settlement and housing plot acquisition has been through the informal land market, and only a tiny percentage of settlers have acquired full legal title to the land they occupy.

The Land Law 1992 preamble stated that local community land rights would be protected and recognized in some different forms of tenure. However, it remained heavily based on the old ideals of state central-planning principles, requiring, for example, that land conceded by the government must be ‘put to effective use’ and retaining the right to subject production to the ‘requirements of national development.’ The attempt to make land tenure security dependent on land use was based on a general hostility towards the concept of private ownership and the social and economic position of rural smallholder producers.

According to the 2004 land laws, the State can only expropriate land for specific public use and must declare this purpose when it does so. Anyone whose land is expropriated for public use has a right to compensation. Where the state grants land concessions for urban development projects, it has a legal duty to publicize this widely.

Any infrastructure project with a significant social or environmental impact must be subject to an impact assessment, including hearings with the affected local population. These specific requirements reinforce the general principle in Angolan law that public administration must provide adequate notice to people whose rights are likely to be affected by its actions.

One of the central problems regarding land rights in Angola is that, without an increase in investment, the land people have access to is insufficient to support them and their families. However, The solution is not to give them more land. As one land rights expert has noted, the average Angolan family needs a minimum of about two hectares of farming land to sustain itself. Still, it is difficult for them to cultivate such an area without animal traction, proper irrigation, and fertilizers. This problem becomes even more acute for female-headed households, orphans, and other vulnerable groups. Therefore, the issue of land rights and tenure security must be seen in a social, economic, civil, and political context (Foley. 2007).

The fieldwork applied Questionnaire A specific to households that practice agriculture in the localities of Cacuaco and Bom Jesus in a herd of ten each.

In Cacuaco, five heads of households are male, and five are female. The investigation ascertained the household head's marital status; and the five women are single, and two of the five men are married. In Bom Jesus, the four women are single, and two of the six men are married (Field Work, Questions C1 and C3).

Regarding the question about the ownership of cultivated land (Question D3), 19 answers were obtained in the sum of the two localities.

In Cacuaco, the ten carry out agricultural activity on land the owner provides for cultivation. In Bom Jesus, one of the interviewees did not answer this question; one answered that the state ceded the land, and eight cultivated inherited land.

7.3.10.2 Land tenure and transfer systems

Land ownership has been problematic since the first Portuguese settlement in Angola. In 1961, the Portuguese population of 6,000 households occupied a land area of 4.5 million hectares, and a subsistence population of 1 million Angolan farming households occupied another 4.3 million hectares.

After Independence in 1975 and a new Constitution, the Angolan government transferred all land ownership to the state. All land use decisions were to be defined by the government, and no private land ownership was recognized. In the early 1990s, a new land law was implemented to grant surface rights to large commercial farmers to promote agricultural investment.

According to the general framework governing land tenure in Angola (Angola Constitution de 1992) stipulates that State-owned land may be subject to various rights: ownership rights, customary use rights, civil utility rights, surface rights and precarious occupation rights. The land tenure system is regulated by the legislation in force in the country and guaranteed access to the use, sale, and protection of land for all citizens. In addition, the State shall respect and protect people's property, whether individuals or corporate bodies, and the property and ownership of lands by peasants, without prejudice to the possibility of expropriation in the public interest, in accordance with the law.

This reinforced the public perception that the government believed only large commercial farms to be viable players in the Angolan agriculture sector's economic growth. This disenfranchised most households in Angola and drove them to participate in informal or unrecognized land markets.

By 2004, the government passed a new land law that redefined land use and rights. It became mandatory for all land occupants to initiate regularization of their land rights before July 2010. If land were not regularized, it would all revert to state control. This law did not guide how to initiate this process or any direction to government ministries on assisting households. Over 50 % of the Angolan population was estimated to move to urban centers during the civil war. This increased urbanization led to more pressure on land resources in an environment where rights to provide security are lacking. In rural areas, subsistence farming households compete for land with concessions granted by the central government for large commercial farms that may overlap with community boundaries or even completely encompass a community (USAID Angola 2008).

The 1992 Constitution of the Republic of Angola gives the government ultimate authority over all land, water, air, soil, and all other natural resources. The legal framework is derived from the Portuguese Civil Code, which does not readily accommodate traditional African land tenure practices.

The primary legislative instrument for land is the 2004 Land Law (Lei de Terras de Angola), the objectives of which include environmental protection and the assurance of sustainable and economically efficient land use. Applicable to all urban and rural land, the law allows the state to confer private property rights over urban land and reintroduces the concept of customary domain over rural land.

The state can confer transferable rights and notably provides for transforming customary rights into legal rights to provide security of tenure and protection from the evictions common throughout both colonial times and the Civil War. The law does not extend to private land, such as the Catholic Church and foreign embassies. Foreigners are permitted to hold ground in Angola. For issues that fall outside the remit of the Land Law, such as the inheritance of property, deference is made to the earlier (2001) Angolan Civil Code (Codigo Civil). Under the 2001 Decree on the Resettlement of Displaced People, the rights of displaced people to housing and provision for additional land allocation are recognized.

Institutional responsibility for the assignment of land is divided between three entities. The Municipality Administrator may authorize concessions of urban land up to 1,000 m^2, while the approval of the Provincial

Governor is required for areas up to 50,000 m^2. Sizes greater than 50,000 m^2 may only be assigned by the Minister of Urban Planning and Housing.

Under the auspices of the Ministry of Agriculture and Rural Development, the Land Law identifies acceptable uses of land to be four-fold:

- for shelter and homes ;
- for natural resources and mining, for agriculture ;
- for forestry and land planning; and,
- for economic and industrial activities.

Also passed in 2004, the Law of Territorial Planning and Urbanization (Lei do Orderamento do Territorio e do Urbanismo) requires territorial development plans to be developed for all rural and urban land at central, provincial, and municipal levels and empowers municipalities to expropriate land for development.

Notwithstanding this legislative provision, many argue the Land Law has not been fully implemented, and land administration and management remain weak. Most people are unfamiliar with land and property legislation and remain without documented proof of tenure or entitlement. Customary law still governs issues such as land access, the control of land and its production, land transfer and land use.

Customary law principles and practices can be highly localized. Still, most are applied on the basis that land is owned by a universal deity, the ancestors of living occupants, the community, or by individuals within a community and is administered for the benefit of the community by the traditional leader or village elder (Soba).

At the level of the Project AoI, the following particularities stand out (site visits by the social experts, Gap Analysis of the 2014 ESIA and Scoping Report and information provided by EPAL):

- The land for WWT (Lot 1), STP (Lot 10) and DC Quilonga Grande (Lot 8) was part of the land reserve of the Z.E.E. (Special Economic Zone) and was made available for construction in 2014. Expropriation is foreseen in the catchment area and along the pipeline that will transport raw water transport from the abstraction area to WTP. EPAL has provided the documentation showing surveys carried out in this sense with the involvement of the local Administration. The indemnities will be done when there are financial conditions finances for this purpose.
- According to the EPAL report (2020), the expansion land expropriation of DC Cacuaco (Lot 3). The land was owned by a private person (M. Germano Lemos) but there were no buildings or any particular activity such as agriculture, etc .
- A large part of the network for the system will be constructed in parallel to the existing road. In some zones, the current space between the road and the buildings (commerce, residences, etc.) is large enough, and there will be no interference with those activities or householder. A large part of the network (Lot 2) will be constructed in parallel to existing road. In some zones, the existing space between the road and the buildings (commerce, residences etc) is large enough and there will be no interference to those activities or householder. In case of the connection to Lots 6 and to Lot 4 the path will be made from the Catete road by dirt tracks or by land unoccupied by any housing or industry. On the other hand, there are sections of the network that will be placed through the interior of a densely populated area (e.g Lot 7 Kapalanga). So far, no expropriations have been carried out in and 2, but possibly some will be necessary in the construction phase. In that will only be defined when the Detailed Design is finished and approved.

- The DC Kapalanga (Lot 7) will be constructed on a large piece of land in the District's center. The Viana municipality knows the Project, which has recommendations to save this area for the construction of the DC. No expropriations have been carried out in this Lot.
- The DC of km 30 (Lot 6) is near a large market. The land (2.5 ha) has been reserved for the construction of the DC. No expropriations have been carried out in this Lot.
- The land occupied by DC Zango 5 (Lot 4) was part of the land reserve of the Z.E.E. (Special Economic Zone). The land was transferred to the Project in May 2015 and, according to EPAL, there was no need for expropriation or public consultation;
- Regarding the DC New Airport (Lot 5) the land is located within the perimeter of the New Luanda International Airport (Agostinho Neto). The land was under the tutelage of the Ministry of Urbanism and Housing, which, through a request, was made available to EPAL for the construction of the referred DC in 2016. According to EPAL, there was no need for expropriation or compensation.
- The land occupied by the DC PIV (Lot 9) belongs to EPA. Differently from other DCs, PIV is already functional, but required expansion works to improve its storage and pumping capacity

Detais on the land transactions and expropriation process has not been provided.

7.3.10.3 Land use in the AoI

Regarding Land Use, the general characterization of the AoI is presented in the Urban and Territorial Planning Chapter, namely in the “Land Use” Chapter, included in the Social Baseline.

However, it was considered relevant to include a more detailed description of land uses on the main project plots, namely Lots 1/10/8 (Abstraction-WTP-STP-Quilonga Grande DC), Lot 3 (DC Cacuaco), Lot 6 (DC Km30), Lot 7 (DC Kapalanga), Lot4 (DC Zango 5), Lot 5 (DC New Airport) and Lot 9 (DC PIV). It is also considered more general characterization along the water transmission network (Lot 2).

Lots 1, 10 and 8 – Water Abstraction, WTP, STP and QG DC

Lot 1 - Water Abstraction

The Abstraction zone is located near existing EPAL facilities, that include a pumping station and other buildings.

The area where the abstraction will be developed is mainly a floodplain, with natural vegetation, namely herbaceous/shrub cover, located between current EPAL facilities and the SODIBA Factory plot, east of the Abstraction.

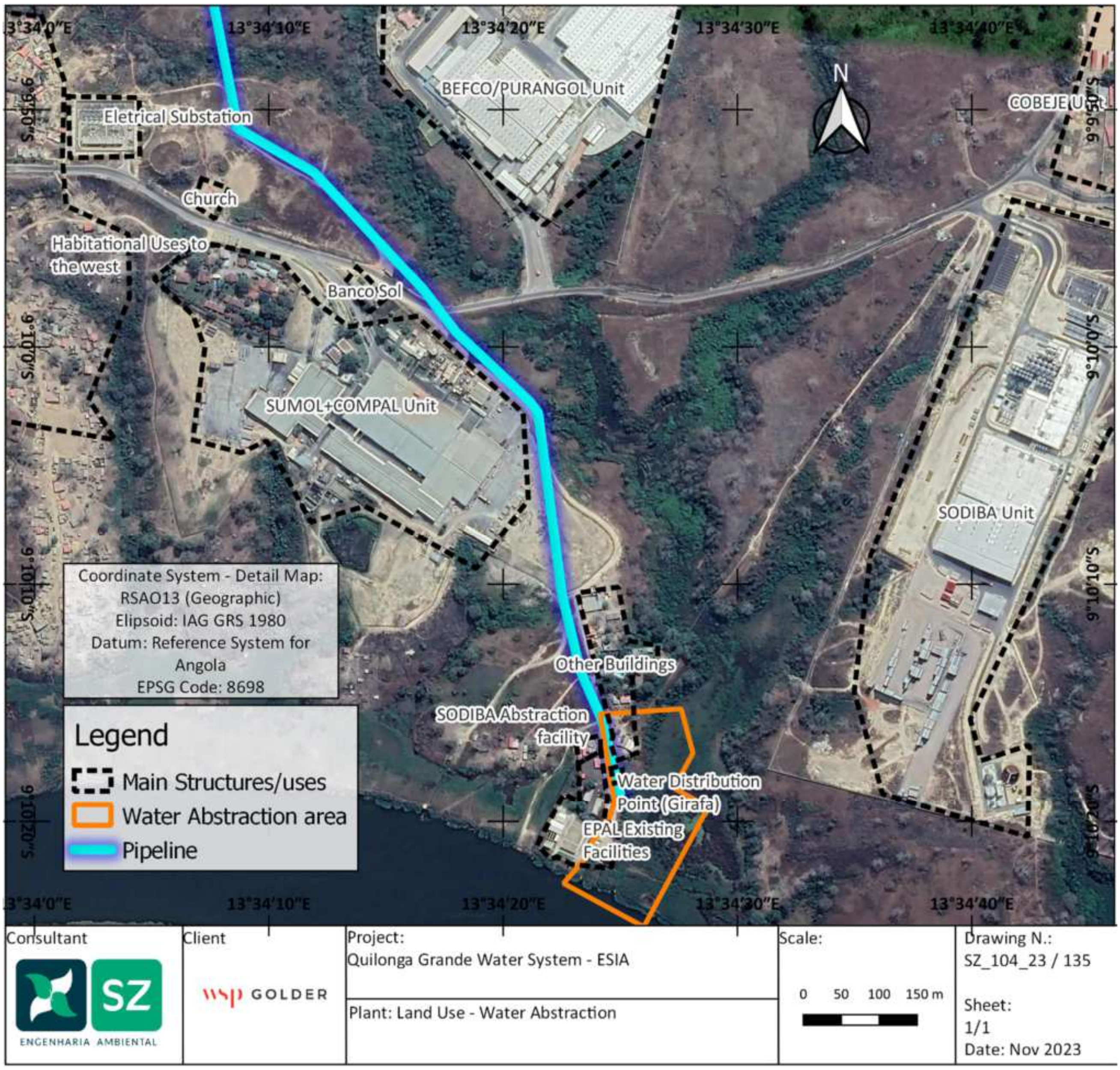

Figure 250: Main Structures and uses near the Abstraction zone (Lot 1)

Figure 251: Existing EPAL Facilities already present in Bom Jesus

Figure 252 : Future Abstraction zone (Lot 1)

Around the abstraction zone, there is only the access road, a water distribution point ("Girafa"), another water abstraction facility, from SODIBA Beverage Factory and some small buildings along the road (houses and services).

Figure 253: Existing water distribution point ("Girafa") in the road to the abstraction zone

Figure 254: Sodiba abstraction facilities

Figure 255: Access road and existing buildings around it (Lot 1)

Pipeline between the Lot 1 – Water Abstraction and the Lot 1- WTP

The pipeline between the abstraction and the water treatment plant extends through approximately 12 km, in a south-north direction.

The first part of the pipeline will go near the existing roads, passing near the industrial plants of Sumol+Compal and Purangol/BEFCO, also having some forest areas in a drainage valley to the East of the road and between the main industrial plants (Purangol, Sumol+Compal, Sodiba and Cobeje).

Near the future pipeline there is also a Bank facility (Banco Sol) and a church. To the West and Southwest, there it starts the Bom Jesus habitational area, with disperse houses. To the west of the future pipeline there is also an electrical substation.

Figure 256: Sodiba facility

Figure 257: Forest areas to the East of future pipeline between WTF and WTP- Lot1

Figure 258: BEFCO/Purangol Facilities

Figure 259: Sol Bank unit

Figure 260: SUMOL+COMPAL facilities (industrial plant and residential area of the plant).

Figure 261: Pentecostal Church

Figure 262: Electrical substation to the west

Figure 263: Communities to the West of future pipeline between WTF and WTP- Lot1

For about 2 km after the industrial area of Bom Jesus, the pipeline will go through forest and shrub land areas, until it gets close to the Bom Jesus Road, which it follows until the CIF Cement Plant.

There are no relevant constructions near this stretch of road, with the exception of a small repair shop and some warehouses.

Figure 264: Bom Jesus Road and forest area next to it

Figure 265: Repair Shop next to the Bom Jesus Road

Figure 266: View of the Bom Jesus Road approaching the CIF Factory

Figure 267: CIF Cement Factory

After the CIF Cement production plant, the pipeline inverts east, alongside an existing access road on the north side of the CIF Plant. On the north side of this road, there is a lot with some construction activity.

Near the CIF Plant Side Entrance (used for truck access), there is an area used as a truck stop, with several trucks parked including during the night period. Due to this activity, there is also an informal commercial venue installed next to the CIF plant fence, that serves food and other items to the truck drivers, with activity extending to the night period. At the end of that road, the water pipeline turns North Again, through a forest and shrub land area until it reaches the Water Treatment Plant Lot.

Figure 268: Access road on the north side of the CIF Plant.

Figure 269: Lot in the north of the CIF Plan (with some construction activities)

Figure 270: Truck stop area and informal commercial venue near the side entrance to CIF Factory

The following figure presents a view of the Pipeline area, with the main structures marked. Due to the larger scale of the area, it was included also the assessment of soil uses considered in the habitat survey, as a general reference of main type of soil uses.

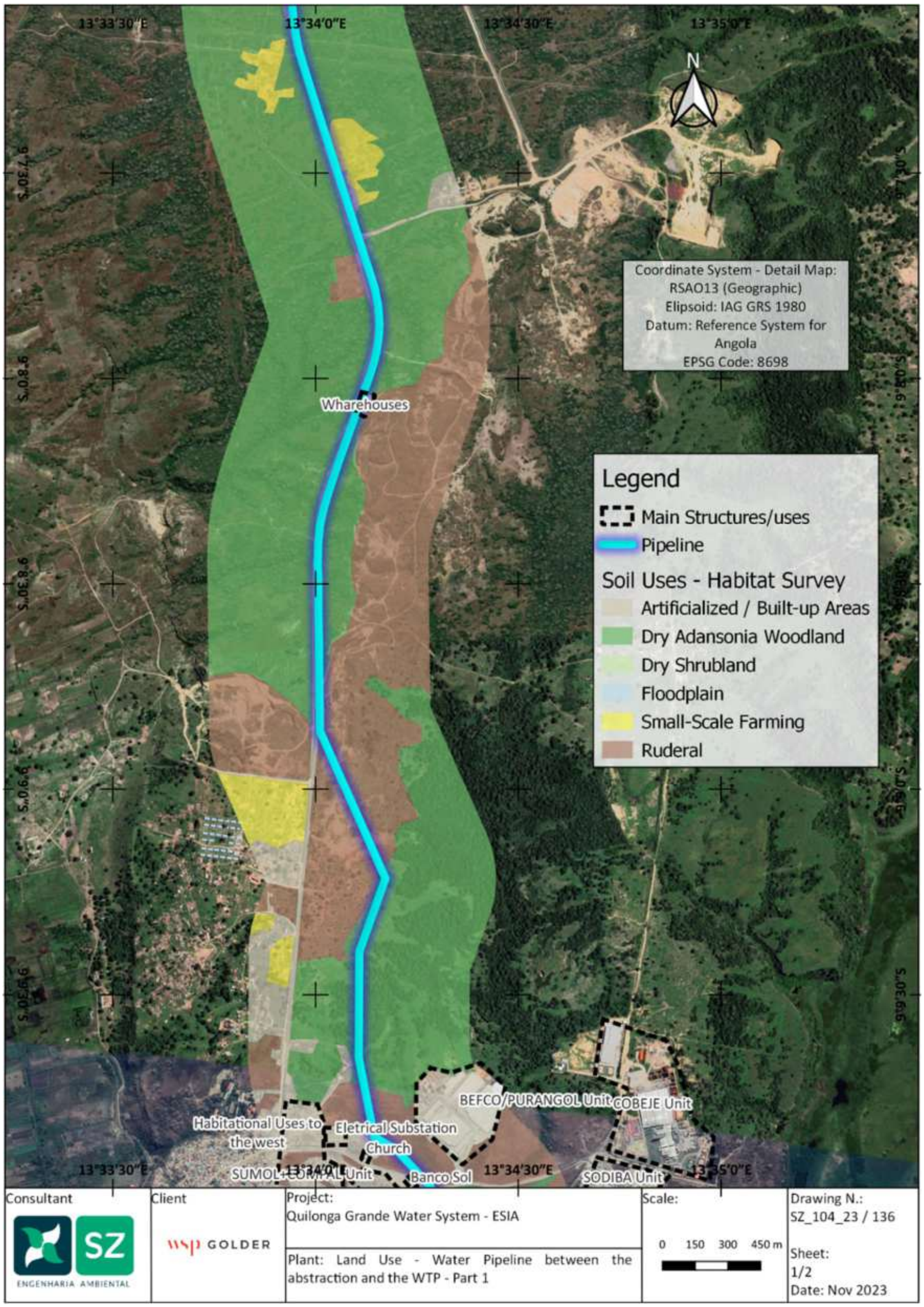

Figure 271: Land Use and main structures between Bom Jesus Industrial area and the Lot 1- WTP (Part 1)

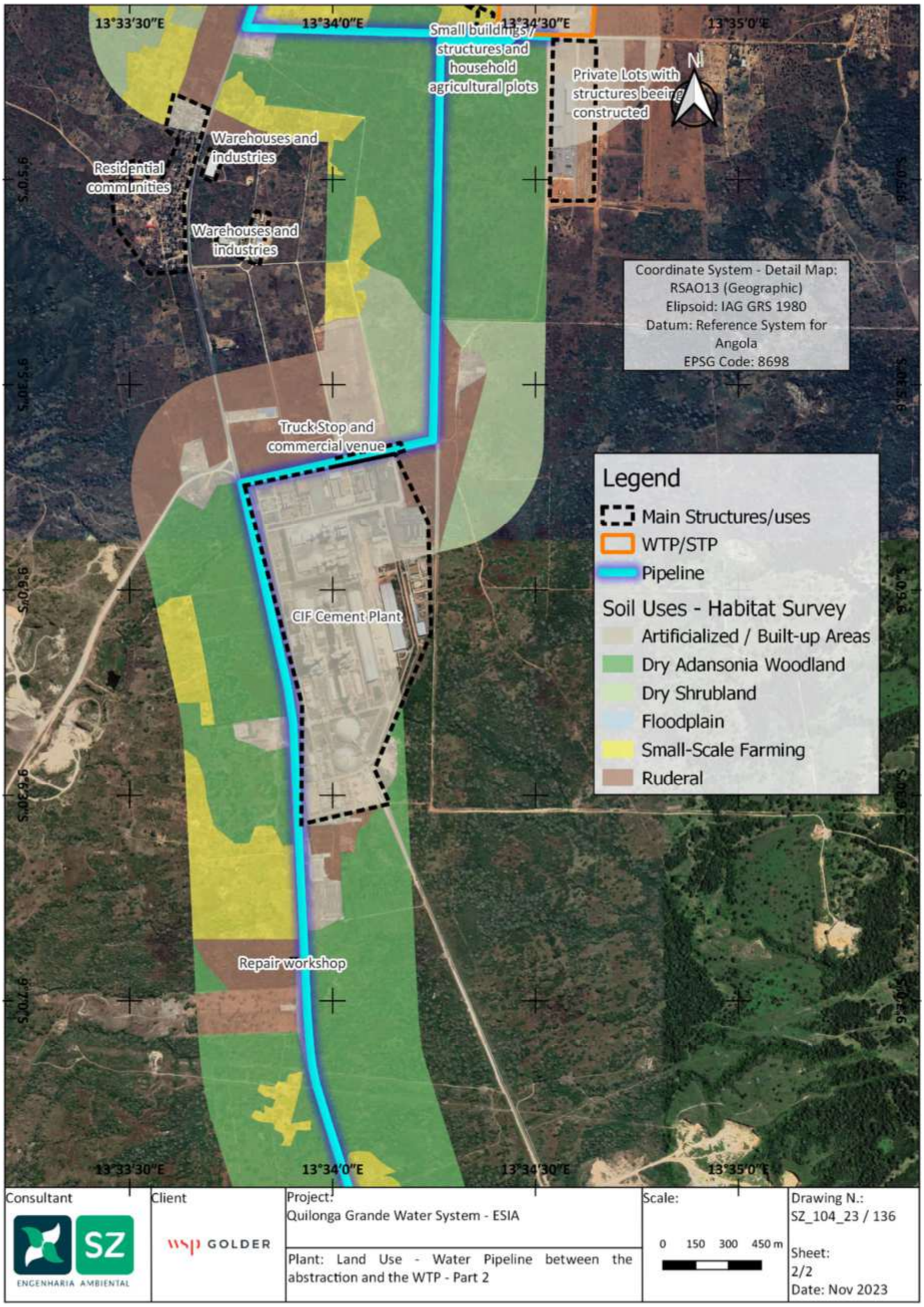

Figure 272: Land Use and main structures between Bom Jesus Industrial area and the Lot 1 - WTP(Part 2)

Lot 1 – WTP, Lot 10 – STP and Lot 8

The WTP , STP and the lot 8 DC will be located inside a closed lot, already in construction.

The entire lot is completely fenced by metal sheet fence, with 2 main entrances. Inside the it, there are areas constructed used for the contractor's support yard, as well as several construction activities ongoing. The lot has been cleared of vegetation, with bare soil or constructed activities.

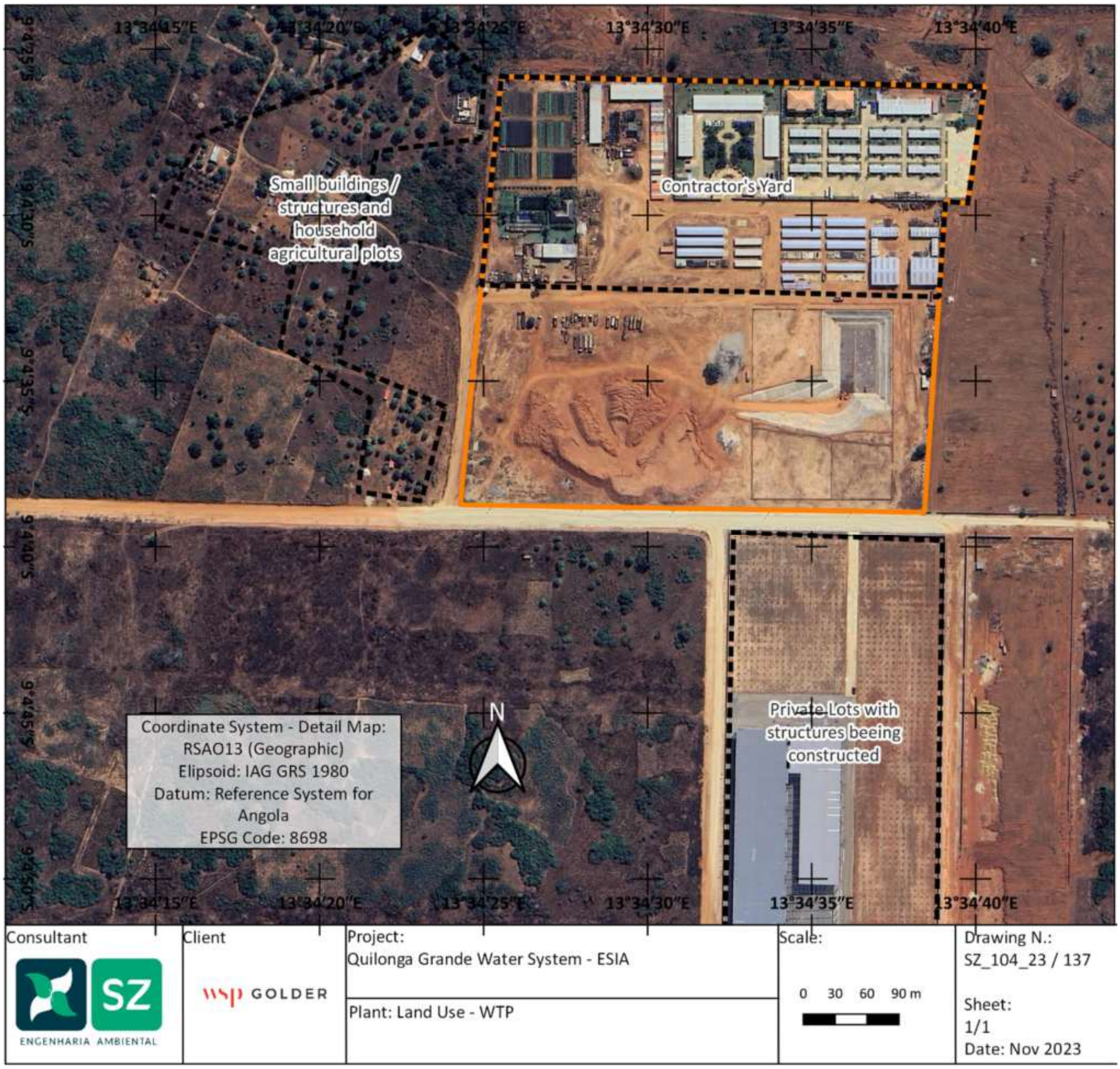

Figure 273: WTP - Location and Main Structures

Figure 274: External view of the Lot 1, 8 and 10 (entrance and fence)

Figure 275: Contractor’s work camp/yard (Lots 1, 8 and 10)

Figure 276: Construction activities being developed inside the plot (Lot 1, 10 and 8)

The area around the plot includes forest and herbaceous areas, some small agricultural plots, for household consumptions, as well as some reserved plots for construction, fenced by concrete walls and already with some structures being built.

Figure 277: Accesses and fenced private lots around the WTP

Figure 278: Industrial buildings in construction in private lots around the WTP.

Figure 279: Some buildings and small agricultural plots used for household consumption.

Figure 280: Forest and herbaceous areas, with signs of fires used by the local population, in some locations, to clear vegetation

Lot 3 – DC Cacuaco

The lot for the installation of the Cacuaco DC is enclosed, by metal fences, which prevent any external access or view to the lot.

Figure 281: Entrance gate to the Lot 3 and external views to the lot’s metal fence

The interior of the Lot has several abandoned structures, previously used as a construction yard. It also has a large cemented paved area and free-soil areas, with herbaceous and shrub vegetation.

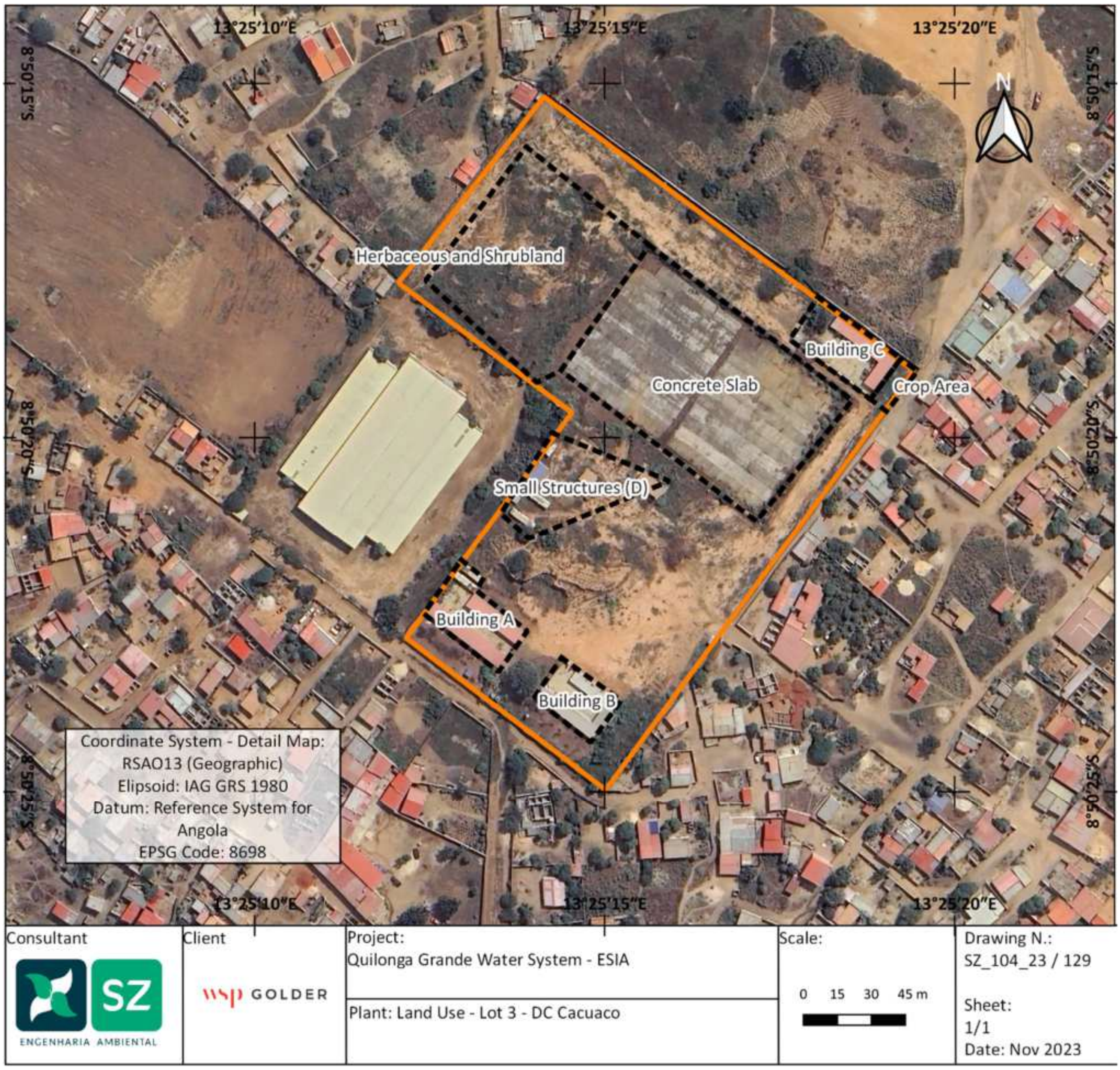

Figure 282: Location of main structures inside the Lot 3.

Figure 283: Main structures and areas inside the Lot 3.

The area around the lot comprises different uses. Is includes low density housing (main use), with large open areas with no use (herbaceous and shrub vegetation), some services, such as repair shops and commerce, and also industrial units.

In the bare soil areas near the lot there are also some small crops used by the households for self-consumption, namely cassava.

Figure 284: Houses and roads around the Lot 3.

Figure 285: Open areas between the houses, used as playground for the children near Lot 3

Figure 286: Small cassava crops near the houses close to Lot 3

Figure 287: Industrial warehouse to the Northwest of the Lot 3 (currently not used)

Figure 288: Local car repair shop near the Lot 3

Lot 6 - DC Km30

The Km 30 plot is an open square, in a transition zone between a residential area and an industrial area.

The square has bare soil, with no constructed structure inside. However, the Northwest part of the square is used for temporary informal commercial activity, with street vendors and mobile structures. This area is also used as a stopping point for motorcycles (gathering point for motorcycle distributors - motoboys).

The square is also used as a transit venue for cattle. There are two important slaughterhouses, at about 400 m southwest of the square, and there are significant movement of cattle on the nearby roads and through the square, as it is being transported to the slaughterhouses.

Figure 289: Lot 6 Km 30 DC Square – Eastern sector (no use)

Figure 290: Lot 6 Km 30 DC Square – Eastern sector (unused area)

Figure 291: Lot 6 Km 30 DC Square – Western sector – Commerce and “Motoboys” gathering point

Figure 292: Lot 6 Km 30 DC Square – Western Sector – Street vendors

Figure 293: Lot 6 Km 30 DC Square – Crossing of cattle going to the slaughterhouses west

The area around the plot comprises urban low density residential area, to the Northeast, East and South, with fenced unused lots to the Northwest and an industrial and commercial zone to the West.

The urban residential area that surrounds the plot also includes small services and commerce, mixed with residential buildings.

Figure 294: Buildings and roads around the plot for Lot 6

Figure 295: examples of Industrial (right photo) and social (church – left photo) services in the urban area existent on the region of the Lot 6.

Lot 7 – DC Kapalanga

As with km 30, the Kapalanga lot is an open public square. The square is mainly unused, although there are some small spots used, namely as a gathering point for motorcycle distributors (“motoboys”) and as a vehicle parking area, where there are also some small, constructed structures.

On the south corner, there is a terrace (restaurant / coffee shop) outside the limit of the plot, but it isn't possible to confirm if it sometimes extends to the plot.

In the lot, there are also two simple football goals, that seem to delimit an informal football field, although wasn't possible to confirm if this field still has any use.

Figure 296: Main areas inside the plot – Lot 7

 

Figure 297: General view of the Lot 7

Figure 298: East side of the plot, with parked vehicles (Lot 7)

Figure 299: South corner of the plot, with nearby terrace (Lot 7)

Figure 300: West side of the plot – Motorcycle distributors gathering point (Lot 7)

Figure 301: Detail of the football goals that exist in the plot (Lot 7).

Around the plot, there is a residential area, with some services and commerce, including street vendors

Figure 302: Urban area around the plot (Lot 7).

Lot 4 – DC Zango 5

The Zango 5 plot includes an already constructed area, used for the existing Distribution Center, and an expansion area around, with no use and covered with herbaceous and shrub vegetation (not visited). The lot is completely enclosed. The distribution center, already in operation, has a concrete wall, with no access from the exterior except through the main entrance gate and EPAL offices. The rest of the plot is also fenced, but by metal sheet fences.

The existing Distribution Center includes several buildings, paved areas, parking areas, roads, and equipment. There is a reserved section for expansion, in bare soil, but already prepared for installing future buildings.

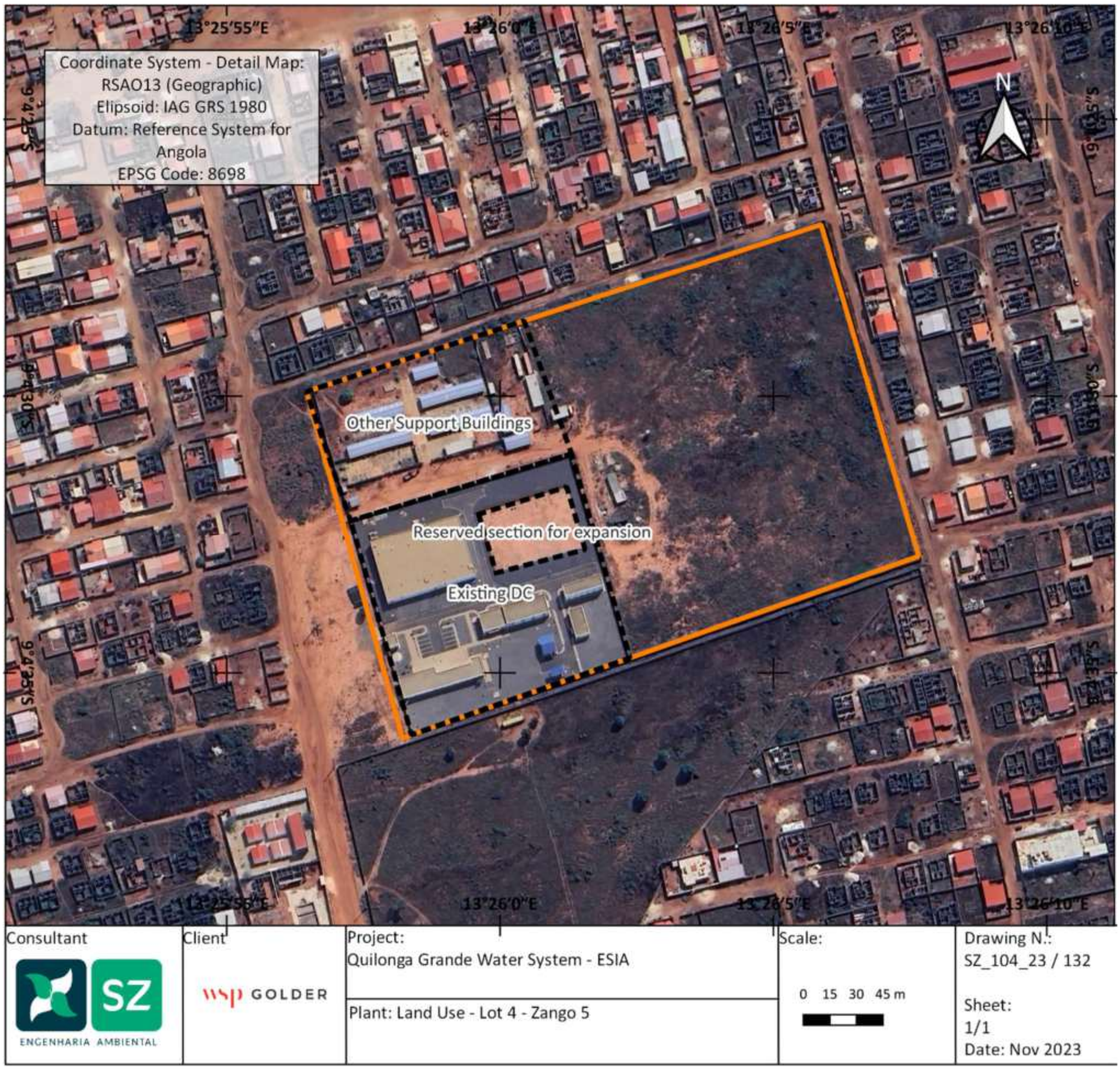

Figure 303: Plot location and areas (Lot 4).

Figure 304: Existing DC Entrance and wall (Lot 4).

Figure 305: Metal fence around the rest of the plot (Lot 4)..

Figure 306: General view of the existing DC already constructed (Lot 4).

Figure 307: Prepared section for future construction inside the existing DC (Lot 4).

Around the Distribution Center, is the Zango 5 Centrality lots, with residential buildings or empty lots, to be constructed. Near the DC, most building are still under construction, with several empty lots and areas with bare soil or herbaceous vegetation cover.

Figure 308: Unused lots around the DC (Lot 4).

Figure 309: Front of the plot (access roads and partially constructed buildings on the left - (Lot 4).

Figure 310: Residential buildings still in construction near Lot 4.

Figure 311: Constructed lots and roads in the centrality around Lot 4.

Lot 5 – DC New Airport

Similar to the Zango 5, the New Airport DC plot includes an area already in construction or constructed, with buildings, paved zones and equipment, and a surrounding plot with some support buildings and unused soil, covered with herbaceous or shrub vegetation or bare soil.

The Distribution Center is still in construction, with equipment being installed and some buildings still in finishing phase. The enclosure wall is still being constructed, and the lot is currently fenced by metal sheet fence.

Figure 312: Project location and surrounding areas (Lot 5)

Figure 313: External view of the plot, with sheet metal fence (Lot 5).

Figure 314: General view of the Distribution Center in construction (Lot 5).

The area surrounding the plot is mainly natural, with herbaceous, shrub and tree coverage. There are also large access dirt roads, associated with the construction of the New Airport. There are no other constructions near the plot.

Figure 315. Area around the plot, with herbaceous, shrub and tree coverage (Lot 5).

Figure 316: Large dirt roads near the plot (Lot 5).

Lot 9 – DC PIV

The PIV DC is also fully constructed, with a concrete wall all around with access only though the entrance gates and EPAL offices.

Figure 317: Project location and surrounding areas (Lot 9)

Figure 318: External view of the Lot 9 (main entrance and side entrance).

Figure 319: General view of the existing Lot 9 DC.

The area around the DC consists mainly of residential buildings to the Northwest and Southwest, and industrial buildings to the Southeast, with also industrial uses and unused industrial lots to the Northeast.

There is also a small commercial venue, along the road, with shops and restaurants near the western corner of the plot.

Figure 320: Urban buildings and roads near the Lot 9.

Figure 321: Commercial venue along the road, next to the residential buildings, near the Western corner of the Lot 9.

Figure 322: Industrial area to the East of the project – Lot 9.

Lot 2 Transmission Network

The pipeline from the WTP to the Distributions centers crosses very diverse areas, with a variety of uses.

The initial part uses the same road north of the CIF Factory (already characterized above), until it reaches the Bom Jesus Road. Then, it follows this road for 3,6 km, where it turns Northwest, in direction of the New Airport.

After the CIF Factory, the Bom Jesus Road has several communities on the west side, and some industries and warehouses mainly on the east side.

Figure 323: Industries, services and warehouses on the East side of the Bom Jesus Road – section of Lot 2

Figure 324: Communities on the West side of the Bom Jesus Road – section of Lot 2

Figure 325: General view of the Bom Jesus Road, facing North (left image) and facing South (right image) – section of Lot 2

Figure 326: Fuel filling station next to Bom Jesus Road – section of Lot 2

As considered for the Pipeline between the abstraction and the WTP, below is also presented a map with the main structures and uses, also including the information form the habitat assessment, as support for land use assessment around the project.

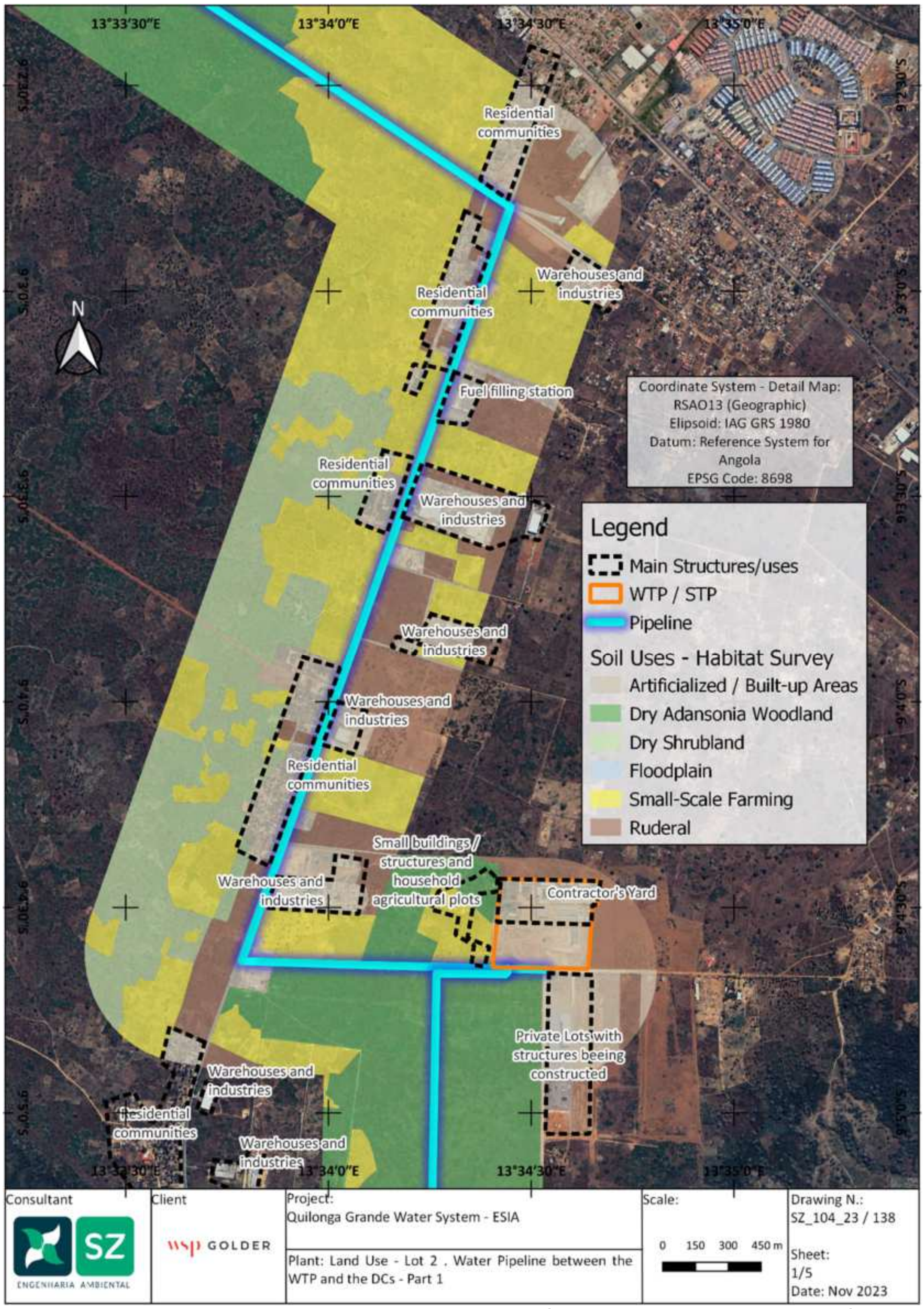

Figure 327: Land Use and main structures in Lot 2 – Part 1 (Along the Bom Jesus Road)

Between the Bom Jesus Road and the New Airport Distribution Center, the pipeline enters the area reserved for the new airport. It crosses mainly herbaceous and shrub land habitats, similar to the area around the New Airport DC, already characterized above. In this area, there are no constructed facilities, due to the airport restricted area, with the exception of the airport itself and construction yards associated with the new airport construction.

It should be noted that there were no specific surveys covering the rest of the transmission network, so there are no additional photographic records for this lot, with exception of some records obtained from desktop review. As such, the assessment presented below is mainly based on the data obtained during the field habitat assessment.

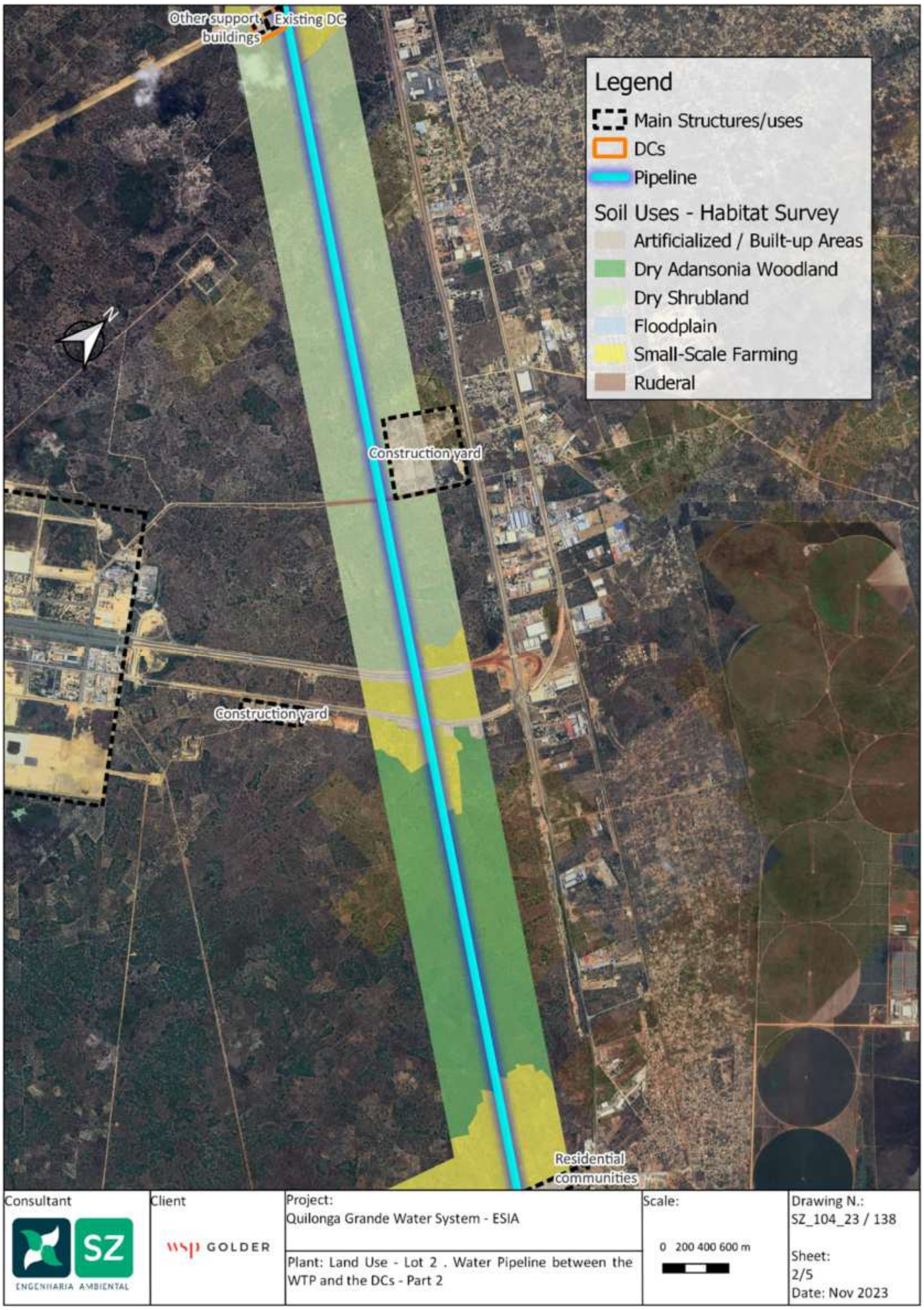

Figure 328: Land Use and main structures in Lot 2 – Part 2 (Bom Jesus Road to New Airport DC)

After the New Airport Distribution Center, the pipeline exists the airport restricted area, and enters the Viana Urban area, following existing roads. The connection between the New Airport DC and the Zango 5 DC crosses forest and shrub land habitats, with some small-scale farming areas. Until reaching the Zango Centralities, the constructed areas are mainly residential use, with disperse construction, of 1-2 storey buildings (individual houses), mixed with open areas. After reaching the Zango Centralities, where the pipeline turns south, the constructed are also of residential type, but with dense construction and with a mix between 1-2 storey individual houses and multi-storey residential buildings. The centralities also include several services, such as police, health infrastructures, schools, commercial stores, and others.

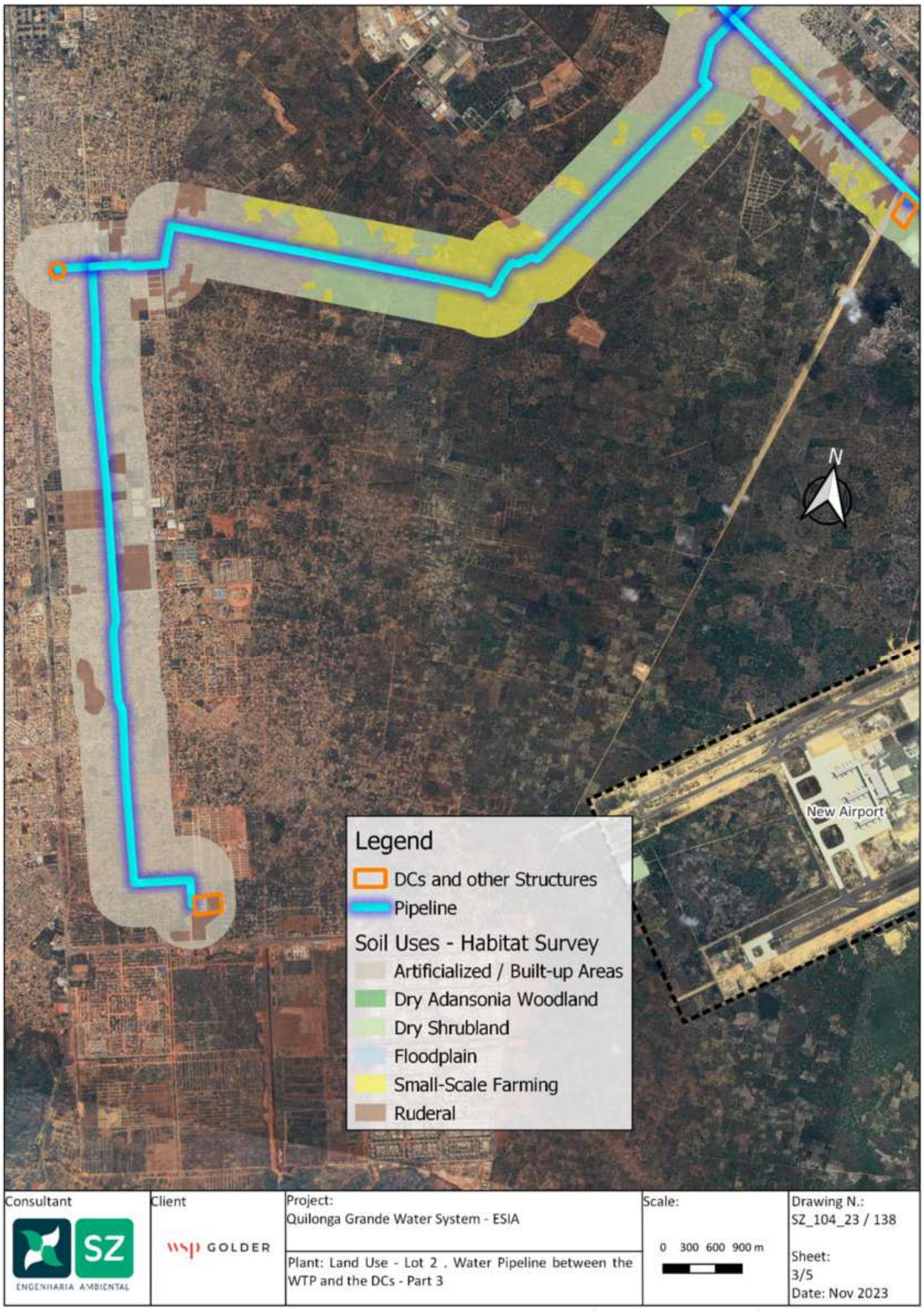

Figure 329: Land Use and main structures in Lot 2 – Part 3 (New Airport DC to the Zango 5 DC)

Figure 330: Roads to be used along the Zango 4 Centrality (Mappilary)

Figure 331: Roads to be used along the Zango 5 Centrality (Mappilary)

The pipeline between the New Airport Distribution Center and the northwest project's structures (PIV DC, Kapalanga DC and the existing Morar 2 Distribution Center) starts crossing industrial zones of the ZEE, going along existing roads. After about 5 km, it inverts Northeast, and then accompanies the Catete Road (Deolinda Rodrigues Avenue).

On the first 6 km along the Catete road, the surrounding uses are mainly industrial plots on both sides of the road. After the Viana Kero Supermarket, the Northeast side of the Catete Road starts to have a residential neighborhood (Kapalanga), with the Southwest side still having industrial plots.

The pipeline that diverges from the Catete Road to the "Morar 2 DC" also starts in an industrial area, surrounded by industrial plots. It will accompany existing roads through the Viana Industrial area, on a Northeast-Southwest direction.

Near the Viana Cemetery, the pipeline inverts Northwest and from there, has residential uses (Vila Chinesa) on the Northeast side and industrial plots on the Southwest side.

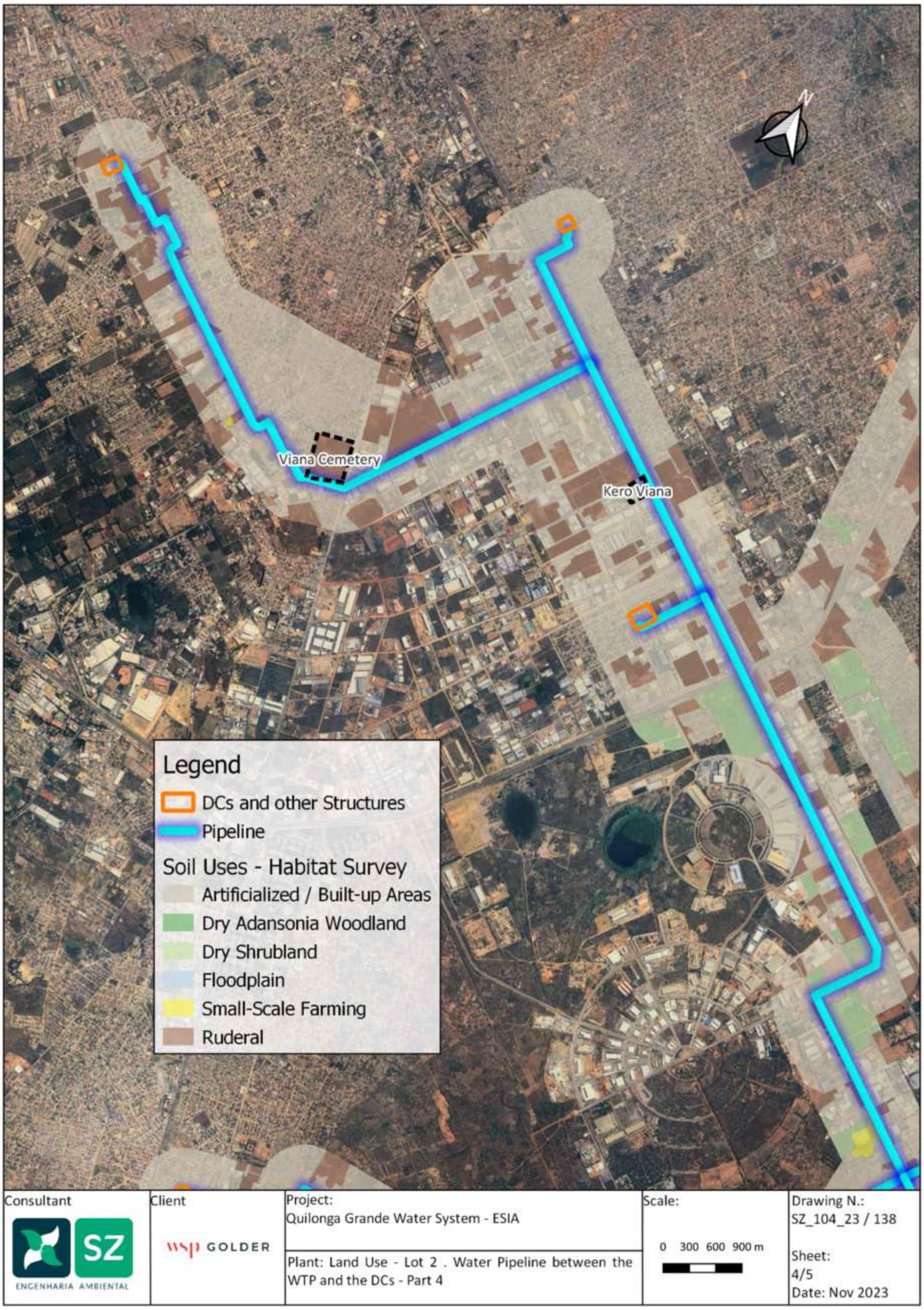

Figure 332: Land Use and main structures in Lot 2 – Part 4 (Connection to the PIV, Kapalanga e Morar2 DC)

Figure 333: Road to be used on the Viana Industrial Area - Connection from to ZEE to the Cacuaco Road) (Mappilary*)*

Figure 334: Catete Road (Mappilary)

Figure 335: Road to be used between the Cacuaco Road and the Viana Cemetery (Mappilary)

The Pipeline that connects the Km30, Sequele and Cacuaco DC starts in Viana, with a Northeast direction. It has industrial plots on the Northwest side and residential (medium density individual houses) on the Southeast side, until reaching the Luanda Railroad. From there, the Pipeline goes next to existing roads and crosses through a medium to high-density residential area, comprising mainly1-2 storey houses, similar to the ones described in the Km 30 Distribution Center chapter.

At about 800 m from the Km 30 DC, there is an industrial and commercial area on the Northwest side of the pipeline, namely associated with the Km 30 Market.

From the Km 30 DC to the Sequele DC, the pipeline follows existing roads that cross both urban residential areas or greenfield areas. On this stretch, the constructed areas are mainly of residential use, with medium density individual houses.

From the Sequele DC to the Cacuaco DC, the pipeline goes next to the main road of the Sequele Centrality and then next to the Via Expresso (Fidel Castro Avenue) Highway. Around these roads, there is mainly urban residential areas or greenfield areas. In the Sequele Centrality there are both individual 1-2 storey houses, to residential multi-storey buildings. Near the Cacuaco DC, the residential area is mainly composed of medium density individual 1-2 storey houses. Close to the crossing between the sequel Road and the Via Expresso Highway, there is a Shopping Mall, a Fuel Filling Station and a Hospital.

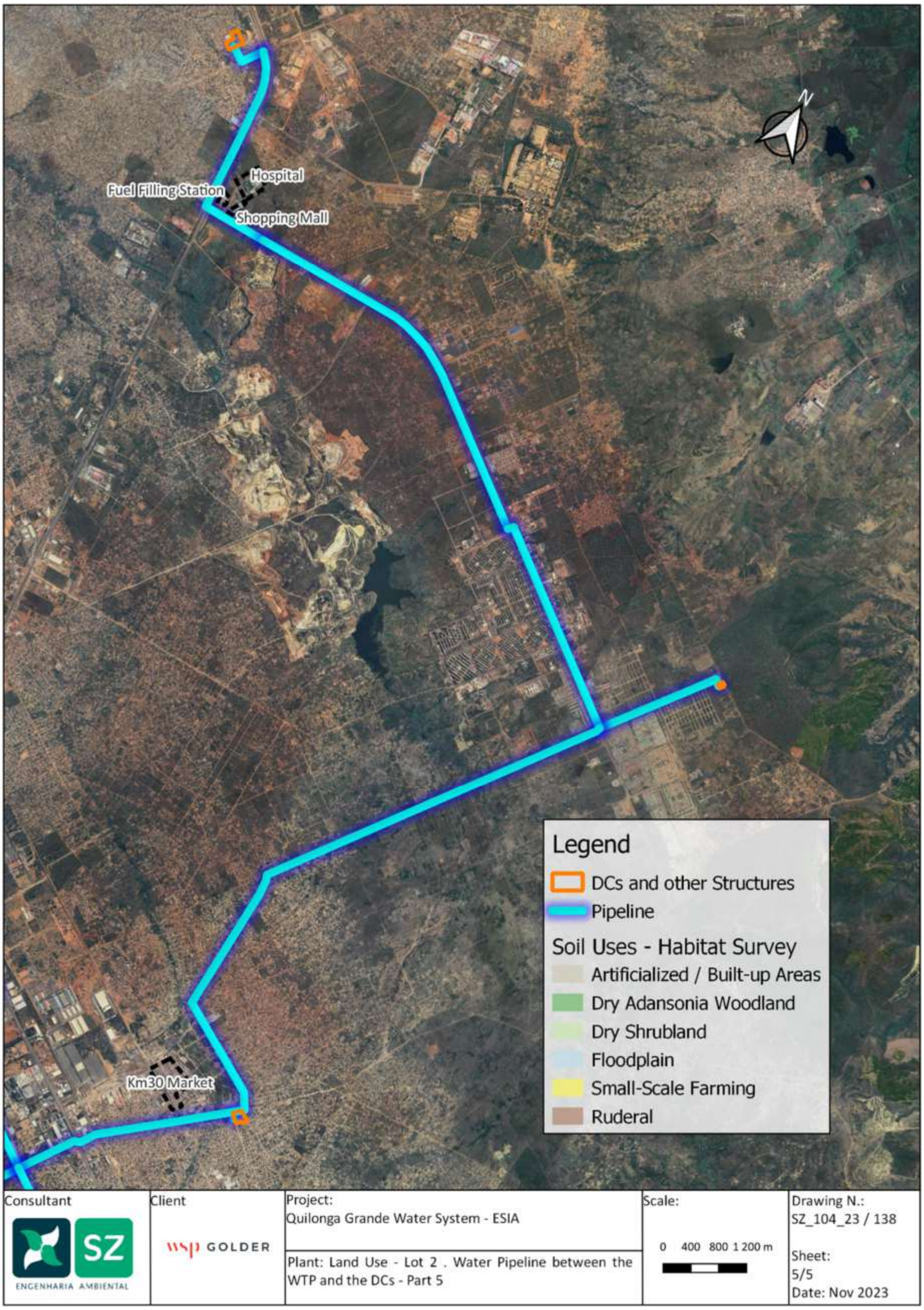

Figure 336: Land Use and main structures in Lot 2 – Part 5 (Connection to KM30, Sequele and Cacuaco DC)

Figure 337: Main road on the Sequele Centrality, to be used (Jornal de Angola)

Figure 338: Via Expresso Highay, near Cacuaco DC (Mappilary)

7.3.11 Housing assets

No information on household assets was collected at the local level. However, it was observed that a significant part of the adult population owned a mobile phone. A considerable amount of households also have a television, which allows them to follow the information.

Other more expensive "urban and modern" indicators/goods, like automobiles and motorcycles, are only owned by far fewer households in the five-neighborhoods. Some additional "luxurious" items, such as gas stoves owned by some of the families, reflect the specific context of Luanda, with the scarcity of coal and firewood, which are more traditional energy sources.

7.3.12 Infrastructure and services

National and Provincial Reference Framework

Angola is a resource-rich country that has made substantial economic and political progress since the end of the civil war in 2002. However, it continues to face significant challenges, including heavy dependence on oil, macroeconomic instability, gender inequality and large pockets of people mired in poverty and lacking access to essential social services. With a new reform-oriented government, Angola now has a window of opportunity to begin a period of more inclusive and sustainable growth that supports equitable outcomes.

While reasonable progress was made toward achieving the Millennium Development Goals (MDGs), Angola did not meet its MDG targets for water and sanitation in 2015. Despite the positive progress made in poverty reduction, primary education, and gender equality since 2002, progress in other key social indicators remains limited.

Angolas's National Development Plan 2018-2022 enshrines that "Economic and social infrastructures are fundamental for improving the population's living conditions, but they are also an important factor in the transformation and diversification of an economy. An enormous effort has been made to restore the productive and social infrastructures of the Country, a basic requirement in any development process. Significant results have been achieved in the field of water supply and electricity supply, rehabilitation of roads, rehabilitation and modernization of Angola's railways, ports and airports in the country." (Angola National Plan 2018-2022).

Angola is one of the founding countries of Southern African Development Community (SADC). This regional economic community aims to achieve peace, stability, and wealth through the integration of markets, cooperation and the joint work of its member states.

The 2030 Agenda for Sustainable Development, "Transforming our world", is a shared vision of 193 member states of the United Nations (UN) to solve the needs of people, both in developing and developed countries.

The 2030 Agenda addresses several dimensions of sustainable development (social, economic and environmental), consisting of 17 SDGs, building on the Millennium Development Goals (which, during the 15 years following 2000, guided the elimination of all forms of poverty), to complete them and respond to new challenges.

The following figure (Figure 339) outlines the 17 Sustainable Development Goals and Angola's overall performance and trends by SDG.

In terms of performance averages, SDG 12 and SDG 13, respectively, Ensure sustainable consumption and production patterns; Take urgent action to combat climate change and climate change Impacts - with results above 75 per cent.

On the negative side, the performance in reducing inequalities (SDG 9) stands out, positioned below 25 per cent of the objective.

Finally, the pursuit of the objective of ensuring the availability and sustainable management of drinking water and sanitation for all (SDG 6) remains stagnant.

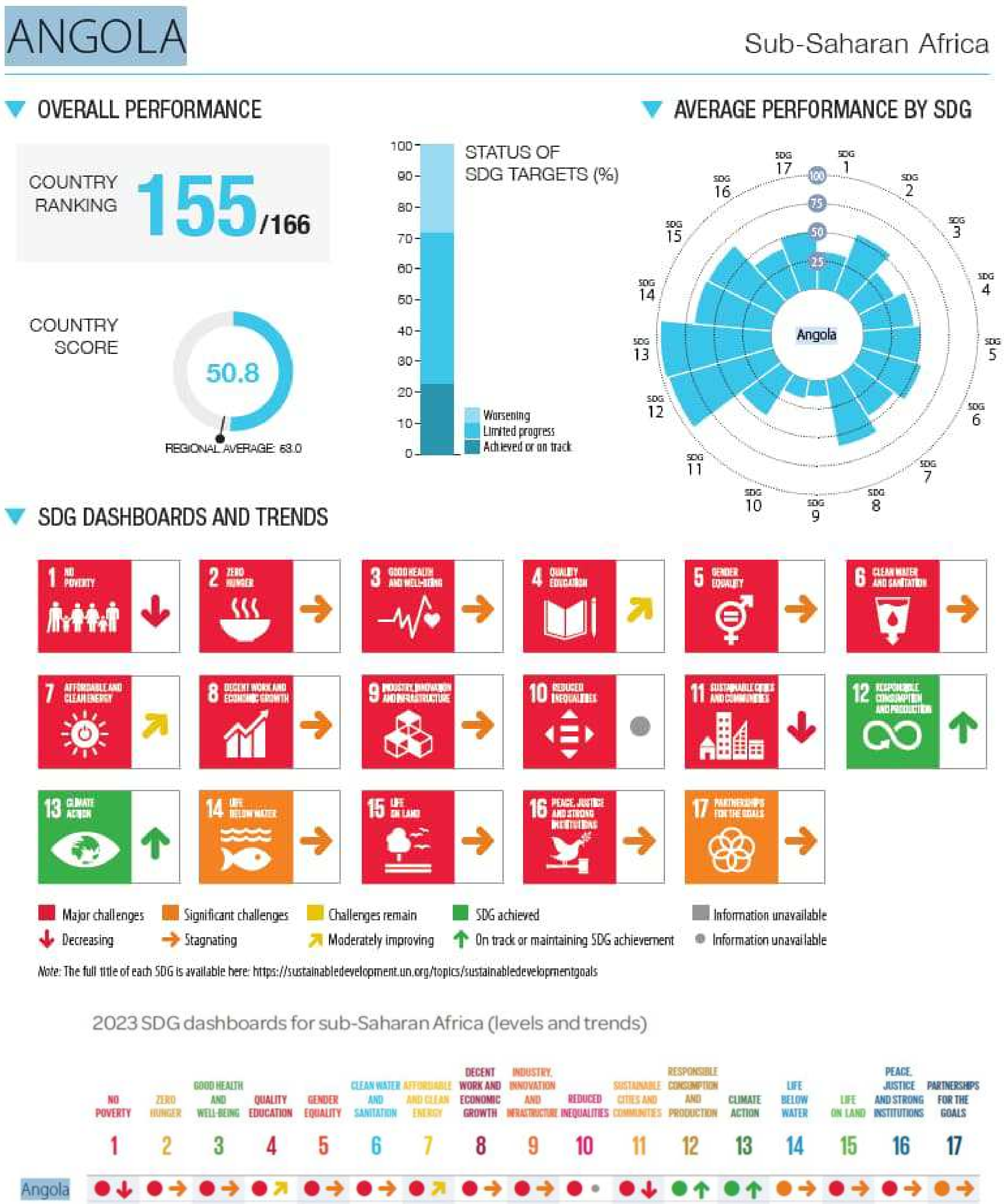

Figure 339: Angola's overall performance and trends by Sustainable Development Goals (SDG)

According to the 2018 edition of the African Development Bank’s Infrastructure Development Index, infrastructure investments account for over half of recent economic growth in Africa. Improvements in information and communication technology principally drive this growth. To fuel the most growth, however, infrastructure must be developed to facilitate connections within a country, between a nation and its region and beyond (African Development Bank 2020).

The 2019 Africa Regional Integration Index (ARII) assesses the regional integration status and efforts of countries that are members of the eight regional economic communities recognized by the African Union. It compares each country to the other countries in its regional financial community and to the countries of Africa. With an average regional integration score of 0.327, African countries are not well integrated. The high score of 0.625 (of a maximum of 1), reached by South Africa, suggests that all of Africa's countries have the potential to integrate more deeply.

South Africa is the continent's highest-ranked country on the infrastructure dimension. With a score of 0.898, it far outstrips the other most integrated countries. Egypt, Seychelles, Morocco, and Tunisia are the next-strongest performers, which scored 0.585, 0.531, 0.530, and 0.498, respectively. Angola is a Low Performer, with a score of 0.149 (Figure 340).

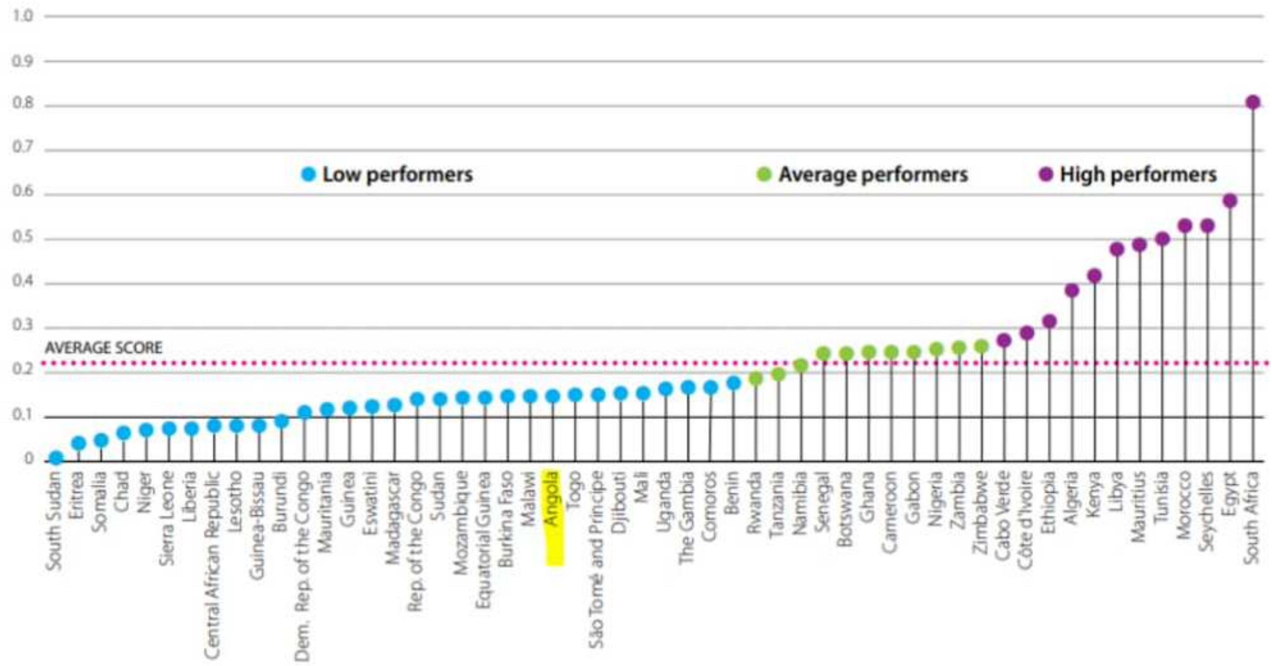

Figure 340: Countries' Scores and Rankings on Infrastructural Integration

Poor infrastructure, such as roads, water supply, and sanitation, can make it difficult for people to access essential services and opportunities. By improving infrastructure, people can access markets, schools, and healthcare facilities more quickly, reducing the burden of poverty. This can be achieved through public investment in infrastructure projects and partnerships with private-sector companies.

7.3.12.1 Health

The cost of the civil conflict was immense, with the country's infrastructure and institutions left in shatters. Half a million people were killed, with uncounted numbers wounded and maimed. An estimated 3.7 million people became refugees or were internally displaced, often migrating to the cities. The social costs were also enormous, as many Angolans were left without proper schooling and health care.

Relative to peers, Angola still overspends on subsidies and underspends on agriculture, education, health, and social protection (World Bank Group, December 2018).

The rural poor continue to suffer from disproportionately lousy health outcomes. Angola's recent growth has helped improve the health of its population, but indicators still lag far behind those of other middle-income countries. The rural poor, in particular, still contend with deficient access to health care compared to those who can afford private care. Access to services is also problematic, with pregnancy health checks and delivery services available in only 25 per cent of rural facilities.

In 2015–2016, only 34 per cent of women in the poorest quintile attended four or more prenatal visits, compared with 88 per cent of women in the wealthiest quintile. Access to these services is also problematic, with pregnancy health checks and delivery services available in only 25 per cent of rural facilities.

Failing infrastructure and underdeveloped supply chains limit the availability of drugs and vaccines in rural areas. This drives up the rural population's health care cost, increasing out-of-pocket spending on medication and reducing access to treatments for life-threatening conditions such as tuberculosis, malaria, and rabies. Malaria infection rates are ten times higher in rural areas compared to urban areas, and climate change could lead to a substantial increase in malaria prevalence in the Angolan highlands by the 2080s. Low health indicators for Angola's indigenous peoples, the San, are worrisome.

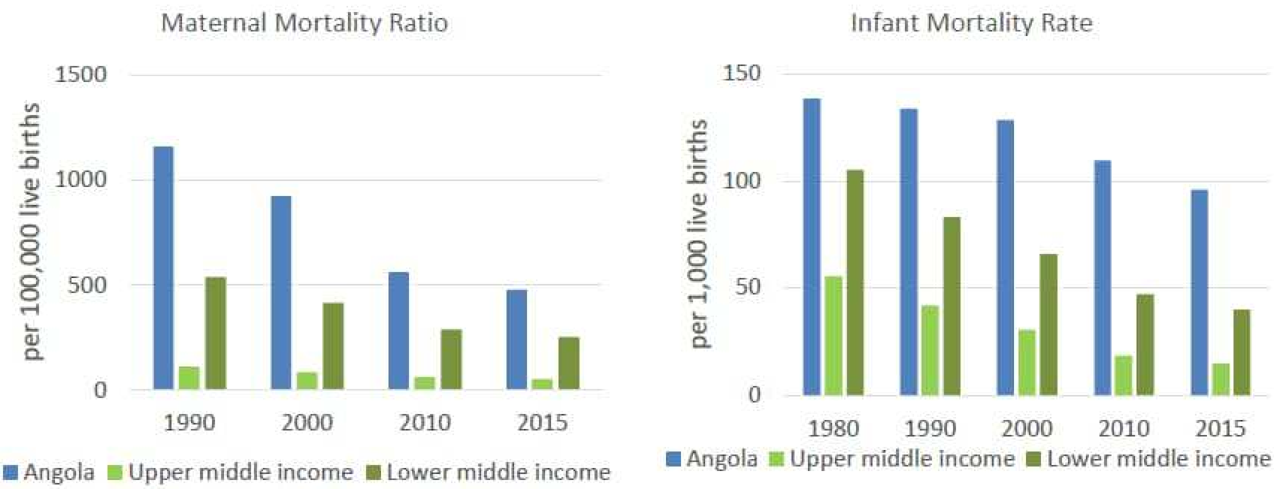

Figure 341: Health indicators for Angola and its income Peers (World Development Indicators from the World Bank)

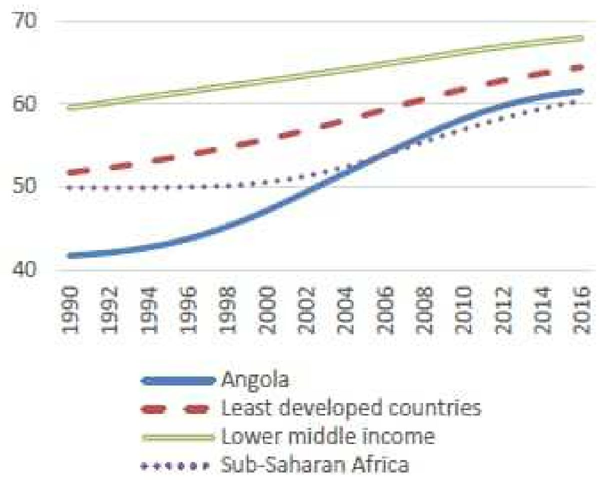

Figure 342: Life Expectancy (years) (World Development Indicators from the World Bank).

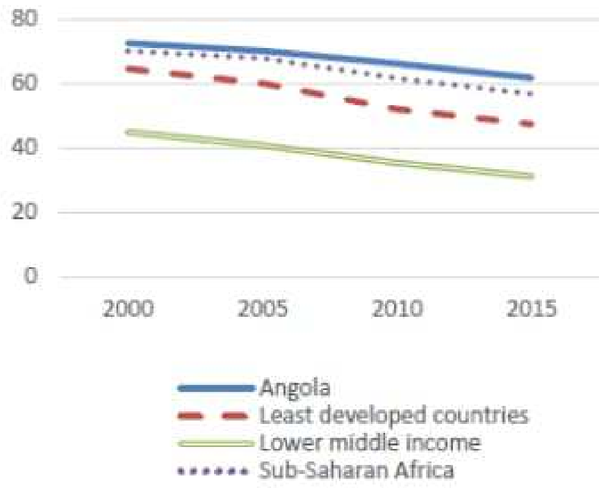

Figure 343: Death from Communicable Diseases (percentage of deaths) (World Development Indicators from the World Bank).

Angola suffers from a scarcity of trained healthcare professionals, low public health expenditure, and weak investment in water and sanitation. Angola has only one physician, less than 23 healthcare workers, and 63 nurses per 10,000 people.

Rural areas are the worst hit by this scarcity, as 85 per cent of healthcare workers are concentrated in the capital. Poor training and education contribute to the country's low-quality healthcare services. Public health expenditure has been declining, dropping from 2.6 per cent of GDP in 2013 to just 1.5 per cent in 2015, and remains far behind the Sub-Saharan average of 5.4 per cent (World Bank Group, December 2018).

Limited access to improved water, sanitation, and hygiene services has detrimental public health consequences such as waterborne diseases and child stunting. Nationally, only 41 per cent of the population has access to essential or improved drinking water services (63 per cent in urban areas and 24 per cent in rural areas).

Although public health expenditure is necessary to help people experiencing poverty, it is low and has declined since 2014. Health spending increased almost four times between 2000 and 2014, but the trend was reversed when spending cuts in 2014 and 2015 led to real reductions of 19 per cent and 39 per cent, respectively.[8]

Limited access to improved water, sanitation, and hygiene services has detrimental public health consequences such as waterborne diseases and child stunting. Angola's indicators for access to water and sanitation missed the 2015 Millennium Development Goals (MDGs) targets and still rank low among comparable peer countries.

[8] World Bank 2017 a.

SDG3 – Good Health and Well-Being

Maternal mortality rate (per 100,000 live births)	221.9	2020
Neonatal mortality rate (per 1,000 live births)	26.6	2021
Mortality rate, under-5 (per 1,000 live births)	69.4	2021
Incidence of tuberculosis (per 100,000 population)	325.0	2021
New HIV infections (per 1,000 uninfected population)	0.5	2021
Age-standardized death rate due to cardiovascular disease, cancer, diabetes, or chronic respiratory disease in adults aged 30–70 years (%)	22.3	2019
Age-standardized death rate attributable to household air pollution and ambient air pollution (per 100,000 population)	142.8	2019
Traffic deaths (per 100,000 population)	26.1	2019
Life expectancy at birth (years)	63.1	2019
Adolescent fertility rate (births per 1,000 females aged 15 to 19)	163.0	2014
Births attended by skilled health personnel (%)	49.6	2016
Surviving infants who received 2 WHO-recommended vaccines (%)	36	2021
Universal health coverage (UHC) index of service coverage (worst 0–100 best)	39	2019
Subjective well-being (average ladder score, worst 0–10 best)	3.8	2014

Figure 344: Angola's overall Health and Well-Being Indicators (Sustainable Development Goals)

The development of the characterization of health services and infrastructures at the provincial level is based mainly on data from the Yearbook of Social Statistics 2015-2019 (Anuário de Estatísticas Sociais 2015-2019), published by INE in 2022. The following table presents the existing health units in Luanda Province and their ratio per 1,000 inhabitants.

Table 95: Health Units by Province, Luanda 2019 (INE, 2022. Anuário de Estatísticas Sociais 2015-2019)

	Hospitals	Health Centers	Medical Centers	Mother and Child Centers	Provincial Hospitals	Municipal Hospitals	Others	Total	Unit / 1,000 inhabitants
Angola	12	455	1963	85	33	178	46	2772	0.09
Luanda	12	37	90	22	4	12	8	185	0.02
% of Country	100,0	8,1	4,6	25,9	12,1	6,7	17,4	6,7	

Luanda Province has 187 health units (year 2019), representing about 7 % of the total of the Republic of Angola. The central hospitals are all located in Luanda Province and comprise about 26 % of the Mother and Child Centers.

Concerning private health units, the Province Luanda concentrates 143 of the 180 Specialty Medical Offices existing in Angola and 87 laboratories of the 155 existing ones (The year 2019).

The following table presents the existing health professionals in Luanda Province and the ratio of doctors and nurses per 1,000 inhabitants.

Luanda concentrates more than fifty per cent of the country's existing doctors and about 29 per cent of nurses. The ratio of doctors per thousand inhabitants in Luanda is double the national average, respectively 0.28 per cent and 0.14 per cent.

Table 96: Health Professionals by Province, Luanda 2019 (INE, 2022. Anuário de Estatísticas Sociais 2015-2019)

	Doctor	Doctor / 1,000 inhabitants	Nurse	Nurse / 1,000 inhabitants	DTT	Administrative	Auxiliary	
Angola	4,165	0.14	33,043	1.01	7,650	11,679	21,094	77,634
Luanda	2,136	0.28	9,423	1.14	3,532	4,704	7,195	26,995
% of Country	51.3		28.5		46.2	40.3	34.1	34.8

At the municipal level, statistics and official documents on the existing health infrastructure are scarce and primarily out of step with the current situation. Thus, some news published by the Angolan media is used to outline the frame of reference in the area of the Project.

More than 32 health units are being built in Luanda under the Integrated Plan of Interventions in Municipalities (PIIM. These new infrastructures will reinforce the 173 already existing in the health network of Luanda Province (Ver Angola 2022).

In the next five years, Luanda will have 600 new health units and expects more than 150 health professionals to be admitted (Ver Angola 2022).

According to this news, the Municipal Director of Health of Cacuaco said that Cacuaco has approximately 1,200,000 inhabitants and has only one municipal hospital, six centers and health posts. Two of these units were built within the Integrated Plan for Intervention in Municipalities (PIIM) framework, some rehabilitated with the administration's resources.

As already mentioned, the scarcity of sanitary medical infrastructure affects the more socially and economically fragile population. In the survey, 78 of the hundred respondents pointed to improvements in health care and health care as one of the social concerns that most affect the community, as illustrated in the Figure 345.

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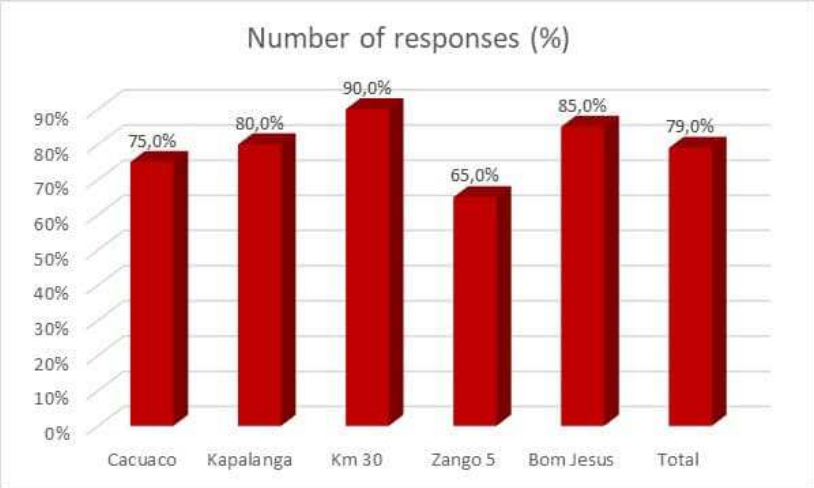


Figure 345: At the local level, a number of respondents pointed to improving Health facilities and services in the Project area as one of the social problems (Source : Filed Survey)

7.3.12.2 Water

The water supply infrastructure was understandably poor following independence from Portugal and the extended civil war. Lack of investment, rehabilitation, and service expansion during this period, compounded by other effects of the war, resulted in low levels of access and poor-quality services. As of 2001, only 27 per cent of the population had access to improved drinking water sources. Access was somewhat better in urban areas, with 42 per cent of the population estimated to have access.

Since the war's end, Angola has increased access to improved water services through public investment, mainly by constructing stand posts in previously unserved urban areas. Between 2006 and 2015, national access to improved drinking water sources remained roughly static, at 49 per cent of the population. In urban areas, however, there was a significant increase in access to improved drinking water sources—from 58 in 2006 to 75 per cent in 2011—driven mainly by expansion of stand posts. However, access to water through private household (yard taps or internal plumbing) connections remains low, at 32 per cent in urban areas. In addition, the data for access in urban areas may be overstated, as peri-urban areas—where density is often as high or higher than formal urban areas and where water is mainly non-existent—are not included in “urban” service estimates. There are also vast disparities in access to improved water sources among urban areas, particularly in provincial capital cities (World Bank Group. s.d.).

Angola is a rich country, with 77 river basins, 43 hydrological basins, and important upstream positions in several international basins. However, water resource management infrastructure and capacity collapsed during the war. Moreover, the country is vulnerable to floods and droughts. These severe weather events and climate change will not only heighten the tensions of water resource utilization and allocation. Still, they could also pose additional challenges to people with difficulty accessing clean water.

The Energy and Water Sector is a fundamental part of the Government's strategy for the economic and social development of the country. The Government Program sets ambitious targets for Governance in 2018-2022 regarding access to electricity and water, installed capacity, and renewable energies (Plano de Ação do Sector de Energia e Águas 2018-2025. s.d.)

Angola has been undertaking a significant effort in rehabilitating and constructing new infrastructures for water supply and collecting and treating wastewater to allow populations adequate and universal access to drinking water and wastewater treatment services.

In recent years, Angola's priorities have been to improve the quality of water supply service in urban areas, suburban areas and rural areas, as well as the institutional development of the sector to ensure efficient management in the operation of the systems and the continued creation of entities dedicated to this purpose.

The average coverage rate of water supply in Angola was around 63 % in 2014, according to the data presented, which justifies the continuity of the Angolan government's commitment to investment in water supply systems to reach the coverage rate of 80 % in rural areas and 85 % in urban areas.

The analysis of investments in Angola's water supply can be divided into four major groups: highlighting the group that frames the Quilonga Grande Project under consideration (Plano de Ação do Sector de Energia e Águas 2018-2025. s.d.).

- Water supply to Luanda: The largest share of the investment was directed to the reinforcement of the water supply capacity to the city of Luanda through the construction of the Bita and Quilonga Grande systems aimed at supplying the South and East of Luanda, respectively, but which was not carried out due to the scarcity of financial resources, that is, the financial coverage for the construction of the new systems (Bita and Quilonga Grande) was partially guaranteed using the China Credit Line, framing two lots of the Bita System (lots B3 and B4) and 7 lots of the Quilonga Grande System (lots Q1, Q3, Q4, Q5, Q8, Q9 and Q10). These lots have started the works, but there remains an urgent need to guarantee financial coverage for the remaining lots, with particular emphasis on the treated water pipelines.

The GoA has emphasized the institutional development of the water sector and has committed to establishing necessary policy and legal frameworks. Right after the end of the civil war, the Water Law (2002) was enacted, mandating cost-recovery tariffs and professionalization of service delivery and devolving the responsibility for service provision to provincial governments. In 2008, the Government approved Vision 2025, which included the goal of universal access to water supply in urban areas by 2025. Building on Vision 2025, the 2013-2107 National Development Plan and the 2013-2017 Energy and Water Sector Action Plan identified as a critical priority the strengthening of urban water supply, particularly in provincial capitals, emphasising the expansion of water systems. Concerning water resource management, the National Strategic Plan for Water (2003) highlighted the need to identify and quantify water uses, identify water resources, and establish a water balance.

The supply of drinking water in Angola is provided by the Public Water Supply Company (Empresa Pública de Abastecimento de Águas), which is also responsible for undertaking studies, projects, and the operation and maintenance of water capture, treatment, supply, and distribution systems, under the terms of the concessions or licenses granted by the competent authorities (Ministry of Energy and Water, 2006). The GoA formally created the Instituto Nacional de Recursos Hidricos (INRH—National Institute for Water Resources) in water resource management in 2010.

The following table presents the evolution of the Angolan water sector—including the institutional and legal framework, policy priorities, investment strategy and level of service, and World Bank involvement.

Table 97: Evolution of the Water and Sanitation Sector (WB, February 16, 2017)

CRITERIA	2000-2010	2010-2017	2017-2023	2023-2030
Legal, Governance and Institutional Framework	Water Law 6/02 and Law 9/95 for the Creation of Public Companies National Water Directorate (DNA) is responsible agency for policy making, management and governmental support to Water Resources Management (WRM) and Water Supply and Sanitation (WSS) sub sectors WSS delivered by provincial governments with support and oversight of DNA	DNA is the responsible agency for planning and implementing infrastructure projects. Creation of, 16 PWSUs, INRH, and IRSEA. However, institutions do not have enough capacity to fulfil their mandates. Economic Instrument for water Resource management – Raw water – created.	Development of tools for WRM Develop regulatory framework and instruments for water supply regulation Strengthening sector agencies Aspects of economic regulation of water services in place.	DNA role limited to policy maker and sector leader for the WSS sub-sector. IRSEA independently and effectively regulates WSS Creation of PWSUs in the remaining provinces. PWSUs improve efficiency and plan and implement capital projects
Sector Policy	Programme for the Development of the Water Sector (PDSA) commitment to MDGs and development of master plans "Water for All" program commits to ensuring access to basic services No cost recovery Flat tariffs determined by provincial governments but not always collected.	Expansion of household connections in peri-urban areas Evolving approach from flat tariff to volumetric consumption tariff	PWSUs organized and functioning as corporatized service providers. Implementation of cost recovery policies. Integrated Water Resources Management (IWRM) approach implemented in pilot river basins. Economic Instruments for water Resource management – Raw water charges– piloted in one river basin	Cost recovery policies in place (including pro-poor tariff guidelines) IWRM adopted country-wide Independent regulatory framework in place and operational, incentivizing performance improvements Economic Instruments for water Resource management – Raw water charges– adopted country-wide.
Sector Financing	Multilateral agencies finance WSS in rural areas and selected urban areas. Capital investments and recurrent costs in urban WSS financed by public funds	Capital financing from development banks and donors O& M costs of WSS mainly supported by public resources.	Capital financing continues from development banks and donors Public subsidies of O&M costs gradually decline	Capital financing for the WSS from the GoA O&M coverage through tariff revenues for WSS
Service Provision	Service expansion through construction of standposts. 11% coverage. Cooperative organizations in charge of peri-urban and rural service	Replacement of standposts with household (yard) connections in peri-urban areas. 30% coverage. PWSU service provided to urban and selected peri-urban areas.	Continued extension of household (yard) connections in peri-urban areas. 70% coverage. Customer care systems in place	Start of construction and operation of urban sanitation infrastructure
World Bank Involvement	Assistance address critical breakdowns:: IRE (1990s) Project prepares WSS and solid waste master plan for Luanda PRUALB (1992-2001) to improve WS&S in the cities of Lobito and Benguela; progress hindered by restarting of the war. EMRP-1 and EMRP-2 (2005-2009)	Rehabilitation and extension of WSS, with particular focus on distribution networks and service provision; Support for the creation of INRH, IRSEA and PWSUs Support DNA capacity in planning and execution of Government budgets	WSS expansion to peri-urban areas and technical assistance Support to capacity building of INRH, IRSEA, and PWSUs Technical assistance in urban sanitation infrastructure planning	Expansion of WSS and development of urban sanitation infrastructure Continued support to INRH, IRSEA, and PWSUs to address the new challenges on sanitation service provision.

In the specific case of the Province of Luanda, EPAL-EP was created with a statute approved by Decree No. 72-A/01 of January 5 of the Council of Ministers to carry out studies, projects, maintenance of systems for the collection, treatment, adduction, and distribution of water in a public service regime, in the province of Luanda (Ministério da Energia e Águas (MINEA). 2018)

The provincial water company EPAL is the sole public-sector service provider. Working at full capacity could provide every inhabitant in Luanda with 57 liters per person daily. Still, it delivers only 60% of this to householders with domestic connections, principally due to leakage in the distribution systems. Unconnected consumers access water through standpipes, water truck operators and home tank owners. EPAL-constructed water-truck filling stations (aptly nick-named giraffes) in the underserved peri-urban areas of the city are a short-term solution, allowing water truck operators to buy treated water for resale to unconnected households (Allan Cain. 2018).

The Drinking Water Tariff provided by EPAL was approved by Joint Executive Decree no. 230/18 of 12 June, which repeals all previous provisions that contradict this Joint Executive Decree, namely Joint Executive Decree no. 707/15 of 30 December.

This diploma stipulates that the tariffs are composed of a variable component that concerns the quantity supplied and consumed and a fixed part that concerns the type of equipment installed and its respective maintenance, being the following:

a) Social Domestic Category — Tariff category with consumption of 0 to 5 m^3 for dwellings with low-income families whose daily consumption does not exceed 166 liters/day;
b) Domestic Category Tier 1 — Tariff category with consumption of 5 to 10 m^3 for dwellings with middle-income families whose daily consumption varies from 166 to 333 liters/day;

c) Domestic Category Tier 2 — Tariff category with consumption greater than 10 m^3 for dwellings with high-income families whose daily consumption is greater than 333 liters/day;
d) Trade and Services category — Tariff category referring to all consumption, including collective entities, namely commercial sector customers, service providers and public bodies;
e) Industry category — Tariff category to all consumption, which includes customers in the industrial sector;
f) Giraffe category — Tariff category relating to all consumption, which includes customers without contractual link with the supplier, who purchase water through tanker trucks;
g) Fountain category—Tariff category covering customers without a contractual link with the supplier, generally comprising populations most in need of social protection; and
h) Raw Water Category — The Tariff category comprises customers who use untreated water for industrial and agricultural activity.

The Drinking Water Tariff Plan that constitutes ANNEX I to the Joint Executive Decree no. 230/18 establishes variable prices according to the eighteen provinces of the Republic of Angola.

The Variable Tariff of Luanda is 117 Kz/m^3, being the highest value and only practiced equally in the Province of Benguela.

The Monthly Variable Rate differs between provinces, the highest in Luanda for the seven tariff categories. The value of Category a) Domestic Social, for consumption between 0 and 5 $m^{3,}$ is 250 Kz, while it does not exceed 200 Kz in the other provinces.

The price of the other categories is also higher in Luanda, reaching the price of 3,000 Kz in the category h) Raw Water Category. The price for category f) Giraffe category is not tabulated.

Faced with the insufficient coverage in the supply of water to the population by EPAL in peri-urban areas, where the water supply by the Public Water Company is either deficient or does not exist, the provincial government recognized the vital role of water distribution truck operators and registered the respective association, ANGOMENHA (Association of Water Collectors and Transporters). The association has bridged the gap between the formal and informal by incorporating themselves to pump, transport and sell river water to the informal market.

Water selling in its various forms is probably the largest subsector of Luanda’s informal economy. The city's water infrastructure was built in the early 1970s for a half-a-million colonial population. It could not be stretched to serve the four million living in the capital by the war's end in 2002. The lack of public investment during the conflict years meant that the informal sector, which provided the only economic opportunity and development source for many, emerged as the principal water supplier. Post-war investments in urban infrastructure extended the water network to supply new middle-class condominiums with household connections and improved services in the central business district. However, little was initially invested in upgrading essential services for the musseques.

In Luanda, where people living in the musseques (shantytowns) are accustomed to paying a high proportion of their income to obtain minimal amounts of water, the population would likely be willing to pay cost-recovery tariffs for higher service standards.

Some indicators extract the current reference framework of the level of care of water services for domestic consumption and basic sanitation (see Figure 346 and Figure 347).

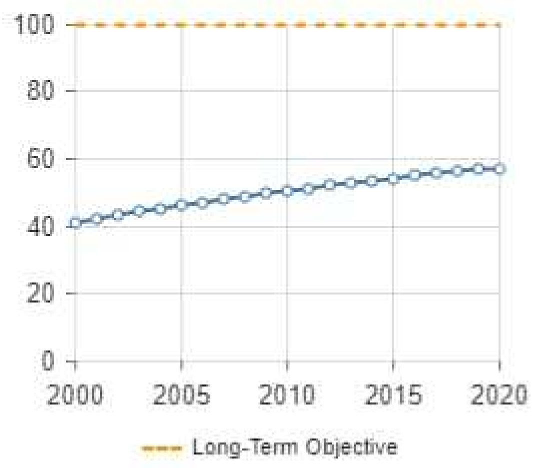


Figure 346: Population using at least essential water services (Source, Sustainable Development Report – Angola)

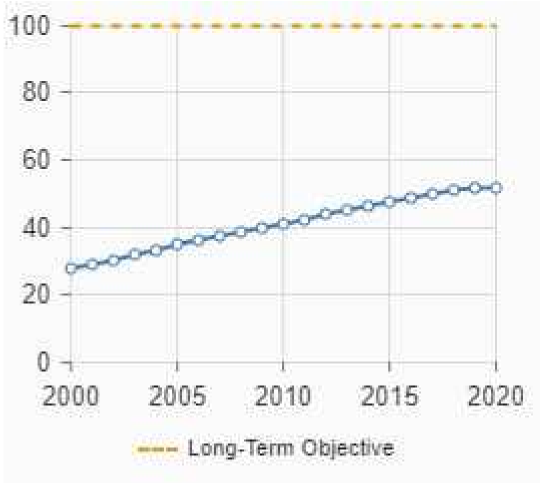


Figure 347: Population using at least essential sanitation services (Source, Sustainable Development Report – Angola)

The following figure (Figure 348) shows the trend of evolution to achieve the Development Goals at the population level served at least by essential water services for human consumption, included in the SDG6 and SDG11 objectives.

In the reference years for each indicator (2020, 2019, 2018 and 2014), the trend is unsatisfactory, with seven indicators showing a negative pattern of evolution compared to previous reference years.

SDG6 – Clean Water and Sanitation

Population using at least basic drinking water services (%)	57.2	2020
Population using at least basic sanitation services (%)	51.7	2020
Freshwater withdrawal (% of available freshwater resources)	1.9	2019
Anthropogenic wastewater that receives treatment (%)	0.0	2020
Scarce water consumption embodied in imports (m^3 H_2O eq/capita)	493.2	2018

SDG11 – Sustainable Cities and Communities

Proportion of urban population living in slums (%)	62.6	2020
Annual mean concentration of particulate matter of less than 2.5 microns in diameter (PM2.5) (μg/m^3)	32.3	2019
Access to improved water source, piped (% of urban population)	59.5	2020
Satisfaction with public transport (%)	32.0	2014

Figure 348: Angola's performance and trends by Sustainable Development Goals (SDG) – SDG6 and SDG11

There is an apparent disparity in the population with access to safe drinking water services between the urban and rural areas, as evidenced in the following figure, referring to the situation in 2022.

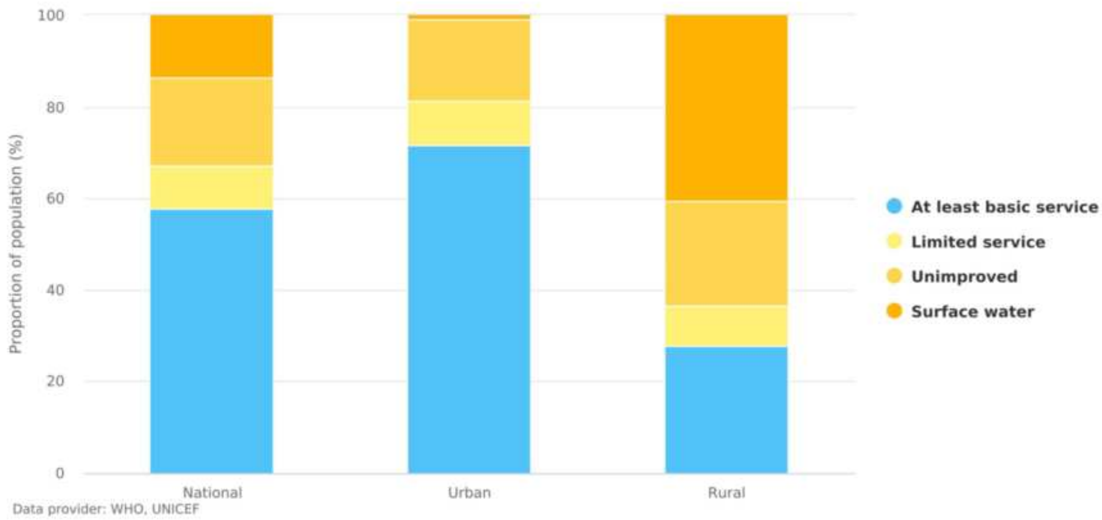


Figure 349: Proportion of population using safely managed drinking water services in Angola by service level and location (2022)[9]

The problems with water are particularly highlighted by the local population and are felt as critical because they directly affect the economy and the well-being of poor households. Most households rely on water sources outside their housing. The water is collected from the rivers around Luanda and taken in trucks to the city to be distributed, being generally considered of poor quality and even dangerous to drink (Lindblom, Henrik 2013).

Km 30 Area

Bom Jesus Area

Figure 350: Example of trucks water sellers

Families arrange and search for other alternative informal services to make up for irregularities in the water supply. Some less low-income families order an underground tank (water reservoir) in their backyard and request tanker trucks for the store. The others are supplied with water in these tanks, paying 50 Kz for each bidon (packaging) of 20 liters.

[9] Proportion of population using safely managed drinking water services > Safely managed service > Overall Drinking water from an improved water source which is located on premises, available when needed and free from faecal and priority chemical contamination.

Km 30 Area

Kapalanga Area

Km 30 Area

Bom Jesus Area

Figure 351: Example of water reservoirs

Another recent informal service, much requested in almost all suburban neighborhood s of Luanda, called Kupapata: "A three-wheeled motorcycle transports up to 500 liters of water. The driver goes from house to house selling water and usually charges 50 Kz for each bidon of 20 liters. When there is a lot of failure in the water supply, the price goes up to 100 Kz".

Zango 5 Area

Zango 5 Area

Figure 352: Example of a three-wheeled motorcycle water transport.

When the fountains, where most of the impoverished families supply themselves with water, either by paying 10 or 20 Kz, are not working for a long time (weeks/months), the situation of these families tends to worsen, the price of water in the tanks rising to 100 Kz for each 20-litre package.

Taken together, the scarcity/poor quality of public services represents severe constraints for people's daily lives and makes them feel marginalized and excluded by the state.

The reference framework of water infrastructures and services in Luanda Province is complemented with data from the 2014 Luanda Census with information up to the level of municipality and commune.

According to the results of the 2014 Census, only 47 % of households have access to appropriate drinking water sources, 48 % in the urban area and 16 % in the rural area.

The primary source of drinking water supply in Luanda Province is the tanker truck (46.0 %), followed by the tap connected to the public network (28.9 %) (see Figure 353).

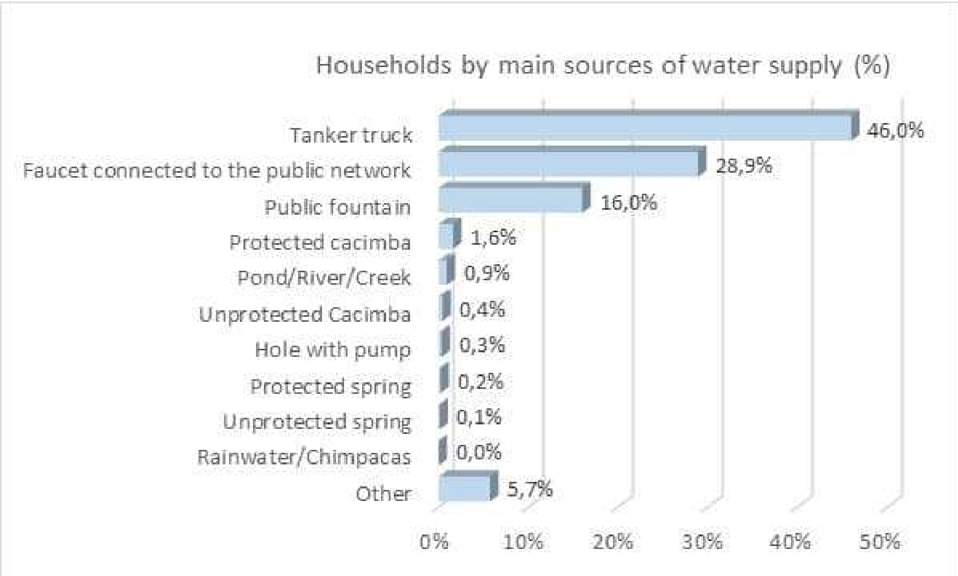


Figure 353: Households by primary sources of water supply for drinking, 2014 (Source, Census Luanda, 2014)

At the municipal level, there are significant differences in access to appropriate drinking water, as shown in the Figure 354.

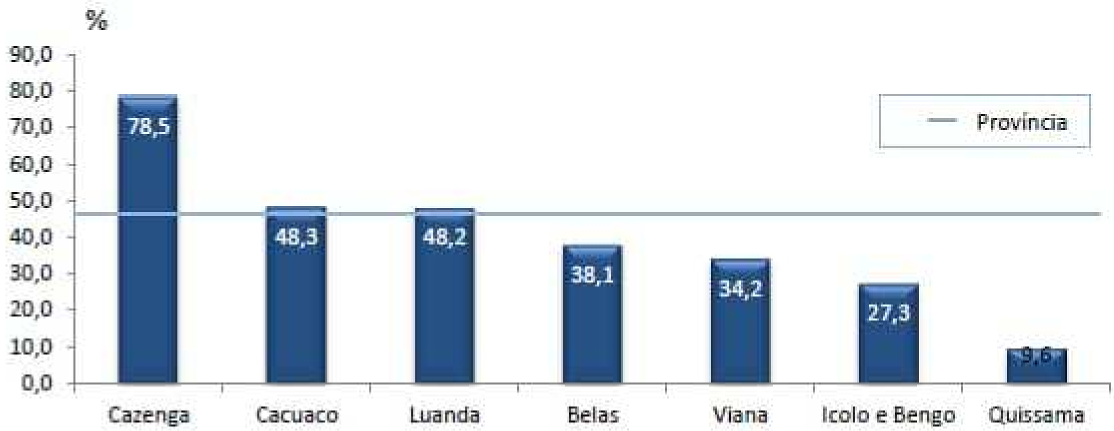


Figure 354: Households using appropriate drinking water sources by municipalities, 2014 (Source, Census Luanda, 2014)

Table 98: Households by area of residence, municipalities and communes, according to the primary source of water for drinking – Appropriate sources, 2014 (Source, Census Luanda, 2014)

Province (rural/urban) Municipality Commune	Number of households	The primary source of water to drink						
		Appropriate sources (%)						
		The faucet in the residence connected to the public network	Building faucet/Neighbor connected to the public network	Public fountain	Hole with pump	Protected cacimba	Protected spring	Total
Luanda	**1484350**	**21,5**	**7,4**	**16,0**	**0,3**	**1,6**	**0,2**	**46,9**
Urban	1437302	22,2	7,6	16,2	0,3	1,5	0,2	47,9
Rural	47048	1,4	0,4	9,6	0,8	3,1	0,4	15,8
Cacuaco	**222989**	**8,2**	**4,4**	**32,9**	**0,5**	**2,2**	**0,1**	**48,3**
Cacuaco	53034	18,3	12,4	31,6	0,5	2,8	0,1	65,8
Icolo e Bengo	**21061**	**2,9**	**0,7**	**19,9**	**0,5**	**2,8**	**0,5**	**27,3**
Bom Jesus	5088	1,4	0,4	19,2	0,8	1,5	0,3	23,6
Viana	**331860**	**18,3**	**4,5**	**9,3**	**0,2**	**1,7**	**0,2**	**34,2**
Zango	46036	46,0	7,3	4,8	0,3	1,8	0,5	60,8
Average Project Area %		15,8	4,9	19,6	0,5	2,1	0,3	43.3

Table 99: Households by area of residence, municipalities and communes, according to the primary source of water for drinking – Inappropriate sources, 2014 (Source, Census Luanda, 2014)

Province (rural/urban) Municipality Commune	Number of households	The primary source of water to drink Inappropriate sources (%)						
		Tanker truck	Unprotected Cacimba	Unprotected spring	Rainwater/ Chimpacas	Pond/River/ Stream	Other	Total
Luanda	**1,484,350**	**46.0**	**0.4**	**0.1**	**0.0**	**0.9**	**5.7**	**53.1**
Urban	1,437,302	45.9	0.2	0.0	0.0	0.2	5.7	52.1
Rural	47,048	49.6	5.6	1.1	0.6	22.6	4.9	84.2
Cacuaco	**222,989**	**47.9**	**0.3**	**0.0**	**0.0**	**1.3**	**2.1**	**51.7**
Cacuaco	53,034	30.7	0.3	0.0	0.0	0.3	2.9	34.2
Icolo e Bengo	**21,061**	**26.6**	**7.1**	**1.7**	**0.6**	**28.5**	**8.2**	**72.7**
Bom Jesus	5,088	53.1	0.4	0.6	0.0	10.9	11.4	76.4
Viana	**331,860**	**59.8**	**0.2**	**0.1**	**0.0**	**0.7**	**5.0**	**65.8**
Zango	46,036	29.9	0.2	0.4	0.0	1.6	7.1	39.2
Average Project Area %		41.3	1.4	0.5	0.1	7.2	6.1	56.7

The Figure 355 summarizes the disparities between urban and rural areas and between the three communities in the project area in the number of households that use appropriate or inappropriate water sources as the source of drinking water (Census 2014).

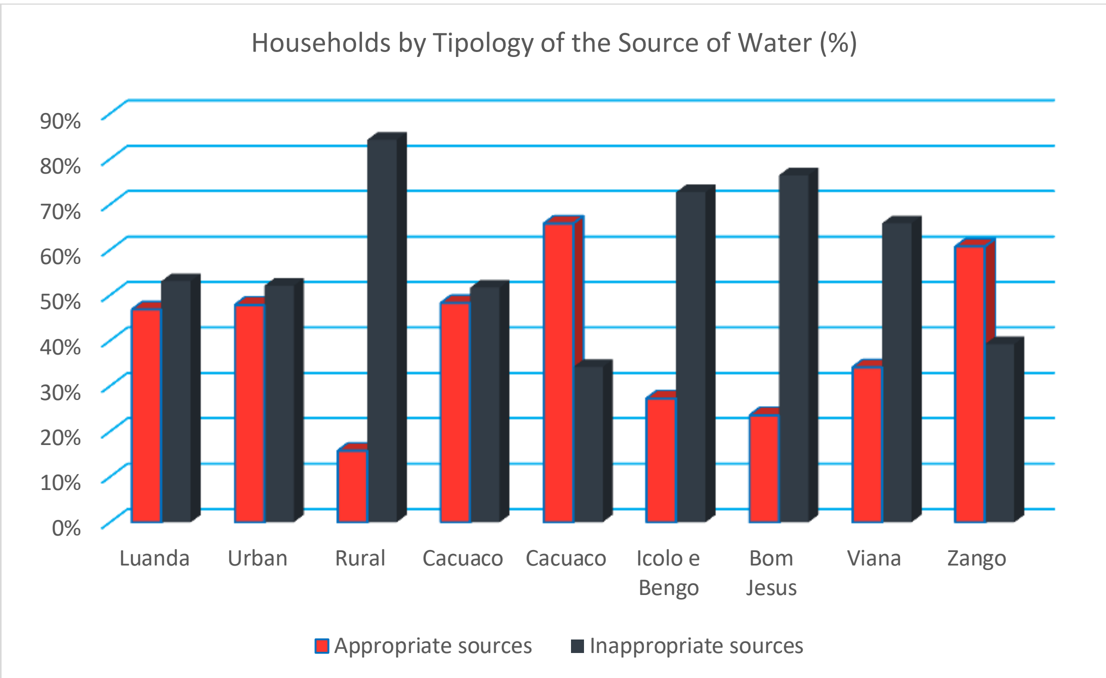


Figure 355: Households using appropriate or inappropriate drinking water sources by municipalities, 2014

Next, the level of care of the population served by water supply services is categorized based on the Household Survey.

The Figure 356 illustrates that most households interviewed are disconnected from the piped water network.

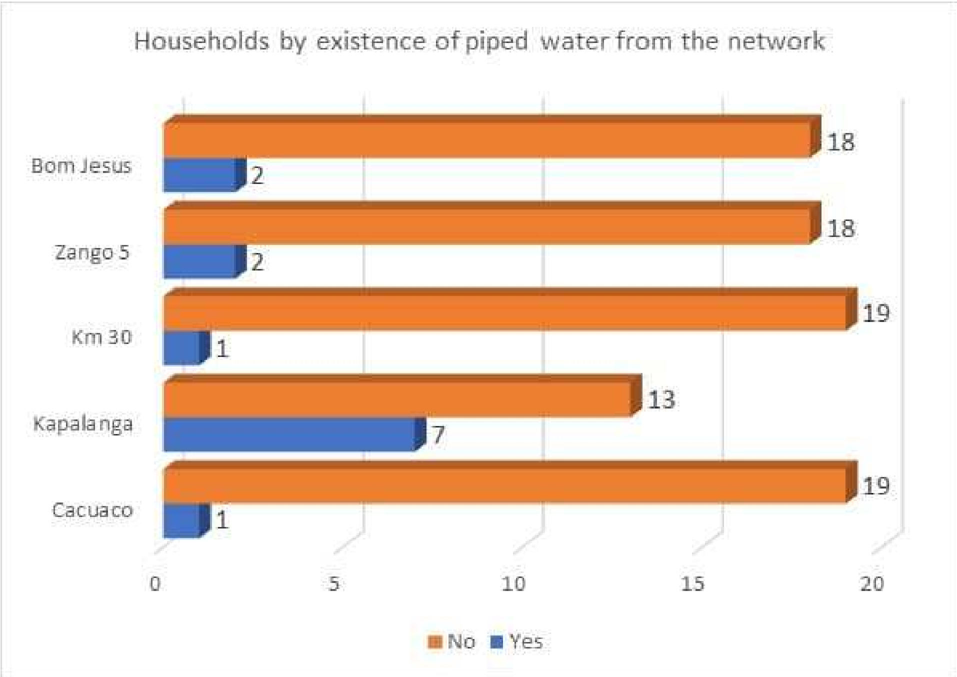


Figure 356: Households by the existence of piped water from the network (Field Survey, Questio D1)

Seven of the twenty households interviewed have conducted water from the grid at home of the five districts covered by the fieldwork. In contrast, in the remaining localities, piped water occurs only in one or two houses (see Figure 357).

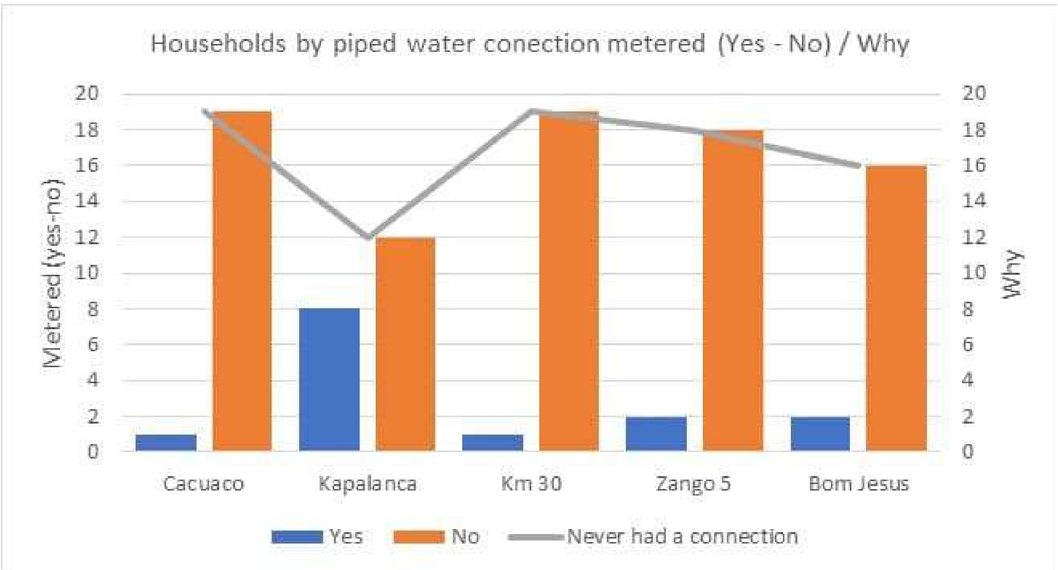


Figure 357: Households by the existence of piped water connection metered (Field Survey, Question D1)

The drinking water in most households (47 per cent) is supplied in drums purchased from vendors using motorcycles.

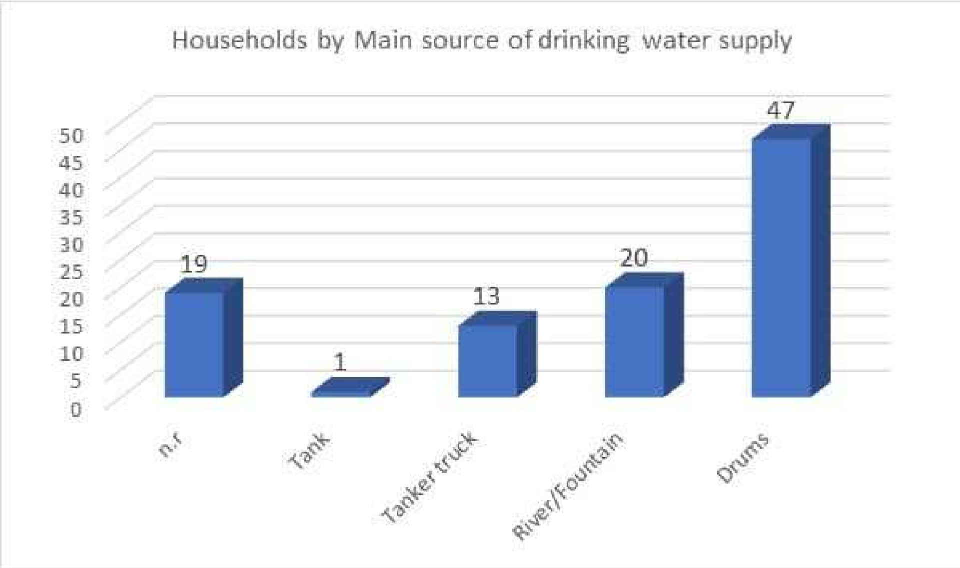


Figure 358: Households by the primary source of drinking water supply (Source : Field Survey, Question D19)

The drinking water supply system management is ensured by 67 per cent of the families themselves, 12 per cent by the water suppliers and 12 per cent by EPAL, according to the respondents' responses.

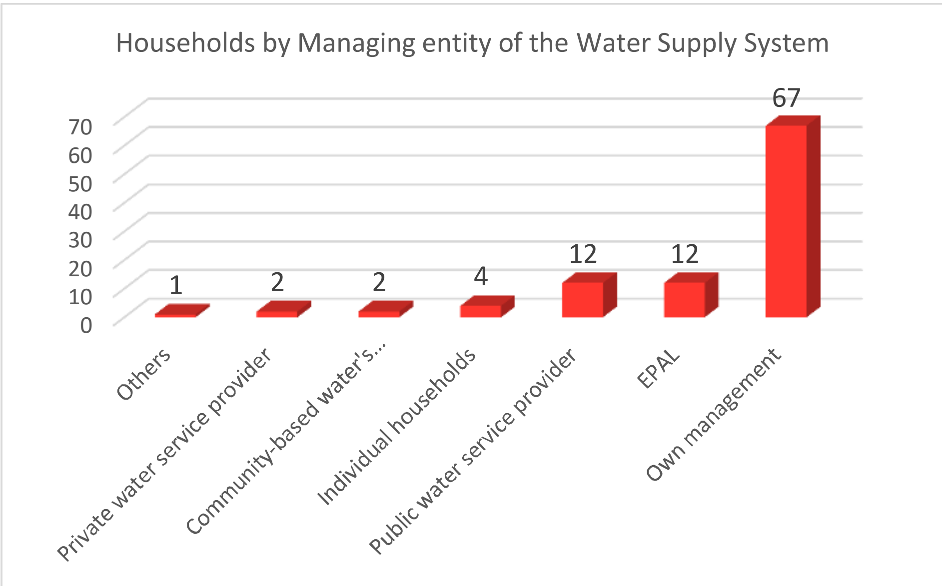


Figure 359: Households by the managing entity of the water supply system (Source, Field Study, Question D20)

Of the 100 households surveyed, only 27 have storage systems, 21 indoors and six outdoors. Fifty-one of the interviewees did not need the location of the water storage system for drinking, and ten still need to answer this question (n.r.).

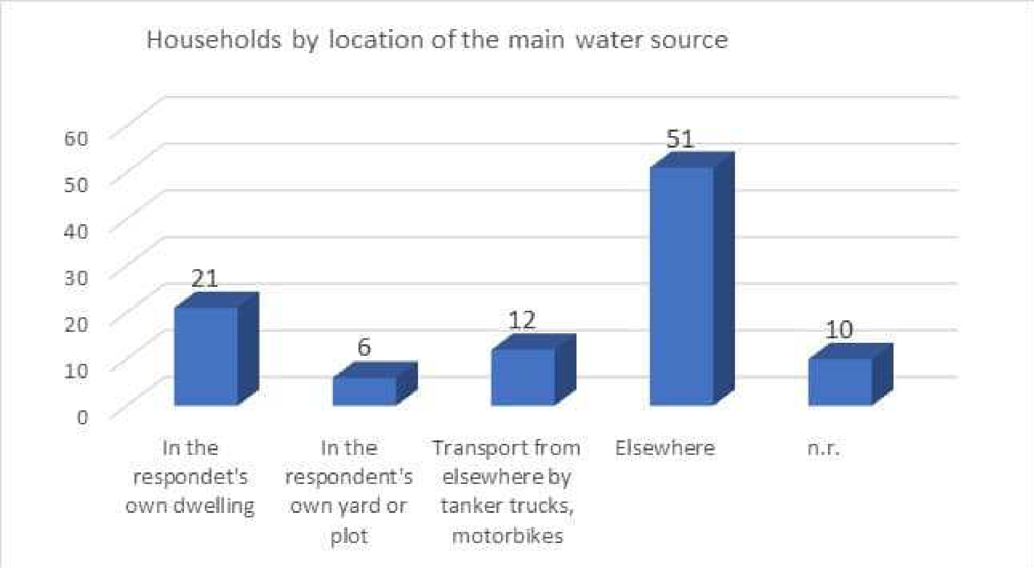


Figure 360: Households by the location of storage of drinking water (Field Survey, Question D21)

The availability of drinking water in households has some variations over time. About 34 per cent of respondents said they were always available, and 18 per cent said they were open most of the time. The level of non-response/do not know was significant at 46 %, which makes it challenging to evaluate this parameter.

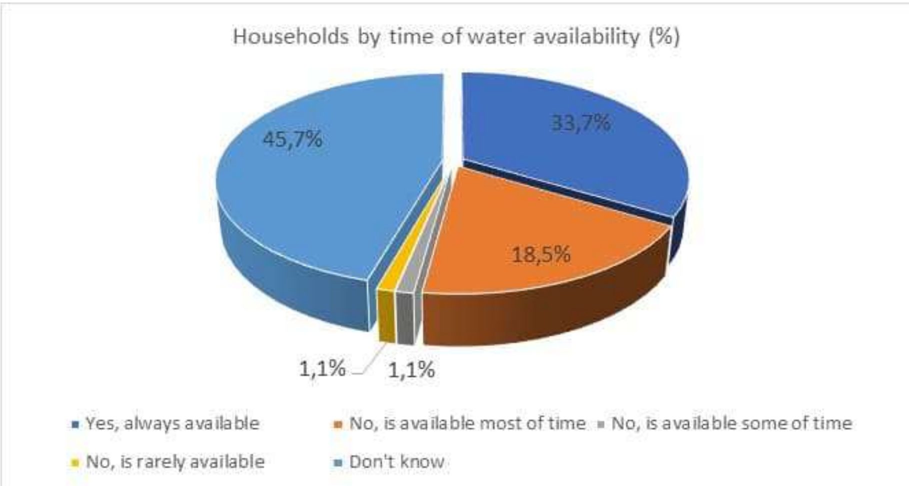


Figure 361: Households by time of water availability (Field Survey, Question D29)

The main reason for the unavailability of water was that it was not available at the source of supply (52 %). Four of the interviewees gave as a reason that water was costly, three in Kapalanga and one in Bom Jesus (Question D31).

The questionnaire also sought to distinguish different aspects related to drinking water, of which the next stand out:

- the application for grants for connection to the network ;

- connection expenses ;
- level of satisfaction with services related to piped water ;
- who usually is responsible for bringing water to the aggregate ;
- water quality, and
- disinfection practices of drinking water.

The answers to most of the questions related to the above aspects were shallow overall, so an overview of these aspects is presented:

- The non-use of subsidies is due to their non-existence and the need for knowledge on the part of the interviewees.
- As most aggregates are not connected to the water network, no overall system costs were indicated.
- The same is related to the level of satisfaction regarding the quality of the piped water network.
- The quality of the drinking water provided is only sometimes good. Sometimes, it has problems with taste, color, and smell.
- The non-answer to whether water was previously treated for consumption and what treatment was done could have been higher, with 77 per cent of non-answers.
- The non-answer to whether water was previously treated for consumption and what treatment was done could have been higher, with 77 per cent of non-answers.
- In Cacuaco, three families do not make any treatment; three families boil the water and add chlorine or bleach.
- In Kapalanga, a family does not make any treatment, and ten families boil the water and add chlorine or bleach.
- Finally, there was no answer in the locality of Km 30, and in Zango 5, only one answered with "Nothing is done."

Question 24 of the Household Questionnaire – "Who usually goes to the main drinking source to fetch water for your household?" aimed to assess who was responsible for fetching water for household consumption and Question 28 - Who usually goes to the main source for other uses, such as cooking and handwashing, to fetch water for your household?" they seek to identify those responsible for transporting water to the household.

The answers to these two questions are systematized in the following two tables.

Table 100: Households by who usually goes to primary drinking source to fetch water for household (Source, Field Survey, Question 24).

Localities	Adult woman and adult man (> 15 years)	Adult woman (> 15 years)	Adult man (> 15 years)	Adult woman (> 15 years); child (≤ 15 years)	Female child (≤ 15 years)	Male child (≤ 15 years)	Non-response
Cacuaco	5	5	1	6			3
Kapalanga	9	5	2				4
Km 30	7	8	1	1			3
Zango 5		6	3				11
Bom Jesus	9	6	1				4
Total	30	30	8	7	0	0	25

Water transport within neighborhood s by women and girls, who account for 85 % of carriers, is rarely factored into the price of water after it is delivered by truck to the owner-reseller of the neighborhood tank or by pipe to the standpost. Women and girls carrying jerrycans, basins, or buckets, sometimes hundreds of meters, to their homes add significant time and value. Child stevedores, seen in the Figures below, are hired to move water carts, typically weighing between 40 and 50 kilograms, for longer distances of up to several kilometers.

Figure 362: Children and women supplying and transporting water to their households (Photo Field Survey)

Table 101: Households by who usually goes to the leading source for other uses, such as cooking and handwashing, to fetch water for household (Source, Field Survey, Question 28).

Localities	Adult woman and adult man (> 15 years)	Adult woman (> 15 years)	Adult man (> 15 years)	Adult woman (> 15 years); child (≤ 15 years)	Female child (≤ 15 years)	Male child (≤ 15 years)	Non-response
Cacuaco	6	3	2	6			3

Localities	Adult woman and adult man (> 15 years)	Adult woman (> 15 years)	Adult man (> 15 years)	Adult woman (> 15 years); child (≤ 15 years)	Female child (≤ 15 years)	Male child (≤ 15 years)	Non-response
Kapalanga	6	5		1			8
Km 30	4	7	3			1	5
Zango 5	2	7					11
Bom Jesus	7	5	1	2	5		
Total	25	27	6	9	5	1	27

Figure 363: Children and women supplying and transporting water to their households (Photo Field Survey)

Water Supply Companies

The fieldwork also had a specific questionnaire for Water Supply Companies in the Project area. A total of 25 questionnaires were conducted between July 31 and August 3, 2023.

This questionnaire was made to five operators in each area corresponding to the six Lots of the Quilonga Grande Sistema V Project.

The level of responses raised was high, which allows us to trace, among others, the following aspects:

- Water supplier profile (gender, age and nature of the business) ;
- How the water supply is done ;
- Origin of the water supplied and quality control ;
- Monthly amount of water given and value ;
- The primary source of water in the communities where it provides the service ;
- Availability of customers to pay for water ;
- Difficulties in the business and ;
- Impacts, concerns, expectations, and community involvement in the Project.

Of the twenty-five respondents, 20 are men, and five are women (see Figure 364).

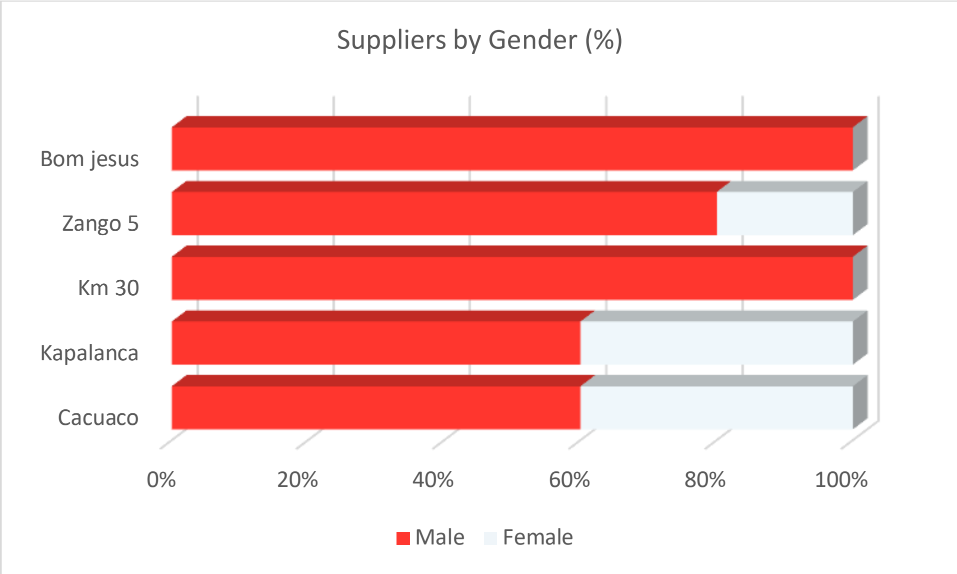


Figure 364: Water suppliers by gender (%) (Source : Field Survey, Question B1)

The ages are divided between 18-25 years and 61 and over. The age group 36-45 years comprises 44 % of respondents.

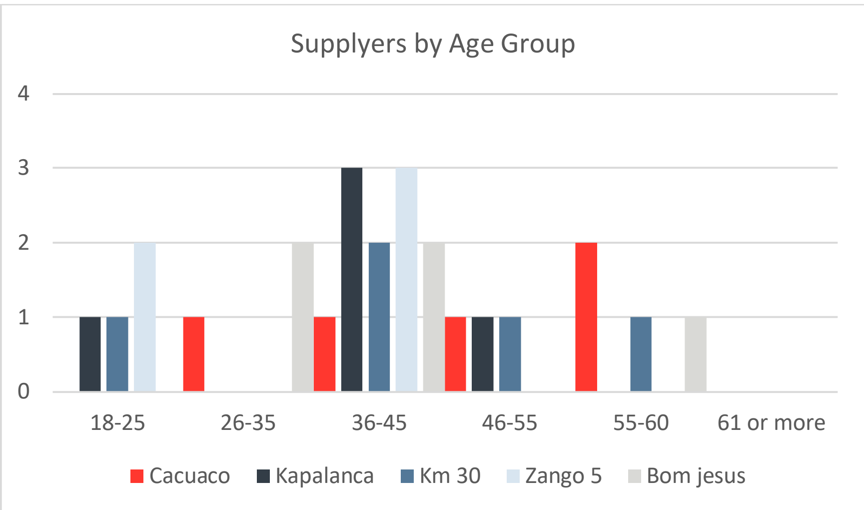


Figure 365: Water suppliers by Age Group (number) (Source : Filed Survey, Questions B2)

The water supply by drums represents 52 per cent of the total. In Cacuaco, the five operators use drums; in Zango 5, four operators also use drums. Other supply forms are the tanker, one in Zango 5 and one in Bom Jesus.

The water sources used by the suppliers are several, namely giraffe of the public network, rivers, wells or holes, fountains, water tanks, EPAL and the biker's house of the moto-tanker.

In Cacuaco and Kapalanga, the five interviewees said they did prior treatment and monitoring of water for sale. In contrast, in the remaining, none do these safety procedures and control the water quality for drinking.

The ten respondents who do water treatment and monitoring did not describe any method used. Only one respondent said they made their records regarding water quality control testing.

Eighteen 25 interviewees (72 %) indicated the monthly water supply in five neighborhood s. The values are between 1,800 liters in Km 30 and 50,000 liters in Bom Jesus.

Twenty-three of the twenty-five water suppliers indicated the monthly values corresponding to the amount of water sold.

The values are between 7,000 in the Belo Monte locality and 200,000 Kz in the Zango 5 locality. The following figure shows the average monthly value of the amount of water supplied and the average value realized with the sale of water by locality.

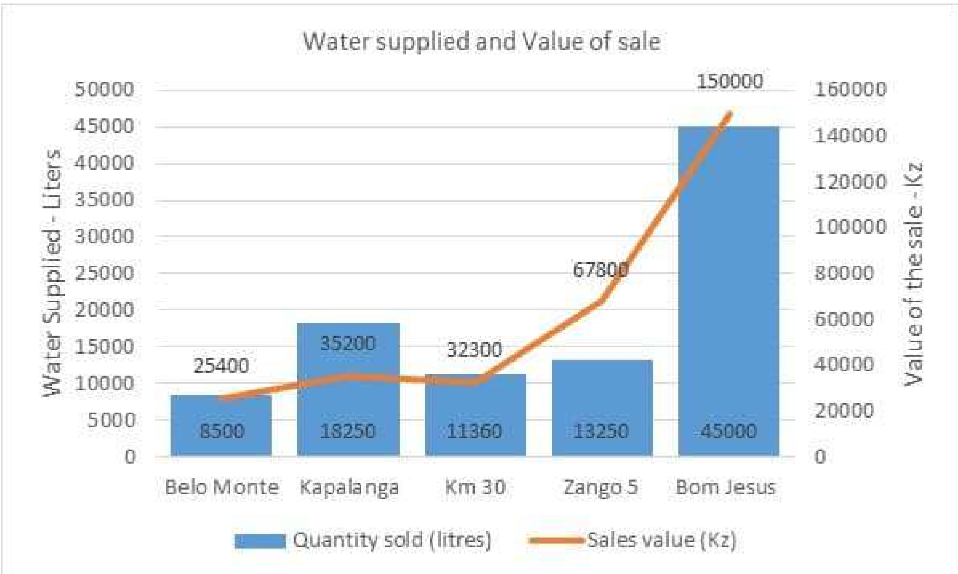


Figure 366: Average of Water supply and average of the sale value by locality (Source : Field Survey, Question C9 and Question C10)

The water supply sources to distribute differ for the five communities where they work. In Cacuaco, the supply is done entirely by a private operator; in Kapalanga, it is divided into private operators, direct public supply in housing and public supply in fountains and giraffes.

In the community of Km 30, the source is the direct public supply in the houses, and in Zango 5, the exact origin is verified in four of the answers and one answer in fountains and giraffes.

In the Bom Jesus community, the supply source is divided into private operators, public operators, and supply in fountains, giraffes, and tanker trucks. In this community, the origin of the water supply varies in the dry season. In the Bom Jesus community, the supply source is divided into private operators, public operators, supply in fountains, giraffes, and tanker trucks. In this community, the origin of the water supply varies in the dry season. In Cacuaco, it is also mentioned that the source of the water supply varies depending on the year's season.

Home tank owners often do not have enough money to buy an entire tanker truck of water regularly once their tank is dry. Until they can collect a lump sum to purchase a complete load of water, they can become users of water from other neighborhood tank owners.

Social networks evolve locally between neighbors, who may be buyers and sellers at different times. Therefore, every water consumer in a poor, un-serviced bairro must maintain friendly social relations with a range of water suppliers within walking distance of their homes.

Street vendors who work in the informal market selling water in small containers or plastic bags also perform a secondary level of retailing. Usually, these vendors receive their water from home tanks and standposts and sell in half-litre units for the equivalent of USD$0.05 to 0.10. Water sale on the street and in markets is often performed by ambulant traders, usually considered at one of the water market's lowest rungs and make only marginal incomes.

7.3.12.3 Solid Waste Disposal and Sanitation

Like public water and electrical power, Luanda has low coverage rates regarding the population served by basic sanitation, considering the doubling of its population in just over two decades. The lack or insufficiency of garbage collection services leads households to adopt unsuitable places such as garbage dumps, which local administrations implicitly acknowledge with some irregularity; they will relieve the excess garbage or cleaning to avoid alarming consequences. These places adapted by the residents are ravines, drainage ditches (in the open), holes, dumpsters (open space), etc. When there is no intervention (cleaning) on the part of those who have the right to these places, the residents who live around these places make fires to reduce the flow of garbage or wait for the charity of rain.

The container collection and cleaning service in Luanda Province covers only the municipalities of Luanda and Cazenga and is provided by the company ELISAL.

ELISAL (Empresa de Luanda e Saneamento de Luanda) is an entity of the Government of the Province of Luanda dedicated to the cleaning and sanitation of the capital of Angola, created under order 26/91 of June 29, 1991, resulting from the inexistence at the time, of a business entity suitable for cleaning and maintenance of the sanitation network.

Angola has many open dumps, and waste collection and treatment methods are inefficient. Data from the 2014 general population census indicate that available waste disposal is still a common practice throughout the country, and according to the final report of the study, garbage is deposited outdoors by 59% of households in urban areas and 87% of households in rural areas.

The only landfill built in the country is the "Mulenvos landfill", located in Luanda, Viana municipality. There is a national project for the implementation of sanitary landfills in all provinces of the country by 2025, which is supported by the guidance of the Strategic Plan for Urban Waste Management (PRESGRU), approved by Presidential Decree no. 196/12 of August 30 (ANGOP, 2018).

The sanitary system of the Mulevos was managed by ELISAL and was concessioned to the company Griner Engenharia, S.A. under a public-private partnership. In addition to budgetary issues, this public-private partnership aims to improve the waste management chain in Luanda by optimizing landfill infrastructure.

A study by the Ministry of Economy and Planning (MEP) estimates that in the province of Luanda, about 3.3 million tons of waste are produced annually, and 45 % of this production has the potential for reuse as raw material for industry, 35 % has the potential for reuse as fertilizers, and the remaining 20 % could be used in energy production (Welwitschi 2021).

The coverage rate of this service is reduced, and the management of solid waste is undertaken by the inhabitants themselves, who bury them, burn them, or merely leave them on the ground (see **Figure 367**).

Some neighborhood s have a precarious garbage collection service, which sometimes works in a few blocks. A truck (adapted) passes in some blocks or places known to families who, in turn, deposit the garbage in the wagon.

Next, the answers to the question of the Domestic Survey regarding solid waste disposal are summarized, which complements the local analysis of the Project area.

Thirty-eight per cent of households said they disposed of solid waste in containers, and eighteen per cent near bushes. The burning of garbage corresponds to fifteen per cent of the responses. Twelve per cent of households said they put the trash in a public container, and nine per cent assumed they dump the garbage in the open space.

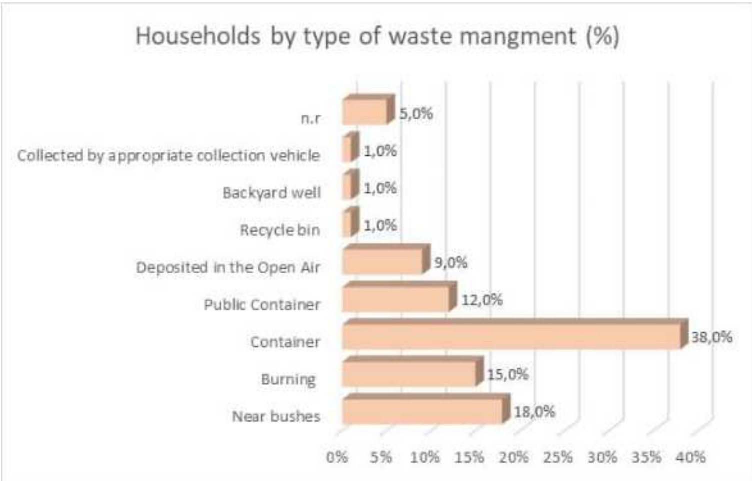


Figure 367: Households by type of waste management (%).

The following figures illustrate this reality identified in the field survey conducted between 31 July and 4 August 2023.

Figure 368: Disposal of waste in an open space and an example of burning them. Area of Lot 3 CD - Cacuaco

Figure 369: Example of waste left on the ground and burning it. Area of Lot 7 CD - Kapalanga

Figure 370: Example of waste management in the area of Lot 6 CD – Km 30

In the Km 30 neighborhood , containers of the Vista operator were observed, as well as in the Zango 5 neighborhood and Bom Jesus neighborhood , as illustrated in the respective figures.

Based on the company's portal, VISTA WASTE started (May 2016) a new service contract for the Provincial Government of Luanda that encompasses the Collection of Waste and Urban Cleaning throughout the Municipalities of Talatona, Belas and the Urban District of Nova Vida in the Municipality of Kilamba Kiaxi covering an area of 1,067 km^2 with a population density of 1.2 million inhabitants.

Figure 371: Example of waste management in the area of Lot 4 CD – Zango 5

Figure 372: Example of waste disposal in the area of Lot 1 and Lot 10 – Bom Jesus

This improper disposal of both industrial and domestic waste is not only an environmental attack from the point of view of soil degradation and contamination of the sub-soil and groundwater resources but also a public health problem. Most respondents also refer to improving waste management as one of the community's leading social problems , as illustrated in the Figure 373.

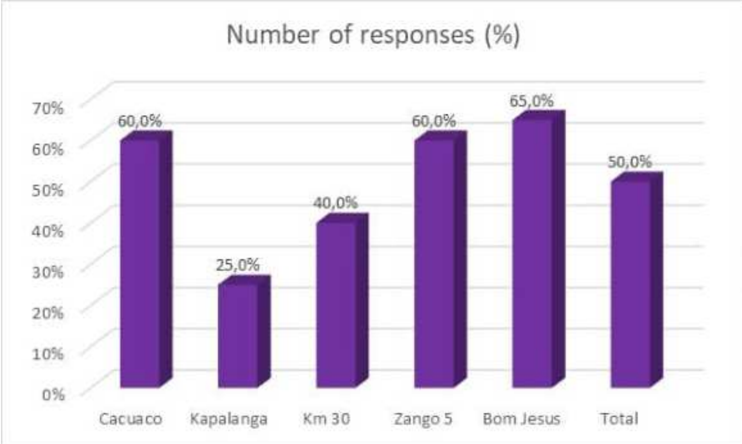


Figure 373: At the local level, a number of respondents pointed to improving waste management as one of the social problems (Source : Filed Survey, Question C10)

The coverage of the public sanitation network is deficient in the municipalities and communes of the Project area (See table). The aggregates with **toilets inside the house** are mostly connected to a septic tank. The average number of connections to a septic tank is 85.4 % in the project area, above the provincial average.

Table 102: Households by area of residence, municipalities, and communes, according to the type of toilet they usually use indoors, 2014

Province (rural/urban) Municipality Commune	Number of households	Type of toilet						
		Indoors (%)						
		Total (N.º)	Toilet connected to the public sewer network	Toilet connected to the septic tank	Toilet connected to the open pit (ditch or river)	Toilet / Latrine connected to the public sewer network	Toilet / Latrine connected to the septic tank	Toilet / Latrine connected to the open pit (ditch or river)
Luanda	**1484350**	**1114345**	**8.48**	**83.54**	**1.44**	**0.18**	**5.95**	**0.40**
Urban	1437302	1103076	8.54	83.62	1.40	0.18	5.87	0.39
Rural	47048	11269	3.32	75.78	5.30	0.28	13.75	1.57
Cacuaco	**222989**	**149984**	**3.73**	**80.12**	**2.45**	**0.24**	**10.70**	**0.76**
Cacuaco	53034	37656	2.52	89.57	2.00	0.35	4.97	0.59
Icolo e Bengo	**21061**	**3049**	**7.87**	**78.94**	**5.58**	**0.23**	**5.94**	**1.44**

Bom Jesus	5088	1337	1.35	86.39	6.51	0.00	4.26	1.50
Viana	**331860**	**254227**	**3.88**	**88.59**	**1.19**	**0.16**	**5.81**	**0.37**
Zango	46036	35435	8.36	88.55	1.07	0.06	1.57	0.39
Average Project Area %			4.62	85.36	3.13	0.17	5.54	0.84

The aggregates with **toilets outside the house** are mostly connected to a septic tank. The average number of connections to a septic tank is 34.4 % in the project area, under the provincial average. The Households with sanitary outside the home present an average of 67 % in the study area. This figure is above the regional and urban area average and below the rural area average.

Finally, the percentage of households that use adequate sanitation systems greatly differs in the Project area.

In Cacuaco and Viana, about 90 per cent of the households use adequate toilet systems, with this value close to the average of the urban area of Luanda Province.

On the other hand, the municipality of Icolo e Bengo and the commune of Bom Jesus have a much lower proportion of appropriate toilet use, with an approximate percentage of the average of the provincial rural area.

Table 103: Households by area of residence, municipalities, and communes, according to the type of toilet they usually use outside the house 2014

Province (rural/urban) Municipality Commune	Type of toilet								Undeclared	Per cent of families using appropriate toiletry
	Outside the house (includes the perimeter of the yard)									
	Total	Toilet connected to the public sewer network	Toilet connected to the septic tank	Toilet connected to the open pit (ditch or river)	Toilet / Latrine connected to the public sewer network	Toilet / Latrine connected to the septic tank	Toilet / Latrine connected to the open pit (ditch or river)	No Toilet / Outdoor		
Luanda	**365085**	**3,07**	**58,25**	**2,80**	**0,33**	**8,16**	**0,67**	**25,39**	**1,33**	**91,09**
Urban	329445	3,36	63,42	2,92	0,35	8,59	0,68	19,24	1,43	92,98
Rural	35640	0,39	9,89	1,70	0,07	4,18	0,58	82,80	0,39	33,36
Cacuaco	**75215**	**1,46**	**53,71**	**4,15**	**0,18**	**10,27**	**0,94**	**28,25**	**1,04**	**86,12**
Cacuaco	15275	1,28	50,15	3,96	0,20	6,05	1,01	36,67	0,67	85,89
Icolo e Bengo	**17982**	**0,39**	**6,26**	**0,64**	**0,02**	**1,12**	**0,52**	**90,89**	**0,17**	**20,11**
Bom Jesus	3751	0,27	14,85	0,16	0,00	1,95	0,51	82,28	0,00	36,73
Viana	**76350**	**2,57**	**56,10**	**2,33**	**0,45**	**8,07**	**0,63**	**28,21**	**1,65**	**91,13**
Zango	10264	3,15	25,52	3,07	0,13	6,79	0,67	57,49	3,18	84,05
Average Project Area %		1,52	34,43	2,38	0,16	5,71	0,71	53,96	1,12	67,34

Next, the answers to the question of the Domestic Survey regarding the sanitation conditions are summarized, which complements the local analysis of the Project area.

Ninety-five per cent of households surveyed said they have a sanitary facility in their home, indoors or outside, in the backyard or annexes of the dwelling. Five of the respondents did not give any answer.

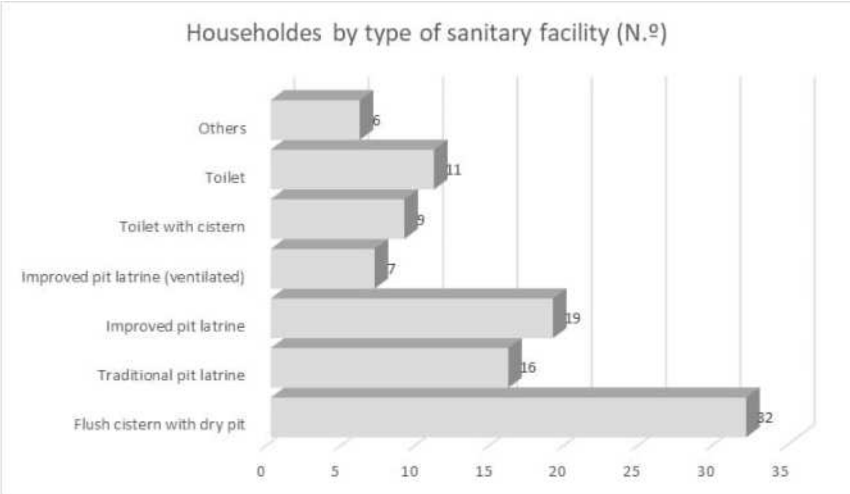


Figure 374: Households by type of sanitary facility (N.º) (Field Survey, Question E1)

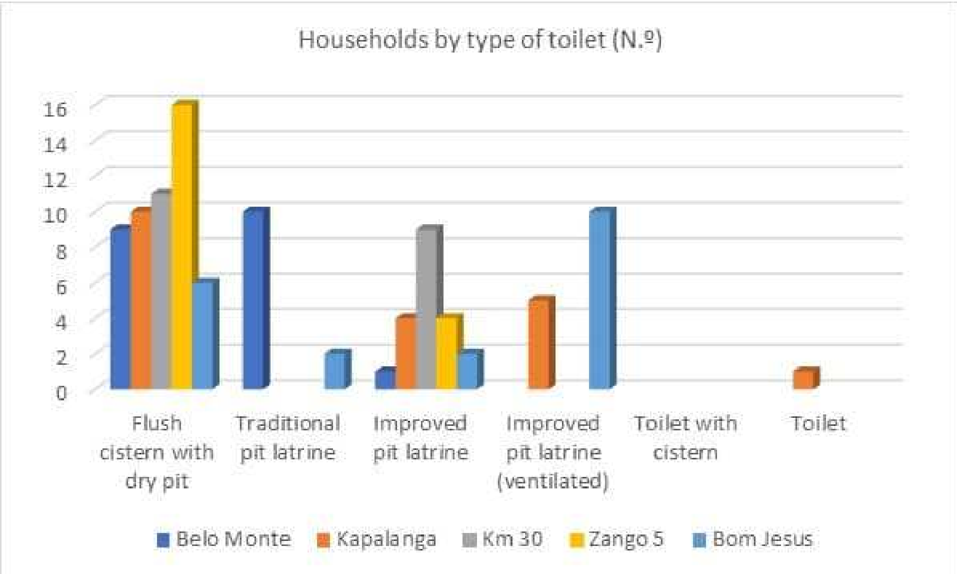


Figure 375: Households by type of toilet (Field Survey, Question E1)

At the local level, 51 per cent of respondents pointed to improving the access path as one of the social problems that most affect the community (Question C.10).

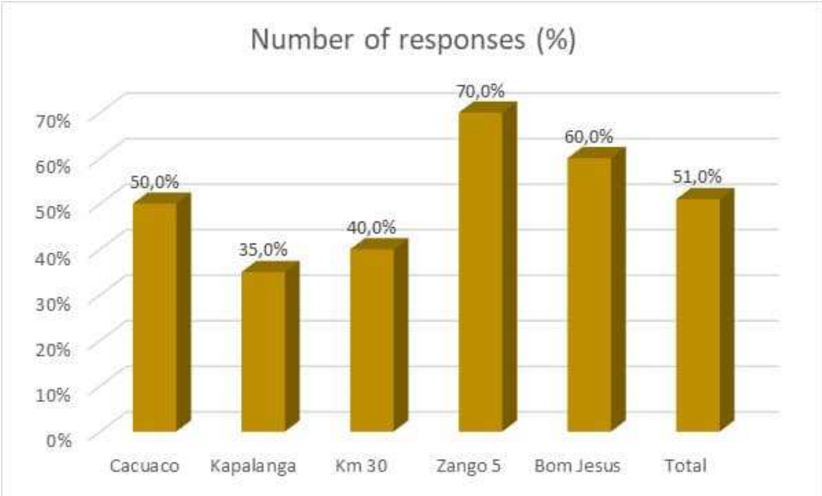


Figure 376: At the local level, a number of respondents pointed to improving the access path as one of the social problems (Field Survey, Question C10)

The following figures illustrate some types of sanitation observed in the field survey conducted between 31 July and 4 August 2023.

Figure 377: Example of a toilet inside the house with a flush toilet (Belo Monte)

Figure 378: Example of a toilet outside the house (Zango 5 area)

Figure 379: Example of a toilet of a toilet outside the house (Bom Jesus area)

Figure 380: Example of an outdoor pit (Bom Jesus area)

7.3.12.4 Road and Transportation

Transport infrastructure was severely damaged during the conflict years and is a problem in its own right and a constraint to the development of the other infrastructure sectors. Road and bridge rehabilitation is an early priority. Except for Luanda, traffic densities and volumes are low. Vehicle ownership and density are low outside urban areas.

By the end of the civil war, more than 70 per cent of the country's road network was in an advanced state of deterioration. National road density is only 29 km per 1,000 $km^{2,}$ and only about 17 per cent of classified and urban roads are paved. The rural accessibility gap impedes growth, as road density remains very low, feeder roads are few, and bridges are lacking.

The rural accessibility gap impedes growth, as road density remains very low, feeder roads are few, and bridges are lacking. The development of domestic trade remains hindered by the limited connectivity between provinces. The transportation gap also makes it difficult for the country to develop regional business and discourages its neighbors from making greater use of the country's ports.

According to the National Development Plan 2018-2022, "The improvement of the competitiveness of the Angolan territory implies the development and consolidation of the transport and telecommunications systems and the progressive implementation of platform networks logistics and supply and distribution".

It also provides for the rehabilitation of roads and railways and their integration, consolidating the public transport of passengers, finalizing the sustained revival of maritime activity at a national and international level, and improving maritime safety and surveillance along the Angolan coast. In the port naval sector, the program envisages the construction of maritime and inland terminals in the country, creating conditions of safety and security in the marine environment.

The Transport and Logistics Policy is contemplated in Axis 3: Infrastructures Necessary for Developing the NDP 2018-2023. Within the framework of the SDGs defined in the United Nations 2030 Agenda, transport has a role Relevant to Goal 11: "Making cities and human settlements inclusive, safe, resilient and sustainable, by proposing to provide safe, affordable and sustainable transport for all, through the expansion of public transport services."

Program 3.1.3: Expansion of Public Transport (NDP 2018-2022)

Developing public transport support infrastructures facilitates commercial relations and the exploitation of the market's potential. It is essential to have a transport network that boosts mobility in the country and enhances the effort made by the Executive to promote economic and social welfare. This program aims to increase the efficiency of the management of Public Transport, ensuring the improvement of the quality of the service provided and the integration mechanisms for users to ensure fluidity and speed in the provision of transport services.

Within the scope of this program, the following specific objectives are highlighted, focusing on Luanda:

- Objective 3: Implement the tariff integration system – Intelligent Transport Management System – Ticketing, in the metropolitan area of Luanda;
- Objective 4: To implement the medium capacity urban transport system - BRT System in Luanda, integrating this modal typology in the urban collective road transport in interface with the rail and maritime systems;
- Objective 7: Implement the cabotage network in northern Angola by constructing maritime and land terminals in Cabinda and Soyo, with connections to Luanda.

The improvement of roads is provided for in Axis 5: Harmonious Development of the Territory / XXII – Spatial Planning and Urbanism Policies of the NDP 2018-2022.

Program 5.5.2: Construction and Rehabilitation of Road Infrastructure (NDP 2018-2022)

“Completing the road network connecting all provinces and major cities is critical to integrating the national territory, favoring the movement of populations and the goods and services produced. In addition, the situation of the roads in Angola needs a thorough intervention, and their rehabilitation should be adjusted to international standards to ensure their durability by serving as a lever for the development of logistics and production clusters in the country.”

Within the scope of the objectives for this Axis, the following stand out:

- Objective 1: To re-establish the links between the provincial capitals and the capital of the country and the connection between headquarters municipal and communal, promoting the construction and rehabilitation of road infrastructures necessary for the country's development process;
- Objective 2: To improve urban roads in provincial and municipal offices.

The new **Road Plan of Angola** was approved by Presidential Decree no. 20/21 of 22 January. According to the official, the novelty of the new Road Plan that repeals the previous Presidential Decree no. 21/92 of May 22 is based on the fact that it is possible, from now on, to identify the entire road network, characterize the categories and the extension of the roads, manage the National Road Network, assigning responsibilities to the central bodies, municipal and local authorities, within the framework of the decentralization of competences.

The Angola Road Plan "is an instrument of Spatial Planning that has as its premise to define the National Road Network, establish the administrative classification of roads and define the rules for road management," concluded the leader. The diploma classifies the roads of the National Road Network into National, Municipal and Special.

Road Infrastructure

The framework of the road infrastructure is made from the Atlas of the roads of the 18 provinces of Angola, made available by the Road Fund of the Ministry of Finance of Angola. The following two figures present the map of the roads of Luanda. The first is the whole of the Province and is the state of conservation, and the second is the structuring roads in Luanda and its state of preservation.

Figure 381: Road map of Luanda Province and maintenance status (Source Adapted from the Ministry of Finance, Road Fund, Atlas of the Roads of the 18 Provinces of Angola, Luanda Province)

The Core Road Network of Angola spans around 75,000 km, connecting between the major cities of Angola. The following roads of the Fundamental Network traverse the Province of Luanda:

- EN 100, which runs along the western coast between Calamba (south) and Cacuaco (north);
- EN 110, which serves the northeastern part of the province between Kifagondo and Catete;
- EN 110, between Catete and Mumbombo, in the south of the Province; and
- EN 230, between Catete and Maria Theresa, in the eastern part of the Province.

The Complementary Network establishes the connection to the Core Network through the following roads:

- EC 10-1, with a link to EN 110 (east of the province);
- EC 108, which serves the municipality of Icolo e Bengo and the commune of Bom Jesus;
- EC 231, between EN 100 and EN 110; and
- EC 110-2, EC 325 and EC 325-1, in the southeastern part of the Province.

The construction of new roads is underway to improve accessibility in Luanda and its peripheries, namely the construction of the Simão Kimbango road, the access viaduct to the Dr António Agostinho Neto International Airport and the 2nd A3 ring road, which aim to improve road traffic in the province of Luanda, have advanced execution. Maintenance and conservation work is still underway on Luanda's main avenues and roads (ESTRADAS EM LUANDA - Obras nas principais vias de acesso em estado avançado 2023)

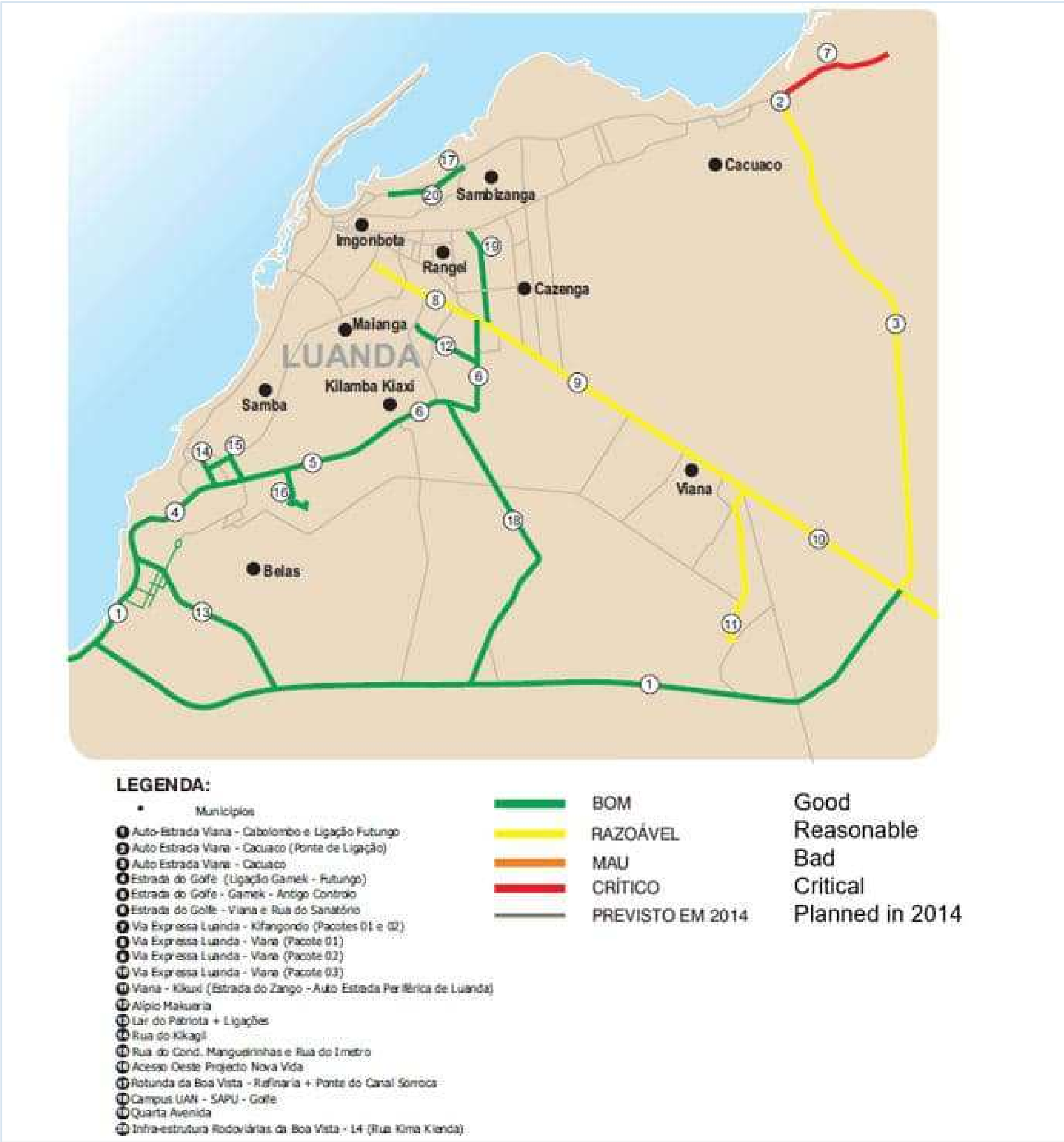


Figure 382: Road Map of Luanda Province. Structural Roads and maintenance status (Source Adapted from the Ministry of Finance, Road Fund, Atlas of the Roads of the 18 Provinces of Angola, Luanda Province)

A study conducted in 2017 showed that 57 % of the country's road network was dirt, 27 % was on asphalt, and 16 % was under construction. The study also showed that 45 % of the road infrastructure remained in critical or degraded condition, while 18 % was in reasonable or good condition, and the rest was unknown.

The Project area, from south to north, i.e., from the point of abstraction on the Kwanza River in Bom Jesus, is served by the Bom Jesus Road, which allows access to the Bom Jesus WTP and DC, until connecting with the Road to Catete. The project follows the alignment of the Road to Catete, with a junction to the New Airport DC and DC 30. Southwards of the intersection for DC 30, the link to Zango III is made by rural roads towards the west of the Road to Catete. The study area is also crossed by the Expressway, crossing the street to Catete and allows access to the PIV DC on the west side of the Road to Catete and towards the Cacuaco DC on the east side of the Road to Catete.

The Via Expresso Road serves the Lot 3 Project area (Cacuaco). The area of the Lot 4 Project (Zango 5) is served by the Zango-Calumbo Road, connected to the Expressway. The area of the Lot 6 Project (Km 30) can be done by the N230 road (Estrada de Catete / Deolinda Rodrigues) and then by an unpaved road. Finally, access to Lot 7 (Kapalanga) can be done by the N230 road (Estrada de Catete / Deolinda Rodrigues) and then an unpaved road.

The road network of the province of Luanda is fed by three main structuring roads that connect to the city center: Samba Road, Catete and Cacuaco. They ensure the distribution of the most significant traffic flows in Luanda, originating in other municipalities and peripheries, to the city center.

Figure 383: Example of Road at Cacuaco – Estrada Fernando Maviuco

Figure 384: Example of Road at Kapalanca – Umpaved road.

Figure 385: Example of Road at Km 30 – Umpaved road and road collective transport.

Figure 386: Example of Road at Zango 5 – Estrada Camama Viana and road collective transport.

Mobility and transport

The transport in Luanda has distinct periods of evolution. Center on the post-independence period, until "the mid-80s of the last century, the satisfaction of the mobility needs of the Luandense population was the responsibility of state-owned companies: "initially the Public Transport Company – ETP (in 1988, it was converted into Transportes Coletivos Urbanos de Luanda – TCUL) and the Luanda Taxi Company – ETL, endowed with legal personality and administrative autonomy" (Lopes, 2006).

In the field of transport, not even with the emergence of other public transport companies, such as the SGO company in 2003, the reopening of the suburban rail transport service itself between 2005/2007 and the maritime passenger transport inaugurated in 2014, was it possible to mitigate the chaotic situation of mobility.

The Ministry of Transport of Angola is the body that oversees the Public Institutes: National Institute of Road Transport (INTR), the National Institute of Railways of Angola (INCFA), the Maritime and Port Institute of Angola (IMPA), the National Institute of Civil Aviation (INAVIC) and Public Companies (EP), in their various sectors of activity.

The public transport network in Luanda consists of the following services:

- Road service: Buses; Candongueiros (collective taxis); Conventional cabs.
- Rail service: the Suburban Train,
- Air services: the International Airport.
- Maritime services: The Catamaran.

Figure 387 shows the different sectors of public transport in Luanda that are classified according to their infrastructure and "rolling stock".

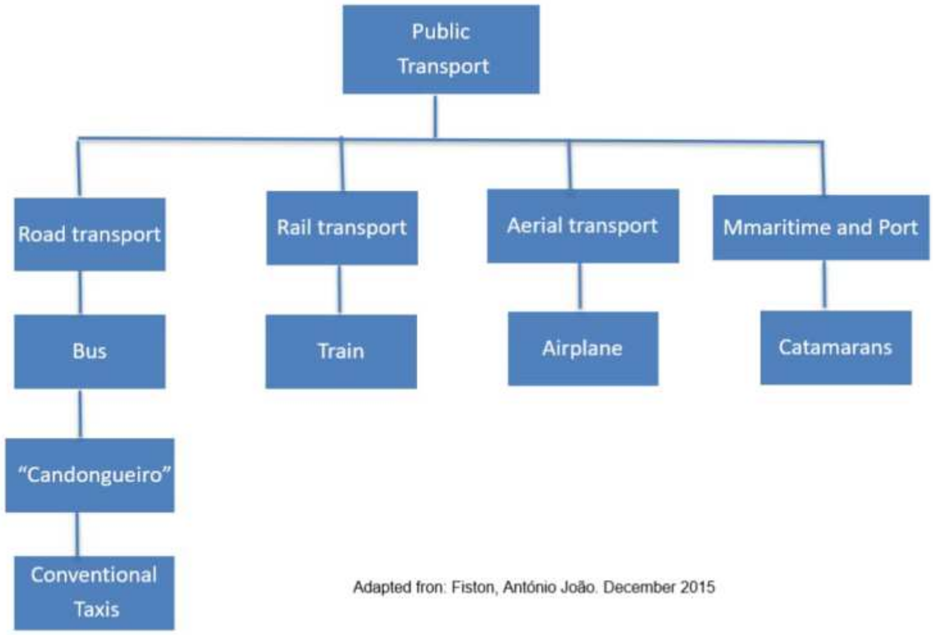


Figure 387: Public transport sectors of Luanda.

In general, the lack of adequate investment in Luanda's transport system compromises the quality and intermodality of all transport networks. For example, road transport (more dynamic and dominant) presents roads in a state of degradation, compromising transport safety and mobility. Thus, Users lose a lot of time on the journey due to congestion and the bus waiting period.

Rail transport, which would be an exciting option to respond to the disruptions caused by a deficient road network, cannot obtain a reasonable coverage encompassing the main areas of origin of the populations that commute daily to the city center.

On the other hand, both rail and sea transport offer a service far beyond what is desired because the waiting time between both means of transport is long, which hinders the intermodality of transportation and the respective mobility of people.

Concerning the connection of the different modal systems, there is no relationship between the modes of transport in Luanda when compared to the transport system of Lisbon, which is entirely connected through its road infrastructures, stations (metro and train) and river and road terminals.

In Luanda, only transport interfaces at the bus and custom taxi stops are implemented near the maritime terminals. At the same time, there is intermodality in the Maritime Passenger Terminal of the Port of Luanda and the central train station of Bungo, 500m apart, on a route covered on foot (Fiston, António João. December 2015).

According to news published by the Angolan media, Luanda will have more than 700 buses to improve urban mobility (Journal de Angola 2022).

"The Ministry of Transport has been working on implementing some reforms in the transport sector to improve the problems of urban mobility in the city of Luanda, such as flooding at the stops of collective buses, reduced number of stops for boarding and disembarking passengers among others".

The mobility in Luanda remains dramatic, especially in the morning. According to the passengers interviewed by RNA, they request more Viana – 1º de Maio, Mutamba – Cassequel, and Cacuaco – São Paulo buses to meet the current scenario. They also demand the return of the Grafanil-Mutamba Route to reduce transportation costs. In the municipality of Cacuaco, the routes of Funda – Vila de Cacuaco Hospital de Cacuaco – Paraíso are routes that are being studied to respond to the request of the city.

Regarding greater passenger demand, there are Largo das Escolas – Capalanga, Benfica – Sanatório – Shoprite, and Zango – Cacuaco routes. To date, the province of Luanda has benefited from 444 new buses to strengthen the fleet of public and private transport operators delivered under the program to reinforce urban passenger transport.

On the other hand, the construction project of the Luanda Surface Metro, whose works should begin next year (2022), includes four lines, totalling 149 kilometers. For the acting Director General of the National Institute of Road Transport, Énio Costa, the Surface Metro will join with the existing transport services, in the case of buses, trains and private taxis, and will have as its primary purpose to improve the urban mobility of the city of Luanda.

Currently, the BRT (Bus Rapid Transit) line is under construction, in a total route of 12 km, starting in the vicinity of the National Stadium 11 de Novembro (municipality of Belas) to the former market of Estalagem (National Road 230). This is part of the North/South corridor that is part of the seven corridors defined by the Luanda Metropolitan General Master Plan - PDGML. The Project emerges as one of the possible solutions to ensure sustainable urban mobility (fast, comfortable, safe and efficient), as confirmed by the Minister of Territorial Administration, Bornito de Sousa (Fiston, António João. December 2015).

At the local level, 51 per cent of respondents pointed to improving the access path as one of the social problems that most affect the community (Question C.10).

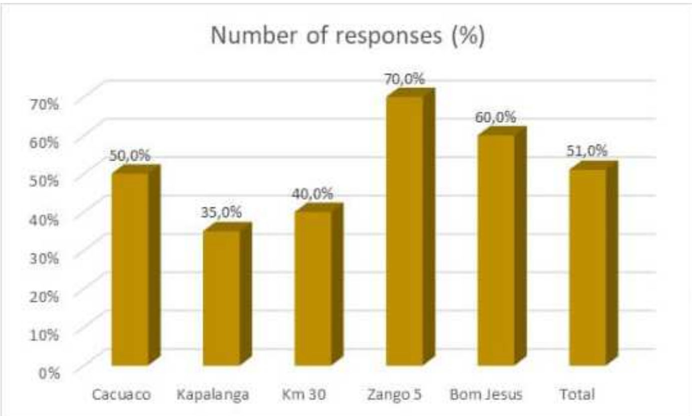


Figure 388: At the local level, a number of respondents pointed to improving the access path as one of the social problems.

7.3.13 Historical, Cultural and Architectural heritage

7.3.13.1 National cultural heritage

Cultural heritage is defined, by the Law on Cultural Heritage, as all material and intangible goods that, for their recognized value, must be the object of the protection of the law. Also, in accordance with the Law, any other property that is considered as such, by the uses and customs and by the international conventions, which bind the Angolan State, constitute Angolan Cultural Heritage.

National languages, historical, paleontological, archaeological, architectural, artistic, ethnographic, biological, industrial, technical and all graphic, photographic, discographic, filmic, phonographic, bibliographic documents reflecting values of memory, antiquity, authenticity, originality, rarity, exemplarity, uniqueness, and other cultural assets are thus recognized as assets of relevant cultural interest. Paragraph 1 of article 13 defines that buildings classified or in the process of classification may not be demolished, in whole or in part, nor be the subject of restoration works, without prior opinion of the competent bodies of the Ministry of Culture.

Presidential Decree No. 53/13 approves the Regulation of Immovable Cultural Heritage and applies to all assets classified or in the process of classification such as monuments, ensembles, or architectural sites, public or private, located in the national territory, whose interest and cultural relevance determines their legal protection.

7.3.13.2 Regional cultural heritage

Regarding Luanda, the primitive Portuguese settlement in Angola was founded on January 25, 1575 by Captain Paulo Dias de Novais who, when he landed on Cape Island, found a very large native population, having established there the first nucleus of Portuguese settlers (about 700 people, including 350 men-at-arms, religious men, merchants, and civil servants).

A year later, recognizing that the place was not suitable, he advanced to the mainland and founded the village of São Paulo da Assunção de Loanda, having laid the first stone for the building of the Church dedicated to São Sebastião, in the place where the Museum of Armed Forces, that is, in the Fortress of S. Miguel (dated 1575), in the old “S. Paulo of Luanda”.

Thirty years later, with the increase in the European population and the number of buildings, the “Vila de São Paulo de Loanda” took on the status of the City, extending from São Miguel to the square opposite the former Hospital Maria Pia (now Josina Machel).

In the period of the Iberian Union, in 1618, the Fortress of São Pedro da Barra was built. The city becomes the administrative center of Angola since 1627. The city was conquered and was under the control of the Dutch West India Company from 1641 to 1648 when it was recovered for the Portuguese Crown by an expedition sent from the Captaincy of Rio de Janeiro, in Brazil, by Salvador Correia de Sá e Benevides.

The history of Luanda's evolution follows the vicissitudes arising from Angola's economic instability, and its urban and demographic development can therefore be divided into three periods:

- Since the founding of the city, in 1576, until the Government of D. Francisco de Sousa Coutinho – 1764;
- From the beginning of this Government until the abolition of the slave trade – 1836;
- From 1836 to the present day.

In terms of relevant built heritage, the city's religious heritage should be highlighted. Devotees of a Christianity with an African flavor, the people of Luanda, also known as Caluanda, express their religiosity in the various temples in the city.

The Baroque Church of Jesus, founded in 1636, is the oldest in the central core of the city. Typically tropical, the Igreja de Nossa Senhora dos Remédios, built in 1679 and currently the Cathedral of Luanda, is enchanting for the leafy palm trees in its churchyard and for the twin towers that ennoble the façade.

Also from the 17th century, the Nossa Senhora do Carmo Church stands out for its hand-painted ceiling, the choir, and the 18th-century tiles. Attached to the church is the old Carmo Convent.

On Ilha do Cabo, at the entrance to the bay and with access to the end of the Marginal, is located the oldest church in Angola, founded in 1575 by the forty Portuguese who lived on the island before moving from the city of Luanda to the mainland, the church of Our Lady of the Cape.

Most of the colonial buildings are in a poor state of conservation. One of these was the famous Iron Palace, one of the most charismatic and mysterious buildings in the capital, a prominent symbol supposedly designed by Gustave Eiffel. The same was, however, the target of recovery interventions, having reopened in 2016 to house the diamond museum.

The buildings of the Customs House and the Josina Machel Hospital stand out due to their good condition. More modern are some government buildings and the headquarters of the National Bank of Angola, with its beautifully restored façade. At the exact point where the Marginal meets the Cape Island, is the Fortress of São Miguel, the first fortification erected to defend Luanda, in 1576. The fortress currently houses the Central Museum of the Armed Forces.

7.3.13.2.1 Tangible cultural heritage

As for tangible heritage, it should be noted that, at national level, the heritage elements considered most relevant are classified at the legal level, by ordinances, dispatches, and various decrees, integrating the list of national historical and cultural heritage compiled by the National Institute of Cultural Heritage (INPC).

When consulting the list of classified heritage, to date, for the province of Luanda there are 104 heritage elements registered (35% of all heritage sites classified in the country).

Most of these elements are located in the old Luanda City, near the bay, where the city was founded and developed through the colonial times. There are few elements located outside this central Luanda area, because most of the urban areas on the outskirts of the old town were developed in recent years, over previous forest and agricultural lands.

Such is the case of the project’s area of influence. Most of the project is developed in Viana and Cacuaco Municipalities, which are composed of new urban and industrial development zones that have expanded along the Road to Catete and occupied mainly forest areas with no previously known uses.

The Bom Jesus, near the Kwanza River, had already some development in Portuguese colonial times. The region was first occupied by a farm that evolved to a small village on the side of the kwanza river. In the village was constructed the old Bom Jesus Sugar Factory that processed the sugar cane from the surrounding farms. The Bom Jesus Village also served as a crossing point for the Kwanza River, making connection, by barge, to the Quiçama park to the south. The village includes then, besides the old sugar factory, administrative and commerce buildings from the beginning of the XX century or older. However, none of these buildings are currently classified of catalogued as relevant heritage sites.

It should also be noted that a new industrial area, with several recent beverage companies, was developed do the East of the old village, with no interference with the old Bom Jesus buildings. The current project (extraction zone, pipelines) is developed in this new industrial area, over 1 km East of the old village.

When assessing the INPC classified heritage sites, the closest ones to the project area are the following:

- São José do Calumbo Church, near the Kwanza River, in Calumbo – XVIII century building, classified by Dispatch (portaria) n. 10678, from March 1959_
  - 9 km South of Zango V DC

  - 17 Km West of the extraction point;
- Kifwangondo Battle Place, in Cacuaco, classified by Dispatch n. 284/04, from December 2004:
  - 9 km North of the Cacuaco DC.
- Mulemba Wacha NGola Historical Mark, classified by Dispatch n. 18/97, from May 1997:
  - 14 km Northwest of the Cacuaco DC

Another source of data that can be consulted is the SIPA – Information System for the Portuguese Architectural Heritage. This is an information and documentation system on Portuguese architectural, urban and landscape heritage and with Portuguese origin or matrix, managed by the Directorate-General for Cultural Heritage (DGPC) of Portugal.

This database catalogs 242 heritage elements existing in Angola, covering different types of buildings, with a majority of buildings from the 20th century, from the colonial period.

In Luanda, this database classifies 94 buildings with relevant heritage value, mostly in the old city of Luanda also. The closest heritage buildings catalogued are located at over 15 km from the project's area, namely the Américo Boavida Hospital (15 km Northwest of the Kapalanga DC) and São Pedro da Barra Fortress, in the coats, at over 16 km Northwest of the Cacuaco DC.

Another document that references classified heritage sites is the Viana Municipal Master plan (PDM), which, in the Plant of Conditions, included heritage sites. However, this Municipal Master Plan only references a single heritage site in the Viana Municipality, namely the São José do Calumbo Church, already mentioned above in the INPC database.

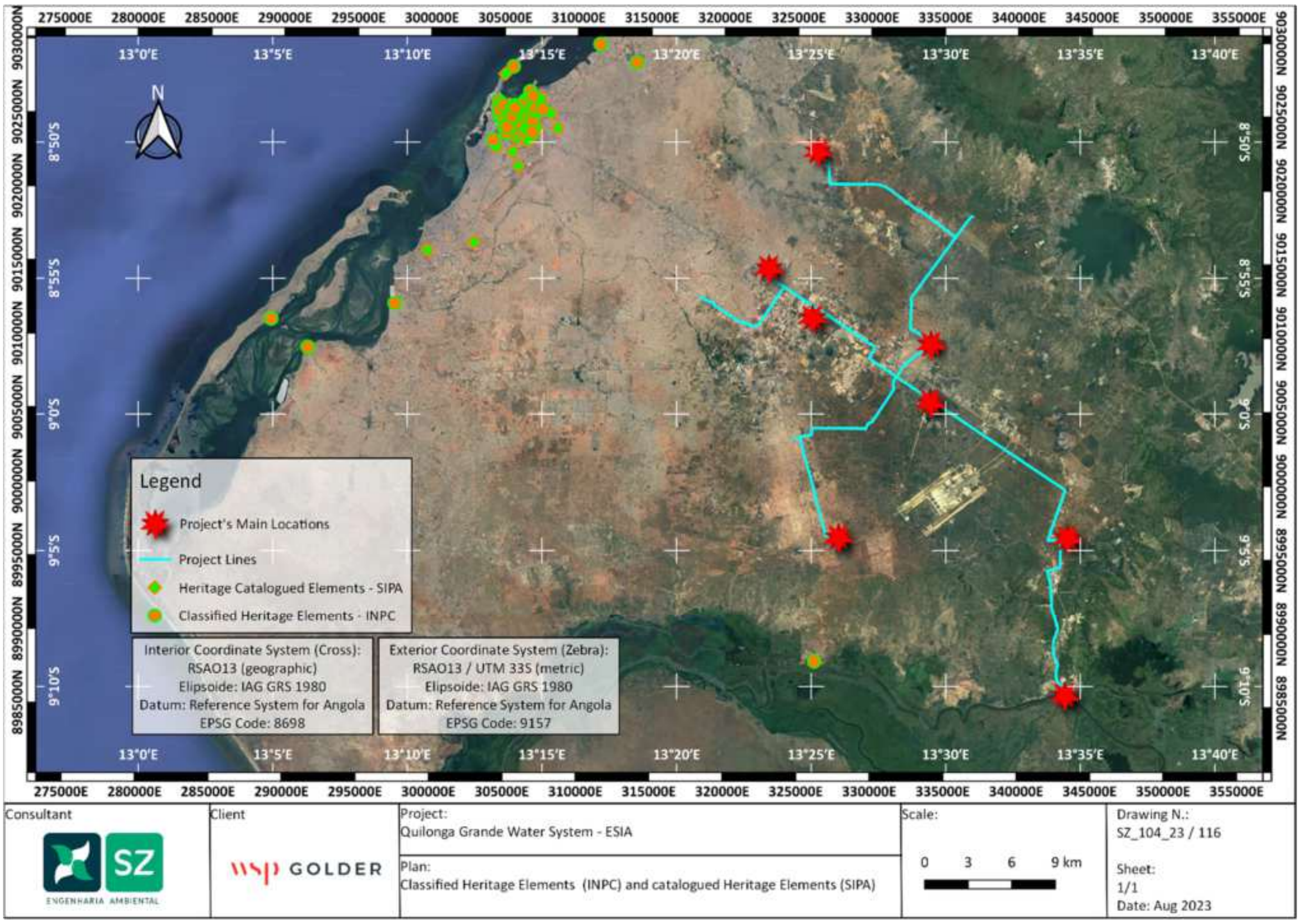


Figure 389: Classified or Cataloged Heritage sites in the project region.

7.3.13.2.2 Intangible cultural heritage

The Bantu linguistic matrix is predominant in Angola. General statistics reveal that in Africa there are more than 600 Bantu languages spoken contemporaneously. In Angola, they are distributed in three zones (Nzau, 2011). In the north and northeast of the country, the Kimbundu (Mbundu) and Kikongo (Bacongo) languages are spoken. In historical terms, Kicongo was the language of the ancient kingdom of Congo and Kimbundu of the kingdom of Ndongo. In the east of the country, the Cokwe language is spoken by the Lunda-Cokwe, and the Ngangela language is spoken by the Ovingangela.

In the center-south are located a number of ethnolinguistic groups, among which: ovimbundu, "ocindonga", owambo, nyaneka-humbe, ovingangela and herero. In the southern part Umbundu is the most widely spoken language, followed by the Nhaneca, Herero, Kwanyama and Cindonga languages.

The geographical and ethnic distribution of languages, however, should be viewed in a more complex and less static way. For example, some of these languages have undergone a process of dialectization, such as Kikongo that originated the Fyote/Ibinda linguistic varieties, spoken in Cabinda (Nzau, 2011). In addition, the ethnolinguistic map presents a general and illustrative overview and should be considered comparatively in relation to local linguistic uses. Such uses comprise often multilingual realities and linguistic mixtures and crossings, especially in border regions.

Among the African languages spoken in the country, some have the status of national language. These, as well as the other African languages, are spoken by the respective ethnicities and have dialects corresponding to the ethnic subgroups. Umbundu is spoken by 23% of the population and is the most widely spoken African language in Angola, as shown in the following figure.

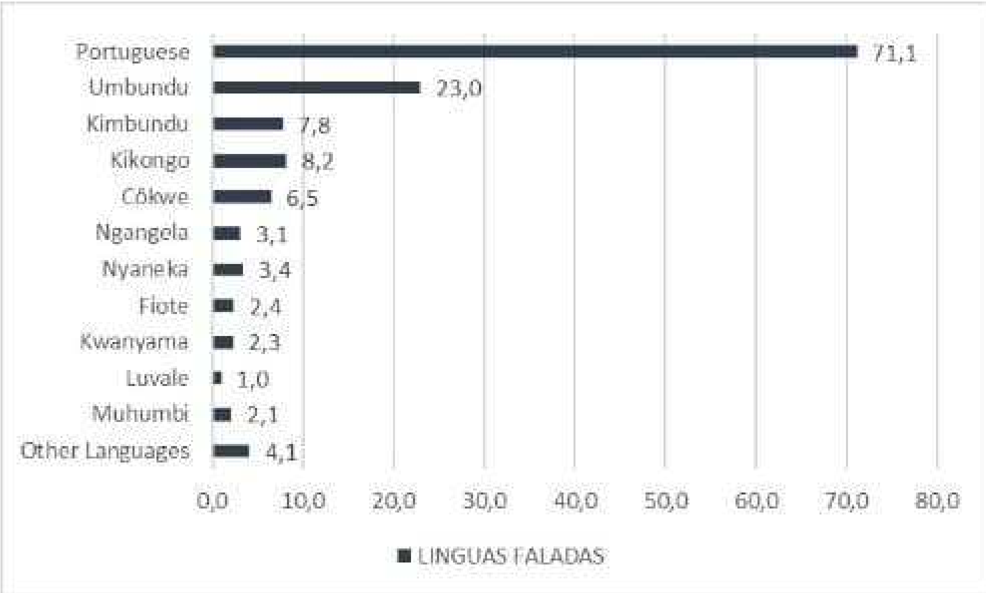


Figure 390: Types of languages spoken at national level (INE, 2016).

The classification of ethnic groups in Angola has historically taken into account the traditional linguistic criterion, assuming that the distribution of languages simultaneously corresponds to the existing ethnic groups in the country.

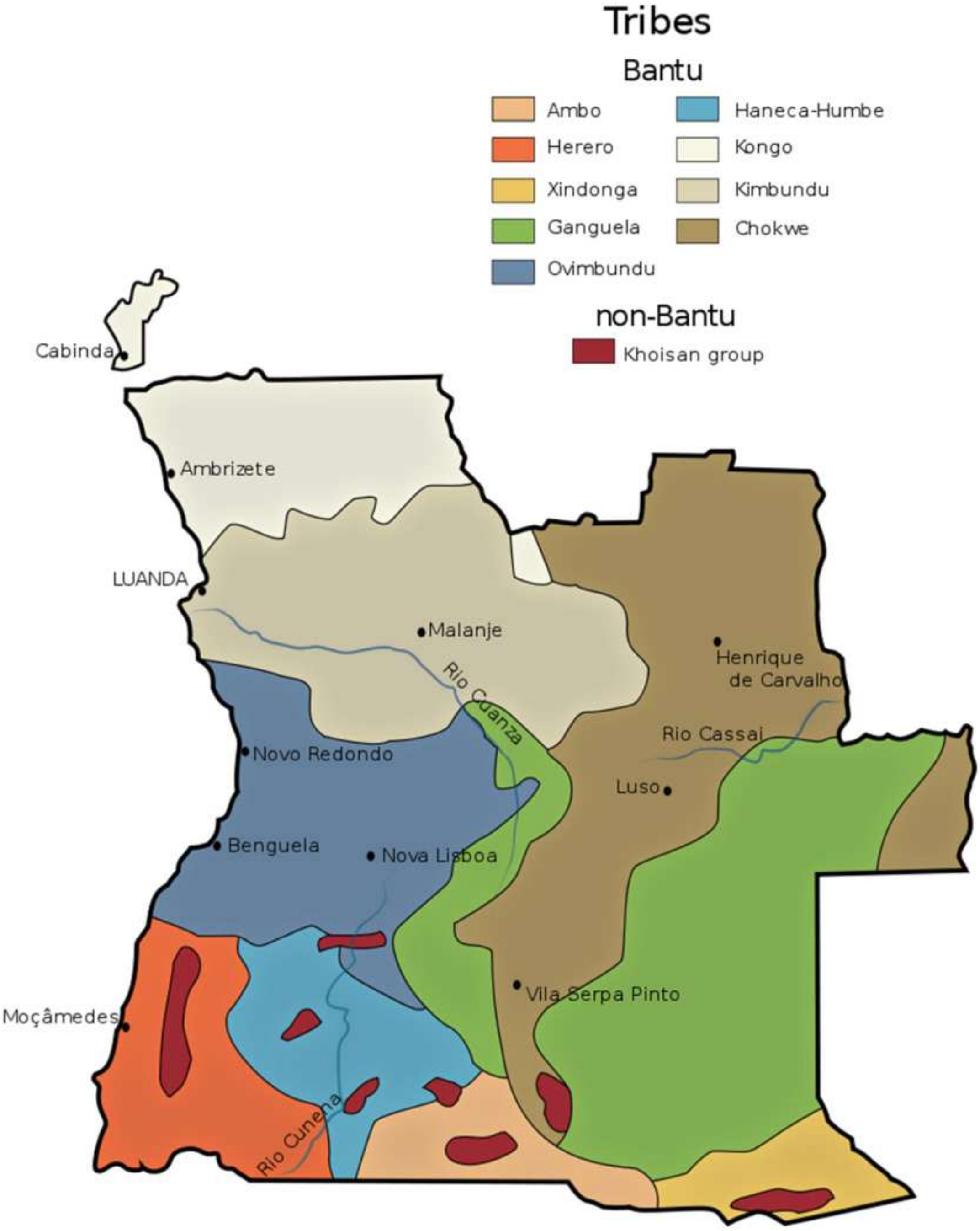


Figure 391: Ethnic Groups in Angola (1970) – Wikimedia Commons, derived from Perry-Castañeda Library Map Collection, Texas University

The local Ethnicity data are thus in line with what is considered in the general map of the country's ethnic distribution, confirming a majority of Kimbundu in the Luanda area.

This ethnic group is not specific to the region, being widely distributed throughout Angola, and which is not socially and culturally distinguished from the rest of the population, not considering the existence of any indigenous people in the region, in the assumption of what is considered in Performance Standard 7 of the IFC/ World Bank.

As for specific Intangible Cultural Heritage, Angola is a signatory of the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage, and has started to classify and register its Intangible Cultural Heritage. Despite the Law on Cultural Heritage also being applicable to Intangible heritage, the classification and register of this type of heritage is a recent effort from the national authorities, and the first intangible heritage classified and protected under Angolan Law is the "*REBITA"* music and dance, classified in 2019. Currently, there are only 6 heritage classifications of this type, namely:

- The REBITA" music and dance, classified in 2019 by the Executive Decree n.º 108/19 ;
- The SONA Ethnomathematical art, as a cultural expression, classified in 2021 by the Executive Decree n.º 99/21 ;
- The Bakama-Zindunga in Cabinda, classified in 2022 by the Executive Decree n.º 269/22 ;
- The Bessangana costumes, classified in 2023 by the Executive Decree n.º 53/23 ;
- The SEMBA, classified in 2023 by the Executive Decree n.º 54/23 ;
- The Dicanza Musical Instrument, classified in 2023 by the Executive Decree n.º 56/23.

The Bakama Zindunga are specific of Cabinda and the SONA is a cultural expression from the East of the country, so not directly applicable to the great Luanda area where the project is being developed.

However, the Rebita and Semba are musical and dance expressions that develop in all Angola, including in Luanda, associated with musical and dance schools, events and festivities, so they are likely to happen in the project's area of influence.

The Dicanza Musical instrument originated in the Bantu regions of the former kingdom of Ngola Kiluange Kia Samba, which extended to the Luanda region. The Arte and Culture Foundation in Luanda has a Dicanza production and teaching center, in the Wyza Amphitheater, in Luanda Island. This production Center is outside the project's area, but the Dicanza can be an instrument used in local festivities in the communities around the project.

Figure 392: Dicanza Musical instrument Production and Teaching center

The Bessangana Costumes are specific of the Luanda region, especially the Luanda Island, and they were used by high society women. Again, this is a heritage from the center Luanda, not specific to the project area if direct influence.

Figure 393: Bessangana Costumes

7.3.13.3 Archaeological site

It was in 1890 that Ricardo Severo published the first scientific study concerning the prehistory of Angola, entitled First: Traces of the Neolithic Period in the State of Angola.

Subsequently, in the first and at the beginning of the second decade of the XX century, there were contributions by Nery Delgado, Paul Choffat and Leite de Vasconcelos regarding prehistoric studies in Angola (Jorge 1974).

Thus, only in the forties and fifties of the XX century, prospections began to be carried out systematically and some excavations, the results of which were already directly usable for a beginning of the survey of the archaeological map of Angola and of knowledge of its Prehistory.

Then, after the first start, the publications grew again, especially in 1950s and 1960s. In 1964 the "Junta de Investigações do Ultramar" edited two volumes largely resulting from the research of its anthropological missions, entitled "Studies on Prehistory of Portuguese Ultramar", and in which Angola occupied the main place. Other relevant contributions include that of J. A. Martins, who in 1959 mapped, for the Geology and Mines Services, all prehistoric stations known in Angola.

Afterwards, with the country's independence, the archeological studies began being developed in the Luanda University, but there was also regular collaboration with Portuguese institutes, especially the Tropical Scientific Research Institute from Portugal (IICT). This institute centralized all information from the previous studies in the country and had the largest heritage archive from Angola. There were several additional missions in the country that extended to the 1990, early 2020, in conjunction between the IICT and Angolan institutions.

More recently, there was a project to georeference the archives from IICT, currently housed in the Lisbon University, developed between 2014 and 2020 and funded by the Portuguese Foundation for Science and Technology (Casanova, C.; Coelho, A. G.; Pinto, I., s.d.) This database has been regularly updated by the Lisbon University and is available in ARCGIS Hub gallery from the University.

The latest update is from February 2021, and includes 366 Archeological Stations in Angola, referenced from several origins.

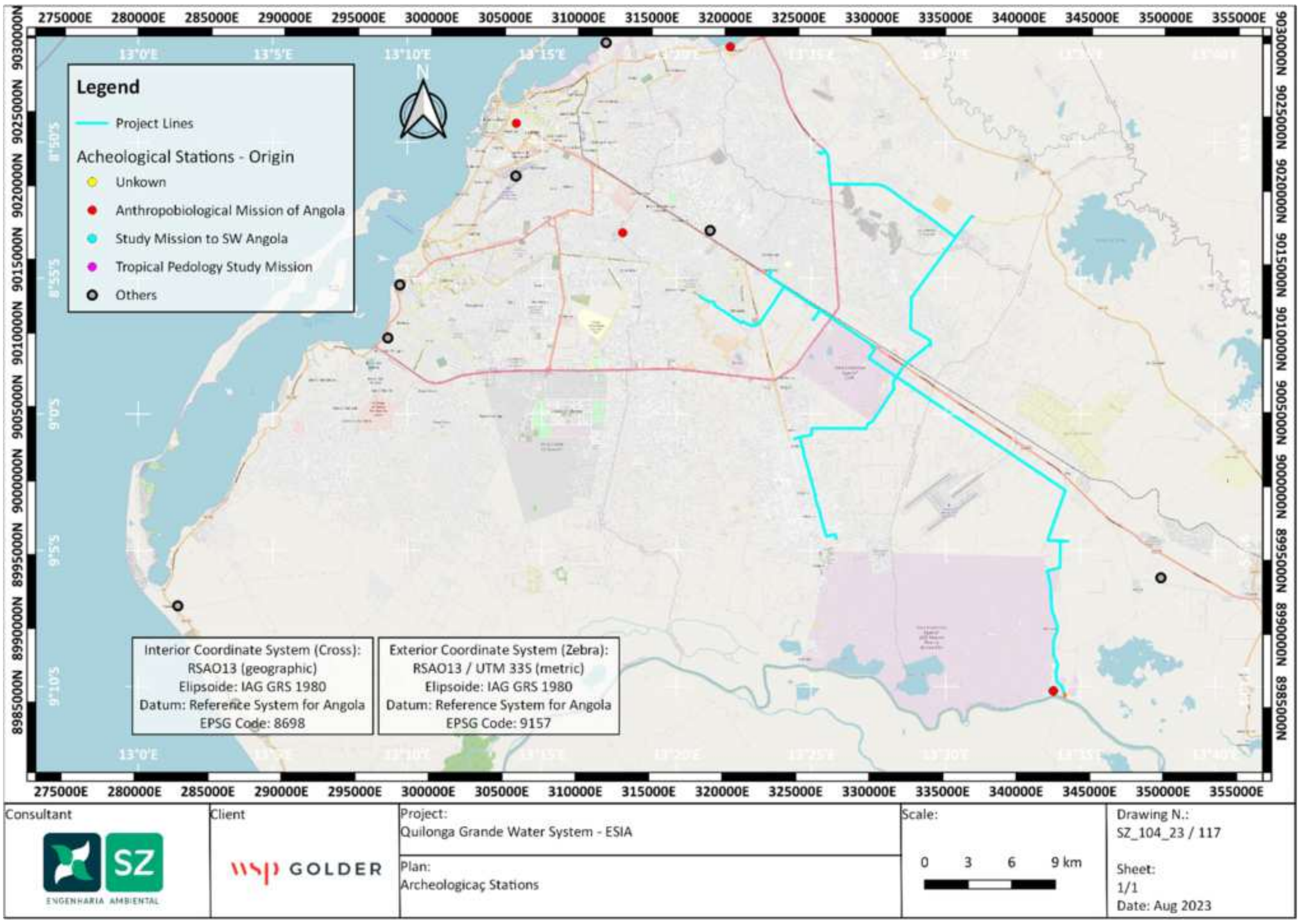


Figure 394: Archeological Stations in the region

The closest stations to the project area correspond to:

- Luanda-Catete Km 12:
    - Referenced by Fernando Moura in 1948;
    - Artifacts from the Neolithic period;
    - About 5 Km Northwest of Kapalanga DC.
- Luanda-Catete Km 30:
    - Referenced by Fernando Moura in 1948;
    - 2 artifacts from the Caliniano period;
    - About 7 km East of the WTP.
- Bom Jesus Stations 1, 2, 3 4 and 5:
    - Referenced in 1955 by António de Almeida and José Camarate França;
    - Covering the Middle Stone Age (MSA), Later Stone Age (LSA), Acheulense, Magosiense and Abevilense periods;
    - Station 1 – 2 artifacts
    - Station 2 – 8 artifacts
    - Station 3 – 6 artifacts;
    - Station 4 – 9 artifacts;
    - Station 5 – 11 artifacts;
    - About 800 m West from the extraction area.

From this stations, only the Bom Jesus Archeological Stations are close to the project intervention area.

These stations were referenced in the Anthropobiological Mission for Angola (1955 Campaign), and identified artifacts from the Stone Age in low terraces from the right bank of the Kwanza River, in 5 different locations.

As such, it is possible that the region registers other archeological artifacts in the Kwanza riverbanks subsoil, still not identified in the archeological missions developed.

7.3.14 Urban and territorial planning

7.3.14.1 Land use (regional scale)

Regarding a regional/national scale, there is no geographic system for classifying land use at national level in Angola, that with this type of information up to date. It was therefore decided to use existing international references in this area, namely the Land Cover Classification System (LCCS) of the Food and Agriculture Organization of the United Nations (FAO), which has a worldwide scope. However, from the analysis of this soil use classification instrument, the data is partially inadequate for the project's region, classifying the soil primarily in herbaceous, shrubby, forest cover and agricultural mosaics with different densities, not identifying the artificial built areas of the city.

Another tool available is the land cover map developed by the European Space Agency (ESA), in a high-resolution version (10 m), for the years 2020 and 2021, based on satellite surveys of the Sentinel-1 and Sentinel project -2, and which also has a worldwide scope.

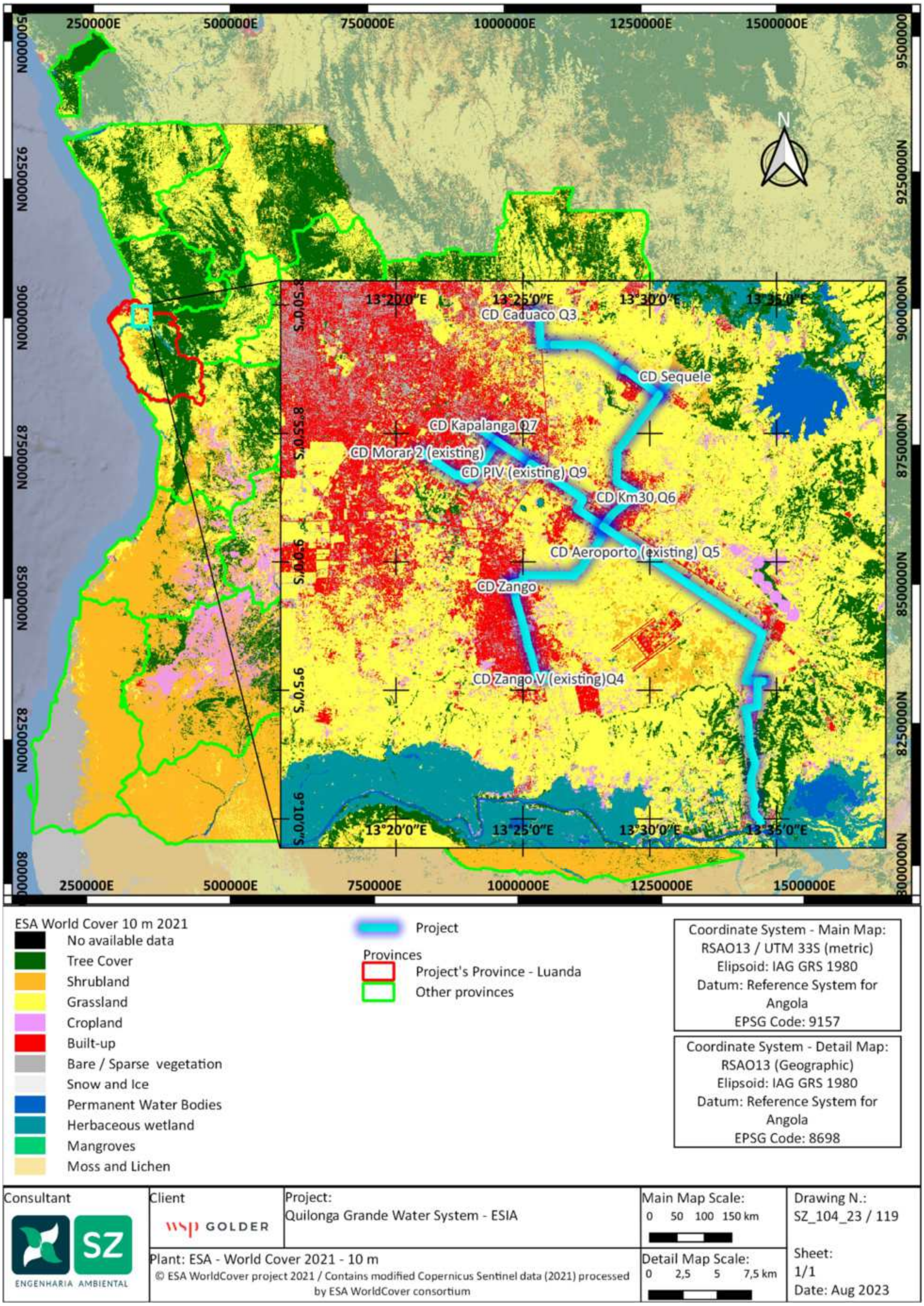


Figure 395: Land Use Chart – ESA-WC 2021 – 10 m.

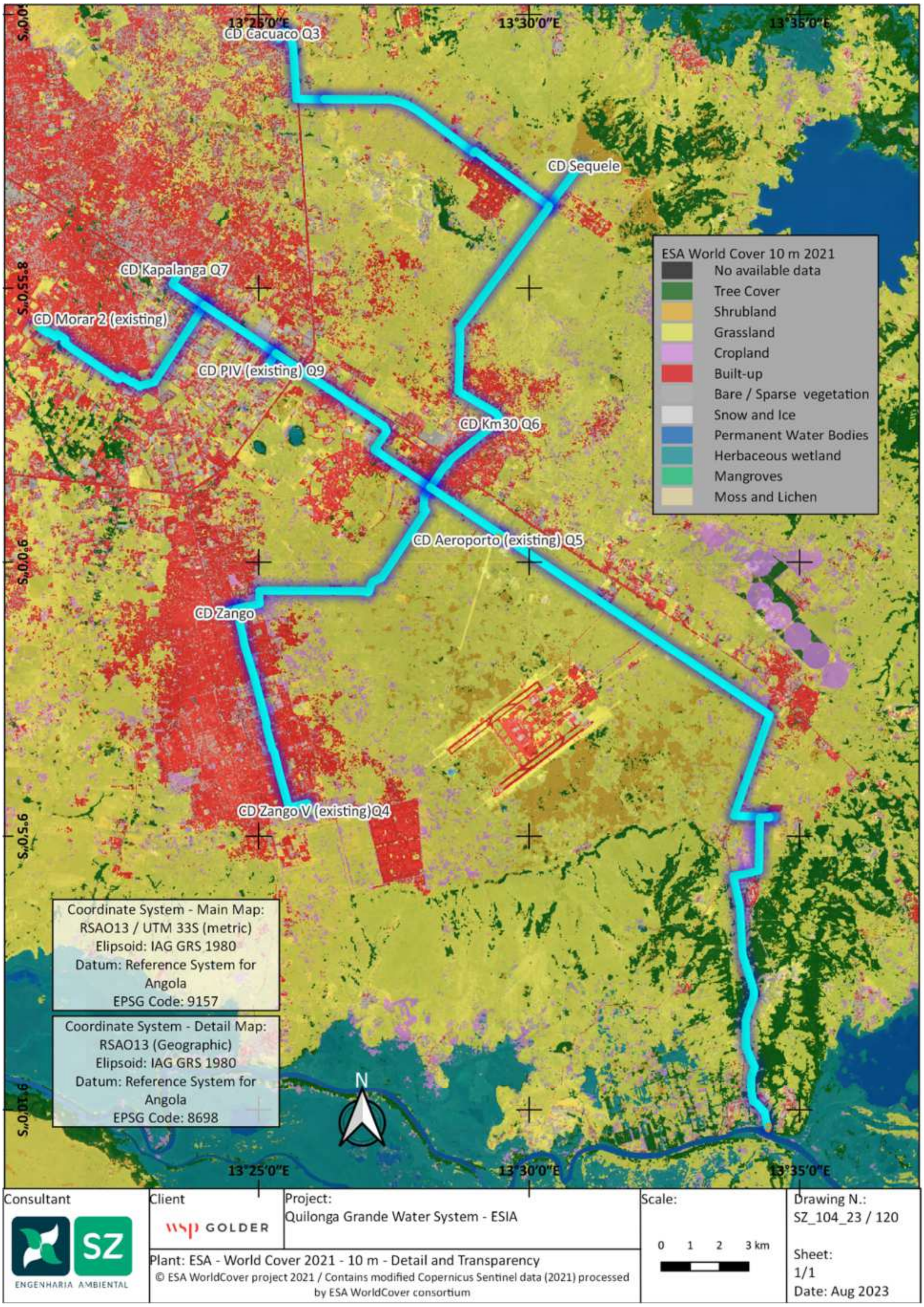


Figure 396: Land Use Chart – ESA-WC 2021 – 10 m – Detail of project Area, with 60% transparency

Since this ESA Map is based on data from the most recent aerial photogrammetric survey (2021) and in greater detail, it considers a soil use cover close to the current reality, with the implantation of the urban fabric in Viana, Bom Jesus and Cacuaco as “Built-up areas ”, with a mixture of areas of shrub land, grassland, and cropland in between.

7.3.14.2 Territorial Planning

The project covers a wide area, extending to the Urban districts of Viana, Zango, Kikuxi and Baia (Municipality of Viana), Mulenvos de Baixo, Sequele e Cacuaco (Municipality of Cacuaco), and Bela Vista (Municipality of Ícolo e Bengo), but also the Rural Commune of Bom Jesus (Municipality of Ícolo e Bengo), all in the Province of Luanda.

In terms of planning and territorial planning instruments, the majority of the project area is covered by the Luanda Metropolitan General Master Plan (PDGML). Also, the project’s areas that are located in the Viana Municipality are also covered by the Viana Municipal Master Plan (PDM).

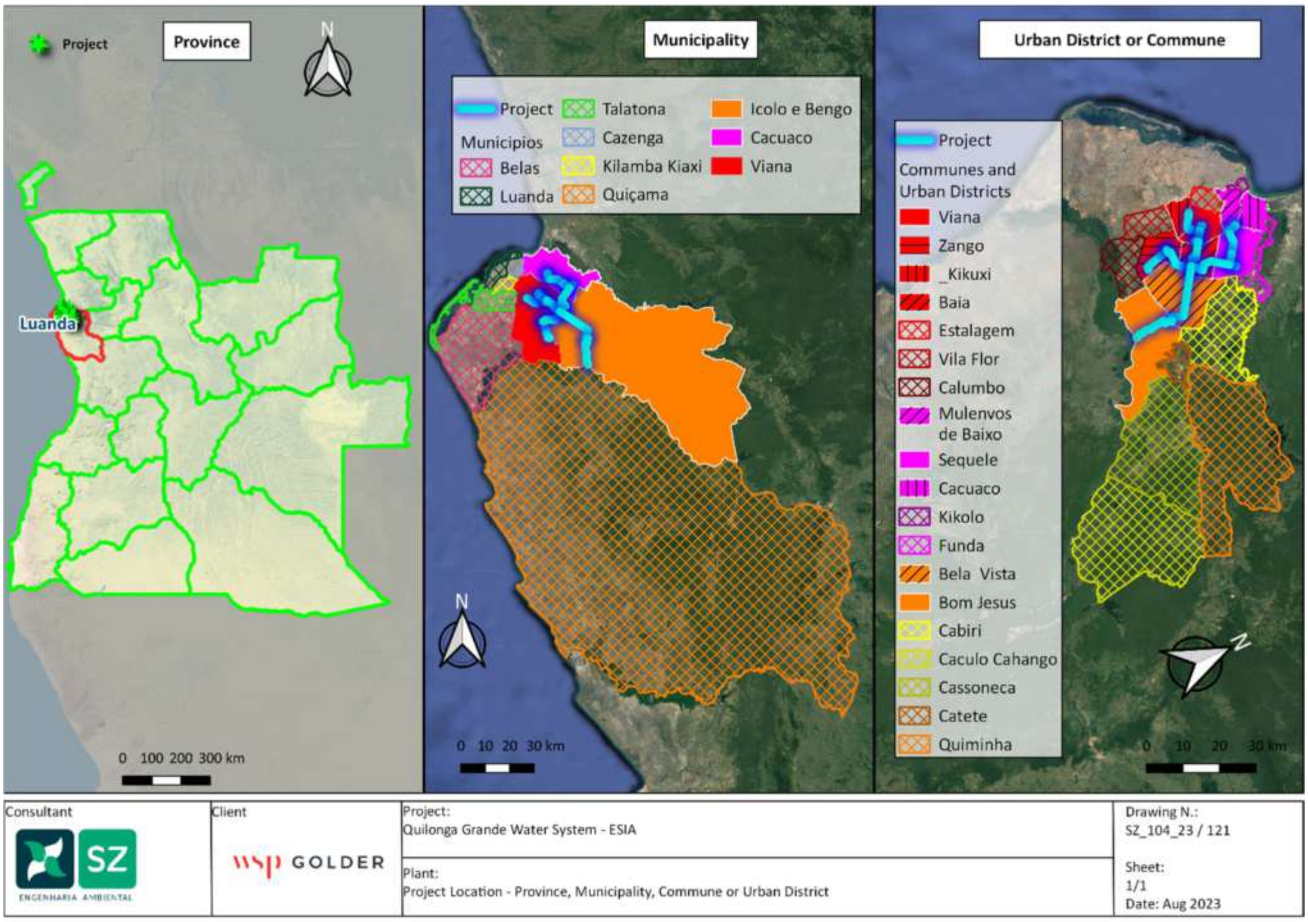


Figure 397: Administrative framework of the project

The Luanda Metropolitan General Master Plan (PDGML) includes a general land use plant, with the proposed strategy for the territory, as presented in the following Figure 201.

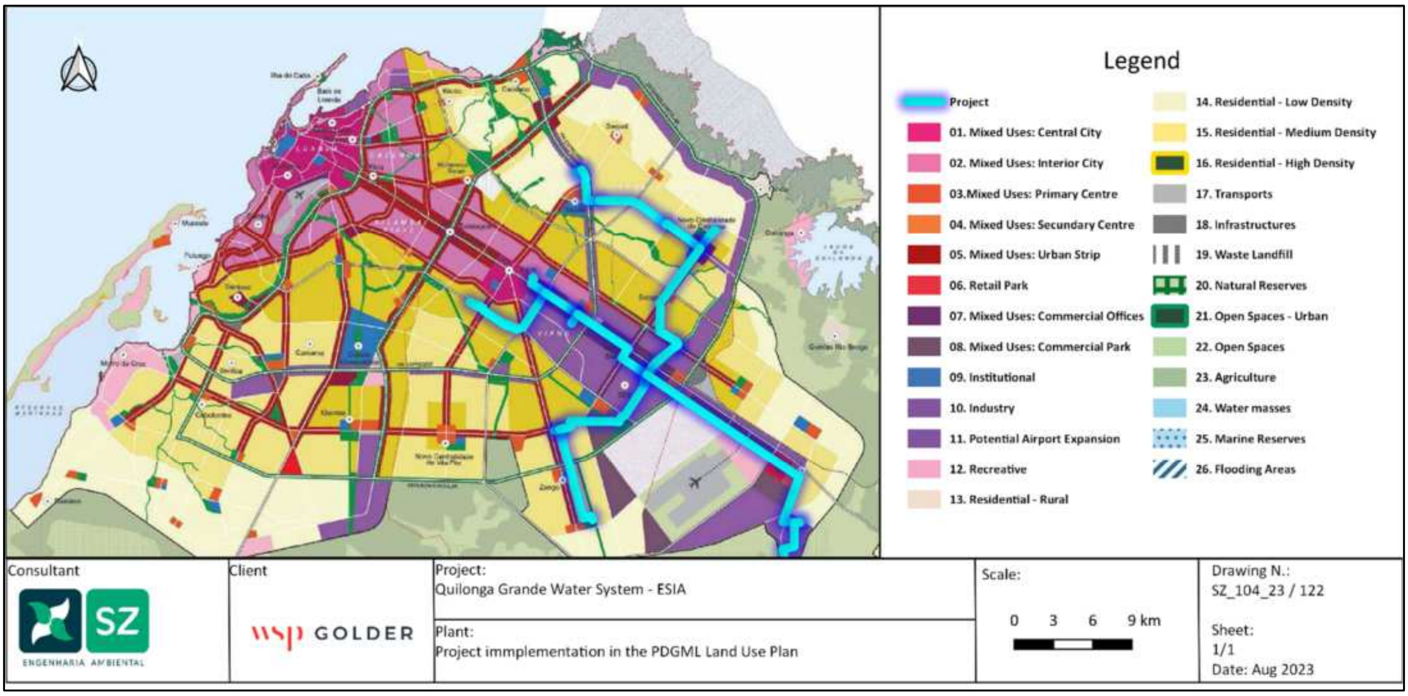


Figure 398: Project implementation in the PDGML Land Use Plant

Regarding the analysis of the PDGML, it has a global strategic planning vision, and does not establish specific limitations or restrictions of use, but present only a general strategy for land use and development of the region.

Assessing the project's intervention area, the project will mainly be developed in areas considered for industrial and mixed uses and also residential areas in the connections to the distribution centers.

For the Municipality of Viana, the vision of economic specialization proposed in the PDGML includes:

- New center of the Province motivated by the connection between the center and the new airport, with mixed uses;
- Industrial hub of the Province, together with Cacuaco;
- Collaboration with Belas in the creation of agricultural clusters.

As for the Municipality of Cacuaco, the vision for the main economic activities proposed in the PDGML includes:

- One of the industrial hubs of the province, including heavy industry, due to its location between the new airport and the Dande Port;
- Logistics Activities and Mixed Uses

Regarding Ícolo e Bengo Municipality, the PDGML proposes the following economic vision:

- Strong development of Logistics and industrial activities near the new Airport;
- One of the main agricultural hubs of the Province, integrating urban and rural uses and promoting tourism near rivers and lakes.

With regard to Viana's Municipal Master Plan, the only municipality in the project area that published this type of planning instrument, the main planning maps correspond to the Restriction Plant and Land Use Plant, which establish the restrictions on land use and the planned territorial uses.

However, in the analysis of the context of the municipality and the definition of the strategy, the PDM also presents plants of Biophysical Conditions and Ecological Structure, which supported the definition of the constraints and territorial planning. The PDM also proposes the definition of a set of Operational Planning and Management Units (UOPGs) for the territory, that establish the specific development strategy and program for each unit.

Below are presented these maps with the implementation of the project.

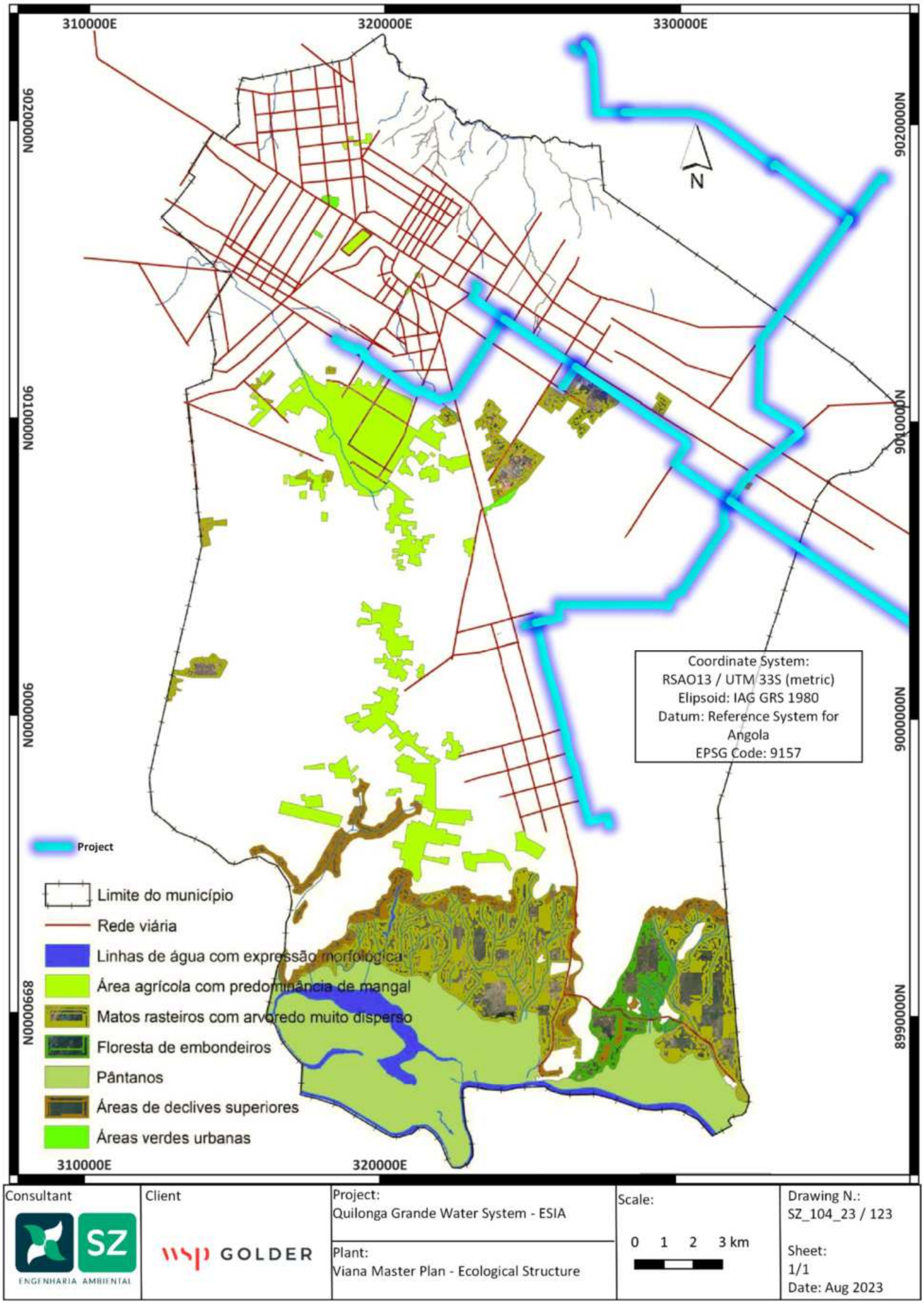
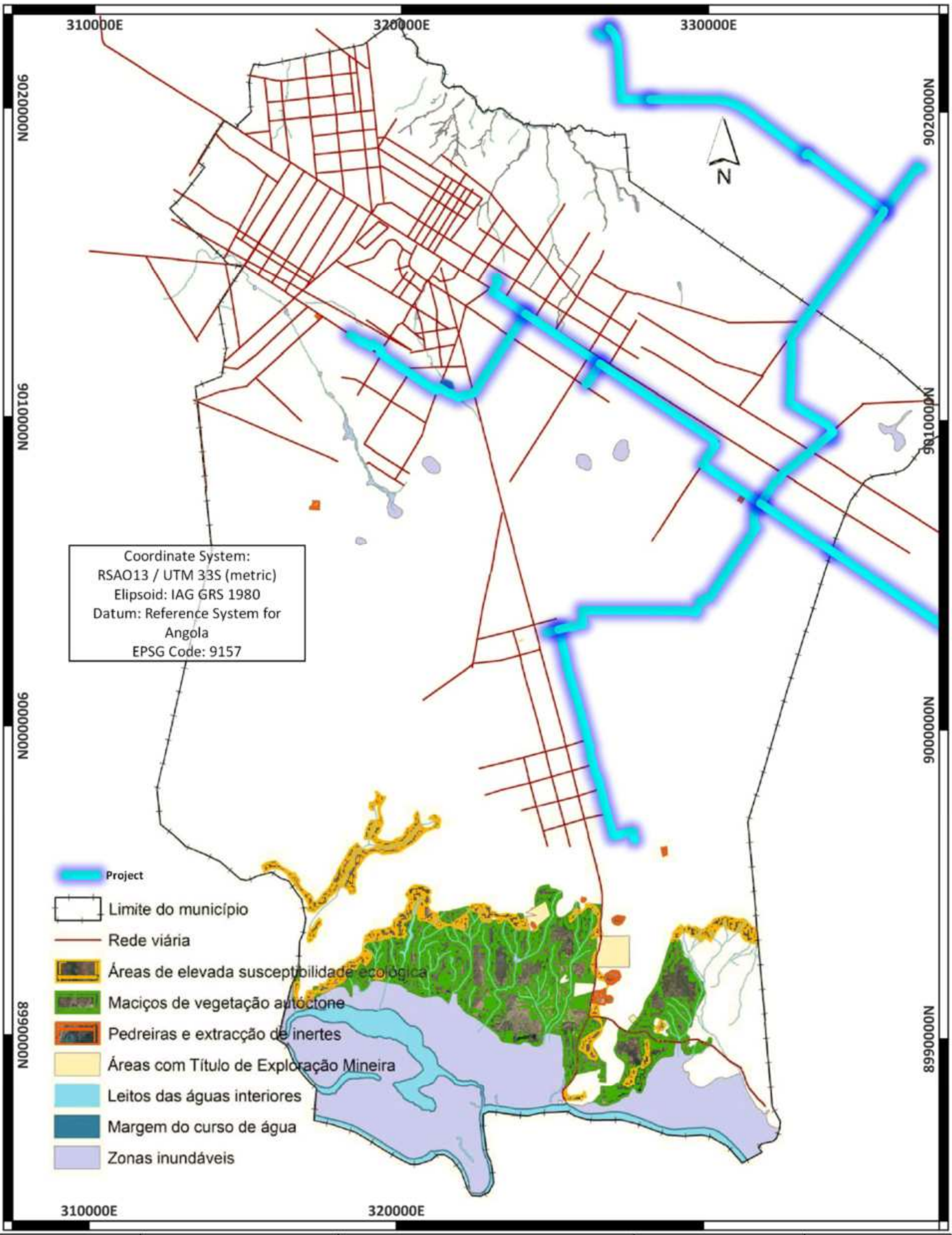
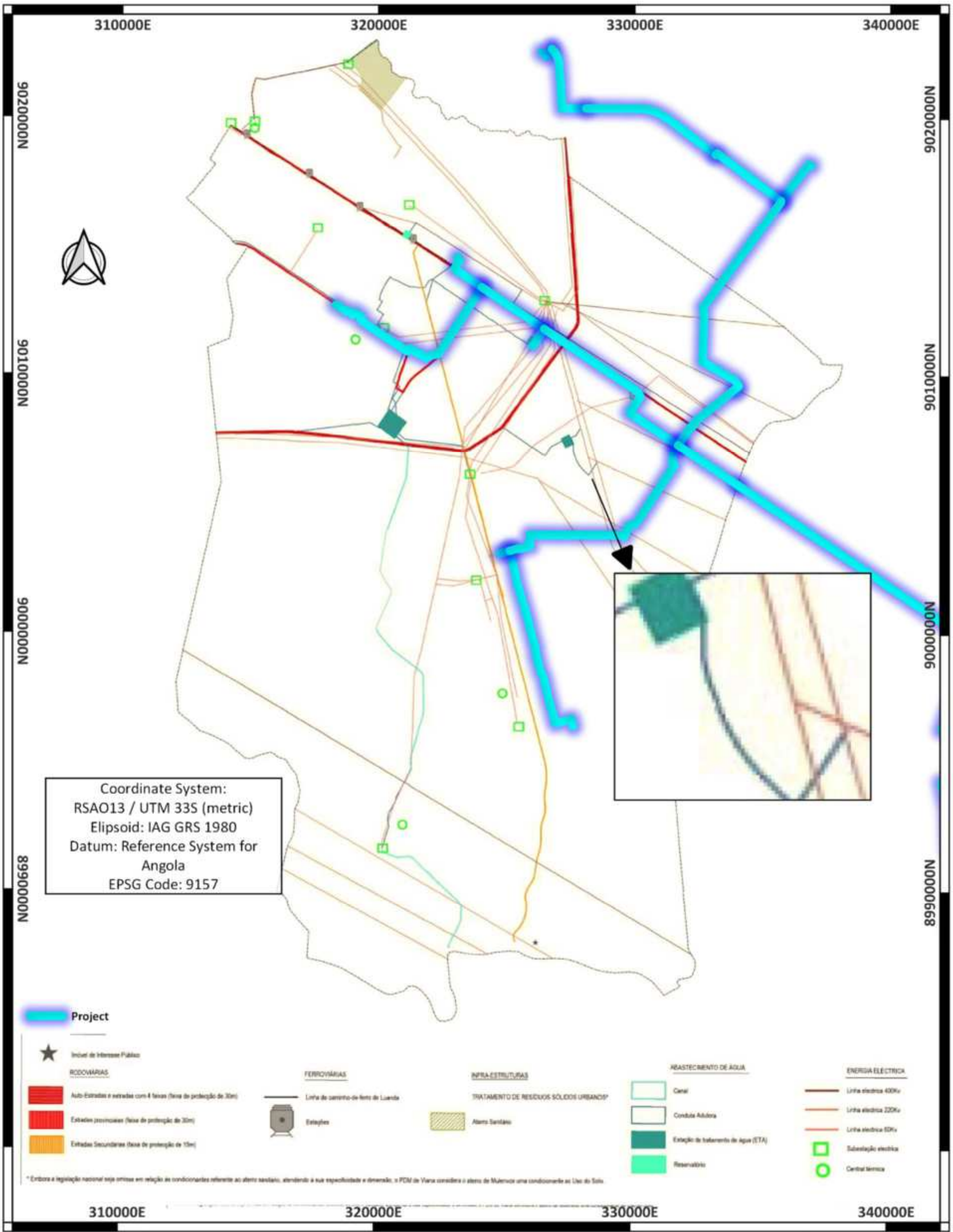


Figure 399: Municipal Ecological Structure



Consultant	Client	Project:	Scale:	Drawing N.:
SZ ENGENHARIA AMBIENTAL	wsp GOLDER	Quilonga Grande Water System - ESIA	0 1 2 3 km	SZ_104_23 / 124
		Plant: Viana Municipal Masterplan - Biophysical Conditions		Sheet: 1/1 Date: Aug 2023

Figure 400: Biophysical Conditions



Consultant	Client	Project: Quilonga Grande Water System - ESIA	Scale:	Drawing N.: SZ_104_23 / 125
SZ ENGENHARIA AMBIENTAL	wsp GOLDER	Plan: Viana Municipal Masterplan - Restrictions Plant	0 1 2 3 km	Sheet: 1/1 Date: Aug 2023

Figure 401: Restrictions's Plant

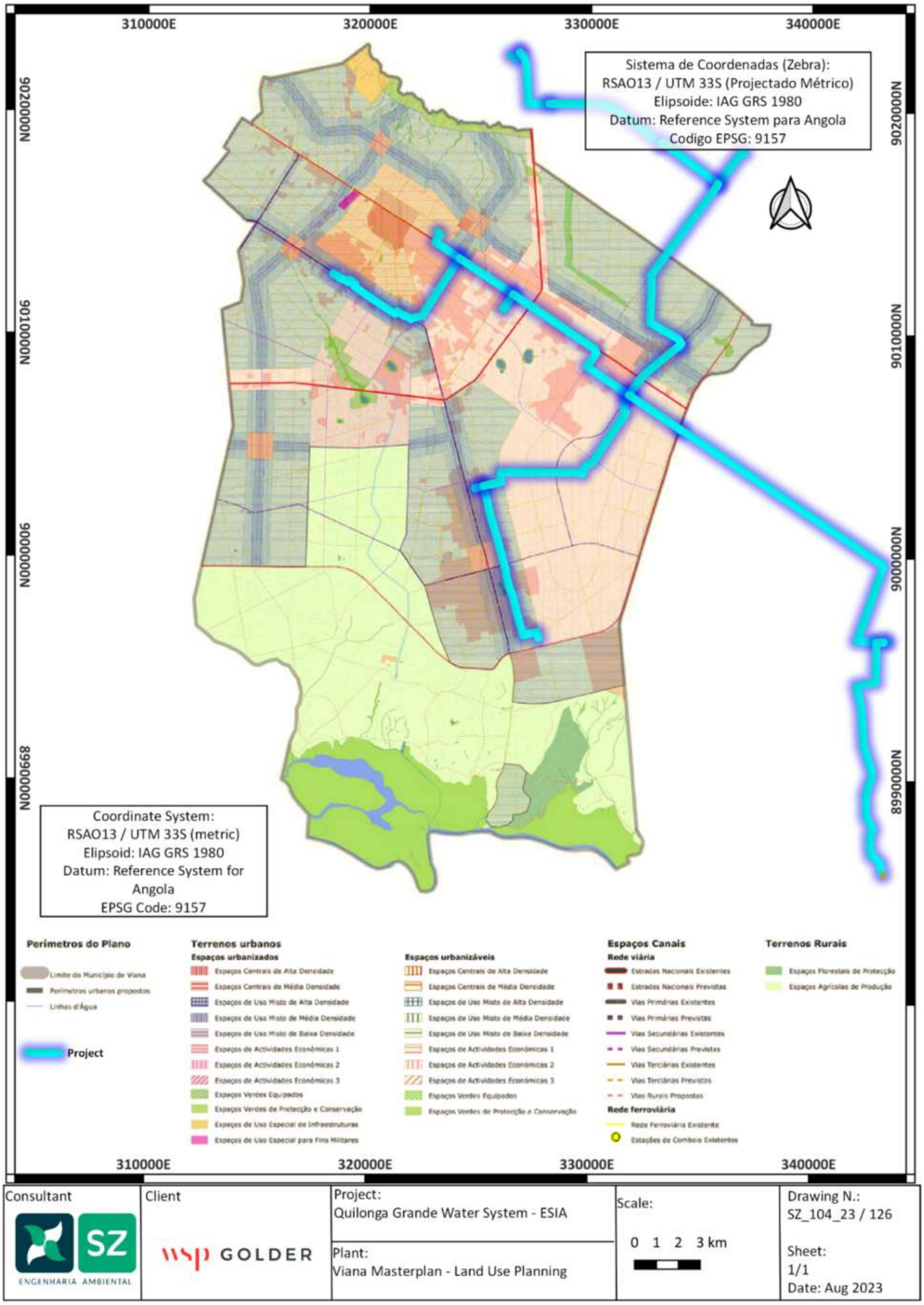
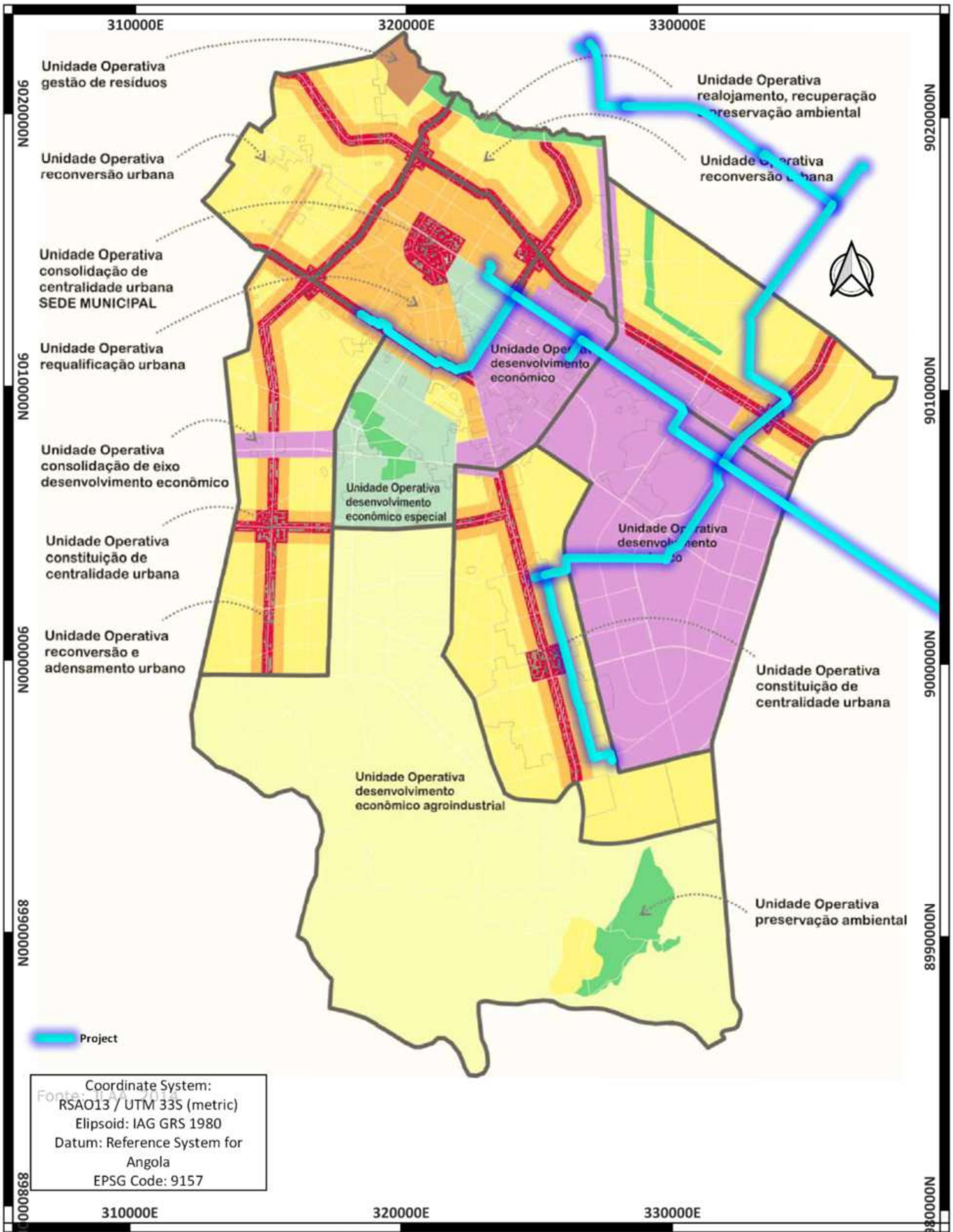


Figure 402: Land use Plant



Consultant	Client	Project:	Scale:	Drawing N.:
SZ ENGENHARIA AMBIENTAL	wsp GOLDER	Quilonga Grande Water System - ESIA	0 1 2 3 km	SZ_104_23 / 127
		Plant: Viana Municipal Master Plan - UOPGs		Sheet: 1/1 Date: Aug 2023

Figure 403: UOPGs Proposal

From the analysis of the PDM plans presented above, it can be seen that the project does not affect any areas considered as ecological structure or biophysical constraints.

In terms of constraints plant, the project does not affect any areas classified as constrain/restriction by the PDM. As for the land use planning plant, it is considered that the project is in line with the considered land use proposed, with no incompatibilities with the general land use planning proposed in the Viana PDM.

7.3.14.3 Development challenges

This point summarizes the critical development challenges in the Greater Luanda area, focusing on various social and economic domains for the Project under study.[10]

Political Instability and Inequality

Government and business are inextricably linked in Angola, with reported incidents of political interference in many areas of the business environment. More excellent political stability has been achieved since the 2017 presidential elections, and the government has indicated its plans to push towards privatizing larger state-owned businesses.

Volatile Economy

Angola continues to rely heavily on oil, which amounts to over 90% of total exports. As an oil-exporting country, Angola's economic performance is dictated by developments in the oil market. The end of the oil boom from 2014 onwards has impacted negatively on the economy. The drop in oil prices and fall in world demand has pushed the economy into a recession from which it has not yet fully recovered.

Poor Ease of Doing Business

Angola continues to face high costs associated with doing business and ranks 177 out of 190 economies in the World Bank 2020 Doing Business Study. The findings of this study reveal that it takes 79,4 days to start a new business in Angola while trading across borders is complicated by high costs and lengthy delays associated with logistical processes to import and export goods. Angola ranks 174 out of 190 countries for the trading across borders indicator.

Poor State of Transport Infrastructure

Angola's transport infrastructure in its current state does not support economic growth and industrialization. The civil war has severely damaged transport infrastructure and systems. Land transport infrastructure (road and rail) is still characterized by missing links and poor network connectivity. Only 24 % of the total road network is paved, while some sections of the paved road network require urgent rehabilitation. Inadequate road infrastructure result in prolonged journeys and cause safety concerns, especially outside urban areas where land mines are still found. The 2019 Global Competitiveness Report ranks Angola 141th out of 190 countries noted the poor state of transport infrastructure.

The civil war has also damaged rail infrastructure and systems and has not been subjected to regular maintenance. Multi-modal infrastructure arrangements are inadequate and do not favor road/rail connectivity.

Poor Access to Health Care

[10] Based and adapted from:Angola: Country Profile Report 2020-21.

Quality health care in Angola is compromised by a shortage of pharmaceuticals, medical supplies, and skilled medical workers (e.g. doctors, nurses, and primary health care workers). Major health concerns include malaria, typhoid, tuberculosis, infectious diseases, cholera, and measles. Due to these limitations, Angola's health indicators rank very low globally. Poor access to proper health care is a deterrent to attracting FDI while undermining business growth. Maximum benefit can only be obtained if the government prioritized the execution of strategic reforms holistically, meaning that political, economic, infrastructure and healthcare reforms (programs) should be executed concurrently.

Poor Access to Water Suitable for Human Consumption

The quality and quantity of water available do not meet the population's current needs. This situation will tend to worsen with the population growth in the city of Luanda and other municipalities.

Workers Education and Training

With a high percentage of the youth unemployed, Angola does not face a shortage of unskilled labor. However, Angola's lack of training and education remains an ongoing challenge. Absenteeism is often reported as a significant cause of the low quality of services. Introducing an incentive scheme based on productivity is still lacking in most public-sector institutions. The status quo calls for urgent government intervention to increase investment in human capital.

Opportunities

With a relatively new government and a reform mission underway, the country has a vision to transform its economy by attracting private investment to help reduce inequality and provide jobs for a young and fast-growing population. The National Development Plan (NDP) for 2018-2022 aims to address structural bottlenecks and promote human development, public sector reform, diversification, and inclusive growth.

8.0 IMPACT ASSESSMENT

The gap analysis of the first ESIA performed in the scoping report by WSP (report WSP n° 23591788-Quilonga_R01_Scoping Report_V2, 10-08-2023), prior the present ESIA, identified several components for which the impacts have either not been assessed or may have changed since the completion of the initial ESIA. This section presents the impact assessment of the identified gaps, based on new field data collected during the baseline update studies, and assessed over the entire Project AoI.

The Project involves the construction of a water pumping station to abstract water from the north back of the Kwanza River, a raw water pipeline to transport the raw water to the Water Treatment Plant (WTP), a WTP and a sludge treatment plant (STP) plus all ancillary facilities, to build a treated water transmission of 100 km aimed at transporting the treated water produced by the WTP to 7 Distribution Centers (DC). At the time of this study (September 2023), the construction of 3 DC out of the total 7 is almost completed. The impact assessment has been performed in this study for the different Lots: Lots 1, 8, 10, 3, 6, 7, WAF. The Lots 4, 5, and 9 have already been constructed and then, they will not be assessed as part during the construction phase impact assessment.

Specific impacts related to operation of drinking water projects are highlighted in the IFC-WB (2207) Environmental, Health, and Safety Guidelines for Water and Sanitation and are applicable to the Quilonga Project are the following and are integrated in the next chapters :

- potential adverse effects of surface water withdrawal on the downstream ecosystems and on human needs
- environmental issues associated with water treatment related to solid waste such as process residuals (including sludge), wastewater, hazardous chemicals in the process air emissions, ecological impacts
- health issues cause by bad water quality due to problems on distribution networks.

The impact assessment is performed following the three main components: physical, biological and social. Each of these main components are subdivided into sub-components, on which the project impacts are assessed. The impact assessment is divided according to the different project phases; considering the project nature, the phases considered here are the construction phase and the operational phase. The methodology for the impact assessment is described in Chapter 5.0.

The interrelation linkages between the Project activities and the physical, biological and social sub-components are summarized in Figure 103.

Table 104: Interrelations between the Project activities and the physical, biological, and social sub-components

Project phase	Impact source (activities of the Project)	Air quality	Noise and vibration	Soil quality, Erosion	Hydrology	Water quality	Terrestrial fauna and habitats	Aquatic fauna	Land use	Population and demography	Economy and employment	Community health, safety, and security	Infrastructures and services	Landscape and visual quality	Cultural heritage
Construction phase	Land acquisition (this is part of pre-construction								x						x
	Job creation									x	x				
	Site preparation (earthworks, vegetation clearance etc)	X	X	X		X	X	X	x			x		x	x
	Presence and use of heavy machinery and construction equipment	X	X	X		X	X					x	x	x	x
	Truck and vehicle road traffic	X	X	X		X	X	X				x	x		x
	Generation of solid waste (domestic and construction)			X		X	X	X				x	x	x	
	Generation of liquid waste (domestic and construction)			X		X	X	X				x			
	Storage, use and disposal of fuel or hazardous products			X		X	X	X				x			

Project phase	Impact source (activities of the Project)	Air quality	Noise and vibration	Soil quality, Erosion	Hydrology	Water quality	Terrestrial fauna and habitats	Aquatic fauna	Land use	Population and demography	Economy and employment	Community health, safety, and security	Infrastructures and services	Landscape and visual quality	Cultural heritage
	Energy consumption and supply	X	X	X		X					x		x		
	Goods and services supply										x		x		
Operation phase	Job creation									x	x				
	vehicle road traffic	X		X			X	X							
	Generation of solid waste (domestic and industrial)			X		X	X	X							
	Generation of liquid waste (domestic and industrial)			X		X	X	X							
	River water abstraction		X		X			X							
	Energy consumption and supply	X									x		x		
	Goods and services supply										x				
	Storage, use and disposal of fuel or hazardous products			X		X	X	X							
	Production and distribution of drinking water	X	X								x	x		x	

8.1 Physical component

The impacts assessment on the physical component are assessed across the Project area of influence (AoI) for the two phases of the Project: the construction phase, corresponding to the construction of the Project facilities and infrastructures, and the operation phase, corresponding to the water pumping, treatment, and supply network exploitation. The physical sub-components retained for this assessment are ; noise and vibrations, air quality, land use and soil, hydrology, surface and groundwater, and climate change.

The interrelation linkages between the Project activities and the biological sub-components are summarized in Table 104.

The baseline field studies performed in 2023 has provided data on noise, air quality and soil. The sampling points for each of these sub-components and their location related to the Lots are summarized in the Table 105 below.

Table 105: Noise, air quality and soil sampling points

Lots	Name	Noise sampling points	Air quality sampling points	Soil sampling points
1, 8, 10	Quilonga Grande	R1	Air 01	Soil 02, 03, 04
2	Network	-	-	-
3	Cacuaco	R9	Air 02	Soil 07
4	Zango 5	R10	-	-
5	New airport	R7	-	-
6	km 30	R8	Air 03	Soil 9 10 11
7	Kapalanga	R11	Air 04	Soil 12 13
9	PIV	PIV	-	-
Lot 1 - WAF	WAF	WAF	Air 04 WAF	-

8.1.1 Noise and vibration

The impact assessment consists of assessing the noise and vibration emissions expected from the construction and operation of the facilities and identifying all the receptors closest to the future project infrastructures and likely to be impacted by the emission of noise and vibration during their construction or operation. Only schools, residential areas, medical centers, monuments and accommodation / recreative facilities are considered as sensitive receptors. Table 106 below provides a summary of the main sensitive receptors identified during the baseline. A percentage of the surface covered by the urban fabric within a radius of 200 m around the facility is also presented to better assess the potential concentration of sensitive receptors around the Project's facilities.

Noise measurements were not carried out along the water pipeline because this construction will cross all project areas and all types of natural and urbanized environments encountered in the project area of influence. For this reason, the sensitivity of the environment is considered high by default and the measurements carried out on the other installations of the project are considered to also be representative of the background noise in the areas crossed by the pipeline.

Table 106: Nearest sensitive noise receptors around Project's facilities (excluding water pipeline footprints)

Lots	Types of facilities	Noise sampling point	Presence of Sensitive Receptors	Urban development (%)	Sensitivity
Lots 1- 8, 10	WAF – WTP - STP Quilonga Grande DC	R1 WAF	No nearby sensitive receptor identified	50 %	Low
Lot 2	Water pipeline network	ref. all noise sampling point	Many receptors all along the pipeline	Depending on the section	High
Lot 3	Cacuaco DC	R9	No nearby sensitive receptor identified	83 %	High
Lot 4	Zango 5 DC	R10	Less than 200m	50 %	High
Lot 5	New Airport DC	R7	No nearby sensitive receptor identified	36 %	Low
Lot 6	Km 30 DC	R8	Less than 200m	100 %	High
Lot 7	Kapalanga DC	R11	Less than 200m	100 %	High
Lot 9	PIV DC	PIV	Less than 200m	100 %	High

8.1.1.1 Impact sources

The impact sources on noise and vibration resulting from the project activities are the following :

- **Construction phase**
  - Site preparation (earthworks, vegetation clearance etc) ;
  - Presence and use of heavy machinery and construction equipment ;
  - Truck and vehicle road traffic ;
  - Energy consumption and supply ;
- **Operation phase**
  - River water abstraction ;
  - Production and distribution of drinking water.

8.1.1.2 Impacts during the construction phase

The identified impacts on the noise and vibration during the construction phase are the following :

P-C-01: Emissions of noise and vibration

During the construction phase, the negative impact resulting from the various sources of noise and vibration will vary depending on the existing background noise at each construction area (see Table 107). Noise produced by the construction phase may generate additional noise intensity but it will be partially covered by surrounding existing background noise. As a result, noise intensity generated by the construction phase can be considered as moderate.

The noise and vibrations impact during the excavation works for the water pipeline installation remain limited for the following reasons :

- The soils to be excavated is not rocky and will not require the use of hydraulic rock breaker
- 99 % of the trenches will be excavated by conventional excavation method using a mechanical excavator or a backhoe loader. Excavation of non-rocky soils to a maximum depth of 2 meters with this type of machine is not expected to generate significant vibrations.
- 1 % of the trenches will be excavated using hydraulic jacks that do not produce significant noise levels or vibrations. The associated generators' motor noise is a typical construction works' noise.
- Soil removal during pipe jacking is done inside the jacking tube itself, which has a noise attenuating effect.
- The areas where pipe jacking will be used are technical embankments (road and railways crossings), so the existence of rock is not expected.

The noise and vibration impacts are expected to remain near the construction works footprint (local extend) and be temporary (the time of the construction). Considering this, impact factors are assessed as minor. The sensitivity of the noise and vibration impact will depend on the vicinity of potential sensitive receptors. Sensitive receptors (residential areas) have been identified in Lot 3, 4, 6,7, and 9 less than 200 m away and in certain sections of Lot 2. Construction of lot 4 and 9 are almost achieved and the sensitivity due to nearby receptors is considered as negligible for this phase. Sensitivity is then assessed from low to high. The impact value induced from the combination of the impact factor and sensitivity is assessed **low to moderate**, depending on existence of nearby sensitive receptors. No significant changes were identified since the initial ESIA (ARTELIA 2014) that already assessed in detail the noise impact of all the different activities during the construction phase.

Mitigation measures

It is recommended that the CESMP include the following measures to mitigate the impacts on noise and vibrations:

P-C-01: Mitigation measures aiming at reducing noise emissions and vibration

- **P-C-01a**: Use construction equipment and vehicles whose noise emission comply with international standards and ensure regular maintenance to keep noise levels within the technical standards.
- **P-C-01b**: Take regular measurements of noise levels during earthworks or equipment installation at the nearest identified receptors. Special consideration should be given to sensitive receptors such as schools and vulnerable groups in residential areas. Punctual background noise measurements will be performed at the same locations as the ones performed in the recent baseline to assess the possible evolution of background noise.
- **P-C-01c**: The measures must be such that the noise impact does not exceed 55 dB in residential zones and 70 dB in industrial zones or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site. Special attention should be given to construction near sensitive receptors (schools, hospitals and vulnerable groups in residential areas including informal settlements)

- **P-C-01d**: Set up a grievance management procedure for the affected population to raise concerns about possible disturbances due to noise and vibrations.
- **P-C-01e**: The Contractor should be proactive in engaging with the occupants of neighboring properties and should notify them of any works forecast to generate appreciable levels of noise, explaining the nature and duration of the works.
- **P-C-01f** : Before starting the works undertake a survey of existing structures and the condition of buildings to assess the scale of vibration impacts and to identify mitigation measures to either avoid reduce, mitigate, or compensate for damage caused by vibrations.

The impacts identified on noise and vibration for the construction phase are summarized in the Table 107. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 107: Potential impacts on noise and vibration during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Type of facilities	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
			Value	Intensity	Extend	Duration				
P-C-01 Noise Emission and vibrations	Lots 1-8-10-5	Water abstraction point WTP-STP-DC	Negative	Moderate	Local	Temporary	Minor	Low	**Minor**	**Negligible**
	Lots 2-3-6-7	Water pipeline DCs	Negative	Moderate	Local	Temporary	Minor	High	**Moderate**	**Negligible**
	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							

8.1.1.3 Impacts during the operation phase

The identified impacts on the noise and vibration during the operational phase are the following:

P-O-01: Emission of noise and vibration

During the operational phase, no noise emission is expected to occur from lot 2 (buried water pipeline). Notable noise emissions can be generated at the Lot 1- Water Abstraction Facility (WAF) by the pumps. For the Lots 1 (WTP) and 10 (STP) the noise mainly comes from the blower in the backwash pump room, the pumps in various pump houses, the centrifugal separator in the dewatering room, and the submersible sewage pump. The noise modelling presented in the initial ESIA (Artelia 2014) concludes with an expected rise of noise level from the pumps located in the DCs of 5dB during daytime. Recent specifications provided by the pumps provider mention that the expected pumps motor noise pressure level is 73 dBA However. In addition, a visit of the Zango 5 (lot 4) DC recently built shows that the pumps are located within a closed building preventing any risk of noise emissions of such level out of the building (Figure 404). No notable noise emissions are therefore expected to be generated by the Distribution and the impact value at these facilities is expected to be negligible.

Figure 404: Pumps room at the newly built Zango 5 (lot 4) Distribution Center

Water flow noise is not expected to occur ; especially outside of the pumping station buildings where all external pipes will be buried/underground.

These noise emissions are therefore expected to be of low to moderate intensity depending of the facilities considered, with project site to local extend and permanent duration. Vibrations are not expected during normal operation. The resulting impact factor value is assessed as **Negligible to moderate**. Sensitive receptors (residential areas) have been identified in Lot 3, 4, 6,7, and 9 less than 200 m away. Considering the type and the distance of these receptors, the sensitivity is therefore assessed as **low to High** depending of the facilities considered.

The resulting impact on these facilities is assessed as a **minor negative impact value**.

Mitigation measures

The following measures are recommended to be implemented for reducing the impacts on noise and vibrations:

P-O-01: Mitigation measures aiming at reducing noise emissions and vibration

- **P-O-01a**: set up a noise monitoring program targeting the nearest receptors around the WAF and WTP/STP, detailing noise monitoring methodology, location, frequency, and evolution.
- **P-O-01b**: Set up a grievance management procedure for the affected population to raise concerns about possible disturbances due to noise and vibration.

The impacts identified on noise and vibration for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 108: Potential impacts on noise and vibration during the operational phase and expected residual impact after implementation of mitigation measures

Impact	Site	Type of facilities	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
			Value	Intensity	Extend	Duration				
P-O-01 Noise Emission and vibration	Lots 1-8-10-5	Water abstraction point WTP-STP-DC	Negative	Moderate	Local	Permanent	Moderate	Low	**Minor**	**Negligible**
	Lots 3-4-6-7-9	DCs	Negative	Low	Project site	Permanent	Negligible	High	**Minor**	**Negligible**

8.1.2 Air quality

As a first step, the impact assessment consists of assessing the dust and gas emissions expected from the construction and operation of the facilities. The construction activities will likely generate dust and exhaust gas during the earthworks and because of the use of heavy machineries and vehicles. The operation phase is not expected to generate notable quantities of dust or gas. All operational facilities will be powered by electricity and will require a limited use of vehicles for transportation of employees, furniture, and sludges from the WTP and STP.

The impact assessment also consists of identifying all the receptors closest to the future project infrastructures and likely to be impacted by the gas and dust emissions during their construction. Infrastructures already built are not considered in this assessment (Lot 4, 5, 9). Table 109 below provides a summary of the main sensitive receptors identified during the baseline. A percentage of the surface covered by the urban fabric within a radius of 200 m around the facility is also presented to better assess the potential concentration of receptors around the Project's facilities. The air quality baseline recently performed at several future Project's facilities locations revealed a highly degraded air quality over the entire Project area of influence, with constant elevated PMs concentrations, including at the water abstraction point along the Kwanza River not subject to heavy traffic. High concentrations of O_3 and SO_2 are also locally detected. These results confirm that the air quality over the whole city is degraded due to the general intense urbanization and concentrated activities.

Air quality measurements were not carried out along the water pipeline because this construction will cross all project areas and all types of natural and urbanized environments encountered in the project area of influence. For this reason, the sensitivity of the environment is considered high by default and the measurements carried out on the other installations of the project are considered to also be representative of the air quality in the areas crossed by the pipeline.

Table 109: Nearest sensitive air and dust receptors around Project's facilities (excluding water pipeline footprints)

Lots	Types of facilities	Air sampling	Presence of Sensitive Receptors	Urban development (%)	Sensitivity
Lots 1-8, 10	WAF – WTP - STP Quilonga Grande DC	Air 01 Air 04 - WAF	No nearby sensitive receptor identified	50 %	Low

Lots	Types of facilities	Air sampling	Presence of Sensitive Receptors	Urban development (%)	Sensitivity
Lot 2	Water pipeline network	Ref. all air sampling	Many receptors all along the pipeline	Depending on the section	High
Lot 3	Cacuaco DC	Air 02	No nearby sensitive receptor identified	83 %	High
Lot 4	Zango 5 DC	None	Nearby receptors less than 200m but construction achieved (already assessed in initial ESIA (Artelia 2014)	50 %	High
Lot 5	New Airport DC	None	No nearby sensitive receptor identified	36 %	Low
Lot 6	Km 30 DC	Air 03	Less than 200m	100 %	High
Lot 7	Kapalanga DC	Air 04	Less than 200m	100 %	High
Lot 9	PIV DC	None	Nearby receptors less than 200m but construction achieved (already assessed in initial ESIA (Artelia 2014)	100 %	High

8.1.2.1 Impact sources

The impact sources on air quality resulting from the project activities are the following:

- **Construction phase**
  - Site preparation (earthworks, vegetation clearance etc) ;
  - Presence and use of heavy machinery and construction equipment ;
  - Energy consumption and supply ;
  - Truck and vehicle road traffic.
- **Operation phase**
  - vehicle road traffic ;
  - Energy consumption and supply ;
  - Production and distribution of drinking water.

8.1.2.2 Impacts during the construction phase

The construction of the Project's facilities (WAF, WTP, STP, DCs) and the installation of the drinking water supply pipeline, will produce atmospheric emissions such as nitrogen oxides (NOx), carbon monoxide (CO), particulate matter (PM), and other volatile organic compounds (VOCs).

The most significant sources of air quality degradation will be dust emissions from excavation, earthworks, and site grading. Table 25 section 2.3.4.2.2 details all vehicles planned to be used for the construction of lot 2, 6 and 7. The construction sites are located in flat areas requiring limited preliminary earthworks for the terrain and foundation preparation : this is confirmed by the limited heavy machinery dedicated to earthworks (1 dozer, 1 grader split over the 3 construction sites, 1 to 2 excavators per construction site at lot 2, 1 backhoe per site at lot 6 and 7).

Other sources of dust emissions will come from the transport of construction materials and equipment on site (up to 12 loading trucks in one of the three construction site for Lot 2) . Dust emissions will depend mainly on the nature and volume of the materials unloaded, moved, or stored, but also on the level of moisture and the content of fine particles in the reworked materials.

The identified impacts on air quality during the construction phase are the following:

P-C-02: Emissions of dust

During the construction phase, the negative impact caused by dust emissions due to earthworks, construction of the different centers, use of construction machinery and vehicle traffic, will be of moderate intensity. The potential impact will be of local extent, as the vehicles circulating to and from the site will produce dust beyond the areas around the construction sites. This impact will be temporary as it is associated with the duration of the work. The resulting impact factor value is considered as **minor**. The sensitivity of the impact is linked to the vicinity of sensitive receptors and assessed as **Low to High**. As a result, the impact is expected to be of **low to moderate negative impact value**.

P-C-03: Emission of exhaust and smoke

During the construction phase, gas will be emitted by light and heavy vehicles as well as construction machinery. the intensity is expected to be moderate because the construction will require extensive use of heavy vehicles only for the installation of the water pipeline; no major earthworks are expected for the construction of the DCs, WAF, WTP and STP. The extend of the gas and dust emissions are considered as of local extension (around the construction site). The emissions will be released only during the construction phase (temporary) although their indirect effects on global warming will be permanent. The resulting impact factor value for this potential impact is considered as **minor**. The sensitivity of this impact is linked to the vicinity of sensitive receptors and assessed as **Low to High**. As a result, the expected impact is expected to be of **low to moderate negative impact value**.

Mitigation measures

It is recommended that the CESMP include the following measures to mitigate the impacts on air quality:

P-C-02: Mitigation measures aiming at reducing emissions of dust:

- **P-C-02a**: Conduct most of the heavy constructions during the rainy season to the extent possible.
- **P-C-02b**: Covering of trucks transporting friable materials.
- **P-C-02c**: Storage of friable materials sheltered from the wind.
- **P-C-02d**: Train local workers to drive responsibly to reduce the risk of accidents, fuel consumption and the production of dust on dirt roads.
- **P-C-02e**: Limit vehicle speed to 30 km/h on site and on access roads or roads along the project's footprint.
- **P-C-02f:** Proceed to regular watering of the construction sites access roads as soon as dust emission is noticed:

- **P-C-02g:** Set up a grievance management procedure for the affected population to raise concerns about possible disturbances due to air quality.

Special attention should be given to construction near sensitive receptors (schools, hospitals, and vulnerable groups in residential areas, including informal settlements)

P-C-03: Mitigation measures aiming at reducing emissions of exhaust and smoke:

- **P-C-03a**: Proceed to regular maintenance of vehicles.
- **P-C-03b**: Optimize journeys (loading / journeys, etc.).
- **P-C-03c**: Prohibit burning of solid materials in the open and promote re-use of plant-residues.

The impacts identified on air quality for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above Table 110.

Table 110: Potential impacts on air quality during the construction phase

Impact	Site	Type of facilities	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
			Value	Intensity	Extend	Duration				
P-C-02 Emission of Dust	Lot 1,8 and 10	Water abstraction and WTP	Negative	Moderate	Local	Temporary	Minor	Low	**Minor**	**Negligible**
	Lot 2-3-6-7	Pipeline DCs	Negative	Moderate	Local	Temporary	Minor	High	**Moderate**	**Negligible**
	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
P-C-03 Emissions of exhaust and smoke	Lot 1,8 and 10	Water abstraction and WTP	Negative	Moderate	Local	Temporary	Minor	Low	**Minor**	**Negligible**
	Lot 2-3-6-7	pipeline	Negative	Moderate	Local	Temporary	Minor	High	**Moderate**	**Negligible**
	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							

8.1.2.3 Impacts during the operation phase

The identified impacts on air quality during the operation phase are the following:

P-O-02: Pollutant emissions

During the Operational Phase the air quality will mainly be affected by emissions of the generator powering the Cacuaco DC, as well as the combustion gases from the circulation of employees' vehicles and the transport of waste residues like sludge generated in the Water Treatment Plant to the final destination. The chlorine used in disinfection can also, under certain conditions, be extracted into the air. It can cause environmental damage at low concentrations and pollute the air by increasing its acidity. These sources are diffuse in nature and as such, contribute to the degradation of the air quality in general and not just in the Project area. The volume of gas emitted during the operation phase by these activities is considered to have a negligible contribution to the ambient air quality.

The environmental impacts for this phase regarding air quality are negative, but of negligible intensity because these activities will have a negligible contribution to the ambient air quality. The impact is expected to last the time of the operation phase (permanent), and its extent to be eventually felt at a project site scale before being dispersed into the atmosphere. The impact factor value resulting from these criteria is assessed as **negligible**. The sensitivity depends on the vicinity of the receptors, assessed **low** for each lot. The resulting impact is considered as a **negligible negative impact value**.

Mitigation measures

It is recommended that the CESMP include the following measures to mitigate the impacts on air quality:

P-O-02: Mitigation measures aiming at reducing emissions of pollutant:

- **P-O-02a**: Train local workers to drive responsibly in order to reduce the risk of accidents and fuel consumption.
- **P-O-02b**: Limit vehicles speed to 30 km/h on site and on Project's access roads.
- **P-O-02c**: Proceed to regular maintenance of vehicles.
- **P-O-02d**: Prohibit burning of solid materials in the open and promote re-use of plant-residues.
- **P-O-02e**: Select energy-efficient equipment, i.e., with low fuel consumption and emission rates.

The impacts identified on air quality for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 111: Potential impacts on air quality during the operational phase and expected residual impact after implementation of mitigation measures

Impact	Site	Type of facilities	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
			Value	Intensity	Extend	Duration				
P-O-02 Emission of Dust and gas	Lot 1-8-10	Water abstraction and WTP	Negative	Negligible	Project site	Permanent	Negligible	Low	**Negligible**	**Negligible**
	Lot 3-6-7	DC	Negative	Negligible	Project site	Permanent	Negligible	High	**Negligible**	**Negligible**
	Lot 4-5-9	DC	Negative	Negligible	Project site	Permanent	Negligible	Low	**Negligible**	**Negligible**

8.1.3 Land use, soil quality, erosion, borrow material

8.1.3.1 Impact sources

The impact sources on the land use, soil quality, erosion and borrow material resulting from the project activities are the following:

- **Construction phase**
  - Site preparation (earthworks, vegetation clearance etc) ;
  - Presence and use of heavy machinery and construction equipment ;
  - Truck and vehicle road traffic Influx / presence of workers ;

  - Generation of solid waste (domestic and construction) ;
  - Generation of liquid waste (domestic and construction) ;
  - Storage, use and disposal of fuel or hazardous products ;
  - Energy consumption and supply.
- **Operation phase**
  - vehicle road traffic ;
  - Generation of solid waste (domestic and construction) ;
  - Generation of liquid waste (domestic and industrial) ;
  - Storage, use and disposal of fuel or hazardous products.

8.1.3.2 Impacts during the construction phase

The main potential impacts on soils resulting from the Project's construction and operation are soil structure degradation and soil contamination through accidental or chronical spills of chemicals.

Table 112: Assessment of soil structure sensitivity based on current land use

Lots	Type of facilities	Urban development %	Other %	Soil type		Construction phase	Sensitivity
Lot 1, 8, 10	Water abstraction and WTP	50 %	50 %	Geo 18	Sandy siliceous soil, brownish, poorly consolidated	Not started	Moderate
Lot 2	Water pipeline	varying			varying	Not started	Low to High
Lot 3	DC	23 %	77 %	Geo 03	Sandy siliceous soil, poorly consolidated	Not started	High
Lot 4	DC	50 %	50 %			Almost finished	Moderate
Lot 5	DC	36 %	64 %			Almost finished	High
Lot 6	DC	89 %	11 %	Geo 02	Sandy siliceous soil, poorly consolidated	Not started	Low
Lot 7	DC	100 %	0 %	Geo 05	Sandy siliceous soil	Not started	Low
Lot 9	DC	6 %	84 %			Almost finished	High

grey boxes indicate not taken data or not available data.

P-C-04: Impact on land use

There is the potential for current land use to be impeded, restricted, or changed during construction and operations due to land clearance activities, construction of Project infrastructure and indirectly through Project-induced in-migration. Some construction works cross areas used for farming or vegetated areas, especially along the section between the WAF and the WTP.

The intensity of this impact is high because the construction works will change the current land use. The extent of this impact will be site-specific (site construction area, trenches, access road and their immediate surroundings). The duration is expected to be permanent because most of the construction sites will be occupied with the facilities. The resulted impact factor is considered as **moderate**. The sensitivity depends on the current nature of the soil and land use. The following table presents a summary of the current land use at each Lot (see figure with habitat maps in Chapter 7 Baseline conditions), and the resulting sensitivity foreseen based on this current land use:

- **High** if the construction will occur on small scale farming areas, vegetated areas, or flood plain grassland;
- **Moderate** if the construction will occur on ruderal areas;
- **Low** if the construction will occur on artificialized /built up areas.

The resulting impact varies from **minor to major negative impact value,** depending on the Lot considered.

P-C-05: Soil Contamination

Soil characterization in the study area was carried out by Artelia/Ecovisao in 2014, but no soils were sampled for chemical characterization. In July 2023, WSP/Saioz undertook a complementary baseline soil characterization at 5 future Project’s facilities locations for chemical analysis. All chemical of concern analyzed revealed concentration below reference criteria, and for hydrocarbons and PAH, concentration almost always below the laboratory limit of quantification.

The risks of soil contamination by toxic substances may be potentially generated by the following activities:

- Heavy machinery and vehicles for the construction, likely to cause pollution by spillage / loss of fuels and mineral oils;
- Production of miscellaneous construction waste;
- Presence of workers generating wastewater and household waste.

The negative impact of possible soil contamination is considered likely of moderate intensity in the event of a spill of liquid or toxic solid waste, because of the limited use of hazardous substances. Its extent would be site-specific. The contamination with hydrocarbons may lead to persistent soil contamination in case of poor spill response and contamination management. This change is consequently considered potentially as permanent. The resulting impact factor is considered as **moderate**.

The sensitivity depends on the nature and land use as described in section 7.2.1, and is assessed from low to high depending on the site location and habitat.

The resulting impact is considered between **minor and major negative impact value**, depending on the construction Lot considered.

P-C-06: Soil erosion

Construction works may generate soil erosion during stripping, excavation, stockpiling, and backfilling activities. Such activities will expose cleared surfaces to erosion in case of absence of appropriate management of runoff water and corrective actions after earthworks completion.

The negative impact of possible soil contamination is considered likely of moderate intensity due to the relatively limited surface of each construction site. The consequence of erosional disturbance could be felt up to a local extent. The duration of the erosional impact would last during the construction phase (temporary). The resulting impact factor is considered as **minor**. The sensitivity is considered as **high** given the presence of sensitive receptors such as nearby households or urban infrastructure. The combination of the impact factor and the sensitivity leads to a **moderate negative impact value**.

P-C-07: Borrow material

Construction materials from regional borrow pits or quarries will be used for the construction of the facilities. For the installation of the pipelines, a bed of sand or crushed materials (reused excavation material) of 15 cm is foreseen along its entire length of 100 km pipelines. Approximately, a total of approx. 40,000 m^3 of sand/crushed material is foreseen for this purpose; and the remaining trench refill material should be excavation material. Furthermore, additional sand, cement, aggregates, and water will also be needed to produce concrete for the valve boxes/chambers. The quantity of such material is not yet quantified and the location of borrow pits not yet determined.

The impact will be of a negative nature as it requires extraction and the provision of borrowing materials from geological formations. The impact may be from local to regional extent, depending on the location of the borrow pits or quarries. Its intensity will be low because the respective constructions will not require a significant amount of borrow material. Effects would be permanent on the borrow pits due to the definitive extraction of material. The resulting impact factor is considered **moderate**.

The sensitivity cannot be assessed at this stage because the origin of the borrow material is not yet defined. It is therefore assumed that the borrow material will be originating from accredited quarries (**low** sensitivity).

The combination of the impact factor and the sensitivity leads to a **minor negative impact value**.

Mitigation measures

It is recommended that the CESMP include the following measures to mitigate the impacts on soil quality, and destructuration for each Lot remaining to be built:

P-C-04: Mitigation measures aiming at reducing the impact on land use:

- **P-C-04a:** The establishment of awareness training on the risks of contamination and the respect of good environmental practices by workers and site managers.
- **P-C-04b:** Soils must be excavated and stored separately from the underlying geological formations so that they can be reused, either to cover areas previously excavated and backfilled (replaced identically), or to be reused in areas poor in soil, to promote revegetation or the development of agriculture in areas devoid of soil.
- **P-C-04c:** Prior to start the construction work in areas occupied by farming activities that will be resumed at post-construction, proceed to a topsoil analysis to evaluate quality and productivity of the soil for agriculture. Replace with similar quantity and quality of soil at post-construction.
- **P-C-04d** (for Lot 2 and temporary footprints): Strip the topsoil during the construction phase of the pipeline trenches and store it separately in appropriate conditions to be used during the rehabilitation.
- **P-C-04e** (for Lot 2 and temporary footprints): Land reshaping after closure of the pipeline trenches. Use topsoil stored separately before seeding the trenches during the rehabilitation.

P-C-05: Mitigation measures aiming at reducing soil contamination:

- **P-C-05a:** A Pollution Prevention and Control.
- **P-C-05b:** A Hazardous Material Management Plan.
- **P-C-05c:** An Emergency Preparedness and Response Plan.
- **P-C-05d:** A Waste Management Plan including soil waste management.
- **P-C-05e:** A Traffic Management Plan: define traffic plans within the construction site, adequate parking and storage areas for heavy equipment, vehicles and material.
- **P-C-05f**: Conduct a pre-construction site-walkover survey to determine the presence of baseline visual evidence of soil contamination.
- **P-C-05g**: the excavated and sorted soils (see P-C-04b) must be analyzed every 150 m^3 to check the absence of pollution before their reuse as agricultural land. The chemical analyses shall identify the concentrations of TPH, PAH.

P-C-06: Mitigation measures aiming at reducing soil erosion:

- **P-C-06a:** Construction sites footprints shall be reduced to its minimum and vegetation maintained as much as possible.
- **P-C-06b:** Construction sites must be clearly demarcated by barriers and signage, access to the construction site must be regulated and a traffic plan established specifying traffic rules and access restrictions outside traffic areas.
- **P-C-06c:** Construction materials must be grouped in dedicated storage areas and covered.
- **P-C-06d:** Runoff water on construction sites must be drained and collected into temporary settling basins regularly maintained to ensure water decanting before release into the environment.
- **P-C-06e:** Construction sites should be regularly inspected after each heavy rain to check for signs of erosion and implement corrective measures immediately to stop soil erosion.

P-C-07: Mitigation measures aiming at reducing borrow material:

- **P-C-07:** Borrow material shall be extracted in quarries approved by competent authority and as close as possible form the construction sites.

The impacts identified on land use and soil quality for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 113: Potential impacts on land use and soil quality during the construction phase

Impact	Site	Type of facilities	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
			Value	Intensity	Extend	Duration				
P-C-04 Change of land use	Lot 1, 8 and 10	Water abstraction and WTP	Negative	Moderate	Project site	Permanent	Moderate	Moderate	**Moderate**	**Moderate**
	Lot 2, 3	Pipeline, DC	Negative	Moderate	Project site	Permanent	Moderate	High	**Moderate**	**Minor**
	Lot 6, 7	DC	Negative	Moderate	Project site	Permanent	Moderate	Low	**Minor**	**Moderate**

	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
P-C-05 Soil Contamination	Lot 1, 8 and 10	Water abstraction and WTP	Negative	Moderate	Project site	Permanent	Moderate	Moderate	**Moderate**	**Negligible**
	Lot 3	pipeline	Negative	Moderate	Project site	Permanent	Moderate	High	**Major**	**Negligible**
	Lot 6, 7	DC	Negative	Moderate	Project site	Permanent	Moderate	Low	**Minor**	**Negligible**
	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
P-C-06 Soil erosion	All lots		Negative	Moderate	Local	Temporary	Minor	High	**Moderate**	**Negligible**
	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
P-C-07 Borrow material	All lots		Negative	Low	Regional	Permanent	Moderate	low	**Minor**	**Minor**
	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							

8.1.3.3 Impacts during the operation phase

The identified impacts on land use and soil quality, during the operation phase are the following:

P-O-03: Change of land use

At the end of the construction phase or at the beginning of the operation phase, some of the areas disturbed during the excavation and installation of the water pipeline will partially revert to their prior land use. However, some sections will probably require the establishment of easements of use which will prevent the recovery of the original land use. The impact will be positive, with a low intensity if most of the pipeline footprint are restricted for access. The duration is permanent and the extent is limited to the pipeline footprint (project-site). As such, the impact factor is considered as **minor.**

The sensitivity is considered as high because some areas are currently occupied with small scale farming or natural vegetation**.**

The combination of the impact factor and the sensitivity leads to a **moderate positive impact value**.

P-O-04: Soil Contamination

The liquid waste from the WTP will be treated at the STP but the final destination of the sludge is not yet defined. The sludge treatment will generate overflow water that will be neutralized and conveyed to tertiary treatment for disinfection and re-usage in agricultural irrigation networks. The neutralized excess is released into the rainwater network and can also be disposed of into the environment. The treated water will be discharged to the Kwanza River if the water quality meets regulatory requirements (Decreto 261 about water discharges limits).

The DCs include a chlorination section as well as a laboratory.

The risks of soil contamination by toxic substances may be potentially generated by the following activities:

- Use of chemicals such as fuels, oil, water treatment chemicals in the WTP, STP and DCs likely to cause pollution by spillage, leakage, or mismanagement ;
- Release of contaminated sludge from the STP into the environment ;
- Release of unproper treated overflow water from the STP to environment ;

- Production of miscellaneous operation waste such as waste from equipment maintenance, hazardous substances from water treatment ;
- Presence of workers generating wastewater and household waste.

The impact magnitude of a potential soil contamination essentially depends on the facility considered and its potential to generate large-scale contamination if protection and monitoring measures are not implemented before its commissioning. The facilities likely to generate the greatest risk of contamination are the WTP and STP. The activities developed at the DCs are likely to generate less contamination although strict maintenance and waste management rules must be put in place. The water pipeline no longer represents any risk after its installation and burial. For these reasons, the negative impact of possible soil contamination is considered from negligible to major intensity in the event of a spill of liquid or toxic solid waste, depending on the facility. Its extent could vary between project site (limited spill restricted to the site) to regional (contamination through the release of contaminated sludge in uncontrolled landfills or natural areas or overflow water to the Kwanza River).

The contamination with chemicals of concern may lead to permanent soil contamination in case of poor spill response and contamination management. The resulting impact factor value could vary from **low** to **major**, depending on the size of the contamination and moreover the type of facility considered. The sensitivity will vary depending on the extension of the contamination potentially reaching sensitive human or natural receptors, from **low** to **high**. As a result, the impact may vary from **minor to major negative impact value**.

Mitigation measures

The implementation of the following measures is recommended for mitigating the impacts on soil quality and land use during the operation phase:

P-C-03: Mitigation measures aiming at reducing the change of land use (Lot 2):

- **P-O-03a:** limit areas subject to the implementation of easements of use and promote the return of soil to its original occupation (farming and vegetation) as much as possible.
- **P-O-03b:** reconstitute the reworked surfaces with the same types of soil and reintroduce vegetation (see mitigation measure B-O-02) as much as possible.

P-C-04: Mitigation measures aiming at reducing soil contamination:

- **P-O-04a:** carry out a detailed chemical characterization of the sludge, based on similar waste generated by other STP.
- **P-O-04b:** identify all disposal centers and recycling the most suitable sludge elimination/recovery process based on their chemical properties.
- **P-O-04c**: identify all disposal centers and recycling possibilities for each type of generated waste from WTP, STP, DCs).
- **P-O-04d:** carry out a detailed chemical characterization of the overflow water and assess its suitability for a reuse for irrigation or release into the environment.
- **P-O-04e:** define a Monitoring Management Plan for the sludge and the overflow water over the operation phase to regularly assess the quality of these effluents and compatibility with defined disposal /reuse solutions**.**
- **P-O-04f:** Elaborate and implement a Pollution Prevention and Control.
- **P-O-04g:** Elaborate and implement a Hazardous Material Management Plan.

- **P-O-04h:** Elaborate and implement an Emergency Preparedness and Response Plan.
- **P-O-04i:** Elaborate and implement a Waste Management Plan including recyclable, inert and hazardous waste management.
- **P-O-04j:** Elaborate and implement a Hazardous Substance Transport Management Plan.
- **P-O-04k:** Implement awareness training on the risks of contamination and the respect of good environmental practices by workers and site managers**.**

The impacts identified on land use and soil quality for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 114: Potential impacts on land use and soil quality during the operational phase

Impact	Site	Type of facilities	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
			Value	Intensity	Extend	Duration				
P-O-03 Change of land use	Lot 2	pipeline	Positive	low	Project site	Permanent	Minor	High	**Moderate**	**Negligeable**
P-O-04 Soil contamination	Lot 1, 8 and 10	Water abstraction and WTP	Negative	High	Regional	Permanent	High	High	**Major**	**Negligible**
	Lot 2	pipeline	NA	NA	NA	NA	NA	NA	**NA**	**NA**
	Lot 3	DC	Negative	Medium	Project site	Permanent	Moderate	Low	**Moderate**	**Negligible**
	Lot 4	DC	Negative	Medium	Project site	Permanent	Moderate	Low	**Moderate**	**Negligible**
	Lot 5	DC	Negative	Medium	Project site	Permanent	Moderate	Low	**Moderate**	**Negligible**
	Lot 6	DC	Negative	Medium	Project site	Permanent	Moderate	Low	**Moderate**	**Negligible**
	Lot 7	DC	Negative	Medium	Project site	Permanent	Moderate	Low	**Moderate**	**Negligible**
	Lot 9	DC	Negative	Medium	Project site	Permanent	Moderate	Low	**Moderate**	**Negligible**

8.1.4 Hydrology

Hydrology refer to the potential impact of the water abstraction over the Kwanza River flowrate and water resource.

8.1.4.1 Impact sources

The impact sources on hydrology resulting from the project activities are the following:

- **Operation phase**
  - River water abstraction.

8.1.4.2 Impacts during the construction phase

No impact are foreseen during the construction phase since the water abstraction will start at the Water Abstraction facility commissioning.

8.1.4.3 Impacts during the operation phase

P-0-05: Decrease in water resources and drop of hydrometry

As described in the baseline section, the evaluation of the flowrate of the Kwanza at the Water Abstraction Facility (WAF) was carried out by reconstituting the hydrometric regime of the river from historical chronicles of the CAMBAMBE station which provides records before construction of the dams upstream of the WAF, and while considering a hydrometric regime unchanged since this period according to the data available over the last 4 decades.

This reconstruction allowed to estimate the average flowrate of the Kwanza at 719 m^3/s, with a QMNA of 218 m^3/s during periods of very low water.

The water abstraction rate at the WAF is expected to reach a maximum of 9 m^3/s when all three pumping lines will be operational. Based on estimated river flowrate at the WAF, it can therefore be considered that the 9m^3/s withdrawal rate planned as part of the project will represent :

- 0.6 % of the natural monthly average flow of April (rainy season) ;
- 1.25 % of the natural interannual modulus, generally encountered in May and December ;
- 3.6 % of the natural average minimum monthly flow, likely in October ;
- 4.1 % of the natural QMNA5, the low-water reference flow that correlates.

However, these estimates do not consider the influence of the dams located upstream of the WAF Figure 405. Since the hydrological monitoring studies presented and analyzed above, several hydroelectric dams have been built on the Kwanza River.

The following map shows the location of the Cambambe, Calculo Cabaca and Capanda dams, as well as the Zenzo project currently under development. Details of these dams are presented in Appendix N.

The operation of these hydroelectric power stations has a significant influence on the hydrological regime of the Kwanza River, due to the following factors:

- During their first years of operation, the filling of the reservoirs induces a drop in downstream flows ;
- During operation, evaporation and infiltration losses are generated by dam impoundments. These losses increase with reservoir level and surface area and are therefore subject to annual variations ;
- The hydropower plants have important equipment flows in comparation with the river's interannual modulus. The reservoirs associated to the power plants are then filled during high-water periods, when the river's natural flow is higher than their design flow (March-April) (leading to flow capping during this period) and deliver water in dry season to ensure electricity production even during low water periods. The electricity demand can lead to inter-day flow variations (lower flows when turbines are shut down and/or higher flows than seasonal norms if turbines are shut down during low-water periods).

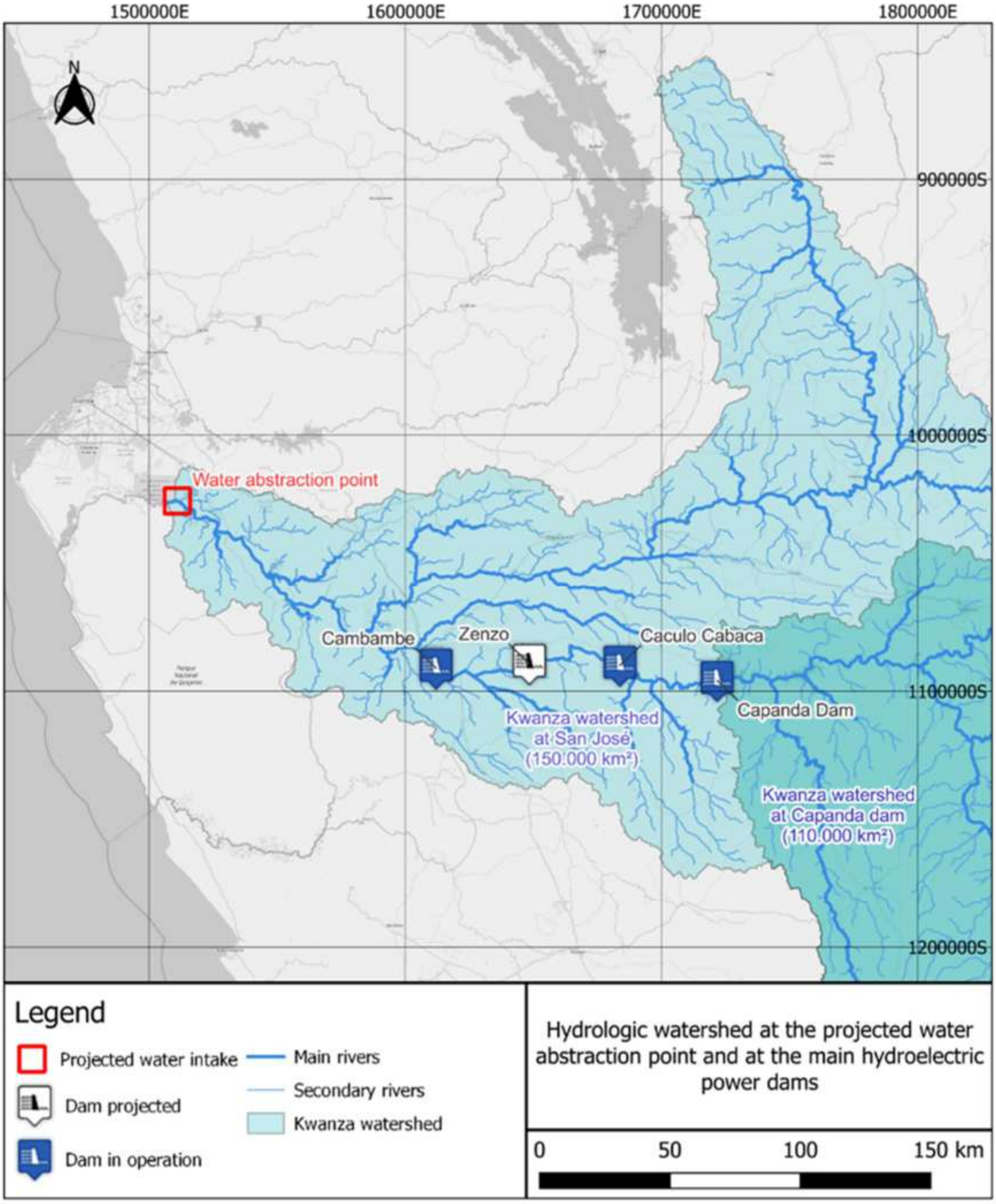


Figure 405: Hydrologic watershed at the WAF and at the main hydroelectric power dams

To date, there are no hydrometric stations for hydrological monitoring downstream of the 3 dams and the confluence of the Lucala, which constitutes a significant natural inflow.

However, a hydrological analysis carried out as part of the impact assessment for the Zenzo project provides information on the hydrological impact foreseen during the Zenzo power plant operation. This study integrates the impact of upstream reservoirs (Calculo Cabaca and Capanda) on the Kwanza River. This study was carried out before the construction of the Calculo dam and is therefore based on assumptions and projections. The Study provides however a hydrogram illustrating the influence of the impacts from the upstream dams.

Using the same methodology as for the reconstitution of natural hydrology at the WAF (application of a coefficient reflecting the difference in drained surface area between the reference station and the site studied), The natural flow observed in the 1950s prior to dam construction was reconstituted at the Zenzo site.

The following graph shows a comparison between the natural hydrology observed at the Zenzo site before dam construction, and the hydrological modelling presenting the expected influence of the upstream dams Figure 406.

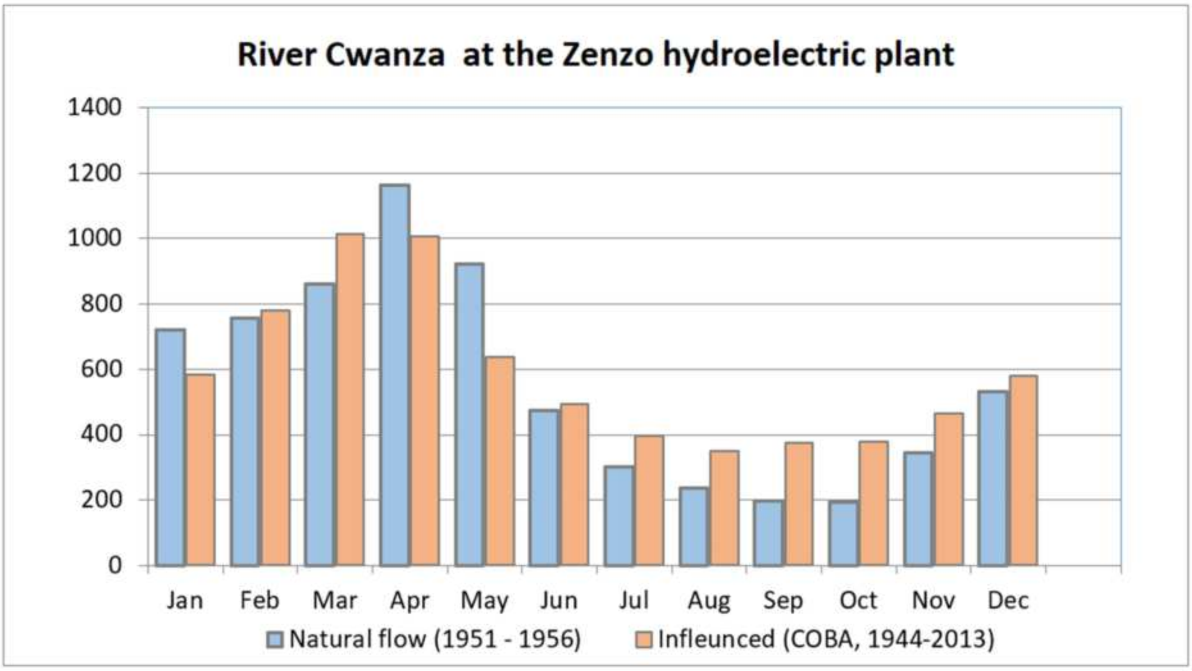


Figure 406: Comparative of the natural and influenced monthly flows at the Zenzo hydroelectric power plant

The diagram shows that the expected annual distribution varies significantly illustrating the impact of the upstream dams detailed previously, with a lower maximum flow-rate during high-water periods due to water storage into the dam, and higher low-water flowrates due to the release of stored water in the reservoirs for power production

Assuming that the Cambamba dam, located downstream of the dams, operates in a similar way to the upstream hydropower plants, the flowrate at the WAF can be considered as equal to the sum of the following flowrates:

- Artificial flowrate at Zenzo power station (Zenzo ESIA) ;
- Natural flowrates of downstream Kwanza tributaries.

It can therefore be considered that the 9m^3/s withdrawal rate planned as part of the project will represent :

- 0.6 % of the natural monthly average flow of April (rainy season) ;
- 1.16 % of the natural interannual modulus, generally encountered in May and December ;
- 2.07 % of the natural average minimum monthly flow, generally encountered in October.

During the Operation phase, the negative impact resulting from the water abstraction for producing drinking water is expected to be of negligible intensity (maximum 2 %) and project site due to its limited impact on the overall water flowrate. This impact will be permanent because associated with the operation of Quilonga Project. The impact factor of this potential impact is considered **negligible**.

A **high** sensitivity given the importance of the river to the population as well as for the economic activities in the watershed. The combination of the impact factor and the sensitivity leads to a **negligible negative impact value**.

Mitigation measures

No specific mitigation measures are recommended because the impact of the Water abstraction on the global Kwanza flowrate is considered as negligible.

P-O-05: It is however recommended to set up and implement a hydrometric monitoring program during the first years of the full rate water abstraction, through targeted gauging campaigns and automatic water level recording, to establish the rating curve of the Kwanza River at the WAF and assess the flowrate variations over the seasons and confirm the estimated water abstraction rate on the Kwanza River.

8.1.5 Surface and groundwater water quality

Water quality refers to water chemical characteristics of the Kwanza River and groundwater.

8.1.5.1 Impact sources

The impact sources on water quality are the following :

  - Site preparation (earthworks, vegetation clearance etc) ;
  - Presence and use of heavy machinery and construction equipment ;
  - Truck and vehicle road traffic Influx / presence of workers ;
  - Generation of solid waste (domestic and construction) ;
  - Generation of liquid waste (domestic and construction) ;
  - Storage, use and disposal of fuel or hazardous products ;
  - Energy consumption and supply.
- **Operation phase**
  - Generation of solid waste (domestic and construction) ;
  - Generation of liquid waste (domestic and industrial) ;
  - Storage, use and disposal of fuel or hazardous products.

8.1.5.2 Impacts during the construction phase

The identified impacts on the water quality during the construction phase are the following:

P-C-08: Contamination of surface water

Throughout the construction period of each of the Lots, solid and liquid waste will be generated, both by the construction activities (packaging, formwork, use of environmentally hazardous products), by the construction machinery (for instance for Lot 2, muddy wastewater produced during pipe-jacking construction, oily washing wastewater produced by construction machinery and concrete mixing, system washing wastewater, and wastewater produced during pipeline pressure test etc), but also by the workforce operating on site and based in the vicinity of the workplaces (wastewater, household waste).

The negative impact of these possible contaminations on surface waters will be of low intensity and local due to the relatively limited the use of hazardous substances waste and only in case of improper discharge of those waste waters or in case of spills. Its duration may quickly become permanent in the event of a spill of non-degradable materials with surrounding soil impregnation or improper discharges of wastewater, and in case of poor spill response and contamination management. The impact factor of this potential impact is considered **moderate**.

A **high** sensitivity given the importance of the surface water to the population. The combination of the impact factor and the sensitivity leads to a **major negative impact value.**

P-C-09: Contamination of groundwater

During the construction phase, in case of spillage of toxic products, the potential impact on groundwater would be negative but of low intensity due to limited amount of chemical that will be used onsite for the construction. The extend will depend on presence and characteristics of the aquifer at the location of the Lot. Groundwater level in the AOI is generally found between 60 and 100 m depth, although on a local scale there are some suspended aquifers (related to the lithological heterogeneity of the Luanda Formation. The extend is considered local. Depending on the chemicals of concern and the position of the nearest aquifer (shallow or deep), this impact can be permanent. The impact factor of this potential impact is considered **moderate.**

Although the baseline did not allow identifying presence of active wells or drillholes used for domestic or industrial water consumption, it is expected that such undeclared equipment exist among the urban fabric and therefore may constitute a **high** sensitivity in case of nearby groundwater contamination. The combination of the impact factor and the sensitivity leads to a **major negative impact value.**

Mitigation measures

P-C-08: Mitigation measures aiming at reducing surface water contamination

All mitigation measures recommended for preventing soil contamination (P-C-05) are applicable for preventing surface and groundwater contamination (see section 8.1.4.2).

PC-08a. (Lot 1-WAF): conduct additional water sampling and analysis of Kwanza River, upstream and downstream the WAF, prior to construction (see list of parameters in Section 7.1.5 baseline surface water quality)

P-C-09: Mitigation measures aiming at reducing groundwater contamination

All mitigation measures recommended for preventing soil contamination (P-C-05) are applicable for preventing surface and groundwater contamination (see section 8.1.4.2).

- **P-C-09**: Conduct groundwater sampling in areas of shallow groundwater

The impacts identified on surface water and groundwater quality for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 115: Potential impacts on surface water and groundwater quality during the construction phase

Impact	Site	Type of facilities	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
			Value	Intensity	Extend	Duration				
P-C-08 Surface Water	All Lots		Negative	Low	Local	Permanent	Moderate	High	**Major**	**Negligible**

contamination	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
P-C-09 Groundwater contamination	All Lots		Negative	Low	Local	Permanent	Moderate	High	**Major**	**Negligible**
	Lot 4, 5, 9	DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							

8.1.5.3 Impacts during the operation phase

The identified impacts on the water quality during the operation phase are the following:

P-O-06: Contamination of surface water

Analytical results of the water sampled into the Kwanza River revealed concentrations above reference criteria for the following parameters: biochemical oxygen demand (BOD_5), zinc (Zn), iron (Fe); total and fecal coliforms. Compared to previous sampling performed during the ESIA baseline of 2014, these recent analytical results confirm a notable and constant microbiological contamination of the Kwanza River.

The sources and risks of surface water contamination during the operation phase is similar to sources and risks of soil contamination and described in section 8.1.4.3. Any soil contamination can induce a surfaced water contamination through runoff water and reach any water body downstream.

In addition, the connection to the incoming water supply network if the connected neighborhoods are not equipped with proper sewage networks and the households with adequate sanitation system, may notably increase the volume of both running and stagnant liquid waste contributing to increased soil and surface water contamination and associated public health concerns. In this case, the access to water in conjunction with a lack of sewage water network and sanitation system likely represents the main risk of soil and water contamination. The average number of connections to a septic tank is 34.4 % in the project area, under the provincial average. The Households with sanitary outside the home present an average of 67 % in the study area.

As such, the intensity of the contamination should be considered as high, mainly because of the risk of lack of adequate sanitation facilities inside the households. The extend is expected to spread over the entire area supplied by water (regional). The impact is expected to be permanent as long as the water supply is operational. The resulting impact factor is considered as **major**.

A **high** sensitivity given the importance of the surface water to the population and the potential contact with wastewater. The combination of the impact factor and the sensitivity may lead to a **major negative impact value**.

P-O-07: Contamination of groundwater

During the operation phase, in case of spillage of toxic products, the potential impact on groundwater would be negative and potentially of high intensity considering the large amount and constant use over time of chemicals at specific facilities such as the WTP, the STP and in a lesser degree at the DCs. The extend will depend on presence and characteristics of the aquifer at the location of the Lot. Groundwater level in the AOI is generally found between 60 and 100 m depth, although on a local scale there are some suspended aquifers (related to the lithological heterogeneity of the Luanda Formation. The extend is considered local. Depending on the chemicals of concern and the position of the nearest aquifer (shallow or deep), this impact can be permanent. The impact factor of this potential impact is considered **major**.

Although the baseline did not allow identifying presence of active wells or drillholes used for domestic or industrial water consumption, it is expected that such undeclared equipment exist among the urban fabric and therefore may constitute a **high** sensitivity in case of nearby groundwater contamination. The combination of the impact factor and the sensitivity leads to a **major negative impact value**.

Mitigation measures

The mitigation measure for preventing any water contamination are similar to the measures recommended for preventing any soil contamination (see section 8.1.4.3). In addition, the following measure should be engaged to avoid soil, water contamination and sanitary issues due to connecting households to water supply:

P-O-06: Mitigation measures aiming at reducing surface water contamination

- **P-O-06:** A program shall be urgently engaged by the Angolian Authorities to generalize the installation of sewage and sanitation systems in the neighborhoods supplied by potable water.

P-O-07: Mitigation measures aiming at reducing groundwater contamination

- See mitigation measure recommended to prevent soil contamination (P-O-04) and surface water contamination (P-O-06).

The impacts identified on surface water and groundwater quality for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 116: Potential impacts on surface water and groundwater quality during the operation phase

Impacts	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
P-O-06: Surface Water contamination	All Lots	Negative	High	Regional	Permanent	Major	High	Major	Minor
P-O-07: Groundwater contamination	All Lots	Negative	High	Local	Permanent	Major	High	Major	Minor

8.2 Biological components

The impacts on the biological components are assessed across the Project area of influence (AoI) for the two phases of the Project: the construction phase, corresponding to the construction of the Project facilities and infrastructures, and the operation phase, corresponding to operation of the water abstraction and treatment plant, sludge treatment plant and network pipelines and distribution centers. This AoI corresponds to a 500 m buffer around the Project footprint and is defined as the area in which the Project might have some direct or indirect impacts on the surrounding environment.

The biological sub-components retained for this assessment are : terrestrial fauna and habitats, and freshwater fauna and habitats. The interrelation linkages between the Project activities and the biological sub-components are summarized in Table 104.

The several Lots of the Project have been considered and assessed separately as they are not in the same development status. Their number, name and status are provided in the Table 117 below.

Table 117: Development status of each Lot

Lots	Name	Construction status	Associated habitats
1-WTP 10, 8	Water treatment Plant Sludge Treatment Plant Quilonga Grande Distribution Center	Not started	Dry Adansonia woodland Dry shrubland
1-WAF[(a)]	Water Abstraction Facility	Not started	Dry Adansonia woodland Floodplain Kwanza River
2	Network for transportation drinking water to DC	Not started	Dry Adansonia woodland Dry shrubland Floodplain Kwanza River Urban
3	Cacuaco Distribution Center	Not started	Urban
4	Zango 5 Distribution Center	Construction nearly completed (90 %)	Urban
5	New airport Distribution Center	Construction nearly completed (79 %)	Dry shrubland Urban
6	Km 30 Distribution Center	Vegetation cleared	Urban
7	Kapalanga Distribution Center	Vegetation cleared	Urban
9	PIV Distribution Center	Construction nearly completed (97 %)	Urban

(a) The water abstraction facility (WAF) is part of the Lot 1 but is sometimes treated separately to highlight the differences of the impact between the water treatment plant (WTP) and the WAF.

The Project will be constructed within the different identified Lots, which present different land covers; some have already been nearly constructed and therefore will only be considered during the operation phase (Lots 4, 5, 9), some lots have already been cleared and only present bare ground (Lots 6 and 7), and some lots are still covered by vegetation (Lots 1, 8, 10, 2, 3 and Lot 1- Water abstraction, which is on the abstraction zone). Most of the baseline field surveys have been performed focused on the vegetated lots and along the pipeline (Lot 2) within a 500 m buffer area (in the AoI).

According to the 2023 baseline field survey, the Project AoI is occupied by both natural (2,382 ha) and modified habitats (7,104 ha). The Project AoI being mainly in an urban area, 75 % of its habitats have been identified as modified. Modified habitats include small-scale farming, ruderal areas, artificialized and built-up areas. Among the natural habitats, four different habitat types have been identified:

- Dry Adansonia woodland, corresponds to a dry savannah dominated by trees with mainly baobabs (*Adansonia digitata*) classified as Vulnerable (VU) in the Angolan Species Red List and covers 1.088 ha (11 %) of the total Project AoI. The degree of degradation ranges between low to medium, and is due to agriculture, grazing, cutting, and burning, and invasive alien species. Considering this, this habitat is assessed to have a **high sensitivity value**.
- Dry shrubland, corresponds to a dry savannah dominated by shrub plants, and covers 1.257 ha (13 %) of the total Project AoI. The level of degradation ranges between low to medium, and is due to agriculture, grazing, periodical human-induced fires, and invasive alien species. Considering this, this habitat is assessed to have a **medium sensitivity value**.

- Floodplain, corresponds to a grassland located in proximity to the dry banks of Kwanza River, also covering part of the humid area, and covers 19 ha (<1 %) of the total Project AoI. The dry banks of the river are dominated by trees, and the grassland in direct contact with the river (palustrine meadow) are made up of an extensive strip of grasses typical of wet areas. The degree of degradation is low, and is mainly due to invasive alien species, but also cutting and burning, and wastewater spills from a beverage factory located upstream. Considering this, this habitat is assessed to have a **medium sensitivity value**.
- Kwanza River, corresponds to the watercourse of the Kwanza River and its banks, in the range corresponding to the land/water interface, therefore covering the submerged and emerging banks, and covers 18 ha (<1 %) of the total Project AoI. The wetland areas, whose extent varies depending on the characteristics of the margin, are covered by floodplain grasslands and small marshy areas. Considering this, this habitat is assessed to have a **medium sensitivity value**.

8.2.1 Terrestrial fauna and habitats

The assessment of the project's impact on the terrestrial fauna and habitats identifies the potential impacts on the terrestrial fauna, flora, and their suitable habitats in the Project AoI during the project's construction and operation phases.

Given the associated habitat type of each Lot and its level of anthropogenic degradation, the terrestrial fauna and habitats sensitivity of each Lot has been assessed in Table 118.

Table 118: Terrestrial fauna and habitats sensitivity assessment in each Lot

Lots	Associated habitats	Degree of anthropogenic degradation[a]	Sensitivity
1-WTP, 8, 10	Dry Adansonia woodland Dry shrubland	High	**Medium**
1-WAF	Dry Adansonia woodland Floodplain Kwanza River	Medium	**Medium**
2	Dry Adansonia woodland Dry shrubland Floodplain Kwanza River Urban	Medium	**Medium**
3	Urban	High	**Low**
4	Urban	High	**Low**
5	Dry shrubland Urban	High	**Low**
6	Urban	High	**Low**
7	Urban	High	**Low**
9	Urban	High	**Low**

[a] From Saioz on-site observations during the 2023 flora surveys.

8.2.1.1 Impact sources

The impact sources on terrestrial fauna and habitats resulting from the project activities are the following:

- **Construction phase**
  - Site preparation ;
  - Land acquisition ;
  - Presence and use of heavy machinery and construction equipment ;
  - Truck and vehicle road traffic and associated ;
  - Generation of solid waste ;
  - Generation of liquid waste ;
  - Storage, use and disposal of fuel or hazardous products.
- **Operation phase**
  - Vehicle road traffic ;
  - Generation of solid ;
  - Generation of liquid waste ;
  - Storage, use and disposal of fuel or hazardous products.

8.2.1.2 Impacts during the construction phase

As the construction of Lots 4, 5 and 9 is almost completed, they were not considered in the impact assessment during the construction phase.

Impact assessment

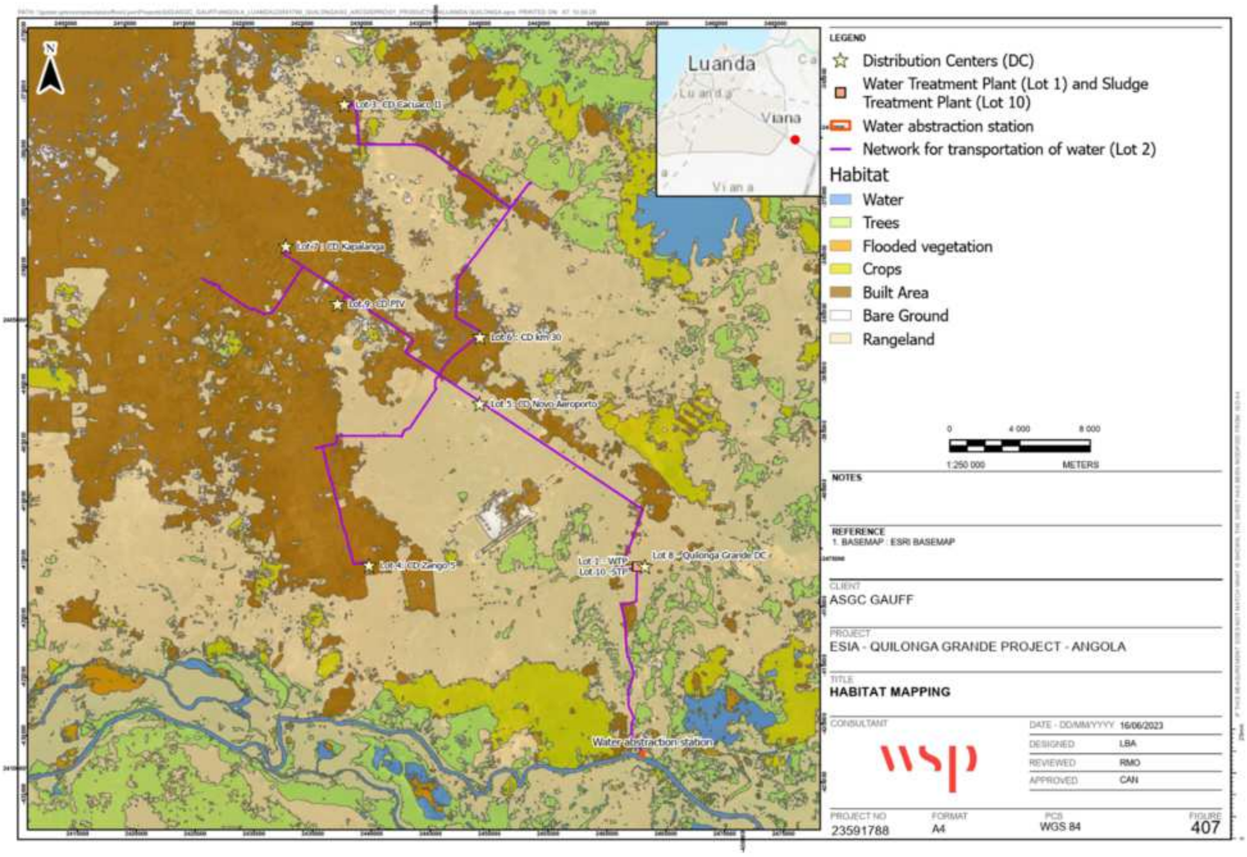
The impacts identified on terrestrial fauna and habitats during the construction phase are the following:

B-C-01: Terrestrial habitats loss

The construction phase will result in construction areas covering a total of 60 km², and will result in habitat modifications due to earthworks, and facilities and infrastructure constructions. During this phase, the Lots with a vegetation cover will need to be cleared before the start of earthworks. All vegetation will be cleared on the Project sites, and ground will be levelled in areas where infrastructure and facilities will be installed. The vegetation clearance will result in a vegetation loss that will negatively impact the Lots 1-WTP & WAF, 8, 10, 2, 3 with an existing vegetation cover, with various intensity depending on the degree of anthropic degradation (Figure 407).

The loss of habitats will result for the fauna in a loss of resources (such as breading areas, nesting areas, food supply areas, corridors, or transit areas) and can lead to a decrease in reproduction efficiency. This loss of terrestrial habitats in the Project footprint might potentially impact the endemic species populations, however, considering the nature of the Project and its location, it is not expected to result in a major adverse impact on endemic species populations at regional or national scale.

Figure 407: Habitat mapping



The habitat loss surfaces during the construction phase will correspond to the temporary footprint of the Project and have been calculated based on the habitat surfaces in the AoI and the temporary Project footprint (Table 119). This will result in a loss of 51.54 ha of modified habitats, representing less than 1 % of the total surface of modified habitats in the AoI, and a loss of 18.65 ha of natural habitats, representing less than 1 % of the total surface of natural habitats in the AoI. The three quarters of the overall Project temporary footprint is located in modified habitats. However, among natural habitat losses, the main habitats impacted are the floodplain which will lose 10 % of its total surface in the AoI, and then the Dry shrubland which will lost 1.2 % of its total surface in the AoI. All other habitats will lose less than 1 % of their surface in the AoI.

Regarding Lot 2, it should be noted the pipeline will be constructed section by section, and not the whole 100 km of pipeline footprint will be cleared and opened at the same time during the construction phase (planned to last approximately 2 years).

Table 119: Loss of terrestrial habitat during the construction phase (temporary footprint)

		Habitats in the Area of Influence (500 m buffer)		B-C-01: Terrestrial habitats loss		
		Surface (Ha)	Percentage of each habitat in the AoI (%)	Surface of the temporary Project footprint (construction phase) (Ha)	Percentage of the Project footprint covering each habitat (%)	Percentage of loss of each habitat in the AoI (%)
Modified habitats	Artificialized built up	4,858.04	50.50 %	45.89	65.38 %	0.94 %
	Ruderal	1,509.58	15.69 %	5.13	7.31 %	0.34 %
	Small scale farming	876.08	9.11 %	0.53	0.75 %	0.06 %
Natural habitats	Dry Adansonia woodland	1,040.17	10.81 %	1.14	1.63 %	0.11 %
	Dry shrubland	1,300.14	13.52 %	15.60	22.23 %	1.20 %
	Floodplain	17.34	0.18 %	1.74	2.48 %	10.04 %
	Kwanza River	18.24	0.19 %	0.16	0.23 %	0.89 %
TOTAL	Habitat patches sum	9,619.59	100.00 %	70.19	100.00 %	0.73 %
Modified habitats		**7,243.70**	75.30 %	**51.54**	73.43 %	**0.71 %**
Natural habitats		**2,375.88**	24.70 %	**18.65**	26.57 %	**0.78 %**

This will result in a potential negative impact with a medium intensity for Lots 1-WTP & WAF, 8, 10, 2 which contain natural habitats and a negligible intensity for Lots 3, 6, 7 which are already in urban areas. Impacts are expected to be contained into the construction areas in the project-sites and to be permanent for every Lots except for Lot 2 on which the impact will be only temporary as the pipeline will be buried and no facilities or infrastructure will remain after the end of the construction phase. The impact factor is then considered as **moderate** for Lots 1-WTP & WAF, 8, 10, **negligible** for Lots 3, 6 and 7, and **minor** for Lot 2.

B-C-02: Terrestrial habitats degradation

The construction works will generate earthworks, traffic of heavy machines and vehicles, stamping, soil removal and storage, heavy or hazardous material storage. Heavy vehicles traffic and rolling are likely to result in noise and dust emissions that will sediment on soil and leaves, degrading the habitats quality in the vicinity of the construction sites. Liquid or solid wastes and hazardous materials will be generated by the construction works (soil, chemicals, oils), and may contain pollutants or substances harmful to the environment; their use or storage could lead to accidental spills and leakage, which could result in environment pollution and have repercussions on the terrestrial habitat quality. Fugitive dust emissions during construction may directly impact plant receptors (e.g. smothering plants) resulting on degradation of natural habitats The presence of heavy machines in construction areas will induce the need of refueling, and then might generate accidental oil spills, resulting in a pollution of the nearby habitats. Also, the increase in noise, night light, vibration, smells, and human presence will decrease habitat quality and suitability for the local fauna or affect their reproduction.

It should be noted that the habitat degradation from vegetation clearing, soil removal, earthworks and ground levelling might negatively impact the protected trees like baobabs (*Adansonia digitata*), if located in proximity of the project footprint, in the event of physical damages from heavy vehicles moving or earthworks to their trunks and roots. Baoba is included in the LVA (Lista Vermelha de espécies de Angola - Angolan Species Red List) in the Vulnerable (VU) category That species dominates the vegetation on the Dry Adansonia Woodland and Floodplain Grassland. but Scattered individuals are also observed in Dry Shrubland. Those habitats are particularly present in the Lots 1,8 and 10 but also in south sections of Lot 2.

The surfaces of habitats potentially impacted and degraded by the Project construction activities have been calculated inside the AoI based on two impacts radius: a 100 m impact radius and a 300 m impact radius (Table 120). In the 100 m buffer, 22 % of the total surface of modified habitats and 20 % of the total surface of natural habitats will be potentially degraded by the indirect impacts of the Project. In the 300 m buffer, 63 % of the total surface of modified habitats and 61 % of the total surface of natural habitats will be potentially perturbated by the indirect impacts of the Project.

Table 120: Degradation of terrestrial habitat during the construction phase (temporary footprint)

		Habitats in the Area of Influence (500 m buffer)		B-C-02: Habitats degradation			
				100 m buffer around the Project footprint		300 m buffer around the Project footprint	
		Surface (Ha)	Percentage of each habitat in the AoI (%)	Surface of habitat impacted (Ha)	Percentage of each habitat in the AoI (%)	Surface of habitat impacted (Ha)	Percentage of each habitat in the AoI (%)
Modified habitats	Artificialized built up	4,858.04	50.50 %	1,135.74	23.38 %	3,113.43	64.09 %
	Ruderal	1,509.58	15.69 %	281.03	18.62 %	896.98	59.42 %
	Small scale farming	876.08	9.11 %	172.72	19.72 %	543.53	62.04 %
Natural habitats	Dry Adansonia woodland	1,040.17	10.81 %	208.12	20.01 %	659.38	63.39 %
	Dry shrubland	1,300.14	13.52 %	257.80	19.83 %	772.76	59.44 %
	Floodplain	17.34	0.18 %	4.68	26.97 %	11.41	65.81 %
	Kwanza River	18.24	0.19 %	3.17	17.35 %	14.54	79.68 %
TOTAL	Habitat patches sum	9,619.59	100.00 %	2,063.26	21.45 %	6,012.03	62.50 %
Modified habitats		**7,243.70**	75.30 %	**1,589.50**	21.94 %	**4,553.94**	**62.87 %**
Natural habitats		**2,375.88**	24.70 %	**473.77**	19.94 %	**1,458.09**	**61.37 %**

The potential negative impact is expected to be located near the project-site and to be of low intensity for Lots 1-WTP & WAF, 8, 10, 2 and negligible intensity for Lots 3, 6, 7, depending on the site location in a natural or urban area, and the disturbance will be of temporary duration. The impact factor is then considered as **minor** for Lots 1-WTP & WAF, 8, 10, 2 and **negligible** for Lots 3, 6 and 7.

B-C-03: Terrestrial habitats fragmentation

The construction activities might result in a habitat fragmentation for terrestrial fauna and flora. As terrestrial flora mainly spread through wind dispersion, and considering the scale of the Project footprint, it is not considered as a barrier to vegetation dispersion and is unlikely to result in a fragmentation of terrestrial flora communities. However, the construction of linear infrastructures like roads and the pipeline might result in habitat fragmentation and a potential reduction of connectivity for the terrestrial fauna.

This will result in a potential negative impact with a low intensity for Lots 1-WTP & WAF, 8, 10, 2 and negligible intensity for Lots 3, 6, 7. Impacts will be of project-site extend because only related to the construction sites areas, and of temporary duration as it will last during construction works. The impact factor is then considered as **minor** for Lots 1-WTP & WAF, 8, 10, 2 and **negligible** for Lots 3, 6 and 7.

B-C-04: Invasive species' introduction

18 exotic species were potentially present in the AoI, especially in or near the Lots1,8 and 10 and in sections of the Lot 2. Construction works could facilitate the dispersion of them. The vegetation could be degraded by the introduction or dispersion of alien invasive species through the movement of soil containing invasive species seeds in the trucks' wheels. Also, a degraded vegetation could enhance the propagation of alien invasive species. Moreover, trucks wheels might introduce invasive alien species by bringing contaminated soil on-site; invasive ants for example might cause a rapid and sensible change in vegetation and in insect composition of the sites.

This will result in a potential negative impact with a medium intensity for Lots 1-WTP & WAF, 8, 10, 2 and negligible intensity for Lots 3, 6, 7. Impacts will be of local extend, and of permanent duration as it may last after the construction works. The impact factor is then considered as **moderate** for Lots 1-WTP & WAF, 8, 10, 2 and **minor** for Lots 3, 6 and 7.

B-C-05: Terrestrial fauna mortality

The construction phase will bring an increase in heavy machinery, trucks and vehicles road traffic that call lead to terrestrial animal collisions and result in a fauna mortality increase due to the Project. Nevertheless, as the main species richness is composed by bird species, this cause of mortality is not expected to represent an impact on endemic or protected species. However, accidental leakages or spills from hazardous chemicals, hazardous wastes or oils might cause in fauna poisoning and result in fauna mortality.

This will result in a potential negative impact with a medium intensity for Lots 1-WTP & WAF, 8, 10, 2 and negligible intensity for Lots 3, 6, 7. Impacts will be temporary and limited to the project-site. The impact factor is then considered as **minor** for Lots 1-WTP & WAF, 8, 10, 2 and **negligible** for Lots 3, 6 and 7.

B-C-06: Terrestrial habitats rehabilitation

At the end of the construction phase, the water pipeline (Lot 2) will be buried, and no Project-related facilities or infrastructures are expected to remain in this Lot 2. Then, were Lot 2 crosses natural habitats, the vegetation destroyed during the construction phase will progressively recolonize the available areas located in natural habitats and will improve connectivity between habitats in the Project AoI. Then, the permanent footprint of the Project in operation phase will be smaller than the temporary Project footprint during the construction phase. The likelihood of natural revegetation success following the construction works is highly uncertain and would involve important time lags for the re-establishment of vegetation associated with some natural habitats. Targeted revegetation efforts will be needed to enhance the natural re-establishment of vegetation. However, revegetation should respect the permanent easement which will require no deep-rooted plants within 3 to 6 meters from the pipeline implantation. Revegetation is assessed as a positive impact for Lot 2 (pipelines).

For Lot 2, this will result in a potential positive impact with a low intensity, of project-site extend because Lot 2 crosses the whole Project AoI across 100 km, and of permanent duration as the habitat won't be disturbed after the pipeline installation is over. The impact factor is then considered as **minor positive** for Lot 2.

In all other Lots (1-WTP & WAF, 3, 4, 5, 6, 7, 8, 9, 10) where facilities will remain during the operation phase, the available area for rehabilitation will be negligible and will then result in a potential positive impact with a negligible intensity, of project-site extend because only related to the facilities in each Lot, and of permanent duration as no earthworks will be performed in these areas after the end of the construction phase. The impact factor is then considered as **negligible positive** for Lots 1-WTP & WAF, 3, 4, 5, 6, 7, 8, 9, 10.

Mitigation measures

The ESMP will have to include measures to mitigate the impacts on terrestrial fauna and habitats.

B-C-01: Measures to mitigate the terrestrial habitats loss:

- **B-C-01a**: Develop and implement a **Vegetation Clearing Plan** for the Lots containing patches of natural habitats. The plan should include at least the measures below:
- **B-C-01b**: Make a preclearance census of endemic trees and every *Adansonia digitata* individuals inside the footprint of the Project facilities, and along the pipeline footprint (Lot 2) crossing natural habitats.
- **B-C-01c**: Integrate trees in the design and infrastructure / facilities layout to avoid their removal as much as possible, especially endemic trees and *Adansonia digitata.* When avoidance is not possible, plant the same species in a similar habitat as close as possible to the footprint of the project.
- **B-C-01d**: Tree removal should follow the national legislation.
- **B-C-01e**: Perform a progressive clearance of vegetation to reduce the risk to slow moving fauna
- **B-C-01f**: Organize the translocation of slow-moving fauna and plants to a suitable receptor site.
- **B-C-01g**: To the maximum possible, retain active bird nests until the young have fledged.
- **B-C-01h**: Implementation of a monitoring program to ensure compliance with control measures during land clearance and earthworks, and supervision of the works by a dedicated wildlife spotter.

B-C-02: Measures to mitigate the terrestrial habitats degradation:

- **B-C-02a**: As far as possible, site areas adjacent to natural habitats will be isolated from noise, dust and any human or mechanical intrusion.
- **B-C-02b**: As far as possible, leave / encourage / introduce vegetation around the site areas to create a visual screen and absorb some of the dust.
- **B-C-02c**: Periodically and regularly raise employee awareness of good environmental practice and the challenges of conserving biodiversity in the broadest sense.
- **B-C-02d**: Develop and implement a **Tree Protection Procedure** that should be appended to the Biodiversity Management Plan for the Lots containing patches of natural habitats to protected sensitive trees, including baobabs. The plan should include at least the measures below:
- **B-C-02e**: With a botanical expert, define and materialize a buffer around each endemic species or *Adansonia digitata* individuals located less than 100 m from a construction to avoid any degradation by heavy machineries through roots compaction, accidental damages.

- **B-C-02f**: With a botanical expert, define and materialize a buffer around each endemic species or *Adansonia digitata* individuals where earthworks can't be carried out in order to avoid any impact on their roots.

B-C-03: Measures to mitigate the terrestrial habitats fragmentation:

- **B-C-03a**: Limit the footprint of the access road from Lot 1-WAF to the sites with Lots 1-WTP, 8 and 10, and especially where the road crosses natural habitats, avoid constructing the road by splitting a patch of natural habitats, conform to the boundary between natural habitat and modified habitat (e.g. the boundary between a savannah and an agricultural field) to limit the net loss and fragmentation of natural habitats.
- **B-C-03b**: Install the water supply pipeline along the access road between Lot 1-WAF and the site with Lots 1, 8 and 10 to minimize the footprint and the habitat destruction.
- **B-C-03c**: For Lot 2 and temporary footprints: Strip the topsoil during the construction phase of the pipeline tranches and stoke it separately in appropriate conditions to be used during the rehabilitation.
- **B-C-03d**: For Lot 2 and temporary footprints: Land reshaping after closure of the pipeline tranches. Use topsoil stored separately before seeding the trenches during the rehabilitation.

B-C-04: Measures to mitigate the invasive species' introduction:

- **B-C-04a**: Conducted a detailed survey to confirm the presence of invasive and exotic species as well as pest within the area of influence of each Lot (or different segments of Lot 2). The survey should determine the species, locations, and their potential for spreading within the zone;
- **B-C-04b**: Develop and implement an **Invasive Species Management Plan** and split the management levels and responsibilities between Sinhydro's Lots 1 and 10, and the Consortium's Lots. The Consortium should consider how a combined plan with Sinohydro can be developed. The plan should include at least the measures below:
- **B-C-04c**: Prevent trucks from bringing alien invasive species like ants by verifying the trucks wheels do not carry soil when entering the construction work site.
- **B-C-04d**: Clean up the trucks wheels before they leave the construction work site to prevent the dispersion of alien invasive species like ants.

B-C-05: Measures to mitigate the fauna mortality:

- **B-C-05a**: Limit the traffic speed in roads crossing natural habitats to avoid the collision with slow moving terrestrial fauna.

B-C-06: Measures to enhance the habitat rehabilitation:

- **B-C-06a**: Develop and implement a **Rehabilitation Management Plan** for Lot 2 and temporary infrastructures. For the sections of Lot 2 near the Lots 1, 8 and 10 coordinate the plans and responsibilities between Sinhydro GAUFF/Casais Consortium's. The plan should include at least the measures below:
- **B-C-06b**: Actively seed at the beginning of the wet season to promote soil stabilization and progressive rehabilitation of natural habitats in accordance with the Rehabilitation Management Plan.
- **B-O-06c**: Plant regrowth will be monitored to ensure a return to the initial state of Lot 2.

Mitigation measures described in the Physical component aiming at reducing the impacts on noise, air quality land use and soil quality (P-C-01, P-C-02, P-C-03, P-C-04, P-C-05, P-C-06, P-C-07, P-C-08, P-C-09) will also mitigate the impacts on terrestrial fauna and habitats during the construction phase.

The impacts identified on terrestrial fauna and habitats for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 121: Potential impacts on terrestrial fauna and habitats during the construction phase

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impacts
		Value	Intensity	Extend	Duration				
B-C-01 Terrestrial habitats loss	Lot 1-WTP, 8, 10	Negative	Medium	Project site	Permanent	Moderate	Medium	**Moderate**	**Minor**
	Lot 1-WAF	Negative	Medium	Project site	Permanent	Moderate	Medium	**Moderate**	**Minor**
	Lot 2 Network	Negative	Medium	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Project site	Permanent	Negligible	Low	**Negligible**	**Negligible**
	Lot 4, 5, 9 DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
B-C-02 Terrestrial habitats degradation	Lot 1-WTP, 8, 10	Negative	Low	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 1-WAF	Negative	Low	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 2 Network	Negative	Low	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**
	Lot 4, 5, 9 DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
B-C-03: Terrestrial habitats fragmentation	Lot 1-WTP, 8, 10	Negative	Low	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 1-WAF	Negative	Low	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 2 Network	Negative	Low	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**
	Lot 4, 5, 9 DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
B-C-04: Invasive species introduction	Lot 1-WTP, 8, 10	Negative	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Negligible**
	Lot 1-WAF	Negative	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Negligible**
	Lot 2 Network	Negative	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Local	Permanent	Minor	Low	**Minor**	**Negligible**
	Lot 4, 5, 9 DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
B-C-05: Fauna mortality	Lot 1-WTP, 8, 10	Negative	Medium	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 1-WAF	Negative	Medium	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impacts
		Value	Intensity	Extend	Duration				
	Lot 2 Network	Negative	Medium	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**
	Lot 4, 5, 9 DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							
B-C-06: Habitats rehabilitation	Lot 1-WTP, 8, 10	Positive	Negligible	Project site	Permanent	Negligible	Medium	**Negligible**	**Negligible**
	Lot 1-WAF	Positive	Negligible	Project site	Permanent	Negligible	Medium	**Negligible**	**Negligible**
	Lot 2 Network	Positive	Low	Project site	Permanent	Minor	Medium	**Minor**	**Moderate +**
	Lot 3, 6, 7 DC	Positive	Negligible	Project site	Permanent	Negligible	Low	**Negligible**	**Negligible**
	Lot 4, 5, 9 DC	*Not evaluated during the construction phase (construction nearly completed during elaboration of this ESIA)*							

8.2.1.3 Impacts during the operation phase

Once the lots have been built and the pipelines buried, few impacts on vegetation are expected during the operation phase. There is no additional impact of the sites (earthwork, construction) on terrestrial fauna and habitats. Once the sites are built, there is no further terrestrial habitat loss is expected.

B-O-01: Terrestrial habitats degradation

The potential disturbance may come from the presence of workers, the maintenance of facilities, and the accidental pollutions and the use of vehicles by employees during maintenance activities. This impact is a continuation of the construction phase impacts, in a smaller scale. The main differences between the two phases are about maintenance and accidental pollutions during sludge and water treatment operations for instance or with vehicles as the maintenance activities will be punctual during the operation phase. Considering the pipeline in Lot 2, the maintenance activities might request interventions on the network which could lead to vegetation degradation were Lot 2 is in natural habitats (see Figure 407).

This will result in a potential negative impact of low intensity for Lot 2 and negligible intensity for Lots 1-WTP & WAF, 3, 4, 5, 6, 7, 8, 9, 10, which is expected to remain near the project-site and to be temporary. The impact factor is then considered as **minor** for Lot 2 and **negligible** for Lots 1-WTP & WAF, 3, 4, 5, 6, 7, 8, 9, 10.

B-O-02: Terrestrial habitats fragmentation

The habitats will remain fragmented during the operational phase as the facilities in the Lots and the access road to the pumping station will remain present and in use and may discourage the movement of fauna across the Project footprint. Given the composition of species in the area, the presence of facilities, access road and buried pipeline is likely to have limited effects on wildlife movement. Considering that the water pipeline is planned to be buried, habitats in Lot 2 won't be fragmented.

This will result in a potential negative impact with a negligible intensity, of project-site extend because only related to the construction sites footprints, and of temporary duration. The impact factor is then considered as **negligible**.

B-O-03: Terrestrial fauna mortality

Fauna mortality could be due to pollutions from accidental spills of oil or chemicals, or to vehicle collisions resulting from the traffic of employees during maintenance activities. In both cases, this impact would be of negligible intensity, and of a very small scale.

This will result in a potential negative impact of negligible intensity, expected to remain near the project-site and to be temporary. The impact factor is then considered as **negligible**.

Mitigation measures

The ESMP will have to include measures to mitigate the impacts on terrestrial fauna and habitats.

B-O-01: Measures to mitigate the terrestrial habitats degradation:

- **B-O-01a**: Lighting should be kept to the minimum required, specifically targeting work areas in use. Consider the use of mobile, temporary lighting if the location of work areas shifts over time.
- **B-O-01b**: For areas not requiring full-time illumination, install motion sensor lights so that lights can turn on and off automatically based on need. These should be installed around administrative buildings and other facilities that do not typically require regular use during night-time hours.
- **B-O-01c**: Minimize light dispersion with the use of high efficiency and directional lighting (i.e., lights fitted with shields to direct lighting towards the ground and minimize sky glow).

B-O-02: Measures to mitigate the terrestrial habitats fragmentation:

- Mitigation measures identified to prevent terrestrial habitats fragmentation in construction phase, and terrestrial habitat degradation in operation phase will help in preventing habitats fragmentation during the operation phase.

B-O-03: Measures to mitigate the terrestrial fauna mortality:

- Mitigation measures identified to prevent terrestrial fauna mortality in construction phase will help in preventing habitats fragmentation during the operation phase.

Mitigation measures described in the Physical component aiming at reducing the impacts on noise, air quality land use and soil quality, surface water and groundwater quality (P-O-01, P-O-02, P-O-03, P-O-04, P-O-05, P-O-06) will also mitigate the impacts on terrestrial fauna and habitats during the operation phase.

The impacts identified on terrestrial fauna and habitats for the operation phase are summarized in the table below Table 122. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 122: Potential impacts on terrestrial fauna and habitats during the operation phase

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impacts
		Value	Intensity	Extend	Duration				
B-O-01: Terrestrial habitats degradation	Lot 1-WTP, 8, 10	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 1-WAF	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 2 Network	Negative	Low	Project site	Temporary	Minor	Medium	**Minor**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impacts
		Value	Intensity	Extend	Duration				
	Lot 4, 5, 9 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**
B-O-02: Terrestrial habitats fragmentation	Lot 1-WTP, 8, 10	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 1-WAF	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 2 Network	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**
	Lot 4, 5, 9 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**
B-O-03: Terrestrial fauna mortality of habitats	Lot 1-WTP, 8, 10	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 1-WAF	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 2 Network	Negative	Negligible	Project site	Temporary	Negligible	Medium	**Negligible**	**Negligible**
	Lot 3, 6, 7 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**
	Lot 4, 5, 9 DC	Negative	Negligible	Project site	Temporary	Negligible	Low	**Negligible**	**Negligible**

8.2.2 Freshwater fauna and habitats

This chapter assesses potential impacts on the aquatic fauna in the Kwanza River and its related habitat during the project's construction and operation phases. This impact will be assessed inside the AoI, at the Lot 1 location near the Kwanza River. Only Lot 1, corresponding to the water abstraction station, will be assessed regarding the impact on freshwater fauna.

According to the baseline, there is the presence of a significant set of freshwater micro-habitats. The areas of still waters with high vegetation cover, areas of abundant floating vegetation, as well as areas of shallow waters and sandy beds, providing breeding and nursery areas for fish and many other groups of fauna, including invertebrates. Also, the desktop studies and surveys on aquatic fauna reveal a very high ratio of endemic freshwater species potentially present in the area. Overall, the flooded grasslands and marginal habitats provide a diverse mosaic of aquatic habitat, supplying areas of refuge, feeding and reproduction/nursery for a variety of species. Based on the eDNA results and field observations, 32 species of fish have been recorded within the Study Area. Only one native fish species with a designation of Vulnerable was recorded to occur within the Study Area. The Madeiran Sardinella (*Sardinella maderensis*) is widespread, with its geographic range extending from Spain and Gibraltar and southward along coastal West Africa, from Morocco to at least Luanda. This is a pelagic, oceanodromous species that forms schools in coastal waters. It shoals at the surface or at the bottom down to at least 50 m. It is tolerant of fairly low salinity and juveniles sometimes enter estuaries.

Based on the overall diversity and extensive marginal habitats, the aquatic fauna and habitats have been classified as **high sensitive receptors**.

8.2.2.1 Impact sources

The impact sources on freshwater fauna and habitats resulting from the project activities, mainly Lot 1 – water abstraction, are the following:

- **Construction phase**
  - Site preparation ;
  - Presence and use of heavy machinery and construction equipment ;
  - Truck and vehicle road traffic and associated ;
    - Generation of solid waste ;
    - Generation of liquid waste ;
    - Storage, use and disposal of fuel or hazardous products.
- **Operation phase**
  - Vehicle road traffic ;
  - Generation of solid waste ;
  - Generation of liquid waste ;
  - River water abstraction ;
  - Storage, use and disposal of fuel or hazardous products.

8.2.2.2 Impacts during the construction phase

The impacts identified on freshwater fauna and habitat during the construction phase of the Lot 1 are the following:

B-C-07: Loss of freshwater fauna and habitat

At Lot 1, marginal vegetation will need to be cleared for the construction of the intake pump station and associated infrastructure. This will result in a loss of habitats near the Kwanza River. Moreover, the pumping station will need to be installed in the riverbed, which will result in construction works below the high-water mark, with a potential to disturb aquatic habitat.

As these habitats are directly used by aquatic biota, habitat destruction may have an impact on aquatic biodiversity. In addition, noise, and vibration as a result of construction activities and machinery my scare individuals away. It is assumed that these disturbances and modifications will be temporary and that species will return to the area once the construction activities cease.

This will result in a potential negative impact with a medium intensity. The effects will only be related to the activities in Lot 1 and therefore will not extend beyond the project-site. Disturbances will be temporary in duration as they will only last during the construction works. The impact factor is therefore considered as **minor**.

B-C-08: Degradation of freshwater fauna and habitat

The proximity of the pumping station construction site from the river will result in heavy machines and vehicles to be used near by the water stream, which may result in oil or chemical accidental spills. A release of a deleterious substance into the Kwanza River would degrade or alter the water quality such that it could directly or indirectly harm fish, fish habitat, or the use of fish by humans. A deleterious substance would include petroleum products, chemicals, sediments, and suspended solids. Any spill that may occur are expected to be small in nature and will be dealt with immediately. Moreover, earthworks and traffic nearby the river might cause soil instability, and the soil being not maintain by vegetation anymore might be eroded by traffic, wind, and rain. This might result in an increase of turbidity in the river water, and affect fish communities by decreasing water dissolved oxygen, but it also could affect aquatic habitats quality such as aquatic meadows, by increasing the amount of sedimented dust on these habitats. The turbidity could also affect the luminosity in the river for the fish and for the aquatic meadows; however, according to the baseline, the light penetrates to a maximum depth of 30 to 50 cm into water, then it is not considered that turbidity from the construction works will have a significant impact on the Kwanza River. Nevertheless, construction works will result in presence and storage of construction wastes that may also degrade the habitats near the river and in the river.

This will result in a potential negative impact with a medium intensity. The effects will only be related to the activities in Lot 1 and with appropriate erosion control measures and spill response plans, can be contained. Therefore, any deleterious substances can be contained and the impact would not extend beyond the project-site. Disturbances will be temporary in duration as they will be dealt with immediately. The impact factor is therefore considered as **minor**.

Mitigation measures

The ESMP will have to include measures to mitigate the impacts on freshwater fauna.

B-C-07: Measures to mitigate the loss of freshwater habitats:

- **B-C-07a**: Develop and implement a Vegetation Clearing and Rehabilitation Plan specifically for the Lot 1-WAF to avoid soil erosion and in riverbank erosion.
- **B-C-07b**: Limit the pumping station footprint in the river to the minimum possible.
- **B-C-07c**: Avoid or minimize the time of presence of heavy machines inside the watercourse.
- **B-C-07d**: Integration of a bank reinforcement system at the water abstraction area.
- **B-C-07e**: Prior to the start of clearing and earthworks, physically demarcate the peripheral areas to ensure that this buffer zone is preserved and to prevent any mechanical intrusion or accidental spillage of soil or landslides into watercourses.
- **B-C-07f**: Install silt curtains to provide isolation within river or screening barriers on land where surface water runoff may flow toward the river
- **B-C-07g**: Implementation of a monitoring program to ensure compliance with control measures during land clearance and earthworks.

B-C-08: Measures to mitigate the degradation of freshwater habitats:

- **B-C-08a**: Introduce landscaping measures during the construction of the water intake on the Kwanza River by replanting vegetation around the water intake to consolidate the riverbanks.

Mitigation measures described in the Physical component aiming at reducing the impacts on noise, air quality land use, soil quality, surface water and groundwater quality (P-C-01, P-C-02, P-C-03, P-C-04, P-C-05, P-C-06, P-C-07, P-C-08, P-C-09) will also mitigate the impacts on aquatic fauna and habitats during the construction phase.

The impacts identified on freshwater fauna for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 123: Potential impacts on freshwater fauna and habitats during the construction phase

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impacts
		Value	Intensity	Extend	Duration				
B-C-07: Loss of freshwater habitats	Lot 1-WAF	Negative	Low	Project site	Temporary	Minor	High	**Moderate**	**Minor**
B-C-08: Degradation of freshwater habitats	Lot 1-WAF	Negative	Low	Project site	Temporary	Minor	High	**Moderate**	**Minor**

8.2.2.3 Impacts during the operation phase

The impacts identified on aquatic habitat and fauna during the operation phase are the following:

B-O-04: Degradation of freshwater habitats

Freshwater habitats are important for a range of species at different life stages. An assessment of the discharge indicated that the project abstraction (9 m^3/s) will amount to approximately 0.6 % of the natural monthly average flow of April (rainy season), 1.16 % of the natural interannual modulus, generally encountered in May and December and 2.07 % of the natural average minimum monthly flow, generally encountered in October. According to section 7.1.4, the water pumping activities will have a negligible impact on the Kwanza River water flow, and then is not anticipated to have an impact on the fish community.

This will result in a potential <u>negative</u> impact on aquatic habitats with a <u>negligible</u> intensity, of <u>project-site</u> extend as it will concern the downstream part of the Kwanza River, and of <u>permanent</u> duration as the water abstraction will last during the whole operation phase. The impact factor is then considered as **minor**.

B-O-05: Mortality of freshwater fauna

The water abstraction at the pumping point might generate entrainment and impingement of fish, eggs, and larvae. Entrainment occurs when a fish is drawn into a water intake and cannot escape, while impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself. Fish that have been entrainment or impingement are likely to be damaged or killed, and therefore the intakes will need to be appropriately screeded.

The African Manatee (*Trichechus senegalensis*), included in the red list published by Executive Decree No. 252/18, of 13th of July and classified as Vulnerable (VU) according to the Global IUCN Status. In the 2014 ESIA it was assumed that there was a strong hypothesis of the Manatee ' occurrence in the lower Kwanza zone, as suggested in different bibliographic sources. In the present study, it was possible to confirm this hypothesis through indirect data, namely the reports of fishermen, who stated that there are sometimes accidental captures of manatees in fishing nets. The exact locations of the captures are not known, but they are not located within the AoI. There are strong gaps in information, including in the assessment promoted by IUCN, regarding the number of population numbers, as well as their distribution across the large rivers and estuaries of West Africa. In any case, despite the species using different habitats at different times of the year, it is known that there is a preference for shallow water areas, mangroves, and lagoons, migrating upstream during the rainy season, to use temporarily flooded areas. Therefore, in the region under study it is safe to assume that the species will mainly use the mangroves in the Kwanza estuary, downstream of the AoI for the aquatic components of the project and the lagoons upstream. The Project AoI will be used mainly as a passage corridor. As the project does not induce any physical barrier to the free movement of the species, impacts due to the project are unlikely. Furthermore, the AoI also does not have particular relevance for the conservation of that species.

This will result in a potential negative impact on aquatic fauna with a low intensity, of project-site extend as it will be felt only near the pumping point, and of permanent duration as the water abstraction will last during the whole operation phase. The impact factor is then considered as **minor**.

Mitigation measures

The ESMP will have to include measures to mitigate the impacts on freshwater fauna.

B-O-04: Measures to mitigate the degradation of freshwater habitats:

- **B-O-04a**: Develop and implement a monitoring program of freshwater habitats in the Kwanza River in low-water period enabling to confirm that modifications of the water flow will not compromise the ecological needs of the endemic freshwater species.
- **B-O-04b**: Properly use safe storage areas for the storage of hazardous products to prevent the consequences of any accidental spillage.

B-O-05: Measures to mitigate the mortality of freshwater fauna:

- **B-O-05a**: Install a screen over the water intake to prevent fish mortality caused by suction from the pump.
- **B-O-05b**: Implement a program to monitor the aquatic habitats of the Kwanza River during low-water periods to confirm that changes in water flow do not compromise the ecological needs of species of conservation concerns.

Mitigation measures described in the Physical component aiming at reducing the impacts on noise, air quality land use, soil quality, surface water and groundwater quality (P-O-01, P-O-02, P-O-03, P-O-04, P-O-05, P-O-06) will also mitigate the impacts on aquatic fauna and habitats during the operation phase.

The impacts identified on freshwater fauna for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 124: Potential impacts on freshwater fauna and habitats during the operation phase

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impacts
		Value	Intensity	Extend	Duration				
B-O-04: Degradation of freshwater habitat quality	Lot 1-WAF	Negative	Negligible	Project site	Permanent	Negligible	High	**Minor**	**Negligible**
B-O-05: Mortality of freshwater fauna	Lot 1-WAF	Negative	Low	Project site	Permanent	Minor	High	**Moderate**	**Minor**

8.2.3 Critical habitats

As per the baseline report, there are 6 species potentially present that could trigger a CH (Section 7.2.8). They were all identified according to the literature review, and none of them has been observed during the field surveys.

Table 125: Species triggering a CH

Taxon	Scientific name	Common name	IUCN Status	National/ Local IUCN Status*	End./ RR	Migratory Status	Lit./ Obs.	PCH/CH	IFC Criteria
Flora	*Pycnocoma dentata*	-	LC	NE	RR	-	**L**	PCH	2a
Amphibian	*Breviceps ombelanonga sp. Nov.*	-	NE	NE	RR	-	**L**	PCH	2a
	Phrynobatrachus brevipalmatus	-	DD	NE	RR	-	**L**	PCH	2a
Reptile	*Monopeltis luandae*	-	LC	NE	RR	-	**L**	PCH	2a
Mammal	*Trichechus senegalensis*	African Manatee	VU	Aex (EN)	-	Full Migrant	**L**	PCH	3a

Their ecology is described here below and has enabled us to link each species to its potential habitat.

Flora:

- ***Pycnocoma dentata*** is a shrub or tree species, growing primarily in the wet tropical biome. It can reach a maximum height of approximately 4 m, and the trunk branches from the base. It is found in dry *Adansonia digitata* savannah and in similar dry savannah lowland vegetation, including *Colophospermum mopane* savannah. During the performed field survey no individuals of this species were observed. The species was considered as potentially present in the AoI based on literature review. This species could be associated to Dry Adansonia woodland and Dry shrubland habitats.

Amphibians:

- ***Breviceps ombelanonga*** is an amphibian species, distributed from the typical western Angolan savannah, with sandy soils and vegetation dominated by *Adansonia digitata*, *Euphorbia conspicua*, *Acacia elwitschia* and *Combretum* sp., together with a considerable grass coverage, to dense Angolan wet miombo woodland in the east. During the performed field survey no individuals of this species were observed. The species was considered as potentially present in the AoI based on literature review. This species could be associated to Dry Adansonia woodland and Dry shrubland habitats.
- ***Phrynobatrachus brevipalmatus*** sp. Nov. is an amphibian species strongly connected to freshwater marshes and intermittent freshwater marshes. During the performed field survey no individuals of this species were observed. The species was considered as potentially present in the AoI based on literature review. This species could be associated to Floodplain and Kwanza River habitats.

Reptile:

- ***Monopeltis luandae*** is a burrowing reptile species. It can be found in deep Pleistocene red sandy soil in small farm plots (fruit trees) mixed with natural vegetation (*Euphorbia conspicua* and *Adansonia digitata* mainly) and near the banks of the Cuanza River. During the performed field survey no individuals of this species were observed. The species was considered as potentially present in the AoI based on literature review. This species could be associated to Dry Adansonia woodland, Dry shrubland and Floodplain habitats.

Mammal:

- ***Trichechus senegalensis*** is a freshwater mammal species whose distributional range occurs in West and Central Africa. This species is present in large and small rivers, coastal estuaries, freshwater and saltwater lagoons, shallow quiet coastal bays, lakes and reservoirs. Its ecological requirements are strongly connected to sheltered water with access to food and freshwater. Literature reports that molluscs and fishes represent approximately 10 % of the lifetime diet in Gabon, and 50 % of diet in both freshwater and marine systems in Senegal. Manatees are mostly solitary, with mothers and calves forming the principal social unit. They usually rest during the day in water that is 1–2 m in depth and sometimes in the middle of a watercourse or hidden in mangrove roots or under natant vegetation. During the performed field survey no individuals of this species were observed. The species was considered as potentially present in the AoI based on literature review. This species could be associated to Kwanza River habitats.

According to this habitat identification, the Lots where the species could potential be found are assessed in Table 126.

Table 126: Habitats and Lots with potential species triggering a CH

Taxon	Scientific name	Associated habitats	Potential Lots
Flora	*Pycnocoma dentata*	Dry Adansonia woodland Dry shrubland	1-WTP & WAF, 2, 5 8, 10
Amphibian	*Breviceps ombelanonga sp. Nov.*	Dry Adansonia woodland Dry shrubland	1-WTP & WAF, 2, 5 8, 10
	Phrynobatrachus brevipalmatus	Floodplain Kwanza River	1-WAF, 2
Reptile	*Monopeltis luandae*	Dry Adansonia woodland Dry shrubland Floodplain	1-WTP & WAF, 2, 5 8, 10
Mammal	*Trichechus senegalensis*	Kwanza River	1-WAF,

Based on this assessment, the sensitivity of the Lots where species triggering CH could potentially be found is assessed as **High** and are summarized in the table below.

Table 127: Sensitivity assessment for CH

Lots	Natural habitats	Species triggering a CH	Sensitivity assessment
1-WTP, 8, 10	Dry Adansonia woodland Dry shrubland	▪ *Pycnocoma dentata* ▪ *Breviceps ombelanonga sp. Nov.* ▪ *Monopeltis luandae*	**High**
1-WAF	Dry Adansonia woodland Floodplain Kwanza River	▪ *Pycnocoma dentata* ▪ *Breviceps ombelanonga sp. Nov.* ▪ *Phrynobatrachus brevipalmatus* ▪ *Monopeltis luandae* ▪ *Trichechus senegalensis*	**High**
2	Dry Adansonia woodland Dry shrubland Floodplain	▪ *Pycnocoma dentata* ▪ *Breviceps ombelanonga sp. Nov.* ▪ *Phrynobatrachus brevipalmatus* ▪ *Monopeltis luandae*	**High**

Lots	Natural habitats	Species triggering a CH	Sensitivity assessment
		▪ *Trichechus senegalensis* ▪ *Clarias ngamensis*	
3	None	-	**Low**
4	None	-	**Low**
5	Dry shrubland	▪ *Pycnocoma dentata* ▪ *Breviceps ombelanonga sp. Nov.* ▪ *Monopeltis luandae*	**High**
6	None	-	**Low**
7	None	-	**Low**
9	None	-	**Low**

According to the baseline study performed, the general sensitivity of flora and fauna species triggering CH is considered to be **High**.

8.2.3.1 Impact sources

The impact sources on critical habitats resulting from the project activities are the following:

- **Construction phase**
  - Site preparation ;
  - Presence and use of heavy machinery and construction equipment ;
  - Truck and vehicle road traffic and associated ;
  - Generation of solid waste ;
  - Generation of liquid waste ;
  - Storage, use and disposal of fuel or hazardous products.
- **Operation phase**
  - Vehicle road traffic ;
  - Generation of solid waste ;
  - Generation of liquid waste ;
  - Storage, use and disposal of fuel or hazardous products ;
  - River water abstraction.

8.2.3.2 Impacts during the construction phase

The general impacts of the project and general mitigation measures for overall biodiversity were described in the previous sections, while the potential direct and indirect impact that could occur on flora and fauna species triggering CH during the construction phase are summarized in Table 128. Additional mitigation measures are also discussed whenever necessary.

The impacts identified on critical habitats during the construction phase are the following:

B-C-09: Loss of critical habitats

This impact might result from different impact factors such as Vegetation and topsoil removal/ degradation.

B-C-10: Degradation of critical habitats

This impact might result from different impact factors such as local morphology changes, emissions of pollutants, dust and particulate matter, introduction and spreading of alien species, local hydrology and surface water quality changes, emissions of noise and vibrations.

B-C-11: Loss of species triggering CH

This impact might result from different impact factors such as increase in traffic but might also be the consequence of habitat degradation and the loss of vital habitat or resources, or the decrease in reproduction due to habitat perturbations.

Considering that the presence of these 6 species triggering CH has not been confirmed on within the AoI, additional pre-construction studies will be mandatory before starting any vegetation clearance or removal. In case some of these species are found during the planned additional studies, the presence of direct and indirect impact to the flora and fauna species populations triggering CH will be re-evaluated, and a Biodiversity Action Plan will be prepared to ensure Net Gain of these key biodiversity features.

Table 128: Potential direct and indirect impact during construction phase on species triggering CH and additional mitigation measures

Taxon	Species	IUCN Red List	Endemism / RR	Obs.	Potential Direct and Indirect Impacts	Additional studies or mitigation measures ***mandatory***	Mitigation Measures to implement ***if the presence of the species is confirmed***
Flora	*Pycnocoma dentata*	LC	RR	L	The presence of this species has not been confirmed in the AoI. If present, If present, this species could be found in Dry Adansonia woodland and Dry shrubland habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10, and direct impacts on populations could be due to the Project footprint at Lots 1-WTP & WAF, 2, 5, 8, 10. Indirect impacts within 100 m could affect populations at Lots 1-WTP & WAF, 2, 5, 8, 10.	Additional studies: Perform a pre-construction assessment in this species' suitable habitat Dry Adansonia woodland and Dry shrubland of Lots 1-WTP & WAF, 2, 5, 8, 10 to ensure the absence of species triggering a CH before starting the construction. Field surveys using a meander search pattern will be performed within the suitable habitats for the presence of the CH flora species to confirm the presence of these species within the AoI and in particular within the Project footprint and 100 m buffer. The fieldwork will be performed during the flowering period and each meander search will last for 20-30 minutes in the vicinity of the survey point selected. If the CH flora species are observed, the exact location	Mitigation for indirect impacts: - Flora On-site Conservation (avoidance): within the Project site, the conservation of CH determining species shall be guaranteed to the extent possible and for those species not directly impacted by the Project footprint Population located wiling 100 m from construction or operation areas will be actively protected from any undirect impact. Mitigations for direct impacts: - **Flora Salvaging and Translocation** (minimization/restoration): in case direct impacts will be unavoidable, individuals belonging to flora species determining CH impacted by the Project footprint shall be identified, salvaged prior to construction and translocated to the appropriate sites. - **Seed collection** (restoration/offset): seed collection and conservation will be performed for the CH determining species, following the best practice. Seeds collected will

Taxon	Species	IUCN Red List	Endemism / RR	Obs.	Potential Direct and Indirect Impacts	Additional studies or mitigation measures ***mandatory***	Mitigation Measures to implement ***if the presence of the species is confirmed***
						and distribution area of the populations will be mapped using a GPS and their extension (m^2), abundance (number of individuals) and percentage (%) of flowering/fruiting/seeding individuals will be recorded.	be separately stored using clearly identifiable codes. - **Biodiversity Action Plan** will include appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring.
Amphibian	*Breviceps ombelanonga sp. nov.*	NE	RR	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found in Dry Adansonia woodland, Dry shrubland and Floodplain habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10. Direct impacts could be associated with loss of suitable habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10 due to the Project footprint. Indirect impacts within 100 m and 300 m buffer could affect this species habitat if not properly mitigated.	Additional studies: Perform a pre-construction assessment in suitable habitat Dry Adansonia woodland, Dry shrubland and Floodplain of Lots 1-WTP & WAF, 2, 5, 8, 10 to ensure the absence of species triggering a CH before starting the construction. Field observations will be performed through a walkover survey within the suitable habitats for the species. Mitigation measures for planned biodiversity during the construction phase are considered sufficient to mitigate impacts.	If the species is found, during pre-construction surveys precautions will be taken to survey the area prior to any vegetation clearing and site preparation activities to identify, safely collect and relocate individuals to suitable and safe locations. If necessary, Biodiversity Action Plan will include appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring.
	Phrynobatrachus brevipalmatus	DD	RR	L	The presence of this species has not been confirmed in the AoI. If	Additional studies:	If the species is found, during pre-construction surveys precautions

Taxon	Species	IUCN Red List	Endemism / RR	Obs.	Potential Direct and Indirect Impacts	Additional studies or mitigation measures ***mandatory***	Mitigation Measures to implement ***if the presence of the species is confirmed***
					present, this species could be found in Floodplain habitats and in the Kwanza River in the immediate surroundings of Lots 1-WAF and 2. Direct impacts could be associated with loss of suitable habitats in the immediate surroundings of Lots 1-WAF and 2 due to the Project footprint. Indirect impacts within 100 m and 300 m buffer could affect this species habitat if not properly mitigated.	Perform a pre-construction assessment in suitable habitat Floodplain and Kwanza River of Lots 1-WTP & WAF, 2, 5, 8, 10 to ensure the absence of species triggering a CH before starting the construction. Field observations will be performed through a walkover survey within the suitable habitats for the species. Mitigation measures for planned biodiversity during the construction phase are considered sufficient to mitigate indirect impact	will be taken to survey the area prior to any vegetation clearing and site preparation activities to identify, safely collect and relocate individuals to suitable and safe locations. If necessary, Biodiversity Action Plan will include appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring.
Reptile	*Monopeltis luandae*	LC	RR	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found in Dry Adansonia woodland, Dry shrubland and Floodplain habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10. Direct impacts could be associated with loss of suitable habitats in the immediate surroundings of Lots 1-	Additional studies: Perform a pre-construction assessment in suitable habitat Dry Adansonia woodland, Dry shrubland and Floodplain of Lots 1-WTP & WAF, 2, 5, 8, 10 to ensure the absence of species triggering a CH before starting the construction. Field observations will be performed through a	If the species is found, during pre-construction surveys precautions will be taken to survey the area prior to any vegetation clearing and site preparation activities to identify, safely collect and relocate individuals to suitable and safe locations. If necessary, Biodiversity Action Plan will include appropriate offset measure to ensure Net Gain depending on the residual impacts

Taxon	Species	IUCN Red List	Endemism / RR	Obs.	Potential Direct and Indirect Impacts	Additional studies or mitigation measures ***mandatory***	Mitigation Measures to implement ***if the presence of the species is confirmed***
					WTP & WAF, 2, 5, 8, 10 due to the Project footprint. Indirect impacts within 100 m and 300 m buffer could affect this species habitat if not properly mitigated.	walkover survey within the suitable habitats for the species. Mitigation measures for planned biodiversity during the construction phase are considered sufficient to mitigate indirect impact.	identified during the additional studies and monitoring.
Mammal	*Trichechus senegalensis*	VU	-	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found within the Kwanza River and its bigger tributaries. No direct or indirect impacts are expected on this species due to project activities.	No additional studies are considered necessary for this species. Mitigation measures for planned biodiversity during the construction phase are considered sufficient to mitigate indirect impact.	No additional mitigation measures are considered necessary if the presence of this species is confirmed in the AoI.

Mitigation measures

The ESMP will have to include measures to mitigate the impacts on critical habitats:

B-C-09 and B-C-10: Measures to mitigate the loss or degradation of CH:

- Implemented mitigation measures identified to prevent loss or degradation of terrestrial and freshwater habitats.

B-C-11: Measures to mitigate the loss of species triggering CH:

- **B-C-11a**: During the tree removal, the exact individual number and species of removed trees will be tracked. If endemic species or species triggering CH are removed, develop a Biodiversity Action Plan to ensure no net loss.

Additional studies should be performed to determine the presence of species triggering CH:

- **B-C-11b**: Conduct the following pre-assessments which will be used to determining the requirement for a biodiversity action plan and offsetting and where (i.e., for which Lots or which segments of Lot 2):
  - Perform pre-construction assessment for each potential terrestrial or aquatic species triggering CH in its related suitable habitat (see specifications in 7.2.8) to ensure the absence of species triggering a CH before starting the construction.
  - Undertake pre-construction targeted stakeholder consultation with specialists to help identify the potential presence of critical habitat triggers

If any species triggering CH (Table 128) is found on-site during the preconstruction surveys or identified via stakeholder consultation the following mitigation measures should be implemented. In case of data gaps or uncertainties a precautionary approach will be taken to the management of critical habitat loss.

- **B-C-11c**: Develop and implement a **Biodiversity Action Plan** prior to construction, including appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring. The plan should include at least the measures below:
- **B-C-11d**: Flora On-site Conservation (avoidance): within the Project site, the conservation of CH determining species shall be guaranteed to the extent possible and for those species not directly impacted by the Project footprint Population located wiling 100 m from construction or operation areas will be actively protected from any undirect impact.
- **B-C-11e**: Flora Salvaging and Translocation (minimization/restoration): in case direct impacts will be unavoidable, individuals belonging to flora species determining CH impacted by the Project footprint shall be identified, salvaged prior to construction, and translocated to the appropriate sites.
- **B-C-11f**: Seed collection (restoration/offset): seed collection and conservation will be performed for the CH determining species, following the best practice. Seeds collected will be separately stored using clearly identifiable codes.
- **B-C-11g**: Biodiversity assessment (restoration/offset): Conduct a systematic biodiversity accounting based on the explicit calculation of biodiversity losses and gains at matched impact and offset sites.
- **B-C-11h**: In order to avoid or minimize direct impacts on *aquatic species* , any work within the riverbeds such as construction of the Water Abstraction Point shall be suspended during spawning in Lot 1-WAF.
- **B-C-11i**: Implement an awareness campaign around the Kwanza River to limit the fisheries activities and avoid any impact on the species triggering CH.

The impacts identified on habitats for the construction phase are summarized in the table below. According to the baseline study performed, the general sensitivity is considered to be **High** for species triggering CHs. Considering the application of the abovementioned mitigation measures, the impact on biodiversity components is presented in the following tables and it is expected to be **Moderate to Minor** for the species triggering CH identified within the AoI. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 129: Potential impacts on flora and fauna species triggering CH in the AoI during the construction phase

Taxa	Impact factor	Species	Suitable habitats	Lots	Impact factor criteria	Impact factor value	Sensitivity	Impact value	Residual impacts
Flora	Vegetation and topsoil removal/ degradation	*Pycnocoma dentata*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: High Extend: Project site Duration: Permanent	Moderate	High	**Major**	**Moderate**
	Local Morphology changes				Value: Negative Intensity: Low Extend: Project site Duration: Permanent	Minor	High	**Moderate**	**Minor**
	Emissions of pollutants, dust and particulate matter				Value: Negative Intensity: Low Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
	Introduction and spreading of alien species				Value: Negative Intensity: Negligible Extend: Local Duration: Permanent	Minor	High	**Moderate**	**Minor**
Amphibians	Vegetation and topsoil removal/ degradation	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: High Extend: Project site Duration: Permanent	Moderate	High	**Major**	**Moderate**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Local morphology changes	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Low Extend: Project site Duration: Permanent	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					

Taxa	Impact factor	Species	Suitable habitats	Lots	Impact factor criteria	Impact factor value	Sensitivity	Impact value	Residual impacts
	Emissions of pollutants, dust and particulate matter	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Introduction and spreading of alien species	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Negligible Extend: Local Duration: Permanent	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Local hydrology and surface water quality changes	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Low Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Increase in traffic	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Emissions of noise and vibrations	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
Reptiles	Vegetation and topsoil removal/ degradation	*Monopeltis luandae*	Dry Adansonia woodland Dry shrubland Floodplain	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: High Extend: Project site Duration: Permanent	Moderate	High	**Major**	**Moderate**

Taxa	Impact factor	Species	Suitable habitats	Lots	Impact factor criteria	Impact factor value	Sensitivity	Impact value	Residual impacts
	Local morphology changes				Value: Negative Intensity: Low Extend: Project site Duration: Permanent	Minor	High	**Moderate**	**Minor**
	Emissions of pollutants, dust and particulate matter				Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
	Introduction and spreading of alien species				Value: Negative Intensity: Negligible Extend: Local Duration: Permanent	Minor	High	**Moderate**	**Minor**
	Local hydrology and surface water quality changes				Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
	Increase in traffic				Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
	Emissions of noise and vibrations				Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Minor**
Mammals	Vegetation and topsoil removal/ degradation	*Trichechus senegalensis*	Kwanza River	Lots 1–WAF, 2	Value: Negative Intensity: Negligible Extend: Project site Duration: Temporary	Negligible	High	**Negligible**	**Negligible**

Taxa	Impact factor	Species	Suitable habitats	Lots	Impact factor criteria	Impact factor value	Sensitivity	Impact value	Residual impacts
	Emissions of pollutants, dust and particulate matter				Value: Negative Intensity: Low Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Negligible**
	Local hydrology and surface water quality changes				Value: Negative Intensity: Medium Extend: Local Duration: Temporary	Minor	High	**Moderate**	**Negligible**
	Emissions of noise and vibrations				Value: Negative Intensity: Negligible Extend: Local Duration: Temporary	Negligible	High	**Negligible**	**Negligible**

Table 129 highlights that the main impact on species triggering CH will be the impact from the vegetation and topsoil removal and degradation, which will negatively impact flora, amphibians, and reptiles.

8.2.3.3 Impacts during the operation phase

The general impacts of the project and general mitigation measures for overall biodiversity were described in the previous sections, while the potential direct and indirect impact that could occur on flora and fauna species triggering CH during the operation phase are summarized in the table below. Additional mitigation measures are also discussed whenever necessary.

The impacts identified on critical habitats during the operation phase are the following:

B-O-06: Loss of critical habitats

This impact is a continuation of the loss of CH identified during the construction phase and result from different impact factors such as the presence of the project facilities.

B-O-07: Degradation of critical habitats

This impact might result from the accidental emissions of pollutants in the event of an accidental oil or chemical spill during the construction phase.

B-O-08: Loss of species triggering CH

This impact will result from different impact factors such as the increase in traffic but might also be the consequence of habitat degradation and the loss of vital habitat or resources, or the decrease in reproduction due to habitat perturbations.

Considering that the presence of these 6 species triggering CH has not been confirmed on within the AoI, additional pre-construction studies will be mandatory before starting any vegetation clearance or removal. In case these species are found during the planned additional studies, the presence of direct and indirect impact to the flora and fauna species populations triggering CH will be re-evaluated, and a Biodiversity Action Plan will be prepared to ensure Net Gain of these key biodiversity features.

Table 130: Potential direct and indirect impact during operation phase on species triggering CH and additional mitigation measures

Taxon	Species	IUCN Red List	Endemism / RR	Obs.	Potential Direct and Indirect Impacts	Mitigation measures ***mandatory***	Mitigation Measures to implement ***if the presence of the species is confirmed***
Flora	*Pycnocoma dentata*	LC	RR	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found in Dry Adansonia woodland and Dry shrubland habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10, and direct impacts on populations could be due to the Project footprint at Lots 1-WTP & WAF, 2, 5, 8, 10. Indirect impacts within 100 m could affect populations at Lots 1-WTP & WAF, 2, 5, 8, 10.	Mitigation measures planned for biodiversity during the operation phase are considered sufficient to mitigate indirect impact.	If necessary, Biodiversity Action Plan will include appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring.
Amphibian	*Breviceps ombelanonga sp. nov.*	NE	RR	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found in Dry Adansonia woodland, Dry shrubland and Floodplain habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10. Direct impacts could be associated with loss of suitable habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10 due to the Project footprint.	Mitigation measures planned for biodiversity during the operation phase are considered sufficient to mitigate indirect impact.	If necessary, Biodiversity Action Plan will include appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring.
	Phrynobatrachus brevipalmatus	DD	RR	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found in		

Taxon	Species	IUCN Red List	Endemism / RR	Obs.	Potential Direct and Indirect Impacts	Mitigation measures *mandatory*	Mitigation Measures to implement *if the presence of the species is confirmed*
					Floodplain habitats and in the Kwanza River habitats in the immediate surroundings of Lots 1-WAF and 2. Direct impacts could be associated with loss of suitable habitats in the immediate surroundings of Lots 1-WAF and 2 due to the Project footprint.		
Reptile	*Monopeltis luandae*	LC	RR	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found in Dry Adansonia woodland, Dry shrubland and Floodplain habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10. Direct impacts could be associated with loss of suitable habitats in the immediate surroundings of Lots 1-WTP & WAF, 2, 5, 8, 10 due to the Project footprint.	Mitigation measures planned for biodiversity during the operation phase are considered sufficient to mitigate indirect impact.	If necessary, Biodiversity Action Plan will include appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring.
Mammal	*Trichechus senegalensis*	VU	-	L	The presence of this species has not been confirmed in the AoI. If present, this species could be found within the Kwanza River and its bigger tributaries. No direct or indirect impacts are expected on this species due to project activities.	Mitigation measures planned for biodiversity during the construction phase are considered sufficient to mitigate indirect impact.	No additional mitigation measures are considered necessary for this species.

Taxon	Species	IUCN Red List	Endemism / RR	Obs.	Potential Direct and Indirect Impacts	Mitigation measures ***mandatory***	Mitigation Measures to implement ***if the presence of the species is confirmed***

Mitigation measures

The ESMP will have to include measures to mitigate the impacts on critical habitats:

B-O-06 and B-O-07: Measures to mitigate the loss or degradation of CH:

- Implemented mitigation measures identified to prevent loss or degradation of terrestrial and freshwater habitats.

B-O-08: Measures to mitigate the loss of species triggering CH:

- **B-O-08a**: To avoid or minimize direct impacts on the fish *Clarias ngamensis*, selective grids should be in place on the water abstraction point to avoid sucking in juveniles during spawning.

If any species triggering CH is found on-site during the preconstruction surveys, the following mitigation measures should be implemented:

- **B-O-08b**: Develop and implement a Biodiversity Action Plan, including appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the monitoring.

The impacts identified on habitats for the construction phase are summarized in the table below. According to the baseline study performed, the general sensitivity is considered to be **High** for species triggering CHs. Considering the application of the abovementioned mitigation measures, the impact on biodiversity components is presented in the following tables and it is expected to be **Moderate to Minor** for the species triggering CH identified within the AoI. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 131: Potential impact on flora and fauna species triggering CH in the AoI during the operation phase

Taxa	Impact factor	Species	Suitable habitats	Lots	Impact factor criteria	Impact factor value	Sensitivity	Impact value	Residual impacts
Flora	Presence of facilities	*Pycnocoma dentata*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: High Extend: Project site Duration: Permanent	Moderate	High	**Major**	**Moderate**
Flora	Emissions of pollutants, dust and particulate matter	*Pycnocoma dentata*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Low Extend: Project site Duration: Temporary	Minor	High	**Moderate**	**Negligible**
Flora	Introduction and spreading of alien species	*Pycnocoma dentata*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Medium Extend: Local Duration: Permanent	Moderate	High	**Major**	**Moderate**
Amphibians	Presence of facilities	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: High Extend: Project site Duration: Permanent	Moderate	High	**Major**	**Moderate**
Amphibians	Presence of facilities	*Phrynobatrachus brevipalmatus*	Floodplain Kwanza River	Lots 1–WAF, 2	Value: Negative Intensity: High Extend: Project site Duration: Permanent	Moderate	High	**Major**	**Moderate**
Amphibians	Local morphology changes	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Low Extend: Project site Duration: Permanent	Minor	High	**Moderate**	**Negligible**
Amphibians	Local morphology changes	*Phrynobatrachus brevipalmatus*	Floodplain Kwanza River	Lots 1–WAF, 2	Value: Negative Intensity: Low Extend: Project site Duration: Permanent	Minor	High	**Moderate**	**Negligible**
Amphibians	Emissions of pollutants, dust and particulate matter	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Low Extend: Project site Duration: Temporary	Minor	High	**Moderate**	**Negligible**
Amphibians	Emissions of pollutants, dust and particulate matter	*Phrynobatrachus brevipalmatus*	Floodplain Kwanza River	Lots 1–WAF, 2	Value: Negative Intensity: Low Extend: Project site Duration: Temporary	Minor	High	**Moderate**	**Negligible**

Taxa	Impact factor	Species	Suitable habitats	Lots	Impact factor criteria	Impact factor value	Sensitivity	Impact value	Residual impacts
	Introduction and spreading of alien species	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Negligible Extend: Local Duration: Permanent	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Local hydrology and surface water quality changes	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Negligible Extend: Project site Duration: Permanent	Negligible	High	**Minor**	**Negligible**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Increase in traffic	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Low Extend: Project site Duration: Permanent	Minor	High	**Moderate**	**Minor**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
	Emissions of noise and vibrations	*Breviceps ombelanonga sp. nov.*	Dry Adansonia woodland Dry shrubland	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: Negligible Extend: Project site Duration: Permanent	Negligible	High	**Minor**	**Negligible**
		Phrynobatrachus brevipalmatus	Floodplain Kwanza River	Lots 1–WAF, 2					
Reptiles	Presence of facilities	*Monopeltis luandae*	Dry Adansonia woodland Dry shrubland Floodplain	Lots 1-WTP, 8, 10 1-WAF, 2, 5	Value: Negative Intensity: High Extend: Project site Duration: Permanent	Moderate	High	**Major**	**Moderate**
	Emissions of pollutants, dust and particulate matter				Value: Negative Intensity: Low Extend: Project site Duration: Temporary	Minor	High	**Moderate**	**Negligible**

Taxa	Impact factor	Species	Suitable habitats	Lots	Impact factor criteria	Impact factor value	Sensitivity	Impact value	Residual impacts
	Introduction and spreading of alien species				Value: Negative Intensity: Negligible Extend: Local Duration: Permanent	Minor	High	**Moderate**	**Minor**
	Local hydrology and surface water quality changes				Value: Negative Intensity: Negligible Extend: Project site Duration: Permanent	Negligible	High	**Minor**	**Negligible**
	Increase in traffic				Value: Negative Intensity: Low Extend: Project site Duration: Permanent	Minor	High	**Moderate**	**Minor**
	Emissions of noise and vibrations				Value: Negative Intensity: Negligible Extend: Project site Duration: Permanent	Negligible	High	**Minor**	**Negligible**
Mammals	Presence of facilities – Lot 1- WAF	*Trichechus senegalensis*	Kwanza River	Lots 1–WAF, 2	Value: Negative Intensity: Negligible Extend: Project site Duration: Permanent	Negligible	High	**Negligible**	**Negligible**
	Emissions of pollutants				Value: Negative Intensity: Negligible Extend: Project site Duration: Temporary	Negligible	High	**Negligible**	**Negligible**
	Local hydrology and surface water quality changes				Value: Negative Intensity: Negligible Extend: Project site Duration: Permanent	Negligible	High	**Minor**	**Negligible**

Table 131 highlights that the main potential impact on species triggering CH will be the impact resulting from the presence of the Project facilities, and the potential introduction of invasive species.

8.2.3.4 No net loss / Net gain assessment

The present No Net Loss/Net Gain assessment identifies residual and unavoidable impacts on Natural Habitats and Critical Habitats identified in the previous chapters and discusses potential offset activities.

In case the presence of net loss on Natural Habitats and Critical Habitats is identified by the following assessment, a Biodiversity Action Plan will be proposed to achieve no net loss/net gain. An offset strategy to achieve no net loss/net gain is anticipated below for each key biodiversity feature.

No Net Loss/Net Gains are assessed separately for the following key biodiversity features:

- Natural Habitats ;
- Flora species triggering Critical Habitats ;
- Terrestrial fauna species triggering Critical Habitats ;
- Freshwater fauna species triggering Critical Habitats.

8.2.3.4.1 Natural habitats

For natural habitats direct impacts are mainly associated with habitat loss in correspondence of the footprint of the Project and its associated facilities and infrastructures.

At the end of the construction phase only part of the Project sites will be available to be restored since most of the Project areas will be occupied by the Project facilities.

Using a precautionary approach, the net loss of Natural Habitats due to the Project is calculated considering the Project facilities and infrastructures areas and footprint in operation as a net loss of natural habitat.

Areas considered as restored are limited to the Construction work areas that will be set free after the end of the construction works, and the pipeline area that will be buried at the end of the construction phase.

The net loss of Natural Habitats associated with the Project is calculated in Table 132**.**

The total expected net loss of natural habitats is of 14.14 ha, which represent about less 0.60 % of the total natural habitat present in the AoI. Most of this area is characterized by Dry Adansonia woodland (10.92 ha). The loss of habitat will also affect Dry shrubland (1.32 ha) and Floodplains (1.74 ha). The Kwanza River will be only marginally affected (0.16 ha).

Table 132: Net loss of Natural Habitats calculated within the AoI

Natural habitats	Total AoI	Net Loss Surface of the permanent Project footprint (operation phase)	
	Surface in the AoI (Ha)	Surface (Ha)	Percentage of each habitat (%)
Dry Adansonia woodland	1,040.17	10.92	1.05 %
Dry shrubland	1,300.14	1.32	0.10 %
Floodplain	17.34	1.74	10.04 %
Kwanza River	18.24	0.16	0.89 %
TOTAL	**2,375.88**	**14.14**	0.60 %

In case, the planned mitigation measures will not be sufficient, additional offset measures will be implemented in order to ensure no net loss and preferably net gain of Natural Habitats. These measures could include the following rehabilitation/Offset activities:

- Protection of existing natural habitats that could be otherwise threatened by impacts other than the Project (e.g. overgrazing, developments).
- Rehabilitation of natural habitats affected by impacts other than the Project (erosion, past development, and infrastructures, etc.) by :
  - Reforestation of suitable areas using local shrub or floodplain species and planting schemes on techniques to maximize biodiversity and mimic mixed shrub or floodplain vegetation succession ;
  - Seeding of areas with flora of interest for nursing and feeding, within the Projects sites if possible, and their immediate surroundings ;
  - Sustainable management of floodplains to promote flora species diversity ;
- Rehabilitation of buffer of floodplain vegetation along the Kwanza riverbanks within the AoI and its surroundings.

8.2.3.4.2 Flora species triggering CH

One flora species potentially triggering CH has been assessed as potentially present in the AoI based on literature review (*Pycnocoma dentata,* LC, RR). This is a shrub species associated with Dry Adansonia woodland and Dry shrubland habitats.

For this species direct impacts are mainly associated with loss of populations present on the footprint of the Project and its associated facilities. Using a precautionary approach, it is considered that it will not be possible to restore the specific ecological niche of the species triggering CHs directly impacted by the Project. Moreover, considering that the translocation of natural species in the wild is not always successful, the potential positive effects of these actions were not considered at present.

Indirect impacts from the project could occur in a 100 m buffer and are mainly associated with the possible changes in local hydrology that could cause changes in the habitat suitability and with competition due to introduction and spreading of alien species into disturbed habitats. Mitigation and monitoring measures presented for the construction and operation phase are considered sufficient for indirect impacts on populations of the species indirectly impacted.

As no individuals have been observed on site, the net loss for this species could be estimated by using the proxy of the net loss of suitable habitats calculated as the area affected by direct impacts at the end of the construction phase and located in Dry Adansonia woodland and Dry shrubland habitats (Table 133).

The net loss surfaces of suitable habitats for flora species triggering CH have been calculated by using the Project footprint during the construction phase as it represents the total area that will be cleared for the project, and then the total area where flora vegetation will be removed.

Table 133: Net loss of suitable habitats for Flora species triggering CH calculated within the AoI

Natural habitats	Total AoI	Net Loss Surface of the temporary Project footprint (construction phase)	
	Surface in the AoI (Ha)	Surface (Ha)	Percentage of each habitat (%)
Dry Adansonia woodland	1,040.17	1.14	0.11 %
Dry shrubland	1,300.14	15.60	1.20 %
TOTAL	**2,340.3**	**16.74**	0.71 %

In case the results of the pre-construction monitoring will show the presence of *Pycnocoma dentata* on site, additional offset measures will be implemented. These measures could include:

- protection of existing populations that could be otherwise threatened by impacts other than the Project (e.g. overgrazing, developments) ;
- reinforcement of existing populations and/or creation of new populations using seeds or other propagules sustainably collected in the wild, preferably passing through a stage of multiplication and growing in a controlled environment.

If necessary, these activities will be performed in collaboration with local research center and institutions to identify the multiplication and translocation protocols and ensure ongoing protection and monitoring of the populations.

8.2.3.4.3 Terrestrial fauna species triggering CH

At the end of the construction phase only part of the Project sites will be available to be restored since most of the Project areas will be occupied by the Project facilities.

However, partially restored areas could have a habitat suitability similar or even higher than pre-construction conditions for fauna species identified triggering CHs.

A net gain/net loss assessment is performed below for each species (Table 134). The net loss surfaces of suitable habitats for terrestrial species triggering CH have been calculated using the Project footprint in operation phase, representing the final net loss of habitats for these species.

Table 134: Potential Net Loss for terrestrial fauna species triggering CH

Taxon	Scientific name	Common name	IUCN Red List Status	End./ RR	Lit./ Obs.	Net Loss
Amphibian	*Breviceps ombelanonga sp. Nov.*	-	NE	RR	**L**	Its presence has not been confirmed on site. Net loss could affect species suitable habitats such as Dry Adansonia woodland (1.14 ha) and Dry shrubland (15.60 ha).
	Phrynobatrachus brevipalmatus	-	DD	RR	**L**	Its presence has not been confirmed on site. Net loss could affect species suitable habitats such as Floodplain (1.74 ha) and Kwanza River (0.16 ha).

Taxon	Scientific name	Common name	IUCN Red List Status	End./ RR	Lit./ Obs.	Net Loss
Reptile	*Monopeltis luandae*	-	LC	RR	**L**	Its presence has not been confirmed on site. Net loss could affect species suitable habitats such as Dry Adansonia woodland (1.14 ha), Dry shrubland (15.60 ha), and Floodplain (1.74 ha).

If necessary, Biodiversity Action Plan will include specific offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring.

Additional mitigation ad offset activities that could be included for amphibian species (*Breviceps ombelanonga sp. Nov.*) and reptile species (*Monopeltis luandae*) using dry terrestrial habitats are :

- Protection of existing natural habitats (shrubland) that could be otherwise threatened by impacts other than the Project (e.g. cutting, developments) ;
- Rehabilitation of natural habitats (shrubland) affected by impacts other than the Project (erosion, past development and infrastructures, etc.) by :
  - Seeding of areas with flora of interest for nursing and feeding, within the Project site and its immediate surroundings ;
  - Sustainable management of shrubland to promote flora species diversity.

Additional mitigation ad offset activities that could be included for amphibian species (*Phrynobatrachus brevipalmatus*) using wet terrestrial habitats and rivers are:

  - Rehabilitation of buffer of riparian vegetation along the riverbanks within the AoI and its surroundings.

8.2.3.4.4 Freshwater fauna species triggering CH

African Manatee (*Trichechus senegalensis*) and Blunt-toothed African Catfish (*Clarias ngamensis*) were identified as the freshwater species triggering CH with suitable habitat potentially impacted by the Project within the AoI.

Net loss for these species could be associated with loss of habitat, or even individuals (adults and eggs) for the Blunt-toothed African Catfish, in case any changes in local hydrology and water quality during construction works, but even more during the operation phase when the water pumping station will be functioning.

Strong mitigation measures are in place to avoid any individual mortality at the water abstraction point. These mitigation measures presented for the operation phase are considered sufficient to avoid any long-term loss of habitats or individuals, however monitoring on freshwater habitat during operation phase will be crucial to ensure these measures are properly applied and ensure that corrective actions are in place in a timely manner, if needed.

A net gain/net loss assessment is performed below for each species (Table 135). The net loss surfaces of suitable habitats for freshwater species triggering CH have been calculated using the Project footprint in operation phase, as the water abstraction activities will represent the highest impact on suitable freshwater habitats for these species during the operation phase.

Table 135: Potential Net Loss for freshwater fauna species triggering CH

Taxon	Scientific name	Common name	IUCN Red List Status	End./ RR	Lit./ Obs.	Net Loss
Mammal	*Trichechus senegalensis*	African Manatee	VU	-	**L**	Its presence has not been confirmed on site. Degradation of aquatic habitat quality or worsening of water quality could affect species suitable habitats such as Kwanza River (0.16 ha) , but a net loss is highly unlikely considering mitigation measures.
Fish	*Clarias ngamensis*	Blunt-toothed African Catfish	LC	-	**L**	Its presence has not been confirmed on site. Degradation of aquatic habitat quality or worsening of water quality could affect species suitable habitats such as Kwanza River (0.16 ha) , but a net loss is highly unlikely considering mitigation measures.

8.3 Social components

The impacts on the social component are assessed across the Project area of influence (AoI) for the two phases of the Project: the construction phase, corresponding to the construction of the Project facilities and infrastructures, and the operation phase, corresponding to the water pumping, treatment, and supply network operation. The social sub-components retained for this assessment are : population and demography, economy and employment, land use, community health safety and security, infrastructures and services, ecosystem services, and cultural heritage.

The interrelation linkages between the Project activities and the social sub-components are summarized in Table 104.

The baseline field studies performed in 2023 has provided data on the social context in the Project AoI.

8.3.1 Land use

Land use is linked to activities carried out on land that could potentially be impacted by Project activities in municipalities.

8.3.1.1 Impact Sources

The impact sources on land use resulting from the project activities are the following:

- **Construction phase**
  - Land acquisition (preconstruction) ;
  - Site preparation.
- **Operation phase**

There are no land use impact sources identified in the operational phase.

8.3.1.2 Impacts during the construction phase

The impacts identified on land use during the construction phase are the following :

- **S-C-01: Changes in land ownership (pre-construction phase)**

During the pre-construction phase of the project, the land acquisition for the construction works of the water treatment plant (lot 1), the sludge treatment plant (lot 10), the water distribution centers (lot 3, lot 6, lot 7, lot 8) and the pipeline network (lot 2) required or will require adequate space and land which will have an impact on the use of land and resources of the local populations. This impact is negative in nature. According to the socio-economic surveys carried out by WSP and its partner Saioz in July and August 2023 in the Project area, the land for the construction of the water treatment plant (Lot 1), the sludge treatment plant (Lot 10) and Lot 8 were part of the land reserve of the Z.E.E. (Special Economic Zone) and were made available to EPAL for construction in 2014.

According to the EPAL report (2020), the expropriation of land for the expansion of the Cacuaco distribution center (Lot 3) has been completed. However, no local buildings or activities have been identified on the sites. As for the Kapalanga distribution center (Lot 7), the center will be built on a large plot of land in the center of the district, and the municipality of Viana, which is responsible for land management in the locality, has planned to keep the land for the benefit of the project. The Km 30 distribution center (Lot 6) will be built close to a large market. A 2.5 ha plot of land has been set aside in the district for construction.

Detains on the land transactions and expropriation process have not been provided for any of those lots.

For the drinking water pipeline works (lot 2), most of the network will be built parallel to the road, so the spacing between the network, the road and the buildings (shops, residences and local people's homes) is large enough that there will be no interference. Project construction activities won't probably result in expropriation or permanent displacement of local populations on those areas, however a more detailed evaluation in the field along the 100 km of pipelines is necessary to identify individual cases.

For lot 1, lot 8 and lot 10 in the municipality of Icolo and Bengo, the intensity of the impact is <u>low</u> due to the expropriation of land in 2014 and the absence of local population permanent activities on the sites. The extended of the impact is <u>local</u>, as it will affect the land selected for construction. The duration of the impact is <u>permanent</u> because it will last during operating phase of the project. The impact value is moderate. The sensitivity is low due to the current land use. The importance of this impact is assessed as <u>minor</u>.

For lots 3, 6 and 7 in the municipalities of Cacuaco and VIana, the intensity of the impact is <u>low</u> because the land has already been reserved in the municipalities and that there are no activities on the sites. The extended of the impact is <u>local</u>, as it will affect the center construction sites. The impact will be <u>permanent</u>, due to the project's operational phase. The sensitivity is low due to the currant land use. The importance of this impact is assessed as <u>minor</u>.

For lot 2, the intensity of the impact is considered <u>medium</u> due to the presence small businesses in places along the roads and future locations of the pipeline. The extended of the impact is <u>local</u>, as it will affect limit number of the community along the axis of the pipeline. The duration of the impact is <u>temporary</u> because it is limited to the construction phase of the project. The importance of the impact is considered **<u>moderate</u>**.

S-C-02: Restriction of access to land

According to the socio-economic surveys carried out in July and August 2023 in the area of influence of the project, people use the land for building houses and also for farming in some municipalities (Icolo and Bengo). It should be noted that the land earmarked for the project's construction work is not usually used by local people for leisure activities or other activities that could be associated with the probable use of the land. However, during the site visit, it was observed that the land reserved for the construction of Lot 6 (CD Km 30) is used for the communities for leisure (football for instance).

Temporary disruptions of economic activities may occur during short periods (15-30 days, according to information provided by the constructor of Lot 2). More detailed evaluation in the field along the 100 km of pipelines is necessary to identify the number of people potentially affected and their locations.

After construction other permanent restrictions will also apply. For the Lot 2. Permanent easement will require no building development and no deep-rooted crops within 3 to 6 meters from the pipeline implantation. Such easement should not affect future constructions or activities on the pipeline trenches located under existing streets and roads, or areas with special status regarding construction and/or agriculture, such as the area of protection of the new airport and the Economic Special Zone (ZEE), which together, correspond to approximately 90 % of the total pipeline length. According to the Viana Master plan water pipelines for human consumption have a **10-meter buffer zone, on each side of the pipeline**, where it is forbidden to build any type of buildings or plant any trees, although, in urban areas, landscape activities can include tree planting, as long as it is demonstrated that the trees or roots will not impact the pipeline.

For the Distribution Centers located in the Vianna municipality (Lots 6, 7, 4 and 9), the master plan considers a 100-meter buffer zone where it is forbidden to construct "new houses or other buildings, install commercial or industrial units, install slaughterhouses, graveyards, waste dumpsites, install hydrocarbons deposits, develop agriculture with the use of manure or artificial fertilizers, discharge wastewater or other pollutants and other restrictions".

The intensity of the impact is considered low due to the absence of permanent activities on the sites (with exception of permanent restrictions to sections of Lot 2). The scale of the impact is local, as it will be felt around the construction sites. The duration of the impact is permanent as those restrictions will remain during the operational phase of the project, except for Lot 2. The sensitivity is low due to the current land use, with exception of Lot 2 (medium). The significance of the impact is considered **minor**.

Mitigation measures

The ESMP will have to include the following measures in order to mitigate the impacts on the land use:

S-C-01: Measures to mitigate the changes in land ownership (pre-construction phase)

- **S-C-01a:** Confirm all the land acquisition and expropriation have been completed, documented and the procedures are according to national and international requirements.
- **S-C-01b:** Develop corrective/compensation measures for affected parties where required (including vulnerable groups).
- **S-C-01c:** Ensure the implementation of grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances to the company in order to facilitate the management and resolution of concerns.

S-C-02: Measures to mitigate the restriction of access to land

- **S-C-02a:** Develop a Resettlement Policy Framework (RPF) which will frame the Resettlement Action Plan (RAP) and the Livelihood Restauration Plan (LRP) in line with the IFC performance Standards as well as Angola legislation . The RPF will mainly need to
  - cover the land uses, ownership, tenure, land take extent and impacts ;
  - describe all of the impacted project-affected people including vendors, traders, businesses , water carriers and households (including informal settlements) in and adjacent to the right of way (RoW) – in the case of Lot 2 ;

- describe efforts to avoid physical and economic displacement through design changes and alternative routing ;
- describe the entitlements and compensation framework ;
- be planned and implemented according to the construction schedule.

The LRP subsequently needs to be prepared to address issues relating to physical and economic displacement, loss of community infrastructure and other asset. Precisely, the following will be included: (a) identification of vulnerable persons and the causes and impacts of their vulnerability; (b) identification of required assistance at various stages of the LRP process: negotiation, compensation, and relocation; (c) implementation of measures necessary to assist vulnerable persons.

The permanent restrictions must communicate to current and future landowners and users. A detailed inventory needs to be done to identify them so that there are informed and if necessary compensated. Compensation must be done according to international standards and its implementation as well as the restrictions must be monitored.

- **S-C-02b:** Ensure that people selling along the roadside are informed in advance of the start of work on construction the water pipe transport network and elaborate compensation measures.
- **S-C-02c:** Provide alternative land or facilities for leisure to the affected communities.
- **S-C-02d:** Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.
- **S-C-02e:** Ensure the implementation of a grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances to the company in order to facilitate the management and resolution of concerns.

The impacts identified on land use for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 136: Potential impacts on land use during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-C-01: Changes in land ownership	Lot 1 - WTP	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 10 - STP	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 2 – network	Negative	Medium	Local	Temporary	Minor	Medium	**Minor**	**Minor**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-C-02: Restriction of access to land	Lot 1 - WTP	Negative	Low	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 10 - STP	Negative	Low	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Low	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 2 – network	Negative	Low	Local	Temporary (permanent in case of permanent easement in some sections)	Minor	Medium	**Minor**	**Minor**

8.3.1.3 Impacts during the operation phase

There are no additional land use impact sources in the operational phase.

8.3.2 Population and demographics

The assessment of population and demographic impacts concerns the density and movement of populations and demographics that could potentially be affected by the project activities.

8.3.2.1 Impact Sources

The impact sources on the population and demographics during the construction and operation phases of the project can be summarized as follows:

- **Construction phase**
  - Job creation ;
- **Operation phase**
  - Job creation.

8.3.2.2 Impacts during the construction phase

The impacts identified on population and demographics during the construction phase are the:

S-C-03: Labor Influx

During construction, there may be an influx of workers into the different municipalities linked to work opportunities. For lot 1, lot 8 and lot 10 of the project, more than 60 workers and some expatriates will be employed for the construction of the pumping and water collection station, the drinking water treatment plant and the sludge treatment plant in the municipalities of Icolo and Bengo. For lots 8, lot 3, lot 7 and lot 6 which concern water distribution centers, more than 100 workers will be employed and 2 expatriates per distribution center in the localities of Bom Jesus, Cacuaco, Kapalanga and Km 30. For lot 2, more than 200 workers will be employed for work on 100 km of water transport pipelines to the distribution centers. More than 80 % of the workers will be recruited locally by the contractors and will live in their residences in each locality and the few qualified workers will come from abroad. It should be noted that the duration of the construction work will be long (approximately 24 to 36 months). This local recruitment system and the future drinking water provision will potentially attract people to the surrounding area of the Project. The population influx will also result from other on going and future developments in the area (Chapter 7.3.2)

The intensity of the impact is considered low because most workers will come from the localities, its extended is therefore local because recruitment will mostly take place in the municipalities concerned, thus the duration is assessed as temporary due to the need for labor during construction work. The sensitivity is high due to the current and past evolution of the immigration rates in the Luanda region. The significance of the impact on the population and demographics is considered **minor**.

Mitigation measures

S-C-03: Measure to limit labor influx

S-C-03a: Prioritize local workforce using measures such as

- Post job vacancies in local areas so that local people can apply for them ;
- Recruit and train local workers for certain positions ;
- Determine numbers of skilled, semi-skilled and unskilled labor requirements for each phase and assess local resource levels through involving local communities' representatives as well as community leaders ;
- Implement Project specific training and community development programs to increase the skills of local workers and the capacity of local businesses to meet the needs and requirements of the Project.

SC-03 b: Provide and communicate clear information about the Project's requirement related to employment and business opportunities and priorities locals where feasible and those; positions for which they are qualified.

The measured above should be included in the Employment Plan.

The impacts identified on population and demographics for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 137: Potential impacts on population and demographics during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-C-03 Labour influx	Lot 1 - WTP	Negative	Low	Local	Temporary	Minor	High	**Moderate**	**Minor**
	Lot 10 -STP	Negative	Low	Local	Temporary	Minor	High	**Moderate**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Local	Temporary	Minor	High	**Moderate**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Local	Temporary	Minor	High	**Moderate**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Local	Temporary	Minor	High	**Moderate**	**Minor**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
	Lot 7 - DC Kapalanga	Negative	Low	Local	Temporary	Minor	High	**Moderate**	**Minor**
	Lot 2 – network	Negative	Low	Local	Temporary	Minor	High	**Moderate**	**Minor**

8.3.2.3 Impacts during the operation phase

There are no additional impact sources in the operational phase.

8.3.3 Economy and employment

The assessment of the project's impact on the economy and employment looks at the impact on socio-economic activities, people's incomes and employment during the project's construction and operation phases.

8.3.3.1 Impact Sources

The impact sources on the economy and employment use resulting from the project activities are the following:

- **Construction phase:**
  - Job creation ;
  - Energy consumption and supply ;
  - Material goods and services supply.
- **Exploitation phase:**
  - Job creation ;
  - Energy consumption and supply ;
  - Material goods and services supply ;
  - Production and distribution of drinking water.

8.3.3.2 Impacts during the construction phase

The impacts identified on economy and employment during the construction phase are the following:

S-C-04: Direct employment in workforce

As already described, the project works will create job opportunities in the different municipalities. This opportunity will contribute to reducing the unemployment rate in municipalities and improving living conditions in certain families. During the construction phase of the project, the impact linked to job creation is considered positive. Concerning lot 1, lot 8 and lot 10, construction sites of the water pumping and collection station, the drinking water treatment station, and the sludge treatment station, more than 60 workers will be employed during approximately 36 months. For lots 8, lot 3, lot 7 and lot 6, intended for the construction of water distribution centers, more than 100 workers will be employed. At the level of lot 2, more than 200 workers will be employed for the pipeline work of the water transport network to the distribution centers during 24 months of works

In call case, the intensity of the impact in these municipalities is <u>low</u> due to the number of workers (compared to the unemployment rates in the region), of <u>local</u> scope due to local recruitment and of <u>temporary</u> duration due to the duration of construction works approximately 36 months. Sensitivity due to the nature of the element (jobs). The impact value is **moderate**.

Construction of Lots 4, 5 and 9 are nearly finalized and therefore unlikely to require additional workforce.

S-C-05: Impact on agriculture

During the construction phase of the project, earthworks, trenching, foundation work, sinking for the water mains, storage of construction materials along the 100-kilometre route, reworking and artificialization of the soil in places will alter the structure of the land and its use. In addition, the upkeep and maintenance of site machinery and vehicles on the sites and storage areas will also lead to accidental spills of hydrocarbons, oils and other solid and liquid waste on the ground. Which will further affect the quality of agricultural land. All these activities are sources of negative impacts on land use. According to socio-economic surveys carried out in July and August 2023, most people engaged in agricultural activities on land in Luanda province grow subsistence crops, as there is little open land for commercial farming. The main subsistence crops produced include cassava, sweet potatoes, and vegetables (tomatoes, cabbage, etc.). In the project area, these activities are practiced in the municipalities of Icolo and Bengo and Cacuaco. According to the field surveys, the agricultural activities are done by both men and women.

Regarding lot 3 in the municipality of Cacuaco, the populations practice various crops such as cassava, corn, tomatoes, onions, eggplants, and cabbage, among other vegetables, for self-consumption and sale. For lot 1 in the municipality of Icolo and Bengo, part of the population of Bom Jesus lives from subsistence agriculture, fishing, and the sale of agricultural products. All these activities constitute the main means of livelihood for households. Profits from agricultural activities enable households to meet their needs and contribute to the economy informally in the province of Luanda. The change in use and loss of cropland could affect the livelihoods of local people. However, the agricultural and livestock activities practiced by local people in the municipalities of Icolo, Bengo and Cacuaco are not identified on the project sites or nearby.

In the municipalities of Icolo and Bengo (lot 1, lot 8 and lot 10) as well as for in the municipalities of Viana and Cacuaco (lot 3, lot 6, lot 7), the intensity of the impact is considered <u>low</u> due to the absence of agricultural activities on and near the sites. The impact is <u>local</u> due to the use of land on the work sites. The duration of the impact is <u>permanent</u> due to land changes during the project's operational phase that will last until the operation phase. The importance of this impact is assessed as <u>moderate</u>. Given the current land use, the sensitivity is considered <u>low</u>. The impact value is considered **<u>minor</u>**.

For lot 2, the intensity of the impact is considered <u>low</u> due to the absence of agricultural activity. The extent of the impact is <u>local</u> due to the axis of the pipeline in the project area. The duration of the impact is <u>temporary</u> due to the construction phase of the project. The importance of the impact is considered **<u>minor</u>**.

S-C-06: Impacts on the supply chain of material, goods, and services

During the construction phase of the project, the construction work will require materials (sand, gravel, aggregates, rubble stones, etc.), equipment (pipe, electric cable, etc.), goods and services. For each site, the contractors have developed a plan for supplying the sites. For lots 1, lot 8 and lot 10 which concern the water treatment plant, the sludge treatment plant, and the distribution center in the municipality of Icolo and Bengo, the company in charge of the works in its plan procurement of materials, equipment, goods and services will use local factories and will purchase its materials and equipment in the province of Luanda and probably in the major cities of Angola. Regarding the distribution centers (lot 3, lot 6 and lot 7) in the municipality of Cacuaco and Viana, according to the procurement plan of the company in charge of the works, some equipment will be purchased on the international market (lot 7) because of their specificity and unavailability on the market in Angola, as well as the services that will be provided internally. While materials and some equipment and goods will be purchased from the local market in Angola. For lot 2, which concerns the water transport pipeline works over 100 km, the construction materials will be purchased locally, except the pipeline pipe which will be purchased on the international market because of the quality of the pipe.

For the needs of materials, equipment, goods and services for the project, the contractors in charge of the work will entrust the contracts to local companies, local factories, and local industries. These needs will allow small and medium-sized businesses and selected local suppliers to significantly improve their income and also their competitiveness. For supply chain operations, local suppliers and local businesses will be able to recruit workers during this period, which will create employment for the populations of the project area, thus improving the living conditions of the people and households. Companies that import equipment and products from abroad will pay taxes which will have a strong impact on the national economy.

The impact is considered positive for the project, the intensity of the impact is medium due to the stimulation of the local economy and the opportunity for local suppliers. The extended of the impact is regional because the materials, equipment, goods, and services of the project will come from the province of Luanda, probably from other cities in Angola and from the international market. The duration of the impact is temporary due to the limited duration of the construction phase of the project. The impact factor is of moderate. The sensitivity is considered medium and the resulting impact has a **moderate** importance on the economy and employment.

S-C-07: Local socio-economic diversification and improvement with the scale of economic development

During the construction phase of the project, the workers of the companies who will work on the sites will have needs for food and products. The presence of construction sites in each locality could be the basis for the spontaneous creation of activities near the construction sites. These activities result in the development of income-generating activities, with the installation of small businesses (sale of food, bottled water and various consumer goods) by women and young people near the site, to meet the needs of company workers. According to socio-economic survey data, there is a significant presence of women in the different municipalities. Some housewives dedicate themselves to small businesses selling various products. Thanks to the project, these small businesses will generate more income near the construction sites because of the presence of company workers. These small businesses in their various forms constitute an informal economic activity which contributes to household income. The impact is assessed as positive for the project.

The impact is low intensity due to the limited needs during the break and the fact that most of the workers are local people. The local extend due to the surface area of the construction sites. The duration of the impact is temporary due to the limited duration of the construction phase of the project. This impact value is of minor. The sensitivity is considered to be high (local economy). The impact value is of **moderate** importance on the economy and employment.

Mitigation measures

The ESMP will have to include the following measures in order to negative impacts and enhance positive impacts on the economy and employment during the construction phase:

S-C-04: Measures to enhance the positive impact of the direct employment in workforce

- **S-C-04a**: Develop an Employment Plan, with clear employment requirements and procedures such as (in addition the those already included in S-C-03a and S-C-03b):
  - Conduct fair and transparent hiring and staff management procedures ;
  - Recruit and train local workers for certain positions ;
  - Encouraging local women to apply for certain positions ;

  - Apply the code of conduct for workers drawn up by contractors ;
  - Sensitize stakeholders on recruitment modalities in the project areas in accordance with the stakeholder engagement plan prepared for the project ;
  - Employment practices and working conditions should conform to International Labor Organization (ILO) Standards and national regulations ;
  - Ensure the EPC contractors adhere to the national and international core labor standards and implement those in throughout the Project's construction and/or operation phase ;
  - Provide workers with adequate living and working conditions, including rest and recreational facilities and time accommodation should conform to the IFC Guidance Note for Workers Accommodation ;
  - Define rules and clearly communicate on alcohol and drugs to workers ;
  - Standard of accommodation non-discriminatory (no discriminations in nationality, ethnicity, religion) to be documented and communicated transparently to the workforce ;
  - Workers will have contracts in place prior to commencement setting out working conditions, terms of employment and EHS responsibilities ;
  - Prior to the construction phase is ended where the Project will reduce number of labors during operation phase, the project will carry out an analysis of alternatives to retrenchment. The retrenchment plan will be developed and implemented to reduce the adverse impacts of retrenchment on workers;
- A grievance mechanism will be developed for workers and included in the ESMS. Workers will be informed about this mechanism at the time of hiring. Grievance mechanism will be extended to non-employee workers in future.
- **S-C-04b**: Ensure the implementation of the grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances to contractors.

S-C-05: Measures to mitigate the impact on agriculture

- **S-C-05a**: Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.
- **S-C-05b:** Ensure the implementation of a grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances to the company in order to facilitate the management and resolution of concerns.

S-C-06: Measures to enhance positive impact on the supply in material goods and services

- **S-C-06a**: Encourage supplies of equipment, goods, and services from local service providers in order to stimulate the local economy.
- **S-C-06b:** Develop and implement a Supply Chain Management Plan that includes capacity building for local enterprises

S-C-07: Measure to enhance the local socio-economic diversification and improvement with the scale of economic development

- **S-C-07a:** Encourage purchase from small businesses.

The impacts identified on economy and employment for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 138: Potential impacts on economy and employment during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-C-04 Direct employment in workforce	Lot 1 - WTP	Positive	low	Local	Permanent	Minor	High	**Moderate**	**Moderate**
	Lot 10 -STP	Positive	low	Local	Permanent	Minor	High	**Moderate**	**Moderate**
	Lot 8 - Quilonga Grande DC	Positive	low	Local	Permanent	Minor	High	**Moderate**	**Moderate**
	Lot 3 - DC Cacuaco	Positive	low	Local	Permanent	Minor	High	**Moderate**	**Moderate**
	Lot 6 - DC km 30	Positive	low	Local	Permanent	Minor	High	**Moderate**	**Moderate**
	Lot 7 - DC Kapalanga	Positive	low	Local	Permanent	Minor	High	**Moderate**	**Moderate**
	Lot 2 – network	Positive	low	Local	Temporary	Minor	High	**Moderate**	**Moderate**
S-C-05 Impact on agriculture	Lot 1 - WTP	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 10 -STP	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Low	Local	Permanent	Moderate	Low	**Minor**	**Minor**
	Lot 2 – network	Negative	Low	Local	Temporary	Moderate	Low	**Minor**	**Minor**
S-C-06 Supply in materials goods and services	Lot 1 - WTP	Positive	Medium	Regional	Temporary	Moderate	Medium	**Moderate**	**Moderate**
	Lot 10 -STP	Positive	Medium	Regional	Temporary	Moderate	Medium	**Moderate**	**Moderate**
	Lot 8 - Quilonga Grande DC	Positive	Medium	Regional	Temporary	Moderate	Medium	**Moderate**	**Moderate**
	Lot 3 - DC Cacuaco	Positive	Medium	Regional	Temporary	Moderate	Medium	**Moderate**	**Moderate**
	Lot 6 - DC km 30	Positive	Medium	Regional	Temporary	Moderate	Medium	**Moderate**	**Moderate**
	Lot 7 - DC Kapalanga	Positive	Medium	Regional	Temporary	Moderate	Medium	**Moderate**	**Moderate**
	Lot 2 – network	Positive	Medium	Regional	Temporary	Moderate	Medium	**Moderate**	**Moderate**
S-C-07 Local socio-economic diversification and improvement	Lot 1 - WTP	Positive	Low	Local	Temporary	Minor	High	**Moderate**	**Moderate**
	Lot 10 -STP	Positive	Low	Local	Temporary	Minor	High	**Moderate**	**Moderate**
	Lot 8 - Quilonga Grande DC	Positive	Low	Local	Temporary	Minor	High	**Moderate**	**Moderate**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
with the scale of economic development	Lot 3 - DC Cacuaco	Positive	Low	Local	Temporary	Minor	High	**Moderate**	**Moderate**
	Lot 6 - DC km 30	Positive	Low	Local	Temporary	Minor	High	**Moderate**	**Moderate**
	Lot 7 - DC Kapalanga	Positive	Low	Local	Temporary	Minor	High	**Moderate**	**Moderate**
	Lot 2 – network	Positive	Low	Local	Temporary	Minor	High	**Moderate**	**Moderate**

8.3.3.3 Impacts during the operation phase

The impacts identified on economy and employment during the operation phase are the following:

S-O-01: Demand of workforce

During the operation phase of the project, the water and sludge treatment plants, the water distribution centers and the network of pipes for transporting drinking water will be commissioned. The sites will be managed by EPAL, the public service operator for the province of Luanda. The activities will involve maintaining the plant equipment, monitoring the network, and managing the water and sludge treatment plants and the water distribution centers. All these activities require manpower and therefore represent an opportunity for job creations at local level. Several tasks, such as cleaning and site security, also represent job opportunities during the project's operational phase. This impact associated with the job opportunity is positive in nature.

The operation of the pipes (lot 2) will be almost entirely done remotely via the telemetry to be installed in the system and the number of jobs to be created is limited and therefore the value is negligible. For all other Lots, the intensity of the impact is considered to be low due to the limited number of workers at the water treatment plants, sludge treatment plant and well field. The extent of the impact is local because qualified workers the most qualifies personal are likely to be in Luanda and already working for EPAL although they could come from other towns in Angola. The duration of the impact is permanent from the operation phase of the project. The resulting impact factor is moderate. The sensitivity is high (job creation).

S-O-02: Water distribution and sales operator

During the operation phase of the project, the supply of drinking water to the population will have an impact on the truck operators who sell the water and the three-wheeled motorbike water transport and distribution operators in the municipalities. Water truck operators could see their livelihoods seriously compromised because of the project coming on stream. According to the results of surveys, these operators in the municipalities are private individuals who buy treated water from EPAL's cisterns and sell it to people in remote neighborhoods and districts that are not connected to EPAL's network. This system of selling water was a response to the inadequate coverage of drinking water in the study area. It should be noted that water truck operators actively contribute to water supply in these localities and have registered their respective association, ANGOMENHA (Association of Water Collectors and Transporters), which is recognized in the province of Luanda.

These water truck operators supply drinking water to people in these localities, and the price for a 25-litre can is set at 50 Kz. In addition to water truck operators, there are also drivers of three-wheeled motorbikes who carry 500 liters of drinking water to sell to households, including a 20-litre can for 50 Kz and 100 Kz in the event of supply difficulties. These activities have contributed to the formal and informal economy in Luanda province.

The impact is negative because it affects the means of subsistence of these operators and individuals, as well as the economy in the Luanda area. The impact is of medium intensity due to the loss of livelihoods for water truck operators and three-wheeled motorbike drivers. The extent of the impact is local due to the project area. The duration of the impact is permanent due to the duration of the project's operation. The impact factor is assessed as moderate. The sensitivity is high (jobs losses). The resulting impact is considered to be **major**.

Mitigation measures

S-O-01: Measure to enhance the demand of workforce

- **S-O-01a:** Post job vacancies in local areas so that local people can apply for them.
- **S-O-01b:** Recruit and train local workers for certain positions.
- **S-O-01c:** Encouraging local women to apply for certain positions.

S-O-02: Measures to mitigate the negative impacts of the new water distribution and sales operator

- **S-O-02a**: Inform water distribution truck operators and three-wheel motorcycle drivers about the impacts of the project for local populations.
- **S-O-02b:** Ensure the establishment of a complaint's mechanism for individuals and groups to formally communicate their concerns, complaints, and grievances to EPAL in order to facilitate the management and resolution of concerns.

The impacts identified on economy and employment for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 139: Potential impacts on economy and employment during the operation phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-O-01: Demand of workforce	Lot 1 - WTP	Positive	Low	Local	Permanent	Moderate	high	**Moderate**	**Moderate**
	Lot 10 - STP	Positive	Low	Local	Permanent	Moderate	high	**Moderate**	**Moderate**
	Lot 8 - Quilonga Grande DC	Positive	Low	Local	Permanent	Moderate	high	**Moderate**	**Moderate**
	Lot 3 - DC Cacuaco	Positive	Low	Local	Permanent	Moderate	high	**Moderate**	**Moderate**
	Lot 6 - DC km 30	Positive	Low	Local	Permanent	Moderate	high	**Moderate**	**Moderate**
	Lot 7 - DC Kapalanga	Positive	Low	Local	Permanent	Moderate	high	**Moderate**	**Moderate**
	Lot 2 – network	Positive	Negligible	Local	Permanent	Minor	high	**Negligible**	**Negligible**
S-O-02: Water distribution and sales operator.	Lot 1 - WTP	Negative	Medium	Local	Permanent	Moderate	High	**Major**	**Major**
	Lot 10 - STP	Negative	Medium	Local	Permanent	Moderate	High	**Major**	**Major**
	Lot 8 - Quilonga Grande DC	negative	Medium	Local	Permanent	Moderate	High	**Major**	**Major**
	Lot 3 - DC Cacuaco	Negative	Medium	Local	Permanent	Moderate	High	**Major**	**Major**
	Lot 6 - DC km 30	Negative	Medium	Local	Permanent	Moderate	High	**Major**	**Major**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
	Lot 7 - DC Kapalanga	negative	Medium	Local	Permanent	Moderate	High	**Major**	**Major**
	Lot 2 – network	Negative	Medium	Local	Permanent	Moderate	High	**Major**	**Major**

8.3.4 Community health, safety and security

8.3.4.1 Impact Sources

The impact sources on the Community health, safety and security resulting from the project activities are the following:

Construction phase

- Site preparation **(**earthworks, vegetation clearance etc) ;
- Presence and use of heavy machinery and construction equipment ;
- Truck and vehicle road traffic ;
- Generation of solid water and liquid waste ;
- Storage, use and disposal of fuel or hazardous products.

Operation phase

- Production and distribution of drinking water.

8.3.4.2 Impacts during the construction phase

The impacts identified on the public health and safety during the construction phase are the following:

S-C-08: Increase of traffic

During the construction phase of the project, machines, trucks, and vehicles will be used on the various sites. The increase in traffic flow will be associated with the movement of trucks and vehicles supplying equipment and construction materials to the project and the movement of workers to come to the work sites with different means of transport. This flow of traffic will cause impacts on local populations, workers and even the risk of accidents**.** At the level of lot 2, for the pipeline work for the transport of drinking water, the opening of the trenches, storage of materials (sand and gravel) along the axis and the laying of the pipeline pipes will affect traffic in places, large part of them in densely populated areas. The impact of increased traffic is negative for local populations. The intensity of the impact is estimated as high for Lot 2 and medium for the others and due to the movement of vehicles and trucks supplying materials and equipment and arrangements made by contractors for the limitation of vehicles on sites. The extent of the impact is local due to the presence of construction sites in the project area. The duration of the impact is temporary due to the construction phase of the project. The importance is rated minor and the sensitivity high (risk of accidents). The resulting impacts value is **minor to moderate** (Lot 2).

S-C-09: Increase occurrence of communicable diseases

Interaction between workforce and local communities may increase occurrence of communicable disease such as sexually transmitted diseases.

The intensity is medium. The extent of the impact is local due to the presence of construction workers locally. The duration of the impact is temporary due to the construction phase of the project. The importance is rated minor and the sensitivity high. The resulting impacts value is **minor**.

S-C-10: Exposure to air emissions, noise, vibration, waste, and hazardous materials

Project activities may generate quantities of dust in localities which will alter the quality of the air breathed by local populations and project workers. Noisen, vibration and the presence of waste can also affect the nearby residents. Those aspects are already discussed in the chapter of impacts on the physical component.

S-C-11: Disruption to normal community life

The physical presence of a workforce can cause a real or perceived disruption of normal community life and conflicts could result on theft, vandalism, and conflicts. Theft and vandalism and more likely to occurs in remote areas, while conflicts in more densely populated zone.

The intensity is high and the geographical extent of the impact is local due to the presence of construction workers locally. The duration of the impact is temporary due to the construction phase of the project. The importance is rated moderate and the sensitivity high. The resulting impacts value is **major**.

Mitigation measures

The ESMP will have to include the following measures in order to negative impacts and enhance positive impacts on the economy and employment during the construction phase and be part of the Community Health, Safety and Security Plan. The Plan must develop in collaboration with MC of different Lots, particularly for the common transport routes. Special attention should be given to areas with vulnerable groups (e.g. schools)

S-C-08: Measures to mitigate the increase of traffic

- **S-C-08a:** Set up protective barriers around construction sites to limit interference with public vehicles traveling in the area.
- **S-C-08b:** Placement of markers, traffic signs and safety infrastructure (speed bumps, pedestrian crossings) during work in the area.
- **S-C-08c:** Install safety and signaling devices along the routes affected by the pipeline work.
- **S-C-08d:** Raise awareness among populations and workers about the risks related to health, safety, and security on sites.
- **S-C-08e:** Raise awareness about the speed limit in the area.
- **S-C-08f:** Provide an emergency system in the event of an accident associated with project activities.
- **S-C-08g:** Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.
- **S-C-08h** Carry out risk assessments and emergency response planning to consider impacts on local communities.
- **S-C-08i:** Ensure the establishment of a complaint mechanism for individuals and groups to formally communicate their concerns, complaints, and grievances to the company to facilitate the management and resolution of concerns related to nuisances.

S-C-09: Measures to mitigate the increase occurrence of communicable diseases

- **S-C-09a:** Implement a Health Management System for the workforce, to ensure it is fit for work and that it will not introduce disease into local communities.
- **S-C-09b:** Conduct training and awareness raising for workforce on diseases such as HIV and other sexually transmitted diseases, malaria.
- **S-C-09c:** conduct health awareness raising campaigns for communities on similar topics. Where special consideration should be given to differentiated exposure to and higher sensitivity of vulnerable groups.

S-C-10: Measures to mitigate the exposure to air emissions, noise, vibration, waste, and hazardous materials

Mitigation measures proposed to reduce those nuisances will also reduce the impact on the community health.

S-C-11: Measures to mitigate the disruption to normal community life

The physical presence of a workforce can cause a real or perceived disruption of normal community life and conflicts could result on theft, vandalism, and conflicts.

- **S-C-11a:** Adoption of a Stakeholder Consultations and Engagement Plan, as a framework for early and ongoing community consultation.
- **S-C-11b:** Ensure the establishment of a complaint mechanism for individuals and groups to formally communicate their concerns, complaints, and grievances to the company to facilitate the management and resolution of concerns related to disruptions.
- **S-C-11c:** All employees of contractors and sub-contractors, supervision staff with a footprint on the ground in the project area must sign and abide by a Code of Conduct.
- **S-C-11d**: Develop the Community Health, Safety and Security Plan, including Voluntary Principles on Security and Human Rights

The impacts identified on community health, safety and security for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 140: Potential impacts on community health, safety and security during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-C-08 Increase of traffic	Lot 1 - WTP	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 10 - STP	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 6 - DC km 30	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 2 – network	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-C-09 Increase occurrence of communicable diseases	Lot 1 - WTP	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 10 - STP	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 6 - DC km 30	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
	Lot 2 – network	Negative	Medium	Local	Temporary	Minor	high	**Moderate**	**Minor**
S-C-11: Disruption to normal community life	Lot 1 - WTP	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**
	Lot 10 - STP	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**
	Lot 8 - Quilonga Grande DC	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**
	Lot 3 - DC Cacuaco	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**
	Lot 6 - DC km 30	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**
	Lot 7 - DC Kapalanga	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**
	Lot 2 – network	Negative	High	Local	Temporary	Moderate	high	**Major**	**Moderate**

8.3.4.3 Impacts during the operation phase

S-O-03: Access to reliable potable water supply

During the operational phase of the project, the drinking water treatment plant, the water pumping station and the water distribution centers will be brought into service. According to data collected during socio-economic surveys in the various municipalities, drinking water supply in the Province of Luanda is provided by the company EPAL, which is responsible for water collection, equipment maintenance, treatment, supply and distribution. EPAL is the only public service provider in Luanda province, and because of leaks in the supply system, it only supplies 60 % of its capacity to households (57 liters per person per day) that are connected to the networks. Households not connected to the network obtain their water from standpipes, tanker operators and domestic water tanks. It should be noted that the water tanker operators buy water treated by EPAL for resale to households in the various neighborhoods and districts that are not connected to the networks.

The situation as it emerges from the socio-economic surveys of July and August 2023 shows that some municipalities rely mainly on these water tankers (Km30, Kapalanga, Bom Jesus). Households buy 20-litre cans to store water at home and pay 50 Kz for a 20-litre can of water. The water is transported by three-wheeled motorbikes called Kupapata (a motorbike can carry up to 500 liters of water and goes from house to house selling the water, generally charging 50 Kz for each 20-litre can). In the event of breakdowns in the water supply, the price of the cans rises to 100 Kz.

Household budgets for drinking water vary according to the type of water point, the method of transporting water from the house to the water point, the size of the household and its financial capacity. Once the plants are up and running, and the supply network from the distribution centers to the community is constructed, they will be able to supply drinking water in sufficient quantity and quality to households, thereby improving their access to drinking water and reducing the time and distances travelled to purchase water, as well as supply-related expenses. The quantity of water will enable households to do their washing at home, which will reduce the presence of laundry detergents on the river Kwanza, thus reducing the rate of dumping of soaps and detergents on the river Kwanza. Thanks to the connections to the network of the main public supplier EPAL in the municipalities, more than 5 million people will benefit from the project, with a capacity of 95 liters per person per day, households will benefit from water service 24 hours a day, 365 days a year.

However, there is a risk of illegally accessing the new water supply. Even if the supply network is not part of the scope of the current ESIA this must be evaluated in the future.

The impact of access to reliable potable water supply in municipalities is positive. The intensity of the impact is assessed as high due to the number of households that will be connected to the networks of the public operator EPAL. The impact extended is regional, as it will facilitate access to drink water for a large number of people living in the eastern part of Luanda province. The impact is expected to be permanent, as the facilities will operate 24 hours a day, 365 days a year and for many years. The sensitivity is high and the significance of the impact is **major**.

S-O-04: Improvement of life quality of local population

During the project's operational phase, the supply of drinking water will make a significant contribution to improving the living conditions of local populations in the eastern part of Luanda province. Improving conditions of access to water will help to reduce the distances and waiting times for people at standpipes, significantly reduce the cost of individual connections, reduce, or even eliminate water cuts, significantly reduce the amount spent on purchasing water, and improve people's hygiene and health. This will considerably reduce the risk of contamination by certain water-borne diseases and help to improve the general health of the population. In addition, the workers will be recruited locally, they will work to earn money and look after their families, which will have an impact on improving their living conditions. The impact on improving of life quality of local population is positive. The intensity of this impact is assessed as medium as it will contribute to the improvement in hygiene and health conditions for the population and the recruitment of more than 80 % of workers at local level. The impact extended is regional as it will affect many people living in the eastern part of Luanda province. The duration of the impact is assessed as permanent due to the water supply throughout the project's operating period. The importance of the impact on the improvement of life quality of local population is **major**.

Mitigation measures

The ESMP will have to include the following measures to negative impacts and enhance positive impacts on the community health and safety during the operation phase:

S-O-03: Measures to enhance access to reliable potable water supply

- **S-O-03a:** Assure maintenance of the whole system and pipelines to avoid leaks, eliminate water cuts and other disturbances as well as reliable delivery of water of suitable quality.
- **S-O-03b:** Provide external tapping point or use a community standpost to provide drinking water for households without adequate sanitary facilities.
- **S-O-03c:** Collect medical and social data to illustrate improvements.
- **S-O-03d**: Assess and prevent illegal access to water.

S-O-04: Measures to enhance the Improvement of life quality of local population

- **S-O-04a:** Measures already provided above (enhance access to potable water) are also applicable here.

The impacts identified on community health, safety and security for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 141: Potential impacts on community health, safety and security during the operation phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual impact
		Value	Intensity	Extend	Duration				
S-O-03: Access to reliable potable water supply	Lot 1 - WTP	Positive	High	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 10 - STP	Positive	High	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 8 - Quilonga Grande DC	Positive	High	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 3 - DC Cacuaco	Positive	High	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 6 - DC km 30	Positive	High	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 7 - DC Kapalanga	Positive	High	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 2 – network	Positive	High	Local	Permanent	Major	High	**Major**	**Major**
S-O-04: Improvement of life quality of local population	Lot 1 - WTP	Positive	medium	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 10 - STP	Positive	medium	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 8 - Quilonga Grande DC	Positive	medium	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 3 - DC Cacuaco	Positive	medium	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 6 - DC km 30	Positive	medium	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 7 - DC Kapalanga	Positive	medium	Regional	Permanent	Major	High	**Major**	**Major**
	Lot 2 – network	Positive	medium	Regional	Permanent	Major	High	**Major**	**Major**

8.3.5 Infrastructures and services

8.3.5.1 Impact Sources

The impact sources on the infrastructures resulting from the project activities are the following:

Construction phase

- Presence and use of heavy machinery and construction equipment ;
- Truck and vehicle road traffic ;
- Energy consumption ;
- Generation of construction waste.

Operation phase

- Energy Consumption.

8.3.5.2 *Impacts during the construction phase*

The impacts identified on the infrastructures during the construction phase are the following:

S-C-12: Interference on roads/infrastructures

During the construction phase of the project, the road infrastructure may be affected by the traffic of vehicles and site machinery due to movements to supply the sites with construction materials and various logistical operations. In addition, the pipeline works will require the sinking and opening of trenches, which may affect certain services along the 100-kilometre route. The results of the socio-economic surveys carried out in the project area show that the municipalities are accessible via the Luanda province road network. Some of the roads in the municipalities are asphalted and passable, while others are dirt roads that are sometimes damaged during the rainy season. The use of roads during the rainy season by vehicles and equipment, as well as by trucks for supplying the project, will damage the road infrastructure. It should be noted that lot 2 is located close to the roads and the houses and dwellings are far away. However, the survey did not cover the entire 100 kilometers of the transport network to check for possible interference with services. The impact resulting from the demand for road transport is negative in nature. The intensity of the impact is low due to traffic limitations for all sites, except Lot 2 (medium). The magnitude of the impact is local due to the project area of influence. The duration of the impact is temporary due to the limited duration during the construction phase. The significance of this potential impact on road infrastructure is considered minor. The sensitivity is medium due to already existing traffic conditions. The resulting impact factor is **minor**.

S-C-13: Energy consumption

During the construction phase of the project, power will be supplied from the national grid in Luanda province. For the construction works, the contractors will use electricity from the national grid in the province of Luanda. For lot 2, in addition to the electricity grid, the contractor will also use diesel generators for alternating current. The construction phase will therefore not have a significant impact on the electricity network. Fuel will also be required for machinery and vehicles. The construction phase will therefore have no significant impact on the electricity network. Fuel will also be required for machinery and vehicles.

Concerning the water distribution centers (lot 3, lot 6, lot 7) and the water treatment, water pumping and sludge treatment plants (lot 1, lot 8 and lot 10), the negative impact resulting from the demand for energy sources will be of low intensity because the project will use limited quantities of electricity during construction. The extent of the impact is local due to the source of energy coming from the province of Luanda and of permanent duration due to the construction and operation phase of the sites. The significance of this potential impact on infrastructure is considered **minor**.

For lot 2, the intensity of the impact is assessed as low due to the limited use of electrical energy during the works, the extent is local due to the project area and the duration is temporary due to the construction phase of the project. The sensitivity is considered medium and the resulting impact value is **minor**.

S-C-14: Generation of construction waste

During the construction phase of the project, the disposal of solid waste and wastewater associated with the work in the various municipalities will result in variable quantities of waste being discharged into the environment. The disposal of solid waste and wastewater on the sites should be carried out to ensure the health of the local population. According to the data covered by the socio-economic survey in the project area, coverage of the public sewerage network is deficient in the municipalities, and the average number of connections to a septic tank is 85.4 %. To manage waste disposal, containers belonging to the operator Vista have been placed in the neighborhoods, enabling people to dispose of their household waste. VISTA WASTE is the Luanda provincial government's contractor for waste collection and urban and municipal cleaning.

For the water distribution centers, the contractors in charge of carrying out the work have set up a system for disposing of solid waste from the works and evacuating around 15,000 liters of liquid waste per month for each lot, including lot 3, lot 6, lot 7 and lot 8. For lot 2, the contractors plan to dispose of 60,000 liters of liquid waste per month on site.

During the construction phase of the project, the impact resulting from the demand for waste disposal and wastewater treatment is of a negative nature. The intensity of the impact is low because the quantity of waste produced during construction is limited. The contractors have planned for the proper disposal of solid and liquid waste but the extension of impact was considered regional due to the fact that that disposal sites are not yet defined. The duration of the impact is temporary due to the limited duration during the construction phase. The significance of this potential impact on infrastructure is considered **minor**.

Mitigation measures

The ESMP will have to include the following measures to negative impacts and enhance positive impacts on the infrastructures during the construction phase:

S-C-12: Measures to mitigate the interference on roads/Infrastructures

- **S-C-12a:** Avoid and minimize the interference of the work on lot 2 for the water transmission pipeline network on services and activities along the 100-kilometre route, including vendors, traders, informal business and access to schools, households. Specific measures should be developed once a detailed inventory on project-affected people is conducted as part of the LRP.
- **S-C-12b:** Inform the local authorities of the schedule of activities that will result in the interruption of infrastructure networks and of measures to limit the impact on local communities.
- **S-C-12c:** Giving instructions to suppliers on speed limits and roads to be used.
- **S-C-12d:** Ensure the maintenance of unsealed roads in the districts.
- **S-C-12e:** Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.
- **S-C-12f**: Access alternative routes for the communities during construction and inform stakeholders.

S-C-13: Measures to mitigate the impacts of energy consumption

- **S-C-13a:** Implement energy saving practices.
- **S-C-13b:** Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.

S-C-14: Measures to mitigate the generation of construction wastes (in addition to those already listed in the chapter 8.1.3.2)

- **S-C-14a:** Store solid waste in a place well away from people and workers until it has been disposed of.
- **S-C-14b** Set up a waste sorting system on sites to separate waste by category.
- **S-C-14c:** Ensure the regular proper disposal of solid and liquid waste produced during construction work.

- **S-C-14d:** Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.

Other mitigation measures proposed to reduce construction waste proposed in the impact assessment chapter of the physical component will also reduce the impact on the infrastructure and services.

The impacts identified on infrastructure for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 142: Potential impacts on infrastructures and services during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	
		Value	Intensity	Extend	Duration				
S-C-12 Interference on Roads/Infrastructures	Lot 1 - WTP	Negative	Low	Local	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 10 - STP	Negative	Low	Local	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Local	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Local	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Local	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Low	Local	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 2 – network	Negative	medium	Local	Temporary	Minor	Low	**Minor**	**Minor**
S-C-13 Energy consumption	Lot 1 - WTP	Negative	Low	Local	Temporary	Minor	medium	**Minor**	**Minor**
	Lot 10 - STP	Negative	Low	Local	Temporary	Minor	medium	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Local	Temporary	Minor	medium	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Local	Temporary	Minor	medium	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Local	Temporary	Minor	medium	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Low	Local	Temporary	Minor	medium	**Minor**	**Minor**
	Lot 2 – network	Negative	Low	Local	Temporary	Minor	medium	**Minor**	**Minor**
S-C-14 Generation of construction waste	Lot 1 - WTP	Negative	Low	Regional	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 10 - STP	Negative	Low	Regional	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Regional	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Regional	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Regional	Temporary	Minor	Low	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Low	Regional	Temporary	Minor	Low	**Minor**	**Minor**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	
		Value	Intensity	Extend	Duration				
	Lot 2 – network	Negative	Low	Regional	Temporary	Minor	Low	**Minor**	**Minor**

8.3.5.3 Impacts during the operation phase

The impacts identified on the infrastructures during the operation phase are the following:

S-O-05: Energy consumption

During the operational phase of the project, energy will be supplied by the national electricity grid in the province of Luanda. This energy will be needed to operate the various water treatment, pumping and sludge treatment plants, as well as the drinking water distribution centers. In addition to electrical power, the project will use 5 x 25,000 KA diesel generators as an alternative source of energy at the pumping and water treatment station in the event of a power cut or failure in the national grid. Energy consumption during the operating phase will have an impact on the electricity network in terms of the project's requirements. The negative impact resulting from energy consumption will be of medium intensity due to the use of electricity from the national grid and is permanent. The extent of the impact is local due to the source of energy coming from the province of Luanda and of permanent duration due to the period of operation of the project. The significance of this impact is considered **minor**.

Mitigation measures

The ESMP will have to include the following measures in order to mitigate the impacts on the ecosystem services during the operation phase:

S-O-05: Measures to mitigate the impact of energy consumption

- **S-O-05a:** Implement energy saving practices.
- **S-O-05b:** Inform stakeholders of potential impacts due to project activities and mitigation measures planned throughout the project.

The impacts identified on infrastructure for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 143: Potential impacts on infrastructure and services during the operation phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual Impact
		Value	Intensity	Extend	Duration				
S-O-05: Energy Consumption	Lot 1 - WTP	Negative	Medium	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 10 -STP	Negative	Medium	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Medium	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Medium	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Medium	Local	Permanent	Minor	Low	**Minor**	**Minor**

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual Impact
		Value	Intensity	Extend	Duration				
	Lot 7 - DC Kapalanga	Negative	Medium	Local	Permanent	Minor	Low	**Minor**	**Minor**
	Lot 2 – network	Negative	Medium	Local	Temporary	Minor	Low	**Minor**	**Minor**

8.3.6 Landscape and visual quality

8.3.6.1 Impact Sources

The impact sources on the landscape and visual quality resulting from the project activities are the following:

Construction phase

- Site preparation (earthworks, vegetation clearance etc) ;
- Presence and use of heavy machinery and construction equipment ;
- Generation of construction waste.

Operation phase

- Production and distribution of drinking water.

8.3.6.2 Impacts during the construction phase

The impacts identified on landscape and visual quality during the construction phase are the following:

S-C-15: Visual disturbance

During the construction, the visual disturbance to the nearby population will be due to the presence of machines, vehicles, construction material, storing of temporary land-take and waste etc. particularly to existing settlements given the close proximity of sensitive receptors. Light emissions can also cause nuisance and disturbance to sensitive receptors.

The impact is of medium intensity due to the dispersed removal of land in the various districts. The extent of the impact is project site, as it will affect the construction areas and will be temporary as it last during the construction phase of the project. The significance of the impact is assessed as minor. The sensitivity is considered low. The impact value is **minor**.

Mitigation measures

S-C-15: Measures to mitigate the visual disturbance

- **S-C-15a**: Where practicable, position equipment, storage containers, and stockpiles out of the sight-line of adjacent receptors.
- **S-C-15b**: Where practicable, use appropriate fencing/hoarding to keep site activities from view.
- **S-C-15c**: Avoid Ordering of surplus construction materials.
- **S-C-15d**: Store stockpiled wastes in areas with easy access for waste trucks.
- **S-C-15e**: Where practicable, restrict construction activities to daylight hours.

Mitigations measures to reduce traffic and waste will also contribute to minimize the visual disturbance and impacts on the landscape.

The impacts identified on landscape and visual quality for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 144: Potential impacts on landscape and visual quality during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residuam impact
		Value	Intensity	Extend	Duration				
S-C-15: Visual disturbance	Lot 1 - WTP	Negative	Medium	project site	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 10 - STP	Negative	Medium	project site	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Medium	project site	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Medium	project site	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Medium	project site	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Medium	project site	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 2 – network	Negative	Medium	project site	Temporary	Minor	Medium	**Minor**	**Minor**

8.3.6.3 Impacts during the operation phase

The impacts identified on the landscape and visual quality during the operation phase are the following:

S-O-07: Presence of new buildings

During the operation phase of the project, the municipalities will house the presence of the new buildings constructed, the water treatment stations, the sludge treatment station, the catchment field as well as the buried pipeline network. some lands selected for the project are in a semi-natural state, so all these infrastructures will give a new appearance to the municipality of Icolo and Bengo, Viana and Cacuaco.

The impact of the presence of project infrastructures is assessed as positive, the intensity of the impact is assessed as medium due to the urbanization of the sites. The extent of the impact is local due to their visibility in the project area. The impact is permanent over the duration of the project's operation. The importance of this impact is considered **moderate**.

Lot 2 will be above ground and therefore will not have a visual impact.

Mitigation measures

S-O-07: Measures to mitigate the impact of the presence of new buildings

- **S-O-07a:** Plant gardens and flowers around the sites to make the land green.
- **S-O-07b:** Take care of watering and maintenance of the gardens.
- **S-O-07c:** Assure permanent building maintenance.

- **S-O-07d:** Painted building with colors that blend with the sky and/or background environment.

The impacts identified on landscape and visual for the operation phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 145: Potential impacts on landscape and visual quality during the operation phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residuam impact
		Value	Intensity	Extend	Duration				
S-O-07: Presence of new buildings	Lot 1 - WTP	Positive	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Moderate**
	Lot 10 -STP	Positive	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Moderate**
	Lot 8 - Quilonga Grande DC	Positive	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Moderate**
	Lot 3 - DC Cacuaco	Positive	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Moderate**
	Lot 6 - DC km 30	Positive	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Moderate**
	Lot 7 - DC Kapalanga	Positive	Medium	Local	Permanent	Moderate	Medium	**Moderate**	**Moderate**

8.3.7 Cultural Heritage

8.3.7.1 Impact Sources

The impact sources on the cultural heritage resulting from the project activities are the following:

Construction phase

- Land acquisition ;
- Site preparation ;
- Presence and use of heavy machinery and construction equipment ;
- Truck and vehicle road traffic.

Operation phase

During the operating phase of the project, there is no foreseeable impact on the natural heritage of the area and archaeology.

8.3.7.2 Impacts during the construction phase

The impacts identified on the heritage cultural during the construction phase are the following:

S-C-16: Impacts on natural heritage

During the construction phase of the project, earthworks, excavations, excavation work, site fencing as well as the construction of buildings and infrastructure could have impacts on the natural heritage of the area. For instance, the displacement or damage to archaeological, historic, or recent cultural heritage sites, harm to local setting and amenity value.

According to socio-economic surveys carried out in the study area, the province of Luanda is full of natural heritage (35 % of all natural heritage sites classified in the country). Classified natural heritage sites close to the project area include:

- São José do Calumbo Church, near the Kwanza River, in Calumbo - 18th century building, listed by Dispatch (portaria) n. 10678, from March 1959: 9 km south of Zango V DC ; 17 km west of the sampling point;
- Location of Battle of Kifwangondo, in Cacuaco, classified by Dispatch n. 284/04, from December 2004: 9 km north of Cacuaco DC;
- Historical Mark Mulemba Wacha NGola, classified by Dispatch n. 18/97, from May 1997.
- The first intangible heritage classified and protected under Angolan law is “REBITA” music and dance, classified in 2019.

Rebita and Semba are musical and dance expressions that develop throughout Angola, including Luanda, associated with music and dance schools, events and festivities, so they are likely to occur in the project area. In addition to the tangible and intangible heritage close to the project areas, there are also archaeological stations at Bom Jesus in the municipality of Icolo and Bengo. These archaeological stations revealed the presence of Stone Age artifacts in low terraces on the right bank of the Kwanza River, in 5 different locations. The impact on cultural heritage is negative in nature, the intensity of the impact is assessed as <u>low</u> due to the shallow depth of the excavations and the distance of identified material heritage and archaeological stations from the construction sites. The extent of the impact is <u>local</u> as it will affect the project area and the duration is <u>temporary</u> due to the construction phase of the project. The significance of the impact on natural heritage is assessed as <u>minor</u> and the sensitivity <u>medium</u>. The impact value is considered **minor**.

Mitigation measures

The ESMP will have to include the following measures in order to mitigate the impacts on the cultural heritage during the construction phase:

<u>S-C-16: Measures to mitigate the impacts on cultural heritage</u>

- **S-C-16a**: Conduct careful site selection of all Lots, taking account of any community consultation/specialist surveys.
- **S-C-16b**: Develop a Cultural Heritage Management Plan covering tangible and intangible (e.g., local traditions and practices) cultural heritage. The plan will detail a chance finds procedure.
- **S-C-16c** Raise awareness among project workers about respecting the intangible heritage of the locality.
- **S-C-16d:** Establish a procedure in the event of chance discoveries of an archaeological object.
- **S-C-16e:** If an object is discovered during the work, be sure to stop the work and declare the object to the country's authorities.

The impacts identified on cultural heritage for the construction phase are summarized in the table below. The residual impact presents the impact value reassessed after the implementation of the mitigation measures defined here above.

Table 146: Potential impacts cultural heritage during the construction phase and residual impact after implementation of mitigation measures

Impact	Site	Impact criteria				Impact factor	Sensitivity	Impact value	Residual value
		Value	Intensity	Extend	Duration				
S-C-16 Impacts of cultural heritage	Lot 1 - WTP	Negative	Low	Local	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 10 -STP	Negative	Low	Local	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 8 - Quilonga Grande DC	Negative	Low	Local	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 3 - DC Cacuaco	Negative	Low	Local	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 6 - DC km 30	Negative	Low	Local	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 7 - DC Kapalanga	Negative	Low	Local	Temporary	Minor	Medium	**Minor**	**Minor**
	Lot 2 – network	Negative	Low	Local	Temporary	Minor	Medium	**Minor**	**Minor**

8.3.7.3 Impacts during the operation phase

During the operating phase of the project, there is no foreseeable impact on the natural heritage of the area and archaeology.

8.4 Ecosystem Services Assessment

The following Ecosystem Services Assessment (ESA) has been conducted in compliance with international best practices, namely International Finance Corporation (IFC)'s Performance Standards (PS). The objectives of the ESA are to :

- Identify the abundance of natural resources used by the local populations and characterize their seasonal variation, where possible.
- Identify existing and potential threats to areas recognized as important for natural resource use.
- Establish the significance (use, financial importance, and level of dependency) of ecosystems in provisioning, regulating, cultural and supporting services for local communities.
- Identify the nature and extent of ecosystem services within the Project area and its vicinity.
- Identify priority ecosystem services (Types I and II) based on a systematic review and prioritization process.

8.4.1 Definition of Ecosystem ServicEcosystem Services

An ecosystem is defined as a dynamic complex of plants, animals, micro-organisms, and non-living components interacting as a functional unit (MEA, 2005). Human communities are an integral part of ecosystems and are beneficiaries of many goods and services they provide. These benefits are recognised as Ecosystem Services

The concept of Ecosystem Services has grown in importance over the last decade, particularly following the Millennium Ecosystem Assessment (MEA). The definition of this concept comes from the evaluation report, which states that such services are the benefits people obtain from ecosystems (MEA, 2005; IFC, 2019).

Ecosystem Services could be considered as the direct and indirect contributions of ecosystems to human well-being (Kumar, 2010).

Ecosystem Services are grouped into four categories:

- Provisioning services: which refer directly to products people obtain from ecosystems (e.g. agricultural products, plants to eat, game, medicinal plants, fresh water, biofuel, timber, etc.) ;
- Regulating services: which are the benefits humans obtain from the regulation of ecosystem processes (e.g. climate regulation, waste decomposition, purification of water and air, etc.) ;
- Cultural services: which refer to the non-material benefits people obtain from ecosystems (e.g. sacred and spiritual sites, ecotourism, education, etc.) ;
- Supporting services: which are the natural processes that maintain the other services (e.g. nutrient cycling, genetic production and genetic exchange channels, etc.).

Ecosystem Services are divided into two types according to IFC's PS 6 (2019):

- Type I: Provisioning, regulating, cultural and supporting ecosystem services, over which the promoter (EPAL) has direct management control or significant influence, and where impacts on such services may adversely affect communities ;
- Type II: Provisioning, regulating, cultural and supporting ecosystem services, over which the promoter (EPAL) has direct management control or significant influence, and on which the project directly depends for its operations.

The Ecosystem Services Assessment is completed to identify Ecosystem Services provided within the Project's Area of Influence (AoI) or ecologically associated with on-site ecosystems, and to determine the Priority Ecosystem Services (PES) as prescribed in IFC's PS6.

The PES are classified into two categories according to specific circumstances (IFC, 2019):

Type I Ecosystem Services will be considered priority under the following circumstances:

- Project operations are likely to result in a significant impact on the Ecosystem Services ;
- The impact will result in a direct adverse impact on affected communities' livelihood, health, safety and/or cultural heritage ; and
- The project has direct management control or significant influence over the Ecosystem Services .

Type II Ecosystem Services will be considered priority under the following circumstances:

- The project directly depends on the Ecosystem Services for its primary operations ; and,
- The project has direct management control or significant influence over the Ecosystem Services.

The PES identified will need to be considered as part of the impact assessment to detail project related impacts and apply the mitigation hierarchy.

8.4.2 Ecosystem Services Area of Influence

As the ESA is based on the baseline and impact assessment information and stakeholders concerns on Ecosystem Services use in the Project AoI, the Ecosystem Services AoI encompasses both the physical, biological, and social areas of influence described in Chapter 5.0, depending on the Ecosystem Services assessed.

8.4.3 Methodology

The information collected during the desktop study, field visit and stakeholder consultations was used to describe ecosystem services and identify priority ecosystem services (PES) in the Project AoI. PES have been identified based on the following prioritization criteria (Table 147):

- Level of dependence on the Ecosystem Services – for affected communities and their well-being (Type I) or for Project performance (Type II) ;
- Interaction with drivers of change on Ecosystem Services (Type I) or with Project operations (Type II) ;
- Replaceability/Management potential – accessibility and efficiency of possible alternative to the affected Ecosystem Services .

Table 147: Ecosystem Services prioritization criteria

LEVEL OF DEPENDENCE ON THE ECOSYSTEM SERVICES – FOR AFFECTED COMMUNITIES AND THEIR WELL-BEING (TYPE I) OR FOR PROJECT PERFORMANCE (TYPE II)	
Low	A few households/communities are beneficiaries for this given Ecosystem Services or this Ecosystem Services contributes slightly to their well-being (Type I) or the Project depends slightly on Ecosystem Services and its performance is slightly affected by the loss. The intensity of use and the degree of dependence are low.
Medium	Benefit from the Ecosystem Services is important among local communities or generalised for given groups (Type I) or the Ecosystem Services loss could affect Project performance without compromising it (Type II). Intensities of benefit and degrees of dependence are variable.
High	Widespread or significant benefit for local communities and Ecosystem Services is of major importance for them (Type I). Project performance is considerably reduced by the Ecosystem Services loss (Type II). Benefit is high and degree of dependence is major.
Interaction with drivers of change on Ecosystem Services (Type I) or with Project operations (Type II)	
Low	The Ecosystem Services can slightly be impacted without significantly changing its availability for beneficiaries or for Project performance. The disturbance can be within the normal range of natural variations.
Medium	The Ecosystem Services can be altered at a point where the availability for beneficiaries or for Project performance can be reduced. However, the impact does not threaten the long-term viability of the ecosystem which provides the Ecosystem Services .
High	The Ecosystem Services can be lost, or a significant proportion of its availability could be reduced for beneficiaries or for Project performance. The long-term viability of the ecosystem which provides the Ecosystem Services is threatened.
Replaceability/Management potential – accessibility and efficiency of possible alternative to the Ecosystem Services affected	
High	Many accessible and effective alternatives for beneficiaries
Medium	Some alternatives exist even if they are less favourable. Beneficiaries can access to the Ecosystem Services considering their capacity to pay or to find an effective alternative.
Low	Highly specific Ecosystem Services , with no alternatives easily accessible or effective.

The first step of the PES identification process is the description of the level of dependence and replaceability of Ecosystem Services provided inside the study area. With the use of a matrix (Table 148), it is then possible to identify the Ecosystem Services that are more prone to be identified as a PES. When the replaceability of an Ecosystem Services is high, it cannot be a PES. Drivers of change on Ecosystem Services are identified by the analysis of anticipated impacts on physical, biological, and social components related to Project activities.

Table 148: Determination matrix for assessment of Ecosystem Services

Level of dependence	Interaction project drivers of change and operations	Replaceability	Priority ecosystem service
Low	Low	Low	Not PES
		Medium	Not PES
		High	Not PES
	Medium	Low	Not PES
		Medium	Not PES
		High	Not PES
	High	Low	PES
		Medium	Not PES
		High	Not PES
Medium	Low	Low	Not PES
		Medium	Not PES
		High	Not PES
	Medium	Low	PES
		Medium	Not PES
		High	Not PES
	High	Low	PES
		Medium	PES
		High	Not PES
High	Low	Low	Not PES
		Medium	Not PES
		High	Not PES
	Medium	Low	PES
		Medium	PES
		High	Not PES
	High	Low	PES
		Medium	PES
		High	Not PES

8.4.4 Identification of Ecosystem Services

The assessment of ecosystem services focused exclusively on terrestrial and freshwater ecosystems, present in the AoI. The following Table 149 presents the analysis carried out by habitat.

The Project AoI is mostly made up of urban areas and anthropogenic activities, with some areas covered by natural habitats. Four types of natural habitats are considered and will be referred to in the ESA. These habitats are:

- Dry Adansonia woodland ;
- Dry shrubland ;
- Floodplain ;
- Kwanza River.

For more information on the habitats of the Project AoI, see the biological baseline in Chapter 5.4.2.

Natural and modified habitats have multiple vocations associated with a range of uses by local communities:

- Provisioning Ecosystem Services are mainly associated with specific species of use value found inside the study area ;
- Regulation Ecosystem Services and support Ecosystem Services are related to interaction between biophysical and social components at a wider scale ;
- Cultural Ecosystem Services are mainly associated with specific habitats inside the study area, for tourism and recreation for instance.

Due to their complexity and overarching quality, support Ecosystem Services have not been specifically assessed inside the AoI but are known to contribute to all types of Ecosystem Services.

Table 149: Ecosystem Services : Ecosystem Services provided inside the Project AoI

Ecosystem services	Definition
Provisioning Services	
Agricultural potential and production (Type I)	Areas with agricultural potential, including all crops and agricultural products grown by local communities for human and livestock consumption.
Livestock and forage resources (Type I)	Forage resources, water and others supporting livestock and animals owned for consumption, domestic or commercial uses.
Hunting and bush meat (Type I)	Animal species trapped or hunted for consumption, including insects, mammals, birds, amphibians and reptiles.
Fishing (Type I)	Fish species collected in the Kwanza River for domestic food or for commercialization
Wild food products (Type I)	Products collected in the wild for food, other than animal proteins (vegetal products, mushrooms or honey).
Traditional medicine (Type I)	Mineral, plant or animal used to maintain people's health as well as to prevent, diagnose, treat or care for physical and mental diseases.
Building. carpentry and craft materials (Type I)	Mineral or vegetal material (ligneous or non-ligneous) used for construction purposes, to construct furniture and to make craft objects.
Biofuel (Type I)	Animal or vegetal products used as energy sources.
Water resources (Type I and 2)	Surface water used as tap water or for domestic. Comprises all the natural processes that regulate its quality or quantity.
Regulation Services	
Air quality control (Type I)	Ecosystems influence in terms of gases exchange or filtration of physical or chemical particles in the air (e.g., dust, O_2, CO_2).
Climate regulation (Type I)	Global: Ecosystems influence the absorption or emission of green gases and in the regulation of air masses.

Ecosystem services	Definition
	Regional and local: Ecosystems influence on regional and local temperatures, rainfalls or on other climatic parameters.
Water regulation (Type II)	Ecosystems influence on the amplitude and period of water flow, water storage, aquifer filling and flood prevention.
Erosion control (Type I)	Ecosystems prevent erosion by retaining soil and by intercepting rainfall, reducing the speed of runoff, etc.
Cultural Services	
Sacred or heritage components (Type I)	Cultural or religious value that population attaches to an ecosystem, a place or a species. Tangible cultural heritage buildings or constructions, or archaeological sites linked to archaeological remains.
Recreation and tourism (Type I)	Nature, particularly protected areas and wildlife plays an important role in supporting tourism. Ecosystems and biodiversity are therefore an important source of employment and income generation.
Support Services	
Primary production (Type I)	Production of organic matter by plants through photosynthesis and nutrient input. It forms the basis of the food chain.
Nutrients cycle (Type I)	Nutrients cycle in the ecosystems (phosphorus, nitrogen, carbon, sulfur, etc.).
Habitat (Type I)	Natural or modified areas which support flora and fauna communities.
Water cycle (Type I and II)	Water transition through different receptors (atmosphere, terrestrial and aquatic habitats) in all its phases (solid, liquid and gaseous).

The following sections describe Ecosystem Services for which an impact is anticipated from the Project's implementation. The description will allow a general understanding of the Ecosystem Services inside the Project AoI, including its availability and distribution, the local population's use of the Ecosystem Services and its dependency as well as the potential interaction of the project with the Ecosystem Services . This information will be the basis for the selection of PES according to the prioritization criteria and the determination matrix presented in the previous section.

8.4.4.1 Provisionning ecosystem services

Agricultural potential and production

According to Social baseline, agriculture and fishing are a source of income for a few households in the local population of the Project AoI, as existing farmers have been identified in the communities around the project AoI. Most people engaged in agricultural activities in Luanda are subsistence farmers, as there isn't much open land for commercial farming. Of the five neighborhoods that were part of the sample, only agricultural surveys were carried out in two locations: Cacuaco and Ícolo e Bengo. The remaining three localities are primarily urban areas. Table 150 shows cultivated crops in the Project AoI. Agricultural activities are carried on by both men and women.

Table 150: Agricultural crops cultivated in the Project AoI

Location	Crops cultivated
Lot 3 CD 3 area - Cacuaco	Kale, lettuce, gimboa, tomato, onion and jindungo
Lot 1 WTP/ Lot 10/ Lot 8 area – Ícolo and Bengo	Okra, tomato, onion, cucumber, gindungo, mangoes, guava, cassava, corn, banana

Most of the population of Bom Jesus has as a means of subsistence agriculture, fishing, and sale of agricultural products, and few have a formal job. Interaction between the Project and the agricultural potential and production is expected to be significant given the small land area available for agriculture in the Project AoI. However, the Project could also have benefits on remaining agricultural potential if water supply pipelines are planned accordingly.

Table 151 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 151: Assessment of agricultural potential and production against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: Limited number of households and individual are dependent on this Ecosystem Services in the Project AoI. And only 9 % of the AOI for the biodiversity component is considered small scale farming . Most of it in the Lot 3, Lot 1/10/3 area and some sections of Lot 2 in Cacuaco and Ícolo e Bengo (see chapter Baseline Land use in the AoI)
Interaction with drivers of change on Ecosystem Services or with project operations	Medium: The agricultural potential can be altered at a point where the availability for beneficiaries or for Project performance can be reduced. That However, the impact does not threaten the long-term viability of small scale farming which provides the Ecosystem Services
Replaceability/Management potential	Medium : Management measures can potentially reduce the impacts on agriculture and the Project can generate benefits for local agriculture. However there are the limited land area available for agriculture in the Project AoI.
Priority ecosystem services	**Not a PES**

Livestock and forage resources

For rural households, keeping livestock plays a significant economic and socio-cultural role in maintaining the well-being of farm families by providing food security, nutrition, income, soil productivity, transport, agricultural traction, and diversification. Livestock is mainly farmed in the southern provinces of Huíla, Cunene, Benguela, Huambo and Namibe (outside the AoI). In urban areas such as Luanda, the dependence on livestock is slightly less significant and is generally on a smaller subsistence scale but remains essential. Due to Luanda's rising population and associated urban sprawl, open space for grazing larger animals such as cattle is in short supply.

Table 152 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 152: Assessment of livestock potential and forage resources against Ecosystem Services prioritisation criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: Limited number of households and individual are dependent on this Ecosystem Services in the Project AoI.
Interaction with drivers of change on Ecosystem Services or with project operations	Low: Interaction between the project and the livestock potential and forage resources is expected to be limited due to the small area of land used for grazing in the Project AoI.
Replaceability/Management potential	Low: Management measures can potentially reduce the impacts and generate benefits for local livestock and forage resources.
Priority ecosystem services	**Not a PES**

Fishing, hunting and bushmeat

Discussions with local people during 2023 field surveys underlined that fishing and hunting still takes place to supplement local diet. In Bom Jesus, only 10 respondents practice fishing on the river, given the proximity to the Kwanza River. Results of informal surveys were carried out seeking to obtain information regarding local fishing practices, species fished, and bycatch are presented in the social baseline (Chapter 5.4.3).

The Bom Jesus is considered a neighborhood of a commune where the fishing activity is quite significant along the Kwanza River, where many of the households are engaged in fishing near the future water abstraction facility, mostly for self-consumption in the household, or to complement the household income. The fishing activity is restricted to a small number of households, close to the kwanza, and not a common activity in all the Bom Jesus Community. Many of the households are engaged in fishing: men as fishermen and women as fishmongers (treatment and marketing of fish). Effects on fish resources would therefore impact livelihood of both men and women.

Referring to wild terrestrial animals used as a food source, all respondents said they did not practice any activity in the forest, such as hunting and gathering products. However, it is important to highlight that in a location (FP018) visited during the performed flora and habitat field survey, children were observed while hunting rodents for food. The consumption of this kind of bushmeat could raise numerous health problems.

Table 153 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 153: Assessment of fishing, hunting, and bush meat against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Medium: Fishing and hunting are not widespread in the Project AoI, so few households' fish and hunt to supplement local diet.
Interaction with drivers of change on Ecosystem Services or with project operations	Medium: Because of the scarcity of bush meat in the Project AoI, construction activities could affect the remaining species that are still hunted by local populations. Although fish activities are mostly located in a restrictive area (Bom Jesus), given the Kwanza River size and flow, the Project is not expected to decrease this Ecosystem Services availability.
Replaceability/Management potential	Medium: Some alternatives exist even if they are less favourable. Beneficiaries can access to the Ecosystem Services considering their capacity to pay or to find an effective alternative.
Priority ecosystem services	**Not a PES**

Wild food products

Since wild food products are sparse in the Project AoI, local communities rarely rely on these species for food and rather use them to supplement their diet when available. According to the local survey questions on ecosystem services, all respondents said they did not practice any activity in the forest, such as hunting and gathering products. However, the Baobab (*Adansonia digitata*), widely present in the natural habitats of the Project AoI, is known as a multi-purpose tree and recently referred to as a “super fruit” based on its nutritional profile:

- the pulp is found to be rich in vitamin C, antioxidants, contain substantial quantities of Ca, K, and Mg
- the leaves are rich in good quality proteins (most essential amino acids). Amino acid analyses revealed high glutamic and aspartic acid contents and the sulfur-containing amino acids as being the most limited amino acids.
- the seeds are a good source of energy, protein and have relatively high lipid content. Oleic and linoleic acids were the major unsaturated fatty acids, whereas palmitic was the major saturated fatty acid.

The pulp, seeds and leaves are all utilized and are essentially wild gathered foods, are consumed daily by rural populations in Africa and are also commercialized. The tuberous tap root of seedlings and young saplings are also eaten, the fruit is used as famine food to prepare decoctions, sauces, porridges, and natural refreshing drinks (Elthair et al., 2019). Although no specific uses of baobabs were recorded during the field surveys, if the Project result in removing baobab trees, it might negatively impact this Ecosystem Services.

Table 154 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 154: Assessment of wild food products against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: Wild food species being sparse in the Project AoI, local communities rarely rely on them for food.
Interaction with drivers of change on Ecosystem Services or with project operations	Medium: Wild food species have been observed in the Project footprint. Project anticipated impacts include loss tree and grass, used as wild food products, resulting from permanent land-take and temporary habitat disturbance
Replaceability/Management potential	Medium: It is most likely that wild food species are available elsewhere in the Project AoI where habitats are similar to those of the Project footprint.
Priority ecosystem services	**Not a PES**

Traditional medicine

No use of the ecosystem for traditional medicine has been observed or recorded during the 2023 field surveys and consultations. However, baobabs (*Adansonia digitata*) are known to be used in the whole African traditional medicine. The pulp is therapeutically employed as febrifuge, analgesic, anti-diarrhea, anti-dysentery and for treatment of smallpox and measles. The various parts of the plant (leaves, bark, and seeds) are used as a panacea to treat almost any disease and specific documented uses include the treatment of malaria, tuberculosis, fever, microbial infections, diarrhea, anemia, dysentery, toothache, and as immune stimulant (Elthair et al., 2019). Although no traditional medicine has been reported during the field surveys, the loss of baobab trees might negatively impact this Ecosystem Services .

Table 155 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 155: Assessment of traditional medicine against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: Traditional medicine is not widespread in the Project AoI.
Interaction with drivers of change on Ecosystem Services or with project operations	Medium: Project anticipated impacts include loss of tree and grass species used in traditional medicine resulting from permanent land-take and temporary habitat disturbance.
Replaceability/Management potential	High: It is likely that species could be found elsewhere in the Project AoI, in similar habitats.
Priority ecosystem services	**Not a PES**

Building, carpentry, and craft materials

According to the biological baseline (Chapter 5.4.2) trees and shrubs in Dry Adansonia woodland are cut for construction activities or burned for the production of charcoal. In the direct incidence of the Project areas, no significant harvesting activity was identified. The better-off group relies on semi-skilled non-farm work in urban areas such as Luanda, the sale of construction materials (sand and stones) and retail trade (household items) to a lesser extent. Also, quarry activities are recorded in the Bom Jesus area and Cacuaco, however the Project is not expected to impact this activity.

Table 156 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 156: Assessment of building, carpentry, and craft materials against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: Local populations are not very dependent on natural resources.
Interaction with drivers of change on Ecosystem Services or with project operations	Medium: Project anticipated impacts include loss of tree and grass species used in traditional medicine resulting from permanent land-take and temporary habitat disturbance.
Replaceability/Management potential	Medium: Management measures can potentially reduce the impacts and generate benefits for local building, carpentry and craft materials.
Priority ecosystem services	**Not a PES**

Biofuel

No use of wood, trees, or shrubs as an energy source for households has been recorded during the 2023 field survey in the Project AoI.

Table 157 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 157: Assessment of biofuels against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: No households are known to use wood as cooking fuel in the Project AoI.

Prioritisation criteria	Results
Interaction with drivers of change on Ecosystem Services or with project operations	**Medium**: Project anticipated impacts include loss of tree and grass species used as biofuel resulting from permanent land-take and temporary habitat disturbance.
Replaceability/Management potential	**Medium**: If households are relying solely on wood for biofuel, they might be affected by limited availability or limited access to their usual collection zones. However, species are likely to be present in similar habitats in the Project AoI outside the project footprint.
Priority ecosystem services	**Not a PES**

Water resources

Regarding drinking water supply, most households rely on water sources outside their housing. The water is collected from the rivers around Luanda and taken in trucks to the city to be distributed, being generally considered of poor quality and even dangerous to drink.

According to the 2014 census, the main source of drinking water for households in Luanda are tanker trucks (46 %), faucet connected to the public network (28.9 %) or public fountains (16 %). The others are collecting water from ponds, reivers, creeks, springs, holes, or rainwaters.

Table 158 details the results of the Ecosystem Services prioritization criteria assessment.

Table 158: Ecosystem Services : Assessment of water resources against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	**High**: Dependence of water is high, mostly for safe drinking water.
Interaction with drivers of change on Ecosystem Services or with project operations	**Low**: The abstraction of water from the Kwanza River will have low to negligible impact on surface water availability. The Project aims at increasing the safe drinking water availability for the population.
Replaceability/Management potential	**High**: Replaceability is high (no surface water scarcity in the region)
Priority ecosystem services	**Not a PES**

8.4.4.2 Regulation services

Regulation services were not systematically discussed with community representatives during focus groups and meetings. However, literature and other baseline surveys (air, water quality, etc.) were used to describe their importance within the Project AoI.

Air quality control

Air pollution has negative consequences for human health and is associated with respiratory and cardiovascular diseases, as well as some forms of cancer.

Vegetation cover plays an important role in air quality control by capturing airborne pollutants and removing them from the atmosphere through absorption and deposition of pollutants on external surfaces such as leaves and bark (Harris and al., 2019). As described in the biological baseline, the Project AoI has many trees in its natural habitats' areas, so air quality control by ecosystems is considered significant.

The construction of Quilonga facilities and water pipeline might decrease the number of trees in the project area. As air quality is already degraded in the Project AoI, resulting from the location in a dense urban area, it is likely that the patches of natural habitats around the Luanda city participate in air quality control. By vegetation cover, the project would affect the ecosystem's ability to enhance air quality.

Table 159 details the results of the Ecosystem Services prioritization criteria assessment.

Table 159: Assessment of air quality control against Ecosystem Services prioritization criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Medium: As air quality is an important issue in the Project AoI, the capacity of ecosystem to control air quality is considered significant as the vegetation cover in natural habitats areas is important.
Interaction with drivers of change on Ecosystem Services or with project operations	Low: Limited negative impacts on air quality are expected during construction and operation. The Project could decrease the ecosystem's ability to control air quality, however most of the project footprint will be located in urban areas.
Replaceability/Management potential	Medium: Vegetation cover can be restored or increased using mitigation measures
Priority ecosystem services	**Not a PES**

Climate regulation

The consequences of increased carbon dioxide and other greenhouse gases in the atmosphere are felt by people around the world through the impacts of climate change on rainfall patterns, storm frequency and severity, temperature, and sea-level rise. By storing carbon in vegetation, ecosystems keep carbon dioxide out of the atmosphere, where it would otherwise contribute to climate change. Given the project area vegetation in natural habitats, the impact on the climate regulation capacity of ecosystems is deemed significant.

As mentioned in the previous section on air quality, a decrease in vegetation could be observed on the Project footprint. However, due to the patches of natural habitats around where trees can be replanted, it is unlikely that this would impact the ecosystem's ability to regulate climate. Similarly, it is unlikely that the Project would impact this Ecosystem Services .

Table 160 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 160: Assessment of climate regulation against Ecosystem Services prioritisation criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: The contribution to global climate regulation is considered low due to fact that the Project is mostly in urban areas where natural vegetation cover is limited
Interaction with drivers of change on Ecosystem Services or with project operations	Low: Interaction is low as the project will not lead to an important loss of vegetation cover and is unlikely to affect climate regulation.

Prioritisation criteria	Results
Replaceability/Management potential	Medium: Vegetation can be restored or increased.
Priority ecosystem services	**Not a PES**

Water regulation

Ecosystems play a key role in water regulation processes, notably by allowing evapotranspiration (involved in precipitation patterns) and water infiltration (water filtration and groundwater recharge) (MEA, 2005). Indeed, sap flow (movement of water in the roots, stems, and branches of plants) of shrub species contribute to water regulation.

The Baobabs (*Adansonia digitata*) are known for its massive water storage capacities, that helps them bearing the water scarcity, but also resist to wildfire. Baobab trees are regarded as the largest succulent plant in the world.

Table 161 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 161: Assessment of water regulation against Ecosystem Services prioritisation criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	High: Water is central to local livelihoods (small-scale agriculture, herding, human consumption). Its availability and quality are highly dependent on ecosystem's ability to regulate water.
Interaction with drivers of change on Ecosystem Services or with project operations	Low: Interaction is low as the project will not lead to an important loss of vegetation cover and is unlikely to affect climate regulation.
Replaceability/Management potential	Low: Replaceability is deemed low as is related to local natural processes that can difficultly be replicated.
Priority ecosystem services	**Not a PES**

Erosion control

Erosion this biogeoclimate is mainly due to vegetation removal causing soil instability, and to droughts. All vegetation in the Project AoI help with erosion control, specifically along the Kwanza River and floodplain grasslands where it prevents erosion due to droughts.

Table 162 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 162: Assessment of erosion control against Ecosystem Services prioritisation criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	High: Erosion is a central issue in tropical ecosystem and vegetation is key to stabilizing soil and acting as natural barrier. Vegetation in the Project AoI is necessary because of its erosion control capacity.
Interaction with drivers of change on Ecosystem Services or with project operations	Low: Interaction is low as the project will not lead to an important loss of vegetation cover and is unlikely to affect erosion.

Prioritisation criteria	Results
Replaceability/Management potential	Medium: Management measures such as artificial bank stabilization and the preservation of banks stabilizing species can be implemented to limit impacts on erosion control capacity of ecosystems.
Priority ecosystem services	**Not a PES**

8.4.4.3 Cultural services

Sacred components

No specific natural features embodying cultural or sacred values were identified in the project area during the baseline and no specific trees were identified. According to 2023 stakeholder consultation activities, no natural sacred site is recorded in the Project AoI.

Most of the tangible cultural heritage elements are located in the old Luanda City, near the bay, where the city was founded and developed through the colonial times. The Project's AoI is composed of new urban and industrial development zones that have expanded along the Road to Catete and occupied mainly forest areas with no previously known uses.

Close to the Project AoI, 3 archaeological stations were identified Luanda-Catete Km 12, Luanda-Catete Km 30, Bom Jesus Stations 1, 2, 3 4 and 5 (see section Archaeological sites) and referenced in the Anthropobiological Mission for Angola (1955 Campaign). Artifacts from the Stone Age were identified in low terraces from the right bank of the Kwanza River, in 5 different locations. As such, it is possible that the region registers other archeological artifacts in the Kwanza riverbanks subsoil, still not identified in the archeological missions developed.

Table 163 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 163: Assessment of sacred components against Ecosystem Services prioritisation criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Low: Although all vegetation is considered sacred by nature, the Project AoI does not have any natural sacred sites.
Interaction with drivers of change on Ecosystem Services or with project operations	Medium: Expected impacts on sacred and archaeological sites include damage or removal during Project construction and operations as well as reduced access. As there were no sacred natural features recorded in the Project AoI, it is unlikely that this Project will involve such impacts.
Replaceability/Management potential	Medium: Management measures can be put into place if sacred natural features were to be encountered.
Priority ecosystem services	**Not a PES**

Tourism and recreational

No tourism or recreational activities have been identified in the Project AoI through the baseline surveys and the stakeholder consultations.

Table 164 below details the results of the Ecosystem Services prioritization criteria assessment.

Table 164: Assessment of tourism and recreation against Ecosystem Services prioritisation criteria

Prioritisation criteria	Results
Level of dependence on the Ecosystem Services	Medium: No tourism activities has been recorded in the Project AoI during the field surveys. However, some areas where the DC will be constructed are currently used for recreation.
Interaction with drivers of change on Ecosystem Services or with project operations	Medium: Parts of the Project is not expected to interact with this Ecosystem Services.
Replaceability/Management potential	Medium: Mitigation measures must be applied to provide accessible and effective alternatives for beneficiaries.
Priority ecosystem services	**Not a PES**

8.4.5 Selection of Priority Ecosystem Services

Based on the Ecosystem Services analysis, there is no identified PES in the Project AoI.

8.5 Greenhouse gas Assessment (GHG)

8.5.1 Impact sources

The impact sources on noise and vibration resulting from the project activities are the following:

- **Construction phase**
  - Site preparation (earthworks, vegetation clearance etc) ;
  - Presence and use of heavy machinery and construction equipment ;
  - Truck and vehicle road traffic ;
  - Energy consumption and supply.
- **Operation phase**
  - vehicle road traffic ;
  - Production and distribution of drinking water ;
  - Energy consumption and supply.

8.5.2 Emission sources

The Project construction scenario consists of several heavy-duty vehicles and stationary equipment consuming diesel oil plus the purchased electricity from the public grid. During the Project operational phase, main emission sources will be due to the purchased electricity from the grid and emergency diesel generators.

Table 165 provides a summary of the activities for which GHG emissions are calculated.

Table 165: GHG emissions sources for the Project

Phase	Source	GHG Emissions

Construction	Vehicle – Combustion of Diesel Oil	On-site construction vehicle emissions, due to diesel combustion (Scope 1)
	Stationary equipment – Combustion of Diesel Oil	On-site construction emissions due to diesel combustion of stationary equipment (Scope 1)
	Purchased Electricity consumption	Indirect emissions due to used electricity (Scope 2)
Operation	Vehicle – Combustion of Diesel Oil	On-site construction vehicle emissions, due to diesel combustion (Scope 1)
	Stationary equipment – Combustion of Diesel Oil	On-site construction emissions due to diesel combustion of stationary equipment (Scope 1)
	Purchased Electricity consumption	Indirect emissions due to used electricity (Scope 2)

8.5.3 Impacts during the construction and operation phases

The Project construction scenario consists of several heavy-duty vehicles and stationary equipment consuming diesel oil plus the purchased electricity from the public grid. During the Project operational phase, main emission sources will be due to the purchased electricity from the grid and emergency diesel generators.

The direct annual GHGs emissions for construction and operation phases of the different construction Lots of the Project are presented in Table 166, where tons of CO_2eq are calculated using the GWPs from section 2.1 above.

Table 166: Direct Annual Project GHG Emissions for Construction and Operation Phases.

Lot	Source	Calculated GHG			Total GHG amount	
		tCO_2/y	tCH_4/y	tN_2O/y	tCO_2e/y	Percentage
Lot 1	**Construction Phase**					
	Vehicles - Combustion of Diesel Oil	1,997.43	0.11	0.77	2,211.23	47.23 %
	Stationary - Combustion of Diesel Oil	501.35	0.02	0.01	503.06	10.74 %
	Purchased Electricity consumption	1,967.61	-	-	1,967.61	42.03 %
	TOTAL				**4,681.90**	**100 %**
	Operation Phase					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	-	-	-	-	-
	Purchased Electricity consumption	4,103.09	-	-	4,103.09	100 %
	TOTAL				**4,103.09**	**100 %**
Lot 2	**Construction Phase**					
	Vehicles - Combustion of Diesel Oil	2,704.02	0.151	1.044	2,993.45	98.72 %
	Stationary - Combustion of Diesel Oil	38.541	0.002	0.001	38.67	1.28 %
	Purchased Electricity consumption	-	-	-	-	-
	TOTAL				**3,032.13**	**100 %**
Lot 3	**Construction Phase**					

Lot	Source	Calculated GHG			Total GHG amount	
		tCO_2/y	tCH_4/y	tN_2O/y	tCO_2e/y	Percentage
	Vehicles - Combustion of Diesel Oil	451.24	0.025	0.174	499.54	76.42 %
	Stationary - Combustion of Diesel Oil	152.94	0.006	0.001	153.47	23.48 %
	Purchased Electricity consumption	0.65	-	-	0.65	0.10 %
	TOTAL				**653.66**	**100 %**
	Operation Phase					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	14.68	0.001	0.0001	14.73	12.84 %
	Purchased Electricity consumption	99.95	-	-	99.95	87.16 %
	TOTAL				**114.64**	**100 %**
Lot 4	**Operation Phase**					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	43.74	0.002	0.0004	43.89	26.34 %
	Purchased Electricity consumption	122.71	-	-	122.71	73.66 %
	TOTAL				**166.60**	**100 %**
Lot 5	**Operation Phase**					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	61.18	0.0025	0.0005	61.39	26.54 %
	Purchased Electricity consumption	169.91	-	-	169.91	73.46 %
	TOTAL				**231.30**	**100 %**
Lot 6	**Construction Phase**					
	Vehicles - Combustion of Diesel Oil	85.65	0.005	0.033	94.82	63.96 %
	Stationary - Combustion of Diesel Oil	52.61	0.002	0.001	52.79	35.61 %
	Purchased Electricity consumption	0.63	-	-	0.63	0.43 %
	TOTAL				**148.24**	**100 %**
	Operation Phase					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	418.68	0.017	0.004	420.05	88.68 %
	Purchased Electricity consumption	53.64	-	-	53.64	11.32 %
	TOTAL				**473.69**	**100 %**
Lot 7	**Construction Phase**					
	Vehicles - Combustion of Diesel Oil	85.65	0.005	0.033	94.82	63.96 %
	Stationary - Combustion of Diesel Oil	52.612	0.002	0.001	52.79	35.61 %

Lot	Source	Calculated GHG			Total GHG amount	
		tCO_2/y	tCH_4/y	tN_2O/y	tCO_2e/y	Percentage
	Purchased Electricity consumption	0.63	-	-	0.63	0.43 %
	TOTAL				**148.24**	**100 %**
	Operation Phase					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	244.23	0.01	0.002	245.03	89.51 %
	Purchased Electricity consumption	28.73	-	-	28.73	10.49 %
	TOTAL				**273.76**	**100 %**
Lot 8	**Construction Phase**					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	-	-	-	-	-
	Purchased Electricity consumption	1.966,17	-	-	1,966.17	100 %
	TOTAL				**1,966.17**	**100.00 %**
	Operation Phase					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	289.98	0.012	0.002	290.97	20.39 %
	Purchased Electricity consumption	1,135.85	-	-	1,135.85	79.61 %
	TOTAL				**1,426.82**	**100 %**
Lot 9	**Operation Phase**					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	132.02	0.005	0.001	132.47	77.58 %
	20-+Purchased Electricity consumption	38.28	-	-	38.28	22.42 %
	TOTAL				**170.75**	**100 %**
Lot 10	**Construction Phase**					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	-	-	-	-	-
	Purchased Electricity consumption	1,966.17	-	-	1,966.17	100 %
	TOTAL				**1,966.17**	**100 %**
	Operation Phase					
	Vehicles - Combustion of Diesel Oil	-	-	-	-	-
	Stationary - Combustion of Diesel Oil	-	-	-	-	-
	Purchased Electricity consumption	46.43	-	-	46.43	100 %
	TOTAL				**46.43**	**100 %**

Table 167: Comparison of Project GHG Annual Emissions to National and Global Emissions and National Projections.

Source	Construction	Operation
Project GHG Emissions (tons CO_2eq/year)	12,596.50	7,007.82
Comparison to Angola-wide Total (%)	0.016 %	0.009 %
Comparison to Angola-wide future emission projections at 2025 with NDC implementation	0.015 %	0.008 %
Comparison to Global Total (%)	0.00008 %	0.00004 %
Angola-wide GHG emissions (2019)[1]	**78,672,000**	
Angola-wide future emission projections[2]	**82,439,000**	
UNFCCC Annex-I 2019 GHG Emissions[3]	**16,697,844,280**	

[1] Obtained from World Bank Database, http://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE?end=2019&locations=AO&start=1990

[2] Obtained from Angola first Nationally Determined Contribution, https://unfccc.int/sites/default/files/NDC/2022-06/NDC%20Angola.pdf

[3] Obtained from UNFCCC GHG database, https://di.unfccc.int/time_series

The overall emissions in tons of CO_2eq for the construction and operation phases of the Project are summarized in Table 167 above. To calculate the project GHG annual emissions for the construction phase, it is assumed, in a precautionary way, that the construction works for the other Lots will be carried out during the most emissive year related to the construction of Lot 1, Lot 8 and Lot 10. The project GHG annual emissions for the operation phase considers the moment since every Lot of the project is fully operative.

Annual emissions for Angola are obtained by the World Bank Database (2019) while the total of Annex-I countries GHG releases are obtained from UNFCCC GHG database for the inventory year 2019. Such countries are those belonging to the OECD (Organization for Economic Co-operation and Development) and the reference is used to compare the emissions from some of the most important economies in the World with the impact related to the project. Angola's future emission projections are detailed in the Angola's "Nationally Determined Contribution" document (NCD) submitted by the Government of Angola in May 2021 and approved by the United Nations.

It is widely accepted that increased anthropogenic GHG emissions are contributing to climate change. However, Project GHG emissions represent an insignificant and unmeasurable increase in global GHG emissions. Country scale and global greenhouse gas emission levels are anticipated to be maintained. Project annual emissions for both phases are well below the threshold of 100.000 set by disclosure requirements under Equator Principles (EPIV), but above the threshold of 25.000 set by IFC PSs (2012).

According to the IFC PS3, in case of projects that are expected to annually overcome such threshold, the owner will quantify direct and indirect emissions. The quantification should be conducted annually in accordance with internationally recognized methodologies and good practices. No lots are expected to overcome the lowest threshold.

Detailed GHG assessment is presented in Appendix K.

Mitigation measures – construction phase

It is recommended that the CESMP include the following measures to mitigate the impacts on noise and vibrations:

P-C-10: Mitigation measures aiming at reducing energy consumption:

- **P-C-10a**: Reducing idling time on electrically powered equipment.
- **P-C-10b**: Implement energy saving practices (see mitigation measure S-C-13a).

P-C-11: Mitigation measures aiming at reducing GHG emissions:

- **P-C-11a**: Engage Regular maintenance of machinery and vehicles.
- **P-C-11b:** Measurement and reporting of fuel consumption associated with vehicle and construction operations.
- **P-C-11c:** Training of workers to use equipment, including vehicles, in an efficient manner to reduce fuel wastage.
- **P-C-11d:** Inform on-site workforce of commitment to monitor and reduce GHG emissions, where possible, through environmental awareness training.

Mitigation measures – operation phase

The ESMP will have to include measures to mitigate the impacts on habitats.

P-O-07: Mitigation measures aiming at reducing use of energy

- **P-O-07a**: see mitigation measure P-C-10

P-O-08: Mitigation measures aiming at reducing GHG emissions

- **P-O-08a**: Initiate actions to promote the supply of Cacuaco DC from the public power grid as soon as possible
- **P-O-08b:** Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the Project .

8.6 Climate Change Risk Assessment (CCRA)

The Climate Change Physical Risk Assessment helped identifying the most critical climate-related risks, at present or in the future, according to different emission scenarios and during the lifetime of the Project as a consequence of Climate Change. The assessment was done for the 3 districts where the Project is located: Cacuaco, Viana and Icolo e Bengo. Detailed results and associated maps are presented in Appendix M.

The assessment suggested that :

- Water scarcity at present is assessed as Very Low for all districts and it may me expected to have a stability of this level. Annual precipitations and daily max precipitations are expected to remain stable in the future. Based on the predictions of these climatic variables, no impact is expected on the Kwanza river flow and no impact on water abstraction of the Quilonga Project.
- Landslides are considered as “Very low” hazards at present for all three districts but is a hazard which is related to the morphology of the territory. it may be expected for the future to have more frequent landslides affecting those areas more prone to such geohazards, based on their morphology peculiarities.

The most relevant hazards are:

- **Urban flood** is the only hazard that shows differences across districts: the level of this hazard is “Low” level at present in Cacuaco, “Very low” in Viana and “Medium” in Icolo e Bengo. Considering the trends of correlated variables, annual precipitations and, most importantly, max daily precipitations, which are both predicted to slightly increase in the future, according to all scenarios, it can be expected to see an increase in the hazard levels of each district, possibly leading Viana to a “Low” level, Icolo e Bengo to “High”, Cacuaco to “Medium”.
- **River flood** is at “High” level for all 3 districts and is predicted to increase in the in future.
- **Wildfire hazard** is already a “High” level for all 3 districts and it can be predicted to remain “High” also for the future. That is particularly relevant in the areas where a mosaic or natural habitats and urban patches is present (Lot 1, 8, 10).
- **Extreme heat** at present is assessed as “Medium” for 3 all districts. It can be foreseen that Extreme Heat hazard is going to become even more relevant in the future, potentially moving to “High” level.

Mitigation measures

The Project Emergency Preparedness & Response Plan should be included procedures and measures to deal with climate hazards. The Plan should be regularly updated.

CC-01: Risks of river flood (construction and operation)

- The construction of the water abstraction pumping station which will be located on the right bank of the Kwanza River should take into consideration mitigation measures already in the design stage to minimize risks such as create water detention areas, build river dikes ;
- Implement an early warning system and make provision for a direct connection with any existing early warning systems at local or regional level to guarantee information on potential extreme event are monitored and shared on a daily basis

CC-02: risks of wildfire (construction and operation)

- Install in each Lot a firefighting system with extinguishers in the building and a gathering point outside the building to minimize the growing wildfire risk identified ;
- Perform regular maintenance of the firefighting system ;
- Conduct regular fire emergency exit training with the workers ;
- Clear vegetation outside each facility fence over a 20 m buffer.

CC-03: Extreme heat (construction and operation)

- Provide adequate and regular maintenance of cooling systems verifying that the adequacy is guaranteed in the face of the expected increase in temperatures and the frequency of conditions of thermal stress and heat waves ;
- Provide for additional shades in public spaces, such as adding shades in parking lots or outdoor staff transit areas ;
- Consider using construction materials for buildings and other infrastructures with a lower capacity to absorb heat and higher capacity to maintain their main properties in case of extremely high temperatures ;
- Provide proper and regular maintenance to buildings, infrastructures, and equipment to avoid increasing their sensitivity to hot temperatures ;

- Reschedule working hours during extremely hot periods to ensure the safety and efficiency of staff working in outdoor areas ;
- Ensure appropriate training is provided about heat stress symptoms and appropriate behavior and information is available daily about temperatures and humidity to all workers ;
- Ensure properly trained medical staff and appropriate medical care is available ;
- Ensure potable water is always available in the right quantity for all personnel.

CC-04: Urban flood (operation and construction)

- Keep manholes and drainage channels clean to avoid potential flooding in case of intense precipitation events ;
- Assure presence and efficacy of dikes or other systems to protect the infrastructures and access roads in case of flood. outside each facility fence over a 20 m buffer.

CC-05: Elaboration of an Adaptation Management plan prior construction, including:

- Material risk identification of key business-related risks that result from potential climate hazards impacts to society and the environment posed by the Project and ;
- Mitigation measures to mitigate risks posed by climate change.

8.7 Unplanned and emergency events

8.7.1 Construction phase

Potential hazards may arise on the construction site due to traffic; on-site materials; hazardous materials and heavy equipment handling; natural hazard events during construction (wildfire, heavy rain, flooding, landslide); working near or in water bodies (specifically applicable for Lot 1 - WAF); equipment failure; fire and explosion; power outages caused by damage to power lines or power station etc.

Emergencies that may need to be planned for include (but are not limited to) serious injuries, explosion, flood, poisoning, electrocution, fire, chemical spill, and structural collapse, buried workers, fall from height, confined space, labor/civil disturbance and external intrusion, vehicle collision. Those unplanned and emergency events may lead to fatalities or health effects of workers, community members and fauna and other damages. Some of those unplanned and emergency events are already mentioned in the impact assessments for the physical, biological and social components (Chapter 8.1, 8.2 and 8.3) such as hazard spills, traffic accidents as well as in the chapter climate change risk assessment (Chapter 8.6) and mitigation measures are proposed.

Emergency Preparedness and Response Plan dealing with the consequences in an emergency situation should be developed for constructors of each of the Lots so that quick and effective actions can be taken in the event of a problem to ease the severity of the situation and to limit the consequences.

Measures to avoid and mitigate contamination of environment due to mismanagement of hazardous waste and materials and consequent effects on workers and public health include (some of them already mentioned in the Chapter 8.1):

- Train construction workers on release prevention specifically on hazardous materials as part of an emergency preparedness response training ;

- Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment ;
- Prepare written Standard Operating Procedures (SOPs) for filling containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response ;
- Identify locations of hazardous materials and associated activities ;
- Make available specific PPE and training needed to respond to an emergency ;
- Make available spill response equipment sufficient to handle at least initial stages of a spill and a list of possible interventions.

Worker and Public health issues and contamination of environment due to releases by natural disasters

- Ensure the full implementation of safety measures set out by the final design ;
- Ensure adequate planning for contingency in case of natural disasters ;
- Train workers at the site on general safety measures and ensure full adherence ;
- Provide special training on emergency situations, evacuation procedures, and recovery from disasters.

8.7.2 Operation phase

Emergency Preparedness and Response Plan should be designed and implemented for the operation of each Lot. Mitigation measures listed for the construction phase also apply to the operation phase.

Specifically for the operation phase are the accidental releases of chlorine gas which could also have impacts on operators and community health. As for chlorination rooms, the structure should promote maximum safety measures such as:

- Design safety systems and operational actions for the use of chlorine gas, in accordance with the applicable international norms/standards and engineering good practices ;
- Use corrosion-resistant piping, valves, metering equipment, and any other equipment coming in contact with gaseous or liquid chlorine, and keep this equipment free from contaminants, including oil and grease ;
- Install alarm and safety systems, including automatic shutoff valves, that are automatically activated when a chlorine release is detected ;
- Install containment and scrubber systems to capture and neutralize chlorine should a leak occur ;
- Store to allow for easy inspection of containers to monitor for leaks or degrading containment (i.e. walkways or containment curbs) and ease of access in case of a spill ;
- Store chlorine away from all sources of organic chemicals, and protect from sunlight, moisture, and high temperatures ;
- Minimize the amount of chlorination chemicals stored on site while maintaining a sufficient inventory to cover intermittent disruptions in supply.

It should be noted that the safe handling of chlorine gas and a secure chlorination system includes a proper facilities design, an operation and maintenance program, the appropriate safety equipment, and an emergency action plan. Exact specifications on these items are not yet available as the detailed design are ongoing and should be detailed in a Hazardous Material Management Plan.

During operation, EPAL site management should make available all necessary provisions to help site workers protect their safety and health and should prepare and well-train their staff on contingency procedures in case of any emergency.

8.8 Human Rights screening

The results of the assessment are described in detail in the APPENDIX L.

The human rights assessment screening for the project was done in a way that firstly presented the risks related to the general human rights context in Angola and secondly the human rights risks. related to the context of the project. As a result of this study, certain high risks have been identified at national level, based on statistical data from the global assessment for countries around the world. The high risks in the country concern the following rights:

- Stability of the Country ;
- Public Corruption ;
- Civic Space Rights ;
- Global Freedom Status ;
- Guarantees of Workers Rights ;
- Living Wage Gaps.

In relation to the context of the project and throughout the supply chain, no high risks have been identified due to the arrangements will be made upstream by the contractors responsible for implementing the activities and the project area.

The level of risk was assessed based on the exposure of workers and local communities to the risks involved and the mitigation measures initially put in place by the contractors to minimise or even avoid them. Human rights indicators were selected from the International Covenants on Civil and Political Rights and on Economic, Social and Cultural Rights to assess the human rights risks associated with the project context.

Overall, the level of human rights risk associated with the project construction phase is considered medium to low. The mitigation measures for each of the rights are considered adequate to reduce the risks to a sufficiently low level. Project operation would be under responsibility of provincial water authority “Empresa Pública de Aguas de Luanda” (EPAL). EPAL project operator's social standards and practices should also pursue alignment with the policy objectives of respect for human rights, gender equality, decent work, stakeholder engagement and conflict prevention, as outlined in the IFC Performance Standards and the World Bank Group's Environment, Health, and Safety (EHS) Guidelines, as well as the Equator Principles.

A **Gender Action Plan** should be developed specifically address the gender-based constraints and opportunities that were identified during the impact assessment related to (but not limited to) economy, livelihood, community health and safety. It should also address appropriate mitigation measures to assure women are not disproportionally affected.

The elaboration of a **full human rights impact assessment** of the Project based on the UN Guiding Principles on Business and Human Rights and the Equator Principles, as outlined in the guidance note on implementing human rights assessments under the Equator Principles (2020) is recommended.

9.0 RESIDUAL IMPACTS

Table 168 lists the residual impacts for each lot and each impact mentioned in the previous section 8.0 during the construction phase, except for negligible impacts, to highlight impacts that persist after mitigation measures. As a reminder, lots 4, 5 and 9 are not evaluated under construction phase, as they are nearing completion. The second one, Table 169, lists the same thing during the operation phase.

During the construction phase, 96 residuals impacts have been identified higher than negligible. No major residual impacts have been identified, but, on the other side, 66 minor and 30 moderate residual impacts have been highlighted. Almost 88 % of these are residual social impacts even if to a lesser extent, there are still physical and biological residual impacts. Among social impacts, 13 are positive (green boxes), this corresponds to three mitigation measures ; S-C-04, S-C-06 and S-C-07.

During the operation phase, 20 residuals impacts have been identified higher than negligible. Almost 50 % have major residual impacts. Only 2 impacts are about physical components and one about biological components. Which means that over 20 residual impacts, 17 are associated to social components. Among them, 9 are positive impacts (green boxes), this corresponds to four mitigation measures ; S-O-01, S-O-03, S-O-04, S-O-07.

Table 168: Residual impacts on the different components (physical, biological, and social) for each lot and each impact associated with during construction phase

Site	Component	Impact	Impact value	Residual impact	Positive or Negative impact
All Lots	PHYSICAL	**P-C-07 - Borrow material**	Minor	Minor	Negative
Lot 1, 8, 10	BIOLOGICAL	**B-C-01 Terrestrial habitats loss**	Moderate	Minor	Negative
	PHYSICAL	**P-C-04 - Change of land use**	Moderate	Moderate	Negative
	SOCIAL	**S-C-01: Changes in land ownership**	Minor	Minor	Negative
		S-C-02: Restriction of access to land	Minor	Minor	Negative
		S-C-03 Labor influx	Moderate	Minor	Negative
		S-C-04 Direct employment in workforce	Moderate	Moderate	Positive
		S-C-05 Impact on agriculture	Minor	Minor	Negative
		S-C-06 Supply in materials goods and services	Moderate	Moderate	Positive
		S-C-07 Local socio-economic diversification and improvement with the scale of economic development	Moderate	Moderate	Positive
		S-C-08 Increase of traffic	Moderate	Minor	Negative
		S-C-09 Increase occurrence of communicable diseases	Moderate	Minor	Negative
		S-C-11: Disruption to normal community life	Major	Moderate	Negative
		S-C-12 Interference on Roads/Infrastructures	Minor	Minor	Negative
		S-C-13 Energy consumption	Minor	Minor	Negative
		S-C-14 Generation of construction waste	Minor	Minor	Negative
		S-C-15: Visual disturbance	Minor	Minor	Negative
		S-C-16: Impacts of cultural heritage	Minor	Minor	Negative
Lot 1-WAF	BIOLOGICAL	**B-C-01 Terrestrial habitats loss**	Moderate	Minor	Negative
		B-C-07: Loss of freshwater habitats	Moderate	Minor	Negative

		B-C-08: Degradation of freshwater habitats	Moderate	Minor	Negative
Lot 2	BIOLOGICAL	**B-C-06: Habitats rehabilitation**	Minor	Moderate	Negative
	PHYSICAL	**P-C-04 - Change of land use**	Moderate	Minor	Negative
	SOCIAL	**S-C-01: Changes in land ownership**	Minor	Minor	Negative
		S-C-02: Restriction of access to land	Minor	Minor	Negative
		S-C-03 Labor influx	Moderate	Minor	Negative
		S-C-04 Direct employment in workforce	Moderate	Moderate	Positive
		S-C-05 Impact on agriculture	Minor	Minor	Negative
		S-C-06 Supply in materials goods and services	Moderate	Moderate	Positive
		S-C-07 Local socio-economic diversification and improvement with the scale of economic development	Moderate	Moderate	Positive
		S-C-08 Increase of traffic	Major	Moderate	Negative
		S-C-09 Increase occurrence of communicable diseases	Moderate	Minor	Negative
		S-C-11: Disruption to normal community life	Major	Moderate	Negative
		S-C-12 Interference on Roads/Infrastructures	Minor	Minor	Negative
		S-C-13 Energy consumption	Minor	Minor	Negative
		S-C-14 Generation of construction waste	Minor	Minor	Negative
		S-C-15: Visual disturbance	Minor	Minor	Negative
		S-C-16: Impacts of cultural heritage	Minor	Minor	Negative
Lot 3	PHYSICAL	**P-C-04 - Change of land use**	Moderate	Moderate	Negative
	SOCIAL	**S-C-01: Changes in land ownership**	Minor	Minor	Negative
		S-C-02: Restriction of access to land	Minor	Minor	Negative
		S-C-03 Labor influx	Moderate	Minor	Negative
		S-C-04 Direct employment in workforce	Moderate	Moderate	Positive
		S-C-05 Impact on agriculture	Minor	Minor	Negative
		S-C-06 Supply in materials goods and services	Moderate	Moderate	Positive
		S-C-07 Local socio-economic diversification and improvement with the scale of economic development	Moderate	Moderate	Positive
		S-C-08 Increase of traffic	Moderate	Minor	Negative
		S-C-09 Increase occurrence of communicable diseases	Moderate	Minor	Negative
		S-C-11: Disruption to normal community life	Major	Moderate	Negative
		S-C-12 Interference on Roads/Infrastructures	Minor	Minor	Negative
		S-C-13 Energy consumption	Minor	Minor	Negative
		S-C-14 Generation of construction waste	Minor	Minor	Negative
		S-C-15: Visual disturbance	Minor	Minor	Negative
		S-C-16: Impacts of cultural heritage	Minor	Minor	Negative
Lot 6	PHYSICAL	**P-C-04 - Change of land use**	Minor	Moderate	Negative
	SOCIAL	**S-C-01: Changes in land ownership**	Minor	Minor	Negative
		S-C-02: Restriction of access to land	Minor	Minor	Negative
		S-C-03 Labor influx	Moderate	Minor	Negative
		S-C-04 Direct employment in workforce	Moderate	Moderate	Positive

		S-C-05 Impact on agriculture	Minor	Minor	Negative
		S-C-06 Supply in materials goods and services	Moderate	Moderate	Negative
		S-C-07 Local socio-economic diversification and improvement with the scale of economic development	Moderate	Moderate	Negative
		S-C-08 Increase of traffic	Moderate	Minor	Negative
		S-C-09 Increase occurrence of communicable diseases	Moderate	Minor	Negative
		S-C-11: Disruption to normal community life	Major	Moderate	Negative
		S-C-12 Interference on Roads/Infrastructures	Minor	Minor	Negative
		S-C-13 Energy consumption	Minor	Minor	Negative
		S-C-14 Generation of construction waste	Minor	Minor	Negative
		S-C-15: Visual disturbance	Minor	Minor	Negative
		S-C-16: Impacts of cultural heritage	Minor	Minor	Negative
Lot 7	PHYSICAL	**P-C-04 - Change of land use**	Minor	Moderate	Negative
	SOCIAL	**S-C-01: Changes in land ownership**	Minor	Minor	Negative
		S-C-02: Restriction of access to land	Minor	Minor	Negative
		S-C-03 Labor influx	Moderate	Minor	Negative
		S-C-04 Direct employment in workforce	Moderate	Moderate	Positive
		S-C-05 Impact on agriculture	Minor	Minor	Negative
		S-C-06 Supply in materials goods and services	Moderate	Moderate	Positive
		S-C-07 Local socio-economic diversification and improvement with the scale of economic development	Moderate	Moderate	Positive
		S-C-08 Increase of traffic	Moderate	Minor	Negative
		S-C-09 Increase occurrence of communicable diseases	Moderate	Minor	Negative
		S-C-11: Disruption to normal community life	Major	Moderate	Negative
		S-C-12 Interference on Roads/Infrastructures	Minor	Minor	Negative
		S-C-13 Energy consumption	Minor	Minor	Negative
		S-C-14 Generation of construction waste	Minor	Minor	Negative
		S-C-15: Visual disturbance	Minor	Minor	Negative
		S-C-16: Impacts of cultural heritage	Minor	Minor	Negative

Table 169: Residual impacts on the different components (physical, biological, and social) for each lot and each impact associated with during operation phase

Site	Component	Impact	Impact value	Residual impact	Positive or Negative impact
All Lots	PHYSICAL	**P-O-06 - Surface Water contamination**	Major	Minor	Negative
		P-O-07 - Groundwater contamination	Major	Minor	Negative
Lot 1 - WAF	BIOLOGICAL	**B-O-04: Mortality of freshwater fauna**	Moderate	Minor	Negative
	SOCIAL	**S-O-06: Alteration of water and fish resources**	moderate	Minor	Negative
Lot 1, 8, 10	SOCIAL	**S-O-01: Demand of workforce**	Moderate	Moderate	Positive

		S-O-02: Water distribution and sales operator	Major	Major	Negative
		S-O-03: Access to reliable potable water supply	Major	Major	Positive
		S-O-04: Improvement of life quality of local population	Major	Major	Positive
		S-O-05: Energy Consumption	Minor	Minor	Negative
		S-O-07: Presence of new buildings	Moderate	Moderate	Negative
Lot 2	SOCIAL	**S-O-02: Water distribution and sales operator**	Major	Major	Negative
		S-O-03: Access to reliable potable water supply	Major	Major	Positive
		S-O-04: Improvement of life quality of local population	Major	Major	Positive
		S-O-05: Energy Consumption	Minor	Minor	Negative
Lot 3, 6, 7	SOCIAL	**S-O-01: Demand of workforce**	Moderate	Moderate	Positive
		S-O-02: Water distribution and sales operator	Major	Major	Negative
		S-O-03: Access to reliable potable water supply	Major	Major	Positive
		S-O-04: Improvement of life quality of local population	Major	Major	Positive
		S-O-05: Energy Consumption	Minor	Minor	Negative
		S-O-07: Presence of new buildings	Moderate	Moderate	Positive

10.0 CUMULATIVE IMPACTS

This Chapter describes the potential cumulative impacts that the Quilonga Project, in combination with other existing or planned developments, could potentially have on identified Valued Environmental and Social Components (VECs) in the Project area of influence.

Cumulative impacts are contextual and encompass a broad spectrum of impacts at different spatial and temporal scales (IFC, 2013). They may arise because a series of projects of the same type are being developed in close proximity (e.g., water extraction from Kwanza River), or as a result of combined effects of a mix of different types of projects (e.g., house developments, industries) (IFC, 2013).

> *Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity, when added to other existing, planned, and/or reasonably anticipated future ones.*
>
> IFC (2013)

Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development (IFC, 2013). Cumulative impacts may result in either:

- An additive impact: where it adds to the impact which is caused by other similar impacts; or
- An interactive impact: where a cumulative impact is caused by different impacts that combine to form a new kind of impact. Interactive impacts may be either countervailing (the net adverse cumulative impact

is less than the sum of the individual impacts) or synergistic (the net adverse cumulative impact is greater than the sum of the individual impacts).

10.1 Methodology

The Cumulative Impact Assessment (CIA) process involves (a) the analysis of the potential impacts and risks of the Project in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen VECs over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible (IFC, 2013).

The *Good Practice Handbook – Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets* (IFC, 2013) was used as a guideline and direct reference in the completion of this CIA study. Figure 408 outlines the steps used in the determination, assessment, and management of cumulative impacts.

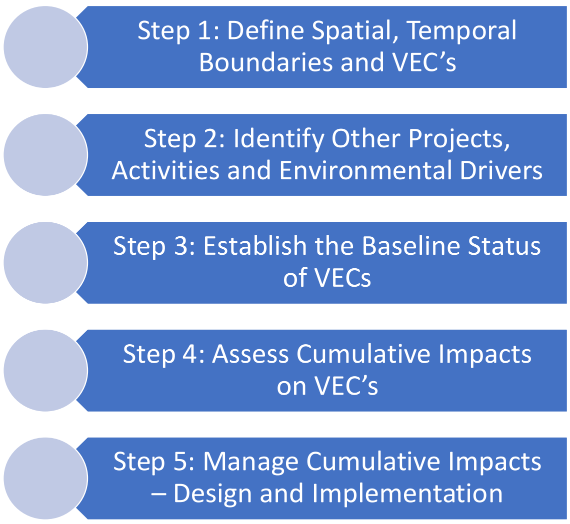


Figure 408: Steps in the CIA Process

10.1.1 Spatial and temporal boundaries of the CIA and Identification of VECs

As required by Performance Standard 1 (IFC, 2012) the CIA Study Area encompasses the following components:

- The primary project site and related facilities that the Project will develop ;
- Areas potentially impacted by cumulative impacts from further planned development of the Project, any existing project or condition, and other project-related developments that are realistically defined at the time the ESIA is undertaken; and
- Areas potentially affected by impacts from unplanned but predictable developments caused by the Project that may occur later or at a different location.

Temporary boundaries for a CIA normally include the complete life cycle of the Project plus the expected time frame of the potential effects of proposed Project which can extend beyond its life cycle.

VECs to include are those that could be affected by the Project but also identified as being of concern by stakeholders.

10.1.2 Identification of other Projects, Activities and Environmental and Social Drivers

Existing, planned, and/or reasonably anticipated future projects and activities ('developments') that have the potential to influence the current environmental baseline within the Project Area of Influence were identified via a review of Luanda and Viana Master Plans, online searches for information on other proposed major infrastructure and/or development plans for the region, as well as review of freely available aerial imagery, and Saioz's knowledge on the region. Those known existing/planned projects/activities, and their potential interactions with VECs, were mapped and described.

Environmental and social drivers of change, primarily climate change and population influx, were contextualised for the CIA Study Area based on literature review of available information.

10.1.3 Baseline Status of VECs

The baseline status of VECs was collated from the baseline data for this ESIA - addendum.

10.1.4 Assessment of Cumulative Impacts

CIA is future-oriented. Therefore, as recommended by IFC (2013), cumulative impacts were assessed as the difference between the estimated future baseline condition of VECs in the context of the stresses imposed by all other sources (existing/proposed developments/activities within the CIA Study Area and natural environmental drivers); and the estimated VEC condition in the context of that future baseline condition plus the Project.

For this assessment, the expected potential environmental and social impacts and risks identified in Step 2 (see Figure 409) are discussed in the context of the predicted future baseline condition of the VECs. The residual impacts of the Project on VECs were then re-evaluated in the light of the impacts generated by the existing and proposed projects and activities in the Study Area, to produce a qualitative determination as to whether the contribution from the Project would result in a significant cumulative impact.

10.1.5 Recommendations for Management of Cumulative Impacts

For significant cumulative impacts on VECs, management strategies to address these, consisting of collaborative/coordinated or adaptive management programmes, must be proposed.

Therefore, the focus of this CIA was on mitigation actions that the Project can take to avoid contributing to the overall cumulative impacts on the future baseline of the identified VECs, building on those mitigation measures already implemented via the Project ESIA's mitigation hierarchy.

10.1.6 Assumptions and Limitations

The cumulative impact assessment is largely based on the review of this ESIA-Addendum and previous ESIA (Artelia 2014) reports, supplemented by a high-level review of the potential impacts that may be contributed by other projects, activities, and drivers of change in the study area. In the absence of specific information on the residual impacts associated with these other projects and activities, the estimated overall cumulative impacts on VECs in the CIA should be considered qualitative.

10.2 Results

10.2.1 Spatial and Temporal Boundaries

The spatial boundary of the CIA included the municipalities Icolo and Bengo, Viana e Cacuaco (for the social receptors) and the catchment of the Kwanza River (for the aquatic environment receptor).

Regarding the temporal boundaries, water supply systems are normally intended to operate for a prolonged period. Treatment plants, CDs and pipelines are more likely to be repeatedly upgraded rather than a site or line totally decommissioned. Therefore, no indicative of closure is provided for the Quilonga Project. The temporal extent of impacts from other past, present, and predictable future developments is considered within the same timeframe.

10.2.2 Valued Environmental Components (VECs)

The resources and receptors (VECs) that may be exposed to cumulative impacts as a result of the Project, in combination with other existing, planned, and/or reasonably anticipated future projects and activities, include:

- Residents of the Icolo and Bengo, Viana e Cacuaco ;
- Kwanza river ;
- Terrestrial natural habitats (Dry Adansonia shrubland, Dry Shrubland, Floodplain).

The VECs and associated indicators identified for the CIA, based on the outcomes of the ESIA are outlined in Table 170.

Table 170: Valued Environmental Components (VECs) for the CIA

Type of VEC	Identified VEC	Indicators
Ecosystem integrity	Natural terrestrial habitat	Natural habitat quantity and quality
	Kwanza river	Kwanza river quality Kwanza river hydrology
Social	Residents of Icolo and Bengo, Viana e Cacuaco	Access to land Employment opportunities Traffic conditions Access to basic services and infrastructure Air quality

10.2.3 Other Identified Projects, Activities and Environmental Drivers

Other Projects and Activities

A summary of the existing, planned, and/or reasonably anticipated future projects and activities that have the potential to influence the future environmental baseline within the Study Area, and result in cumulative impacts on identified VECs, are set out in the Table 171. The Luanda Metropolitan Master Plan and the Viana Municipal Masterplan don't have specific project mentioned, except for some infrastructures, especially transport.

Table 171: Existing, planned, and/or reasonably anticipated future projects in the CIA study Area

Project	Notes
Zango Centrality Expansion (Areas de Expansão Zango)	The entire Zango area has been progressively urbanized in several phases (I, II, III, IV, V), but has not yet been completed.

Project	Notes
	The Quilonga project includes the Zango 5 DC in that zone. However, new residential buildings will also be built around this DC, continuing the expansion of the centrality to new areas to the south. Zango centralities still have several areas are reserved and are already delimited with access roads.
Sequele Centrality Expansion (Centratidade Sequele)	Similar to Zango, there are still areas not developed around the Sequele Centrality, with possible future housing development
Onzo Yami - A Minha Casa, O Meu Lar Project	This project is already starting and is part of the Sequele Centrality expansion. It Includes 5,000 new houses.
Nova Era Shopping (Projecto Nova Era Centro Comercial)	This is a large new shopping area being constructed near the Cacuaco DC, that will house 400 new shops, with 10,000 estimated direct jobs.
Luanda New International Airport (Agostinho Neto Airport) (Novo Aeroporto)	The new airport will be officially opened in November 2023, with the accreditation process still ongoing. It is expected that operation will start between December and beginning 2024. Besides the large traffic influx of the new airport, it is also expected to have future land use changes around the airport, with new service, commercial projects to serve the airport. There are already new hotels and commercial areas associated with the airport.
ZEE industrial area (Área industrial da ZEE)	The ZEE industrial reserve still has many plots available for future industrial development, so it is expected that there will be future industrial development in this area, with new industrial units.
Future Luanda Surface Metro	The Surface Metro will be a major project in the future mobility plans for Luanda. It is already starting construction of the first phases. There is a line (Grey Line) that will extend along the Catete Road until Viana, with interventions near the project area, namely the PIV and Kapalanga DC. There isn't available the location of these future lines since they will be constructed only further along. However, it is expected that the Grey Line will follow closely the existing railroad, turning west in Viana.
Existing and Future water dams in the Kwanza river (**Figure 411**)	Although located many kilometers upstream of the Project's AoI, there are several hydroelectric dams located along the Kwanza River. There are already 3 dams constructed, Capanda (furthest upstream), Lauca and Cambambe (last dam in the Kwanza before the Luanda Area and the river connection to the Atlantic ocean). There is a fourth dam in construction, Caculo Cabaça, downstream of Laúca. Prodel is considering the future construction of 4 additional hydroelectric dams, namely Zenzo 1, Zenzo 2, Túmulo do Caçador and Luíme, all located between Caculo Cabaça and Cambambe. Although the future projects will all be located between two existing dams (Laúca and Cambambe), the construction of additional water dams along the Kwanza could have impacts on water quality downstream.
Existing and future water extractions in the Kwanza for drinking water supply	EPAL already has in operations 4 extraction systems, 1 to 4 (BITA), that supply water to Luanda. The Bita Project, set to supply the south region of Luanda with capacity of treatment of 3 m3/s by 2026, is in a more advanced stage than Quilonga. The expansion of the Bita System to further increase its capacity to 6 m3/s is planned to a later stage (2027-2029).

Project	Notes
	Furthermore, in the Luanda Metropolitan Master Plan it is mentioned additional investments, between 2020 and 2030, in 3 other water supply systems, after the Quilonga Grande (System 5). These will be Systems 6, 7 and 8. Detailed information about those is not currently available.
Water extractions in the Kwanza for industrial purposes	There are several companies with water extractions located in the Bom Jesus Area which are associated with the beverage sector.
Other activities are present in the Bom Jesus Area	Other industrial activities are present in the vicinity of the Lot 1 – Water abstraction, such as the CIF Cement factory, Coca Cola factory, Cuca beer factory as well as sand and clay extraction units and warehouses.

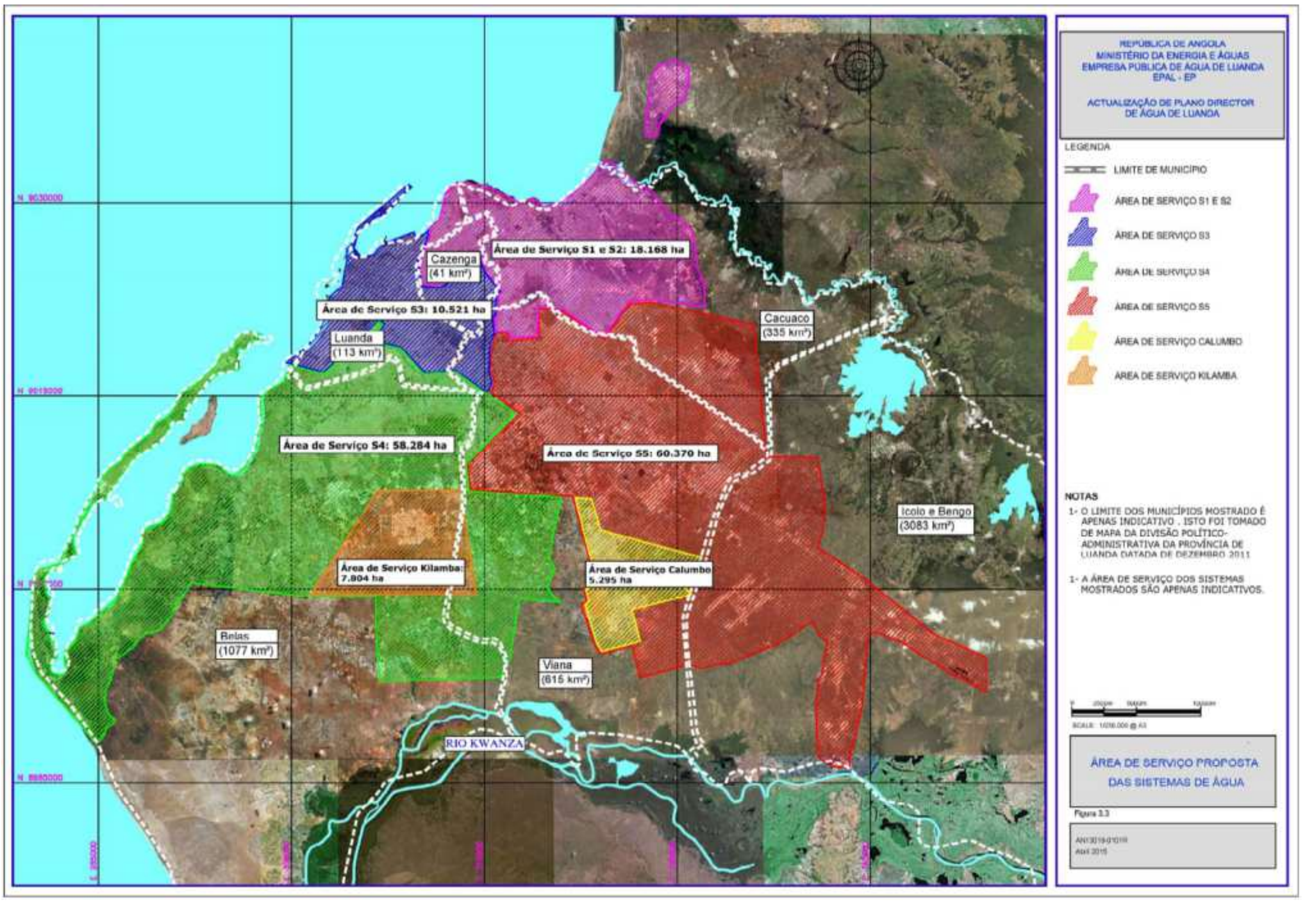


Figure 409: Existing and Planned Systems of Drinking Water Supply for Luanda Province, EPAL Linhas de Orientação do Plano Estratégico 2015-2020.

Figure 410 shows the main planned developments in the study area for the CIA.

Figure 410: Main planned developments in the study area of the CIA (Saioz)

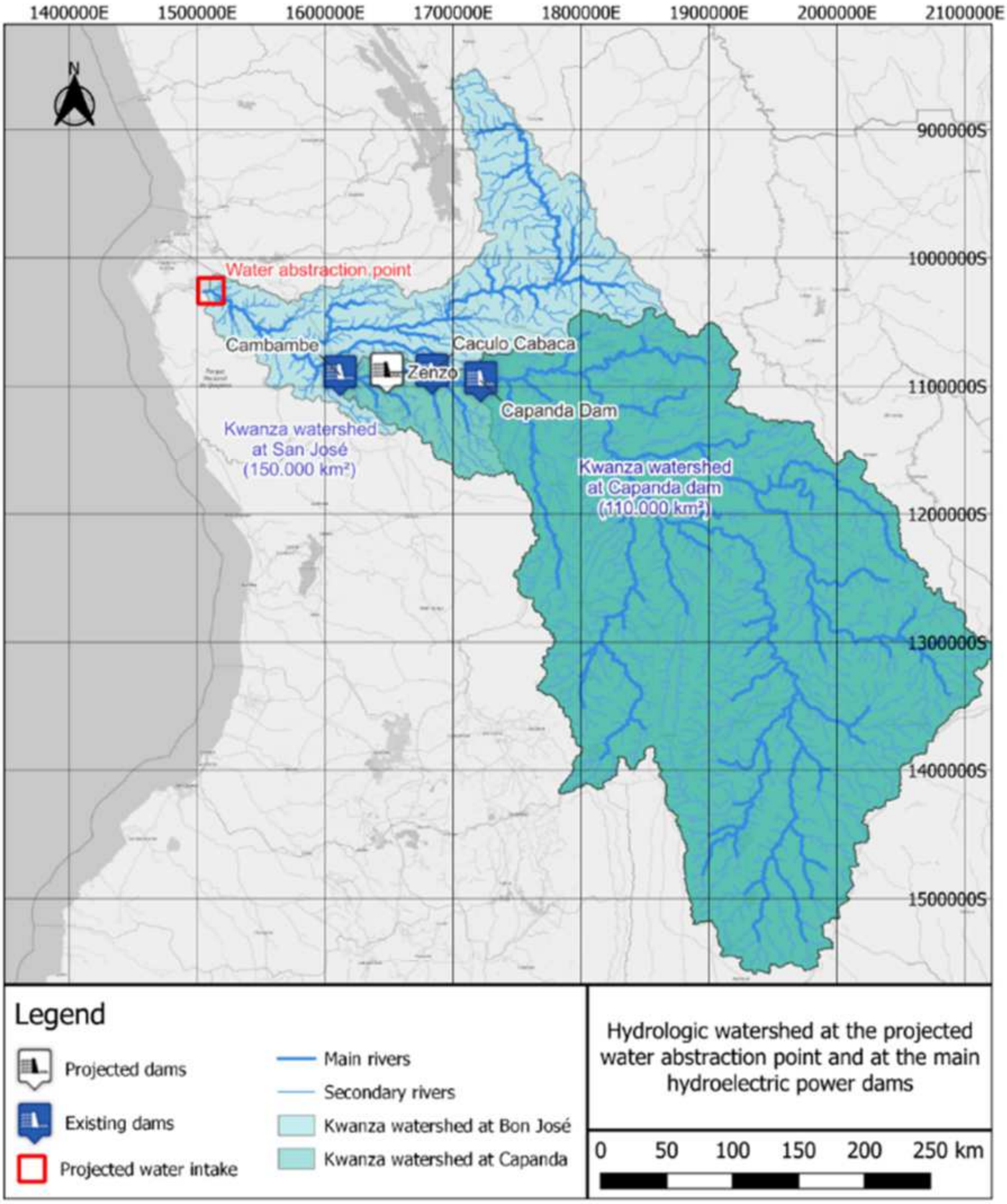


Figure 411: Existing and Future water dams in the Kwanza River in the study area of the CIA

Other Environmental and Social Drivers

- Climate Change

The Climate Change Physical Risk Assessment for the Quilonga Project (Appendix M) helped identifying the most critical climate-related risks, at present or in the future, according to different emission scenarios and during the lifetime of the Project as a consequence of Climate Change. The assessment was done for the 3 districts where the Project is located: Cacuaco, Viana and Icolo e Bengo. The most relevant hazards are urban flood, river flood, wildfire hazard and extreme heat.

- Population influx

The Province of Luanda, with 2,418 km^2, represents only about 0.2 % of the territory of Angola and about 27.5 % of the total population. Due to high fertility rates and urban migration after many years of civil unrest, the population of the Province of Luanda is facing a rapid growth. Luanda has been one of the world's fastest-growing urban areas, and the growth is expected to continue over the next decade. By 2030, a population of 12.9 million is projected for the Province. Currently 32 % of the population of the Province leaves in the Municipality of Luanda, 23 % in Vianna, 15 % in Cacuaco and 1 % in Icolo and Bengo municipalities. It is likely that population growing projections are also applied to those municipalities, especially Vianna and Cacuaco.

10.2.4 Estimated Overall Cumulative Impact on VECs

For a cumulative environmental and/or social impact to occur, there must be an effect caused by the Project, which combines cumulatively with the and/or social effects from other projects or activities, and environmental and/or social drivers (Table 172). The cumulative impacts on VECs that are likely to arise from the Quilonga project in combination with the other identified existing/proposed projects in the Study Area are discussed in the following sub-sections.

Table 172: : projects or activities, and environmental and/or social drivers in the CIA Study Area

VEC	Impacts on social VEC			Impacts on ecosystems		
Project/ activities	Increased demand for and pressure on land and natural resources	Traffic increase and accidents	Pressure on basic services and infrastructure	Terrestrial habitat degradation and loss	Changes on Kwanza river hydrology	Kwanza river degradation
Zango Centrality Expansion	-	x	x	x	-	-
Sequele Centrality Expansion	x	x	x	x	-	-
Onzo Yami - A Minha Casa, O Meu Lar Project	x	x	x	x	-	-
Nova Era Shopping	x	x	x	x	-	-
Luanda New International Airport (Agostinho Neto Airport)	x	x	x	x	-	-
ZEE industrial area	-	x	x	x	-	-
Future Luanda Surface Metro	x	x	x	x	-	-
Existing and Future water dams in the Kwanza river	-	-		-	x	x
Existing and future water extractions in the Kwanza for drinking water supply	-	-		-	x	x
Water extractions in the Kwanza for industrial purposes	-	-	-	-	x	x

VEC	Impacts on social VEC			Impacts on ecosystems		
Other activities are present in the Bom Jesus Area	-	-	-	x	-	x
Climate Change	-	-	-	x	-	
Population Influx	x	x	x	x		x

Social Effects

Several large- and medium-scale developments are currently operating or will start operating in the Study Area in the near future, which will further bolster the economy of the Icolo and Bengo, Viana e Cacuaco municipalities. These developments are likely to result in employment opportunities becoming available and will attract opportunity-seekers to the area – resulting in an increased population influx into Luanda municipality. These opportunity seekers will place additional strain on lacking social infrastructure and services and impact on community health, security, and safety. However, such economic benefits are expected to also give rise to opportunities to raise community revenue and revenue through royalties and taxes (such as the new Airport) which should be reinvested in community development. Should this occur successfully, the municipalities and surrounding areas will be able to improve social services and infrastructure, addressing key needs areas such as road infrastructure, sewage supply infrastructure and electricity supply. However, these activities are all expected to increase prices and result in inflation – which, unless controlled, may result in a perpetuation of the poverty cycle which many households in and around Luanda Province find themselves in.

The Project is expected to overlap to some degree with the developments specifically regarding the following positive impacts, especially in terms of employment opportunities, community development and community health. Particularly, the Quilonga and Bita systems will largely contribute to the access to reliable potable water to the population of the capital city and contribute to the reduction of social and political pressure on the existing system to supply the rapidly expanding population.

However, the Quilonga Project will also contribute to negative social impacts specifically:

- Traffic increase and accidents (during construction) ;
- Increased demand for and pressure on land and natural resources ;
- Pressure on basic services and infrastructure.

Traffic increase and accidents

Although the Project will result in an increased traffic of machines, trucks and vehicles and workforce transport during the construction phase, the impact on traffic during the operation phase is expected to be limited. Nevertheless, high numbers of pedestrians/cyclists/motorbike on the roads combined with limited road traffic awareness, increased cumulative levels of heavy machinery from surrounding developments, and poor road conditions will increase the risk of traffic accidents on transportation networks, and an additive cumulative impact on social VECs in the CIA study area is likely.

Increased demand for and pressure on land and natural resources

The land for the construction of the water treatment plant (Lot 1), the sludge treatment plant (Lot 10) and Lot 8 were part of the land reserve of the Z.E.E. (Special Economic Zone). For lots 3, 6 and 7 the land has already been reserved in the municipalities and that there are no activities on the sites. The importance of this impact was assessed as minor for those lots. For lot 2, small businesses are present in places along the roads and future locations of the pipeline and the importance of the impact is considered moderate. However, as already explained, the Project will contribute to population growth in the through an in-migration of project employees (even if the majority of the employees are supposed to be hired locally), and through an in-migration of opportunity seekers. Restrictions to land caused by the project infrastructure requirements combined with a project-induced population influx and increased demand for supplies may increase demands for land and natural resources in the CIA Study Area. These project effects, in combination with other existing and planned projects within the Icolo and Bengo, Viana e Cacuaco, could increase conflict within the project area, as a result of increasing population or exacerbation of any existing tensions in the communities. Conflict may also occur due to increased population with tensions between 'locals' and 'outsiders', which often relate to access to land and use of natural resources (as well as employment opportunities).

Therefore, the Project is likely to contribute to cumulative impacts in the VECs on the CIA study area in this regard, together with other existing and planned projects. However, population influx and consequent pressure on land and natural resources are expected to continue to those 3 municipalities, despite the Quilonga Project.

Pressure on basic services and infrastructure

Population influx to the CIA study area will increase pressure on already limited basic services and infrastructure, including education facilities, health care facilities, water, sanitation, waste disposal facilities as well as roads and transportation. The few facilities that do exist within the project area are largely in poor condition with insufficient capacity or equipment. Potable water supply is limited and will be benefited by the Quilonga Project and other drinking water supply projects already planned. An increase in population will further exacerbate the shortfall in social services. Increasing activities in highly urbanized areas will deteriorate the air quality which is already considered highly impacted by Particulates Matters (Pms2.5 & PM10) and exhaust gas (SOx, CO, NOx) from vehicles traffic.

Effects on ecosystems

- Terrestrial habitat degradation and loss

A large part of the Quilonga Project will be constructed in artificialized build up land, as well as many of the new developments listed in Table 171.

The habitat loss surfaces during the construction phase of the Project Quilombo represent less than 1 % of the total surface of modified habitats in the AoI, and a loss less than 1 % of the total surface of natural habitats in the AoI. The three quarters of the overall Project temporary footprint is located in modified habitats. However, among natural habitat losses, the main habitats impacted are the floodplain which will lose 10 % of its total surface in the AoI, and then the dry shrubland which will lost 1,2 % of its total surface in the AoI. Vegetation could be degraded by the introduction or dispersion of alien invasive species through the movement of soil containing invasive species seeds in the trucks' wheels. Also, a degraded vegetation could enhance the propagation of alien invasive species.

Therefore, the Quilonga Project, together with other future developments will contribute to the contribute to cumulative impacts on terrestrial habitats, especially those located in the Icolo and Bengo Municipalities, namely Luanda New International Airport and ZEE industrial area. Climate hazards such as wildfire will may also contribute habitat loss and degradation.

- Changes on Kwanza River hydrology

As already identified in the ESIA 2014, a potential cumulative impact of the Quilonga Project is related to the abstraction of water from the Kwanza River in combination to the known as Bita S4 Water Supply Project, set to supply the south region of Luanda with capacity of treatment of 3 m^3/s by 2026. The ESIA done for the Bita project (DAR, 2019) indicate low significant impact on hydrology of the Kwanza River, although a quantitative hydrological study was not conducted. Another important information to consider is the already existing water extraction systems of EPAL. According to the annual report from EPAL. That represents an extraction volume (assuming 365 days and 24 hours operation) of 575.103 m^3/day or 6.6 m^3/second.

The impact assessment done for the Quilombo Project, presented in the present ESIA-addendum indicated a negligible negative impact value during operation. The cumulative impacts of both systems in hydrology of Kwanza are expected to be minor.

Based on publicly available information, the four main private companies extracting the water from Kwanza River in the Bom Jesus Area would extract 2.301 m^3/day (or 287.64 m^3/hour). Assuming a minimum of 8 hours of daily production cycle, that would represent a maximum extraction flow of 0.08 m^3/second. As such, a preliminary estimate for the private companies with water extraction in the Kwanza is under 1 % of the proposed extraction volume for the Quilonga Project.

Table 173: Estimated water consumption from private companies uin the Bom Jesus area

Company	Available information	Estimated water Consumption (in m3/day) (*)
BEFCO Industria / Purangol	3 water production lines + 4 juice production lines, with 250 m3 of extracted water per day	250
Compal+Sumol	3 juice production lines with 800 m3/day – expansion to 5 production lines (assumed a direct increase to 1300 m3/day)	1 333
SODIBA	2018 data (1st full production year): 22 million liters of beer per year - assumed 365 production days, with 60 m3/day)	61
COBEJE	Production average of 2 million and 400 hectoliters/year - assumed 365 production days, with 657 m3/day)	657
	Total for the 4 companies	2,301.14

(*) assuming that the production value is similar to the water extraction volume

Regarding the hydroelectric dams, as demonstrated in the hydrological assessment, the presence of several of them upstream of the Quilonga Lot 1-WAF generate a positive impact on flow rates and water levels during low flow periods. Indeed, the production of electricity in the dry season requires pumping of water stored in dams during the wet season, and consequently a release of water downstream leading to an increase in flow and hydrometric levels at the WAF during the dry season.

- Kwanza river degradation

At Quilonga Lot 1, marginal vegetation will need to be cleared for the construction of the intake pump station and associated infrastructure. This will result in a loss and degradation of habitats near the Kwanza River. Moreover, the pumping station will need to be installed in the riverbed, which will result in construction works below the high-water mark, with a potential to disturb aquatic habitat. As these habitats are directly used by aquatic biota, habitat destruction may have an impact on aquatic biodiversity. In addition, noise and vibration as a result of construction activities and machinery my scare individuals away. The disturbances will be temporary and will only be related to the activities in Lot 1 and the impact factor is therefore considered during construction as minor. During operation the water abstraction at the pumping point might generate entrainment and impingement of fish, eggs and larvae, but the impact on fish mortality was considered as minor.

Other existing activities that can lead to river degradation such as aquatic pollution include (Artelia ESIA 2014):

- Uncontrolled open dumping of various types of waste ;
- Intensive and irrigated agriculture, in which large quantities of chemically synthesized fertilizers and phytopharmaceuticals are usually used, causing water eutrophication ;
- Using the kwanza river or its tributaries for bathing, washing cloths and kitchenware/tableware, using detergents and/or soaps ;
- Discharge of liquid industrial effluents ;
- Discharge of fine-grained aggregates (silts and clays) in an abandoned sandpit ;
- Selling of fuel, lubricants, additives, and oils on the roadside, without any containment of spills and Settlements (without any pits or with poorly constructed pits).

The combined residual impacts on Kwanza River stemming from the Project in combination with other existing/future developments/activities within the CIA Study Area, could potentially have a negative impact on aquatic biodiversity.

10.3 Recommendations for Management of Cumulative Impacts

The recommendations for management of cumulative impacts focus on how Quilonga Project can enhance the management of residual project impacts, and how this can be integrated with the overall management of cumulative effects across the numerous projects in the Luanda region. Those are in addition to those measures already listed via the Project ESIA's mitigation.

It is also important that EPAL and Quilonga Project constructors of all Lots:

- Collaborate, exchange, and align their CESMP and those plans meet international requirements ;
- Adhere strictly to environmental quality management protocols (including noise, soil, waste, water and air and others) to ensure that the overall Project environmental impacts are minimized ;
- Promote (and participate in) the development of an integrated regional-level social and environmental management strategy ;
- Promote (and participate in) the development of an integrated regional water resource management strategy together with the other industry partners, local government, and relevant NGOs, and include plans for addressing potential cumulative impacts on water quality and quantity of Kwanza River.

10.3.1 General recommendations

It is recommended that a regional environmental and development forum is established by the municipalities Icolo and Bengo, Viana e Cacuaco, EPAL, future developers and existing industries. The mandate of the forum should be to:

- Monitor and manage cumulative environmental and social impacts of the development of the drinking water supply, that are beyond the responsibilities of the individual companies ;

- Ensure that any actions taken to manage cumulative impacts are aligned with governmental policies and plans, including Luanda and Viana Master Plans ;
- Communicate widely and effectively with stakeholders, including local project-affected communities and local and international NGO's.

The forum should involve the DAR/constructors of the different lots of Quilonga Project, industry partners, developers, relevant municipalities, urban districts and communities, relevant ministers (e.g., Energy and Water, Public Works, Urbanism & Housing, Environment) and a core group of other stakeholders such as community representatives of citizens, fishermen, farmers, and local business, as well as contractors and suppliers.

10.3.2 Specific Recommendations to minimize cumulative effects on ecosystems

It is recommended that EPAL, as part of the forum above:

- Participate in a landscape-wide/regional biodiversity offsetting scheme for the impacted VECs. For example, an opportunity to contribute to greater understanding of the biodiversity value of the CIA Study area in order to assist in its conservation and management may exist, at both the Project-specific and landscape/regional levels.
- Conduct fish studies in the Kwanza river to verify the presence of *Clarias ngamensis a* species, but which presence has not been confirmed in the AoI of the ESIA.
- Form a collaboration with other companies within the CIA to cumulatively manage and monitor residual biological impacts.

10.3.3 Specific Recommendations to minimize cumulative social effects

The key management measures to mitigate negative cumulative socio-economic impacts and to enhance positive socio-economic impacts are centered around developing a regional influx management plan and regional community development plan. Since cumulative impacts arise from interactions between various projects and/or developments, responsibility lies with all relevant role players to manage the impacts.

It is recommended that EPAL and constructors of the Quilonga project, as part of the forum above:

- Maximize opportunities for involvement in Project employment: Although many of these positions will be skilled positions, the establishment of appropriate training and skills development at an early stage will allow local community members to benefit from such opportunities. An increase in the wage-earning population would indirectly increase the demand for goods and services, potentially providing local business the opportunity to supply this demand, thus developing the local economy.
- Develop a common influx management plan aiming to minimize population influx: Common aspects such as access routes and control, worker transport, workforce recruitment policy and management, and procurement of goods and services should be considered.
- Ensure transparency and understanding of all project activities: The Project contribution to potential conflict amongst communities within the CIA Study Area can be reduced through consultation activities in line with the Stakeholder Engagement Plan to ensure transparency and understanding of all project activities. Ongoing involvement of all relevant Stakeholder in project activities and decisions where possible will assist with spreading consultation messages and reduce the potential for conflicts relating to perceptions of unequal involvement in the project. Communication will ensure that communities are aware of project procedures and measures to address issues such as employment distribution and development to reduce pressure on services.

- Promotion and participate in regional-level management strategies to minimize impacts on community health as a result of noise, contamination of water, soil, and air quality.
- Participate in the development and implementation of a municipal-level traffic management plan to minimize impacts to community health, safety, and security as a result of increased levels of traffic. This should include demarcation of recommended speed limits on roads and through villages for all vehicle types, with speed bumps constructed in key areas of concern; set standards for health and safety training for vehicle drivers using public roads, including defensive driving for dealing with poor road conditions, exclusion zones around construction areas to prevent safety risks to community members, and community awareness raising programmes for traffic risk, particularly programmes that consist of road safety training specifically-targeted for children, with information being made available in schools and public places.
- Conduct human rights due diligence on an ongoing basis, to avoid inadvertently taking part in human rights abuses and avoid potential legal and economic liability that could substantially undermine the success/viability of the Project.

11.0 ALTERNATIVE ANALYSIS

According to the NO25. “For new projects, the ESIA will include an examination of technically and financially feasible alternatives to the proposed project and a justification of the reasons for the choice of the proposed course of actions. The purpose of these alternative analyses is to improve decisions on the design, construction and operation of the project based on alternatives to the proposed project. This analysis can facilitate the consideration of environmental and social criteria in the early stages of development and decision making based on the differences between real choices. The analysis of alternatives should be carried out early in the process and should consider other possible solutions; alternative locations, project design or operational processes or other ways of dealing with environmental and social impacts”.

The alternative analysis was based on the following documents:

- Feasibility Study Report on the Q1, Q3 and Q10 Lots of the Quilonga Grande Water Supply Project ;
- Questionnaires sent to the MC ;
- Alternative locations of Lot 2 (kmz files) provided by the constructor.

11.1 No project scenario

Currently there is a still large water supply shortage in the east and southwest of Luanda. The Quilonga Project will improve the life quality and drinking water safety of millions of residents, reduce diseases, and increase the benefits of various economic activities. Without this Project the implementation of the Water Supply Master Plan will not be possible. Furthermore, the construction of the Lots 4, 5 and 6 are nearly finalized and therefore the completion of the remaining lots is necessary to ensure the water supply in the eastern region of Luanda.

11.2 Choice of the source for drinking water

The Kwanza River represents an abundant water supply, good water quality, relatively stable river regime, little variation in the riverbed, and good water intake conditions, thus is an ideal water source for Project. The water intake flow of this Project takes up 1.16 % of the Kwanza River’s annual average water flow of 775 m^3/s and 2.07 % of the Kwanza River’s average minimum monthly water flow of 435 m^3/s. Therefore, the Kwanza River is fully reliable in terms of rate of guaranteed water. No other surface water bodies in the area would fulfil the same requirements.

11.3 Choice of materials, processes and designs

The choice of materials, process and designs were based not only on technical and economic criteria and constrains but also convenience in terms of operation and management by local technicians.

Regarding Lots 1, 10 and 2, after technical comparison and selection and taking into full consideration of local operation habits, the recommendations were the following:

- **pump type (Lot 1):**

After comparing three pump types (horizontal double-suction pumps, long shaft deep well pumps and vertical double-suction pumps), the horizontal double-suction centrifugal pump from the perspective of technological and economical rationality and reliability of project practice. However, the performance characteristics of horizontal centrifugal pumps inevitably require that the pumps, motors and electrical equipment are assembled below the characteristic water level of the raw water pump station, and that the pump house adopts a water-proof hydraulic structure design to avoid the risk of flooding the pump house. If it is a must to assemble the motor above the flood level, the vertical double-suction centrifugal pump scheme is the only choice, and the pump house will adopt a double-foundation structure. Nevertheless, the constructors highlighted that there is no successful design and operation experience of large-flow and large-head pump unit with vertical long shaft deep well pump structure similar to the capacity of this Project, thus having risks of designing the pump unit structure. During the Work Conference on the Integrated System of Lots Q1, Q8 and Q10" from March 12 to 15, 2019, EPAL's representative requested adoption of vertical pump to ensure that the motor is assembled above the flood level. With the advantages and disadvantages of various pump types taken into account, and fully respecting the wishes of EPAL, vertical double-suction pumps were selected for this Project.

- **Coagulation Process (Lot 1):**

Two alternatives were evaluated: Tubular static coagulator and mechanical stirring and coagulation tank. After this Project is put into production, it is expected that the water volume will gradually increase. Given the tubular coagulation has poor adaptability to water volume, mechanical coagulation was recommended.

- **Clarification Process (Lot 1):**

After comparing pulse clarifier and high-density clarifier, the first was selected given its advantages of less equipment, convenient operation and management, and simple maintenance.

- **Filter Types (Lot 1):**

Two alternatives were considered : V-shaped filters or shutter-type filters now. The first type was chosen due to mature technologies, good treatment and backwashing effects, and is widely used in local regions. Moreover, EPAL has rich experience in the operation and management of this filter type.

- **Sludge treatment process (Lot 10):**

Three options were considered:

  - Option 1: Thickening treatment of the sludge water in the sedimentation tank and transporting backwashing water in filter and initial filtered water to the reuse pool for recycling.
  - Option 2: Transporting the sludge water in the sedimentation tank and the backwashing water in filter to the sludge tank for thickening treatment, and the initial filtered water to the reuse pool for recycling.
  - Option 3: Mixing the sludge water in the sedimentation tank, the backwashing water in filter and the preliminary filtered water in the regulating tank at first, and then transporting them for thickening.

Given the actual local conditions, the Option 1 was selected for this Project as it is systematic, simple and clear, making it convenient for operation and management.

- **Dewatering methods (Lot 10):**

Three methods were evaluated: centrifugal separator, plate and frame filter and press belt filter press. The first were selected with advantages of relatively low investment and simple management.

- **Pipelines (Lot 2):**

Steel was chosen as the material for the designed pipes, instead of FFD, for the following reasons: more economical, especially for large sizes; larger supply options for large dimensions (> DN 1000); more flexible supply conditions in terms of pipe length; greater strength and lower weight. Additionally, the connections are considered completely tension-resistant due to the welded joints.

- **Water tower (DC):**

For the DCs located near the airport, the water towers cannot be constructed for safety reasons.

11.4 Choice of energy source

For lot Q1, lot Q3 and lot Q10 a series of measures have been taken within the feasibility study to control energy consumption of the project scientifically, reasonably, and effectively in all aspects, according to the engineering characteristics and construction requirements. In particular, process measures for energy conservation (such as reasonable selection of the water treatment process system and hydraulic design to minimize head loss and so saving energy, water treatment facilities with less water consumption, assuring a high value in efficiency especially at the principal operating point) and electrical energy conservation measures (for instance designing a safe, reliable, simple and reasonable power distribution system, using energy-saving electrical equipment, energy-saving fixtures for buildings) were individuated.

Lot Q2 will not require any motorized equipment and, in case of decentralized equipment for operation and control, a photovoltaic system will be considered, as an alternative strategy to rely on energy saving technologies and clean energy production system. This will not reduce the GHG emissions stated above but will not lead to further contributions.

For lot Q4, lot Q5 and lot Q9, a series of good practice were implemented to reduce GHG emissions during both construction and operation phases. The aim was to minimize the energy consumption using energy saving technologies and clean energy production. Plus, training for employees to raise environmental awareness in any applicable case, so they are encouraged to take actions in saving energy. Alternative analyses were implemented for the equipment and vehicles of the project. The priority was to choose equipment with low GHG emission to reduce the impact on environment and improving their energy efficiency.

For lot Q6 and Q7, typical civil engineering works are planned for the construction phase, which mostly require the usage of fuel-based equipment. Almost all equipment that will be used during the construction phase will be of new generation, specifically acquired for this project. The chosen brands and models use the most recent motors in the market, so they are expected to be more efficient and so will assure less emissions.

The same applies to the operation phase: new equipment (mainly electricity-based such as pumps) – are planned for lot Q6 an Q7 and of new generation, assuring higher efficiencies and, consequently, less emissions in comparison with older models/motors.

Therefore, also considering the contribution given by the lots in GHG emissions, alternative strategies in addition to those already implemented could lead to neglectable positive impacts.

11.5 Pressure testing of the pipeline (Lot 2)

Two alternatives have been considered, but a decision of which one of them to implement is not yet made. Their technical, environmental and safety advantages and disadvantages are discussed below.

- **Alternative 1 – Hydrostatic Pressure Testing**

Installed transmission mains pressure testing with clean/treated water, in accordance with European norm DIN EN 805 and German norm DVGW W400-2 (other international norms are also used in other countries, although the testing procedures are similar to the ones defined in the mentioned European and German norms).

Summarily, after the full installation of a given pipe stretch (trench digging, pipe lowering, pipe welding and trench backfilling, except in the welding areas) the pipe is filled with water and subjected to a pressure i) 1.5 times its nominal pressure (PN) or ii) its PN+5 bar for a given time - i) for <PN16 and ii) for ≥ PN16 – through the use of a pump.

The pressure value decrease is registered and leakage in the pipe welding areas is checked. If pressure decrease values remain below a given value, the test is considered successful and that pipe stretch is considered ready for operation. If not, the necessary repairs shall be done and, afterwards, the same procedure shall be repeated until the desired values are achieved.

The water volumes used in the pressure testing are removed/drained from the tested pipes and can either to be reused in further pipe testing or discharged to existing drainage systems or natural water bodies.

This method is most widely used testing procedure, with the corresponding good knowledge of all players in the water distribution field of expertise and it is based on well-known European and international regulating norms, assuring clear methodology and well-known procedures.

On the other hand, considerable volumes of water is used for testing, which are directly proportional to the tested pipes length and DN (se Chapter 2.0). Furthermore, there is a need to assure a correct discharge of the used test water volumes.

- **Alternative 2 – Pneumatic Pressure Testing**

The principle of the pneumatic pressure testing is the same as for the hydrostatic testing - i.e., applying a given pressure to an installed pipe stretch in order to assure that no leaks or installation anomalies are present. In this alternative, air is used instead of water and, therefore, a compressor instead of a pump to achieve the desired test pressures. This is a less known procedure, especially for water pipelines, being more often used for gas pipelines and other industrial applications.

No European norms are known for this alternative, an international known norm which regulates pneumatic testing procedures is the American norm ASME B31.3.

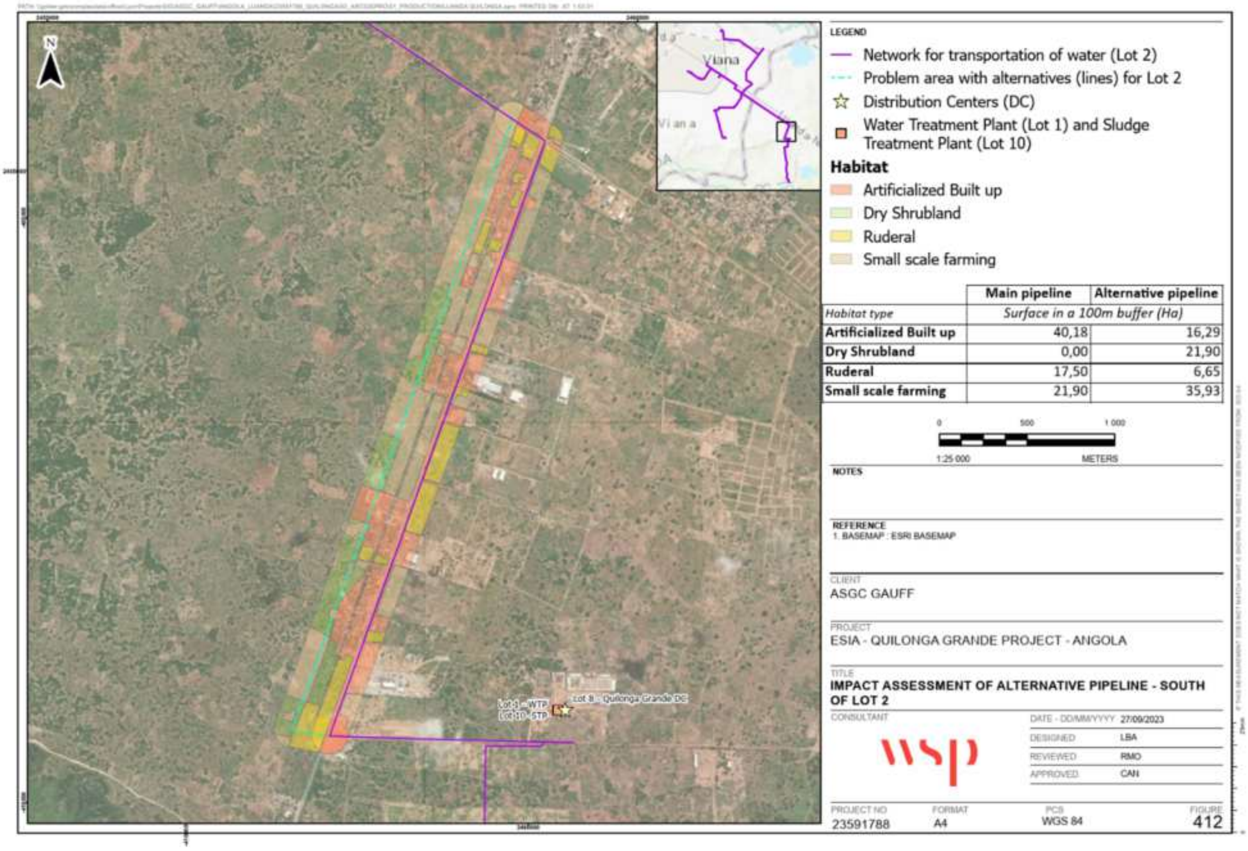
As for alternative 1, after the tested pipe is subjected to the test pressure during a given time without a pressure drop above a given value, it is considered tested and ready for operation. In case of pressure test failure, the needed repairs shall be performed, and the testing procedures shall be repeated until a successful result is achieved.

Compared to alternative 1, it allows a much easier and less costly use of pressure test medium (air instead of water), which is a considerable advantage for larger pipelines and in remote areas. There is no need to discharge water volumes used in the pressure testing procedures. However, this method is rarely used testing procedure for drinking water, with corresponding issues regarding knowledge of contractors and acceptance from employers and official entities. It is also more dangerous procedure due to the compressibility of air and potential dangers in case of test failure.

11.6 Choice of the location

The locations of the new distribution centers were defined and duly identified to the local municipal authorities. The planned sites are completely free of infrastructures, with some informal street vending to be found in small areas of the total site. Therefore, no alternatives to the planned location of the DCs are considered. Regarding Lot 1, the considered locations were defined by EPAL long ago and no alternative locations have been provided.

For the Lot 2, the transmission mains routes considered as per today are same which have been considered in the initial planning, studied in 2014's ESIA. However, in the 2014's planning was in an early stage, not even a survey of the areas along the mains' routes was performed at the time. Since then, detailed surveying has been performed allowing identification of areas with potential constraints and possible alternative traces in some locations. These alternatives were considered by the constructors to avoid areas where the construction works would be highly challenging, mainly due to foreseeable conflicts between the work fronts (not only the ditch works but also material storage, accessory machinery, transport of material to the work front, etc.) and the normal movement of traffic and population. In some locations, alternative traces were also considered due to existing infrastructures which were not present in 2014. The main and alternative traces are shown in



	Main pipeline	Alternative pipeline
Habitat type	*Surface in a 100m buffer (Ha)*	
Artificialized Built up	40,18	16,29
Dry Shrubland	0,00	21,90
Ruderal	17,50	6,65
Small scale farming	21,90	35,93

Figure 412 to Figure 416 details on different segments of the pipelines, referred hereafter as South, Cross, Centre, North 1, North 2 and Ouest.

Comparison between the "main" traces (currently considered by the constructor) and the "alternatives" are presented below in terms of their overlap with natural and modified habitats (considering the trace plus 100 meters buffer). Table 174shows results in hectares and Table 175 as percentages of the total overlapped areas.

- South section: the main route would be constructed largely in Artificialized/Built-up Areas (50 %). The alternative location would be a natural habitat (Dry shrubland), which the main location won't (0 %) and a greater percentage of small-scale Farming (44 %). Based on that assessment, the main route is the best choice.

- Cross section: The overlap with natural and modified habitats (Dry shrubland) are basically the same when comparing the main and alternative routes.
- Center section: The overlap with natural habitats (Dry shrubland) is slightly greater for the two alternative routes (4 %) compared to the main rout (1 %) which is expected to be mainly in artificialized/Built-up Areas. (96 %). Based on that assessment, the main route cold the best choice.
- North 1 section: The overlap with natural and modified habitats (Dry shrubland) are basically the same when comparing the main and alternative routes.
- North 2 section: The overlap with natural habitats (Dry shrubland and Dry Adansonia Woodland) is greater for the main route (13 %) compared to the alternative route (7 %). In both cases, large part of the section would be on Artificialized/Built-up Areas (57 % for the main route and 64 % for the alternative route). Based on that assessment, the alternative route could the best choice, unless it would cross for instance, sensitive receptors or buildings.
- Ouest section: The overlap is 100 % with modified habitats (Ruderal and Artificialized/Built-up Areas) for both the main and alternative routes.

The evaluation above is only based on satellite images. Further on-site assessments would be required verify for instance, the presence of sensitive receptors or technical constrains.

Table 174: Alternative traces of Lot 2 and overlaps with natural and modified habitats (surface in hectares plus 100 m buffer)

	South		Cross		Center			North 1		North 2		Ouest	
	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline n°1	Alternative pipeline n°2	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline
Natural habitats													
Dry Adansonia Woodland								23.72	16.00	24.65	0.00		
Dry shrubland	0.0	21 .9	8 .3	6.5	1.1	5.7	5.7	10.4	18.5	38.1	23.0		
Floodplain Grassland													
River Kwanza													
Subtotal	0.0	21.9	8.3	6.5	1.1	5.7	5.7	34.1	34.5	62.7	23.0	0.0	0.0
Modified habitats													
Small-scale Farming	21.9	35.9	18.6	21.6				16.9	3.7	30.4	13.6		
Ruderal	17.5	6.6	21.3	20.8	5.4	24.2	19.3	30.6	36.7	113.7	90.3	26.8	26.8
Artificialized/Built-up Areas	40.2	16.3	49.6	49.2	145.8	122.0	128.0	111.3	104.4	272.2	221.2	119.4	109.7
Subtotal	79.6	58.9	89.5	91.6	151.2	146.2	147.3	158.8	144.7	416.3	325.2	146.2	136.5
Total	79.6	80.8	97.7	98.1	152.3	151.9	152.9	192.9	179.2	479.0	348.2	146.2	136.5

Table 175: Alternative traces of Lot 2 and overlaps with natural and modified habitats (percentages on overlap considering a 100 m buffer)

	South	Cross	Center	North 1	North 2	Ouest

	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline n°1	Alternative pipeline n°2	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline	Main pipeline	Alternative pipeline
Natural habitats													
Dry Adansonia Woodland	0 %	0 %	0 %	0 %	0 %	0 %	0 %	12 %	9 %	5 %	0 %	0 %	0 %
Dry shrubland	0 %	27 %	8 %	7 %	1 %	4 %	4 %	5 %	10 %	8 %	7 %	0 %	0 %
Floodplain Grassland	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
River Kwanza	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Subtotal	**0 %**	**27 %**	**8 %**	**7 %**	**1 %**	**4 %**	**4 %**	**18 %**	**19 %**	**13 %**	**7 %**	**0 %**	**0 %**
Modified habitats													
Small-scale Farming	28 %	44 %	19 %	22 %	0 %	0 %	0 %	9 %	2 %	6 %	4 %	0 %	0 %
Ruderal	22 %	8 %	22 %	21 %	4 %	16 %	13 %	16 %	20 %	24 %	26 %	18 %	20 %
Artificialized/Built-up Areas	50 %	20 %	51 %	50 %	96 %	80 %	84 %	58 %	58 %	57 %	64 %	82 %	80 %
Subtotal	**100 %**	**73 %**	**92 %**	**93 %**	**99 %**	**96 %**	**96 %**	**82 %**	**81 %**	**87 %**	**93 %**	**100 %**	**100 %**
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

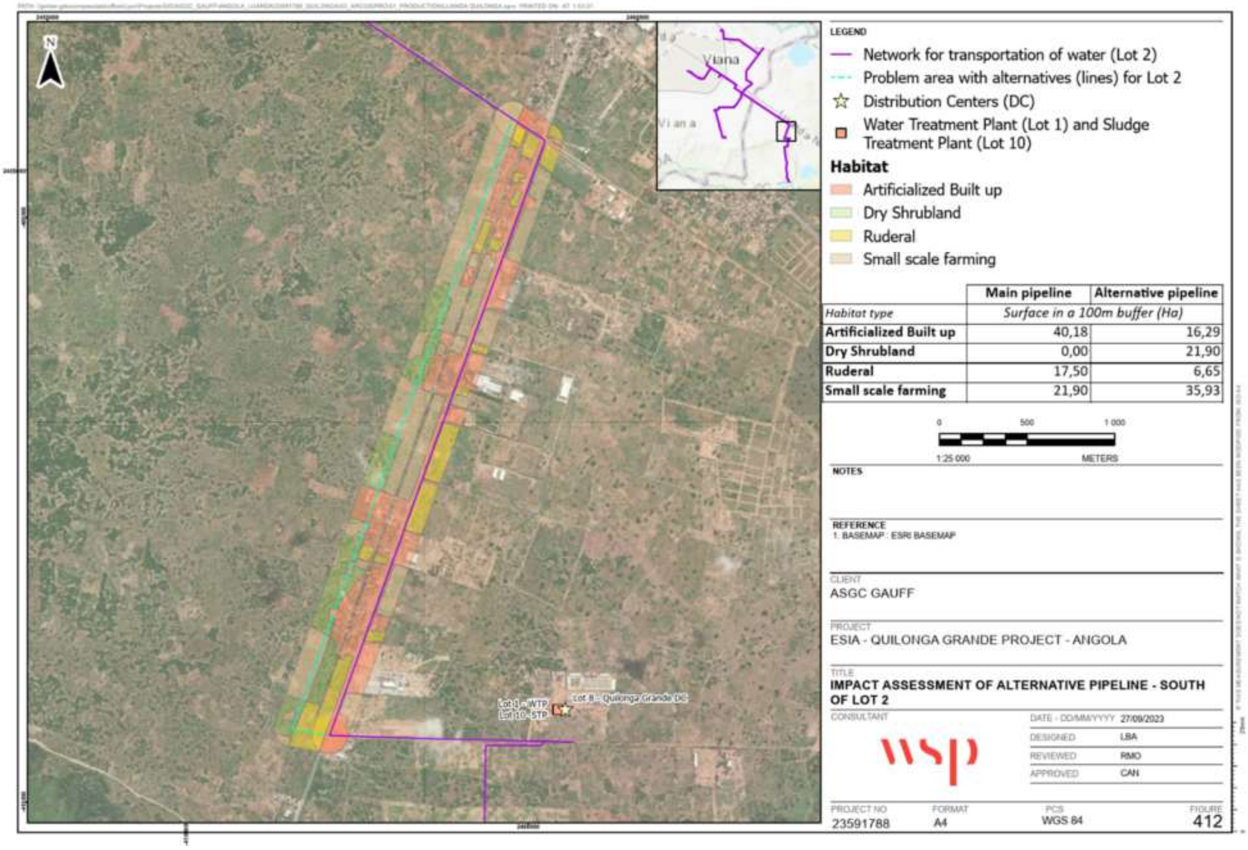


Figure 412: Alternative routes the network for transportation of drinking water (Lot 2) – South section

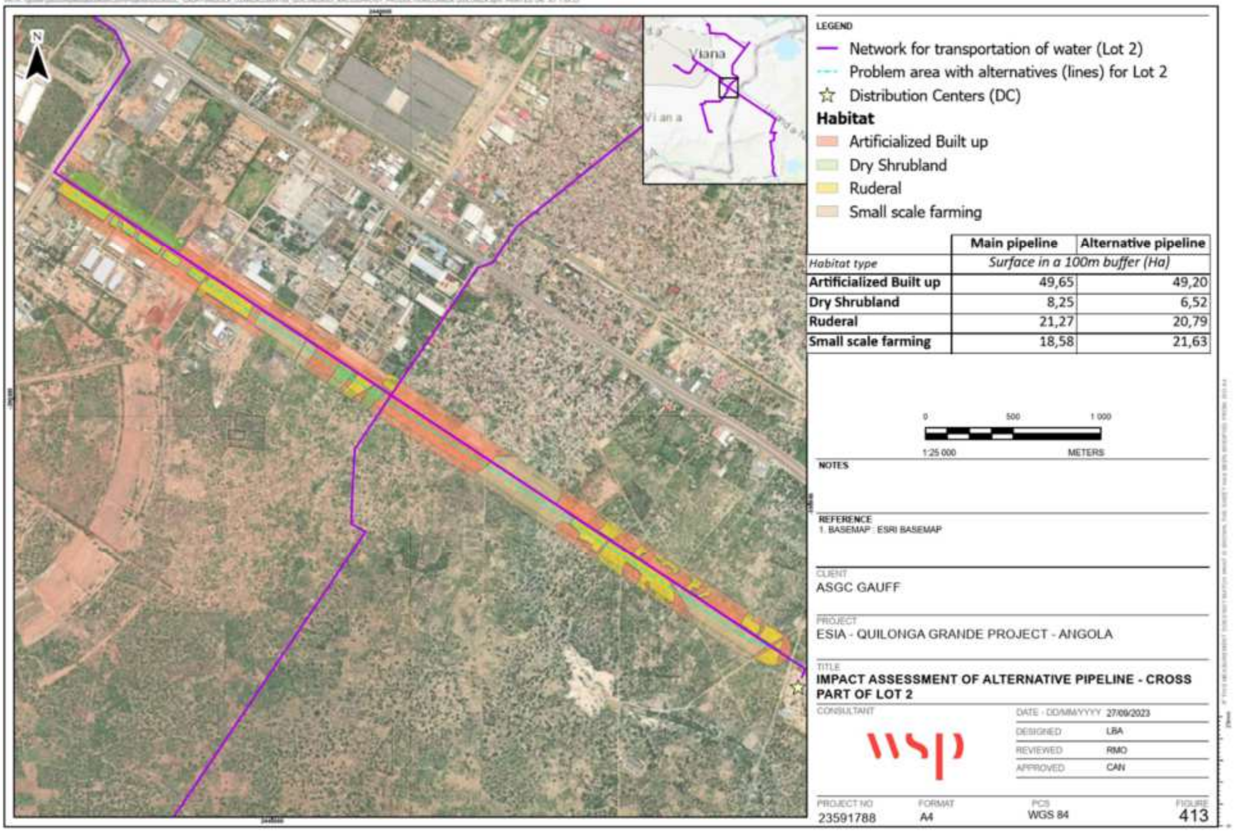
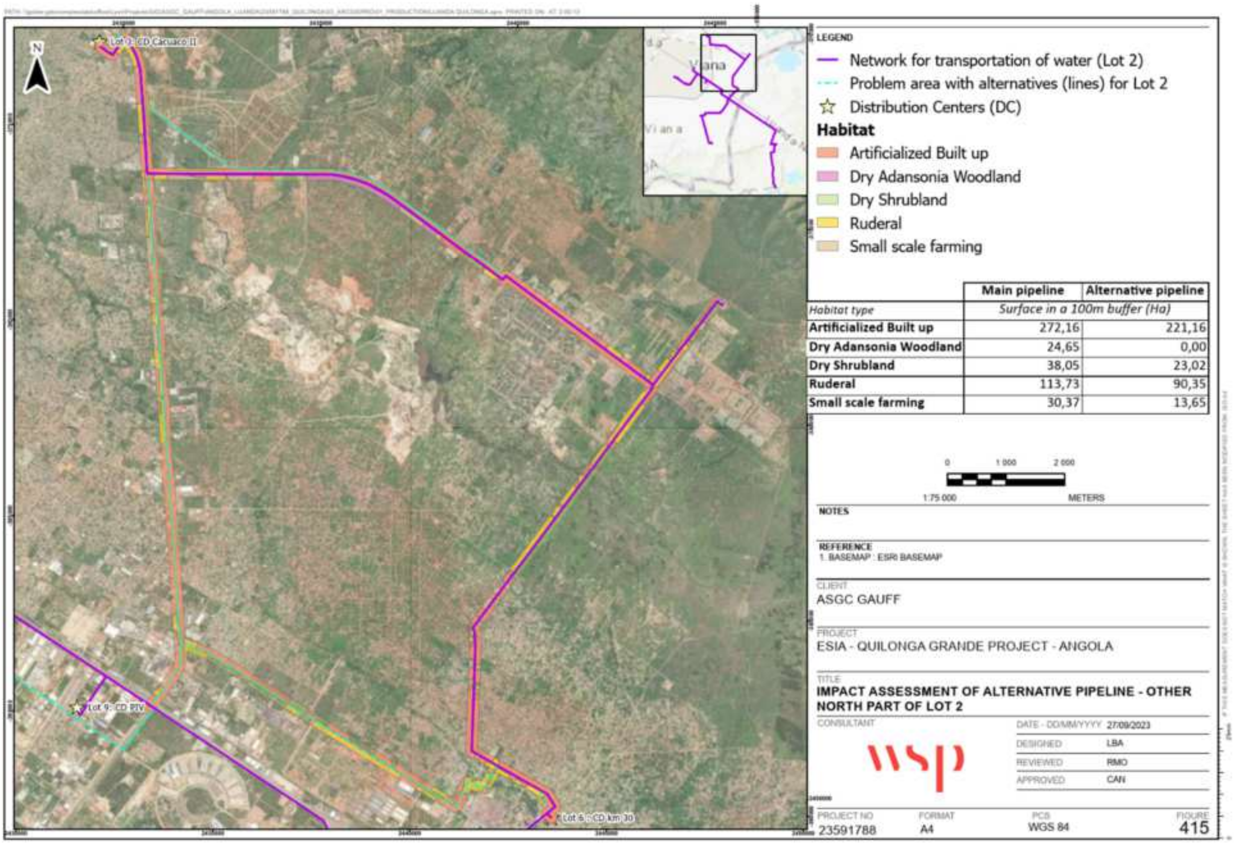
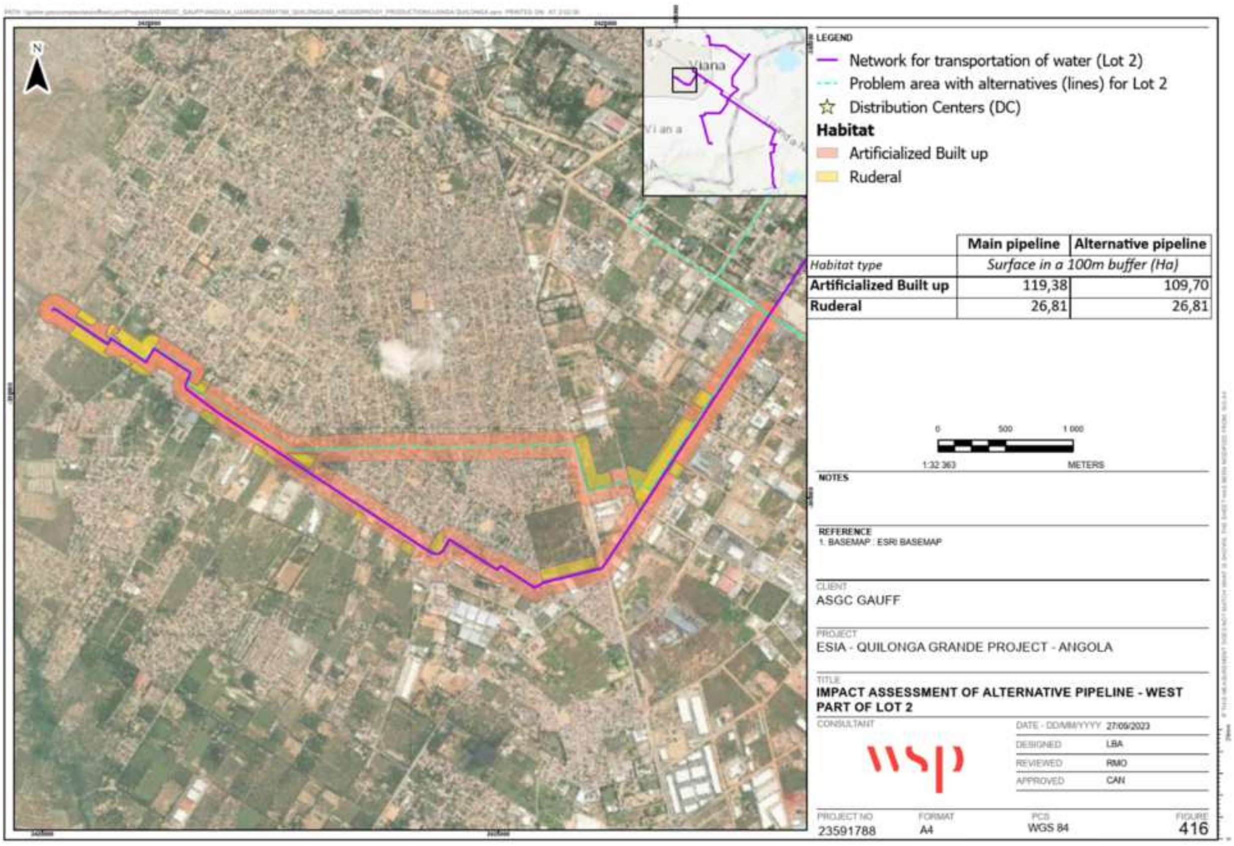


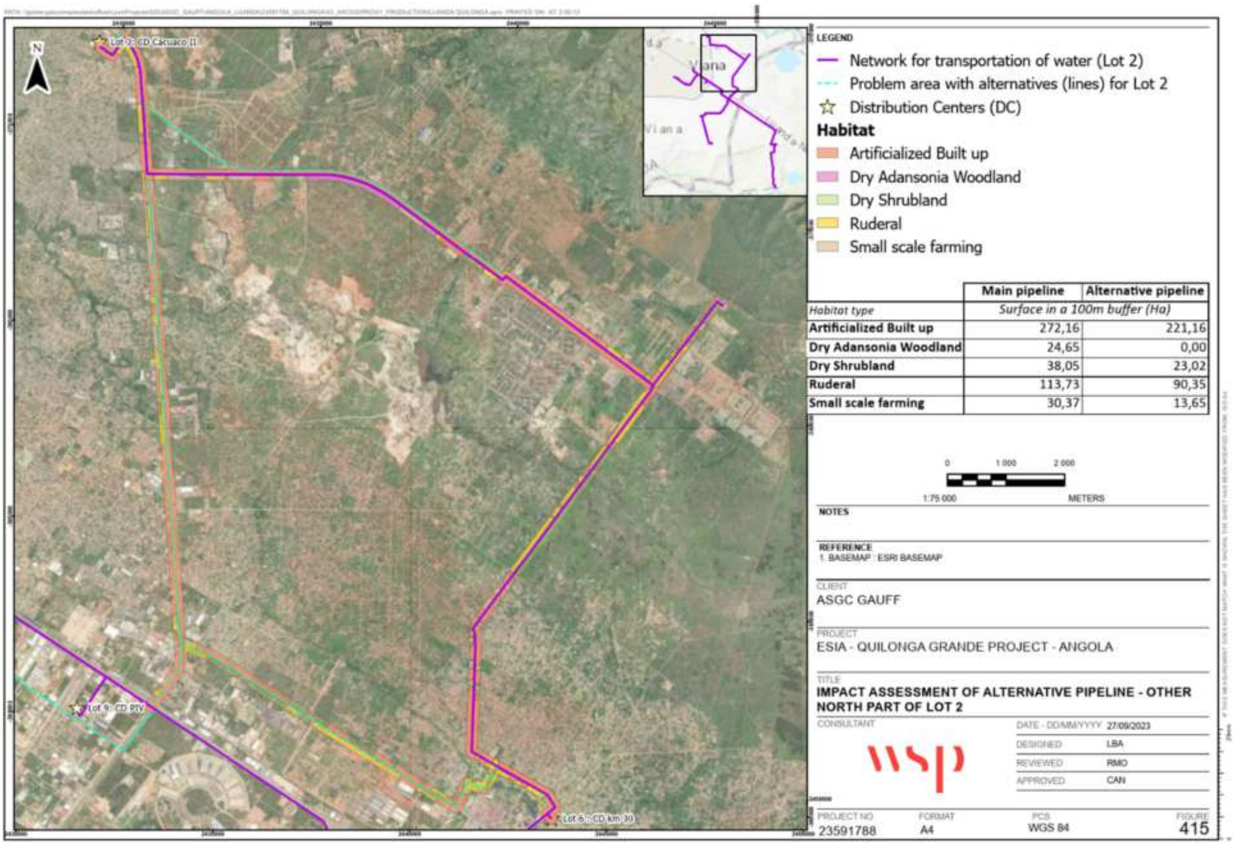
Figure 413: Alternative routes the network for transportation of drinking water (Lot 2) – Cross section



Habitat type	Main pipeline	Alternative pipeline
	Surface in a 100m buffer (Ha)	
Artificialized Built up	272,16	221,16
Dry Adansonia Woodland	24,65	0,00
Dry Shrubland	38,05	23,02
Ruderal	113,73	90,35
Small scale farming	30,37	13,65

Figure 414: Alternative routes the network for transportation of drinking water (Lot 2) – Nord 1 section


LEGEND
Network for transportation of water (Lot 2)
Problem area with alternatives (lines) for Lot 2
Distribution Centers (DC)
Habitat
Artificialized Built up
Ruderal
Viana
Main pipeline
Alternative pipeline
Habitat type
Surface in a 100m buffer (Ha)
Artificialized Built up 119,38 109,70
Ruderal 26,81 26,81
0 500 1 000
1:32 363
METERS
NOTES
REFERENCE
1. BASEMAP : ESRI BASEMAP
CLIENT
ASGC GAUFF
PROJECT
ESIA - QUILONGA GRANDE PROJECT - ANGOLA
TITLE
IMPACT ASSESSMENT OF ALTERNATIVE PIPELINE - WEST PART OF LOT 2
CONSULTANT
DATE - DD/MM/YYYY 27/09/2023
DESIGNED LBA
REVIEWED RMO
APPROVED CAN
PROJECT NO 23591788
FORMAT A4
PCS WGS 84
FIGURE 416



	Main pipeline	Alternative pipeline
Habitat type	*Surface in a 100m buffer (Ha)*	
Artificialized Built up	272,16	221,16
Dry Adansonia Woodland	24,65	0,00
Dry Shrubland	38,05	23,02
Ruderal	113,73	90,35
Small scale farming	30,37	13,65

Figure 415: Alternative routes the network for transportation of drinking water (Lot 2) – Nord 2 section

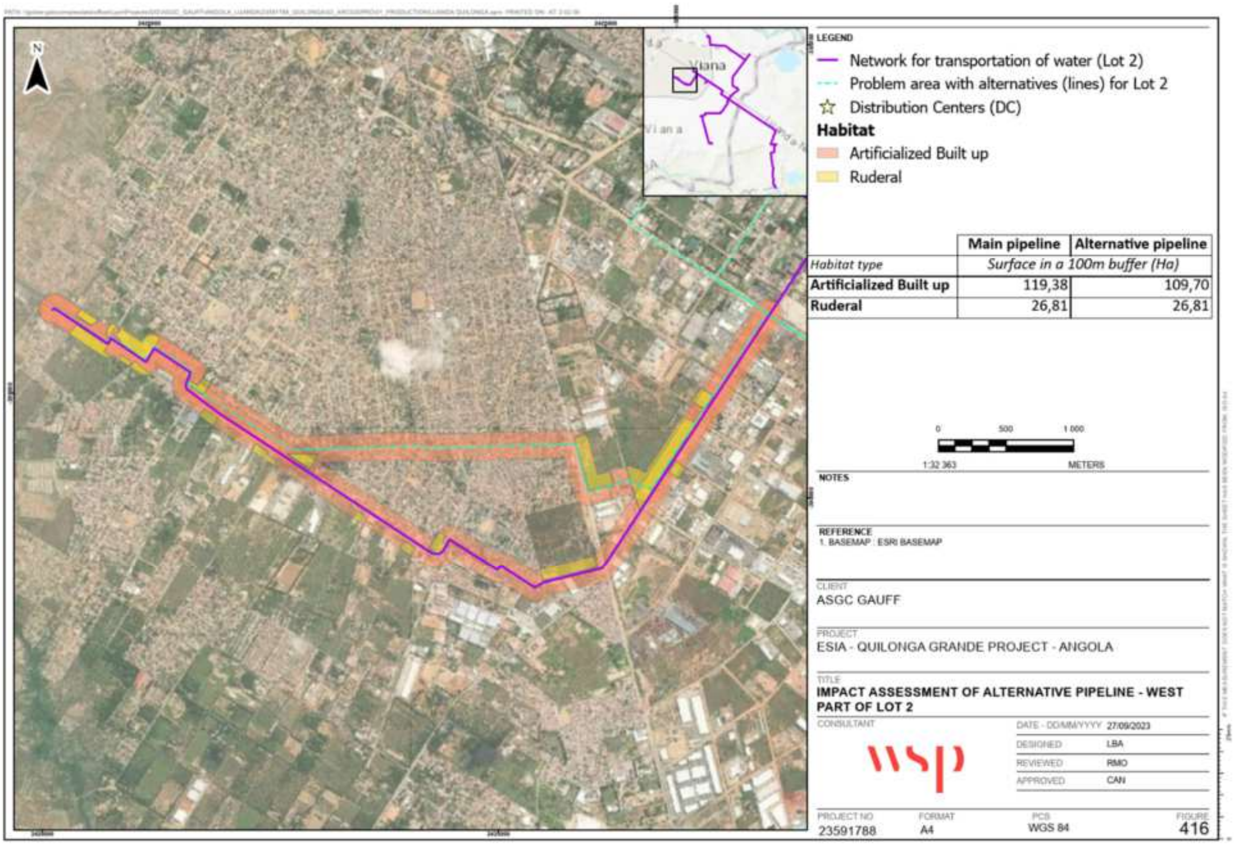


Figure 416: Alternative routes the network for transportation of drinking water (Lot 2) –Ouest section

12.0 FRAMEWORK FOR ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN FOR THE CONSTRUCTION PHASE (CESMP)

12.1 Objectives and scope of the Framework CESMP

The Framework CESMP identifies the practices and measures that must be followed by each Lot and members of the consortium (in principle, not applicable for the ones already or nearly finalized, i.e., Lot 4 - DC Zango 5; Lot 5 - DC New Airport ; Lot 9 - DC PIV) defining their specific Construction ESMPs, in order to achieve the environmental and social performance goals set in the ESIA-Addendum.

As the Quilonga Grande projects progress, the details of the plans listed in Chapter 12.5.2 that comprise the CESMP will, later on, will need to be developed into a full CESMP prior to construction. These plans must be based on Angolan guidelines and legal framework, Main Contractors (MC) and Promotor corporate standards, and may draw from applicable international standards (chapter 12.5.4).

ESMP for the operation and closure phases are out of the scope of this document.

12.2 Environmental and Social Management System (ESMS)

The preparation of an ESMS is an international good practice. An ESMS provides a tool to manage the Project construction, operations, and activities methodologically and in a structured manner to ensure that potential risks and impacts are avoided and minimized, and that Project benefits are enhanced. An ESMS comprises a number of elements, which have been initiated through the ESIA process and development of an ESMP.

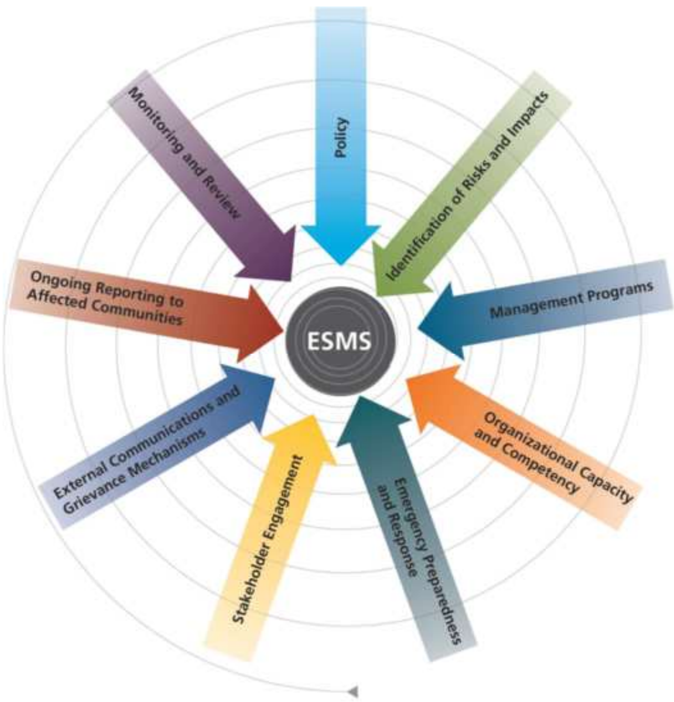


Figure 417: Elements of an environmental and social management system (ESMS) (IFC 2015)

The status of those elements is summarized in Table 176.

Table 176: Status of the ESMS development for the Quilonga Project

Elements	Status of the ESMS for the Quilonga Project
Environmental and social policy	To be developed by Promotor and Constructors during pre-construction and will guide all phases of the project.
Identification of risks and impacts	Completed as part of the ESIA Chapter 12.5.1
Environmental and social Management plans	Construction phase: To be developed in full by Promotor and Constructors during pre-construction. The necessary plans for the construction phase are presented in chapter 12.2. Operation phase: to be developed by the Promotor.
Organizational capacity and competences	Construction phase: Framework structure for Project roles and responsibilities presented in chapter 12.4, to be developed in full during pre-construction. Operation phase: to be presented/developed by the Promotor.
Emergency preparedness and Response	Construction phase: Framework structure for developing procedures to respond to potential Project emergency situation during construction presented in chapter 12.5.3, to be developed in full during pre-construction. Operation phase: Procedures to be developed by the Promotor.
Stakeholder engagement	Ongoing stakeholder engagement activities, to be undertaken in line with engagement program set out in the Stakeholder Engagement Plan (SEP) developed for the Project.
External communication and grievance mechanisms	Procedure for external communication and grievance mechanisms, to be undertaken outline in the SEP developed for the Project.
On going reporting to affected communities	Procedures for reporting to be undertaken outline in the SEP developed for the Project.
Monitoring and Review	Construction phase: Monitoring program, audits, declarations, and inspections, outlined in chapter 12.5.4 to be developed in full during pre-construction. Operation phase: to be developed by the Promotor.

12.3 Policies

Policies summarize the commitment that the company has made to managing environmental and social risks and impacts. They establish the expectations for conduct in all related aspects of the business.

For the construction phase the contractors should develop at least the following policies / guidelines:

- Environmental and sustainability policy;
- Sustainable procurement policy;
- Occupational health and safety policy;
- Drug free & alcohol policy;
- Employee code of ethics and business conduct policy;
- Human rights policy;

- Non-discrimination and harassment policy;
- Worker's employment policy;
- Workplace violence policy;
- Worker welfare procedure policy;
- Complaints & grievances procedure policy.

12.4 Organizational Capacity, Responsibilities and Training

The Project is separated into 10 Lots (presented in Chapter 2.3.1) which were divided in to three groups, managed by separate contracts and three main contractors - ASGC, Sinohydro and GAUFF.

Ultimate responsibility for the Project construction will lie with the Promotor (EPAL, *Empresa Pública de Aguas de Luanda* - Luanda Public Water Company) Administrative Council who is responsible for:

- Compose a Project Implementation Unit (PIU);
- Appoint its subcontracted Project Management Consultant (PMC);
- Appoint an internal ESHS officer to monitor the implementation of the CESMP at all Lots with qualified ESHS professionals with relevant ESHS expertise.

The organizational structure of EPAL is presented in Figure 418. DAR, as the PMC, is responsible for Project quality management and site supervision. On behalf of EPAL's Project Implementation Unit (PIU), DAR shall:

- Oversight and coordinate Project activities;
- Assess and approve of the full CESMPs of all Lots;
- Produce Project progress reports for compliance with requirements, including monitoring and reporting for each Lot.

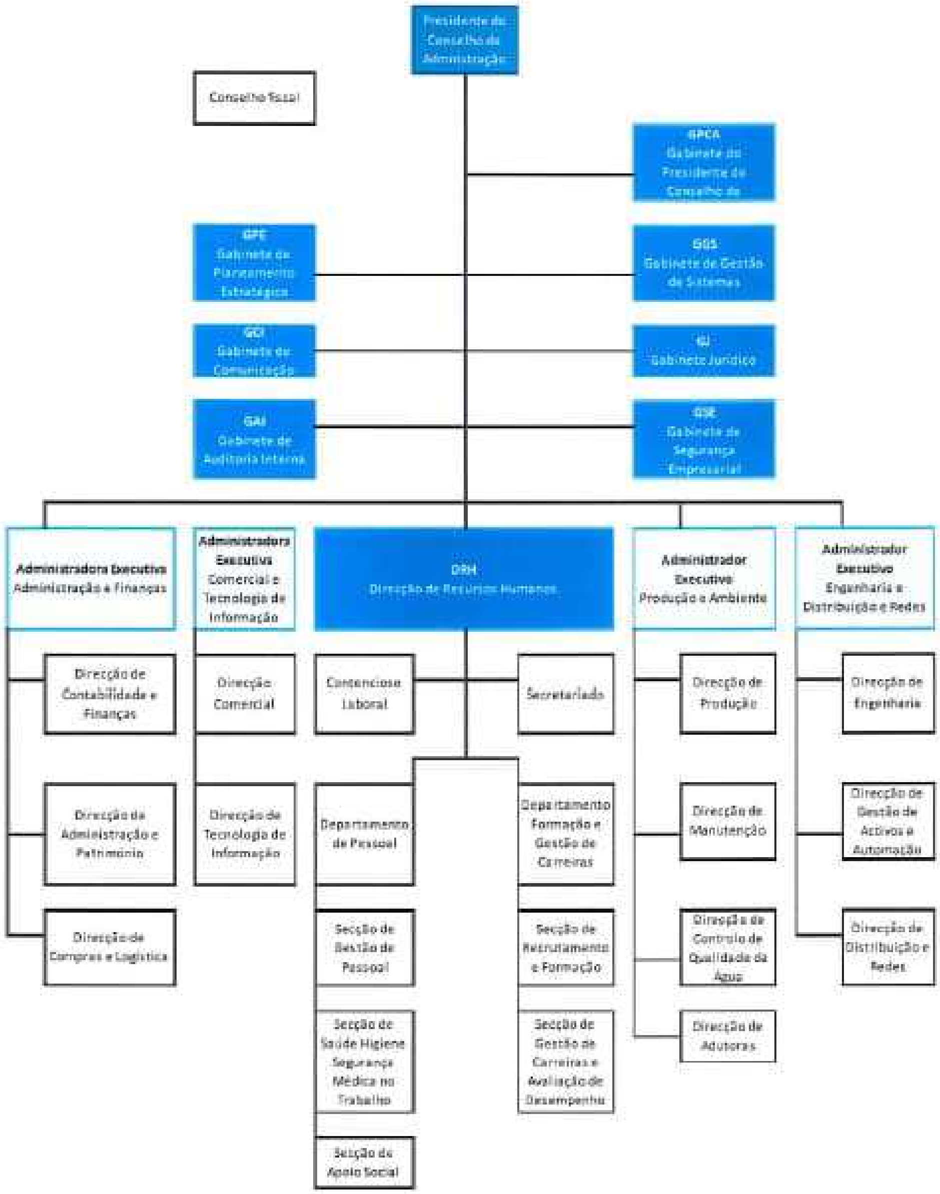


Figure 418: Organizational structure of EPAL (EPAL 2021)

Main Contractors (MC) will be guiding Consortium Members / local constructors and their Environment, Social Health, and Safety (ESHS) Managers to develop site-specific Construction ESMPs (CESMPs) that will be complying with the lender's requirements. The organizational E&S structure of the Project is presented on Figure 419.

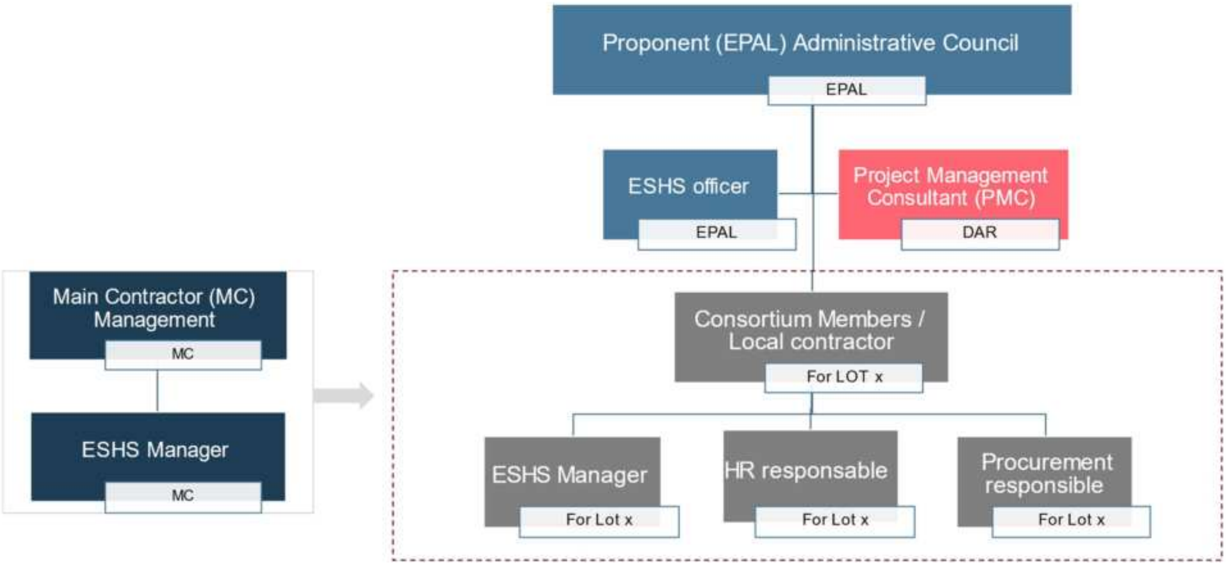


Figure 419: Organizational E&S structure of the Quilonga Project - Construction phase (applicable to each Lot)

The roles, responsibilities and authority that will be allocated on an ongoing basis to achieve effective implementation of the environmental and social management commitments for the Project construction is presented in Table 177 and Table 178. The personnel will have the knowledge, skills, and experience necessary to:

- perform their work, including current knowledge of the Angola's regulatory requirements and the applicable international E&S requirements;
- implement the specific measures and actions required under the site-specific CESMP and the methods required to perform the actions in a competent and efficient manner.

Table 177: Roles and Responsibilities for Environmental and Social Management of the Quilonga Project during construction phases (applicable for Lots under responsibility of the Consortium CNT, GAUFF, CASAIS, OPAIA)

Roles	Responsibilities for the project's environmental and social performance
Main Contractor (MC) Manager and its Environment, Social Health, and Safety (ESHS) team	▪ Guide Consortium Members /local constructors on the development site-specific Construction ESMPs for the Lot ▪ Ensure that all contractors are duly informed of the CESMP and associated responsibilities and implications of CESMP. ▪ Liaise with EPAL´s Project director and Project Management Consultant (PMC).
Consortium Members / Local contractor Management	▪ Ensure availability of the resources required for CESMP implementation (including staff and training). ▪ Ensure all actors involved in the construction know, understand and implement the CESMP and related Management Plans (MPs)
Environment, Social Health, and Safety (ESHS) Manager(s) for each Lot construction under reasonability of the Consortium CNT,	▪ Responsible for ownership and overall implementation of the CESMP for the Lot. ▪ Establish and review the Environment, Social Health and Safety (ESHS) implementation measures to ensure their compliance with Angolan regulation and international standards.

Roles	Responsibilities for the project's environmental and social performance
GAUFF, CASAIS, OPAIA	▪ Responsible for implementation of the social requirements of the CESMP, including community liaison, stakeholder engagement, grievance mechanisms. ▪ Ensure that external Contractors effectively implement the required measures. ▪ Ensure full CESMP is known and available to all employees and Contractors involved in the construction of the Lot. ▪ Interact with the authorities and agencies and is the main point of contact to manage permits and EHS authorizations when required by the activities; and to ensure all permits are in order. ▪ Undertake periodic audits and inspections of construction sites against the requirements of the full CESMP. ▪ Prepare quarterly and annual environmental reports including details on environmental performance. ▪ Collect report all hazards, non-conformances and incidents and inform senior management. ▪ Report all complains in the complaints management register.
Human Resources Responsible of the contractor in charge of the Lot construction	▪ Assure that labour and working conditions; hiring, non-discrimination, anti-harassment, remuneration and other labour policies are in compliance with Angolan regulation and international standards (such as IFC PS 2)
Procurement Responsible of the contractor in charge of the Lot construction	▪ Responsible for supply chain assessment based on CESMP requirements and conduct supply chain audits.
All Constructors and contractor staff, all visitor	▪ All personnel onsite, including employees, contractors, and consultants are responsible for the implementation of the CESMP and good practices respect. ▪ All employees, contractors, consultants, and visitors will receive a mandatory induction on EHS main topics on site before start working on the Lot construction under reasonability of Consortium CNT, GAUFF, CASAIS, OPAIA

Table 178: Roles and Responsibilities for Environmental and Social Management of the Quilonga Project during construction phases (applicable for Lots under responsibility of the SinoHydro / Griner/ASGC)

Roles	Responsibilities for the project's environmental and social performance
Main Contractor (MC) Manager and its Environment, Social Health, and Safety (ESHS) team	▪ Guide Consortium Members /local constructors on the development site-specific Construction ESMPs for the Lot ▪ Ensure that all contractors are duly informed of the CESMP and associated responsibilities and implications of CESMP. ▪ Liaise with EPAL´s Project director and Project Management Consultant (PMC).
Consortium Members / Local contractor Management	▪ Ensure availability of the resources required for CESMP implementation (including staff and training). ▪ Ensure all actors involved in the construction know, understand and implement the CESMP and related Management Plans (MPs)
Environment, Social Health and Safety (ESHS) Manager(s) for	▪ Responsible for ownership and overall implementation of the CESMP for the Lot.

Roles	Responsibilities for the project's environmental and social performance
each Lot construction under reasonability of SinoHydro / Griner/ASGC	▪ Establish and review the Environment, Social Health and Safety (ESHS) implementation measures to ensure their compliance with Angolan regulation and international standards. ▪ Responsible for implementation of the social requirements of the CESMP, including community liaison, stakeholder engagement, grievance mechanisms. ▪ Ensure that external Contractors effectively implement the required measures. ▪ Ensure full CESMP is known and available to all employees and Contractors involved in the construction of the Lot. ▪ Interact with the authorities and agencies and is the main point of contact to manage permits and EHS authorizations when required by the activities; and to ensure all permits are in order. ▪ Undertake periodic audits and inspections of construction sites against the requirements of the full CESMP. ▪ Prepare quarterly and annual environmental reports including details on environmental performance. ▪ Collect report all hazards, non-conformances and incidents and inform senior management. ▪ Report all complains in the complaints management register.
Human Resources Responsible of the contractor in charge of the Lot construction	▪ Assure that labour and working conditions; hiring, non-discrimination, anti-harassment, remuneration and other labour policies are in compliance with Angolan regulation and international standards (such as IFC PS 2)
Procurement Responsible of the contractor in charge of the Lot construction	▪ Responsible for supply chain assessment based on CESMP requirements and conduct supply chain audits.
All Constructors and contractor staff, all visitor	▪ All personnel onsite, including employees, contractors, and consultants are responsible for the implementation of the CESMP and good practices respect. ▪ All employees, contractors, consultants, and visitors will receive a mandatory induction on EHS main topics on site before start working on the Lot construction under reasonability SinoHydro / Griner/ASGC)

The EHS managers of the contractor will implement a training program to ensure that the workforce (including management, all other direct employees and contractor workers) are aware, committed, and competent to manage and operate in the workplace in accordance with relevant policies and standards.

The following list presents the minimum training program for all employees (including managers) and contractors:

- Induction: Incorporates environmental and social aspects to provide an understanding of general best practices; complaint management system; worker-management interaction;
- Environmental awareness: To ensure full CESMP compliance and to include management actions for protecting flora and fauna, archaeology and cultural heritage, and water resources;
- Emergency preparedness and response procedures: To ensure emergency preparedness and response procedures are understood and can be actioned when required, including fire and spill response;

- Health and safety: Including training on dust, noise, and hazardous materials, etc.; to be developed as part of a Health and Safety Management System.

Specific trainings include (non-exhaustive list):

- For HR Department: Introduction to Labor and Working Conditions according to international standards (such as IFC PS 2);
- For Procurement team: supply chain according to international standards;
- For Drivers: For driving on both unpaved and paved roads to reduce potential environmental impacts and increase safety (awareness of pedestrians, livestock/wildlife and other forms of transport, adherence to speed limits, road signs etc).

12.5 E&S Management Program

The foundation of environmental and social management is a record of the potential impacts and risks (beneficial and adverse) and how these will be mitigated, or beneficial impacts enhanced. The potential environmental and social impacts of the Project construction and associated measures to mitigate negative impacts and enhance positive impacts measures are presented in Chapter 8.0.

12.5.1 Impacts, Mitigation Measures, Indicators and responsibilities

The Framework CESMP will be developed into a full CESMP prior to construction; Table 180 to Table 185 include the general mitigation measures for different Lots to apply to every single construction Lot (except noted otherwise). They correspond to best practice. Their implementation shall lower / minimize the identified negative impacts during construction in each site. Additional measures can be identified in a case-by-case scenario and in that case shall be developed in the full CESMP.

12.5.2 Environmental and Social Management Plans

The full CESMP prior to construction will comprise a set of detailed management plans which will provide procedures, guidelines, and protocols in order to manage identified environmental and social risks and impacts and implement mitigation measures. Development of the plans will be an evolving and dynamic process through the Project construction, and they will be revised regularly to reflect changes in construction practices, legislative requirements and to strive towards continuous improvement.

Table 179 presents the environmental and social management plans to be developed for the different Lots. Some of those plans overlaps with and has cross-linkages with the other management plans. The development and implementation of some of those plans may require specific experts such as botanical or fish expert.

It is also important that Quilonga Project constructors of all Lots collaborate, exchange, and align their CESMP and those plans meet international requirements and adhere strictly to environmental quality management protocols (including noise, soil, waste, water and air and others) to ensure that the overall Project environmental impacts are minimized.

Table 179: Environmental and Social Management Plans – Construction phase

E&S Management Plan	Purpose and scope	Trigger
Environnemental Management Plan	It defines the principles and mitigations measures to minimize and monitor water, soil and air (dust and gas) pollution, noise and vibration disturbances, including pollution prevention and control measures	To be developed for and implemented in all Lots.

E&S Management Plan	Purpose and scope	Trigger
Waste (liquid and solid) Management Plan	It describes the types and likely quantities of wastes arising, and outline the arrangements for waste categorization, handling, storage, segregation, treatment/reuse (where appropriate), transport and disposal. It includes Hazardous Material Management Plan to avoid or, when avoidance is not possible, minimize and control the release of hazardous waste and material sand soil waste.	To be developed for and implemented in all Lots.
Emergency Preparedness and Response Plan	It details the response procedures, equipment, resources, roles and responsibilities, and communication chains which are required to be notified and mobilized in the event of a Project accidental and emergency situations in a manner appropriate to prevent and mitigate any harm to people and/or the environment. It includes the identification of areas where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially Affected Communities and periodic training to ensure effective response.	To be developed for and implemented in all Lots.
Biodiversity Management Plan	It details the objectives and the measures to avoid, minimize, restore, and enhance the biodiversity value. The overall plan aims at protecting biological systems and includes detailed procedures on specific topics listed hereafter.	To be developed for the Lots containing patches of natural habitats.
	Vegetation Clearing Plan with measures to minimize visible disturbance to public and disturbance on natural habitat during the construction phase.	To be implemented for the Lots containing patches of natural habitats (mainly Lots 1, 8 10 and 5, sections of Lot 2).
	Tree Protection Procedure with measures to avoid or minimize the risk of injury or mortality to sensitive trees including baobabs during the construction phase.	To be developed for the Lots containing patches of natural habitats (mainly Lots 1, 8 10 and 5, sections of Lot 2).
	Invasive species with measures to avoid or minimize the risk of flora and/or fauna alien invasive species	To be developed for the Lots containing patches of natural habitats (mainly Lots 1, 8 and

E&S Management Plan	Purpose and scope	Trigger
	transfer, introduction and spread on the Project sites during construction and operation phases.	10, parts of Lots 2) and implemented.
	Rehabilitation Management Plan that promotes soil stabilization and progressive rehabilitation of natural habitats at the end of the construction phase. It also includes specific measures to avoid erosion and floodplain vegetation disturbance of Kwanza River.	To be developed and implemented for the Lots containing patches of natural habitats (mainly Lots 1, 8 10 and 5, sections of Lot 2). Lot 1-Water Abstraction Facility (WAF).
	Biodiversity Action Plan will be needed if any species triggering critical habitat is found on-site during the preconstruction surveys. It will describe mitigation strategy to achieve net gain of those biodiversity values for which the critical habitat was designated, including an offset strategy.	To be developed with presence of endemic species or species triggering critical habitat (mainly Lots 1, 8 10 and 5, sections of Lot 2).
Labour Management Plan	It defines the principles and measures for the management of workers to ensure that their rights are respected, in terms of fair and equal treatment and non-discrimination. The Plan has to be aligned with national legislation, lenders' requirements, and applicable International Labor Organization conventions.	To be developed for and implemented in all Lots.
Employment Plan	It provides the framework for ensuring that recruiting and procurement is performed at the local level to the extent possible, in order to maximize the benefits that the Project can generate among local communities.	To be developed for and implemented in all Lots.
Gender Action Plan	It recommends activities that specifically address the gender-based constraints and opportunities that were identified during the impact assessment related to (but not limited to) economy, livelihood, community health and safety. It sets appropriate mitigation measures to assure women are not disproportionally affected.	To be developed for and implemented in all Lots.

E&S Management Plan	Purpose and scope	Trigger
Community Health Safety and Security Management Plan	It defines actions to be taken to avoid or minimize the risks and impacts to the health and safety of the Affected Communities during the Project construction related-activities; arising from infrastructure and equipment, traffic and transportation of goods, hazardous materials, changes to ecosystem services, use of security personnel, workforce interaction with community members, exposure to diseases, and emergency events. Risks and impacts to community health and safety are to be managed alongside local authorities. It has to be aligned with national legislation good international industry practice such as World Bank Group Environmental, Health and Safety Guidelines The plan also highlights the Voluntary Principles on Security and Human Rights.	To be developed for and implemented in all Lots.
Occupational H&S Management Plan	It establishes and maintains an effective health and safety management system to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, as far as reasonably practicable, the causes of hazards during the construction phase. It should consider specific threats to women. It should be aligned with Angolan legislation and good international industry practice, including the World Bank Group Environmental, Health and Safety Guidelines.	To be developed for and implemented in all Lots.
Livelihood Restoration Plan	It defines the principles and approach to be followed for the definition of Project Affected People (PAP), the identification of the livelihood losses caused by the Project and the assessment of the compensations that the PAPs are entitled to. It refers to loss of assets or access to assets that leads to loss of income sources or other means of livelihood as result of project-related land acquisition and/or restrictions on land use. The process has to include stakeholder engagement, including Affected Communities.	The need for a Livelihood Restoration Plan would be triggered by Lots causing economic displacement, based on the activities conducted on site or on the structures present. If no economic displacement is generated, a LRP for the Lot is not necessary.

E&S Management Plan	Purpose and scope	Trigger
Traffic Management plan	It maximizes public safety and minimizes nuisance to the local community and users of the road network. It details driver training requirements, local community awareness programmed and implementation of driving procedures and road safety, including traffic plans within the construction site, adequate parking and storage areas for heavy equipment, vehicles and material. Special attention should be given to areas close to vulnerable groups (e.g. schools)	To be developed for and implemented in all Lots.
Cultural Heritage Management Plan	Encompasses both tangible and intangible (e.g., local traditions and practices) cultural heritage forms during construction activities.	To be developed for and implemented in all Lots.
Supply Chain Management Plan	It defines measures to enhance positive impact on the supply in material goods and services, including capacity building.	To be developed for and implemented in all Lots.
Project Adaptation Management Plan	Identifies material risk of key business-related risks that result from potential climate hazards impacts to society and the environment posed by the Project and as well as mitigation measures to mitigate risks posed by climate change.	To be developed for and implemented in all Lots.

All management plans prepared as part of the CESMP will include the following general components:

- Objectives and scope;
- Roles and Responsibilities;
- Project standards (including international standards and national legislation);
- Mitigation and management measures controls;
- Implementation schedules;
- Monitoring, including;
  - key performance indicators and targets; and
  - monitoring activities, methods, periodicity, and responsibility;
- Training;
- Audit and reporting.

12.5.3 Incidents, non-compliance and emergence response

For each Lot, constructors will develop an incident and non-compliance procedure for the construction of the Quilonga Project containing:

- Identification of a non-compliance/ incident through environmental monitoring, regular walk-overs, inspections, reporting or internal or external auditing;
- Investigation into the cause of the non-compliance/ incident;
- Communication with responsible person/ department;
- Implementation of measures to regain compliance;
- Documentation of the non-compliance/ incident on a report card and/ or management system;
- Monitoring of non-compliances/ incidents to identify and respond to trends.

Additionally, an Emergency Preparedness and Response Plan (as mentioned in Table 179) must be developed for the construction please which will include procedures to cover potential emergencies on-site arising from system/ equipment failure, natural events, or disease outbreak.

These procedures will include descriptions of routine site inspections, resources required to respond to an emergency, actions to be taken in the event of emergencies, clear lines of responsibility for actions, a listing of relevant contact numbers for authorities capable of providing assistance, and the location of any abatement equipment held on-site. Such emergencies may include:

- Fire and explosion;
- Accidental spill and of hazard chemicals;
- Traffic accidents involving workers, members of the public and/ or livestock or wildlife;
- Natural disasters (wildfire, heavy rain, flooding, landslide etc.);
- Power outages, caused by damage to power lines or power station, or fuel theft;
- Epidemic disease outbreak.

12.5.4 E&S Performance monitoring and review

Environmental and social monitoring will be employed to determine performance against the CESMP objectives, to demonstrate compliance against Project standards and determine if implemented mitigation measures are achieving their designed effect.

Monitoring and review during construction can be based on:

- Visual observation during physical walk-throughs of Lots and surrounding land of fire detection, alarm and fighting equipment, use of PPE, warning signs, storage of hazardous materials, drinking water and sanitation facilities, information displayed on notice boards (e.g., policies and regulations), worker and manager interactions;
- Interviews with workers, managers, and external stakeholders;
- Measuring and testing using equipment (e.g., air emissions, noise levels);
- Document reviews such as waste disposal records, chemical use and discharges records, operational H&S records, complaints logs, policies and procedures, training records.

The monitoring indications (Targets) as well and the Frequency and responsibility for the construction phase are indicated in Construction ESMP – Physical component

Table 180 to Construction ESMP – Social component

Table 182. The indications are presented according to the social, physical, and biological components of the environmental impact assessment and refers to the relevant impacts identified during the construction phase of the project. Detailed KPI should be developed in the full CESMP for each Lot.

ESHS Manager for each Lot construction will submit monthly report to MC throughout the life of the project construction. Consortium Members / Local contractor are responsible for obtaining all monitoring results from the sub-contractor (where applicable).

MC E&S experts will review the periodic reports either internally or with the help of an external ES consultant.

The MC, on the Promotor’s behalf, will submit an E&S report every six months to the International Financial Institutions showing relevant E&S performance data. The report will summarize and describe all the E&S performance, incidents, and accidents as well as any stakeholder’s engagement activities undertaken in the relevant 6-month reporting period for all Lots under construction within the reporting period.

Submission of monitoring reports to local authorities will be the responsibility of EPAL/local constructors.

12.5.4.1 Construction ESMP – Physical component

Table 180: Framework for CESMP – Physical component

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
Noise and vibrations			
P-C-01 Emission of noise and vibration	**P-C-01a:** Use construction equipment and vehicles whose noise emission comply with international standards and ensure regular maintenance to keep noise levels within the technical standards.	Target: 100% of maintenance activities are recorded Frequency: at each maintenance activity	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	P-C-01b: Take regular measurements of noise levels during earthworks or equipment installation at the nearest identified receptors. Special consideration should be given to sensitive receptors such as schools and vulnerable groups in residential areas. Punctual background noise measurements will be performed at the same locations as the ones performed in the recent baseline to assess the possible evolution of background noise.	Target: Noise below the levels of thresholds Frequency: daily when near habitations	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	P-C-01c: The measures must be such that the noise impact does not exceed 55 dB in residential zones and 70 dB in industrial zones or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site. Special attention should be given to construction near sensitive receptors (schools, hospitals, and vulnerable groups in residential areas, including informal settlements)	Target: Environmental Management Plan, including noise management set up Frequency: before construction Target: Number of records showing an exceedance of the defined threshold levels /Numbers of noise monitoring performed during site construction with noise reduction measure in place: 0 % Frequency: as soon as the works may impact the receptors	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	P-C-01d: Set up a grievance management procedure for the affected population to raise concerns about possible disturbances due to noise and vibration.	Target: Grievance management procedure developed and implemented Frequency: before construction	Promotor management team /ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	P-C-01e: The Contractor should be proactive in engaging with the occupants of neighboring properties and should notify them of any works forecast to generate appreciable levels of noise, explaining the nature and duration of the works	Target: All occupants of neighboring properties are informed of the work and any potential nuisance it may cause Frequency: before the construction phase	Promotor management team /ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-01f: Before starting the works undertake a survey of existing structures and the condition of buildings to assess the scale of vibration impacts and to identify mitigation measures to either avoid reduce, mitigate, or compensate for damage caused by vibrations	Target: Potential vibrations are identified and mitigation measures implemented Frequency: before the construction phase	Promotor management team /ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
Air quality			
P-C-02 Emission of dust	**P-C-02a:** Conduct most of the heavy constructions during the rainy season to the extent possible	Target: Develop and implement an Environmental Management Plan, including dust management including this first recommendation Frequency: before the start of the construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	P-C-02b: Covering of trucks transporting friable materials	Target: 100% of trucks covered if carrying friable materials Frequency: as necessary	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-02c: Storage of friable materials sheltered from the wind	Target: the contract of the EPC contractor includes such a clause Frequency: before the start of construction Target: 100% of inspections show storage of friable materials sheltered from the wind Frequency: monthly	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-02d: Train local workers to drive responsibly to reduce the risk of accidents, fuel consumption and the production of dust on dirt roads	Target: 100% of staff is trained Frequency: before the start of each major phase of work during daily quick H&S inductions	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-02e: Limit vehicle speed to 30 km/h on site and on access roads or roads along the project's footprint	Target: the contract of the EPC contractor includes such a clause Frequency: before the start of construction Target: speeding violations recorded: 0 Frequency: weekly	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-02f: Proceed to regular watering of the construction sites access roads as soon as dust emission is noticed	Target: Roads are regularly watered Frequency: when necessary, during the dry season	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-02g: Set up a grievance management procedure for the affected population to raise concerns about possible disturbances due to air quality. Special attention should be given to construction near sensitive receptors (schools, hospitals, and vulnerable	Target: Grievance management procedure developed and implemented Frequency: before the start of construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	groups in residential areas, including informal settlements)		
P-C-03 Emission of exhaust and smoke	**P-C-03a:** Proceed to regular maintenance of vehicles	Target: 100% of maintenance activities are recorded Frequency: at each maintenance activity	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-03b: Optimize journeys (loading / trucks routes, etc.)	Target: Logistics designed to reduce unnecessary journeys and incomplete loads Frequency: before the construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-03c: Prohibit burning of solid materials in the open and promote re-use of plant-residues	Target: The Waste Management Plan provides recommendations and procedure to manage the plant-residues according to their size and nature in accordance with local community's needs; Frequency: before the start of the vegetation clearance Target: 100% of removed vegetation is re-used Frequency: after clearing works	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
Land use, soil quality, erosion, borrow material			
P-C-04 Impact on land use	**P-C-04a:** The establishment of awareness training on the risks of contamination and the respect of good environmental practices by workers and site managers	Target: Number of staff trained on the risks of contamination and the respect of good environmental practices: 100% Frequency: before the start of each major phase of work	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	P-C-04b: Soils must be excavated and stored separately from the underlying geological formations so that they can be reused, either to cover areas previously excavated and backfilled (replaced identically), or to be reused in areas poor in soil, to promote revegetation or the development of agriculture in areas devoid of soil.	Target: 100% of soils re-used Frequency: Before and during the construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-04c: Prior to start the construction work in areas occupied by farming activities that will be resumed at post-construction, proceed to a topsoil analysis to evaluate quality and productivity of the soil for agriculture. Replace with similar quantity and quality of soil at post-construction.	Target: Topsoil analysis implemented Frequency: Post construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-04e (for Lot 2 and temporary footprints): Land reshaping after closure of the pipeline trenches. Use topsoil stored separately before seeding the trenches during the rehabilitation	Target: Topsoil stored Frequency: Pre-construction and construction	Consortium Members / Local contractor Management/ ESHS Manager for Lot 2 construction
	P-C-04e (for Lot 2 and temporary footprints): Land reshaping after closure of the pipeline trenches. Use topsoil stored separately before seeding the trenches during the rehabilitation	Target: Topsoil stored appropriately used for rehabilitation Frequency: Before end of construction	Consortium Members / Local contractor Management/ ESHS Manager for Lot 2 construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
P-C-05 Soil Contamination	**P-C-05a**: A Pollution Prevention and Control	Target: An Environmental Management Plan including pollution prevention is developed and implemented Frequency: before the construction phase Target: Pollution in soil is controlled when there is a pollution suspicion (soil color, accident, etc.) Frequency: as necessary	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-05b: A Hazardous Material Management Plan	Target: All hazardous products used onsite are defined, and their storage / containment / handling / distribution areas equipped with the necessary protective equipment are defined and planned Frequency: before the start of the construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-05c: An Emergency Preparedness and Response Plan	Target: Emergency Preparedness and Response Plan developed and implemented Frequency: Before the start of the operation	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	P-C-05d: A Waste Management Plan including soil waste management.	Target: Waste Management Plan developed and implemented, and includes the following: -The reception facilities to put in place for the various types of waste (sorting containers, oil pits, etc.); -The identification of the recycling and burial channels for non-recyclable waste and the method for monitoring waste until it is delivered to the recycling / disposal centre; -The detailed waste tracking procedure to follow during the construction phase The training program for workers in waste management awareness. Frequency: before the start of the construction phase	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-05e: A Traffic Management Plan: define traffic plans within the construction site, adequate parking and storage areas for heavy equipment, vehicles, and material	Target: Traffic Management Plan in place: including traffic plan, parking, material, and vehicles storage Frequency: Before starting the construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-05f: Conduct a pre-construction site-walkover survey to determine the presence of baseline visual evidence of soil contamination.	Target: Visits are conducted to identify indicators of potential soil contamination Frequency: before and during the construction phase	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	P-C-05g: The excavated and sorted soils (see P-C-04b) must be analyzed every 150 m3 to check the absence of pollution before their reuse as agricultural land. The chemical analyses shall identify the concentrations of TPH, PAH.	Target: 100% soil used in agricultural land analyzed and compliant with soil quality for agricultural use Frequency: Before the land application (if compliant)	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
P-C-06 Soil erosion	**P-C-06a:** Construction sites footprints shall be reduced to its minimum and vegetation maintained as much as possible	Target: The limits of the site are clearly defined and fenced Frequency: at the beginning of the construction phase Target: A Vegetation Clearing Plan is developed and implemented (see B-C-01a) Frequency: before the construction phase	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-06b: Construction sites must be clearly demarcated by barriers and signage, access to the construction site must be regulated and a traffic plan established specifying traffic rules and access restrictions outside traffic areas.	Target: Barriers and signage are in place Frequency: at the beginning of the construction phase Target: The Traffic Management Plan is developed and implemented (see P-C-05e) Frequency: before the construction phase	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-06c: Construction materials must be grouped in dedicated storage areas and covered.	Target: Material storage zones are defined and 100% of the storage are covered Frequency: before the construction phase and as necessary	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	P-C-06d: Runoff water on construction sites must be drained and collected into temporary settling basins regularly maintained to ensure water decanting before release into the environment.	Target: Temporary settling basins are created Frequency: before the construction phase Target: The maintenance of the basins is done Frequency: as necessary	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	P-C-06e: Construction sites should be regularly inspected after each heavy rain to check for signs of erosion and implement corrective measures immediately to stop soil erosion.	Target: Erosion control are done Frequency: after each heavy rain Target: Measures to stop the soil erosion are implemented Frequency: after each heavy rain	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
P-C-07 Borrow material	**P-C-07:** Borrow material shall be extracted in quarries approved by competent authority and as close as possible form the construction sites	Target: The chosen quarries are the closest to the site Frequency: before construction phase	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
Hydrology			
NA	No impact		
Surface and groundwater water quality			
P-C-08 Contamination of surface water	**P-C-08a:** (Lot 1-WAF): conduct additional water sampling and analysis of Kwanza River, upstream and downstream the WAF, prior to construction (see list of parameters in Section 7.1.5 baseline surface water quality)	Target: Water sampling and analysis of Kwanza River Frequency: Prior to construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	See all mitigation measures recommended to prevent soil contamination (P-C-05a to P-C-05e)	See P-C-05	See P-C-05
P-C-09 Contamination of groundwater	Conduct groundwater sampling in areas of shallow groundwater	Target: Ground water sampling and analysis Frequency: Prior to construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	See all mitigation measures recommended to prevent soil contamination (P-C-05a to P-C-05e)	See P-C-05	See P-C-05

12.5.4.2 Construction ESMP – Biological component

Table 181: Framework for CESMP – Biological component

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
Terrestrial fauna and habitat			
B-C-01 Terrestrial habitat loss	**B-C-01a:** Develop and implement a Vegetation Clearing Plan for the Lots containing patches of natural habitats. The plan should include at least the measures B-C-01 below.	Target: Vegetation Clearing Plan developed and implemented Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-01b: Make a preclearance census of endemic trees and every *Adansonia digitata* individuals inside the footprint of the Project facilities, and in particular along the pipeline footprint (Lot 2) crossing natural habitats.	Target: Endemic and protected trees are censed and their GPS location is mapped Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-01c: Integrate trees in the design and infrastructure / facilities layout to avoid their removal as much as possible, especially endemic trees and *Adansonia digitata*. When avoidance is not possible, plant the same species in a similar habitat as close as possible to the footprint of the project.	Target: Vegetation Clearance Plan implemented to include endemic trees in the design Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-01d: Tree removal should follow the national legislation.	Target: National legislation about tree removal is known Frequency: Prior to vegetation clearing Target: If needed, permit application is prepared and includes an estimate of number of trees requiring clearing. Frequency: Priori to vegetation clearing Target: If needed, permits are in place. Frequency: Prior to vegetation clearing	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	B-C-01e: Perform a progressive clearance of vegetation to reduce the risk to slow moving fauna	Target: Vegetation Clearance plan is developed and implemented Frequency: before the clearance of vegetation	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-01f: Organize the translocation of slow-moving fauna and plants to a suitable receptor site.	Target: Slow-moving fauna and plants identified, suitable receptor sites selected with a biological expert, and Slow-moving fauna and plants translocated into the dedicated receptor sites. Frequency: Prior to vegetation clearing	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-01g: To the maximum possible, retain active bird nests until the young have fledged	Target: Bird nests are identified Frequency: Prior to vegetation clearing Target: No trees with nests cut Frequency: During the whole breeding season	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-01h: Implementation of a monitoring program to ensure compliance with control measures during land clearance and earthworks, and supervision of the works by a dedicated wildlife spotter.	Target: Monitoring program developed and implemented, with periodical inspections and a dedicated responsible Frequency: Priori to vegetation clearing	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
B-C-02 Terrestrial habitats degradation	**B-C-02a:** As far as possible, site areas adjacent to natural habitats will be isolated from noise, dust and any human or mechanical intrusion.	See B-C-01d and P-C-06b	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-02b: As far as possible, leave / encourage / introduce vegetation around the site areas to create a visual screen and absorb some of the dust.	Target: The surroundings of the Project sites are still vegetated to the maximum possible (see P-C-06a). Frequency: Prior to construction and during the whole construction phase	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	B-C-02c: Periodically and regularly raise employee awareness of good environmental practice and the challenges of conserving biodiversity in the broadest sense.	Target: 100% employees are trained about challenges of biodiversity conservation Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-02d: Develop and implement a Tree Protection Procedure that should be appended to the Biodiversity Management Plan for the Lots containing patches of natural habitats to protected sensitive trees, including baobabs.	Target: Tree Protection Procedure developed and implemented appended to the Biodiversity Management Plan Frequency: Prior to vegetation clearing	See B-C-01d and P-C-06b
	B-C-02e: With a botanical expert, define and materialize a buffer around each endemic species or Adansonia digitata individuals located less than 100 m from a construction to avoid any degradation by heavy machineries through roots compaction, accidental damages.	Target: Buffer zone identified and physically delimited around each *Adansonia digitata* tree Frequency: Prior to vegetation clearing	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-02f: With a botanical expert, define and materialize a buffer around each endemic species or Adansonia digitata individuals where construction works earthworks can't be carried out in order to avoid any impact on their roots.	Target: Buffer zone implemented around each *Adansonia digitata* plant Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
B-C-03 Terrestrial habitats fragmentation	**B-C-03a:** Limit the footprint of the access road from Lot 1-WAF to the sites with Lots 1-WTP, 8 and 10, and especially where the road crosses natural habitats, avoid constructing the road by splitting a patch of natural habitats, conform to the boundary between natural habitat and modified habitat (e.g. the boundary between a savannah and an agricultural field) in order to limit the net loss and fragmentation of natural habitats.	Target: Limit the road footprint to the minimum possible Frequency: Prior to construction Target: Adapt the road design to target no natural habitat loss Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	B-C-03b: Install the water supply pipeline along the access road between Lot 1-WAF and the site with Lots 1, 8 and 10 to minimize the footprint and the habitat destruction.	Target: The water supply pipeline is installed along the road, and its footprint is limited to the minimum possible Frequency: During the construction phase Target: Adapt the pipeline design to target no natural habitat loss Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
B-C-04 Invasive species' introduction	**B-C-04a** : Conducted a detailed survey to confirm the presence of invasive and exotic species as well as pest within the area of influence of each Lot (or different segments of Lot 2). The survey should determine the species, locations, and their potential for spreading within the zone	Target: 100% of invasive and exotic species and pest survey concluded Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-04b: Develop and implement an Invasive Species Management Plan and split the management levels and responsibilities between Sinhydro's Lots 1 and 10, and the Consortium's Lots. The Consortium should consider how a combined plan with Sinohydro can be developed. Plan should include B-C-04b and B-C-04c.	Target: Invasive species management plan developed and plan implemented Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-04c: Prevent trucks from bringing alien invasive species like ants by verifying the trucks wheels do not carry soil when entering the construction work site.	Target: 100% of truck's wheel are verified or cleaned Frequency: Before entering in construction site	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-04d: Clean up the trucks wheels before they leave the construction work site to prevent the dispersion of alien invasive species like ants.	Target: 100% of truck's wheel are cleaned Frequency: Before they leave the construction site	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
B-C-05 Terrestrial fauna mortality	**B-C-05a:** Limit the traffic speed in road crossing natural habitats to avoid the collision with slow-moving terrestrial fauna.	Target: Speed traffic limited Frequency: during the construction phase	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
B-C-06 Terrestrial habitats rehabilitation	**B-C-06a:** Develop and implement a Rehabilitation Management Plan for Lot 2 and temporary infrastructures for the sections of Lot 2 near the Lots 1, 8 and 10 coordinate the plans and responsibilities between Sinhydro GAUFF/Casais Consortium. The plan should include at least the measures below (B-C-06b and B-C-06c).	Target: Rehabilitation Management Plan developed and plan implemented Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-06b: Actively seed at the beginning of the wet season to promote soil stabilization and progressive rehabilitation of natural habitats in accordance with the Rehabilitation Management Plan.	Target: Seeding performed Frequency: At the beginning of the wet season	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-06c: Plant regrowth will be monitored to ensure a return to the initial state of Lot 2.	Target: Monitoring plant regrowth Program implemented Frequency: During the construction phase	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
Freshwater fauna			
B-C-07 Loss of freshwater fauna and habitat	**B-C-07a:** Develop and implement a Vegetation Clearing and Rehabilitation Plan specifically for the Lot 1-WAF to avoid soil erosion and in riverbank erosion.	Target: A Vegetation Clearing Plan is developed and implemented Frequency: Prior to construction and during vegetation clearing Target: Rehabilitation Plan is developed and implemented Frequency: At the end of the construction phase	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-07b: Limit the pumping station footprint in the river to the minimum possible	Target: The footprint in the River is of minimum extent. Frequency: During the whole construction phase	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	B-C-07c: Avoid or minimize the time of presence of heavy machines inside the watercourse.	Target: Heavy machines in the River only the minimum necessary duration. Frequency: During the whole construction phase / Daily checks	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-07d: Integration of a bank reinforcement system at the water abstraction area.	Target: Bank reinforcement system in place and no riverbank erosion observed Frequency: During the whole construction phase / Monthly checks	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-07e: Prior to the start of clearing and earthworks, physically demarcate the peripheral areas to ensure that this buffer zone is preserved and to prevent any mechanical intrusion or accidental spillage of soil or landslides into watercourses.	Target: The overall areas are physically demarcated, well-known, visible, with non-penetrable fences in place (see P-C-06a). Frequency: Priori to vegetation clearing	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-07f: Implementation of a monitoring program to ensure compliance with control measures during land clearance and earthworks.	Target: Monitoring program developed and implemented, with periodical inspections and a dedicated responsible Frequency: Priori to vegetation clearing	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
B-C-08 Degradation of freshwater fauna and habitat	**B-C-08a:** Introduce landscaping measures during the construction of the water intake on the Kwanza River by replanting vegetation around the water intake to consolidate the riverbanks.	Target: Landscape measures defined, Frequency: Prior to construction Target: No riverbanks with bare ground, Frequency: During the whole construction phase / Monthly checks	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
Habitats			
B-C-09 Loss of critical habitats	Implemented mitigation measures identified to prevent loss or degradation of terrestrial and freshwater habitats.		Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
B-C-10 Degradation of critical habitats	Implemented mitigation measures identified to prevent loss or degradation of terrestrial and freshwater habitats.		Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
B-C-11 Loss of species triggering CH	**B-C-11a**: During the tree removal, the exact individual number, and species of removed trees will be tracked. If endemic species or species triggering CH are removed, develop a Biodiversity Action Plan to ensure no net loss.	Target: 100% removed trees are recorded by environmental technician with botanical identification skills. Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-11b: Conduct the following pre-assessments which will be used to determining the requirement for a biodiversity action plan and offsetting and where (i.e., for which Lots or which segments of Lot 2) ■ Perform pre-construction assessment for each potential terrestrial or aquatic species triggering CH in its related suitable habitat (see specifications in Table 126 to ensure the absence of species triggering a CH before starting the construction. ■ Undertake pre-construction targeted stakeholder consultation with specialists to help identify the potential presence of critical habitat triggers	Target: 100% of pre-construction surveys and stakeholder consultation carried out. Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	If any species triggering CH is found on-site during the preconstruction surveys or identified via stakeholder consultation: **B-C-11c**: Develop and implement a Biodiversity Action Plan prior to construction, including appropriate offset measure to ensure Net Gain depending on the residual impacts identified during the additional studies and monitoring. The plan should include at least the measures below:	Target: BAP developed and implemented Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	B-C-11d: Flora On-site Conservation (avoidance): within the Project site, the conservation of CH determining species shall be guaranteed to the extent possible and for those species not directly impacted by the Project footprint Population located wiling 100 m from construction or operation areas will be actively protected from any undirect impact.	Target: 0% of flora removal. Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-11e: Flora Salvaging and Translocation (minimization/restoration): in case direct impacts will be unavoidable, individuals belonging to flora species determining CH impacted by the Project footprint shall be identified, salvaged prior to construction, and translocated to the appropriate sites.	Target: 100% of impacted flora individuals are translocated. Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-11f: Seed collection (restoration/offset): seed collection and conservation will be performed for the CH determining species, following the best practice.	Target: 100% of removed individuals are the object of seed collection. Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-11g: Biodiversity assessment (restoration/offset): Conduct a systematic biodiversity accounting based on the explicit calculation of biodiversity losses and gains at matched impact and offset sites	Target: 100% of Biodiversity assessments concluded. Frequency: Prior to construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-11h: In order to avoid or minimize direct impacts on the aquatic species, any work within the riverbeds such as construction of the Water Abstraction Point shall be suspended during spawning in Lot 1-WAF.	Target: 0% construction works within the riverbed during spawning periods. Frequency: During construction	Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	B-C-11i: Implement an awareness campaign around the Kwanza River to limit the fisheries	Target: Awareness campaign conducted. Frequency: Prior to construction	ESHS officer of the Proponent / PMC

Measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	activities and avoid any impact on the species triggering CH		Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

12.5.4.3 Construction ESMP – Social component

Table 182: Framework for CESMP – Social component

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
Land Use			
S-C-01 Changes in land ownership	**S-C-01a:** Confirm all the land acquisition and expropriation have been completed, documented and the procedure are according to national and international requirements.	Target: ▪ 100% of the land has been expropriated in accordance with national and international requirements; ▪ Land and acquisition report. Frequency: before the start of construction	Promotor management team/ESHS officer of the Proponent / PMC
	S-C-01b: Develop corrective/compensation measures for affected parties where required (including vulnerable groups)	Target: ▪ Report of compensation/corrective measures provided for vulnerable groups. Frequency: before the start of construction	Promotor management team/ESHS officer of the Proponent / PMC
	S-C-01c: Ensure the implementation of grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances to the company in order to facilitate the management and resolution of concerns.	Target: ▪ Grievance Mechanism in place and correctly implemented. ▪ Number of complaints from people affected documented in the complaints management register; ▪ Complaint resolution report. Frequency: before the start of construction	Promotor management team/ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
S-C-02	**S-C-02a**: Develop a Resettlement Policy Framework (RPF) which will frame the Resettlement Action Plan (RAP) and	Target: Resettlement Policy Framework developed and implemented including the different topics previously cited	Promotor management team/ESHS officer of the Proponent / PMC

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
Restriction of access to land	the Livelihood Restauration Plan (LRP) in line with the IFC performance Standards as well as Angola legislation . The RPF will mainly need to : ▪ cover the land uses, ownership, tenure, land take extent and impacts; ▪ describe all of the impacted project-affected people including vendors, traders, businesses , water carriers and households (including informal settlements) in and adjacent to the right of way (RoW) – in the case of Lot 2 ▪ describe efforts to avoid physical and economic displacement through design changes and alternative routing ▪ describe the entitlements and compensation framework ▪ be planned and implemented according to the construction schedule The LRP subsequently needs to be prepared to address issues relating to physical and economic displacement, loss of community infrastructure and other asset. Precisely, the following will be included: (a) identification of vulnerable persons and the causes and impacts of their vulnerability; (b) identification of required assistance at various stages of the LRP process: negotiation, compensation, and relocation; (c) implementation of measures necessary to assist vulnerable persons. The permanent restrictions must communicate to current and future landowners and users. A detailed inventory needs to be done to identify them so that there are informed and if necessary compensated. Compensation must be done according to international standards and its	Frequency: Prior to construction Target: The Resettlement Policy Framework frame the RAP. Frequency: Prior to construction Target: The RPF frame the LRP and include the herebefore requirements. Frequency: Prior to construction	Consortium Members / Local contractor Management/ ESHS Manager for Lot 2 construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	implementation as well as the restrictions must be monitored		
	S-C-02b: Ensure that people selling along the roadside are informed in advance of the start of work on construction the water pipe transport network and elaborate compensation measures.	Target: ▪ Awareness-raising report for vendors along the Lot 2 road; ▪ Grievance Mechanism in place and correctly implemented. Frequency: Before the start of work to lot 2 and during the construction phase	Promotor management team/ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for Lot 2 construction
	S-C-02c: Provide alternative land or facilities for leisure to the affected communities.	Target: ▪ Report on the handover of alternative sites to the affected communities; ▪ Grievance Mechanism in place and correctly implemented. Frequency: before the start of construction	Promotor management team/ESHS officer of the Proponent / PMC
	S-C-02d: Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.	Target: Awareness-raising report on the potential impact of activities and mitigation measures. Frequency: Before and during the construction phase	Promotor management team/ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	S-C-02e: Ensure the implementation of a grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances	Target: ▪ Grievance Mechanism in place and correctly implemented.	Promotor management team/ESHS officer of the Proponent / PMC

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	to the company in order to facilitate the management and resolution of concerns.	▪ Number of complaints from people affected documented in the complaints management register; ▪ Complaint resolution report. Frequency: before the start of construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction and Human Resources Responsible of contractors
Population and Demographics			
S-C-03 Measures to limit labour Influx	**S-C-03a**: Prioritize local workforce using measures such as ▪ Post job vacancies in local areas so that local people can apply for them; ▪ Recruit and train local workers for certain positions; ▪ Determine numbers of skilled, semi-skilled and unskilled labour requirements for each phase and assess local resource levels through involving local communities' representatives as well as community leaders; ▪ Implement Project specific training and community development programs to increase the skills of local workers and the capacity of local businesses to meet the needs and requirements of the Project; **SC-03 b:** Provide and communicate clear information about the Project's requirement related to employment and business opportunities and priorities locals where feasible and those; positions for which they are qualified	Target: ▪ Copies of job advertisements published in the localities; ▪ Number of recruitment local workers; ▪ Training report for local workers recruited for certain posts; Frequency: Before the start the construction	Promotor management team/ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ Human Resources Responsible of Contractors

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	The measured above should be included in the Employment Plan.		
Economy and employment			
S-C-04 Direct employment in workforce	**S-C-04a**: Develop an Employment Plan, with clear employment requirements and procedures such as (in addition to those already included in S-C-03a and S-C-03b): ■ Conduct fair and transparent hiring and staff management procedures; ■ Recruit and train local workers for certain positions; ■ Encouraging local women to apply for certain positions; ■ Apply the code of conduct for workers drawn up by contractors; ■ Sensitize stakeholders on recruitment modalities in the project areas in accordance with the stakeholder engagement plan prepared for the project; ■ Employment practices and working conditions should conform to International Labour Organisation (ILO) Standards and national regulations; ■ Ensure the EPC contractors adhere to the national and international core labour standards and implement those in throughout the Project's construction and/or operation phase; ■ Provide workers with adequate living and working conditions, including rest and recreational facilities	<u>Target</u>: ■ Fair and transparent recruitment procedure applied to all workers; ■ Copies of job advertisements published in the localities; ■ Local communities clearly aware of the employment needs; ■ Number of recruitment local workers; ■ Prioritize local workers; ■ Training report for local workers recruited for certain posts; ■ Number of local women employed; ■ Code of Ethics and Professional Conduct for Employees Developed by Contractors and communicated to local workers; ■ EPC contractors adhere to national/international core labour standards; ■ Worker's facilities are compliant with IFC guidance note;	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management /Human Resources Responsible of Contractors

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	and time accommodation should conform to the IFC Guidance Note for Workers Accommodation; ▪ Define rules and clearly communicate on alcohol and drugs to workers; ▪ Standard of accommodation non-discriminatory (no discriminations in nationality, ethnicity, religion) to be documented and communicated transparently to the workforce; ▪ Workers will have contracts in place prior to commencement setting out working conditions, terms of employment and EHS responsibilities; ▪ Prior to the construction phase is ended where the Project will reduce number of labors during operation phase, the project will carry out an analysis of alternatives to retrenchment. The retrenchment plan will be developed and implemented to reduce the adverse impacts of retrenchment on workers; ▪ A grievance mechanism will be developed for workers and included in the ESMS. Workers will be informed about this mechanism at the time of hiring. Grievance mechanism will be extended to non-employee workers in future.	▪ Workers are aware of the strict rules regarding alcohol and drugs; ▪ Workforce are aware of the accommodation non-discriminatory standards; ▪ Non-discrimination standards accommodations are implemented; ▪ The clear needs for skilled/un-skilled employment are identified and communicated to community leaders; ▪ Project specific training are defined and implemented; ▪ Community Development Plan is loped and implemented; ▪ Workers have contracts defining working conditions; ▪ Grievance Mechanism for workers in place and correctly implemented. Frequency: Before the start and during the construction Target: ▪ Carry out an alternative analysis to retrenchments; ▪ A Retrenchment Plan is developed and implemented; Frequency: Before the end of the construction phase	

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	S-C-04b: Ensure the implementation of the grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances to contractors.	Target: ▪ Grievance Mechanism in place and correctly implemented. ▪ Number of complaints from people affected documented in the complaints management register; ▪ Complaint resolution report. Frequency: before the start of construction	Promotor management team / ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction and Human Resources Responsible of contractors
S-C-05 Impact on agriculture	**S-C-05a:** Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project;	Target: Awareness-raising report on the potential impact of activities and mitigation measures. Frequency: Before and during the construction phase	Promotor management team / ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	S-C-05b: Ensure the implementation of a grievance mechanism allowing individuals and groups to formally communicate their concerns, complaints, and grievances to the company in order to facilitate the management and resolution of concerns.	Target: ▪ Grievance Mechanism in place and correctly implemented. ▪ Number of complaints from people affected documented in the complaints management register; ▪ Complaint resolution report. Frequency: before the start of construction	Promotor management team / ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management /Human Resources Responsible of Contractors
S-C-06 Measures to enhance positive impact on the	**S-C-06a**: Encourage supplies of equipment, goods, and services from local service providers in order to stimulate the local economy.	Target:	Consortium Members / Local contractor Management/

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
supply in material goods and services		▪ Copies of published information on procurement opportunities for local communities and businesses; ▪ Report on the number of local subcontractors and suppliers; ▪ Code of Ethics and Professional Conduct for Employees Developed by Contractors; ▪ Grievance Mechanism for workers in place and correctly implemented. Frequency: Before the start and during the construction	Procurement Responsible of contractors
	S-C-06b: Develop and implement a Supply Chain Management Plan that includes capacity building for local enterprises	Target: Supply Chain Management Plan developed and implemented Frequency: Prior to construction	Consortium Members / Local contractor Management / Procurement Responsible of contractors
S-C-07 Local socio-economic diversification and improvement with the scale of economic development	**S-C-07a**: Encourage purchase from small businesses.	Target: ▪ Copies of published information on procurement opportunities for local communities and businesses; ▪ Report on the number of local subcontractors and suppliers; ▪ Code of Ethics and Professional Conduct for Employees Developed by Contractors; ▪ Grievance Mechanism for workers in place and correctly implemented. Frequency: Before the start and during the construction	Consortium Members / Local contractor Management / Procurement Responsible of contractors
Community health, safety, and security			

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
S-C-08 Increase of traffic	The Community Health and Safety Plan (to be developed prior construction) must consider the following measures and be developed in collaboration with MC of different Lots, particularly for the common transport routes. Special attention should be given to areas with vulnerable groups (e.g. schools): **S-C-08a**: Set up protective barriers around construction sites to limit interference with public vehicles traveling in the area.	Target: ▪ Presence of protective barriers around worksites; ▪ Report on raising awareness among local populations of the risks associated with the presence of the worksite; ▪ Health, safety, and hygiene policy implemented by contractors; ▪ Grievance Mechanism in place and correctly implemented. Frequency: During the construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	S-C-08b: Placement of markers, traffic signs and safety infrastructure (speed bumps, pedestrian crossings) during work in the area.	Target: ▪ Presence of markers, road signs and safety devices (speed bumps, pedestrian crossings) on the sites; ▪ Report on raising awareness among local populations of the risks associated with the site ; ▪ Health, safety, and hygiene policy implemented by contractors. Frequency: before the start of construction.	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	S-C-08c: Install safety and signaling devices along the routes affected by the pipeline work.	Target: ▪ Presence of safety devices and signage along the Lot 2 pipeline network; ▪ Report on raising awareness in local communities of the risks associated with the works;	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		▪ Grievance Mechanism in place and correctly implemented; Frequency: During the construction.	
	S-C-08d: Raise awareness among populations and workers about the risks related to health, safety, and security on sites.	Target: ▪ Report on raising awareness in local communities and workers of the risks associated with the works. Frequency: before and during the construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	S-C-08e: Raise awareness about the speed limit in the area.	Target: ▪ Speed limit sheets on work vehicles and lorries; ▪ Copies of forms signed by local suppliers and subcontractors to ensure compliance with procedures; ▪ Health, safety, and hygiene policy implemented by contractors. Frequency: before and during the construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	S-C-08f: Provide an emergency system in the event of an accident associated with project activities.	Target: ▪ Emergency plan put in place in the event of an accident associated with project activities; ▪ Health, safety, and hygiene policy implemented by contractors. Frequency: before and during the construction	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	S-C-08g: Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.	Target: ▪ Stakeholder awareness report on the potential impacts of activities and mitigation measures. Frequency: before and during the construction.	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS Manager for each Lot construction
	S-C-08h: Carry out risk assessments and emergency response planning to consider impacts on local communities.	Target: ▪ Emergency plan put in place in the event of an accident associated with project activities; ▪ Health, safety, and hygiene policy implemented by contractors. Frequency: before and during the construction.	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction
	S-C-08i: Ensure the establishment of a complaint mechanism for individuals and groups to formally communicate their concerns, complaints, and grievances to the company in order to facilitate the management and resolution of concerns related to nuisances.	Target: ▪ Grievance Mechanism in place and correctly implemented; ▪ Number of complaints from people affected documented in the complaints management register; ▪ Complaint resolution report. Frequency: before the start of construction	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction and Human Resources Responsible of contractors
S-C-09 Increase occurrence of communicable diseases	**S-C-09a**: Implement a Health Management System for the workforce, to ensure it is fit for work and that it will not introduce disease into local communities.	Target: ▪ Emergency plan put in place in the event of an accident associated with project activities; ▪ Health, safety, and hygiene policy implemented by contractors.	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		Frequency: before and during the construction.	
	S-C-09b: Conduct training and awareness raising for workforce on diseases such as HIV and other sexually transmitted diseases, malaria.	Target: ▪ Report on training and awareness campaigns for workers on the risks of sexually transmitted diseases and malaria; ▪ Attendance record. Frequency: before and during the construction.	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction
	S-C-09c: Conduct health awareness raising campaigns for communities on similar topics. Where special consideration should be given to differentiated exposure to and higher sensitivity of vulnerable groups.	Target: ▪ Report from community health awareness campaigns; ▪ Attendance record. Frequency: before and during the construction.	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction
S-C-10 Exposure to air emissions, noise, vibration, waste hand hazardous materials	**S-C-10a**: Mitigation measures proposed to reduce those nuisances will also reduce the impact on the community health.		
S-C-11 Disruption to normal community life	**S-C-11a**: Adoption of a Stakeholder Consultations and Engagement Plan, as a framework for early and ongoing community consultation.	Target: ▪ Stakeholder engagement plan developed and implemented. Frequency: before and during the construction.	Promotor management team / ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	S-C-11b: Ensure the establishment of a complaint mechanism for individuals and groups to formally communicate their concerns, complaints, and grievances to the company in order to facilitate the management and resolution of concerns related to disruptions.	Target: ▪ Grievance Mechanism in place and correctly implemented; ▪ Number of complaints from people affected documented in the complaints management register; ▪ Complaint resolution report. Frequency: before the start of construction	Promotor management team / ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction and Human Resources Responsible of contractors
	S-C-11c: All employees of contractors and sub-contractors, supervision staff with a footprint on the ground in the project area must sign and abide by a Code of Conduct.	Target: ▪ Code of Ethics and Professional Conduct for Employees Developed by Contractors and communicated to local workers; Frequency: Before the start and during the construction	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction and Human Resources Responsible of contractors
	S-C-11d: Develop the Community Health, Safety and Security Plan, including Voluntary Principles on Security and Human Rights	Target: Community Health, Safety and Security Plan developed and implemented Frequency: Prior to construction	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction
Infrastructure and Services			
S-C-12 Interference on roads/infrastructures	**S-C-12a**: Avoid and minimize the interference of the work on lot 2 for the water transmission pipeline network on services and activities along the 100-kilometre route, including vendors, traders, informal business and access to schools, households. Specific measures should be developed once a detailed inventory on project-affected people is conducted as part of the LRP.	Target: ▪ Presence of safety devices and signage along the Lot 2 pipeline network; ▪ Report on raising awareness in local communities of the risks associated with the works;	ESHS officer of the Proponent / PMC ESHS Manager for Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		▪ Grievance Mechanism in place and correctly implemented. Frequency: During the construction	
	S-C-12b: Inform the local authorities of the schedule of activities that will result in the interruption of infrastructure networks and of measures to limit the impact on local communities.	Target: ▪ Report of information meetings and awareness raising of local authorities; ▪ Letter or mail sent to present the calendar of activities. Frequency: Before the start of work.	Promotor management team / ESHS officer of the Proponent / PMC ESHS Manager for Lot construction
	S-C-12c: Giving instructions to suppliers on speed limits and roads to be used.	Target: ▪ Presence of markers, road signs and safety devices (speed bumps, pedestrian crossings) on the sites; ▪ Speed limit sheets on work vehicles and lorries; ▪ Copies of forms signed by local suppliers and subcontractors to ensure compliance with procedures; ▪ Health, safety, and hygiene policy put in place by contractors. Frequency: Before and during the construction.	ESHS officer of the Proponent / PMC ESHS Manager for each Lot construction and Procurement Responsible for each Lot construction
	S-C-12d: Ensure the maintenance of unsealed roads in the districts.	Target: ▪ Maintenance and watering plan for unsealed roads in neighborhoods. Frequency: During the construction.	ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management / ESHS

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
			Manager for each Lot construction and Chief Mechanic of the contractors
	S-C-12e: Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.	Target: ▪ Stakeholder awareness report on the potential impacts of activities and mitigation measures. Frequency: before and during the construction.	Promotor management team / ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction and Human Resources Responsible of contractors
	S-C-12f: Access alternative routes for the communities during construction and inform stakeholders	Target: Alternatives routes identified, practicable and clearly indicated for local communities. Frequency: Prior modifying the road traffic, and during the whole traffic perturbation	Promotor management team / ESHS officer of the Proponent / PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction and Human Resources Responsible of contractors
S-C-13 Energy consumption	**S-C-13a**: Implement energy saving practices.	Target: ▪ Presence of alternative means of energy use on the sites;	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		▪ Energy consumption plan prepared by contractors. Frequency: Before and during the construction.	
	S-C-13b: Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.	Target: ▪ Stakeholder awareness report on the potential impacts of activities and mitigation measures. Frequency: before and during the construction.	Promotor management team / ESHS officer of the Proponent /PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction and Human Resources Responsible of contractors
S-C-14 Generation of construction waste	**S-C-14a**: Store solid waste in a place well away from people and workers until it has been disposed of.	Target: ▪ Presence of a solid waste storage device in a place sheltered from workers and local communities; ▪ Solid waste disposal monitoring report; ▪ Local contract signed as part of waste treatment. Frequency: During the construction.	ESHS officer of the Proponent /PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	S-C-14b: Set up a waste sorting system on sites to separate waste by category.	Target: ▪ Waste separation plan implemented on site; ▪ Worker awareness report on sorting and separation of waste on site;	ESHS officer of the Proponent /PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		▪ Solid waste disposal monitoring report; ▪ Local contract signed as part of waste treatment. Frequency: During the construction.	
	S-C-14c: Ensure the regular proper disposal of solid and liquid waste produced during construction work.	Target: ▪ Presence of a solid waste storage device in a place sheltered from workers and local communities; ▪ Solid waste disposal monitoring report; ▪ Local contract signed as part of waste treatment. Frequency: Monthly during the construction.	ESHS officer of the Proponent /PMC Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	S-C-14d: Raise awareness among stakeholders about the potential impacts of project activities and the mitigation measures planned throughout the project.	Target: ▪ Stakeholder awareness report on the potential impacts of activities and mitigation measures. Frequency: before and during the construction.	Promotor management team / ESHS officer of the Proponent ESHS Manager for each Lot construction and Human Resources Responsible of contractors
Landscape and Visual quality			
S-C-15 Visual disturbance	**S-C-15a**: Where practicable, position equipment, storage containers, and stockpiles out of the sightline of adjacent receptors.	Target: ▪ Presence of a room for storing materials and equipment on construction sites; ▪ Reduction of the work footprint on site.	Promotor management team / ESHS officer of the Proponent Consortium Members / Local contractor Management/ ESHS

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		Frequency: During the construction.	Manager for each Lot construction
	S-C-15b: Where practicable, use appropriate fencing/hoarding to keep site activities from view.	Target: ▪ Presence of a room for storing materials and equipment on construction sites; ▪ Reduction of the work footprint on site. Frequency: During the construction.	Promotor management team / ESHS officer of the Proponent ESHS Manager for each Lot construction
	S-C-15c: Avoid Ordering of surplus construction materials.	Target: ▪ Presence of a room for storing materials and equipment on construction sites; ▪ Reduction of the work footprint on site. Frequency: During the construction.	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction And Procurement Responsible for each Lot construction
	S-C-15d: Store stockpiled wastes in areas with easy access for waste trucks.	Target: ▪ Presence of a solid waste storage device in a place sheltered from workers and local communities; ▪ Presence of a room for storing materials and equipment on construction sites; ▪ Local contract signed as part of waste treatment. Frequency: During the construction.	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	S-C-15e: Where practicable, restrict construction activities to daylight hours.	Target: ▪ Reduction of the work footprint on site.	Consortium Members / Local contractor Management/ ESHS

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		Frequency: During the construction.	Manager for each Lot construction
Cultural Heritage			
S-C-16 Impacts on naturel heritage	**S-C-16a**: Conduct careful site selection of all Lots, taking account of any community consultation/specialist surveys.	Target: ▪ Land acquisition report; ▪ Socio-economic survey report. Frequency: Before the start of construction.	Promotor management team / ESHS officer of the Proponent
	S-C-16b: Develop a Cultural Heritage Management Plan covering tangible and intangible (e.g. local traditions and practices) cultural heritage. The plan will detail a chance finds procedure.	Target: ▪ Tangible and intangible cultural heritage management plan; ▪ Chance finds procedure included in the plan ▪ Worker awareness report on respect for local traditions and practices. Frequency: Before and during the construction.	Promotor management team / ESHS officer of the Proponent Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	S-C-16c: Raise awareness among project workers about respecting the intangible heritage of the locality.	Target: ▪ Worker awareness report on respect for local traditions and practices. Frequency: Before the start of construction.	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	S-C-16d: Establish a procedure in the event of chance discoveries of an archaeological object.	Target: ▪ Developed sheet of chance discoveries of an archaeological object.	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		Frequency: During the construction.	
	S-C-16e: If an object is discovered during the work, be sure to stop the work and declare the object to the country's authorities.	Target: ▪ Object discovery report. Frequency: During the construction.	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

12.5.4.4 Construction ESMP – Greenhouse Gaz Emissions (GHG)

Table 183: Framework for CESMP – Greenhouse Gas Emissions

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
Greenhouse Gas (GHG)			
GHG-C-01: Mitigation measures aiming at reducing energy consumption:	**GHG-C-01a**: Reducing idling time on electrically powered equipment.	Target: Electricity consumption is reduced to minimum use Frequency; During construction phase	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	GHG -C-01b: Implement energy saving practices (see mitigation measure S-C-13a).	(See mitigation measure S-C-13a).	(See mitigation measure S-C-13a).
GHG-C-02: Mitigation measures aiming at reducing GHG emissions:	**GHG-C-02a**: Engage Regular maintenance of machinery and vehicles.	Target: Maintenance is planned in accordance with the different engines and equipment, proofs are preserved Frequency; Prior and during construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	GHG-C-02b: Measurement and reporting of fuel consumption associated with vehicle and construction operations.	Target: Fuel monitoring consumption are tracked and regularly reported Frequency; During the construction phase	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	GHG-C-02c: Training of workers to use equipment, including vehicles, in an efficient manner to reduce fuel wastage.	Target: 100% employees are trained Frequency; Prior to construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	GHG-C-02d: Inform on-site workforce of commitment to monitor and reduce GHG emissions, where possible, through environmental awareness training.	Target: 100% workforce sensitized and informed Frequency; Prior to construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
	▪		

12.5.4.5 Construction ESMP – Climate Change

Table 184: Framework for CESMP – Climate Change

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
Climate Change			
CC-C-01 Risks and river flood	**CC-C-01a:** ▪ The construction of the water abstraction pumping station which will be located on the right bank of the Kwanza River should take into consideration mitigation measures already in the design stage to minimize risks such as create water detention areas, build river dikes. ▪ Implement an early warning system and make provision for a direct connection with any existing early warning systems at local or regional level to guarantee information on potential extreme event are monitored and shared on a daily basis	Target: ▪ mitigation measures already in the design stage implemented to minimize risks such as create water detention areas, build river dikes. ▪ early warning system implemented and provision for a direct connection with any existing early warning systems at local Frequency: Prior to construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
CC-C-02 Risks of wildfires	**CC-C-02a:** ▪ Install in each Lot a firefighting system with extinguishers in the building and a gathering point outside the building to minimize the growing wildfire risk identified ▪ Perform regular maintenance of the firefighting system. ▪ Conduct regular fire emergency exit training with the workers ▪ Clear vegetation outside each facility fence over a 20 m buffer.	Target: ▪ Firefighting systems are developed and implemented in each Lot and comprises extinguishers in buildings and gathering points outside the buildings. ▪ Firefighting systems are regularly maintained; ▪ Fire emergency trainings are performed 2 times a year; ▪ Vegetation is cleared in a 20m buffer around facilities.	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
		Frequency: Prior to construction start and during the whole construction phase	
CC-C-03 Extreme heat	**CC-C-03a** ■ Provide adequate and regular maintenance of cooling systems verifying that the adequacy is guaranteed in the face of the expected increase in temperatures and the frequency of conditions of thermal stress and heat waves. ■ Provide for additional shades in public spaces, such as adding shades in parking lots or outdoor staff transit areas. ■ Consider using construction materials for buildings and other infrastructures with a lower capacity to absorb heat and higher capacity to maintain their main properties in case of extremely high temperatures. ■ Provide proper and regular maintenance to buildings, infrastructures, and equipment to avoid increasing their sensitivity to hot temperatures. ■ Reschedule working hours during extremely hot periods to ensure the safety and efficiency of staff working in outdoor areas. ■ Ensure appropriate training is provided about heat stress symptoms and appropriate behavior and information is available daily about temperatures and humidity to all workers. ■ Ensure properly trained medical staff and appropriate medical care is available. ■ Ensure potable water is always available in the right quantity for all personnel.	Target: The list (to the left) must be applied Frequency: Prior to and during construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
CC-04 Urban flood	■ Keep manholes and drainage channels clean to avoid potential flooding in case of intense precipitation events.	Target: The list (to the left) must be applied	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
	▪ Assure presence and efficacy of dikes or other systems to protect the infrastructures and access roads in case of flood.	Frequency: Prior to and during construction	
CC-05: Adaptation	▪ Elaborate an Adaptation Management plan prior construction, including: ▪ material risk identification of key business-related risks that result from potential climate hazards impacts to society and the environment posed by the Project, and ▪ mitigation measures to mitigate risks posed by climate change	Target: Adaptation Management plan developed Frequency: Prior construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

12.5.4.6 Construction ESMP – Unplanned and Emergency Events

Table 185: Framework for CESMP - Unplanned and Emergency Events

Impact measure number	Mitigation or compensation measures	Monitoring indicators (Target / Frequency)	Responsibilities
Unplanned and emergency events			
UEE- 01 Mismanagement of hazardous waste and materials	(In addition to those already mentioned as pollution prevention) Train construction workers on release prevention specifically on hazardous materials as part of an emergency preparedness response training; Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment; Prepare written Standard Operating Procedures (SOPs) for filling containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response; Identify locations of hazardous materials and associated activities; Make available specific PPE and training needed to respond to an emergency; Make available spill response equipment sufficient to handle at least initial stages of a spill and a list of possible interventions	Target: The list (to the left) must be applied Frequency: Prior to and during construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction
UEE- 02- Releases by natural disasters	Ensure the full implementation of safety measures set out by the final design; Ensure adequate planning for contingency in case of natural disasters; Train workers at the site on general safety measures and ensure full adherence; Provide special training on emergency situations, evacuation procedures, and recovery from disasters	Target: The list (to the left) must be applied Frequency: Prior to and during construction	Consortium Members / Local contractor Management/ ESHS Manager for each Lot construction

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APPENDIX A

Site visit report- Scoping phase

A1 - Photos of the different lots taken during the site visit

A2 - Slides with the presentation of the Quilonga project to stakeholders at EPAL headquarters by Dar (April 20th, 2023)

A3 - Schedule of the site visit from 19th to 20th April 2023

A4 - Minutes of the site visit (EPAL)

A5 - Attendance register of the site visit

APPENDIX B

Inventory of buildings located in the zone where the pipeline to transport raw water from the abstraction to the WTP will be constructed - lot 1 (Source: EPAL)

APPENDIX C

Saioz and lab certificates

APPENDIX D

Lab reports

APPENDIX E

Geological Environment Field Surveys

APPENDIX F

Noise Field Data

APPENDIX G

Photography report – biodiversity studies

APPENDIX H

List of Species and Associated Information

APPENDIX I

Environmental DNA sampling sheets

APPENDIX J

Stakeholder consultation documents

APPENDIX K

WSP report: GHG emissions calculations

APPENDIX L

WSP Report: Human Right Risk Assessment Screening (HRRA)

APPENDIX M

WSP Report: Climate Change Risk Assessment (Physical Risks)

APPENDIX N

Hydroconseil Report: Impact on the hydrology of the Kwanza River

APPENDIX O

NatureMetrics Report: Environmental DNA

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