

ETUDE D'IMPACT ENVIRONNEMENTAL ET SOCIAL APPROFONDIE

TRAVAUX D'AMENAGEMENT DES VOIES D'ACCES ET **TRAVERSEES DE COTONOU (ATC): LOT1**

DRAFT The World Bank has not yet cleared this draft document



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LIST OF ACRONYMS

ABE AE AID ANDF ANaTT APD ASECNA ATC BAAC	: Beninese Agency for the Environment : Environmental Audit : Action Impact Development : National Agency for Land and Land : National Agency for Land Transport : Detailed Preliminary Project : Agency for the Safety of Air Navigation in Africa : Access and Crossings of Cotonou
BCEAO BSIC CA CAT CCE UNFCCC CECO BTP CEREMA	: Bulletin d'Analyse des Accidents Trouvés: Central Bank of West African States: Sahelo-Saharan Bank for Investment and Trade: District Chief: Convention against Torture: Certificate of Environmental Compliance: United Nations Framework Convention on Climate Change: Control, Studies and Coordination of Building and Public Works Works: Centre for Study and Expertise on Risks, Environment, Mobility and Planning: Land and State Code: Environmental and Social Management Framework: Convention on International Trade in Endangered Species of Wild Fauna and Flora: International Centre for Research on Cancer: National Social Security Fund: National Road Safety Centre: Northern Cotonou Bypass: Coordinated
CFD CGES CITES	Regional climate Downscaling Experiment: Conference of the Parties: Corona Virus Desease: Planned Nationally Determined Contributions: Population Resettlement Policy Framework: Double Reinforced Concrete: Biomedical Waste: Departmental Directorate of Living Environment and
CIREC CNSS CNSR CONOCO CORDEX COP 21 COVID	Sustainable Development: Department of Geography and Spatial Planning: Directorate-General for Environment and Climate: Directorate-General for Water, Forests and Hunting: Directorate-General for Housing and Construction: Directorate-General for Infrastructure: Directorate for Promotion and Economic Cooperation: Directorate for Land Transport: Solid and Household Waste: Strategic Environmental Assessment: Harmonized Survey on Household Living Conditions: Environmental and Social Impact
CPDN CPRP DBA DBM DDCVDD	Assessment: Undesired Event: Personal Protective Equipment: Stratified Simple Point-Type Sampling: Climate Change Risk Assessment: Environmental, Health and Safety: Valued Elements of the Environment
DGEC DGEFC DGHE DGI DPCE	
DTT DSM EES EHCVM EIES ENS EPI	
EPS ERCC ESS EVE	



EUI FCFA

FOL FR GES GIIP GIIP GNSP GPS GSC GSF GSM ICF IE IGATE IGN INF INSAF IPC IST I GBTH OS MASM MCVDD MEF MEM MDGL MGP MIT MO MST MTFP MPD NP OBRGM OECD ODK OIT WMO WHO PAC NGO UN PANA PAP PAPC PPP PPP PSF SAH SE SIDoFFE SIG: Industrial Wastewater: African Financial Community Franc: Heavy Fuel Oil : Road Fund : Greenhouse Gases : Good International Industry Practice Integrated Water Resources

Management : National Fire Brigade Group : Global Positioning System Great Hot Season Great Cold Season Global System for Mobile Status of Women Index · Environmental Inspection Institute of Geography of Spatial Planning and the Environment

: National Geographic Institute : National Institute for Women : National Institute of Statistics and Economic Analysis : Corruption Perception Index : Sexually Transmitted Infections : Laboratory of Ecology of Botany and Plant Biology : Lesbian, Gay, Bisexual, Transgender : Level of Service : Ministry of Social Affairs and Microfinance : Ministry of Living Environment and Sustainable Development : Ministry of Economy and Finance: Ministry of Water and Mines: Ministry of Decentralization and Local Governance: Complaint Management Mechanism: Ministry of Infrastructure and Transport: Project Owner: Sexually Transmitted Disease: Ministry of Labour and Public Service: Ministry of Planning and Development: Performance Standards: Beninese Office of Geological and Mining Research: Organisation for Economic Co-operation and Development: OpenDataKit: International Labour Organization: World Meteorological Organization: World Health Organization: Autonomous Port of Cotonou: Non-Governmental Organization: United Nations: National Programme of Action for Adaptation to Climate Change: Person Affected by the Project: Cotonou City Rainwater Sanitation Project: Public-Private Partnership: Short Cold Season: Wet Analogue Scenario: Executive Secretary: International Finance Corporation: Integrated Family, Gender and Child Data System: Geographic Information System



SIRAT SRTM ONPI PAE PAR PARC PARP PAG PDC PGES PL PM PMU PPP	WGS: Société des Infrastructures Routières et de l'Aménagement du Territoire: Shuttle Radar Topography Mission: Office National d'Edition de Presse et d'Imprimerie: Environmental Action Plan: Resettlement Action Plan: Resettlement and Compensation Action Plan: Population Resettlement Action Plan: Government Action Programme: Municipal Development Plan: Environmental and Social Management Plan: Light Weight Passenger Car
RGPH	: Particulate Matter : Urban Mobility Plan : Public-Private Partnership : Ouality-Health-Safety-Environment : General Population and Housing
SBEE	Census : National Inter-State Road : Beninese Electric Energy Company :
SGDSN SIDA	Waste Management and Sanitation Company of Greater Nokoué : Acquired Immunodeficiency Syndrome : Road Infrastructure and Spatial Planning
SIRAT SA	Company : Beninese Brewery Company : National Company Waters of
SOBEBRA	Financial Disclosure: Terms of Reference Central Land: Musculoskeletal
SSS	Disorders: 2Wheel Drive: Catholic University of West Africa: West African
TCFD	Economic and Monetary Union: Ultra Fine Particles: International Union for
TdR TPC	Conservation of Nature: National University of Agriculture of Porto-Novo:
TMS 2RM	Biomonitoring and Conservation Research Unit Protected Areas and Wildlife :
UCAO	Urchin Tracking Module : Gender-Based Violence : Human
	immunodeliciency virus : Light vehicle : world Geodesic System
UNAP	

UTM GBV HIV VL

UR-BICAF



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EXECUTIVE SUMMARY

CONTEXT OF THE PROJECT

Launched since 2016 in Benin's development dynamic, the implementation of the Government Action Program (PAG), which is the compass of this political commitment, is effective. This program which in its phase 1 has transformed the major cities of Benin, in particular the city of Cotonou through road and sanitation infrastructure. Asphalting is a model of road development that combines road infrastructure; sanitation and landscaping. Indeed, the economic capital of Benin today has an undeniable and perceptible attraction through the implementation of the Asphalting project, phase 1 which has changed the face with the asphalt development of almost all the streets (Fidjrossè, Agla, Ganhi, Akpapka, Cocotier, Haje vive, etc.) concerned by this project. In addition to these various infrastructures, there is now the Cotonou Rainwater Sanitation Program (PAPC) currently being carried out, which will also have a positive impact on formerly flood-prone and flooded neighborhoods in Cotonou, the Cotonou Urban Mobility Project (PMU), the Sika Toyota Interchange Construction Project, etc. The Waste Management and Sanitation Company of Greater Nokoué (SGDS-GN) through its actions maintains the healthy and pleasant living environment for our populations. All these actions make it possible to increase and facilitate mobility in the city of Cotonou and then contribute to the improvement of the living environment.

Notwithstanding this glowing picture, the main access and crossing roads of the city of Cotonou remain in a state of advanced degradation with defective roads and signage that do not conform to the urban roads and use they are used today. Indeed, the state of play of these arteries does not ensure a good flow of traffic, resulting in longer travel times for users and increased vehicle maintenance costs. In addition, (i) the existence of non-compliant signage and inoperative light regulation systems, (ii) the presence of impassable islands on certain roundabouts and roundabouts, (iii) the absence of pedestrian paths and parking lots, creates congestion at rush hour at intersections, traffic accidents and insecurity for pedestrians and all users of these roads. It is therefore to correct this state of advanced deterioration of the urban road network and offer assured safety and an attractive living environment to the populations that the Government, through the Road Infrastructure and Spatial Planning Company (SIRAT-SA) has initiated this project of resurfacing/strengthening/rehabilitating the accesses and crossings of Cotonou.

The streets concerned by this project are grouped into two lots, including lot 1, which is the subject of this report. This lot has a total length of 16.125 km with a set of 7 streets located in the East and South sectors of the city of Cotonou.

To comply with the requirements of the environmental framework law and implement a viable and sustainable project, this project has been subject to an Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP).



PRESENTATION OF THE PROJECT AND THE STUDY

Project to be carried out:	Development of access roads and crossings of Cotonou (ATC)
Promoter	The Beninese State through the Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT) SA
Project Batch Number	Lot 1
Number of roads	Seven (07)
identified for lot1	
Linear to be fitted out	 > Ancient bridge – SOBEBRA crossroads – OPT PK3 crossroads – Bélier crossroads; > Third Bridge – SOBEBRA Crossroads; > Place du Souvenir – Carrefour 3 Banques; > Carrefour Marché Saint Michel – Carrefour NASUBA – Échangeur Steinmetz – Carrefour Notre Dame; > Carrefour 3 Banques – Carrefour Air Afrique; > Carrefour Air Afrique – Old Bridge; > Carrefour Cheminot – Steinmetz overpass On the
Layout to be carried out	 the rehabilitation of arteries from façade to façade the installation or redevelopment of local traffic to set up parking areas for certain arteries, the development of footbridges to facilitate pedestrian passage in certain places, the installation of speed bumps and road signs for the declaration of the 30 zone the installation or renewal of existing separation systems from the railway the development of parking areas, the installation of public lighting equipment; the rehabilitation of the sanitation structures on each axis following the existing route the installation of signage (vertical and horizontal), the implementation of the TPC landscaping; At Intersections on the planned axes: make corrections of oversized rings by reducing widths and eliminating storage lanes; implement directional islands at the level of single carriageway branches in accordance with standards and within the limits of the available rights-of-way; implement central islands at the level of the large ordinary flat intersections;
	 make drawdowns of the BAU before entering the crossroads; reduce the cases where the BAU is used as a cycle lane, the entry and exit lane of this cycle lane by inserting an island for pedestrian refuge.



	site installation;
	 development of the identified bypasses;
	 clearing of rights-of-way (specific case of runways);
	 reprofiling and resizing of the tracks in accordance
	with the selected optional model;
	earthworks and paving of the various components of the arterious (reads, sidewalks, TPC, reads string, second string)
	arteries (roads, sidewaiks; TPC, pedestrian crossings etc.);
	 redevelopment of sanitation structures for better
Implementation Activity	regulation of their functions;
implementation / tearing	• installation of signage (installation of vertical traffic
	signs and drawing of horizontal signs) and road safety
	(installation of street lamps or electricity poles for public
	lighting, harmonization of traffic lights);
	a corruing out the related works and environmental
	carrying out the related works and environmental measures to be taken into account in the context of the
	preject:
	• dismantling.

METHODOLOGICAL APPROACH TO CARRYING OUT THE ESIA

The conduct of this impact study was based on an approach marked by a series of actions brought together in three phases, including (i) a phase of scoping and preparation of the mission, (ii) a phase of fieldwork and (iii) a phase of synthesis of the data collected and the actual drafting of the ESIA report.

The fieldwork was carried out according to specific and coherent approaches that led to (1) the clarification of the issues related to the implementation of the project, (2) the characterization of the biophysical environment and (3) the analysis of the socio-economic characteristics of the project host area.

The methods for public consultation, baseline analysis, assessment of potential environmental and social impacts, and definition of the corresponding mitigation measures were developed in accordance with the environmental requirements in force in Benin (national ESIA regulations and guidelines).

LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

The implementation of this road development project is governed by a set of international and national texts. Basically, it defines the legal repertoire essential to the implementation of the project. Also, it was specified the institutional actors who can be involved in the monitoring of the various activities planned in the environmental and social management plan.

The Beninese Environment Agency (EBA) and the Departmental Directorate of the Atlantic-Coastal Living Environment, the operational arms of the Ministry of Living Environment and Sustainable Development, will ensure on the one hand compliance with and application of the environmental impact review and assessment procedure in Benin and on the other hand the monitoring of the implementation of the ESMP and the RAP with the sectoral ministries involved in the monitoring activities.



In addition, the various measures and recommendations formulated by this Environmental and Social Impact Assessment (ESIA) have been inspired by the directives and standards defined by the legislative and regulatory texts relating to the protection of the environment in force in the Republic of Benin. Their implementation is therefore subject to compliance with the framework law on the environment in the Republic of Benin and its implementing decrees. Apart from the decrees implementing this law, other national texts (laws, decrees, orders, etc.) relating to the sectors covered by the activities to be undertaken have been identified to frame the implementation of the project.

DESCRIPTION OF THE RECEIVING ENVIRONMENT

Lot 1 of the project for the development of access roads and crossings of Cotonou will be carried out in seven (07) districts of the municipality of Cotonou.

Designation of axes	Linear (KM)	Boroughs	Neighborhoods
Old bridge-crossroads	6 705	1 Arrondissement	Donaten; Finagnon; Tokplégbé Akpakpa
PK3-Carrefour le Bélier	0,720	4 District	Dodomè; Fifadji Houto
		3 District	Kpankpan; Gbénonkpo
Third crossroads bridge SOBEBRA	2,4	4 District	Dédokpo; Misséssin; Gbèdjèwin; Sodjèatinmè Centre; Sodjèatinmè West; Sodjèatinmè Est
Place du	25	5 District	Guinkomey
souvenir-Carrefour 3 banks	2,5	12 District	the coconut palms; Ahouanlèko
St Michel market crossroads- NSASSOUBA crossroads-	1.0	5 District	New Bridge; Mifongou; Gbédokpo; Bocossi Tokpa, Missèbo; Avlékété Jonquet; Tokpa Hoho
Steinmetz interchange- Notre Dame crossroads	1,9	6 District	Dantokpa
		7 District	Sèdjro Saint Michel
Carrefour 3 Carrefour banks Air Afrique Carrefour Air	1,1	5 District	Xwlacodji Kpodji; Guinkomey
Afrique-Ancien pont	0,5	5 District	Xwlacodji Kpodji
Railway Junction-Steinmetz Overpass	1,0	5 District	Guinkomey; Tokpa Hoho
Total	16,125		

The right-of-way of all these crossings includes private and public property that will be cleared before the start of the work. There are also socio-economic activities that will be disrupted by the implementation of the project. Indeed, the work of the ATC project will affect 362 PAPs composed of 113 women and 249 men.



PROJECT IMPLEMENTATION CHALLENGES

Security issues			
Negative issues identified Positive	ssues identified		
 Deterioration of the access road (diversion Disruption of the mobility of standard po Modification of the habits of road users labeled of safety of the 	on) Installation of roads in accordance with the pulations and roads in good condition Loss of vegetation cover Improvement of the		
Road traffic accidents for all users	 Improved traffic flow Existence of parking Reduction of traffic congestion on the situle metric conduction of traffic congestion on the situle metric. 		
• Madification of the landscape So	Job promotions		
iviounication of the landscape Soc	au-economic issues inegative		
issues identified Positive issues ide	entified		
 Disruption of access to used goods Cresidential workers; local populations; Destruction of infrastructure for urban us Sustainability and viability of streets and Destruction of socio-community property and public facilities; Attractive living en Disruption of economic activities and 	reation of temporary jobs for commercial and se, housing and related mobility; their implementation y in accordance with security standards; wironment; Development of income-generating activities;		
 Reduction of carbon sequestration due to Creation of new potentialities the restriction of access to various place employment work. Temporary flooding of streets Recording of cases of theft and vandalis 	co Reduction of flooding; cutting of trees s of economic and Ecological issues Negative		
issues identified Positive issues identified			
 Destruction of trees located in the right-of Loss of habitat for dependent animals Attra ecosystems to be destroyed Job creation Decrease in the rate of atmospheric carbon sequestration Disruption of ecosystem services provided by trees and ecosystems to be destroyed 	of-way Creation of landscaping active living environment with		
Socio-environmental issues			
Negative issues identified	Positive issues identified		
 Dust emission due to the movement of machinery, trucks and vehicles Noise production due to the movements of machinery, trucks, vehicles; the presence of a large number of users on construction sites 	 Creation of income-generating activities Increased revenue Job creation 		



Solid and liquid waste generation
 Exposure of site users to the risks of occupational and traffic accidents
 Exposure of site users to occupational diseases
 Socio-environmental and technical issues Negative issues identified/ Comment Positive issues identified/ Comment
 Difficulty in installing the technical bases or installing the bases in tight spaces and close to homes
 Nuisance to neighbouring homes and human installations
 Degradation of the work environment

PUBLIC CONSULTATION

From the results of the various consultations with the various stakeholders, the following strong recommendations emerged:

- On the preservation of biodiversity
 - avoid cutting down large trees on the ATC project's arteries as much as possible. In the event that they are affected, compensate them in large numbers;
 - Associate the services of the Calavi forest inspectorate and those of the Atlantic/Littoral Departmental Directorate of Living Environment and Sustainable Development for the implementation of the activities of the ESMP.
- On road safety activities
 - Familiarize yourself with road safety standards for the planting of trees along the roads;
 - proceed with this project to harmonise the signage in the context of the traffic lights to be installed;
 - harmonise the facilities between cycle paths and local traffic according to the rights-of-way;
 - Adapt the materials used to make the panels to avoid vandalism.

• On the preservation of the safety and social welfare of the populations For the interests of the affected populations and the local residents, recommendations are made by the local authorities as well as the populations and other actors consulted. These are:

- work with the Solid Waste Management Company (SGDS), SONEB and the Beninese Electric Energy Company (SBEE) to preserve and or relocate the installations/structures located in the project right-of-way and to plan future installations to reserve the spaces; involve local
- o authorities in the identification of bypass plans and involve them in their development and security;



- Involve the local authorities in the identification of excavated material storage areas and then in the management of the latter in order to use this excavated material/rubble for the maintenance of secondary roads;
- Prioritise the local workforce and involve the local authorities (Heads of Districts and CGs) who will make the lists available to companies;
- o Involve the district chiefs in mass awareness for a frank, constant and permanent collaboration

The first arrondissement proposes to make available to companies a site for the storage and management of excavated material.

Finally, with regard to the various damages to be caused to access ramps, fences, economic activities and/or possible floods affecting the population, technically and financially ensure compensatory measures for any damage caused by the project.

MAIN IMPACTS OF THE PROJECT AND PROPOSED MEASURES

The environmental assessment carried out for this project identified two categories of impacts, positive and negative. For each category of impacts, related measures have been proposed. The above matrices present a synoptic of each category of impacts and their measures.

• Positive impacts and measures

Positive impacts of the project Maximization measure	s Periodic maintenance and
Development of green spaces and planting; trees a	along the developed axes; rigorous
• improvement of the waste management system;	
Reduction of the city's risk of flooding.	
Radical improvement of the beauty of the city;roads comply with standards.	Periodic and rigorous maintenance
Improving traffic in the city;Traffic flow	Regular monitoring and maintenance
 Reduction of traffic jams on the main roads of the city; 	
Safe transport.	
 recruitment of the workforce for the execution of the work; Strengthening and revitalizing trade routes. 	Prioritise local labour (with equal skills)
 increase in satisfaction with the services provided to the population; better security and better social organization promoting the development of the localities concerned; Opening up certain areas of the city. 	 Regular monitoring and surveying; Regular maintenance of infrastructure.

• Negative impacts and measures

DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF COTONOU (ATC) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) LOT N° ATC- 01



Nie westikke inswerente	Draw and a stimu
	Proposed actions
Loss of property and	- Ensure fair and prior compensation for PAPS;
astivities and revenue sources	- Implement the KAP completed for the project.
activities and revenue sources	Informe the manufactions of the locality hafenshered
Disruption of the full-time availability of networks (water.	 Inform the populations of the locality beforehand about the temporary network cut programs that may
electricity, etc.) to the	occur;
population of the	 Take steps to avoid outages lasting several hours.
Disruption of socio-economic habits	 Inform and sensitize the population sufficiently on the date of the start of the work for the individual measures to be taken.
Loss of vegetation cover and habitat for wildlife	 Destroy the trees just needed and carry out selective deforestation; Take the tree cutting permit before the trees are cut down; Ensure maintenance until maturity of all the trees and tree gardens to be set up; Ensure compensatory reforestation in the degraded areas of the commune of at least 2000 plants of local species such as Khaya senegalensis.
Loss of the potential for sequestration of the existing carbon stock	 Destroy the trees just needed and carry out selective deforestation; Prioritize trees with high carbon sequestration for landscaping to be done; Ensure maintenance until maturity of all the row and garden trees to be planted; Ensure compensatory reforestation in the degraded areas of the municipality of at least 2000 plants of local species with a high rate of carbon sequestration.
	- provide all users with appropriate PPE and ensure
	that they are effectively worn:
Development of respiratory and allied diseases	 Water potentially dusty areas regularly;
	Use equipment in good working order.
Increase in the provolence of	- Naise awareness among sile users for strict
covid 19	 Provide the construction sites with a collective
	protection system (handwashing device)
	- Conduct awareness-raising sessions coupled with
Increase in the prevalence of	screening for these diseases and distribution of
contagious diseases (STDS,	condoms;
STDS, HIV, AIDS, HEPATITIS,	- Periodically raise awareness among users about
etc.) and unwanted pregnancies	contagious diseases (STD, STD, HIV, AIDS, HEPATITIS,
	etc.) and the consequences of unwanted pregnancy.
	 Provide all users with appropriate PPE and ensure
Accident at work	inal they are effectively worn;
	- set up markers, signs and safety instructions on construction sites:
	 provide construction sites with HSE agents:
	 collect and remove dangerous roughness such as
	nails, screws, pieces of iron, etc., immediately after
	stripping the formwork;



DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF COTONOU (ATC) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) LOT N° ATC-01

	 Subscribe employees to health insurance; Declare employees to the CNSS; Provide construction sites with well-equipped infirmaries; Raise awareness among users about compliance with safety instructions.
Traffic accident	 Have a traffic plan on all construction sites and ensure that it is respected; Raise awareness among drivers about the need to respect the highway code (speed limit, good health, no drinking and driving, etc.); Equip construction sites with HSE agents; Ensure regular maintenance of access roads; Declare the staff to the CNSS; Raise awareness among users about the new road signs and compliance with the Highway Code (speed limit, good health, no drinking and driving, etc.); Ensure the regular maintenance of the lighting equipment installed.
Air pollution by dust and exhaust gases	 provide all users with PPE (masks); Periodically water potentially dusty traffic areas; Use equipment in good working order.
Noise	 Provide all users with appropriate PPE (ear kits) and ensure that they are effectively worn; Respect rest hours in accordance with the labor code in force; Respect rest hours in accordance with the labor code in force; Ensure the use of less noisy machinery and equipment.
Development of respiratory and allied diseases	 provide all users with appropriate PPE and ensure that they are effectively worn; Water potentially dusty areas regularly; Use equipment in good working order; Avoid speeding by trucks transporting materials along the lanes; Ensure coverage of loads of trucks transporting construction materials and equipment.
Soil and water pollution by solid construction waste and excreta	 Install garbage cans for the pre-collection of solid waste and contract with the SGDSM for its removal; Equip the site with sex-mobile toilets and contract for their regular maintenance; Raise awareness among users of the provisions put in place for pre-collection and waste collection.
Soil and water pollution by liquid waste (urine and waste oil, grease, etc.)	 Equip the site with drums for the storage of liquid waste and ensure their removal by approved structures; Install watertight platforms for the handling of hydrocarbons and oils;



	 Equip the site with absorbents for the management of accidental spills; Equip the site with sex-mobile toilets and contract for their regular maintenance; Raise awareness among site users about the respect of the hygiene and soil protection measures put in place.
Crowding and degradation of the soil by concrete and bitumen waste	 Strictly comply with technical specifications in the production of aggregates; Use bitumen residue (garbage) on defective neighbourhood streets.
Flooding of alleys, houses and infrastructure in the road right-of-way	 Regularly maintain the detour routes; Avoid the creation of water basins during the work; Equip construction sites with water evacuation equipment in the event of flooding; Respect the deadlines of the work; Rigorously comply with the technical specifications (slope, longitudinal profile, etc.) of the market.
Degradation of the environment and visual quality	 Obtain materials from regularly authorized quarries or take all authorizations before the opening of quarries and borrowing areas; Respect all environmental and social clauses in the opening and operation of a quarry and borrowing areas; Ensure a redevelopment of the technical bases at the end of operation.
Development of other occupational diseases other than respiratory diseases	 provide all users with appropriate PPE and ensure that they are effectively worn; Raise awareness among all site users about the respect of the protection and hygiene measures put in place Make a pre-employment medical examination for all workers and staff on the construction sites To subscribe to an insurance policy for staff and workers; Declare the staff to the CNSS.
Fire on construction sites	 Equip construction sites with fire-fighting equipment and install it in accordance with the recommendations of the GNSP; Train users on the use of firefighting equipment; Have an Internal Operation Plan (POI) to be updated periodically; Raise awareness among staff to comply with safety measures.
Deterioration of the living environment	 Conduct a dismantling audit of the technical bases and implement the recommendations before its release
Job losses	 Poaching employees in accordance with the labor code in force in the Republic of Benin.
Soil congestion and pollution by waste electrical equipment	 Contract with the equipment supplier for the collection of end-of-life equipment



Flooding of all	eys,	house	es and
infrastructure	in	the	road
right-of-way			

Rigorously comply with the technical specifications (slope, longitudinal profile, etc.) of the market.

NON-TECHNICAL SUMMARY OF RAP

1. Sub-project relocation data summary sheet

-

N°.	VARIABLES	DATA
1.	Project Country	Benin
2.	Department.	Littoral
3.	Municipalities	Cotonou
		1 Arrondissement
		4 Arrondissement
4.	Rounding	5 Arrondissement
	-	7 Arrondissement
		12th Arrondissement Dandji; Tanto;
		Nvènamèdé; Tokplégbé ; Finagnon;
		Fifadji Houto Guinkomey; Tokpa
5.	Neighborhoods	Hoho; Gbédokpo Xwlacodji Kpodji;
		Mifongou; Enagnon; Ahouanlèko and
		Les Cocotiers Road rehabilitation
6.	Type of project	Cotonou Access and Crossings
7	Project Title	Project (ATC) Asphalting Road
/.		Infrastructure and Spatial Planning
8.	Resettlement-Induced Activities	Company (SIRAT SA) National budget
0	Promoter	605 612 040
9.	FIOIIIotei	
10.	Funding	
11.	RAP Overall Budget	
12.	Deadline	07 June 2022
13	Date of consultation of the PAPs	25 and 27 May 2022, 03, 09 and 22
15.	Date of consultation of the PAPS	June 2022 362
11	Number of people affected by the project	
14.	(PAP)	
15.	Number of Dependants	986
16.	Number of women affected	113
17.	Number of women heads of household	03
18.	Children under 1 year of age	32
19.	Children from 5 to 13 years old	360
20.	Children from 14 to 17 years old	193
21.	Adult men and women	478
22.	Number of vulnerable PAPs	24
		Owner: 79
		Tenant : 209
22	PAP Category	Representative:
20.		42 Squatter: 25
		Heir : 05 Managar : 02
		wanager: 02

 Characteristics of the properties located on the Old Bridge - SOBEBRA Junction - OPT PK3 Junction - Le Bélier Junction



Type of property	Area/ linear (m²/m)	Number
Apatam	5	1
Awning	1766	128
Terrace	1500	1
SBEE Cab	500	1
Access staircase	8	2
Synthetic turf	1	5
Generators	15	2
Fence wall Parking Terrace	606(m)	24
Access ramps to buildings	1560	2
	2047	32
	6793	158
Total	14801	356

 Characteristics of properties located on the Carrefour 3 Banques – Carrefour Air Afrique axis

Type of property	Area (m²) N	umber	
Tiled terrace Customer	30 1 800	1	
parking Access ramp to			
buildings	50	1	
Total	880 3		

• Characteristics of properties located on the Carrefour Air Afrique-Ancien Pont axis

Type of property	Area/ linear (m²/m)	Number
Awning Telephone	44	5
booth Mobile	5	1
display Garden	150	2
Fence wall	50,283	1
Parking Ramps to	(m)	7
buildings Terrace	83	1
	455	20
	55	1
Total	1125	38

• Characteristics of properties located on the Carrefour Cheminot-Passage supérieur axis

Type of property	Area/ linear (m²/m)	Number
Terrace	28	2
Broken tile ramp	6	1



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Enclosure wall	195	1
Mobile display	6	1
Total	235	5

• Characteristics of the properties located on the Carrefour Marche Saint Michel Carrefour NASUBA-Echangeur Steinmetz-Carrefour Notre Dame axis

Type of property	Area/linear (m²/m)	Number
Awning	614	78
Mobile display	42	5
Enclosure wall	35	5
Parking lot	25	1
Cobblestone	20	1
Building ramps	442	31
Terrace	53	5
Total	1231	126

Characteristics of properties located on the Troisième Pont - Carrefour SOBEBRA axis

Type of property	Area (m²)	Number	
Awning	116	21	
Mobile display	115	3	
Customer parking	145	1	
Flower bed	15	1	
Building ramps	1325	18	
Terrace	976	12	
Total	2692	56	

 Public goods impacted on the Carrefour Marche Saint Michel Carrefour NASUBA-Echangeur Steinmetz-Carrefour Notre Dame axis

Assets Affected by Axis Number Cabinet 46		
Cab 26 Counter 24 Total 96		

 Public goods impacted on the Carrefour Marche Saint Michel Carrefour NASUBA-Echangeur Steinmetz-Carrefour Notre Dame axis

Allocated assets by axis	Number	
BEN AFRICA Booth	24	
Optical fiber	348	
Concrete power pole	270	
Wooden power pole	20	
Total	662	



• Properties impacted on the Carrefour Marche Saint Michel Carrefour NASUBA-Carrefour Notre Dame interchange

SONEB structure affected	Number
Fire hydrant	12
Pipe	96
Total	108

• Trees located in the CTA project right-of-way along the axes

Name of the axis A1 (Old bridge-crossroads	Linear (KM)	Number	Percentage (%)
SOBEBRA-Carrefour OPT PK3-Carrefour le	6,725	220	24.4
Berlier) A2 (Third bridge-Carrefour SOBEBRA)		230	34,4
A3 (Place du souvenir-Carrefour 3 Banques) A4	2,4	73	10,5
(Carrefour marché st Michel-Carrefour	2,5	190	27,5
NASSOUBA-Echangeur Steinmetz-Carrefour	1,9		
Notre Dame) A5 (Carrefour 3		81	11,7
Banques-Carrefour Air Afrique) A6 (Carrefour			
Air Afrique-Ancien pont) A7 (Carrefour	1,1	41	5,9
Cheminot-Passage supérieur Steinmetz) Public	0,5	24	3,5
space Total	1,0	23	33
		20	5,5
		22	3,2
	16,125	692	100,0

2. Context and justification of the RAP Road projects are generally initiated to promote balanced regional development and contribute to economic development (tourism, administration, etc.). These types of projects are effective structural mechanisms for poverty reduction in Africa, and to a certain extent this requires the development of sustainable transport systems. Indeed, like other modes of transport, roads make it possible to open up geographical areas and ensure the free movement of people, goods and factors of production, in addition to revitalizing economies and facilitating access to basic socio-community infrastructure for local and other populations.

In April 2006, the Beninese authorities have adopted strategic development guidelines for an emerging Benin for the period 2006-2011. These strategic guidelines constitute the strategic framework of reference with a view to providing all actors with the necessary benchmarks for action. Their overall objective is twofold: (i) to create and energize poles of growth and development and (ii) to significantly reduce poverty. In the same vein, the Government of the Republic of Benin has developed a Government Action Program (PAG) since it came to power for the 2016-2021 five-year term, reflecting the vision of the Head of State in all development sectors. The flagship actions to be carried out to ensure the harmonious development of Benin revolve around major road and infrastructure projects.



3. Positive and negative social impacts of the CTA project The CTA project has both positive and negative impacts.

• Positive social impacts of the project The reconstruction of accesses and crossings will have positive effects with a view to improving the social and economic situation of the populations of the beneficiary districts and neighbourhoods:

- the creation of temporary jobs for local populations;
- Improving urban mobility;
- the sustainability and viability of streets and their compliance with safety standards;
- the improvement of comfort and the living environment;
- the development of income-generating activities;
- Flood reduction;
- the creation of new economic potential and jobs.

• Negative social impacts of the project The main negative social impacts of the project are essentially:

- the disruption of access to commercial and residential properties on the roads concerned by the ATC project;
- the destruction of residential and ancillary infrastructures;
- the destruction of socio-community property and public facilities;
- disruption of economic activities and sources of income;
- the loss of trees of economic value or used as shade;
- restricting access to various workplaces.

4. Methodological approach To achieve the objectives of this study and to meet the terms of reference, the methodological approach used was based on the following main axes: a documentary review, consultations with stakeholders, data collection in the field (socio-economic survey, inventory of assets and PAPs, inventory of impacted assets), data processing and analysis, the drafting and submission of interim reports, the consideration of amendments and the production of the final RAP report.

5. Political, legal and institutional frameworks for resettlement The Government's Action Programme (PAG 2) 2021-2026 is supported by three pillars: "Strengthening democracy, the rule of law and good governance", "Continuing the structural transformation of the economy" and "Continuing to improve the social well-being of the population". It aims to accelerate Benin's economic and social development in a sustainable manner. Based on the strategic objectives of the National Development Plan 2018-2025, the priority targets of the 2030 Agenda for the Sustainable Development Goals as well as the objectives of the African Union's Agenda 2063, the PAG 2021-2026 is the only instrument for steering government action during the five-year term. In the same vein, Strategic Axis 7 (Balanced and Sustainable Development of the National Space) of the Programme



of Government Action (PAG), in its point 3 (improvement of land and housing management), set out a number of reforms, including: (a) the adoption of the Construction and Housing Code, (b) the updating of the national housing policy, with a housing and real estate development strategy, (c) the reform of leases and rents, (d) the installation of a computerized national cadastre, (e) the densification of the geodetic coverage of the national territory and; (f) the operationalization and deconcentration of the National Agency for Land and Land (ANDF).

The Constitution of the Republic of Benin has enshrined the right to property, including the right to land ownership. It is Title II relating to the rights and duties of the human person that deals with the right to property. Indeed, in its article 22, the constitution states that "every human person has the right to property. No one may be deprived of his property except for reasons of public utility and against just and prior compensation." It is through this article that Law No. 90-32 of December 11, 1990 on the Constitution of the Republic of Benin, as amended and supplemented by Law No. 2019-40 of November 7, 2019, seals the right to property. Indeed, from this fundamental law derive all the other texts relating to land and state issues, in particular the Land and State Code.

In 2013, the Land and Property Code (CFD) was adopted and constitutes the main legal reference in land and property matters in the Republic of Benin. It repeals the texts that were in force (art. 537) before its adoption. The adoption of the CFD thus harmonizes Benin's legal arsenal in land and state matters by remedying the plurality and dualism that characterized land and state law.

6. Eligibility criteria In general, the eligibility criteria for the RAP are the conditions to be met in order to benefit from compensation measures for the damage suffered, in accordance with the regulatory provisions in force. The eligibility criteria for this RAP are based on national legal bases and the provisions of the World Bank's ESS 5 "Land Acquisition, Land Use Restrictions and Involuntary Resettlement". Affected persons may be considered to be persons who: (a) have formal legal rights to the affected land or property; (b) do not have formal legal rights to the land or property concerned, but have claims to such land or property that are or could be recognised under national law; or (c) have no legal rights or legitimate claims to the lands or property they occupy or use. The census will determine the status of those affected.

7. Profile of the people affected by the ATC project The data show that the work of the ATC project will reach 362 PAPs composed of 113 women and 249 men. These PAPs are responsible for 986 people, consisting of 462 women and 524 men. When looking at the specifics of dependents, they are counted as children aged 5 to 13, 175 female and 185 male. As for children under 1 year of age, PAPs have 16 female and 16 male children. The target of children aged 5 to 13, PAPs have 175 female and 185 male. Children aged 14 to 17 are 94 are female and 99 are male. There are 287 adult female dependents of PAPs and 191 adult men. PAPs



of the 36-45 age group represent 38.67% of all PAPs surveyed. PAPs between the ages of 46 and 55 make up 24.31%. PAPs between the ages of 26 and 35 are 22.65% and 8.56% for PAPs aged 56 to 65. PAPs aged 18 to 25 and over 65 represent 4.70% and 1.10% respectively. In terms of marriage, monogamous married PAPs represent 70.44% of all PAPs surveyed. Single PAPs are 22.38%. PAPs married polygamously with two (2) women are 3.59%. The results show that PAPs who have a secondary level constitute 30.94%. Those with a higher level of education represent 30.66%. PAPs who have never been to school represent 23.48% and those with primary level are 14.36. Literate PAPs are 0.55%.

The results show that seven out of ten PAPs (72.93%) are women traders. 22.10% of PAPs are craftsmen. PAPs that use property within the ATC project right-of-way as a base for industry and housing constitute 2.21% and 1.10%, respectively. They are 1.66% of PAPs who are involved in various activities. Of the various activities carried out by the PAPs, it appears that those with a daily profit of between 500 and 2000 CFA francs represent 31 per cent. The PAPs who earn between 2001 and 5000 CFA francs from their activity constitute 22%. They are 13% of PAPs who have a daily profit of between 5001 and 10000 FCFA. The PAPs who make a daily profit of between 20,000 and 25,000 CFA francs are 8%. The PAPs who earn more than 65000 FCFA are 8%. PAPs earning between 10,001 and 15,000 CFA francs represent 5%. Those that declare a profit margin of 30,000 to 35,000 CFA francs and 40,000 to 45,000 CFA francs are 3% and 5% respectively.

8. Summary of consultations with the public and institutional stakeholders All the stakeholders consulted in the context of the implementation of the environmental and social safeguard instruments of the Cotonou Access and Crossings (ATC) project welcomed the idea of rehabilitating the six (06) axes of Lot 1; these are (i) Old Bridge-SOBEBRA-OPT PK3 Crossroads - Le Bélier Crossroads; (ii) Carrefour 3 Banques - Carrefour Air Afrique; (iii) Carrefour Air Afrique-Ancien Pont; (iv) Carrefour Cheminot-Passage supérieur de Steinmetz; (v) Carrefour Marché Saint Michel, Carrefour NASUBA- Echangeur Steinmetz-Carrefour Notre Dame and (vi) Third Bridge - Carrefour SOBEBRA. The consultation sessions took place on May 25 and 27, 2022, June 03, 09 and 22, 2022. During these sessions, participants expressed concerns and fears and asked questions. The concerns raised by the participants were:

- Carry out in accordance with the texts in force the Action Plan for the resettlement of people affected by the project so as not to create frustration among the population;
- take into account the compensation of the people who will be affected because on some projects currently in execution, some people have not been compensated so far;
- Recruit local labour during the execution of the ATC project;
- make arrangements for the planting of trees on the edges of the tracks;



- install signs along the roads to be developed by using materials adapted to the Beninese environment in order to avoid cases of theft of the panels, especially in aluminum;
- Identify adequate plans for secondary diversion and ensure that they are maintained;
- Align this project with existing development projects in the area (northern Cotonou bypass, western bank of Ganhi, port terminal, etc.);
- Approach all the competent services in the context of human mobility in Cotonou to collect the information necessary for the realization of this project;
- propose adequate sanitation solutions to avoid hindering the normal functioning of coastal protection structures;
- take into account previous (existing) geotechnical studies in order to propose developments in accordance with the geotechnics of each area;
- consult the National Road Safety Centre (CNSR) beforehand for support in the context of a technical road safety report before the implementation of the project;
- involve the Beninese Electric Energy Company (SBEE) and the National Water Company of Benin (SONEB) to avoid damage to their installations.

The main questions asked by participants in the various consultation sessions can be summarized as follows:

- What are the compensatory measures for the economic activities of the populations that will be affected by the project?
- What share of the excavated material would be the responsibility of the local authorities for the closure of flooded roads in the streets;
- What measures have been taken to develop the bypass roads that will be degraded during the diversions?
- What will be the procedure for granting a technical basis for companies?
- How will the assistance of local elected officials be taken care of during the execution of the work?
- How long is the work on Lot 1 of the ATC project?
- What percentage of young people to be recruited per district or district that a District Manager can propose?
- Does the project provide for the involvement of the district chiefs to raise awareness among the populations living along the axes of Lot 1?
- What measures has the research firm taken to bring information to the local population?
- Are measures taken to compensate for the loss of economic activities that will be linked to the restriction of access during the execution of this project?
- How will the management of the excavated material work?
- What will become of the women fruit sellers located at the ASECNA level?
- What measures have been taken to limit speed on local traffic and cycle paths?



To these concerns and questions, the consultant provided adequate answers in order to meet the expectations and fears of the actors consulted.

9. Complaints management mechanism Development work leading to the resettlement of affected persons is regularly accompanied by various problems. This leads some populations or stakeholders living near the project site to make complaints to address concerns caused by project activities. In practice, complaints and conflicts that arise during the implementation of a RAP may include, but are not limited to:

- non-compliance with the procedures established by the Environmental and Social Management Plan (ESMP) and the Resettlement Action Plans (RAPs);
- the omission of PAPs during the census operation;
- errors in the identification of PAPs (misspelled first and last names of PAPs);
- Failure to understand/accept eligibility criteria
- the interference with a resident's commercial activity;
- Damage to an individual's property or equipment

Informing the population about the complaint management mechanism (in particular the EAS/HS) can be done through the organization of information and awareness campaigns on socio-community organizations (schools, health centers, homes, mosques, churches, places of prayer, places of worship, etc.);

- conflicts over the ownership of an asset (work equipment);
- the disagreement on the evaluation of PAPs on the method of assessing compensation;
- complaints relating to the exclusion of certain persons from the benefits of the Project
- insufficient communication on the project implementation process;
- conflicts between beneficiaries and non-beneficiaries of the project;
- -Gender-Based Violence (harassment, abuse, sexual violence, paedophilia, etc.) on the construction site;
- Violence against children on construction sites:
- the lack of communication of the work plan to the local populations;
- etc.

the complaint management mechanism using town criers, community relays, local radios, the print media and other local communication channels (town criers, development associations, etc.).

The bodies responsible for receiving and managing complaints related to the implementation of the project are structured around three levels of intervention:

- level 1: local committees of the 1st , 4th, ^{5th}, 7th and 12th Districts of Cotonou created by Municipal Decree on the creation, composition and functioning of complaint management committees and Municipal Decree on the appointment of members of local complaint management committees (CLGP);
 - level 2: Cotonou Communal Committee created by Municipal Decree on the attribution, organization and functioning of the Communal Complaint Management Committee (CCGP) of the ATC project of the Municipality of Cotonou



• level 3: national committee based at the management of SIRAT SA in Cotonou created by Regulatory Act establishing and operating the National Complaints Management Committee (CNGP/SIRAT SA) of the Minister of Infrastructure and Transport (MIT).

The National Complaints Management Committee is responsible for steering the MGP. It is the supreme body for the resolution of cases of amicable complaints and appeals not settled by the local complaint management committees and the communal complaints management committee. Indeed, the committees in the districts concerned by the work of the ATC project are set up by the General Management of SIRAT SA before the implementation of the RAP. The management of complaints on a stage that is subject to deadlines at the level of each committee. Any complaint filed with the local management committee must be dealt with within four (04) days. Any complainant who is not satisfied with the resolution may refer the matter to the Communal Complaints Management Committee. At this level, the treatment is six (06) days. In case of dissatisfaction, the complainant may submit his or her complaint to the National Complaints Management Committee. This committee has eight (08) days to empty the file sent to it. At each level of the MGP, the approach consists of the analysis of the facts with priority to dialogue, consultation, negotiation and amicable solutions, the visit to the field for observations, the preparation of the report of findings and consultations. The complaint management procedure follows the following process: (i) receipt and registration of complaints at the level of the committee chosen by the complainant; (ii) acknowledgement of receipt issued to the complainant; (iii) eligibility of the complaint; (iv) handling of the complaint; (v) notification of the resolution to the complainant and decisions taken; (vi) resolution and implementation of the proposed measures; (vii) closing the complaint and (viii) monitoring and documenting the complaint management process.

10. Institutional framework for resettlement The main institutions involved in the resettlement process in Benin are the Directorate of Planning, Administration and Finance of the Ministry of Infrastructure and Transport (DPAF/MIT), the National Agency for Land Development (ANDF) through the Communal Land Development Offices (BCDF) and the Village Land Management Structures (SVGF), the Municipality of Cotonou, the Beninese Environment Agency (EBA), the Departmental Directorates of the Living Environment and Sustainable Development (DDCVDD), the Environmental Unit of the Directorate of Planning, Administration and Finance of the Ministry of Infrastructure and Transport, the Departmental Directorate of Infrastructure and Transport, the Prefecture of Cotonou and civil society organizations. The following table presents the actors and their responsibilities in the implementation of the TAC Project RAP.

Institutional arrangements for the implementation of the RAP

Institutional actors	Responsibilities
SIRAT SA	RAP implementation Participation in complaint management Training of actors on the project's complaint management mechanism Strengthening of implementing actors on the resettlement process



Institutional	Responsibilities
actors	1 Coportoibilitico
(CTA Project Management Unit)	BM Payment of compensation and allowances for PAPs Preparation of the RAP implementation report; Transmission of the RAP implementation report to the Bank for approval Monitoring and processing of residual cases Monitoring and evaluation of the resettlement process Preparation of monthly reports on the level of implementation of the RAPs and the management of related complaints Transmission of progress reports on the implementation of RAPs to the Bank Ensuring proper documentation of the resettlement process Facilitation of the process of mobilizing the necessary funds To provide the APRM with the necessary funds for the payment of compensation
	Supervision of the process of drawing up the RAP Publication -
Ministry of Finance	Dissemination of the RAP at the national level Participates in the information/awareness-raising of the PAPs Observes the effectiveness
(MEF/DGTCP)	of the release of the rights of way and reports to the Prefect after
МІТ	settlement of the compensation Support for the amicable complaint settlement process Support for the implementation of the compensation measures contained in RAP Follow-up on RAP implementation Validation of RAP reports Follow-up of resettlement activities Review and Approval of RAP ToR Review, approval and publication of RAP on its website Review and approval of RAP Implementation Audit reports Review and approval of monthly RAP implementation reports
ABE	
Management of unr	esolved complaints MJL (courts)
Prefecture of Cotonou Establishment	the Technical Committee for Resettlement (CTR) by an order Participation in the information/awareness-raising of the PAPs Participation in the management of conflicts amicably (in support of the CTR) Participation in the monitoring of the implementation of the RAPs
CLGP	Receiving and resolving complaints Raising awareness of PAPs Assistance to PAPs, especially vulnerable PAPs Management of residual cases
Social NGO to support the implementation of the RAP	Information and awareness-raising for people affected by the project Support for the organisation of public consultations Support for vulnerable people Awareness-raising on the rational use of compensation and support for economic and physical rehabilitation



Institutional actors Responsibilities

Proposal to the prefectural authority of the City Hall executives to be members of the Cotonou City Council of the CTR Identification of a temporary rehousing site with the agreement of the PAPs Participation in the information/awareness-raising of the PAPs Observation of the effectiveness of the release of the rights of way and report to the Prefect after settlement of the compensations Support for the amicable dispute resolution process Support for the implementation of the compensation measures contained in the RAPs Support from the monitoring and evaluation of the resettlement process Participation in the census; PAP participation in information and awareness sessions; Participation in public consultation sessions; Referral to the local committee for the management and follow-up of complaints for any concerns; Formulation and submission of complaints to the local complaints management and follow-up committee.

Implementation of the complaint management mechanism Management committees Support for the payment of compensation and compensation to PAPs for complaints Assistance to PAPs, especially vulnerable PAPs Reception and resolution of complaints Management of residual cases Amicable resolution of complaints

11. Overall cost of implementing the RAP The overall cost for the implementation of the RAP of the works of Lot 1 of the ATC project is six hundred five million six hundred and twelve thousand forty (605,612,040) CFA francs. It is broken down as follows:

- 259,402,000 CFA francs for the compensation of private property located in the right-of-way of the ATC project;
- 202,154,400 CFA francs for compensation for loss of economic income;
- 3,600,000 CFA francs for assistance to vulnerable PAPs;
- 19,400,000 CFA francs for the cost related to the operation of the MGP;
- 66,000,000 CFA francs for the monitoring and evaluation of the implementation of the RAP;
- 55055640 FCFA representing unforeseen events;
- Public property and private companies located in the ATC project area are budgeted for during the works. This budget is not included in this RAP

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Through the environmental and social management plan, all the measures proposed to ensure that the identified impacts are taken care of have been planned so that their implementation is effective. Thus, an estimate of the cost of implementing social and environmental safeguard measures has been proposed. Thus, the implementation of this ESMP will require, without the costs for Memory (PM), six hundred and fifty-nine million five hundred



forty-two thousand nine hundred and forty-three (659. 542,943 CFA francs), of which one hundred and twenty-six million six hundred and fifty thousand (126,650,000 CFA francs) for the integration of environmental measures and five hundred and thirty-two million eight ninety-two thousand nine hundred and forty-three (532,892,943 CFA francs) for the implementation of the RAP.

Compliance with these proposed environmental tools (ESMP & PAR) and the technical and social clauses that will be included in the specifications of the delegated project owner would constitute a guarantee for the sustainability of this project.



INTRODUCTION

The development of any nation's economic activities requires the development of certain important levers, including transport, tourism, trade and industry. The importance of transport infrastructure in this development process for underdeveloped countries is recognized. Infrastructure is both a finished product offering direct services to consumers and an intermediate product that contributes to the productivity of production sectors. A high-quality infrastructure network is a decisive factor in improving communication between producers and consumers, between exporters and importers, and is a key determinant of price and non-price competitiveness in international markets by enabling the timely and safe delivery of goods and services (OECD, 2006). Over the past several decades, the growth of transportation by two-wheeled motorcycles, four-wheeled vehicles and trucks has put more strain on road networks in all countries. In this context, these countries are forced to invest more and more money in maintaining and improving their networks. This is also the case in the city of Cotonou in Benin.

In the Republic of Benin, the improvement of the living environment of the population is one of the strategic priorities of the government's development policy and action plan. This option aims to guarantee a healthy living environment for the population and to promote sustained infrastructure development, which will have a lasting impact on development levers. Thus, to promote economic growth, the mobility of people and goods in the country in general and in Cotonou in particular, the Beninese government intends to improve urban traffic through the construction of urban roads and the sanitation of the city through the rehabilitation and resurfacing of crossings and certain arteries in Cotonou.

Indeed, the crossings of the city of Cotonou represent an important link in the road network of the economic capital. Their rehabilitation and resurfacing will improve internal mobility and urban accessibility as well as regional integration. The implementation of the project will have a positive social impact, in the form of job creation during the construction period, and will also contribute to strengthening the vitality of the urban economy through the development of secondary activities.

Aware of the development challenges and in line with the vision of the Head of State, Patrice TALON, the Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT) has initiated this project called: "WORKS FOR THE DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF COTONOU (ATC)" for an attractive living environment. Cotonou, by virtue of its position and functions, benefits from many projects in progress or in view of its implementation, such as: "The Rainwater Sanitation Project of the City of Cotonou (PAPC)", the "Asphalting Project 1 & 2", the "Northern Bypass of Cotonou: CONOCO, etc.", which will undoubtedly strengthen the level of urbanization of this city.

This ATC project, in its active phase, will strengthen the fluidity on the main arteries in general and traffic in Cotonou in particular, that is to say that it will improve traffic conditions and offer the conditions for an efficient management of the mobility of goods and vehicles.



persons. It will create many new jobs, thus contributing to the reduction of poverty and underemployment.

Of course, these various activities will not be without consequences on the physical environment (destruction of trees, air pollution, etc.) and socio-economic (destruction of private property: private sanitation works, SONEB pipes, etc.; problems of accessibility to houses and diseases linked to the emission of dust, noise, etc.). They also pose acute environmental and social problems, including the disruption of some important ecological functions of ecosystems and the risks of occupational and traffic accidents.

These eventualities of the occurrence of these various problems require, in order to control these impacts and manage the environment as well as possible, to subject the activity to the provisions of Law No. 98-030 of 12 February 1999 on the Framework Law on the Environment in its provisions relating to environmental impact studies and reinforced by Decree No. 2017-332 of 6 July 2017 on the organization of environmental assessment procedures in the Republic of Benin. Indeed, in accordance with the provisions of Law No. 98-030 of 12 February 1999 on the Framework Law on the Environment in the Republic of Benin in its Title V, Article 88 which stipulates that: "No one may undertake developments, operations, installations, plans and programmes or the construction of structures without following the Environmental Impact Assessment (EIA) procedure, when the latter is required by laws and regulations...", the present project is therefore subject to an in-depth environmental and social impact study.

This Environmental and Social Impact Assessment (ESIA) report focuses on the following points:

- a description of the receiving environment and the environmental and social issues of the project;
- the presentation of the methodological approach for the assessment of the environmental and social impacts of the project;
- the presentation of the legal and institutional framework of the project;
- Analysis of project variants;
- the analysis of the environmental and social impacts of the project;
- the proposal of measures to mitigate negative impacts and improve positive ones;
- the presentation of the public consultations of the various direct and indirect actors of the project;
- the development of an Environmental and Social Management Plan (ESMP);
- the proposal of an environmental monitoring and follow-up programme.


1. CONTEXT AND RATIONALE FOR THE PROJECT

1.1. Context and justification of the project Road projects are generally initiated to promote balanced land use planning and to contribute to economic, touristic, administrative development, etc.). These types of projects are effective structural mechanisms for poverty reduction in Africa, and to a certain extent this requires the development of sustainable transport systems. Indeed, like other modes of transport, roads make it possible to open up geographical areas and ensure the free movement of people, goods and factors of production, in addition to revitalizing economies and facilitating access to basic socio-community infrastructure for local and other populations.

Since April 2006, the Beninese authorities have adopted strategic development guidelines for an emerging Benin during the period 2006 – 2011. These strategic guidelines constitute the strategic framework of reference with a view to providing all actors with the necessary benchmarks for action. Their overall objective is twofold: (i) to create and energize poles of growth and development and (ii) to significantly reduce poverty. In the same vein, he has developed, by the Government of the Republic of Benin since his accession to power for the 2016-2021 five-year term, a Government Action Program (PAG) reflecting the vision of the Head of State in all development sectors. The flagship actions to be carried out to ensure the harmonious development of Benin revolve around major road and infrastructure projects.

Indeed, the current reforms implemented by the Beninese State through the implementation of the PAG aim to achieve development objectives, with 47 infrastructure projects, the most concrete of which are mostly under implementation. However, the road to development thus traced passes through the development of the road, as we are often used to saying. As part of the important actions for the development of the road network, the government has initiated a new approach to project financing known as Public-Private Partnership (PPP).

As part of this new dynamic in terms of planning and balanced development, the Beninese government, through its many agencies, has initiated studies on urban mobility in Greater Nokoué, on the rainwater sanitation of Cotonou, on the establishment of private parking lots and pounds in the city of Cotonou, etc. Beyond road congestion, other problems related to mobility are emerging, including road safety, parking difficulties (currently limited to downtown Cotonou) and especially air pollution. According to the WHO, this last phenomenon is responsible for significant mortality in Greater Nokoué, due to the high concentration of pollutants emitted by transport, particularly in connection with the age of the vehicles used and the quality of the fuel used.

1.1.1. Context of development and road safety in Cotonou The speed at which large cities and the urban population are increasing is a general phenomenon in almost all underdeveloped countries. This fact is all the more important since it is the city that generally crystallizes the will to progress and that in reality prepares the process



development. If it is the reflection of the industrial, administrative or economic world by the importance of modern buildings and by the presence of so many signs of modern comfort, it also shows the poverty and the wounds of its region of influence, as much by the functions it exercises, as by its landscape, and even by the disorganization and inadequacy of its public services. Everywhere else, the services that the city offers to the region are intimately linked to its administrative and commercial function or role. In a city like Cotonou, such a duality of function is coupled with geographical solidarity in the location of its activities.

The powerful global dynamic of urbanization raises as many concerns, in terms of sustainable development for example, as hopes, in terms of emancipation and improved living conditions. While the challenges and problems are colossal, there can be no room for doom and gloom. A positive perspective, without being naïve, is even possible. Global urbanization, as terrifying as some of its dimensions may be, can be favorable to humanity. The same goes for the environment.

According to the journal consulted on May 28, 2022 quoting Éric Denis, the global dynamics of urbanization in 2008 signed, to a certain extent, a major change in the history of humanity. According to figures provided by the UN, the urban population has become the majority¹. One in two human beings, or about 3.3 billion people, are now estimated to actually live in cities. They were only one in ten at the beginning of the twentieth century. In a word, as in a hundred, homo sapiens becomes homo urbanus(²). Between 2008 and 2050, the world population is expected to increase from 6.7 to 9.2 billion people, according to the same sources. Over this period, the population of people living in cities is expected to increase from 3.3 billion to 6.4 billion. In 2050, in total, 70% of the world's inhabitants will be urban dwellers. Every day between now and 2050, the urban population could grow by around 200,000 inhabitants. Of course, this is only an image, extrapolated from commonly accepted demographic projections. It nevertheless gives a striking idea of the orders of magnitude that characterize the urbanization dynamics that affect the contemporary world. It is no longer the high rates of urban growth that are remarkable, but the absolute dimensions of the phenomenon.

Better still, the National Inter-State Roads take shape from Cotonou to reach the neighboring countries. The port or railway station in turn attracts the location of industries, warehouses, wholesale trade, the large Dantokka market, export and import houses, etc. to stay next to the bank and administrative and political services in general. The city of Cotonou became a pole of attraction and conurbation, creating around it, the "Greater Nokoué" which brought together the communes of Cotonou, Porto-Novo, Abomey-Calavi, Sèmè-Podji and Ouidah, the commuting movements that converged the populations of the surrounding communes towards Cotonou in the morning and back in the evening.

In addition, we know that the road network is an indicator of urban dynamics. This network is sometimes constrained by the dynamics of the population which is constantly growing. Through the

¹) The data was widely communicated. It is not of perfect quality, even if the collection and comparison systems are progressing. See Éric Denis, "Recent sources of urban land observation in developing countries. Towards harmonisation and transparency? ", Études foncières, n° 139, 2009, p. 33-36.

²) See Thierry Paquot, Homo urbanus, Le Félin, 1990.



mechanism of their formation, the main causes of the degradation have been identified, namely traffic, climate, quality of materials and implementation. When road maintenance is not carried out properly, the evolution of degradation is rapid and accentuated by traffic and water infiltration. The process of evolution of degradation is specific to each type of degradation³. In Cotonou, and despite the efforts of the government of the Rupture, the causes of the deterioration of the urban road network seem to verify the problem insofar as economic activities, displacement and migration are closely linked, which means that the development of its activities has repercussions on traffic, i.e. increases migration and justifies the flourishing number of means of transport observed on the arteries. Similarly, the failure of the rail sector had the greatest impact on traffic. This failure has led the population to put excessive pressure on the road and we are witnessing a shift in the flow of goods to the road, which has experienced a cyclical situation over the years. Therefore, and after the completion of the first phase of the asphalting project of the first five-year term of the current government, it is essential to support investment by maintaining the existing roads and especially the main arteries and crossings of Cotonou.

It is in this context that the Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT) has identified certain roads (Lot 1 and Lot 2) in the city of Cotonou, the country's economic capital, to develop and make the city attractive and traffic fluid for users.

1.1.2. Accident statistics in the city of Cotonou between 2011-2020 The forms of the Bulletin d'Analyse des Accidents Trouvés (BAAC) which include the variables to be filled in after a traffic accident report, filled in by the agents of the Republican Police whose one of the sovereign missions is to conduct the procedures for recording traffic accidents at the national level; the data collection sheets of the hospitals, the forms filled in after analysis of the registers of the emergency services of the reference hospitals sent to the National Road Safety Centre (CNSR) according to a procedure rigorously controlled by the CNSR services (forms collected by the CNSR) are checked and corrected before data entry. The data is entered and used using software programmed under Access; all these documents are used to provide information on accident statistics over the last ten years in Cotonou. The causes of accidents are determined from the circumstances, the condition of the premises, the sketch reference, etc. This work is reserved for the services of the CNSR. A list of causes exists in the BAAC-Benin software in three groups: human causes, causes related to rolling stock and causes related to the road environment.

³ https://biblionumeric.epac-

uac.org:9443/jspui/bitstream/123456789/1162/1/M%C3%A9moire%20%20LOKO%20Y.%20Bonaventure_comp ressed.pdf ; accessed on 25/05/2022



1.1.2.1. Overall statistics of accidents, severities and vehicles involved over the last 10 years in Cotonou From the data extract and based on statistics between 2011 and 2020 from the National Road Safety Centre (CNSR) in the city of Cotonou, the number of accidents is 2774 cases, including 680 cases of serious bodily injury and 76 fatalities per year. On average:

- road fatalities account for 3% of cases of bodily injury;
- 25% for serious injuries;
- and 38% for mild cases.

A downward trend is noted in the number of accident cases. Indeed, from 3235 cases in 2011, this number has fallen to 873 cases in 2020, certainly the result of numerous awareness sessions, the positive evolution of the quality of roads in Cotonou (implementation of various road development programs) and also the improvement of the car fleet in Benin. This decrease can also be observed in the number of fatalities, serious cases, and mild cases on the roads of Cotonou (Table 1).

Table 1: Overall statistics of accidents, vehicles involved, types of bodily injury during the years 2011 to 2020 Year Accidents Vehicles Killed Injured Slightly seriously injured 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 Average over the last ten years Percentage of fatalities, serious injuries and minor injuries

· · · · · · · · · · · · · · · · · · ·					
	3235	6487	98	852	1177
	3031	5990	78	905	1285
	3135	6085	91	885	1532
	3432	6634	100	976	1547
	3335	6467	86	907	1429
	3272	6338	77	739	1213
	3075	5976	68	563	896
	2317	4463	55	448	562
	2036	3846	62	343	598
	873	1680	40	185	253
	2774	5397	76	680	1049
			25%	38%	25%

Source: CNSR, 2022.







Figure 1: Evolution of accidents with the types of vehicles involved and types of personal injuries in Cotonou between 2011 and 2020 Spring : SIRAT-CECO-BTP June 2022, field work.



1.1.2.2. Representativeness of vehicles The representativeness of the vehicles involved in the various cases of accident in Cotonou is also an indicator in identifying the many causes.



Figure 2: Percentage (%) of vehicle types involved in crashes (2011-2020) Source: SIRAT/CECO-BTP June 2022, fieldwork.

The analysis of the table above tells us that on average 43% of accidents involve 2WD, 22% HGVs, 2% 3WD and 53% LCVs of all categories.

Other main findings, we have:
2WD vehicles are involved in almost one in 2 accidents;

- 3WD vehicles start by being involved in accidents;
- Passenger vehicles constitute the bulk of vehicles involved in accidents in the city of Cotonou;
- There is a downward trend in the involvement of 2WD vehicles in the event of accidents, except in 2020, with an increase of one point compared to the previous year (2019). It can be said that the introduction of traffic lanes and the compulsory wearing of helmets have given positive results;
- On the other hand, an increase in the involvement of light vehicles is noticeable. This trend demonstrates the lack of awareness among LCV drivers, which may be due to:
 - o At the age of the drivers,
 - o Increasing the number of vehicles,



- o Improving the quality of traffic on road infrastructure (roads without potholes, ruts, alopecia areata and others),
- o Drivers' perception of danger;
- the share of involvement of HGV vehicles in the event of accidents remains high. This demonstrates the need for development in the absence of traffic corridors, the delimitation of traffic routes.

1.1.2.3. Percentage of minor or serious bodily injuries, killed and material by type of conflict The conflicts generating the most fatalities in Cotonou are conflicts between light vehicles and 2WD vehicles (rate of 20% on average per year over the last ten years). However, the rates of the following conflicts are equally high:

- 2WD (RM) alone: 10%;
- HGV/2WD: 16%;
- Passenger cars/pedestrians: 17%;
- 2WD/Pedestrian: 10%.

Wheel Drive (RM), Light Vehicle (LCV), Light Vehicle (LCV), Light Vehicle Passenger Car (HGV) For other types of personal injury, LCV/2Wheel conflicts are by far the most representative.

It should be noted that these rates only take into account those killed on the spot in accidents. The current collection system does not allow for the inclusion of deaths in hospital or during the transfer of the wounded to hospitals.

Notwithstanding the obligation to wear helmets and the establishment of traffic corridors for 2-wheelers, the rates are still high; which testifies either to a non-compliance with these obligations, or to the ineffectiveness of these solutions. It is also noted that 2Wheeler users have a constant tendency to violate the two rules that require police forces to be constantly vigilant, preventing them from carrying out other tasks. The reasons given (the helmet ruffles the hair " especially in women ", the helmet prevents hearing " priority argument in motorcycle taxis ", the traffic corridors are in poor condition and/or laid out with cobblestones, etc.) are each as fallacious as the next, proof of ignorance and a lack of consideration for their own lives.

To reduce conflicts between light vehicles/pedestrians and 2R/pedestrians, the construction of pedestrian crossing corridors is necessary, especially at the level of socio-community infrastructures such as; stadiums, primary and secondary schools. The development of a 30 zone is also a solution unless the security measures put in place for their boundaries are really restrictive.

1.1.3. Climatic and environmental context of the living environment of Cotonou

Today, no country is immune to the effects of climate change. Benin is becoming more and more urbanized and nearly one in two Beninese now lives in urban areas. Mainly concentrated on the coast, urban growth is poorly controlled, often covering areas



environmental risk. Indeed, Benin's coastal cities are highly exposed to climate change, particularly through rising sea levels. These risks are a major obstacle to the sustainable development of exposed cities, for many populations living on flood-prone land and more generally for the country's economy. These cities must therefore be better prepared and planned for the effects of climate change. While the impacts of climatic events are caused by climate change, the poor occupation of the territory resulting from rapid and uncontrolled urbanization is also responsible for the aggravation of these effects on the habitat of populations.

Considered one of the most vulnerable countries to the adverse effects of climate change, Cotonou, like all of Benin in general, will have to build sustainable cities and infrastructure. Indeed, due to climate change, the quantity of water varies, and so does the heat weather. With the different climatic scenarios, a major change will take place, especially in the receptacle areas with the risk of flooding of the final natural receptacles in the south of Benin, such as Lake Nokoué and the lower Ouémé valley. Significant profound changes in the physical environments (natural resources and infrastructure and built structures) will take place. Thus, the entire existing road network in Cotonou could be exposed to vulnerability to climate change. There is a need for harmonization of all programmes, projects and works ("The Cotonou Rainwater Sanitation Project (PAPC)", the "Asphalting Project 1 & 2", the "Northern Cotonou Bypass: CONOCO, etc."), which is underway in Cotonou.

The Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT SA), aware of these issues (environmental, social and those related to climate change) on the physical and human environments, and in accordance with international and national regulations, has initiated this environmental and social impact study in order to identify and evaluate the impacts, "check list", of all the impacts and effects to be taken into account, in accordance with the environmental and social standards and environmental and social safeguard policies of the World Bank (and possibly other future financial partners) and to obtain the Certificate of Environmental Compliance (CEC), in accordance with the provisions of the general guide for carrying out ESIAs in the Republic of Benin.

According to the guidelines of the General Guide for the Conduct of ESIA in Benin (Appendix 1), the said project will be subject to an in-depth ESIA, because it crosses a coastal wetland, classified as an ecologically sensitive area and taking shape in an agglomeration with a high human density considered very sensitive. In compliance with Law No. 98-030 of 12 February 1999 on the Framework Law on the Environment in the Republic of Benin. In accordance with this law, in its Title V, Article 88, and with reference to the General Guide for Carrying Out EIAs in Benin (Annex 1, Title XIII.2. relating to the Rehabilitation of > 20m and 5km > Length of the General Guide to EIAs in Benin) and the requirements of Decree No. 2017-332 of 6 July 2017 on the organization of environmental assessment procedures in the Republic of Benin, This road infrastructure project is subject to an In-Depth Environmental and Social Impact Assessment. To meet administrative, environmental and



SIRAT SA wishes to obtain a Certificate of Environmental Compliance (CCE).

1.2. Project objectives

1.2.1. Overall objectives of the project The main objective of this project for SIRAT SA is to develop 16.125 km (Lot 1) of urban roads in order to improve traffic conditions and traffic flow in Cotonou while promoting time savings and the reduction of accidents and vehicle operating costs.

1.2.2. Specific objectives of the project Overall, therefore, this mission will make it possible to analyse the social and environmental impacts of the activities envisaged as part of the work and to propose measures to mitigate the negative impacts identified in order to verify the compliance of these activities with national environmental assessment regulations and the satisfaction of the environmental and social requirements of the financial partners, in terms of biodiversity protection and special attention to the affected populations. The implementation of this project will specifically make it possible to:

- Redevelop or rehabilitate certain arteries and roads in Cotonou;
- resurfacing the lanes by separating the traffic lanes of wide-body aircraft from those of simple vehicles;
- clear the right-of-way of cycle paths and rebuild them to international standards;
- carry out engineering and sanitation works;
- To provide public lighting for identified arteries and roads;
- put a suitable hedge of planes along each selected axis;
- to carry out measures to support vulnerable populations, directly from the people affected by the road project.

The present project will also allow the localities crossed by the project's area of influence to benefit from job creation opportunities for youth and assets for their socio-economic development, thus reducing poverty.

1.2.3. Specific objectives of the ESIA

Specifically, it was a question of (e):

- Describe the initial/baseline situation on the environmental and social level as well as the environmental and social issues of the project by highlighting the Valued Elements of the Environment (EVE) likely to be affected by the implementation of the project;
- Specify the main environmental, social and climate issues of the project;
- analyse the institutional and legal framework of the environmental, social and climate impact assessment of the project;
- assess and analyse the environmental, social and climate risks associated with the project;
- Present and analyze the variants of the project;



- organise the consultation of the various stakeholders concerned and those affected by the project, accompanied by minutes signed by all in order to establish coherence;
- Identify the positive and negative impacts of the project activities on the natural and human environment in the area of influence;
- analyze and evaluate the impacts and then propose mitigation/avoidance and/or compensation measures for negative impacts and measures to strengthen/enhance the positive impacts;
- propose an Environmental and Social Management Plan (ESMP) accompanied by an assessment of the costs of implementing the proposed measures;
- develop the environmental monitoring and follow-up programme by indicating the different actors and their roles;
- Develop a Resettlement Action Plan (RAP) for Project-Affected Persons (PAPs) who must be compensated within the framework of the project.

1.3. General information about the project

1.3.1. Exact title of the study In-depth Environmental and Social Impact Assessment (ESIA) of the works "Development of the Access Roads and Crossings of Cotonou (ATC): Lot 1".

1.3.2. Type of EIA required With reference to the General Guide to EIAs in Benin, this project is subject to an In-Depth Environmental and Social Impact Assessment.

1.3.3. Type of the Project Infrastructure Construction Projects Title XIII.2. relating to the Rehabilitation of roads, a 20m > and a length > 5 km of the General Guide to EIAs in Benin.

1.4. Project leader

1.4.1. Main Parties

Since coming to power, the Government of the Republic of Benin has developed a Government Action Programme (PAG) reflecting the vision of the Head of State in all development sectors. The flagship actions to be carried out to ensure the harmonious development of Benin revolve around major road and infrastructure projects.

The list of parties involved in the Project is presented in Table 2.

Table 2: Parties involved in the Project

ENTITY	ROLE RESPONSIBILITIES
Republic of Benin	In charge, with the Donors, of the Project Loan Project Management Agreement on behalf of the Beninese Government.
SIRAT SA: Société des Infrastructures Routières et de l'Aménagement du Territoire	Within the framework of this project, it is responsible for carrying out or participating in the delegated mobilization of appropriate financing for the construction of road infrastructure falling within the scope of its corporate purpose.

Beninese Environment Agency (EBA)	Review and validation of the Environmental & Social (E&S) Regulator documentation of the Project. Issuance of certificates and other environmental issues.		
Control, Studies and Coordination of Building and Public Works (CECO BTP)	Consulting engineering firm specialized in Civil engineering, particularly in the fields of technical design of transport infrastructure and hydraulic projects		
Landlords ⁴ To be specified	Provision of the necessary funds for the Project to the Beninese State through the Ministry of Living Environment and Sustainable Development (MCVDD).		
Entrepreneur	Finalization of the preliminary project. Acquisition To be specified of the components of the Project. Construction of the Project (NB: will not act as Operator).		

Spring : CECO-BTP, June 2022

1.4.2. Project Owner / Coordination and Execution Bodies The institutional set-up provides for the execution of this project under the project management provided by the Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT). SIRAT SA will manage and monitor the project's infrastructure. Their main roles are the supervision of activities, the control and monitoring of performance, of the project managers and the contracting companies.

COMPANY NAME	SOCIÉTÉ DES INFRASTRUCTURES ROUTIERES ET DE L'AMÉNAGEMENT DU TERRITOIRE (SIRAT SA)		
Address	SIRAT annex building; Square 396 Ahwanlèko West Beach, 2nd Villa, Ground Floor, Conference Room		
Email	<u>oaboumon@sirat.</u> bj		
Telephone Form	+229 21300500		
of company	Public limited company		
Managing Director	Serge AHOUANDOGBO		
Company Overview	Created by Decree No. 2018 - 133 of April 18, 2018, the Benin Road Infrastructure Company (SIRB SA) is a public limited company administered by a Board of Directors. It became the Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT SA) following the major decisions of the Council of Ministers on November 24, 2021, approving the amended articles of association and increasing the capital of the Société des Infrastructures Routières du Bénin which became the "Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT) S.A" by absorption of the Agence du Cadre de Vie pour le Développement du Territoire as well as the appointment of the members of Board of Directors of the new Company. Under the terms of its statutes, its missions are:		

⁴ At the time of writing this ESIA report, the Donors had not yet been identified.

 to manage, develop and maintain all road infrastructure except rural roads, toll-free roads and all other road infrastructures expressly excluded from its management; to carry out or participate in the mobilisation of appropriate financing for the construction of road infrastructure falling within the scope of its corporate purpose; to operate or have used tolls and ancillary services and to organise the securing of resources resulting from the operation of the road network; the direct or indirect participation of the company in any industrial, commercial or financial, movable or immovable activities or operations, in any form whatsoever, provided that these activities or operations may be directly or indirectly related to the corporate purpose or to any similar, related or complementary objects; and more generally all economic operations falling within the company's purpose or likely to promote its development.

Table 3 presents the experts who contributed to the preparation of this report.

COMPANY NAME	CECO BTP Consulting Engineers		
Address	04 BP 1165 Cotonou Benin Lot		
Head Office	C/2118 Parcel G Mènontin		
Email	cecobtp@cecobtp.com/cecobtp@leland.bj		
Telephone Fax	+229 21 38 36 52 +229 21 38 09 24 Limited Liability Company (SARL)		
Form and Share Capital	100,000,000 FCFA		
Commercial register	07 B 535 (Old No.: 15866-B)		
Area of expertise	 Project management; Study Control and Coordination of Building and Public Works Works; Technical studies and preparation of tender documents; Project management; Control and supervision of the works. 		
Objectives Methodologies and Human Resources	CECO BTP's objective is first and foremost total customer satisfaction. To this end, it offers its customers a wide range of services and solutions that combine economy and efficiency in the fields of engineering and project management. A unique methodology is developed for each project in strict compliance with the requirements of the client (natural or legal person) in order to provide a satisfactory result. It is a company made up of design and application engineers, qualified projectors and civil engineering technicians, surveyors, draftsmen and other executives		

1.5. Presentation of the Proxy Consultant



	administrative process to meet the needs of the various development actors.	
	 Asphalting work in coconut trees; Asphalting work (Presidential Villas-Montaigne axis); 	
Expertise	 Asphalting works Axis Ministry of the Interior-Cabinet of Digital Economy; Asphalting works on the MAEP-Direction de la Poste axis; Landscaping of cobblestone streets, etc. 	

FUNCTION	NAME	PROFILE
Environmental Assessment Expert Senior Consultant	Camille Prudence AGBO	Specialist in Environmental Assessment with more than 20 years of practice. Coordinator of various studies and implementation of the Resettlement and Compensation Action Plan (RAP/PARCP). Expert in Sui- Evaluation of Programs and Projects.
		Tel: (00229) 95 85 20 57 / 97 53 67 17; E-mail: <u>pc_agbo@yahoo.fr / agboprudence80@gmail</u> .com
Associate Environmental Assessment Manager	DEGBO Mahussi .E. Hermine	Engineer in Environmental Geoscience and Sustainable Development Specialist in Environmental Assessment, Specialist in Quality-Health-Safety-Environment (Q-HSE) Tel: (00229) 95 43 43 99 / 96 27 54 71; E-mail: hermine_el@yahoo.fr Senior Lecturer at CAMES (Ornithology/Zoogeography) PhD in Biology of
Environment and Biodiversity Expert: Wildlife	Prof. Toussaint LOUGBEGNON	Organisms, Ecology and Evolution Unique Doctorate in Environmental Management and Spatial Planning. School of Tropical Forestry (EForT), National University of Agriculture of Porto-Novo (UNAP) Republic of Benin. Tel: (00229) 95564465/67177538, Email: tlougbe@yahoo.fr
Expert in Environment and Biodiversity: Flora	Dr. Laurent HOUESSOU	Assistant Professor of Applied Ecology (CAMES), Unique Doctorate in Agronomic Sciences, Teacher-Researcher at the Faculty of Agronomy, University of Parakou (Benin) Head of the Research Unit in Biomonitoring and Conservation of Protected Areas and Wildlife (UR-BICAF) at the Laboratory of Ecology, Botany and Plant Biology () of the University of Parakou. Tel: 00229 96485593 / 95604141, Email: houessoulaurent@gmail.com
Expert Climatologist	Prof Ibouraima YABI	Lecturer at the Universities of CAMES (Applied Physical Geography/Climatology. Unique PhD in Geography and Environmental Management, specialty: climatology and agrarian systems. Teacher-researcher at the Department of Geography of the University of Abomey-Calavi, Republic of Benin.



		Tel: +22997476828; Email: yafid2@yahoo.fr / ibouayabi@gmail.com / <u>ibouraima.yabi@flash.uac.</u> bj
GHG & Climate Change Managers	Dr. Gervais ATCHADE	
Expert in Socio-Anthropology & PAR	Dr. Nicolas AKOTCHAYE	Doctor in Sociology-Anthropology of Development, specialist in population issues and urban dynamics, expert in social protection Tel (00229 6637 6082/ 95586547 Email: nakotchaye@yahoo.fr
Assistant to the Socio/PAR Expert	BABALAO	
Cartographer / GIS Experts Dr	Dr. Emile EDEA	Lecturer-Researcher: Part-time lecturer at the Department of Geography and Spatial Planning (DGAT), at the Institute of Geography of Spatial Planning and Environment (IGAT) of the University of Abomey-Calavi and at the Catholic University of West Africa (UCAO). Single PhD in Geography and Environmental Management: Specialty – Cartography and Remote Sensing) and Master of Science (M.Sc.) in Geomatics and Remote Sensing Applied to Regional Planning and Spatial Analysis. Tel. 96 21 35 61 / 95 34 79 63. Email. edeaemile72@gmail.com



2. PRESENTATION OF THE PROJECT AND ITS OPTIONS

2.1. Presentation Project Summary

The project for the development of access roads and crossings of Cotonou (ATC) initiated by SIRAT SA aims to improve traffic flow and traffic conditions for road users and concerns two (02) lots, lot 1 of which is the subject of this report. It serves seven (07) axes which represent for the most part functional or downgraded sections of the RNIE 1 "Hillacondji – Cotonou – Porto/Novo – Akpro-Missrété – Zian – Igolo". With a total length of 16.125 km with a set of streets located in the eastern sectors of the city of Cotonou, this lot takes into account several city districts spread across various districts (Table 4):

Table 4: Presentation of the axes by arrondissements and districts concerned by Lot 1 of the ATC project

Designation of Linear Axes (KM) Arrondissements Districts Donaten; Finagnon; Old bridge-crossroads 1st Arrondissement Tokplégbé SOBEBRA- Carrefour OPT 6.725					
PK3-Carrefour le Bélier 4th	Akpakpa Do	domè; Fifadji			
		Houto District			
		3rd Kpankpan Dis	strict; Gbénonkpo		
Third bridge-crossroads 2.4 Arrondissement Centre; So	4 Dédokpo; odjèatinmè \	Misséssin; SOBEBR Vest; Sodjèatinmè E	RA ^{4th} Gbèdjèwin; Sodjèatinmè st		
Place du souvenir-Carrefour 3 Guinkomey Arrondissement 2.5 banks 12th Les C					
Anouanieko New Bridge Dist	nct, milongo	JU,			
5th Gbédokpo; Bocossi Tokı Jonquet; Carrefour NASSOI	oa, Carrefou JBA- 1,9 To	ır Marché St Michel- kpa Hoho Echange∟	Missèbo District; Avlékété ır Steinmetz- 6 ^{ème}		
Carrefour Notre Dame Ar	rondisseme	nt Dantokpa			
		7 District	Sèdjro Saint Michel		
Carrefour 3 banks-Carrefour Air Afrique	1,1	5 District	Xwlacodji Kpodji; Guinkomey		
Carrefour Air Afrique-Ancien pont	0,5	5 District	Xwlacodji Kpodji		
Railway Junction-Steinmetz Overpass	1,0	5 District	Guinkomey; Tokpa Hoho		
Total		16,1	125		

Source: Processed data from ODA, CECO-BTP June 2022



The implementation of this development project through the resurfacing/strengthening/rehabilitation activities of the roads and crossings of Cotonou will make it possible to improve the traffic conditions in terms of urban mobility of people and goods on these axes of the city of Cotonou and their surroundings, and this will be done from façade to façade.

Figure 3 shows the project area and arteries affected by Lot 1 of the ATC project.







Figure 3: Summary plan of the different arteries taken into account by Lot 1 of the ATC project Source: CECO-BTP, June 2022

CECO CONSTRUCTION/SIRAT



In addition, taking into account the main objectives of all road developments, in combination with the parameters for the implementation of an urban road (legibility, visibility, conflict of use and road development), is therefore essential for an overall description of the streets to be developed.

2.2. Overall inventory of the streets of the ATC project of the lot:1 Table 5 presents the general summary of the observations made on the seven (07) axes in a global way. As for the specific presentation of each of its axes, it is more fully detailed in the chapter devoted to the description of the project's receiving environment.



Table 5:	Summary table of the general observations made for all seve	en (07) axes co	onstituting the lot 1	_ATC
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- Absence and/or inadequacy of police and directional signs (speed limit signs, no parking and no stopping, school signs, no manoeuvring signs)	Aspects analysed	Observations made	Illustrations		
Vertical signage Non-replacement of signs damaged by road traffic accidents or acts of vandalism Road signs stormed by the population for advertising or election campaign boards Improper placement of some traffic signs in the middle of narrow PWCs Photo 1: Damaged and vandalized sign Construction Photo 2: Wiregap Bangh, Erased Panel Background located on the TPC 	Vertical signage	 Absence and/or inadequacy of police and directional signs (speed limit signs, no parking and no stopping, school signs, no manoeuvring signs) Non-replacement of signs damaged by road traffic accidents or acts of vandalism Road signs stormed by the population for advertising or election campaign boards Improper placement of some traffic signs in the middle of narrow PWCs 	<image/> <image/> <image/> <image/> <image/> <image/>		



DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF, CO,TONOU (ATC) ENVIRONMENTALI AND SOCIALI IMPACT ASSESSMENTI (ESIA) LOT N° ATC- 01

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Horizontal Signage	 Non-visibility/overall erasure of horizontal signage dating from the years of construction or rehabilitation of its tracks Failure of the property of the paints used for the floor marking from the inspection carried out 	Photo 4: Marking of the pedestrian crossing in front of the institute IRGIG AFRICA
Risks related to sanitation works	 Although as a whole, the sanitation works are doing well and continue to perform their primary function, that of keeping the roads out of water, and/or the transit of rainwater; the latter have some defects, potential sources of insecurity for users during inspections; These are: openings in the gutters due to missing slabs; openings in buried gutters caused by the theft of buffers and other ferrous devices; failure to repair or replace the closing slabs of damaged gutters Geotechnical inspection visits, various existing deterioration 	Photo 5: Opening in the gutters
Road Hazards	 increasing the risk of road safety for users have been counted, such as: potholes, alopecia areata, cracks, ruts and earthenware, Deformations, holes and poor pavement arrangements that pose risks to pedestrians who can fall heavily and worse on the roadway Deterioration of the alleys, their condition is the main argument for changing lanes operated by 2WD drivers. Subsidence of the road due to network relocation work causing risks related to the safety of users. 	



1	$\Box C$)T	N	۰,	A٦	LC:	- 0	1

	 Presence of openings in gutters, holes in sidewalks, which are thus sources of insecurity for pedestrians 	
	- Pedestrians are hit for the most part, when crossing the road at an intersection and especially in a section of the road.	
	 Disappearance, non-use, and/or lack of awareness of 	
	the importance of pedestrian crossing markings, by most road users.	Photo 6: Students and other pedestrians crossing the lane in an area without a pedestrian crossing
	 Non-existence, non-development of lanes reserved for pedestrian passage, and or occupation of these lanes for other uses (parked vehicles due to the absence of parking lots, billboards, informal activity, etc.). 	
Pedestrian safety	 Presence of billboards and alignment trees located on narrow sidewalks, thus obstructing the free movement of pedestrians; 	
	 absence of the slabs closing the gutters, damaged or not closed after the cleaning operations; 	Photo 7: Occupation of the sidewalk by billboards
	 Non-existence of a pedestrian bridge on any of the axes contained in lot 1 of the present project; 	
	- Poor lighting and/or no lighting of certain axes	
	- Lack of public lighting on certain roads of lot 1	
		Photo 9: Hole in the Pavement Slab/ risk of removal/ risk of bodily injury to pedestrians

Spring : ODA data, CECO-BTP June 2022



2.3. Improvements to be carried out With regard to the intended functions for the roads on the one hand and the geotechnical and topographical studies, followed by the road safety study carried out on the other hand, the developments to be carried out will consist of:

- the rehabilitation of arteries from façade to façade;
- the installation or redevelopment of local traffic to set up parking areas for certain arteries;
- the development of footbridges to facilitate pedestrian passage in certain areas;
- the installation of speed bumps and road signs for the declaration of the 30 zone;
- the installation or renewal of existing separation systems from the railway track;
- the development of parking areas;
- the installation of public lighting equipment;
- the rehabilitation of the sanitation structures on each axis following the existing route;
- the installation of signage (vertical and horizontal);
- the implementation of the TPC landscaping;
- etc.

As for the intersections on the planned axes, some will undergo modifications since they are the ones that determine the flow capacity. We will therefore have to:

- make corrections of oversized rings by reducing widths and eliminating storage lanes;
- > implement directional islands at the level of single carriageway branches in accordance with standards and within the limits of the available rights-of-way;
- > implement central islands at the level of the large ordinary flat intersections;
- > make drawdowns of the BAU before entering the crossroads;
- reduce the cases where the BAU is used as a cycle lane, the entry and exit lane of this cycle lane by inserting an island for pedestrian refuge.

To achieve this, the following work will be carried out:

- site installation;
- development of the identified bypasses;
- clearing of rights-of-way (specific case of runways);
- reprofiling and resizing of the tracks in accordance with the selected optional model;
- earthworks and paving of the various components of the arteries (roads,
- sidewalks; TPC, pedestrian crossings etc.) ;
- redevelopment of sanitation structures for better regulation of their functions;
- installation of signage (installation of vertical traffic signs and drawing of horizontal signs) and road safety (installation of street lamps or electricity poles for public lighting, harmonization of traffic lights);



- carrying out the related works and environmental measures to be taken into account in the context of the project;
- dismantling.

2.4.Definition of the project's area of influence The project's area of influence shall be determined in such a way as to facilitate the consideration of all perceptible elements of the biophysical, human and socio-economic environment that may be affected directly or indirectly by the development of the access roads and crossings of Cotonou in this project. These are indeed areas with a well-distributed distribution scale, where all the positive and negative impacts of the ATC project will be felt. To do this, it can be broken down into three zones:

• A restricted zone: it is reduced to the 16.125 km to be developed, the right-of-way of these roads, the agglomerations that border them as well as the areas where the project sites are installed. This is the area of direct impacts on the biophysical environment (in terms of natural resources and elements of the climate that could be disturbed) and the human environment characterized by all the populations of the seven (07) districts crossed by the project for lot 1 and their neighborhood.

• An extended zone: It extends to all the localities crossed by the RNIE 1 which includes most of the streets of the lot under study and its related roads in all the municipalities of Cotonou, Abomey Calavi and Porto-Novo which will be positively impacted by the implementation of this project.

• A regional zone: cumulatively with all the road and sanitation projects that have been and are underway in the major cities of Benin, this zone takes into account the whole of Greater Nokoué in particular and the entire country which is in the process of metamorphosis. The image will be a territory with an attractive living environment, well sanitized, a compliant road network and ensuring the free movement of goods and people.

The development of these major arteries will include a series of activities that will be carried out in both limited and broad scope. Its implementation contributes to road safety in Cotonou, to the change in the socio-economic and environmental situation of the host environment. Indeed, it will not only breathe new positive life into the local economy of the localities concerned, but will also allow for a healthier occupation of young people and the working population in general, as desired by the elders, notables and local authorities of each district taken into account by lot 1 of the project. Thus, this project would reduce the risk of road accidents on these arteries to a high percentage and its implementation will expose the population to significant safety risks to which measures must be proposed.

2.5. Analysis of Project Options

2.5.1. Current situation of the project area

The axes of lot 1 of the ATC project to be developed belong to a highly urbanized area with the presence of many state, private and semi-public services. Indeed, it is noted that



presence of several official buildings: banks, administration, hospitals, schools, general trade, services, sports facilities, public markets, business center. In addition to these public and private infrastructures directly adjacent to the tracks, it is also necessary to take into account the so-called second-line economic and commercial activities whose accessibility passes through the planned axes.

The biophysical features marking the project area and specifically the sites to be developed are presented in Table 6 below.

Table 6: Some character-defining elements of the project site



DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF COTONOU (ATC) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) LOT N° ATC- 01



Socio-cultural services provided by the trees in the project area (repo and pavement sites on the Old Bridge axis – relaxation for the population). SOBREBRA Junction



Source: Field data, CECO-BTP June 2022

2.5.2. "No project" and "with project" options

The "no project" or "with project" option consists of evaluating the positive and negative changes likely to occur following the implementation or not of the project with regard to the biophysical and socioeconomic specificities of the host environment. Table 7 shows the comparative advantage of its options and those that are best for the country's development.

Table 7. Evaluation of	+60	"No Droigoto"	and "\Alith	Droigot"	Ontiona and	Chaina	sf tha (Cost Effortive	Ontion
Table 7. Evaluation of	me	INO PIOIECIS	and with	Project	Oblions and	Choice c	л ше с	Jost-Enective	ODIION.
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CRITERIA	OPTIONS			
	Without a project	With Project		
	The non-disruption of traffic	The existence of a road network that approximately a standarday		
^	on the roads during the	complies with standards;		
A	development,	 the improvement of the level of safety of the notional road network for all 		
V		users in general and in particular for		
Has		the most vulnerable users (pedestrians, cyclists and motorcyclists).		



T HasroadCodeGESIncrease in the level of degradation (potholes, alopecia in the pavement of the arteries concerned, Maintaining existing local traffic in poor condition and/or paved areas; increased risk of road accidents related to anarchic parking of vehicles on the rate of road accidents on the arteries concerned by the project degradation observed; liegbibility or erasure of the horizontal SIncrease in the level of degradation (potholes, alopecia in the pavement of the arteries concerned; Maintaining existing local traffic in poor condition and/or paved areas; increased risk of road accidents related to anarchic parking of vehicles on the rate of road accidents on the arteries concerned by the project due to the project axes and is signage on the project axes and is signage on the project axes and the rate of road accidents related to maintenance of the defective state of the police road signs; Keeping the guitters open due to missing slabs; Surge in subsidence observed at the level of the roads related to the relocation of networks; Presence of holes in the sidewalks, which are sources of insecurity for pedestrians; Exposure of users to the various risks of road accidents due to the poor passability of the roads and corsensing of Colonou would risk compromising the road safety and prevention policy and the development of the access roads and crossings of Colonou would risk compromising the road safety and prevention policy and the constines to be productive, enjoy a qualityCCSafety and prevention policy and theCSafety and prevention policy and theCSafety and prevention policy and theCSafety and preve	Ν		• ensuring a sustainable reduction in
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DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF, CO,TONOU (ATC) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) LOT N° ATC- 01

M E N T A I R E S	 mobility in Cotonou, which is a city located at the confluence particularly with the inter-state road axis RNIE 1. Thus, the absence of this project would constitute an obstacle to the actions to be implemented by the Beninese Government for the development of efficient and modern road infrastructure in order to support economic growth and social well-being. It should be concluded that the "No Project" option with the maintenance of the status quo is not conceivable in the context of a prosperous and revealed Benin. 	improving the productivity, quality of life and efficiency of its population. As a result, the Government of Benin would benefit from implementing this road project because it would not only promote the development of road safety and mobility in Cotonou but also make it possible to take better advantage of the geographical position that Benin occupies with its neighboring countries, particularly Nigeria. Also, by submitting this project to this environmental assessment, SIRAT SA seeks a better integration of the environment in the project for the assurance of a sustainable project. This choice is an advantageous alternative for both the Commune of
Option Chosen	The cost-effective option for the harmoniou implementation of this project for the deve (ATC)	s development of the country is the implementation of elopment of access roads and crossings of Cotonou

Source: CECO-BTP, field data, June 2022.



3. METHODOLOGICAL APPROACH

The Environmental and Social Impact Assessment is a process that aims to identify the likely impacts of a project's activities on the physical and human environment, as well as on human health and well-being or their interactions.

As a result, the methodological approach was carried out following a participatory process that helps to determine the relative importance of the impacts in a specific approach in order to reveal the impacts, their importance and to propose corrective measures. It involves the effective involvement of the various actors (the affected populations, the company, the State and its decentralized or decentralized structures, local authorities, etc.) as well as the local population.

The mobilization of materials and the adoption of appropriate methods made it possible to undertake various actions within the framework of the project for the collection, processing and analysis of data for the purpose of preparing the report.

3.1. Methodological approach to carrying out the study The

methodological approach was based on three axes. These are:

- (i) the general approach to the conduct of any scientific study;
- (ii) the specific approach to environmental and social analysis and;
- (iii) the project risk analysis approach.

These different approaches are described in Figure 4.



DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF, CO, TONOU (ATC) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

LOT N° ATC- 01



Spring: CECO-BTP, June 2022



The various investigations consisted of analysing the theoretical reference models currently used in the implementation of environmental and social impact assessments and identifying guiding principles applicable in the context of this study.

3.2. Different approaches to carrying out the study

- 3.2.1. General approach
 - 3.2.1.1. Framing

The scoping phase allows us to better understand the project and its activities and to determine, together with certain key players, the main orientations to be given to the study. In this sense, it involves various meetings on the one hand between the firm and the sponsor of the study, and on the other hand with the regulatory and review bodies of the environmental aspects induced by the projects in Benin.

The meeting with the study sponsor aims to gain a better understanding of the project and the objectives of the mission. Beyond a simple project title, the consultant was able to identify the activities as well as the degree of commitment of the promoter to the respect of the environmental standards in force. This step allowed the consultant to collect technical data from the proponent and to assess the compliance or otherwise of the various sites.

As the Environmental Impact Assessment is above all a scientific study, the approach to conducting any scientific study is the one that was first adopted. It consisted of conducting the documentary research related to the project before starting the data collection phase. The information collected at the site has been processed, analysed and the results and observations have been recorded in this study report.

3.2.1.2. Development of the terms of reference (ToR) In order to comply with the spirit of the texts and the requirements of Law No. 98-030 of 12 February 1998 on the Framework Law on the Environment in the Republic of Benin and then those of Decree No. 2017-332 of 6 July 2017 on the organization of environmental assessment procedures in the Republic of Benin, the Terms of Reference (ToR) have been developed. It is a question of starting from the ToRs globally and summarily elaborated by SIRAT for the drafting of the ToRs in the specific framework of this study which in reality, requires the movement of goods and services, hence the development of the Resettlement Action Plan (RAP).

Then, clarification and validation sessions of the ToR at the level of the associate experts of the CECO-BTP firm made it possible to ensure the proper understanding of the mission by all the associated experts/consultants. The main methodological orientations of the conduct of this study were the next step in this phase and made it possible to develop appropriate tools for a judicious collection of data (questionnaires, interview guides, observation grids, census sheets of fauna and flora as well as the characterization of the various habitats of these faunal groups, etc.) and the development of the mission's implementation programme. A list of the technical documents essential for the proper conduct of the study was drawn up and sent to SIRAT SA.



3.2.1.3. Documentary research Documentary research is the transversal, continuous and iterative method that preceded the fieldwork and continued throughout the duration of the study. It made it possible to understand the international and national context of quarrying, to know the national policies and strategies for the construction of major road infrastructures and to characterize the study environment (climatic, pedological, geological, hydrological, floristic, faunal, socio-economic, health, cultural characteristics, etc.). The desk research began in the firm's library through consultation of the EBA's environmental assessment framework, some general works, dissertations, theses, project documents and scientific articles. Other sources of information collection are:

- Ministry of Infrastructure and Transport (MIT);
- The Department of Land Transport (DTT);
- The Directorate General of Infrastructure (DGI);
- The Road Fund Directorate;
- The National Road Safety Centre (CNSR);
- the National Water Company of Benin (SONEB);
- the Ministry of Living Environment and Sustainable Development (MCVDD);
- the Departmental Directorate of Living Environment and Sustainable Development (DDCVDD) Atlantic/Littoral;
- the Beninese Environment Agency (EBA);
- the City of Cotonou;
- the National Land Transport Agency (ANaTT);
- the Republican Police;
- the Fire Brigade;
- Non-Governmental Organizations working in the field of road safety;
- the Arrondissements taken into account by Lot 1 of the ATC project;
- Documentation Centre of AID Group Sarl;
- Documentation Centre of the CECO BTP Sarl firm;
- Internet.

The analysis of the framework for the implementation of the study (policy, institutional, legal, legislative and regulatory, normative, etc.) also required data collection and a literature review.

3.2.1.4. Field data collection Several field visits were carried out in order to observe the study environment and its surroundings, to verify and compare the information provided by the document review, to identify the valued elements of the environment specific to the project site and to involve the grassroots stakeholders in this evaluation process.

A total of three (3) site visits were conducted as part of this study apart from the reconnaissance visit to the project sites:



a) the first visit was that of identification and characterization of the site: held on May 24, 2022, it was a question of visiting and characterizing the potential arteries taken into account by the ATC project. It consisted of direct observations of the roads, data verifications, characterization of the biophysical environment of the roads and their surroundings, the realization of tracking and GPS coordinates, measurements and contacts for the preparation of the public consultation (interviews with local populations and authorities). The floristic surveys were carried out to report on the observations made.

(b) The second was that of public consultation. It consisted of interviews with the actors concerned by the road development works taken into account by lot 1 of the ATC project, in particular local authorities, resource persons or institutional actors, elders, young people at the level of Districts 1, 2, 3, 4, 5, 6, 7, 12 of the Municipality of Cotonou. It allowed for a judicious sharing of information and the collection of opinions on the project.

c) the third was that of the characterization of the biophysical environment of the site and its surroundings. It made it possible to define the type of relief, the type of soil and the land cover units marking the site and its surroundings. Floristic and faunal inventories of the species encountered on the site and in the project area were carried out. As for the floristic inventory of each site, it was carried out in two stages (i) the prospecting phase of the roads concerned during the first field visit, which made it possible to briefly understand the relevant components of the receiving environment (soil, water, plant and animal species, landscape and human communities) and the collection of the floristic data themselves. This phase made it possible to prospect the roads which took place in two sub-stages, namely:

- direct interviews with residents close to the project area, in particular the population whose arteries are affected by lot 1 of the project cross their neighbourhood or borough and the resource persons.
- The inventory of plant species contained in the project area was made according to a methodology of investigation of the natural environment.

3.2.1.5. Processing of the data collected and the drafting of the report

The processing of the data collected was done through:

- the analysis of the results obtained during the fieldwork, coupled with the data from the literature review and technical documents;
- Map analysis for better visualization and spatialization of information and results.

• Processing and analysis of physical and biological data Several types of data were used in the context of the environmental impact assessment of the Cotonou Access and Crossings (ATC) access and crossings development project. These include:



- data on the natural environment;
- climatological data;
- socio-economic data;
- Map data.

In short, the scientific approach can be summed up:

- making contact with the various departments of the administration, CECO-BTP etc;
- the development of terms of reference;
- the framing of the mission;
- document review;
- the collection of data in the field and the taking of measurements (geographical coordinates, photographs of the elements of the site);
- the processing and analysis of the data collected;
- the drafting of the various reports.

• Collection, processing and analysis of geophysical/GIS data One of the main methodological activities carried out was desk research. This activity made it possible to consult the grey literature (reports, communications) available at the level of the specialized agencies and on the websites. Similarly, data and information from the scientific literature (articles, theses, etc.) are used. This documentation activity made it possible to synthesize the geological, geomorphological, hydrographic and pedological contexts of the receiving environment that is the city of Cotonou.

As for the analysis of climatic characteristics, it required the collection and processing of data. Thus, to analyze the current climatic conditions, rainfall, temperature, and wind data from the Cotonou synoptic station for the period from 1951 to 2020 are collected. These data were obtained from the National Directorate of Meteorology (Météo-Bénin).

Regarding the future climatic context, projected rainfall (Horizon 2055) and temperature (Horizon 2080) data are used. They are derived from the outputs of the climate models of the CORDEX (Coordinated Regional Climate Downscaling Experiment) program that were used. These are high-resolution data provided in the form of grids of 0.44° * 0.44°, which is close to 50 km * 50 (Giorgi et al., 2009). A future aspect where simulations are carried out according to both RCP 4.5 and 8.5. In addition to data from model outputs, empirical judgment based on temporal analogy (analogous scenario) is used. It allowed the wet analogue scenario (HAS) to be considered to describe future rainfall contexts by considering historical data.

The interannual variability of annual rainfall is analysed from the distribution of surplus (wet) and deficit (dry) years, defined in relation to the Lamb index (the deviation from the mean



normalised by the standard deviation) which is expressed by the equation below:

IP = (Pi-P)/ Where: represents the annual mean total obtained per station for year i, P and represents, respectively, the mean and standard deviation of the series in question. Thus, a year will be considered normal if its index is between -0.1 and +0.1. It will be said to be wet if its index is greater than 0.1 and dry below -0.1.

 Analysis of current climate trends The implementation of rainfall and thermometric trends was done using the regression method. It consists of an affine regression line graph that shows the linear evolution and allows the trend to be detected. The equation of the trend line is in the form: Y = ax + b; where y represents the parameters considered, and t the time, a and b being constants, such as: a = (i)(i)(i)(i); b = i(i)(i)(i)(i)

- If at > 0, we have an upward trend;

- If at < 0, we have a downward trend.

Similarly, the moving average technique was used. It consists of smoothing out irregularities by associating the yti values of a chronicle with new zti values which are the arithmetic averages of an original yti value and the values that frame it. Moving averages may be calculated at a variable frequency of five (5) years or ten (5) years. In this study, the five (5) year smoothed moving average is chosen for rainfall and the ten (10) year smoothed average for temperatures.

In addition, the approach of Pettiit (1979) has been used to better assess current climate trends. It is a non-parametric test that detects "breaks" in thermometric rainfall series. This test has often been used for the study of hydrometeorological variables in Africa and in the Beninese context. The absence of a break in the series (Xi) of size N constitutes the null hypothesis. The implementation of the test assumes that for any time t between 1 and N, the time series (Xi) i=1 to t and t+1 to N belong to the same population. The variable to be tested is the absolute maximum of the variable Ut, N defined by

with
$$gn_{sgn}$$
 Z 1 Z 0; 0 if Z 0 and -1 if Z 0. Let KN be the variable defined by the maximum in absolute value of U

to N-

1. If K denotes the value of KN taken from the series studied, under the null hypothesis, the probability of exceeding the value K is given approximately by:

Dii

Prob
$$\mathbf{K}$$
 \mathbf{K} 2 exp 6 $\mathbf{K}^{2/}$ \mathbf{N}^{3} \mathbf{N}

For a given α risk of the first kind, if Prob (KN > K) is less than α , the null hypothesis is rejected. This test is renowned for its robustness. Methodology for investigating the



natural environment

Drone flight over the roads of lot1

As part of the development work on the roads of lot 1, a drone was deployed to take stock of the trees planted along the said axes in order to analyse the impact of the project on the trees. Thus, aerial image taking missions by drone have been carried out and aerial images are taken at the level of the axes concerned by Lot 1. A DJI Mavic 2 Pro drone was used for the acquisition of aerial images and videos. The DJI Mavic 2 pro is a powerful compact drone, equipped with two cameras (a 640 x 512 pixel 30 Hz radiometric thermal sensor as well as a 1/2-inch CMOS sensor that displays 48 MP) to facilitate professional-level imaging. The block of video cameras was used to identify the wooded areas along the axes, while the digital camera (CMOS sensor) was dedicated to the acquisition of still images. It weighs 907g and is at a maximum altitude of 6 km and can reach 18 km as a maximum flight distance (no wind) at constant 50 km/h. The DJI Mavic 2 Pro drone has a 4S Lithium Polymer intelligent flight battery (with 4 cells) with an energy concentration of 59.29wH. It flies for 31 minutes and has an extremely reliable omnidirectional obstacle detection system. Omnidirectional obstacle detection includes left/right, up/down, and forward/backward obstacle detection. Photo 10 shows the image of the DJI Mavic 2 Pro drone used during the mission.



Photo 10: DJI Mavic 2 Pro drone used in this study Source: Field data, CECO BTP June 2022

In this mission, the drone flights were conducted in manual mode in order to fly at a suitable altitude, to better orient the camera in any direction during the flight for good quality images and to avoid obstacles or bring the drone back in case of GPS signal interference. The images were taken in sections along the axes where there are planted trees. Some images were taken vertically on the ground (camera oriented at 90°). Figure 5 shows the roads flown over during the mission.



DEVELOPMENT OF ACCESS ROADS AND CROSSINGS OF COTONOU (ATC) ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

LOT N° ATC- 01



Figure 5: Roads overflown Source: Field data, CECO BTP June 2022

The drone images and videos were taken at the level of the axes concerned by Lot 1 except the Carrefour Marché St Michel-Carrefour NASSOUBA axis which was not overflown, because it is in a geo-prohibited zone (Photo 11) and the Place du souvenir-Carrefour 3 Banques axis which is in a sensitive area.



Photo 11: No fly zone (Axis Carrefour St Michël – Carrefour NASSOUBA) Source: Field data, CECO BTP June 2022


· Method of studying flora and habitats

• Sampling and data collected On the basis of the topographic map of Cotonou and presenting the different axes selected within the framework of the Cotonou Access and Crossings Development Project (ATC) _lot 1, a systematic inventory of woody species was made. This inventory consisted of identifying all the woody species present on these axes in the right-of-way from one fence to the other along the axis (Table 9). In addition, the trees in public squares potentially impacted have been taken into account. These include, for example, the trees in the public square of the bus stop on campus. The main features are (i) the name of the species, (ii) the circumference of the tree measured at 1.3 m above the ground using the trim tape, (iii) the height of the tree foot measured using the Suunto clinometer, and (iv) the coordinates of each foot using the GPS receiver. Photos

Table 8: Three banks and then from the fairground square between the asphalt road and the square

12 & 13 indicate a partial view of the tree inventory operations in the field.

Coding system for designating roads in lot1

Acronyms Linear axes Designation of axes (Km)	
Earmar bridge groooreede SORERRA Carrofour Av1 6 72	
Former bruge-crossioaus SODEDRA-Carrelour AXT 0,72	DUPI
PK3-Carrefour le Bélier.	
Ax2 Third bridge-crossroads SOBEBRA 2.4 Ax3 Place	du
souvenir-Carrefour 3 banks 2.5 Carrefour marché st	
Michel-Carrefour Ax4 NASSOUBA-Échangeur	
Steinmetz-Carrefour 1.9 Notre Dame.	
Ax5 Carrefour 3 banks-Carrefour Air Afrique 1.1 Ax6 C	arrefour
Air Afrique-Ancien pont 0.5	
Ax7 Railway Junction-Steinmetz Overpass 1.0	

Source: Field data, CECO BTP June 2022





Photo 12: Circumference measurement and taking Photo 13: Tree height measurement using the GPS coordinates of a clinometer. Source: Field data, CECO BTP June 2022

• Equipment and method of faunal investigations

• Study material To carry out this inventory, two categories of equipment were used. These are the biological material consisting of the species of fauna of the various zoological groups in the area covered by the project and the equipment for observing this fauna, as well as the characterization of the various habitats of these wildlife groups.

• Biological material It concerns the fauna of the project's area of right-of-way. The zoological groups that have been the subject of an inventory here are: o Those that are easily recognizable by all the actors and are very widely distributed in the different ecosystems and habitats in the project's area of scope;

- Those that can be easily used as part of an ecological diagnosis to study biodiversity and also that can be used to define ecological indicators as part of an environmental diagnostic study,
- o Those who can be considered as "umbrella species" whose conservation and habitat restoration actions can be beneficial to many other taxa (species).

Understood as such, the inventories took into consideration: mammals, birds, reptiles, ophidians and terrestrial amphibians in the project's area of scope. It is important to note that the species of fauna listed in this inventory are those encountered in the fence-to-fence right-of-way along the axes. As a result, it does not take into account the species found in



the wooded formations and other related ecosystems adjacent to the linear routes of the roads subject to the project.

- Inventory equipment The wildlife inventory equipment used for this study can be summarized as:
 - o a 10' tablet equipped with the ODK Collect V1.30.1 and Locus Map 4.2 applications for recording survey sheets and georeferencing in the field;
 - o A digital camera for taking photos in the field;
 - o a pair of binoculars for wildlife observation (birds and mammals);
 - o a bird identification guide (Borrow & Demey, 2001),
 - o a mammalian identification guide (Kingdon 1997);
 - o a taxonomic identification guide for West African fishes (Lévêque et al. 2003; Lévêque and Paugy, 2006);
 - o Wildlife survey sheets.

• Data collection The theoretical planning of field prospecting (definition of the points and circuits to be prospected, the integration of the coordinates of these points in the Locus map, the identification with sufficient precision of the different types of habitats and ecosystems to be prospected, etc.).

• Field survey phase This phase concerns wildlife inventories. Thus, according to the project's cartographic route provided by Locus map (from google maps), an inventory of wildlife in the areas of the highways' right-of-way was carried out as defined from fence to fence. For these inventories, various cartographic files (Kml format) are defined and exported in the Locus Map application installed on tablets. These files include strategic, predefined, or sampled waypoints to collect wildlife data along highways along buffer lines. Thus, the sample points for data collection are searched in the field from the locus map application installed on the tablet.

The daytime inventories start in the morning at 7 a.m., continue all day and end in the evening at 7 p.m. The inventories were completed by some nocturnal surveys for nocturnal birds and bats which lasted from 20 to 24 hours.

During the routes, several wildlife counting techniques were applied. Indeed, the census of fauna data was made according to the different zoological groups dependent on terrestrial and water ecosystems (Cotonou Channel), which are mammals, fish, molluscs, crustaceans, reptiles and ophidians and road birds. The inventories start in the morning at 7 a.m. and continue all day and end in the evening at 7 p.m.: For the mammalian fauna inventory, the technique of looking for signs of the presence of different mammal species was used. Surveys were carried out in the different habitats present to search for signs of the presence of mammal species based on visual and acoustic contacts (vocalizations, calls, songs, etc.), and indirect contacts based on the search for droppings, footprints, remains, bone remains, roosts, etc. The contact points



of these indices are georeferenced. Mammal species were identified on the basis of the Mammal Identification Guide (Kingdon 1997).

• For avifauna, the inventory method used is stratified sampling of the simple point type (PSS). This method is based on 20-minute listening points within stations surveyed in a large radius (Lougbégnon, 2021). It consisted of counting the birds inside the predefined listening points located along the roads. Thus, 9 points of count have been defined on axis 1 and 2 (Figure 6), 6 points of view have been defined on axis 3 (Figure 7), 5 points of view have been defined on axis 5 (Figure 9), 3 points of view have been defined on axis 6 (Figure 6, 4 points of view have been defined on axis 7 (Figure 11).



Figure 6: Cartering points: Old bridge-SOBEBRA-OPT PK3- crossroads le Bélier

Spring: Field data, CECO BTP June 2022



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Figure 7: Priority 3 listening points: Place du souvenir-Carrefour 3 banks Source: Field data, CECO BTP June 2022



Figure 8: Axis 4 point count: St Michel market crossroads-Nassouba-Steinmetz interchange-Notre Dame crossroads Source: Field data, CECO BTP June 2022



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Figure 9: Axis 5 Listening Points: Carrefour 3 banks-Carrefour Air Afrique Source: Field data, CECO BTP June 2022



Figure 10: Point counts for axis 6: Air Afrique-Ancien pont Source: Field survey, CECO BTP June 2022



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Figure 11: Axis 7 Clews: Railway Junction-Steinmetz Overpass Source: Field survey, CECO BTP June 2022

In these point counts, birds are inventoried from songs, calls or flights over the habitat. At each point count, the observer remains motionless for 5 minutes in order to mitigate the effect of his presence on the birds. The surveys were mainly diurnal and mention the species (systematic inventory). Data from old night surveys from our survey stations in the city of Cotonou concerning the roads have been added in addition. Bird species were identified using the Bird Identification Guide (Borrow & Demey 2001).

- For herpetofauna, surveys were carried out along the main roads. The data collection concerned on the one hand direct contact with the species, but also the search for signs of presence such as the remains of organs, egg-laying sites, burrows, amphibian calls and songs.
- For the itchyofauna were made from the catches of fishermen encountered during the fieldwork between the channel and the sea. Thus, the catches of all fishing gear (gillnet, sparrowhawk net, trap, landing net, baited and unbaited hook) were inventoried. The fish specimens collected in this way were identified, when possible on site at the specific level using the available identification keys (Murai et al. 2003, Paugy et al. 2003a, 2003b, Lévêque & Paugy 2006), then photographed and subsequently determined in the event of non-direct identification in the field. Those belonging to species whose determination is problematic were preserved in 90% ethanol for subsequent laboratory analysis.



These direct surveys were also coupled with surveys (semi-structured interviews) that were carried out with executives from the fisheries administration, research, resource persons, socio-professional associations of fishermen and local communities because of the species of itchyofauna of the Cotonou channel.

Ethnozoological surveys of the local populations were completed in addition to these direct inventories in order to refine the data collected during the observations. The information collected from these local populations has made it possible to draw up a list in the local language of the species considered to be present along the main roads. When the respondents have drawn up a list of the species known to them, they are shown a plate of photos of the species mentioned that may be present (according to the bibliography relating to the study area), in order to help them recognise these species and identify them under their scientific name and to measure the potential uses made by the populations of these species.

• Processing and analysis of drone overflight data The images and videos collected taken by drone were classified by roads overflown and the geographical coordinates extracted using the Pix4Dmapper application were attached.

• Processing and analysis of the collected data of flora and habitats The collected data

were compiled in an Excel spreadsheet and the following main parameters were calculated. These are:

- Species richness by axis: This represents the total number of plant species inventoried on each axis.
- Woody species with a special conservation status with regard to the IUCN Red List and forest legislation in Benin.

Data on the conservation status of plant species were obtained using: the International Union for Conservation of Nature (IUCN) Red List; https://www.iucnredlist.org/) which defines the threat categories of different species on a global scale. The IUCN nomenclature defines the status of species as follows:

- EW (Extinct In The Wild). These are species recognized as extinct in the wild;
- CR (Critically Endangered). These are species that are critically endangered;
- EN (Endangered). These are species recognized as endangered;
- VU (Vulnerable). These are species considered vulnerable;
- NT (Near Threatened). They are near-threatened species;
- LC (Least Concern). These are species that face a Least Conservation Concern;
- DD (Data Deficient). These are species for which the current available data do not yet allow their conservation status to be assessed satisfactorily;



- NE (None Evaluated). These are species that are not on the IUCN list so their conservation status has not been assessed.
- the IUCN Red List in Benin, which gives in particular the conservation status of flora species in Benin (Neuenschwander et al., 2011).
- Law No. 93-009 of 2 July 1993 on the forest regime) and Decree No. 96-271 of 2 July 1996 on the application of the forestry regime, which gives in its annex the species of flora (in particular trees) considered to be protected in Benin and therefore prohibited from logging without authorization.
 - The number of tree feet along each axis: This represents the total number of tree feet inventoried per axis. This number was reported per kilometre for the sake of comparing the amount of cover to be destroyed per axis.
 - The average diameter of the trees (average basal area tree): this is the root mean square of the tree diameters per axis. It gives a rough idea of the size of the trees that will be impacted by the project along each axis. It is determined by the formula:

where di is the diameter of the shaft i and n is the number of feet measured on the axis.

• The amount of carbon stored by trees at each axis: Above-ground biomass (AGB) was calculated based on the generalized biomass estimation model with three predictors (DBH, total height and wood density) developed by Chave et al. (2014).

$$AGB = 0.0673 \times (X DBH \times H)$$
 (2)

With AGB = above-ground biomass in kg per tree, DBH = diameter at breast height in cm, ρ = wood density in g^{cm-3} and H = total height of the tree in m.

The amount of carbon stored by these trees at each axis was determined using the default value of the carbon fraction which is 0.47 (IPCC, 2006; Sharma et al., 2010). It is calculated according to the formula:

• Wildlife data analysis

• Analysis of direct wildlife survey data

Initially, the analysis is based on the grouping by zoological groups of the species of fauna inventoried according to the roads. Then, the different wildlife species identified were grouped by different types of ecosystems (or habitats). Finally, all these species are classified by families, genera and species. In addition, an analysis of the species richness of the species inventoried according to the zoological groups was carried out,



by road axis. In addition, the main focus on endangered species in the analysis of the degree of threat to wildlife species and their ecological importance along the roads investigated is highlighted. To this end, we have used the literature available respectively on the various IUCN red lists of the threat status of species both in Benin and internationally. From this summary basis, we determined (i) the conservation status of each species, regardless of its taxonomic group, on the IUCN World Red List (www.redlist.org), (ii) their conservation status on the IUCN Benin Red List (Neuenschwander et al., 2011) and (iii) the CITES Appendix to which the species is possibly mentioned. The list used in determining whether a given species belongs to any of the CITES Appendices is available at https://cites.org/fra/app/index.php.

Law No. 93-009 of 2 July 1993 on the forest regime, which in its annex lists protected species of fauna and flora and prohibits felling under the law, is also used.

Then, each taxon is associated with the set of information contained in Table 9.

Table 9: Type of data collected for each taxon

Family: The f	amily to v	which the species belongs
Genus: Scien	tific nam	e of genus
Sp.: Scientific	name o	f the species
Name: Verna	cular/loc	al name of the species
IUCN: IUCN	Red List	Status
CITES: Prese	nce in th	e CITES Appendix (I, II or III)
Migration: Mig	gratory s	atus of the species (avifauna only)
Habitat: Type	of habita	at in which the species has been recorded

The migratory status of avian species is indicated as follows:

- R = Resident (non-migratory species present all year round);
- IA = Inter-African migrant (migratory species between neighbouring countries, but mainly confined to West and Central Africa);
- P = Palearctic (migratory species between Europe, Asia and Africa).

As with flora, the International Union for Conservation of Nature (IUCN; https://www.iucnredlist.org/) Red List and the IUCN Red List at the national level have also been used to define the conservation status of different species of fauna.

Finally, by considering these datasets, it was possible to analyze the possible impacts of the construction of the roads on wildlife. Additional proposals to mitigate possible threats from the implementation of road projects to ecosystems and the species of fauna that depend on them have been made. In addition, restoration actions have been proposed.



• Analysis of ethnozoological data The data collected in this section have been analysed according to zoological groups by food and medicinal categories.

• Method of processing cartographic data The methodology is based on the scientific basis of any study in general and particularly on the methodological requirements in particular.

As far as mapping is concerned, the methodological approach adopted to produce the various thematic maps (Location, land use, pedology, spatialization of exposed properties, geomorphology, relief, etc.) consisted of collecting data in GIS format relating to the themes concerned and the collection of additional data, in particular base maps and field data. The information collected in the various institutions producing cartographic data, namely: the National Geographic Institute (IGN), the Cartography Laboratory of the University of Abomey-Calavi (LC/UAC), etc. are supplemented by GPS readings and photographs taken along the seven (7) sections of the study area, namely: Old Bridge - SOBEBRA Crossroads - OPT PK3 Crossroads -Le Bélier-Third Bridge Crossroads - SOBEBRA Crossroads; Place du Souvenir -Carrefour 3 Banks; Carrefour Marché Saint Michel – Carrefour; NASUBA - Steinmetz Interchange - Notre Dame Crossroads; Carrefour 3 Banques - Carrefour Air Afrique; Carrefour Air Afrique - Ancien Pont ; Carrefour Cheminot - Steinmetz overpass. The field mission was also interested in the various activities that are carried out in the defined area and the users located in the right-of-way of the tracks. During this stage, GPS surveys and photographs of the remarkable sites were carried out.

• Processing and analysis of the data collected The data for these maps were processed in a Geographic Information System (GIS) which allows the superposition of several layers of information with spatial reference. The orthophotos were interpreted and made it possible to obtain the land cover map. The relief map was produced from the 2 m pitch DTM produced in an ellipsoid reference frame with a margin of error of +- 1 m.

The projection parameters used are:- UTM 31N projection system.

- Data: WGS 1984.
- Spheroid: WGS 84.
- Data and tools for making maps
 - Digital data
 - Shapefile of soil units extracted from the background of the reconnaissance soil map produced by the National Centre for Agro-pedology of Benin;
 - SRTM, Topographic Radar Shuttle Mission: In February 2000, during the Topographic Shuttle Radar Mission, the Space Shuttle Endeavour collected



three-dimensional radar data from the earth's surface using a specially modified radar system. The data were converted to numerical height models (DEMs) covering the earth's surface between 60° North and 58° South:

- (ftp://e0srp01u.ecs.nasa.gov/srtm/version2/SRTM3/Africa/);
- Shapefile of the 2018 land cover units of the IGN.

• Tools for making maps Processing software: these have enabled the processing of the data collected, the transformation into information vectors and the editing of the various maps. Among those that have been used are:

- Excel.
- ArcGIS pro 2.9
- Global Mapper 23

 Method for Socio-Economic Characterization of the Study Area The method for collecting and characterizing socio-economic data varies according to the issues, targets, activities and, more generally, according to the areas of interest. Indeed, several investigations take place, depending on whether we are with the PAPs or the local or vulnerable populations. They were conducted in the project area, in particular in the districts crossed by the ATC lot 1 project. These investigations made it possible to identify the environmental and socio-economic issues of the environment in relation to the project submitted to the in-depth ESIA and to complete the information collected in the documentation. To carry out the fieldwork well, ten (10) pairs of enumerators were used under the responsibility of socio-economic experts and in PAR.

As a result, digital cameras were used to capture snapshots for the illustration of this report. Similarly, GPS was used to take the coordinates of the valuable elements of the environment likely to be affected by the implementation of the project.

In addition, interviews were organised with all the persons concerned by the project or who are in the area of influence of the project on the basis of the questionnaires provided and the manual drawn up for the occasion (Confer Annex). To this end, an exhaustive census of the affected populations and their properties affected by the project were carried out in agreement with the PAPs themselves.

These socio-economic surveys have made it possible to collect the data necessary to estimate resettlement needs. It is a question of:

- to systematically identify the properties impacted (telephone and electrical billboards, advertising billboards, access ramps to properties, shops, etc.) by the project and the people to whom they belong, as well as those who occupy them;
- describe the movable property/estate and its characteristics;



- Collect the perception of the population on the project's activities, its impacts and record their grievances;
- Assess sources of income for formal and non-informal activities affected by the project;
- identify activities and measures to support vulnerable people, etc.

The data and information collected with these different tools were processed and analyzed.

3.2.2. Specific approach to environmental analysis

This is the classic and recommended method for conducting an environmental impact assessment and is recorded in the general guide for carrying out an environmental impact assessment drawn up by the Beninese Environment Agency (EBA) in February 2001. As part of this study, this approach was adopted to conduct the environmental scan. It is a step-by-step approach that is based on:

• Determining the potential impacts of the project; the assessment of the significance of the impacts; the development of the environmental and social management plan.

3.2.2.1. Method of determining the potential impacts of the project The determination of impacts is carried out by relating the activities planned or carried out by the project to the elements of the environment. For each interrelationship between activities and components of the environment, the probability and nature of the impact must be identified in order to assess its significance. Therefore, the identification of impacts is made by following a method that relates the planned activities (or sources of impact) to the valued elements of the environment. Sufficient knowledge of the project, based on its various operations and articulations, is necessary to deduce the potential effects on the elements of the environment.

Physical impacts on natural environments were sought among the potential or actual changes in resources in the environments: soil, water, air, flora and fauna. Impacts on living conditions are sought in the different areas defining "quality of life":

- health (effects modifying the air, diet or noise level);
- safety (effects modifying the probability of bodily injury or material accidents as well as attacks on people or property);
- income (effects modifying economic activity, the productivity of facilities, land, buildings and locations, as well as private and public expenditure);
- Travel;
- access to public services and social organization;
- cultural (effects modifying the times, distances and arduousness of travel and in particular access to services and employment, as well as the quality of the image and the cultural or social role of the sites);
- Cult.



Potential environmental and socio-economic impacts were also estimated based on data collected from the proponent, based on a comparison between current socio-economic and environmental conditions, and those that would result from the implementation of project activities.

3.2.2.2. Determination and assessment of the significance of potential impacts This determination of impacts was carried out by linking the activities planned or carried out by the project to the elements of the environment. For each interrelationship between activities and environmental components, the probability and nature of the impact were identified in order to assess its significance. Therefore, the identification of impacts is made by following a method that relates the planned activities (or sources of impact).

This identification of the project's impacts is based on a step-by-step methodological approach including:

- the identification of the environmental components affected;
- the identification of both positive and negative impacts (using Leopold-type matrix).



Table 10: Leopold's Matrix for the identification of environmental components affected by project activities

		Environmental Components										
		Physi	cal, Bio	logi	cal and	Socio	Econo	mic				
Phases	Air quality	Soundscape	Water Resources	Ground	Number of tree feet	Landscape	Socio-economic activities	Health and Safety	Employment/ Income	Urban mobility	Living environment	Tourism
1. Preparatory												
2. Construction												
3. Operation												

Source: EBA, 1998.

Sufficient knowledge of the project, based on its various operations and articulations, is necessary to deduce the potential effects on the elements of the environment. Thus, physical impacts on natural environments are sought among the potential or actual modifications of resources in the five environments: soil, water, air, flora and fauna.

Impacts on living conditions are sought in the various areas defining "quality of life": health (effects modifying the air, food or noise level), safety (effects modifying the probability of bodily injury or material accidents as well as attacks on people or property), income (effects modifying economic activity, the productivity of installations, land, etc.). buildings and locations, as well as expenditure (private and public), travel, access to public services and social and cultural organisation (effects modifying the times, distances and arduousness of travel and in particular access to services and employment, as well as the quality of the image and the cultural or social role of a site).

Potential environmental and socio-economic impacts were also estimated based on data collected in the field and from a comparison between current socio-economic and environmental conditions, and those resulting from the implementation of the project.

3.2.2.3. Assessment of the significance of the impacts The assessment of three (03) parameters, namely the duration (momentary, temporary or permanent), the extent (punctual, local or regional) and the degree of disturbance (very strong, strong, medium or low) of the negative impact contributed to the assessment of the impacts. The cross-referencing of these three parameters will make it possible to deduce whether the importance of the impact is high, medium or low. It is a value judgement that makes it possible to establish levels of acceptability taking into account the standards in force and the national and local specificities in terms of environmental management. The EBA Impact Assessment Reference Grid (1998) was used for this purpose.



• Duration of the impact The duration of the impact specifies its temporary dimension, i.e. the period of time during which the changes undergone by the environmental components will be felt. This duration factor is grouped into three classes:

- o Momentary, when the effect of the impact is felt at a given time and for a period of time less than a season;
- o temporary, when the effect of the impact is felt continuously for a period of time shorter than the duration of the project;
- o permanent, when the effect of the impact is felt over a period of time greater than or equal to the duration of the project.

• Extent of impact This expresses the scope or spatial influence of the effects generated by an intervention of the project activity on the environment. This notion refers either to a distance or an area over which the changes undergone by a component will be felt or to the proportion of a population that will be affected by these changes.

It is punctual, local or regional depending on whether the impacts of the project activities act only on the project site, in the district concerned, in particular in the villages bordering the site and beyond the project area in the other departments of the country.

• Impact Scale This expresses the scope of impact in terms of scale. It can be low, minor, medium or major.

• Frequency It expresses the measure of the constancy or periodicity of the impact. It can be regular, continuous, rare.

• Degree of disruption The "degree of disruption" each impact encompasses several possible dimensions of the anticipated impact, namely: extent, duration, and scale and frequency. The degree of disturbance caused corresponds to the extent of the changes that affect the internal dynamics and function of the affected element. It makes it possible to define the extent of the modifications that will affect the component under study given the sensitivity to the proposed development. The importance to be given to an impact reflects the degree of disturbance that a given environmental component will undergo. There are four degrees: very strong, strong, medium and weak.

For each area studied by the ESIA (e.g. noise, biodiversity, social aspects, etc.), a specific methodology was applied to define the intensity of the changes, while maintaining the same designations. For example, for easily quantifiable impacts such as noise, numerical values were used to define their size, while for other aspects such as social impacts, a more qualitative classification was required.



The disturbance can be very strong when the impact profoundly compromises the integrity of the affected element, alters its quality and nullifies any possibility of its use. It is strong when the impact compromises the integrity of the affected element, alters its quality or significantly restricts its use. It is medium when the impact somewhat compromises the use, quality or integrity of the affected element. It is low when the impact does not noticeably change the integrity, quality or use of the affected item.

As a result, the significance of the impact can be classified into three categories:

- strong, when the components of the affected environmental feature are likely to be Destroyed;
- medium, when they are modified without the integrity or their existence being threatened;
- Low, when only mildly affected.
- negligible, when no resource/receptor (including humans) will be affected by a particular activity or the anticipated effect is considered "imperceptible" or indistinguishable from natural variations.

These above criteria were determined concretely on the basis of an expert discussion, also drawing on similar cases and the specialist literature on environmental analysis. The significance of the impacts was classified as high, medium or low according to a combination of the above criteria.

The assessment was made on the basis of the EBA terms of reference in Table 11.

Table 11: Terms of Reference for Assessing the Significance of Impacts

DEGREE OF DISTURBANCE DURATION EXTENDED Low Medium Strong Very							
high Impact impo Medium Tempor	high Impact importance Momentary Point Low Medium Momentary Local Low Low Medium Temporary Low Average Temporary Low Low Medium Temporary Low						
Low Medium Me	dium Tempora	ry Regional L	ow Medium Me	edium Tempo	orary High		
Temporary Region	onal Low Mediu	ım High High					
Permanent	Local Low M	ledium Stron	g Regional Me	dium Strong	Strong		
Permanent	Strong						

Source: EBA, 1998

Measures have been proposed for each significant impact, distinguishing between measures to maximize and those intended to limit or mitigate impacts. Emphasis was also placed on preventive or mitigation measures, with their regulatory basis and the technical conditions for their implementation.

Only the importance of the negative impacts is assessed, with the positive impacts being



considered assets for the project.

Once the impacts have been identified, we propose measures to maximize the positive impacts and mitigate the negative impacts in order to better manage them.

3.2.2.4. Development of the Environmental and Social Management Plan The environmental management plan defines in an operational manner the recommended measures and the conditions for their implementation. In accordance with the current environmental assessment legislation, and according to the guidelines of the EBA's General EIA Guide, the EIA report must present an Environmental and Social Management Plan (ESMP). Indeed, the ESMP is a project implementation dashboard that identifies the managers within the project responsible for the implementation of mitigation activities (Monitoring Plan) on the one hand, and the officials within public institutions responsible for the control and effective execution of these activities. The implementation of this plan is coordinated by the EBA. Based on the results of the analyses and with respect to the mitigation measures, we have selected the significant concrete elements that can correct the disruptive effects of the project. The ESMP includes the following headings: title of the action which is nothing more than the measure to mitigate or maximise an impact;

- impact indicators;
- responsible for monitoring and monitoring the activity;
- timeline;
- Cost.

3.2.2.5. Consultation of the public and institutional stakeholders The public participation stage during this process of carrying out the environmental and social impact study of the project for the development of the Cotonou Access and Crossings (ATC) roads was carried out according to a strategic approach with the use of several techniques, including individual interviews with the populations in their place of residence, institutional actors, telephone communications and public consultations. For the large groupings, each of the public consultation sessions was sanctioned by minutes signed by the representatives of the various actors present.

To ensure the participation of all local stakeholders in the public consultation, a two-phase methodological approach was adopted: a preparatory phase to share the objectives of the mission and a consultation phase proper with all stakeholders. However, the approach adopted during the information and awareness-raising sessions has not changed, in order to hold the same discourse to the different targets but also to avoid any confusion and misinterpretation. In addition, the agenda adopted in the conduct of each meeting is essentially as follows:

- Presentation of the project, its technical options and its socio-economic and socio-security issues;
- collection of opinions and recommendations from the various stakeholders;
- collection of proposals for bypass plans and areas that can be used as a technical



base for life.

The purpose of these various consultations is to collect and take into account the points of view of the various stakeholders, their concerns and expectations on the one hand, and on the other hand, the appropriation of the project by the public, accepts it, accompanies it in its implementation and ensures its sustainability through recommendations.

3.2.2.6. Environmental monitoring and follow-up programme The environmental monitoring and follow-up programme proposes measures to verify the accuracy of the assessment and the effectiveness of the proposed mitigation measures with regard to the main environmental and social impacts induced by the project activities.

3.2.2.7. Resettlement Action Plan (RAP)

The project requires the development of a RAP. This RAP will identify and specify potential procedures and measures to properly resettle and/or compensate affected individuals and communities. On the one hand, it will make it possible to identify all the people affected by the project and to justify their displacement once the alternative solutions that would make it possible to minimize or avoid this displacement have been considered. It will also set out eligibility criteria for affected parties, set compensation rates for loss of property, and outline levels of assistance for the relocation and reconstruction of affected households.

3.2.3. Technological risk analysis approach The technological risk analysis of the project was essentially based on the description of the characteristics of the various structures to be carried out and, above all, their scope and the equipment to be used. Then, it was carried out to identify the potential hazards (materials, processes and equipment at risk) and their location as well as to understand the functioning of the safety systems in the construction and operation phase of the road. It has led to the identification of safety barriers wherever the need arises. In short, the method of conducting this analysis is schematized by Figure 12.



LOT N° ATC- 01



Figure 12: Approach to carrying out the technological risk analysis of the project Spring : CECO-BTP, field work June 2022



4. POLITICAL, REGULATORY, LEGAL AND INSTITUTIONAL FRAMEWORK OF THE PROJECT

The political, regulatory, legal and institutional framework makes it possible to identify and understand the texts to which the project is subject and the institutional web on which the actors act and position themselves in the infrastructure construction sector and the environmental but also socio-economic sector. This framework is developed to highlight the legal and institutional bases for the implementation of the project, taking into account national requirements and international contingencies.

The work on the Cotonou Access and Crossings (ATC) road development project of lot 1 is part of a legislative and institutional context characterized by the availability of sectoral and institutional legal texts in charge of their implementation. In the context of this environmental and social impact study for the project, the legislative and regulatory framework relates to the living environment, security, infrastructure, socio-economic activities and decentralization. The interactions between these different institutional and legal frameworks and the special provisions to which special attention must be paid during the implementation of the project were discussed. For the institutional component, emphasis was placed on international, national and local institutions with a proven role in the implementation of this project.

4.1. Policy Framework for Project Implementation The strategic documents:

4.1.1. National Agenda 21 National Agenda 21 is a national adaptation of Agenda 21 (so referred to in allusion to the challenges of the 21st century) which was adopted at the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992. Adopted on 22 January 1997 by the Government, the National Agenda 21 aims to define the guidelines and conditions for achieving sustainable development. It is therefore the instrument for integrating national environmental concerns into development programmes and plans, a sine qua non condition for achieving sustainable development and poverty eradication. This document, in accordance with the structure of Agenda 21 adopted at the Earth Summit in June 1992 in Rio de Janeiro, consists of three (03) parts, namely:

- Social, Economic and Cultural dimensions with eight (08) chapters;
- Conservation and Management of Resources for Development with eleven (11) chapters;
- Strengthening the role of the major groups and the means of implementation with sixteen (16) chapters.

4.1.2. Environmental Action Plan Aware of the challenges of environmental management for sustainable development and poverty reduction, the Beninese public authorities adopted an Environmental Action Plan (EAP) in January 1992, which is the basic tool for the



country's environmental policy. The EAP was revised in 2007 and is divided into 7 programs, which are:

- a. the education, training, awareness-raising and communication programme;
- b. the Research Action on Terroirs programme;
- c. the Biodiversity Management Programme;
- d. the Water Resources Management programme;
- e. the programme for the improvement of the rural living environment;
- f. the programme for the improvement of the urban living environment;
- g. the Institutional and Legislative Framework, Environmental Information System programme.

To remain in line with the EAP, the project must contribute to the environmental education of the actors involved in the implementation in order to develop environmental protection skills in their daily activities.

4.1.3. Benin's policies in the face of climate change The main climate change policy reference documents are as follows:

- Initial communication on climate change in 2001;
- Implementation strategy document for the United Nations Framework Convention on Climate Change (UNFCCC) in 2003;
- National Action Programme for Adaptation to Climate Change (PANA) in 2008;
- Second national communication on climate change in 2011;
- Intended Nationally Determined Contributions (INDCs) under the 21st Conference of the Parties (COP 21), in 2015;
- National Climate Change Adaptation Plan.

The use of these documents shows that Benin, in its climate change adaptation policy, has opted to take the environment into account upstream of any project, program and plan in order to develop adequate tools to deal with it.

4.1.4. Transport Sector Strategy 2007-2011

Two objectives stem from this strategy:

- ensure the conservation and maintenance of road heritage;
- ensure the development of the network by modernizing and rehabilitating roads.

4.1.5. Government Action Programme (PAG) for the period 2016-2021: The PAG considers the improvement of transport infrastructure to be an important lever for the country's economic development.



4.1.5.1. Road safety strategy:

Benin does not yet have a road safety strategy document validated and adopted by the Government. Its development is included in the action plan for the Decade of Action 2011-2020.

- Actions on road infrastructure Road infrastructure is now the subject of particular attention in terms of road safety in Benin:
 - Road construction projects are controlled against road safety standards, whether for the route, the signage and the various equipment. The National Road Safety Centre regularly participates in these inspections and gives its opinion on the content of the various study reports;

• The National Road Safety Centre carries out safety inspections of existing roads in order to identify anomalies that may constitute major risks to traffic and propose their correction; In addition, Benin is in the final phase of the implementation of the road safety audit of road projects:

- The audit manual has been developed and validated as well as the application guides;
- Administration executives, companies and design offices have been trained in the use of these tools;
- The National Road Safety Centre has set up a Road Safety Audit Unit to not only continue the inspections of road construction sites and inspections, but also to effectively coordinate the audits as soon as they start.

• Capacity building for Republican Police officers The information system on traffic accidents has been the subject of a trainer's manual published and made available to the Republican Police for the knowledge to be acquired by each officer working within the units in charge of traffic accident reports. In addition, a group of trainers has been trained within the executives of the Republican Police and the National Road Safety Centre. These trainers are responsible for disseminating the necessary knowledge within the Republican Police in order to increase the capacity of officers to effectively collect data on traffic accidents. Based on the data collection bulletins transmitted by the Police, the CNSR regularly updates the database of road accidents and produces statistics that allow, among other things, the analysis of road accidents. The data are verified, corrected, updated and validated annually to be made available to the public through statistical yearbooks and to meet requests for statistics from various national operators and international agencies.



The Republican Police plays a major role in improving the behaviour of road users by regularly carrying out control, deterrence, awareness-raising and repression operations. The actions of the Police have made it possible for drivers of motorized two-wheelers to wear helmets, particularly in the city of Cotonou, as well as to respect the use of the few lanes dedicated to two-wheelers.

 Financing road safety Like many African countries, Benin also has problems financing road safety, as the national road safety financing fund is not yet in place. However, a self-financing mechanism has been set up to ensure a minimum of stable and sustainable resources for the national body in charge of road safety (operation, activities, investments). These resources come mainly from the vehicle technical inspection and go directly into the organisation's budget. When the National Road Safety Centre (CNSR) was created in 1987, the Beninese State decided to entrust it with the monopoly of vehicle technical inspection, understood as an activity for the prevention of road accidents.

The resources from the Vehicle Technical Inspection allow the National Road Safety Centre:

- to finance information, education and awareness-raising campaigns for road users;
- to organise regular awareness-raising or coercive roadside checks in collaboration with the police;
- managing the accident database (data collection and processing);
- to acquire equipment such as speed control radars, vehicle technical inspection equipment, breathalyzers, GPS for the geographical location of road accidents, etc.
- to support NGOs working in the field of road safety at national level;
- Participate in various works and forums on road safety in Africa and elsewhere in the world;
- Strengthen the capacities of its staff;
- Etc.

It is clear that road safety funding must go far beyond the means available to the CNSR because it is necessary to ensure greater investment in order to make real progress towards achieving the objectives. The mobilization of the 10% of the cost of road projects and the 5% of the cost of road maintenance could mitigate the deficit.

4.2. Legislative and regulatory framework for the implementation of the project According to the constitutional provisions in force in the Republic of Benin (Article 27), "every citizen has the right to a healthy, satisfactory and sustainable environment and has the duty to defend it. The State shall ensure the protection of the environment".



To this end, Benin has adopted several national texts and legal documents as well as international conventions that govern actions in the environmental field. This set of legal and regulatory provisions forms the legal framework. In the following sections, the legal framework applicable to the project is described. We can thus list, among the main texts.

4.2.1. Orders and decrees on the organisation of the State, roles of ministries, directorates and agencies

- Order No. 309/MTPT/DC/SG/DGTT of 11 May 2004 on attributions, organisation and functioning of the General Directorate of Land Transport;
- Decree No. 2016-205 of 4 April 2016 on the creation, allocation and organisation of the operation of the National Agency for Land Transport (ANaTT), and Decree No. 2017-300 of 21 June 2017 updating the statutes of the ANaTT;
- Decree No. 366 of 16 June 2016 on the creation, attributions, organization and functioning of the Bureau of Analysis and Investigation at the Presidency of the Republic;
- Decree No. 418 of 20 July 2016 on the attributions, organization and functioning of the Ministry of Infrastructure and Transport;
- Decree No. 2016-501 of 11 August 2016 on the attributions, organisation and functioning of the Ministry of the Living Environment and Sustainable Development.

4.2.2. Sectoral laws, orders and decrees

- General Decree of 24 July 1956 regulating the use of roads open to public traffic;
- Decree No. 79-109 regulating road transport in the People's Republic of Benin.
- Law No. 98-030 of 12 February 1999 on the framework law on the environment;
- Decree No. 2000-671 of 29 December 2000 regulating the importation, marketing and distribution of second-hand equipment and capital goods;
- Order No. 2016/MTPT/MISD/DC/SG/CTTT/DGTT/SPC/SER of 7 March 2016 regulating the operation of motorcycles used for public passenger transport (motorcycle taxis).

4.2.3. Laws on municipalities

- Law No. 97-028 of 15 January 1999 on the organization of the territorial administration of the Republic of Benin;
- Law No. 97-029 of 15 January 1999 on the organization of Communes in the Republic of Benin;
- Law No. 2021 14 OF 20 DECEMBER 2021 on the Code of Territorial Administration in the Republic of Benin;
- Decree No. 2022-321 of 1 June 2022 setting the general framework for the internal regulations of the Communal Councils;



- Decree No. 2022-321 of June 1, 2022 setting the conditions and modalities for the delegation of power and signature of the mayor and the executive secretary;
- Decree No. 2021-541 of 27 October 2021 on the attribution, organization and functioning of the Ministry of Decentralization and Local Governance;
- Decree No. 2022-319 of June 1, 2022 setting the criteria for the categorization of Municipalities in the Republic of Benin;
- Decree No. 2022-303 of 25 May 2022 on the creation, organization and operation of the monitoring and control unit for the management of the Municipalities in the Republic of Benin.

In addition, the legislative and regulatory framework is one of the links in the road safety chain which is based on legal texts, decrees, orders and supranational texts such as conventions and various treaties oriented towards the movement of goods and people in adequate safety conditions.

4.2.4. Relevant multilateral agreements ratified Benin's constitutional provisions are strengthened by the international commitments entered into by the State through the ratification of international conventions and agreements on the environment.

4.2.4.1. International conventions and agreements The most directly related to the objectives of this project are shown in Table 12.

Table 12: Ratified multilateral conventions/agreements applicable to the project

Date	of N° Conventions/agreer	nents Ratificati	on / Principle/ Relevance within the framework of
the p	roject Accession to the Ky	oto Protocol to	the Convention- Framework of the Climate Impact
of the	e Project's activities (emis	sions 01 Unite	d Nations on 25 February 2002 of CO2, in particular
in the	e construction phase and (Climate Chang	e of operation of 11/12/1997 Stockholm Convention
Risks	s of direct or indirect pollut	ion of POPs or	n pollutants (in particular from combustion)
	$\langle \rangle$		
02	January 2004 (POPs) of	22/05/2001 Ca	artagena Protocol on 16 May 2002
_	Impact of the Project on	local biodiversi	ty
03	Biodiversity		



			African Regional Convention of General Scope on
		on	the Protection of Nature and Natural Resources; it has unquestionably laid the foundations of the fundamental principles that govern Biosphere Reserves today, namely:
04	African Convention on Conservation of nature and natural resources	55, 1998	 uses; the conservation of natural resources as an integral part of management plans; the obligation of impact assessments; inter-African cooperation in the conservation and management of natural resources. The project, beyond the main component which is the exploitation and management of the "water" resource, will also generate various sub-activities such as the destruction of plant cover, ecological disturbance at the level of fauna and flora. To this end, measures will have to be taken to promote the impacts on natural resources for a better conservation and protection of the environment.
05	Convention of Nations United Nations Convention on Biodiversity	Ratified on 30 30, 1994	To reduce the loss of biodiversity at the global and national levels, requiring each State to develop a national monograph and strategy. Article 14, paragraph 1-a, invites each contracting party to "adopt procedures to require the assessment of the impacts of projects it plans that are likely to cause significant harm to biological diversity with a view to avoiding and minimizing such effects". The project area includes a diversity of plant and fauna species to be preserved and protected as best as possible for this purpose.
06	United Nations Framework Convention on Climate Change (New York) of 09/05/1992 Montreal Protocol on	30/06/1994	Climate impact of Project activities (e.g. CO2 emissions) during the construction and operation phase
07	The Ozone Layer of 22/03/1985	3131, 1988	Climate impact of the Project's activities (e.g. CO2 emissions) during the construction and operation phases This protocol governs the
08	Montreal Protocol on ozone-depleting substances Ratified	Ratified on 31 October 1988	implementation of the Vienna Convention. With the vision of preserving the ozone layer by reducing the manufacture and use of substances that deplete and then giving up.
			Therefore, the use of products containing toxic substances, including chlorine, bromine, carbon and nitrogen derivatives, should be avoided. Framework



09	agreement anations United Climate	Change Ratified on	30 30,	1994 This convention establishes a comprehensive framework agreement on intergovernmental efforts to meet the challenge of climate change. It recognizes that the climate system is a common resource whose stability can be be affected by industrial emissions, carbon dioxide and other greenhouse gases (GHGs); that the activities of this project will be able to generate, due to the use of various equipment and machinery.
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Source: Literature review, CECO-BTP June 2022

Ratification of the listed international conventions thus provides Benin with legal and political means to achieve its objectives of conservation of its environment and contributes to the conservation of the global environment.

4.2.4.2. Human Rights Framework Benin has ratified the majority of United Nations human rights treaties. The application of national and international legislation nevertheless remains an obstacle to the improvement of the human rights situation in Benin.

Benin has also ratified the ILO's eight core Conventions, including Convention No. 105 on the Abolition of Forced Labour, Conventions Nos. 138 and 182 on the Elimination of Child Labour, and Conventions Nos. 100 and 111 on Non-Discrimination.

The view of this map with the status of ratifications of 18 international human rights treaties, as observed, Benin has ratified 17 out of 18. A complete list of United Nations human rights treaties signed and/or ratified by Benin is included in Table 14.

Human rights instruments Date of ratification	
Convention against Torture and Other Degrading Treatment or Punishment Protocol to the Convention against Torture (CAT-OP) 20 September 2006	(CAT) Optional
International Covenant on Civil and Political Rights (ICCPR) 12 March 1992	
Second Optional Protocol to the International Covenant on Civil and Political Rights, aiming at the abolition of the death penalty (CCPR-OP2-DP)	July 5, 2012
Convention for the Protection of All Persons from Enforced Disappearance (CED)	Nov 2, 2017
Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)	March 12, 1992
International Convention on the Elimination of All Forms of Racial Discrimination (CERD)	Nov 30, 2001
International Covenant on Economic, Social and Cultural Rights (ICESCR)	March 12, 1992

Table 13: International human rights conventions and protocols in Benin



International Convention on the Protection of the Rights of All Migrant	July 6, 2018
Workers and Members of Their Families (CMW)	
Convention on the Rights of the Child (CRC)	August 3, 1990
Optional Protocol to the Convention on the Rights of the Child on the	January 31, 2005
involvement of children in armed conflict (CRC-OP-AC)	
Convention on the Rights of Persons with Disabilities (CRPD)	July 5, 2012

Source: United National Human Rights Treaty Bodies, accessed athttps://tbinternet.ohchr.org/_layouts/15/TreatyBodyExternal/Treaty.aspx?CountryID=19&Lang=EN

In order to strengthen these conventions, at the national level, a set of legal texts has been promulgated and/or adopted. Their goal is directly oriented towards the protection and sustainable management of environmental resources and the living environment.

4.2.4.3. International best practices and lenders' requirements Compliance with the lenders' environmental and social requirements is a condition for the financing of the project and therefore has direct implications for the effective implementation of the project. The donors and standards applicable to the project are the OECD Common Approaches, the IFC Standards and Guidelines, and the Equator Principles. These are described in the next section.

4.2.4.3.1. OECD Common Approaches Taking into account the participation of external technical and financial partners, the project will have to comply with the Recommendation of the Council on Common Approaches on Officially Supported Export Credits and Social and Environmental Due Diligence (the "Common Approaches"), adopted by the OECD Council in June 2012. The Common Approaches include requirements for the following:
Classification based on the potential for environmental and social impacts;

- Environmental and social review;
- · Evaluation, decision-making and follow-up;
- Exchange and disclosure of information; and,
- Reporting and follow-up of recommendations.

4.2.4.4. IFC Performance Standards and Guidelines and World Bank Group EHS Guidelines The IFC Performance Standards are the international benchmark standards for environmental and social assessment. For lenders, the project and related documentation will need to align with the IFC's Environmental and Social Performance Standards and Environmental, Health and Safety (EHS) Guidelines.

4.2.4.5. IFC Performance Standards The IFC Performance Standards provide a framework for managing the environmental and social risks and impacts of a project. There are eight performance standards that cover a range of environmental and social themes, including:

- NP1: Assessment and Management of Environmental and Social Risks and Impacts;
- NP2: Workforce and working conditions;



- NP3: Resource Efficiency and Pollution Prevention;
- NP4: Community Health and Safety;
- NP5: Land acquisition and involuntary resettlement;
- NP6: Conservation of biodiversity and sustainable management of living natural resources.
- NP7: Indigenous Peoples; and,
- NP 8: Cultural heritage.

The implementation of the performance standards must result in a project that promotes healthy and sustainable social and environmental performance and aims to continuously improve performance in this area; that demonstrates improved financial, environmental and social performance; which identifies and assesses its environmental and social impacts; that avoids, minimizes and mitigates impacts to the extent possible; and that ensures appropriate engagement of affected communities and local stakeholders.

4.2.4.5.1. General HSE Guidelines

The WBG EHS Guidelines provide additional guidance on the issues raised in the requirements of Performance Standards 2, 3 and 4. The guidelines are technical reference documents containing general and sectoral examples of international good industrial practice.

The IFC Guidelines contain general information on environmental, health and safety issues potentially applicable to all industrial sectors and on the levels and performance measures generally considered achievable in new facilities at a reasonable cost using existing technologies.

The IFC EHS Guidelines are technical reference documents containing general and industry-specific examples of Good International Industry Practice (GIIP) and are referenced in the World Bank's Environmental and Social Framework and the IFC's Performance Standards. These guidelines contain performance levels and measures that are normally acceptable to the World Bank Group, and that are generally considered feasible in new facilities at reasonable costs by existing technology.

The General EHS Guidelines contain (among other things) the following information regarding environmental issues and community health and safety:

4.2.4.5.2. Environment

- Air emissions and ambient air quality;
- Wastewater and ambient water quality;
- Water conservation;
- Waste management; and,
- Noise.



4.2.4.5.3. Health and safety of the Communities

- o Water quality and availability;
- o Structural security of the project infrastructure;
- o Road safety;
- o Transport of dangerous goods; and,
- o Emergency preparedness and response.

These guidelines provide an approach to managing significant sources of emissions, including specific guidance for assessing and monitoring impacts.

In particular the following specific guidelines will be applicable to the Project:

• Environmental, Health and Safety Guidelines for the Extraction of Building Materials (2007) They contain information relating to the extraction of building materials such as aggregate, limestone, slate, sandstone, gravel, clay, gypsum, feldspar, silica sand and quartz as well as the extraction of dimension stone. This includes mining activities as independent projects as well as those carried out in construction, civil engineering and cement projects. Although the guidelines for the extraction of building materials are mainly aimed at large-scale and complex activities, the concepts presented in the guidelines are also applicable to small businesses.

• Environmental, Health and Safety Guidelines for Toll Roads (2007) These include information on the construction, operation and maintenance of toll roads, including bridges and footbridges. Issues related to the construction and operation of maintenance facilities are addressed in the General EHS Guidelines. Aspects of sourcing of building materials are discussed in the Guidelines for the Extraction of Construction Materials, while those related to service areas are addressed in the EHS Guidelines for the Sale of Fuels at Retail.

4.2.5. National legislation and regulations applicable to the project The integration of the environment into development policies, plans, programmes and activities is a legal requirement, the principles of which are defined in national laws and texts.

 Law No. 90-32 of 11 December 1990 on the Constitution of the Republic of Benin, as amended and supplemented by Law No. 2019-40 of 7 November 2019 It mentions in its article 27 that "everyone has the right to a healthy, satisfactory and sustainable environment and has the duty to defend it. The State shall ensure the protection of the environment". This section of the constitution already obliges all Beninese citizens to preserve the living environment on the protection of the environment.



• Law No. 98-030 of 12 February 1999 on the Framework Law on the Environment It includes provisions relating to the clarification of concepts, sanctions, the protection and enhancement of receiving environments, the protection and enhancement of the natural environment and the human environment, pollution and nuisances, impact studies, public hearings on the environment, emergency plans and incentives.

This law is the basic text of the national environmental policy, in the sense that it covers all aspects from the identification of sources of pollution to their control and enforcement, including environmental assessments (Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), Environmental Audit (EA), Environmental Inspection (IE), capacity building and environmental information management.

Article 3 stipulates that: Article 3-c "the protection and enhancement of the environment must be an integral part of the economic and social development plan and the strategy for its implementation";

- Article 3-d. "The various social groups must intervene at all levels in the formulation and implementation of national environmental policy; This principle is crucial in the fight against poverty and promotes the development of the country." It is for the purposes of this principle that the administrative process of the EIA and the public hearing procedure which ensure a real participation of the stakeholders concerned in the decision-making process have been implemented;
- Article 3-f. "Any act detrimental to the protection of the environment engages the direct or indirect responsibility of its perpetrator who must ensure that it is repaired".

This consideration of the environment is reflected in the Impact Assessment and Audit procedures placed under the responsibility of the MCVDD and under the technical coordination of the Beninese Environment Agency. Thus, any large-scale project must be subject to an environmental and social assessment.

• Law No. 2022-04 of February 16, 2022 on Public Hygiene in the Republic of Benin It defines the various terms related to public hygiene in the Republic of Benin. It legislates:

- hygiene on public roads;
- the hygiene of swimming pools and bathing areas;
- Hygiene of homes;
- hygiene of foodstuffs;
- water hygiene;



- Hygiene of industrial and commercial facilities;
- the hygiene of establishments at the various levels of education, and health establishments;
- the hygiene of prison premises;
- the hygiene of public buildings;
- the hygiene of the natural environment;
- menstrual hygiene;
- sound hygiene;
- the hygiene of morgues;
- the hygiene of cemeteries.

Its objective is to preserve and promote the health of the population.

In Title IV of the Code on Hygiene in the Republic of Benin, penal provisions are provided. Chapter I is devoted to the establishment of infringements. Chapter 2 talks about prosecutions and sanctions.

Chapter 3 talks about the distribution of the proceeds of fines. In Article 182 of the Act, the various provisions do not prevent the right of decentralized communities to prescribe by regulation any special protection measure likely to preserve the health of the population, not provided for in this Act, with a view to ensuring public hygiene, in accordance with their competences.

• Law No. 98-004 of 27 January 1998 on the Labour Code in the Republic of Benin

It clearly defines the legislative and regulatory mechanisms for occupational health and safety management. Article 182 of this Law stipulates that "in order to protect the life and health of workers, the employer is obliged to take all necessary measures that are appropriate to the operating conditions of the enterprise, etc."

Similarly, according to Article 183 of this law, "every employer is required to organise practical and appropriate training in health and safety for the benefit of newly hired employees, those who change jobs or techniques and those who return to work after a work stoppage of more than six months. This training must be updated for the benefit of all staff in the event of changes in legislation, regulations or work procedures, etc. ».

• Law No. 2017 05 of 29 August 2017 setting the conditions for hiring, labour placement and termination of employment contracts in the Republic of Benin

Article 3 of this law provides that "Any head of an establishment or enterprise or any employer shall freely recruit his staff who benefit from occupational safety and health benefits.

However, he is required to inform the competent services of the Ministry of Labour



of the posts for which recruitment has been carried out. It also registers and enrols workers with the structures in charge of social protection".

The development of the Cotonou Access and Crossings (ATC) roads will require the recruitment of manpower. This law will allow the management of the conditions of hiring, termination of employment contracts, and poaching. Similarly, relations between workers and employers are dealt with by the provisions of this law.

 Law 2010 44 of 22 November 2010 on Water Management in the Republic of Benin It advocates Integrated Water Resources Management (IWRM) as a basic principle for water management in Benin. Article 1 of this law sets out the constitutional principle that "everyone has the right to a healthy, satisfactory and sustainable environment and has the duty to defend it. The State shall ensure the protection of the environment and the conservation of natural resources in general, in this case water". In particular, it entrusts the State and the decentralized local authorities with the responsibility of providing drinking water to the population and of carrying out the purification of waste water as well as the drainage and evacuation of rainwater. In addition, it entrusts the National Water Council with an advisory role on the orientations and main decisions relating to the public service of water distribution and sanitation. Articles 6 to 16, grouped together in Chapter II, specify the principles relating to water management. Of particular note in this chapter is Article 14 below, which confirms Articles 7 and 8 preceding it. "When the activity of natural or legal persons is likely to cause or aggravate water pollution or the degradation of the aquatic environment, they shall contribute to the financing of the measures that the State and local authorities must take to combat this pollution, compensate for its effects and ensure the conservation of aquatic ecosystems". It should be noted that Article 31 provides for the creation of a National Water Fund and Article 33 specifies that the resources of this fund will consist of, inter alia, the proceeds of fees, taxes instituted for water management, fines imposed pursuant to the same law and the "polluter pays" and polluter/user pays principles.

In addition to the Environmental Framework Act, the legislation also provides for other legislation applicable to the project, which is summarized in Table 14.

REFERENCE	LIBEL
Decree No. 2017-332 of 06 July 2017	Organizing environmental assessment procedures in the Republic of Benin.
Decree No. 2001-235 of 12 July 2001	Setting drinking water quality standards in the Republic of Benin. It sets the physical, chemical, biological and bacteriological standards for water intended for the

Table 14: Decrees and orders applicable to the project



	human consumption and routine domestic uses, in accordance with the provisions of Law No. 98-030 of 12 February 1999 on the framework law on the environment in the Republic of Benin. In Chapter II, it defines more precisely in Articles 28, 29, 30, 31 and 32 the perimeters for the protection of groundwater, rivers and bodies of water, and surface water.
Decree No. 2001 094 of 20 February 2001	Setting the standards for the quality of waste water in the Republic of Benin. Chapter 3, comprising articles 3 to 17, specifies the terms and conditions for the discharge of industrial wastewater and the standards for discharge into a receiving environment according to the types of industries in the agri-food sector (oil mills, fish and seafood, brewery, dairy products, slaughterhouses and sugar) and other industries (textiles, soaps and detergents, pharmaceuticals, surface treatment and thermal power plants). Sections 4 and 5 stipulate that any discharge of industrial wastewater into a receiving environment must comply with the requirements of the discharge permit. This permit is issued by the Minister for the Environment.
Decree No. 2001 109 of 4 April 2001	Setting the standards for the quality of waste water in the Republic of Benin. Chapter 3, comprising articles 3 to 17, specifies the terms and conditions for the discharge of industrial wastewater and the standards for discharge into a receiving environment according to the types of industries in the agri-food sector (oil mills, fish and seafood, brewery, dairy products, slaughterhouses and sugar) and other industries (textiles, soaps and detergents, pharmaceuticals, surface treatment and thermal power plants). Sections 4 and 5 stipulate that any discharge of industrial wastewater into a receiving environment must comply with the requirements of the discharge permit. This permit is issued by the Minister for the Environment.
Decree No. 2001-095 of 20 February 2001	On the creation, attributions, organization and functioning of environmental units in the Republic of Benin. A functional unit within the administration that houses an interface between the EBA and public developers, its mission is to ensure the integration of environmental dimensions into development policies, programmes and projects in its ministerial sector or in the territory of the department concerned.
Decree No. 2003-332 of 27 August 2003 Decree No. 2003-330 of	Solid waste management in the Republic of Benin. It includes several articles, in particular those relating to the prevention and limitation of nuisances during waste management, the provisions specific to the recovery of waste; the transfer of waste, etc.
27 August 2003	storage, collection, treatment, storage and storage operations.



	recovery and transport of used oils.
Decree No. 2001 110 of 4	Setting air quality standards in the Republic of Benin; It
April 2001	defines the quality of the ambient air recorded outside the
April 2001	industrial units concerned.
Decree 2022-301 of 25	Carrying the noise regulations in the Republic of Benin,
May 2022 regulating noise	which classify and set noise levels throughout the territory.
in the Republic of Benin	
On the creation, attributions,	organization and functioning of the environmental police. It
oversees the application of e	nvironmental legislation, informs and sensitizes the
population on environmental	issues as well as on Decree No. 2001-096 of the 20th
National Strategy for the Prot	ection of the Environment; then, from February 2001, it
investigates, observes and p	unishes violations of environmental legislation, in
conjunction with judicial polic	e officers and agents and agents authorized by special laws.
Decree No. 2015-010 of 29 Ja	nuary 2015 on the attributions, organization and operation
of the National Agency for Lar	d and Land (ANDF) Setting the conditions and modalities
for the issuance of the permit	for the discharge of "industrial wastewater (EUI)" in the
Republic of Benin. It sets out t	he conditions and procedures for the issuance and
withdrawal of the wastewater	discharge permit Industrial Ministerial Order in the Republic
of Benin, pursuant to the	
n°095/MCVDD/DC/SGM/D	
GBE/DEIE/SLPND/SA051	provisions of Articles 5, 6, 7, 8 and 11 of Decree No. 2001-109 of the
04/04/01 setting the standard	s for the quality of waste water in SGG 17 of 07 August 2017
Republic of Benin and the int	
	n U94/WCVDD/DC/SGW/DGABE/DEIE/SLPND/SA049S
	and analysing waste water in the Republic of Benin

Source: Literature review, CECO-BTP June 2022

4.3. Legal framework for the implementation of the project According to the constitutional provisions in force in the Republic of Benin (Article 27), "every citizen has the right to a healthy, satisfactory and sustainable environment and has the duty to defend it. The State shall ensure the protection of the environment".

4.3.1. Texts on decentralization Decentralization has been effective in Benin since March 2003. It now grants the local level very broad responsibilities in terms of environmental management and spatial planning. In this case, Law 97-029 of 15 January 1999 on the organization of the Communes in the Republic of Benin, states that the commune is competent in the fields of sanitation, waste management, environmental management and natural resources in particular. It is at this level that all national strategies relating to the protection of the environment


and natural resources within its territorial jurisdiction must be implemented.

In addition, "the municipality develops and adopts its development plan. It ensures that it is carried out in harmony with national guidelines with a view to ensuring the best living conditions for the entire population. In this context, it prepares the necessary planning documents:

- the municipality's development master plan;
- the economic and social development plan;
- urban development plans in agglomerated areas;
- the rules relating to the use and use of land;
- detailed plans for urban development and subdivisions;
- it issues housing permits, building permits
- it ensures the permanent control of the compliance of achievements and contributions with the regulations in force".

The application of environmental regulations, negotiations for possible compensation, monitoring of the quality of water supplied to the population, etc. therefore involve the participation of the Mayors of the municipalities in the area where they are located.

Law No. 2021 - 14 OF 20 DECEMBER 2021 on the Code of Territorial Administration in the Republic of Benin in its Article 1^{sets} the general framework of territorial administration in the Republic of Benin and determines in particular the categories of local authorities, the distribution of competences between these authorities and the State, the distribution of public resources, the conditions for the exercise of supervision by the representative of the State.

Law No. 2009-17 of 13 August 2009 on the modalities of inter-municipal cooperation in the Republic of Benin opens up prospects for concerted management between municipalities with a view to pooling resources and improving efficiency in the areas where this provision is applicable. In this case, inter-municipal cooperation is essential in the management of sanitation and regional development.

• Local authorities The laws on decentralisation (Law No. 97-029 of 15 January 1999) grant the Communes powers as decentralised local authorities in environmental matters. They contribute with the State and other local authorities to the administration and planning of the territory, to economic, social, health, cultural and scientific development, as well as to the protection of the environment and the improvement of the living environment. In accordance with the provisions of Articles 84 to 86 of Section 1, and Chapter III, the Commune shall draw up and adopt its development plan. It ensures that it is carried out in harmony with national guidelines with a view to ensuring the best living conditions for the entire population. In this context, the local authority develops and delivers, among other things:

- the economic and social development plan;
- the rules relating to the use and use of land;



- the urban development and subdivision detail plan; the housing and building permits;
- and also ensures the permanent control of the compliance of the achievements and constructions with the regulations in force.

It regulates, authorises and controls the temporary occupation of its public domain. It is consulted beforehand on all work on its public domain in order to ensure coordination of interventions.

In accordance with the provisions of Articles 94 and 96 of Section 3, Chapter III, the Municipality shall ensure the protection of natural resources, in particular forests, soils, wildlife, hydraulic resources and groundwater, and shall contribute to their better use. It implements its own policy for the management of the environment and natural resources, but in accordance with national laws and guidelines. It gives its opinion whenever it is envisaged that any project likely to harm the environment is to be created on its territory.

Title III which addresses: Competences, Organization and Functioning of Local Authorities through Article 24 of Chapter 1, Article 24: The commune is the decentralized territorial collectivity in the Republic of Benin. It constitutes the institutional framework for the exercise of democracy at the grassroots level and the privileged place for citizen participation in the management of local public affairs.

Article 29 of Chapter II of the first section states that the municipality has its own powers as a decentralised territorial authority. It also exercises, under the supervision of the supervisory authority, other powers that fall within the competence of the State.

The municipality contributes with the State and other local authorities to the administration and development of the territory, to economic, social, health and cultural development.

The Town Halls and the representatives of the decentralised institutions concerned ensure the facilitation of the smooth running of the missions in the field (public consultation and dissemination of information).

4.3.2. Environmental and social standards applicable to the sub-project The above-mentioned provisions are further reinforced by national standards with which the activities of this project must comply in order not to cause irreversible degradation of the elements of the environment likely to be affected. These standards are set by the decrees and orders below.

• Wastewater standards Wastewater is one of the first nuisances that could be recorded. To this end, the standards relating to the discharge of industrial wastewater will be applied. These standards are defined in Decree No. 2001-109 of 4 April 2001, setting the standards for the quality of waste water in the Republic of Benin. The limit values used are given in Table 15.



Table 15: Release Standards for Conventional and Non-Conventional Contaminants in Industrial Wastewater

		(A) Allowable [Daily Average	(B) Quantity
Physico-chemical	Units	Concentration		of
parameters	(1)	If quantity	If quantity	contaminant
parametere	(.)	rejected < B	discarded> B	released
	Conventio	nal Parameter	rs	
BOD	mg O2/l	100	30	30 kg/day
MY	mg/L	100	35	15 kg/day
COD Mg 300 125 100 kg/d O2/l Total þils and fats mg/l 100 30 1 kg/d pH 6 < pH<9				
at all times N/a Temperatur	e 5°C highe	er than C° Reo	ceiving water temp	erature N/a
Non-conventional parameter	ers Phosph	orus (2) mg/1	100 10 15 kg/d	
(2) Total Nitrogen (NNT) (2) mg/1,200	30 g/d		
(2) mg/1: milligram (mg) of	contaminan	t per liter (1) d	of liquid.	

Source: Decree No. 2001-109 of 4 April 2001 setting waste water quality standards in the Republic of Benin

• Ambient air standards The use of machines can cause air pollution through the evaporation of toxic gases or greenhouse gases. Consequently, Decree No. 2001-110 of 4 April 2001 setting air quality standards in the Republic of Benin is applicable in this draft. It defines ambient air quality in accordance with the provisions of the Framework Law on the Environment (Table 16).

Table 16: Ambient air quality standards

Length of Value Period Polluta	hts Average Measurement 8-h	bur average
Ozone (03) 0.08 ppm 1-hour average 40 mg/m3 8-hour average carbon		
monoxide (CO) 10 mg/m3		
	1-hour average	1300 µ g/m 3
Sulphur dioxide (SO2)	24-hour average	200 µ g/m 3
	annual average	80 µ g/m 3
Suspended particles (< 10	24-hour average	230 µ g/m 3 50 µ g/m 3
microns)	annual average	οσ μ g/m σ
Nitrogon diovido (NO2)	24-hour average	150 µ g/m 3
Nitrogen dioxide (NO2)	annual average	
Lead (Pb)	Annual average	2 µ g/m 3

Source: Decree No. 2001-110 of 4 April 2001 setting air quality standards in the Republic of Benin



• Noise standards Decree 2022-301 of 25 May 2022 regulating noise in the Republic of Benin also remains valid in this case. Its first article aims to regulate and prevent noise pollution resulting from human activities and all other sources likely to manage noise. The noise source shall be located within a minimum radius of 200 metres from sensitive establishments. Depending on the time slot, noise levels are set in decibels outside the sources as follows (Table 17).

Slot	Noise intensity in dB (Private spaces: Outside the springs)	Noise intensity in (Public spaces: springs)	Db Outside
07:00 to 13:00	60	70	
1:00 p.m. to 3:00 p.m.	50	50	
3:00 p.m. to 10:00 p.m.	60	70	
10:00 p.m. to 7:00 a.m.	50	50	

Table 17: Noise emission standards

Source: Decree No. 2022-301 of 25 May 2022 regulating noise in the Republic of Benin

Solid waste management standards

Decree No. 2003-332 of 27 August 2003 on solid waste management in the Republic of Benin contains several articles, including those relating to: the transfer of waste; special provisions for the recovery of waste; the prevention and limitation of nuisances during waste management; etc. The objectives of the decree are therefore to:

- Prevent or reduce the production of waste, in particular by recycling, reuse, recovery, use as an energy source;
- Promote the recovery of waste, in particular through recycling, reuse,
- recovery, use as a source of energy;
- Organize waste disposal;
- limiting, monitoring and controlling waste shipments;
- Ensure the restoration of the sites.

The liability of waste producers is also defined in Article 9 of the Decree and stipulates that: "any person who produces or holds waste is required to ensure or have it managed in conditions that limit the negative effects on water, soil, flora and fauna, to avoid inconveniences due to noise and odours and, in general, not to harm the environment or human health

». Given that this project would be a source of waste production, compliance with the regulatory provisions of this decree is necessary and remains in line with the government's vision in the ecological and sustainable sanitation of the living environment of the population.



• Toxic Substance Standards The daily average concentrations and permitted release quantities are reported in Table 18.

Table	18.	Toxic	Substance	Release	Standards
Table	10.	10/10	oubstance	I CICaSC	Otanuarus

	Allowable	of release for
Parameters	daily average	exemptionma/l
	concentration	oxomptioning/i
	Limit quantity	
Sulphides Fluorides Cyanides Metals:	2,5	50
Arsenic Cadmium Hexavalent	4	150
Chromium Total Chromium Copper	1,0	1
Mercury Nickel Lead Zinc Phenolic		
Compounds Total Hydrocarbons	0,5	1g/l
Monocyclic Aromatic Hydrocarbons	1,0	5g/l
(HAM) Total Halogenated	0,1	1g/l
Hydrocarbons Polycyclic Aromatic	2,5	5g/l
Hydrocarbons Polychlorinated	2,5	5g/l
Biphenyls (PCBs) Other Inorganic	0,03	0.1
Contaminants (Each) Other Organic	2,5	5
Contaminants (Total)	1,0	5
	5,0	20
	1,0	3
	10	100
	0,5	1
	0,5	1
	0,5	1
	0,15	0,5
	5,0	10
	0,5	1

Spring : Decree No. 2001-110 of 4 April 2001 setting air quality standards in the Republic of Benin

• Standards for waste oils The use of

machinery often generates liquid waste, including waste oil, which deserves to be collected and treated. Decree No. 2003-330 of 27 August 2003 on the management of waste oils in the Republic of Benin defines the methods of collection, transport, grouping, pre-treatment, disposal or recovery.



 Physico-chemical quality standards for water intended for human consumption and domestic use

Table 19 presents these standards Table 19: Physico-chemical quality standards for drinking water

Baramatara	Lipit	Maximum
Parameters	Onit	Allowable Value
Physical parameters		
Turbidity	UTN or FNU	5.0
Inorg	ganic chemical parameters	
Arsenic mg/l	mg/l mg/l	0.05
Barium		1.0
Boron		5.0
Cadmium mg/l	mg/l mg/l mg/l mg/l mg/l mg/l	0.005
Chrome mg/l	mg/l mg/l mg/l – mg/n/l mg/l	0.5
Copper mg/l	mg/I mg/I Organic chemical	2.0
Cyanides para	meters mg/l mg/l mg/l	0.2
Fluorides Ope	rational Standards mg/l mg/l	1.5
Mercury mg/l	mg/l mg/l 3	0.001
Nickel		0.02
Nitrates		45
		10
Nitrites		3.2- 0.1
Lead		0.05
Selenium		0.01
Sulphates		500
Ph		6.5< pH < 8.5
Benzene Phenolic		0.010
Compounds		0.002
Calcium		100
Chlorides		250
Iron		0.3
Magnesium		50
Manganese		0.1
Zinc		

Source: Decree No. 2001-094 of 20 February 2001 establishing drinking water quality standards in the Republic of Benin

4.3.3. Legislative framework The legislative framework refers to all the texts and laws in force in the Republic of Benin. The main texts that are directly related to the present draft are summarized as follows.



4.3.3.1. The Constitution of the Republic of Benin

Law No. 90-32 of 11 December 1990 on the Constitution of the Republic of Benin, as amended by Law 2019-40 of 7 November 2019, lays down certain principles relating to the environment and the living conditions of citizens. These principles are found in the following articles:

Article 8: The State shall ensure that these citizens have equal access to health, education, culture, information, vocational training and employment.

Art.22: Everyone has the right to property. No one may be deprived of his property except in the public interest and in return for just and prior compensation.

Art.27: Everyone has the right to a healthy, satisfactory and sustainable environment and has the duty to defend it. The State shall ensure the protection of the environment.

Article 74: High treason occurs when the President of the Republic has violated his oath, is found to be the author, co-author or accomplice of serious and serious violations of human rights, of the transfer of part of the national territory or of an act detrimental to the maintenance of a healthy, satisfactory, sustainable environment conducive to development.

Art.98: The rules concerning: the protection of the environment and the conservation of natural resources are within the scope of the law.

4.3.3.2. Law No. 98-030 of 12 February 1999 on the Framework Law on the Environment in the Republic of Benin and its Implementing Decrees Voted and promulgated on 12 February 1999, the Framework Law on the Environment in the Republic of Benin is of general scope and lays down a number of legal and institutional provisions. It "defines the bases of environmental policy and organises its implementation" (Art.1.). It includes provisions relating to the clarification of concepts, sanctions, the protection and enhancement of the natural and human environment, pollution and nuisances, impact studies, public hearings on the environment, etc. A few articles deserve to be highlighted.

Regarding the obligation of strategic environmental impact assessments and environmental impact assessments in Benin and the applicable sanctions:

Article 88 stipulates that "No one may undertake developments, operations, installations, plans, projects and programmes or the construction of works without following the environmental impact assessment procedure, when the latter is required by laws and regulations.";

Section 89: "Any person who intends to undertake an activity referred to in section 88 shall file a written notice with the Minister requesting the issuance of a certificate of environmental compliance and describing the general nature of the activity. This certificate of environmental compliance is one of the documents to be submitted to the supervisory authority to obtain the final decision on the implementation of the proposed activity." Article



122: "Any person convicted of having falsified the result of an impact study or altered the parameters allowing the carrying out of an impact study shall be punished by a fine of five million (5,000,000) to twenty-five million (25,000,000) francs and a prison sentence of one (1) to three (3) years, or by one of these penalties only. The use of the falsified or altered result of an impact study referred to in the preceding paragraph shall be punishable by the same penalties".

Concerning the protection of the marine environment, particular attention is paid to the following articles of the Framework Law on the Environment:

Article 39 which provides that "in addition to the provisions of international conventions, treaties and agreements ratified by the Republic of Benin and relating to the protection of the sea, the discharge, immersion, direct or indirect introduction or incineration at sea of materials likely to: (i) harm public health and biological resources are prohibited; (ii) impede maritime activities, including maritime navigation and fishing ;(iii) alter the quality of seawater and (iv) degrade the leisure values and tourism potential of the sea".

Articles 43 and 50 make activities likely to harm the marine and human environment of the coastal zone subject to prior authorisations. To this end, Article 43 provides that "no occupation, operation, construction, establishment likely to constitute a source of nuisance of any kind whatsoever may be carried out or carried out on the shore of the sea and on the entire extent of the public maritime domain without an authorization from the competent Beninese authorities". The said authorization can only be granted "after technical advice from the Beninese Environment Agency, which must make a report on the impact study produced by the project owner and concerns only the performance of activities of general interest, and must not hinder free access to the public maritime domain or free movement on the beach". Art.50 specifies that "Any activity that may harm animal species or their natural environments is either prohibited or subject to the prior authorization of the administration".

Some decrees implementing the framework law on the environment require attention. These are:

- Decree No. 2001-190 on the organization of the public hearing procedure in the Republic of Benin;
- Decree No. 2005-437 on the organization of the environmental inspection procedure in the Republic of Benin.
- Decree No. 2001-110 of 4 April 2001 establishing air quality standards in the Republic of Benin.
- Decree No. 2003-332 of 27 August 2003 laying down the procedures for solid waste management in the Republic of Benin.
- Decree No. 2003-330 of 27 August 2003 laying down the procedures for the management of waste oils in the Republic of Benin



- Decree No. 2001-094 of 20 February 2001 establishing drinking water quality standards in the Republic of Benin.
- Decree No. 2005-466 of 28 July 2005 laying down the procedures for the implementation of environmental auditing in the Republic of Benin.
- Decree Decree No. 2022-301 of 25 May 2022 regulating noise in the Republic of Benin.
- Decree No. 2017-332 of 6 July 2017 on the organization of environmental assessment procedures in the Republic of Benin.

4.3.3.3. Law No. 2016-06 of 26 May 2016 on the framework law on spatial planning in the Republic of Benin Article 40 of this law specifies that a Certificate of Spatial Coherence (CCS) is instituted issued by the authority in charge of spatial planning following a spatial coherence study carried out for all projects of national and regional scope.

The procedures for drawing up and issuing as well as the content of the Certificate of Spatial Coherence are specified by the implementing texts.

4.3.3.4. Coastal law on the protection, development and development of the coastal zone This coastal law is particularly aimed at the protection of biodiversity, the regulation, use, management and interventions relating to coastal areas. According to the principles of this law, "the Beninese coastal zone is a sensitive space between the parallels 6° 10' and 6°40' north latitude and the meridians 1°40' east and 2° 45' east longitude".

The law provides that "the exploitation of sand and gravel in the coastal zone must be carried out according to an exploitation schedule defined by order of the ministers in charge of mines and the environment, after technical advice from their competent structures". Similarly, it specifies that the determination of the perimeter of sea sand exploitation in a given area is "subject to the natural replenishment capacity of sand in that area. A preliminary study must be carried out for this purpose".

In addition, "the authorisation to exploit quarry substances is granted by the Minister in charge of mines, after consulting the Minister in charge of the environment and the municipal or municipal council concerned". It therefore requires companies whose activities are likely to lead to discharges into water and the atmosphere to carry out an environmental impact assessment before their installation.

4.3.3.5. Law No. 98-019 of 21 March 2003 on the Social Security Code in the Republic of Benin This law established in the territory of the Republic of Benin:

- a general social security scheme for workers in the formal sector subject to the provisions of the Labour Code;
- a special scheme for self-employed, agricultural workers and the informal sector.



Article 2 of the law lays down the main fundamentals of social security. In Article 53, it specifies the beneficiaries of health and social action, which are the wives of workers and salaried women who are pregnant or have given birth, under medical supervision, to a child, and the children of these women who are regularly registered in the beneficiary's family record book. Article 55 of the Act considers an accident at work, whatever the cause, to be an accident occurring as a result of or in the course of work to all the workers referred to in Article 4 of the Act. Similarly, an accident occurring to the worker during the journey from his residence to the place of work and vice versa, or during the journey between the place of work and the place where he habitually eats his meals, and vice versa, is also considered to be an industrial accident, provided that the journey has not been interrupted or diverted for reasons of a personal nature or unrelated to employment, during trips for which the costs are borne by the employer under the provisions of the Labour Code.

With regard to personal safety, article 57 of the Act requires the employer to report simultaneously to the labour inspector and to the Social Security Fund, within 48 hours of being informed, any occupational accident or disease affecting employees employed in the enterprise. As for article 58, it confirms the employer's liability: "Even in the event of a late declaration by the employer, the Fund shall ensure compensation for the accident in accordance with the provisions of this law. However, it is entitled to bring an action against the employer to recover its disbursements, which does not exclude the criminal sanctions provided for in Article 139 of this law". During the work phase, it is important that the staff who will be mobilised on the sites be declared to the National Social Security Fund with regard to the sensitivity of the site and the associated security risks.

4.3.3.6. Law on the Labour Code (No. 98-004 of 27 January 1998) and Law No. 2017-05 of 29 August 2017 laying down the conditions and procedure for hiring, placing workers and terminating the employment contract in the Republic of Benin This law defines a worker, regardless of sex and nationality, any person who has undertaken to place his or her professional activity, in return for remuneration, under the direction and authority of a natural or legal person, public or private. For the purpose of determining the status of worker, neither the legal status of the employer nor that of the worker must be taken into account. Among other things, it legislates on working conditions and occupational health and safety rules. Thus, the legal working time may not exceed forty hours per week. The actual daily working time per worker may not exceed eight hours, unless a derogation is set by decree issued by the Council of Ministers or by collective agreements. However, in agricultural holdings, the legal working time is set at two thousand four hundred (2400) hours per year. Article 182 of the Act stipulates that in order to protect the life and health of workers, the employer is required to take all appropriate measures appropriate to the operating conditions of the enterprise.

Given that for the implementation of the planned arrangements, the executing company will employ several people to ensure the workforce, it will then have to ensure the provisions of



the Beninese Labour Code throughout the process in accordance with article 3 of this law which stipulates that "any head of establishment or company or any employer shall freely recruit his staff who benefit from occupational safety and health services".

To this end, the company in charge of the work is required to inform the competent services of the Ministry of Labour, of the jobs for which recruitment will be carried out and also to register and affiliate workers with the structures in charge of social protection, in particular the CNSS.

4.3.3.7. Law No. 2006-17 of 17 October 2006 on the Mining Code and Mining Taxation in the Republic of Benin The mining sector in Benin is governed by Law No. 2006-17 of 17 October 2006 on the Mining Code and Mining Taxation in the Republic of Benin. It applies to the prospection, exploration, exploitation, holding, processing, transportation, processing and trade of mineral resources. Articles 41 to 48 of the Act set out the conditions for the exploitation of mineral resources and oblige operators to conduct activities in such a way as to avoid as much as possible any adverse impact on the environment, including pollution of the land, atmosphere and water and damage to or destruction of flora or fauna. It also makes the exploitation of lagoon sand quarries subject to statutory provisions and prohibits the exploitation of sea sand.

The provisions of this law will guide the opening of sand quarries for the needs of the work, among other things.

4.3.3.8. Law No. 2010-44 of 21 October 2010 on water management in the Republic of Benin This law establishes "Integrated Water Resources Management (IWRM)" as a principle of water management and sets the general legal framework and the basic principles of IWRM in Benin with the aim of ensuring balanced use, equitable distribution and sustainable use of the available resource. The said law confirms the water protection regime of Art.28 of the Framework Law on the Environment in Benin according to which "discharges, flows, discharges, direct or indirect deposits of any kind that may cause or increase water pollution are prohibited, are subject to prior authorization in accordance with the laws and regulations in force in Benin".

Articles 17 and 18 define water as an element of the national common heritage and a part of the public domain which includes surface water and groundwater as well as their dependencies and the public works assigned or necessary for their management. This includes:

- watercourses;
- natural and artificial lakes, lagoons, ponds, ponds and bodies of water in general;
- springs and outlets;
- human areas and spaces where the presence of water, without being permanent, is regular;



- wells, boreholes, watering troughs, fountains or standpipes and other water points assigned to the use of the public or to a public service, as well as any immediate protection perimeters, delimited pursuant to Article 48 of this Law;
- dikes, dams, causeways, locks and their outbuildings or ancillary structures;
- irrigation, sanitation and drainage canals;
- aqueducts, pipes, diversions and water pipes, reservoirs and wastewater treatment plants and, in general, hydraulic works used for public use or for a public service, as well as the facilities and land dependent on them.

Project activities will affect water resources such as swamps, lagoons and ponds. This law is therefore important to take into account.

4.3.3.9. Law No. 2017-15 of 10 August 2017 amending and supplementing Law 2013-01 of 14 January 2013 on the Land and State Code in the Republic of Benin This law and its implementing decrees constitute the main legal references in land and state matters in Benin. Its purpose is to "determine the fundamental rules and principles applicable in matters of land and property and to govern the organization and functioning of the land and property system in the Republic of Benin" (Art. 1). It applies to "the public and private domains of the State and local authorities, the real estate of private persons, the organization and functioning of the land and property Code in the Republic of Benin" (Art. 3).

With regard to development projects, Art 5 of the Land and State Code (CFD) provides that "within the framework of the implementation of development policies and for reasons of public utility, the State and local authorities, subject to fair and prior compensation, have the right to expropriate any holder of land rights". The terms and conditions of this expropriation are set out in Title IV of this law. Article 210 states that the infringement of the right of cleanliness may consist of expropriation in the public interest, a limitation of the right to property for the purpose of urban or rural development and the issuance of easements in the public interest. More specifically, Article 215 provides additional information on the precise conditions under which expropriation for reasons of public utility takes place.

As regards the procedure, the law states that the expropriation of immovable property, in whole or in part, or of real property rights in the public interest is carried out, in the absence of an amicable agreement, by court decision and against the payment of fair and prior compensation (Article 211). An act declaring it to be in the public interest (a law, decree or order) indicating the geographical area concerned by the planned works of general interest and specifying the period (12 months maximum) during which the expropriation must be carried out is issued (Article 217). Following the declaratory act of public utility, an inquiry is carried out under the authority of a



commission of inquiry, chaired by the Minister, the prefect, the head of the region or the mayor or their representative, as the case may be. The provisions of Decree No. 2015-013 of 29 January 2015 on the composition and functioning of the commissions of inquiry of commodo and incommodo and compensation in matters of expropriation for reasons of public utility, complete the law. The allowances are retained by mutual agreement with the parties concerned. They must cover all the direct, material and certain damage caused by the expropriation. They shall be determined according to the nature of the property, taking into account its value and, where appropriate, the increase or loss in value resulting from the execution of the planned work for the part of the building not expropriated.

According to Article 235, transactions, modifications or improvements of any kind, such as constructions, plantations, various installations, acquisition of goods, which have been made to the building, industry or goodwill, even prior to the expropriation order, do not give rise to any compensation if, by reason of the time at which these transactions, modifications or improvements took place, or any other circumstance, it appears that they were made with the aim of obtaining a higher compensation. As soon as the parties agree on the amount of compensation to be awarded, a record of this agreement signed by all parties is drawn up. The expropriation file, including the report, is submitted to the president of the court of the location of the premises for the judicial phase. In the event of disagreement, a report is also drawn up and the matter is referred to the court by simple letter or by summons by the most diligent party.

Other provisions of the law specify the conditions for expropriation in the public interest, in particular the emergency procedure for expropriation, temporary occupations by the administration or local authorities, the limitation of the right to property for the purpose of land use planning and town planning, and easements of public utility, and the constitution of public domains.

The resettlement activities of the populations provided for in the project will therefore have to comply with these provisions of the Land and State Code and its implementing decrees. It is important to note that in relation to the "fishing road" project, Art.264 of the Land and State Code recognizes that the following are in the natural public domain of the State and local authorities: "(i) the sea shore up to the limit of the highest tides as well as an area of one hundred (100) meters measured from this limit; ... (ii) lakes, ponds and lagoons within the limits determined by the highest water level before overflow, with a twenty-five (25) metre wide passage zone from these limits on each outer shore and on each of the edges of the islands; (iii) flood-prone, swampy or shifting lands and areas... ».

Some of the decrees implementing Law 2013-01 of 14 January 2013, a number are:

• Decree No. 2015-007 of 29 January 2015 on the attributions organization and and functioning of the Land Advisory Council (CCF);



Decree No. 2015-008 of 29 January 2015 on the attributions, organization and operation of the Land Compensation Fund (FDF) in the Republic of Benin. This decree is particularly noteworthy in the context of this project. Indeed, Article 4, which sheds light on the missions of the Land Compensation Fund, presents them as follows:

• Provide financial assistance for the access of the State and local authorities to land in Benin and outside Benin within the framework of their development policies and to meet the needs of public utility;

• ensure the financing of procedures in the cases provided for by the Land Code, and state-owned property: expropriation procedures for reasons of public utility and related compensation; procedures for exercising the right of pre-emption;

• Assisting the State in the purchase of buildings built in favour of a bona fide occupant threatened with forced eviction in execution of a court decision;

• ensure the rental and purchase of built buildings to interested parties in the case of expropriated or pre-empted buildings, as an alternative solution to eviction procedures;

• carry out all land operations directly or indirectly related to the missions specified above or entrusted to it by the State or local authorities;

• to conserve, manage and put into use by citizens who request it, for agricultural, pastoral or industrial purposes, the property of the real estate of the State, pending the realization of public service projects;

• to provide financial assistance to the National Agency for Land and Land in the implementation of its land policy.

- Decree No. 2015-009 of 29 January 2015 laying down the terms and conditions for exercising the right of pre-emption and lease-purchase of pre-empted or expropriated buildings;
- Decree No. 2015-010 of 29 January 2015 on the attributions, organization and functioning of the National Agency for Domain and Land (ANDF);
- Decree No. 2015-011 of 29 January 2015 on the terms and conditions of transfer for consideration, alienation free of charge, and rental of land and immovable property in the private domain of the State and local authorities;
- Decree No. 2015-012 of 29 January 2015 setting the terms and conditions for the award, development and takeover of private state concessions in rural areas;
- Decree No. 2015-013 of 29 January 2015 on the composition and functioning of the commissions of inquiry of commodo and incommodo and compensation in matters of expropriation for reasons of public utility; This decree determines the procedures to be followed by the commission responsible for the investigation of commodo et incommodo and the commission for the evaluation of the compensation to be awarded to victims of expropriation in the public interest and determines their composition and the modalities of their operation.



- Decree No. 2015-016 of 29 January 2015 on the conditions and modalities of occupation of public property;
- Decree No. 2015-017 of 29 January 2015 on the attributions, organization and functioning of the land management commission of the commune and the village land management section;
- Decree No. 2015-18 of 29 January 2015 laying down the procedures for establishing the rural land plan and confirming land rights on the basis of the rural land plan;

4.3.3.10. Law No. 2002-016 of 18 October 2004 on the Wildlife Regime in the Republic of Benin With a view to protecting the natural heritage of wildlife species, this law aims to exploit wildlife resources that do not exceed the limits that guarantee the renewal of their stock. It reaffirms the principles of Art.50 of the Framework Law on the Environment, which states that "any activity that may harm animal species or their natural environments is either prohibited or subject to the prior authorisation of the administration". The said law establishes the rational and participatory management of wildlife and its natural habitats, the creation and management of protected areas, and the protection of endangered species.

The area of project activities is largely the Beninese coastline which is an area of wildlife resources classified as ecologically sensitive, the project in the exercise of its activities will have to take the necessary measures to conserve or failing that limit the degradation of the wildlife habitat and maintain the conditions necessary for the reproduction of species beyond this biosphere reserve. The provisions of this law will be useful for this purpose.

4.3.3.11. Law No. 97-029 of 15 January 1999 on the organization of municipalities in Benin The territorial administration of the Republic is provided by the decentralized authorities and services of the State and by the decentralized territorial authorities. Decentralization, which has been effective since March 2003, assigns powers to decentralized communities in terms of environmental management and land use planning. Indeed, Law 97-029 of January 15, 1999 on the organization of municipalities in Benin, states that the municipality is competent with regard to sanitation, waste management, environmental and natural resource management. It is up to the municipality to implement national strategies for the protection of the environment and natural resources on its territory. In order to exercise its powers, the municipality shall equip itself with planning documents such as the development plan, the master plan for development, urban planning, subdivision and urban development plans, etc. it is also the responsibility of the municipality to issue housing and building permits in accordance with and collaboration with the ANDF and the national land provisions.

Decree No. 2022-319 of June 1, 2022 setting the criteria for the categorization of Municipalities in the Republic of Benin and, Decree No. 2022-320 of June 1, 2022 on the categorization of Municipalities in the Republic of Benin confirms, Cotonou as a Municipality



with a special status, pursuant to Article 28 of the Code of Territorial Administration in the Republic of Benin.

In the implementation of this project, which is the subject of this study, the involvement of the local authorities of the municipality of Cotonou is essential.

All of these legislative texts and their implementing texts make it possible to settle the issues of the environment, land expropriation, management of quarries and ecological zones related to the implementation of the project. To this must be added those concerning environmental assessment in the Republic of Benin.

4.3.3.12. Decree No. 2021-391 of 21 July 2021 on the creation and approval of the statutes of the National Institute for Women (INF). In article 3 of this law, the National Women's Institute is placed under the supervision of the Presidency of the Republic.

The National Institute for Women is the framework for consultation with the organizations of the civil society that works for the protection and advancement of women. As such, he:

- draws up an inventory of the problem of all forms of violence and more generally all forms of discrimination against women and girls, initiates and conducts studies and research in this area;
- assesses the impact of all forms of violence and discrimination on women's inclusion in sustainable development, their participation in public and political life, and their fulfilment within their families;
- ensures the production, dissemination and updating of all information, documentation, archives, and all statistical, legislative and regulatory data equipped by sex in general, and relating to women and girls in Benin in particular;
- participates in the development of policies, strategies, plans and programmes of action aimed at the protection and promotion of women and girls in Benin;
- Participates in the supervision and coordination of the implementation of these policies, strategies, plans and action programmes and provides technical and operational support;
- proposes tools and gives technical advice to facilitate this implementation, including the development of codes of conduct, guides, manuals and protocols for use by both public and private actors; participates in the evaluation of the results of the implementation of these policies, strategies, plans and action programmes;
- evaluates the actions initiated in the context of the protection and promotion of women and girls by actors in the public and private sectors and by civil society organizations;
- Supports gender mainstreaming in all sectors;



- works to improve the legal status of women and in particular evaluates the legislation in force, and proposes reforms or new laws; organises the fight against all forms of discrimination against women: physical, psychological, economic violence, sexual harassment, levirate, female genital mutilation, exploitation and trafficking, forced marriage, early marriage, etc. and mobilizes support for this fight;
- Organizes social dialogue on the elimination of traditional, customary, religious and stereotypical attitudes that perpetuate violence and other forms of discrimination against women and girls with actors

political, religious, civil society, traditional authorities, local elected officials, with a view to:

- o Reflect on the influence of certain religious traditions, customs and practices on community attitudes and their role in perpetuating violence against women.
- o to work towards the identification of cultural values promoting the status of women and prohibiting any discrimination against them, with a view to their valorization;
- Leverage the influence of these actors with communities to eliminate customs and practices relating to inheritance and matrimonial property that have a negative impact on the status of women;
- To encourage these actors to support and facilitate efforts to eliminate the exclusion of women from political and public life;
- leads a framework for consultation with civil society organizations working for the protection and advancement of women;
- provides information, advice and assistance to all persons on the legislation in force and the means of asserting their rights in cases of violence and all forms of discrimination;
- carries out, in consultation with the Ministry in charge of Social Action,
- awareness-raising actions for the general public and certain target groups;
- identifies and proposes actions to strengthen the capacities of actors involved in the chain of holistic care for victims of gender-based violence and other forms of discrimination;
- proposes or contributes to the design of a module for a university degree course on issues related to gender, equal rights and opportunities between women and men in the private, public, activist and associative sectors, and the organization of this training in the universities of Benin;
- ensures the availability of public services for reception, transitional accommodation, and medical, social, psychological and legal care for victims of gender-based violence and other forms of discrimination;



- works to integrate men into strategies to raise awareness and remove social, cultural and religious barriers;
- participates in the preparation and validation of periodic reports due under regional and international instruments ratified by Benin as well as in their presentation to the committees and other competent mechanisms;
- Actively participates in all international and regional debates related to the protection, advancement and participation of women in development;
- ensures the popularization of all laws, regulations and international or regional instruments for the protection and promotion of
 - women and ensures permanent social communication about them;
- organizes international, African and national days relating to the protection and advancement of women;
- identifies and proposes to the Grand Chancellery men and women who have distinguished themselves in the protection and promotion of women, for honorary awards or distinctions;
- runs a listening service, ensures the availability of a helpline for any report and receives reports from victims or people with knowledge of acts of violence or discrimination;
- provides optimal support to victims and in particular assists them in dealing with any structure or administration accused or suspected of discrimination against them;
- takes legal action, is a civil party before the ordinary courts and also before all specialised courts;
- ensures that the budget lines allocated to the implementation of the INF's responsibilities are allocated by the supervisory authority, the ministries and the municipalities.

4.3.3.13. Laws and regulations for the environmental assessment of the project In addition to the provisions of Articles Art.43 and Art.50 of the Framework Law requiring the establishment of an environmental impact assessment (EIA) for any activity likely to harm the environment in the maritime public domain; the provisions of the Framework Law in its Art.88 stipulate that "No one may undertake developments, operations, installations, plans, projects and programmes or the construction of works without following the environmental impact assessment procedure, when the latter is required by laws and regulations". These provisions are a sine qua non condition for obtaining a certificate of environmental compliance issued by the Minister in charge of the environment. Art. 89 of the said Act provides that "Every person who intends to undertake the carrying out of one of the activities referred to in section 88 shall file a written notice with the Minister requesting the issuance of a certificate of environmental compliance to the initiator of the activity, the nature, scope and extent of the environmental impact study that the latter must prepare... the impact study must be prepared and submitted with the application for authorization to the Minister".



The decree on the organization of environmental assessment procedures in the Republic of Benin was issued to operationalize the provisions of the framework law. Several other decrees on quality standards governing environmental components, air, drinking water, wastewater, noise, etc. were also adopted.

 Decree No. 2017-332 of 6 July 2017 on the organization of environmental assessment procedures in the Republic of Benin

It applies to "any policy, plan, programme, project or development activity likely to have positive and/or negative effects on the environment" (Art.2). According to Art.3, the Environmental Assessment (EA) includes: "the Strategic Environmental Assessment (SEA), the Environmental and Social Management Framework (ESMC), the Environmental and Social Impact Assessment (ESIA), the Environmental Audit (EA), the Public Hearing (PA) and the Environmental Inspection (EI), the Population Resettlement Action Plan (PARP) and the Resettlement Policy Framework (RPF)".

This decree has the advantage of integrating a number of environmental and social safeguard instruments of international organizations over the others, including the Environmental and Social Management Framework (ESMC), the Population Resettlement Action Plan (PARP) and the Population Resettlement Policy Framework (CPRP).

Article 5 states that "the purpose of strategic environmental assessment is to integrate environmental considerations into policies, strategies, plans and programmes during their preparation, approval and maintenance". Similarly, it makes it possible to identify and evaluate the issues and effects on the environment.

The policies, strategies, plans and programmes referred to in Article 5 may be of a sectoral, national or local nature (Article 6). The SEA is defined as "(i) policies, strategies, plans or programmes concerning, inter alia, protected areas, agriculture, forestry, fisheries, energy, mining, industry, transport, waste management, water management, telecommunications, socio-economic infrastructure, tourism, education, health, urban planning documents, development plans and any other area likely to have an impact on the environment. the environment.

Policies, strategies, plans or programmes covered by national defence secrecy may not be subject to Strategic Environmental Assessment processes; if necessary, a decree is issued by the Council of Ministers" (Art.8).

This decree makes the development of the ESMC mandatory by integrating it into environmental assessments (Art.3).

4.3.4. Environmental standards applicable to the project The compliance standards applicable to the execution of the project are defined by the various implementing texts, namely:

• Decree No. 2001-110 of April 2001 on air quality standards in the Republic of Benin, which defines the quality of ambient air outside the industrial units concerned, the



standards for the discharge of motor vehicles and the atmospheric emission standards for stationary sources, in accordance with the provisions of Act No. 98-030 of 12 February 1999 on the framework law on the environment in the Republic of Benin. These ambient air quality standards are as shown in Table 20.

Table 20: Ambient Air Quality Standards

Pollutants	Duration of the measurement period	Average value
Ozone (O3) 8-hour average 1-hour	average Carbon	0.08 ppm
monoxide (CO) 8-hour average 8-h	our average Sulphur	40 mg/m3
dioxide (SO2) 24-hour average Anr	ual average	10 mg/m3
Suspended particulate matter (< 10	24-hour average	100 μg/m3 200 μg/m3
microns) Annual average 24-hour a	verage Nitrogen	80 μ g/m3
dioxide (NO2) Annual average Lead	l (Pb) Annual average	230 μg/m3
		50 μg/m3
		150 μ g/m3
		100 μg/m3
		2 µ g/m3

Source: **BeprateioNof** 2001-110 of 4 April 2001 setting air quality standards in Benin.

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Institution types Parameter		Emission limit criteria
Cement plant (clinker grinding and fo	rmulation)	50 g/T clinker
Particulate matter Combustion plants using hy	drocarbon	85 mg/MJ
particulate matter as NOx fuel		325 ppm

Spring : Decree No. 2001-110 of 4 April 2001 setting air quality standards in the Republic of Benin.

• Deisrede the 2020 and 1 roft Marti2 b, 2012 &, could be so of noise emission and in its article 7, the Reise bevels according to the time slots and the types of zones throughout the territory. The following table summarizes these provisions.

Decree No. 2022-301 of 25 May 2022 regulating noise in the Republic of Benin also remains valid in this case. Its first article aims to regulate and prevent noise pollution resulting from human activities and all other sources likely to manage noise. The noise source shall be located within a minimum radius of 200 metres from sensitive establishments. Depending on the time slot, noise levels are set in decibels outside the sources as follows (Table 22).



Table 22: Noise emission criteria

Type of area Slot	Noise intensity in dB (Private spaces: Outside sources)	Noise intensity in dB (Public spaces: Outside sources)
07:00 to 13:00	60	70
1:00 p.m. to 3:00 p.m.	50	50
3:00 p.m. to 10:00 p.m.	60	70
10:00 p.m. to 7:00 a.m.	50	50

dB: decibel.

Source: Decree No. 2022-301 of 25 May 2022 regulating noise in the BR

In addition, specifically to road infrastructure, Article 13 of Chapter V states that "noise levels near dwellings located along a road or a major traffic artery must not exceed 70dB(A) between 00 a.m. and 5 a.m."

- Decree No. 2003-330 of 27 August 2003 on the Management of Used Oils in the Republic of Benin, which presents, among other things:
 - the storage, collection and transport of used oils;
 - the approval of collectors and transporters of waste oils;
 - the conditions for the pre-treatment, recovery and disposal of waste oils in Benin;
 - the conditions for obtaining approval for operators of used oil pre-treatment, disposal and recovery units.

Article 2 defines waste oils as "Any oil, derived from the refining of crude or synthetic oil, intended for lubrication or other purposes, and which has become unfit for its original use due to the presence of impurities or the loss of its original properties; they include lubricating oils, hydraulic oils, metalworking oils, and insulating or heat transfer fluids." This Article 2 prohibits:

- deposit, pour or leave waste oil in any place where it may pollute the environment, including in or on the ground, in surface water or groundwater, in sewers, pipes or collectors;
- to carry out the combustion of waste oils in an unapproved installation unless it is carried out under the conditions provided for in Article 26 of this decree;
- add or mix water or any foreign matter, such as solvents, cleaning products, detergents, other fuels or other materials, to these waste oils, before or during collection, or before or during storage;
- to mix used oils with polychlorinated biphenyls (PCBs) or with toxic or hazardous waste during collection and storage;
- Mixing mineral oils with synthetic animal or vegetable oils.



• Decree No. 2003-332 of 27 August 2003 on the management of solid waste in the Republic of Benin defines the objectives and provisions for the protection of the environment and human health from any harmful influence caused by waste. This decree includes several articles, in particular those relating to the prevention and limitation of nuisances during waste management; the special provisions for waste recovery; the transfer of waste, etc.

It aims, among other things:

- the prevention or reduction of waste and its harmfulness;
- the organisation and disposal of waste, the limitation, monitoring and control of waste shipments;
- the assurance of the restoration of the sites.
- Decree No. 2001-109 of 4 April 2001 establishing the Waste Water Quality Standards in the Republic of Benin prohibits the discharge of toxic substances into a receiving environment in concentrations above the thresholds set out in Table 23.

Parameters Average concentra exemption Sulphides 2.5 mg/l 5	tion Limit of daily allowable 0 g/day	quantity of release for
Fluorides 4 mg/l 150 g/d Cyanie	des 1.0 mg/l 1 g/d	
Metals: Arsenic 0.5 mg/l 1 g/d 0 chromium 0.1 mg/l 1 g/d Total o g/d Mercury 0.03 mg/l 0.1 g/d N Zinc 5.0 mg/l 20 g/d Phenolic c Total 10 mg/l 100 g/d	Cadmium 1.0 mg/l 5 g/d He hromium 2.5 mg/l 5 g/d Co lickel 2.5 mg/l 5 g/d Lead 1. ompounds 1.0 mg/l 3 g/d Hy	avalent oper 2.5 mg/l 5 0 mg/l 5 g/d /drocarbons
Monocyclic aromatic hydrocarbons (HAM)	0.5 mg/l	1 g/d
Total halocarbons	0.5 mg/l	1 g/d
Polycyclic aromatic hydrocarbons	0.5 mg/l	1 g/d
Polychlorinated biphenyls (PCBs)	0.15 mg/l	0.5 g/d
Other inorganic contaminants (each)	5.0 mg/l	10 g/d

Table 23: Discharge limit standards for waste water admitted to the Republic of Benin



Other contaminants 0.5 mg/l 1	g/d organic (total)	

Source: Decree No. 2001-109 of 4 April 2001 establishing Waste Water Quality Standards in the Republic of Benin

4.3.5. Environmental impact assessment requirements

4.3.5.1. Regulatory basis

Benin's legal and regulatory framework for environmental and social protection establishes the obligation to evaluate projects through an EIA. The Environmental Impact Assessment (EIA) will present and take into account the laws and regulations that are applicable to the project and will make recommendations based on legal requirements, so that the project complies with the regulations.

The main legal and regulatory texts in force in Benin relating to EIAs are in particular:

The Constitution of 11 December 1990 as amended and supplemented by Law No. 2019-40 of 7 November 2019;

• Law No. 98-030 of 12 February 1999 on the Framework Law on the Environment in the Republic of Benin;

• Decree 2017-332 of 6 July 2017 on the organization of environmental assessment procedures in the Republic of Benin. This decree clarifies the responsibilities and sets the administrative procedure for the issuance of the Certificate of Environmental Compliance (CCE) by the Minister of Living Environment and Sustainable Development (MCVDD), and;

• The General Guide for Carrying out an Environmental Impact Assessment in Benin, drawn up by the EBA in February 2001.

• These texts are the reference for Environmental Impact Assessments in Benin. The purpose of the EIA is to determine the effects that the implementation or execution of the Project may have on the environment. It must be carried out by (i) an approved design office or (ii) a team of experts led by an approved expert. The approval of the said office of experts or team is issued by the Minister in charge of the Environment after technical advice from the EBA for a renewable period of five years.

In accordance with Article 88 of the Framework Law on the Environment on the one hand, and the directives of the General Guide to Carrying Out an EIA in its Title III.3, the Project is subject to an In-Depth Environmental and Social Impact Assessment, applicable to projects whose activities are either likely to significantly modify the environment or planned to be carried out in a risk or ecologically sensitive area.



Figure 13 shows the procedure for conducting EIAs in Benin.



Figure 13: Procedure for carrying out the ESIA in Benin Source: Fieldwork, CECO-BTP 2022

4.3.6. Institutional framework for the implementation of the project The institutional framework is based on the ministries and various structures of the public administration in the Republic of Benin, which have the necessary powers to intervene in the implementation of this project and in obtaining the various authorizations to be issued, and their role clarified.

To this end, for a good follow-up of the implementation activities of the Cotonou Access and Crossings (ATC) development project, in particular on the environmental and social aspects, the applicable institutional framework includes the actors, namely: the bodies in charge of the management and implementation of the project, the Ministry of Living Environment and Sustainable Development (MCVDD) through the Beninese



Environment Agency (EBA), the Ministry of Infrastructure and Transport (MIT) through the Directorate of Land Transport (DTT), the Directorate General of Infrastructure (DGI), the Road Fund (FR), the National Agency for Land Transport (ANaTT) and the National Centre for Road Safety (CNSR) and then the Ministry of Decentralization and Local Governance (MDGL) in through the prefecture and local authorities.

The Berline Rola (Strates under the source (STROB) in the second of Directors. Placed under the Presidency of the Republic, STRAT SA has, under the terms of its articles of association, among others:

- to manage, develop and maintain all road infrastructure except rural roads, toll-free roads and all other road infrastructures expressly excluded from its management;
- to carry out or participate in the mobilization of appropriate financing for the construction of road infrastructure falling within the scope of its corporate purpose;
- to operate or have used tolls and ancillary services and to organise the securing of resources resulting from the operation of the road network;
- the direct or indirect participation of the company in any industrial, commercial or financial, movable or immovable activities or operations, in any form whatsoever, provided that these activities or operations may be directly or indirectly related to the corporate purpose or to any similar, related or complementary objects;
- and more generally all economic operations that fall within the company's purpose or are likely to promote its development.

Other structures and central directorates under the supervision of MIT provide control and technical monitoring in support of SIRAT SA.

4.3.6.2. Ministry of Development and Coordination of Government Action (MPD) It is responsible for promoting social and economic development, monitoring the implementation of the Government's decisions, projects, programmes and policies in the field of local, regional and national development. It is also responsible for developing long-term development strategies to enable Benin to develop its national potential and anticipate the challenges related to its development.

4.3.6.3. Ministry of Economy and Finance (MEF) As the Government of the Republic of Benin is the contracting authority for this project, it is represented by the Ministry of Economy and Finance. The Ministry of Economy and Finance has the mission in this project, the signature of the contract on behalf of the State as well as the follow-up in the mobilization and settlement of commitments on behalf of the State.



Indeed, according to Decree No. 2016-421 of July 20, 2016 on the attributions, organization and functioning of the Ministry of Economy and Finance, Article 3 stipulates that "the Ministry of the Economy and Finance has the mission of designing, implementing, monitoring and evaluating the general policy of the State in economic matters, and in terms of the constitution and conservation of the State's land and immovable assets". The MEF's intervention in the project will be carried out through the following different directorates and structures:

• Public Procurement Control Unit Article 21: The Public Procurement Control Unit ensures the a priori control of public procurement operations whose amounts are below the thresholds set by decree.

The Public Procurement Control Unit is responsible for:

- Validate the Contracting Authority's procurement plan and the tender documents before the launch of the call for tenders;
- granting, at the request of the Contracting Authority, the necessary authorizations and derogations, in accordance with the texts in force;
- to assist in the opening of the tenders;
- validate the comparative analysis report of the proposals and the provisional contract award report;
- to validate draft amendments;
- to draw up an annual report of activities for the attention of the Contracting Authority.

• The National Directorate for the Control of Public Procurement Article 32: The National Directorate for the Control of Public Procurement is the national body for the control of public procurement and public service delegations. It carries out an a priori control of the procedure for the award of public contracts and public service delegations for an amount greater than or equal to the threshold marking the limit of the competence of the Public Procurement Control Units.

Article 34: The authorization of contracts by mutual agreement falls under the jurisdiction of the National Directorate for the Control of Public Procurement in accordance with Article 48 of Law No. 2009-02 of 7 August 2009 on the Code of Public Procurement and Public Service Delegations in the Republic of Benin. This authorization is given on the basis of a reasoned report drawn up by the Contracting Authority.

The National Directorate for the Control of Public Procurement shall ensure that, in each fiscal year and for each Contracting Authority, the total amount of contracts by mutual agreement does not exceed ten percent (10%) of the total amount of public contracts awarded in the Republic of Benin.

The MEF develops strategies for mobilizing and securing resources on behalf of the State, ensures the quality of expenditure and the sound management of assets as well as national and international financial commitments, in accordance with international conventions, laws and regulations in force in the Republic of Benin.



As such, it is responsible for resource mobilization:

- to develop and monitor the implementation of the Government's economic and financial policy;
- to draw up finance bills;
- to ensure the preparation of the general budget of the State;
- Defining and implementing the government's policy on debt and the financing of programmes and projects;
- preparing, negotiating and monitoring economic and financial programmes with partner institutions;
- negotiating loans and grants and managing public debt;
- To seek and mobilize external and internal resources for the financing of programs and projects, budget support and to ensure their good management;
- monitoring the implementation of agreements and financing agreements relating to projects, programmes and budget support from external partners.

4.3.6.4. Ministry of Infrastructure and Transport (MIT) In accordance with the provisions of Decree No. 418 of 20 July 2016, on the attributions, organisation and functioning of the Ministry of Infrastructure and Transport (MIT), and Article 3 thereof, its mission is to design, implement, monitor and evaluate the State's general policy on land transport, maritime and river-lagoon and air as well as public works and other infrastructure, in accordance with the laws and regulations in force in the Republic of Benin. In this capacity, it is responsible, among other things, for:

• Initiate and conduct reflections and studies contributing to the definition of national policy and the implementation of strategies to promote its areas of competence with a constant concern for sustainable and equitable development;

Develop and ensure compliance with technical standards and national and international regulations in its areas of competence;

• ensure the planning, organization, monitoring and control of all actions aimed at the establishment and maintenance of transport and traffic infrastructure in rural, urban and peri-urban areas;

• to ensure that the population, in healthy conditions and throughout the country, has access to basic social services in the areas of land, air, sea and river-lagoon transport;

• To promote and supervise professions related to transport and public works;

• contribute to ensuring the protection of the marine coastline and the development of river-lagoon banks with a constant concern for integrated economic development and ecological preservation; Monitor and evaluate the implementation of international and regional conventions and agreements relating to transport and public works.



In order to properly accomplish its mission, the MIT is structured into several technical directorates in accordance with the provisions of Chapter VII: Technical Directorates and Departmental Directorates, in particular in its Section 1: Technical Directorates, Article 55 which provides "the Technical Directorates are the operational structures of the Ministry. (...) They are organised into general directorates, specific directorates and departmental directorates. The Ministry's Technical Directorates are:

 the Directorate-General for Infrastructure; the Directorate of Land Transport;

• the Merchant Marine Directorate; the Directorate of River-Lagoon Transport; the Ports Directorate;

- the Directorate of Studies and Quality;
- the Departmental Directorates of Infrastructure and Transport.

4.3.6.4.1. Land Transport Directorate (DTT) is responsible for: The

mission of the DTT is, among other things:

- developing, managing and ensuring the proper implementation and monitoring of land transport policy;
- to develop a strategy for the circulation of road transporters that is organised, safe and in peri-urban areas;
- controlling, regulating and organising road and rail transport, in particular with regard to the safety of people and property as well as noise and environmental pollution;
- develop a strategy to improve travel conditions and modes of transport for goods and people in urban, peri-urban and rural areas;
- to define and regulate optimal pricing for land transport, both private and public, in collaboration with the various structures concerned;
- design, manage and revitalize a framework for public-private consultation contributing to the implementation of the national urban mobility policy, by initiating contracts-plans;
- to design an integrated information system for the collection and processing of road and rail freight data;
- To ensure the representation of Benin in international bodies dealing with rail and road transport issues.

4.3.6.4.2. Directorate-General for Infrastructure (DGI) is responsible for:

The DGI is responsible for:

 managing all aspects of the installation, development and maintenance of public works at the expense of the Ministry;



- To develop and implement strategies for the long-term development and maintenance of the road network in accordance with the government's macroeconomic and political orientations, in collaboration with the various structures concerned;
- to act as project manager for all road construction works, drainage networks, dams, engineering and water retention structures, and all civil engineering works that are not entrusted to other specific structures;

The role of the National Land Transport Agency (ANaTT) is: to support the construction of public works infrastructure at the expense of the State, and to control the works carried out on its behalf in the public interest;

- To participate in the development, application and adaptation of standards and regulations concerning road traffic and public works;
- to guarantee the technical control of the various toll and/or weighing units;
- to contribute to the preservation of various areas of public works services as well as the right-of-way of the roads under the responsibility of the Ministry.

The Ministry oversees the following structures:

4.3.6.4.3. National Land Transport Agency (ANaTT), responsible for:

- to participate in the drafting of regulations and the control of road and rail transport;
- implementing the national mobility policy in collaboration with the municipalities;
- to assist local authorities in the design, organisation and management of urban, interurban and rural transport;
- to determine road transport tariffs in collaboration with the competent national bodies;
- issuing and checking transport tickets and authorisations;
- Implement national and international agreements on land transport;
- to issue approval to driving schools (Driving Education Establishments) and to monitor their activities;
- initiate and conduct reflections and studies likely to improve the conditions of transport of goods and people in peri-urban and urban areas;
- · Collect and process rail and road freight data;
- centralize, monitor and coordinate the various inter-state road transit and transport facilitation activities;
- ensure compliance with rail and road freight regulations in Benin;



• to develop and promote research in the field of land transport.

4.3.6.4.4. National Road Safety Centre (CNSR): It is the national body in charge of road safety issues in Benin. Its main mission is to study, research and implement all means intended to increase the safety of road users, in particular through measures to prevent and combat road accidents. In addition, the CNSR identifies security needs through studies and surveys established upstream. Extensive research is being carried out in this sector in order to authenticate the causes of accidents. These results lead to recommendations and advice offered to the public authorities. It is important to understand the impact of these findings. Its published conclusions allow the State to generate new measures at the level of:

- the Highway Code and its reform in line with changing needs;
- the improvement of the condition of the traffic lanes and its facilities, in order to make users safer;
- the imposition of traffic offences and recent control systems (automatic speed camera);
- education and information programmes for road users such as the recovery point course;
- studies and experiments, to develop the best safety system, both in terms of infrastructure and vehicles;
- standardised equipment requirements for all types of transport;
- the maintenance and sustainability of the gendarmerie and the national police;
- a conglomerate of its various measures, allowing for adjustment between the different partners and achievements.

4.3.6.5. Ministry of Water and Mines Given that the implementation of the project will require the supply of materials, particularly crushed and silty sand, the Ministry of Water and Mines will certainly have to intervene according to its field. The MEM manages the exploitation of mining resources through the Directorate General of Mines (DG-Mines) and the Beninese Office of Geological and Mining Research (OBRGM), which are the two fundamental structures responsible for the regulation, research and promotion of geological and mining activities. The MEM is concerned with this project because of the offshore sand dredging activities for reloading.

4.3.6.6. Ministry of Decentralisation and Local Governance (MDGL) / Prefecture of Cotonou The Ministry of Decentralisation and Local Governance (MDGL) is responsible for implementing the policies defined by the government in the field of local governance. Indeed, Law 97-029 of 15 January 1999, on the organization of the communes of the Republic of Benin, gives the municipality jurisdiction over the construction and maintenance of roads, tracks and engineering structures on its



territory. It also recognises its competence in the construction and maintenance of urban roads, sewerage networks in built-up areas, as well as the construction and maintenance of road signs and public lighting networks.

Within the framework of this project, the Cotonou City Hall under the supervision of the Cotonou Prefecture will intervene in the monitoring of the implementation of environmental measures and any activity emanating from their prerogative.

4.3.6.6.1. Prefecture of Cotonou In accordance with the provisions of Law No. 97 028 of 15 January 1999 on the organization of territorial administration in the Republic of Benin, the prefect is the depositary of the authority of the State in the department. In this capacity, he is the sole representative of the government and of each of the ministers taken individually. He communicates directly with each of the ministers and sends ampliation of all correspondence to the minister in charge of territorial administration. Similarly, the Minister in charge of territorial administration is responsible for all correspondence sent by a Minister to the Prefect. In addition, an administrative conference is created, around the prefect, composed of directors and heads of the decentralised State services in the department. A council called the departmental council for consultation and coordination is established at the level of the department, composed of:

- the Prefect of the department;
- the Mayor of the city of Cotonou and his deputies;
- a representative of the departmental consular chamber
- a representative of the departmental federation of parents' associations.

The Departmental Council for Consultation and Coordination must be consulted on the economic, social and cultural development programmes of the municipalities and on the consistency of these with the national programmes. Thus, the Departmental Council for Consultation and Coordination deliberates on:

- the land use plan and the department's development projects;
- environmental protection measures;
- the policy for the creation and use of collective facilities of departmental interest such as general, technical and vocational secondary schools;
- departmental hospitals and solidarity with vulnerable populations; road and communication infrastructure of a departmental nature; tourism; energy; classified forests and hunting areas; promotion of regional culture; twinning projects between departments or cooperation with national or foreign institutions; proposals for mergers, splits and modification of the boundaries of the departmental territory; or those of the municipalities of which it is composed; the arbitration of inter-municipal disputes. The Prefect of the



Littoral will play a leading role in the implementation of the ATC project, particularly with regard to issues relating to the management of complaints from PAPs and the establishment of the Technical Resettlement Committee.

4.3.6.6.2. Cotonou City Hall: Articles 84 and 86 of Law 97-029 of 15 January 1999 on the organization of municipalities in the Republic of Benin make the City Halls responsible for the implementation and application of municipal land use planning documents.

The municipality exercises its powers in accordance with the sectoral strategies, regulations and national standards in force (Article 108). Individual road alignments, building permits and other road-building permits are issued by the Mayor. In the event of a refusal by the Mayor that is not justified by the general interest, road-building permits on public roads under the latter's jurisdiction and whose purpose is in particular the establishment of water, gas or any other industrial product pipeline may be granted by the supervisory authority (Article 78) The municipality has its own powers as a decentralised territorial authority. It also exercises, under the supervision of the supervisory authority, other powers that fall within the competence of the State. It contributes with the State and other local authorities to the administration and planning of the territory, to economic, social, health, cultural and scientific development, as well as to the protection of the environment and the improvement of the living environment (Article 82). The municipality draws up and adopts its development plan. It ensures that it is carried out in harmony with national guidelines with a view to ensuring the best living conditions for the entire population.

In this context, it draws up the necessary planning documents such as:

- the municipality's development master plan;
- the economic and social development plan;
- urban development plans in agglomerated areas;
- rules relating to the use and use of land;
- Detailed plans for urban development and subdivisions.

It issues residence permits and building permits and ensures the permanent monitoring of the compliance of construction and construction with the regulations in force (Article 84).

The municipality gives its opinion whenever it is envisaged that any project likely to harm the environment is created on its territory. It takes into consideration the protection of agricultural land, pastures, green spaces, the water table, surface water bodies and watercourses in the implementation of various public or private projects (Article 96).



The Mayor of the city of Cotonou, as a beneficiary of the CTA project, has a double responsibility. Specifically, before the start of construction work, he has the duty to manage all issues related to the involuntary displacement of populations. It is in this perspective that he will set up a Local Resettlement Committee in each district impacted by the project. In addition, after the work has been completed, he is responsible for the maintenance of the structures.

4.3.6.7. Ministry of Living Environment and Sustainable Development (MCVDD)

Since April 2016, the Ministry of Living Environment and Sustainable Development (MCVDD) has been responsible for defining, monitoring the implementation and evaluating the State's policy on housing, urban development, urban mobility, cartography, geomatics, land use planning, sanitation, the environment, and the management of the effects of climate change. reforestation, protection of natural and forest resources, preservation of ecosystems, protection of banks and coasts. It also participates in the definition and monitoring of the State's land and land registry policy. It is the MCVDD that issues the Certificate of Environmental Compliance (CCE).

It is responsible for, among other things:

- Define and periodically update the national policy on the environment, climate change management, reforestation and protection of fauna and flora and implement related strategies and actions;
- Develop and implement policy on combating climate change and water, air and soil pollution;
- Mobilize funding for the implementation of policies, plans, programmes and projects of the sectors concerned;

• monitor and preserve marine, coastal, coastal and riverbank ecosystems;

• Monitor the implementation of Benin's commitments to sustainable development as well as international and regional conventions relating to its areas of competence.

Within the framework of the project under study, the main structures of the MCVDD that will be actively involved are presented below.

4.3.6.7.1. Beninese Environment Agency (EBA) The Beninese Environment Agency (EBA) is a social, cultural and scientific office with legal personality and financial autonomy. A public institution created in 1995, it is responsible for the implementation of the national environmental policy adopted by the government as part of its development plan (art. 12). It is also the body responsible for implementing the environmental and climate policy defined by the Government in the framework of the general development plan. It is placed under the supervision of the MCVDD. As such, it works in collaboration with other sectoral ministries, local authorities, non-governmental structures, civil society and the private sector. It manages all environmental assessment procedures. It is responsible for analysing and approving the EIA report and proposing to the Minister the technical opinion on the



environmental acceptability of the project, which is sanctioned by the issuance of a certificate of environmental compliance signed by the said Minister to the project promoter.

All in all, the various interventions of various structures will be carried out in the form of control and verification of environmental compliance, assistance and support during the implementation of measures aimed at eliminating, reducing and compensating for the harmful consequences of the project on the environment.

4.3.6.7.2. Departmental Directorate for the Living Environment and Sustainable Development (DDCVDD) of the Atlantic and Coastal Departments The Departmental Directorate for the Living Environment and Sustainable Development carries out all the functions devolved to the MCVDD at the departmental level. Under the authority of the prefect of the department, it is responsible for the management of sectoral action plans, technical assistance and advisory support to municipalities in accordance with the laws on decentralization. It has the Environmental Police, an entity that has the role of protecting the environment and ensuring compliance with environmental regulations by third parties at the local level.

The DDCVDD will therefore monitor the implementation of the activities of the ESMP carried out for this project and will ensure the non-degradation of the components of the environment (water, air, fauna, flora, human environment, etc.) related to the activities of this project.

4.3.6.8. Ministry of Labour and the Civil Service The Ministry of Labour and the Public Service (MTFP) is responsible for defining, implementing and monitoring and evaluating the State's policy on labour, the civil service and administrative and institutional reform, in accordance with the laws and regulations in force in the Republic of Benin and the Government's vision and development policies. Under its supervision, the Directorate-General for Labour is responsible for the policy on work promotion.

4.3.6.8.1. Directorate-General for Labour The Directorate-General is the body responsible for promoting the State's labour policy. As such, it is responsible for:

- designing, implementing, monitoring and evaluating the national labour policy;
- designing and drafting laws, regulations and conventions in the fields of labour, labour and social security;
- to promote health at work;
- Promote social dialogue in the workplace;
- to promote social security in all sectors of activity;
- Promote the fight against child labour;
- to collect and publish labour statistics.



For the present project, this direction is identified because the project will create a lot of jobs. To do this, it is necessary to respect the various rules relating to hiring, the rights of workers, children and women.

4.3.6.8.2. National Social Security Fund (CNSS) This is a public social institution, under the supervision of the MTFP, which is responsible for the management of the general social security scheme for salaried workers in the formal sector subject to the provisions of the Labour Code. It is responsible for the pension, occupational risks and family and maternity branches. Through its branch that deals with occupational risks, the CNSS works to prevent and compensate for occupational accidents and diseases. This compensation takes the form of benefits in kind and in cash. As part of this project, any company recruited to carry out the various works will have to declare its employees to the CNSS. Thus, the CNSS will intervene as an insurance policy for cases of work accidents and occupational diseases for the social security coverage of employees.

4.3.6.9. NGOs and neighbourhood/district development associations Public consultation has also been extended to neighbourhood and district development associations as well as road safety defence structures (e.g. Alinagnon NGOs) whose activities cover the project area subject to environmental assessment.

The development associations will take an active part in public consultations, in the identification of the actions of the ESMP but also in the monitoring of the actions during the project implementation period as well as in the post-project phase.

It can therefore be concluded that the environmental management of road projects is particularly effective in Benin, particularly in terms of administrative procedures, the definition of responsibilities and concrete actions in terms of monitoring and follow-up. To all the above, it is interesting to add the question of gender.

4.3.7. Institutional management of gender issues At the institutional level of gender management, several organizations work within the framework of gender promotion in Benin and can be of use to the project for the continuous improvement of its performance in gender aspects:

- The Observatory for the Family, Women and Children created by Decree No. 2005/929/MFPSS/DOFFE/SA of 1 July 2005. Its mission is to produce data and advocacy for the enhancement of the status of women;
- Directorate for the Promotion of Women and Gender under the supervision of the Ministry of Family and Social Affairs with the objective of ensuring the implementation of the national policy of support for economically vulnerable people, particularly women, and proposing policies, strategies, and action plans for the promotion of gender;

• The National Institute for the Advancement of Women, created by Decree No. 2009-728 of 31 December 2009, a body for reflection, studies and the advancement of women with the mission of promoting women's participation and contribution to public and political life.

CECO CONSTRUCTION/SIRAT


5. DESCRIPTION OF THE RECEIVING ENVIRONMENT OF THE PROJECT

The initial state of the receiving environment represents a reference situation that is subsequently impacted by the project. It is essentially characterized by its sensitivity, which is defined in relation to the very nature of its components, but also in relation to the nature of the project. The purpose of the description of the initial state of the project site is to provide adequate knowledge of the components of the ecosystems of the receiving environment that are at risk of degradation by project activities. The description of the initial state of the environment is based, on the one hand, on documentary and bibliographic data, and on the other hand, on field surveys and in situ measurements during site visits. The study area is the geographical area potentially subject to the temporary and permanent, direct and indirect effects of the project.

The delineation of the study area covers the entire area likely to be influenced by project activities, including related activities. For the following, the description of the initial state of the environment of the CTA project takes into account the following aspects: Physical environment (soil, water and air);

- Biological environment (fauna and flora);
- Socio-economic and cultural environment (economy, society, infrastructure and culture).

In addition to the physical and biological aspects, this description also emphasizes the socio-economic characteristics of the environment and its immediate surroundings.

5.1. Administrative situation The works of the project for the development of the Cotonou Access and Crossings (ATC) roads of lot 1 extend over 16.125 km all, in the city of Cotonou in the Littoral department. Indeed, the receiving environment of the project is located in the coastal zone of South Benin. More precisely, it is between the parallels 6°20' and 6°23' north latitude and 2°22' and 2°30' east longitude (Figure 14). It is bordered to the north by Lake Nokoué, to the south by the Atlantic Ocean, to the east by the commune of Sèmè-Kpodji and to the west by the communes of Abomey-Calavi and Ouidah.



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Figure 14: Geographical location of the receiving environment (city of Cotonou)

Source: CECO-BTP, May 2022



The areas of direct influence of the project are the administrative units (Districts and Districts) whose territories are concerned by the road infrastructure. On the administrative level, the project's footprint extends over six (06) Districts of the Municipality of Cotonou (Table 23 and Figure 3).

Table 24: Designation of the axes concerned by the ATC project: Lot 1.

DESIGNATION OF LINEAR AXES (km)		
Ancien Pont - Carrefour SOBEBRA - Carrefour 6,725	rofour	
SOBEBRA 2.4 Place du Souvenir – Carrefour 3 Ban	ks 2.5	
Carretour Marche Saint Michel – Carretour NASUBA Tesonetz Interchange – Carrefour Notre Dame Carre	v – 1.9 e four 3	
Banks - Carrefour Air Afrique 1.1 Carrefour Air Afrique	e – périeur de	
Steinmetz 1.0 Total 16.125		

Source: Project document (SIRAT SA), May 2022

The area of the development of the Cotonou Access and Crossings (ATC) roads is located in the coastal zone. The biophysical conditions that characterize this area are those found globally in the coastal zone of Benin in general and in Cotonou in particular. From the overall analysis of the biophysical conditions of the coastal zone, those concerning more specifically this area of right-of-way will be deduced in order to better locate the biophysical potentialities and constraints on the various roads concerned.

5.2. Physical characteristics of the study environment

5.2.1. Climatic conditions The receiving environment is part of the coastal zone, which benefits from a sub-equatorial climate of the "Beninian" type (Boko, 1988). The average annual rainfall totals oscillate around 1300 mm with an East-West gradient due to the diagonal of drought that characterises this environment (Figure 15). The average annual number of rainy days is 140 days. The rainfall regime is bimodal (Figure 15) characterized by the alternation of two rainy seasons and two dry seasons that are unevenly distributed. From December to March, the long dry season is observed, with rainfall of less than 40 mm or almost no rainfall in December, January, February and March. The period is characterized by breezes and especially the harmattan wind from the Libyan anticyclone which brings drought and dust. Wind speeds are low and the humidity is also low. The main rainy season extends from April to July with the maximum values obtained in May (200 mm) and especially June (350 mm). This period corresponds to the presence of monsoon flows, which is the main source of rain in Benin. Then, the short dry season occurs at the end of July and lasts until the end of August and corresponds to the period of upwelling of deep and cold marine waters.





Figure 15: Average rainfall patterns in the receiving environment Source: CECO-BTP, June 2022.

As for the short rainy season, it lasts from September to October. Monthly rainfall exceeds 100 mm but does not reach the thresholds of the main rainy season. The rainy seasons coincide with the flood periods, which depend on both local rains and the overflow of Lake Nokoué, whose regime is influenced by the rains coming from the more northern regions.

As far as the thermal values are concerned, they depend on the duration of the insolation and the maritime influence. Temperature variations remain small and the annual average is around 27°C. On a seasonal scale, it remains high in the dry season (27.5°C on average) and relatively low in the rainy season (24°C). The months of February, March and April, the hottest (Figure 16), experienced relatively large amplitudes: cool nights (23-24°C) followed by sunny and warm days (31-33°C). In July and August, the drop is noticeable (25°C) in connection with the phenomenon of upwelling.



Figure 16: Monthly change in air temperatures in Cotonou Source: CECO-BTP, May 2022.



As for winds, there are two types in the environment with generally low speeds (Figure 17). These are those resulting from regional flows linked to pressure fields and local winds. The winds associated with the regional flows are those from the southwest sector and those from the northeast sector. The former blow mainly during the rainy season (March, April, May, June, October and November) while the latter blow during the dry season (harmattan). In general, the average wind speed is low during the dry season and high during the rainy season.



Figure 17: Monthly change in average wind speeds in Cotonou Source: CECO-BTP, May 2022.

The highest speeds are recorded in July (5.3 m/s), August (5.5 m/s) and September (5.1 m/s) and the lowest values are recorded in November (3.6 m/s), December (3.4 m/s) and January (3.5 m/s).

Despite their low speed, these winds are capable of carrying odours, raw materials used in the composition of bitumen during the construction phase or causing some dust deposits on the machinery or the roofs of houses located in the immediate vicinity of roads under repair.

5.2.2. Marine hydrology As Cotonou is a coastal city, it is under the influence of the sea swell. It is an important factor in sediment transport and seasonal erosion (natural causes) and in the dynamics of the coastline. On an annual scale, their evolution of significant heights (Hs) shows two swell seasons: the first characterized by strong swells (Hs > 1.3 m) from April to October and the second characterized by moderate swells (Hs < 1.3 m) from October to April.

5.2.2.1. Sea surface temperature

The temperature of the sea surface along the Beninese coastline and the project site is characterized by seasonal variations that make it possible to distinguish four marine seasons: a short cold season (PSF) is observed from January to February; a large hot



season (GSC) sets in from March to June; a long cold season (GSF) from July to September and finally a small hot season (PSC) from October to December (Figure 18).



FogigeeADJE C, 2019 18: Periods of coastal upwellings in Benin

5.2.2.2. Ocean surface salinity (SSS) Sea surface salinity (SSS) is the content of salts in the ocean, the main element of which is sodium chloride. Theoretically, salinity can be defined as the total amount of solid residues (in grams) contained in 1 kg of seawater, when all carbonates have been converted to oxides, bromine and iodine have been replaced by chlorine, and all organic matter has been oxidized. The SSS is therefore an important contributor to ocean circulation, which in turn strongly influences climate. The figure

19 below represents the average climatology of sea surface temperature on the Beninese coast over the period from 2005 to 2014.





Figure 19: Average climatology of sea surface temperature on the Beninese coast over the period 2005-2014

Source: DG_Eau, 2015: Determination of thresholds and alert levels for the risks of sea level rise and coastal erosion in Benin. Report, 182p

In detail, the variations in surface salinities are characterized by:

- a first drop in salinity (3 months) like those of temperatures in the same period, but earlier because it starts in April and ends in June,
- a first period of increase in July August;
- a second period of decline that is always earlier than that of temperatures, as for the first period of decline, but more marked from September to November;
- finally a second period of increase that began in December, longer than the first but much more irregular.

A comparison of temperature and salinity variations shows that salinity variations always precede temperature variations by at least one month for the first two phases and by more than two months for the last two.

The coastal hydrological regime is characterized by four distinct periods:

- Decrease in salinity and cooling of the water (3 months);
- increase in salinity (4 months) and cooling of the waters (2 months) during the fourth quarter of the year;
- increase in salinity (3 months) and warming of the water (3 months).

There is a sort of annual cycle that begins in April.

Hydrological conditions are characterized by two warm salty periods and two cold and desalinated periods.

The surface temperature of the water varies from 28.8°C in the northern coastal part to 28.3°C offshore. Under the influence of inland water inflows, the surface salinity of the water is minimal near the coast at 33.0 g/l, and increases as you go offshore to 34.5 g/l.



The salinity rises with the increase in depth and the maximum is observed around 45 to 50m (35.9g/l) then the regular decrease in salinity takes place.

The hydrological characteristics specific to the waters of the Beninese continental shelf make it possible to distinguish three clear hydrological zones (Jean Pliya; 1981):

- the one located east of Cotonou;
- the one centred on Ouidah (from Djakovi to Djondji);
- and finally that of Grand-Popo to the border of Togo.

5.2.2.3. Oceanic hydrodynamics Two types of forcings punctuate marine hydrodynamics: tide and swell. The ocean tide is semi-diurnal and microtidal with extreme tidal ranges of +1.95 m and -0.20 m, but the amplitude is generally around one metre. The direction and regime of the swells are linked to storms in the South Atlantic, in particular those generated by the Saint Helena High (Sitarz, 1960, Anthony and Blivi, 1999) and secondarily to local winds. These storms define the two wind seasons described above on the Beninese coast. These winds cause two swell seasons to appear on the coast: one, with low swells (0.4 to 0.5 m on average) from October/November to May; the other, where during the boreal summer, from June to September, heights can reach and exceed 2 m (Rossi 1989).

The swell directions are constant and show a predominance of S to SSW for the former and SSW to SW for the latter (Sitarz, 1960, Rossi, 1989). It can be considered that the swell, an essential factor in the transport of sediments on the Beninese coast, has a period of between 10 and 15 s with an average frequency of 11 - 12 s. At break, the obliquity of the swell with respect to the shore varies between 4° and 9°, with an average of around 6°-7° (Rossi, 1989). It carries a coastal drift current directed from west to east and whose speed measured in Cotonou is of the order of 0.3 to 1 m/s (Sitarz, 1960). This current is responsible for the annual transit of 1.2 to 1.5 million m3 of sand along the coast of the Gulf of Guinea (Sitarz, 1960; NEDECO, 1975; Lackner, 1983 and LCHF, 1984).

- 5.2.2.4. Wave Climate and Water Levels
- Overview of the wave climate

The wave climate along the coast of Benin is dominated by "swell" waves from the S-SSW. These are long-crested waves with a long period and narrow directional propagation produced by distant thunderstorms in the South Atlantic Ocean. Due to a natural "triage" process combined with the propagation of waves over large distances, these have a relatively "uniform" appearance. Persistent swell conditions from the S-SSW, combined with the orientation of the Benin coast, result in a very large sediment transport along the shore from west to east.

Local winds also produce "sea" waves; which are of shorter period, short-crested waves, with great spread. These waves, which are superimposed on top of the wave waves, have a highly irregular and complex appearance, with a range of wave amplitudes, periods, and



directions. In general, 'sea' waves are much smaller than 'waves'.

• Offshore wave climate

The wave climate is a critical point in the planning, design and construction of any coastal project. Unfortunately, the temporal and spatial exposure of recorded wave data (surface measurements or satellite observations) is generally insufficient to develop reliable assessments of long-term wave climate and extreme design conditions for most coastal projects. As such, coastal engineers rely on wave "retrospective simulation" models, which provide an assessment of wave states based on historical wind data. These models, when properly calibrated and verified against wave data recorded at specific sites, provide a reliable assessment of wave conditions.

A 40-year (1959-1999) retrospective wind and wave simulation, including the entire South Atlantic Ocean, was undertaken by Baird using a second-generation wave model (WAVAD - ; Reference to Resio, 1981; Resio and Perrie, 1989) and a Global Wind Model (NCEP/NCAR project reanalysis; refer to Kalanay et al., 1996) to define the deep-water wind climate beyond the coast of southern West Africa.



Figure 20: Sea Wave Rose Source: Siafato Spur East Coastal Protection Project, Final Design Report, (Baird, 2003)

Figure 1.2 provides a sea wave rose for retrospective simulation for the 40-year wave climate in deep sea water. This figure clearly illustrates the dominant nature of the S-SSW wave waves.



Wave climate near the shore

The offshore wave climate has been transformed to a depth of 20 m based on standard office procedures, specifically Snell's law of refraction and linear shoal effect (Reference to USACE, 2001). These simplified procedures are applicable globally to the project site by considering, in a first approximation, that the bathymetry is relatively simple (i.e., straight contours parallel to the shoreline). The resulting wave climate near the shore is summarized in Figure 1.3 (Wave Rose near the shore) and in Table 1.1 (Excess wave amplitude near the shore).



Figure 21: Wave Rose near the Shore (20 m depth) Source: Siafato Spur East Coastal Protection Project, Final Design Report, (Baird, 2003)

5.2.2.5. Offshore swell The swell roses resulting from the statistical analysis at the offshore points PT1 and PT2 are presented in Figure 22.



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Figure 22: Swell roses and exceedance curves obtained from Globocéan wind data over the period from January 1, 1992 to December 31, 2019.

Source: ARTELIA, 2020: Phase 1 report: Error! Use the Home tab to apply PdG_Nom_projet to the text you want to appear here.

5.2.3. Hydrographic components From a hydrological point of view, the Atlantic Ocean, Lake Nokoué, the Djonou and Todouba lagoons and the depressions with temporary or permanent hydromorphism are the important water bodies that influence the city of Cotonou. Lake Nokoué communicates with the sea through the Cotonou Channel (Cotonou Lagoon) which separates the eastern and western expanses of the city. In addition, there is a system of lagoons and shallows in its surroundings with which it was originally in communication, but which are currently isolated by the urbanization of the city. The flooding of Lake Nokoué is linked to the descent into this same lake of rainwater from the great rainy season, the maximum rainfall that has fallen in the north and which must return to the sea by transiting through the lake. The overflow of these hydrographic units is a source of flooding in several



districts of Cotonou. The most exposed localities are Vossa, Djidjè, Hindé, Ahouansori, Vodjè, Agla, Fidjrossè to the west of the Cotonou channel and Yénawa, Missessin, Sodjèatimè, Avotrou, Suru- Léré to the east of the channel. Despite efforts in terms of drainage and sanitation works, the floods continue to disrupt the socio-economic activities of the populations of the city of Cotonou. Indeed, the shallow depth and inclination of the city's topographical base favor the rapid submersion of sanitation works, and even more so when they have been neglected. This is the case of what is frequently observed on either side of the sections such as: Carrefour-SOBEBRA- Carrefour OPT PK3-Carrefour le Bélier and others (photo 14).



Photo 14: Ground temporarily waterlogged after rain on the Place du souvenir - crossroads 3 banks axis Source: AID, May, 2022

5.2.4. Geological and geomorphological contexts

The city of Cotonou is located in the margino-littoral domain of the coastal sedimentary basin and has a morphology that is essentially based on a large component: the coastal plain made up of an elongated strip of land EW and parallel to the coast formed by 3 generations of sand bars (Gnélé, 2010). These are i- the yellow sand barrier (a barrier that stretches from the southern limit of the Allada plateau to the Djonou lagoon in Godomey), ii-the grey sand ridge, at an altitude varying between 2 and 4 m, it is located between the yellow sand ridges to the north (old) and the subcurrent ones (recent) and iii- the brown sand barrier or subcurrent barrier or recent barrier which is closer to the line shoreline.

From a geomorphological point of view, the sections concerned are located on the shoreline (MEHU, 1993). The relief is quite flat and devoid of any gradient. The elevations oscillate between 1.02 and 6.52 m in relation to the geographical datum in places, the highest altitudes could be found on the Place de souvenir-Carrefour- 3Banques section; Carrefour Marché Saint Michel-Carrefour NASUBA - Echangeur Steinmetz- and the Carrefour Notre Dame and Carrefour-SOBEBRA-Carrefour OPT PK3-Carrefour le Bélier (figure). The part of the city built on the sand ridge is the highest part and the heights vary around 5.02 m. Thus, this relief is not favourable to the flow of rainwater. Rather, it promotes stagnation and infiltration and gives the hydrogeology of the entire region a



particular importance in the effort to understand the rainfall-discharge relationships in the city.

5.2.5. Soil components From a pedological point of view (Figure 23), the sections studied are based on loose sediment and mostly extend over acidic sandy soils (white soils with a podzolic tendency). These soils, which are not very evolved in profile, are very poor in chemicals. Their grain size (medium and fine) and morphology (blunt, shiny) are clearly in favour of a marine origin. The fine sands, which are generally well sorted, were deposited under homogeneous hydrodynamic conditions, even if there are some local disturbances (MEHU/ABE/PAZH, 2001). These soils reveal on the surface a superficial horizon, quite humus-rich, of low thickness, resting on a more or less altered mineral horizon. These are poor soils with a very low capacity for exchange and low water retention capacity because of their lack of clay. Overall, three types of soils are observed, according to Volkoff and Willaime (1976).



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Figure 23: Soil formations of the city of Cotonou



- The poorly developed soils of non-climatic origin, located on the current barrier (sections Carrefour Marché Saint Michel-Carrefour Nasuba-Echangeur Steinmetz-Carrefour Notre Dame; Carrefour-3Banques-Carrefour Air Afrique; Air Afrique Carrefour - Old Bridge; Railway Junction-Steinmetz Overpass). On the surface, there appears on the surface, a poorly differentiated A horizon of reduced thickness (10 cm) followed by a yellow C horizon, dotted at depth with diffuse greyish streaks.
- Hydromorphic soils that are moderately organic, humic to gley, not or slightly salty (sections: Ancien pont-Carrefour-SOBEBRA-Carrefour OPT PK3-Carrefour le Aries). These soils are developed in marshy areas.
- Hydromorphic, mineral or low humus-bearing soils, with gley, leached with a podzolic tendency on Quaternary sand, which are in the majority (Carrefour Marché Saint Michel-Carrefour NASUBA- Échangeur Steinmetz-Carrefour Notre Dame). These soils have been discoloured (white sands) under the action of a very fluctuating aquifer at a depth of 1 or 3 m, oscillating to the surface. Below the surface horizon, they have a layer of organic accumulation of dark reddish brown colour (Figure 24).

Overall, these soils do not constitute any major obstacle for the project, not only in terms of the types of activities to be carried out, but also in terms of the fact that its soils already supported a number of road infrastructures that facilitate the mobility of the populations in the city of Cotonou.



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Figure 24: Soil formations superimposed on the sections to be developed



5.2.6. Biological components and the state of biodiversity The city of Cotonou is a humanised area and as a result, the issues related to biodiversity during the rehabilitation of these roads are perceived as a new introduction of human settlements into existing landscapes and natural ecosystems. To do this, a series of precautions must be taken so as not to modify or distort too much the natural landscapes crossed as well as the biological elements of interest that are found on the route of these different roads. Indeed, today, due to human occupation, the natural vegetation of the city is completely destroyed and replaced by human settlements. Within these establishments, urban forestry is characterized by a diversity of both exotic and endogenous plant species. On the edge of the coast, the sands of the barrier beach are covered with coconut plantations (Cocos nucifera). On the other hand, within the city, forestry is made up of private and public training that essentially boils down to linear types of development, pleasure gardens and plantations. Species diversity varies according to the objectives and type of spatial planning. The dominant plant species of urban forestry in Cotonou are Khaya senegalensis, Terminalia mantaly, Terminalia catappa and Delonix regia.

5.2.6.1. Initial state of the natural environment

5.2.6.1.1. Overview of the initial state of the roadscapes of lot 1 The classified images show the state of the landscape taken by drone of the various roads of lot 1. A video analysis of the drone overflights was also carried out in the form of a film to serve as a reference state archive image.



Axis 1: Old bridge-crossroads SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier



Axis 1: Old bridge-crossroads SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier

Third Bridge	nt Olkh Beidg	ests	
Longitude	Latitude	Altitude	
2,4444	6,3607	92	
	-	Cantola Street G	
State Property	Constant and		
		STREET.	
States and		The s	
Carline .			
and the second second			
		MALL	
2.57	- to V		
	A la la		
The second	AN		
220			
1 Lan		Lat 1/2 2	
5% N	1-1-		
	n milling	70:	

^{of the} cemetery towards the crossroads at Le Milliadaire





Axis 1: Old bridge-crossroads SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier

Erom the crossroads at Le Milliardaire to the SOBEBRA crossroads



From the SOBEBRA crossroads to the Rotary crossroads





Axis 1: Old bridge-crossroads SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier From the Rotary crossroads to the Abattoir crossroads



From the Abattoin trassroads to the Le Berlier crossroads

Axis 2: Third SOBEBRA bridge-crossroads





Axis 5: Carrefour 3 Crossroads Banks Air Afrique

Axis 4: St Michel market crossroads-Nassouba crossroads-Steinmetz interchange- Notre Dame crossroads

Longitude Latitude Altitude	
2,4308 6,3659 153	
	NAME AN ALL NO.

NASUBA junstion to Steinmetzeintenehange



Steinmetz-Carrefour Notre Dame interchange



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Axis 7: Railway Junction - Steinmetz Overpass

LOTIN AAT-O-101



Steinmetznewienpassiton Garvefo Ua Cheminoteminot



Carrefour Cheminot



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Plate 1: Inventory of the landscape taken by drone of the different roads of lot 1



5.2.6.2. Habitats and flora encountered in the project area 5.2.6.2.1. Mapping of the distribution of tree bases along the axes In the project area,

the trees in the range as well as a few tree gardens in public spaces and in the agglomerations represent the vegetation cover in the project right-of-way. Figure 25 shows the map of the distribution of tree species along the axes that make up the project right-of-way. The analysis of this figure shows that the distribution of vegetation cover is not uniform from one axis to another.



Figure 25: Distribution of trees along the project right-of-way Source: Field data, CECO-BTP, June 2022

5.2.6.2.2. Description of the different types of housing The project is located in a highly urbanised area with large agglomerations and the presence of numerous state, private and semi-public services. Unfortunately, in the city's occupation plan, no place has been reserved for natural ecosystems. Thus, in the project's right-of-way, there are no longer any natural habitats for the species. The initial vegetation is completely. There are also some tree gardens in the courtyard of public services and institutions along the road, as well as the presence of a few rare tree gardens in public spaces such as the fairground and at the Three Banks. In addition, there is a wetland ecosystem on the Old Bridge-Crossroads SOBEBRA-Carrefour OPT PK3- Carrefour le Bélier axis and on the Third Bridge-Crossroads SOBEBRA axis, which is the fringe of open water represented by the Cotonou Channel.



The description of the different habitats is as follows:

• Range Tree: These are rows of trees planted on either side of the road to serve as a greening of the city after the existing natural vegetation was stripped away during the previous construction of the road (Photo 15). This row of trees is not habitat for species per se, but is used by a few birds for nesting. The number of trees per kilometre is not the same for an axis. It varies from 76 feet/km to 23 feet/km, indicating that some roads are almost devoid of alignment trees, as is the case of the Carrefour Cheminot-Passage Steinmetz overpass axis and the Third Bridge-Carrefour SOBEBRA.



Photo 15: Partial view of the alignment trees along the axis Place du souvenir Carrefour 3 Banks (court-level), May 2022

Source: Field data, CECO-BTP, June 2022

• Tree garden in institutions: These are tree plantations made on the courtyards of different structures and even in houses (Photo 16). They range from a few feet of trees to several feet forming urban vegetation serving as habitat for many species. These gardens also serve as shade and pleasure gardens within these institutions. These tree gardens are found, for example, in the Presidency, the Embassy of France, the Embassy of Germany, etc.



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Photo 16: Overview of Tree Garden in built-up areas in Cotonou, May 2022

Source: Field data, CECO-BTP, June 2022

• Tree gardens in public squares: These are also tree plantations made on spaces open to the general public, as is the case at the fairground and at the three banks crossroads (Photo 17). They play the role of a space of pleasure, a resting place for the inhabitants of the city.





Photo 17: Tree Garden at the Three Banks Public Square, May 2022

Source: Field data, CECO-BTP, June 2022

• Fringe of open water: It is represented by the portion of the coastal lagoon crossed by these two axes. It is a body of brackish water in contact between the sea and Lake Nokoué. It is a wetland of international importance because it is located in Ramsar site 1018 (Photo 18).



Photo 18: Partial view of the open water fringe at the level of the old bridge and third bridge



5.2.6.2.3. Diversity of habitats in the project right-of-way Despite the artificial nature of the vegetation found in the project right-of-way, it is no less negligible in diversity. A total of 34 woody species in 19 botanical families were inventoried in the project's right-of-way. The analysis of this flora indicates that 68% of the species are foreign to the local flora and highlights the low value of native species in the landscaping of our cities.

Overall, on all the axes concerned by the project, the most common species encountered are Cordia sebestena (15.9%); Khaya senegalensis Guaiacum officinale (9.2%); Pithecellobium dulce (8,09%); Jatropha integerrima (6.94%);

Terminalia mantaly (6.50%) and Roystonea Regia

Table 25 shows the diversity of plant species as well as the tree species frequently encountered by axis in the project area.

Axis	Species richness	Abundant species	Number family	Most represented families
Old SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier crossroads bridge	21	Cordia sebestena (41%), Jatropha integerrima (18%), Terminalia catappa (13%)	15	Anacardiaceae (2) Apocynaceae (2) Arecaceae (2) Combretaceae (2) Fabaceae (2) Meliaceae (2)
Third bridge - SOBEBRA crossroads	14	Roystonea Regia (23%), Terminalia catappa (22%), Ficus microcarpa (18%)	11	Combretaceae (2) Fabaceae (2) Moraceae (2)
Place du souvenir Carrefour 3 Banques	19	Pithecellobium dulce (29%), Guaiacum officinale (19%), Khaya senegalensis (17%),	11	Fabaceae (7) Arecaceae (2) Combretaceae
Carrefour St Michel-Carrefour market NASSOUBA- Steinmetz-Carrefour Notre Dame	6	Khaya senegalensis (67%), Guaiacum officinale (13%), Terminalia catappa (11%)	4	(2) Combretaceae (3)
interchange Carrefour 3 Banks- Carrefour Air Afrique	7	Terminalia mantaly (37%), Azadirachta indica (24%), Delonix regia (17%)	5	Combretaceae (3) Meliaceae (2) Myrtaceae (2) Zygophyllaceae
Carrefour Air Afrique- Old Bridge	8	Terminalia catappa (29%), Cordia sebestena (17%), Elaeis guineensis (17%)	7	(2) Arecaceae (2)
Railway Junction - Steinmetz Overpass	9	Pandanus spp (48%), Borassus aethiopum (17%)	8	Combretaceae (2)

Table 25: Diversity of plant species in the project area according to the different axes

Source: Fieldwork, CECO-BTP June 2022



5.2.6.2.4. Structural Parameters of Trees along the Axes Table 26 shows the total number of feet, the number of feet per kilometre, the average, minimum and maximum diameters of the trees. In total, 692 plants of different tree species were counted on the roads concerned. The abundance of trees is 76 feet/km (axis from Place du souvenir Carrefour 3 Banques) to 23 feet/km (axis from Carrefour Cheminot-Steinmetz overpass). The largest trees are located on the Carrefour Air Afrique-Ancien pont axis and the smaller ones on the tree on the Ancien pont-carrefour SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier axis.

Axis	Total number feet	Abundance of abres (tree/km)	Diameter Medium
Old bridge-crossroads SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier	238	35,39	25,74
SOBEBRA	73	30,42	28,95
Place du souvenir-Carrefour 3	190	76	34,17
st Michel- Carrefour NASSOUBA- Steinmetz interchange- Carrefour	81	42,63	28,17
Carrefour 3 Banks- Carrefour Air Afrique	63	57,27	47,55
Carrefour Air Afrique-Ancien pont	24	48	50,26
Railway Junction-Steinmetz Overpass	23	23	26,89

Table 26: Structural parameters of the trees in the project area according to the different axes

Source: Fieldwork, CECO-BTP June 2022

5.2.6.2.5. Quantification of carbon stored by trees in the project area In the project area, the total quantity of above-ground biomass stored by all trees is 224,626.47 kilograms of dry matter, corresponding to 105.56 tonnes of carbon. The potential for sequestering the carbon stock of plant species in the project area varies from 1.5 tonnes (Carrefour Cheminot-Passage supérieur Steinmetz) to 36.87 tonnes (Place du souvenir-Carrefour 3 Banques).

The "Carrefour 3 Banques-Carrefour Air Afrique" axis was the one with the highest average amount of carbon stock (AGC = 0.46 tonnes/tree). It should be noted that for all axes, 5 plant species contribute significantly to the sequestration of atmospheric carbon in the



project's right-of-way. These are Terminalia catappa, Azadirachta indica, Cocoloba uvifera, Khaya senegalensis, Terminalia mentaly and Delonix regia.

Table 27 presents the distribution of the above-ground biomass quantity (AGB) and the carbon stock (CGA) by axis at the project right-of-way area.

Table 27: Distribution of above-ground biomass (AGB), carbon stock (AGC) and species characterizing high carbon sequestration potential by axis

Axis No.	Biomass Quantity Air (Kg DM)	Stock quantity Carbon (Ton)
Old bridge-crossroads SOBEBRA-Carrefour OPT PK3-Carrefour le Berlier Third	31471,67	14,78
bridge-crossroads SOBEBRA Place du	11748,49	5,52
souvenir-Carrefour 3 Banks Crossroads St	78456,57	36,87
Michel market-Carrefour NASUBA- Interchange Steinmetz-Carrefour Notre Dame	19023,58	8,94
Carrefour 3 Banks-Carrefour Air Afrique	61149,18	28,74
Carrefour Air Afrique-Old bridge Carrefour	19559,45	9,20
Cheminot-Steinmetz overpass	3217,53	1,51
Total	224626,47	105,56

Source: Fieldwork, CECO-BTP June 2022

In view of the project, the destruction of these trees will therefore cause the loss of the atmospheric carbon storage capacity necessary for the fight against climate change. Indeed, the construction of roads in the compact city must not contribute to exacerbating the phenomenon of global warming. During construction work, work should be done to avoid these trees as much as possible and to reforest roads that are currently bare, i.e. with a low Kilometre Index of Abundance.

5.2.6.2.6. Ecosystem services provided by trees in the project right-of-way The trees encountered in the project right-of-way play several roles and offer various services to the population. These are: Supply service: In the project's right-of-way, the organs of several plant species are collected by local populations to meet various needs. This is the harvesting of tree bark and leaves for medicinal purposes. This is the case, for example, of Khaya senegalensis, whose tree trunks are systematically debarked for the collection of bark which is used in traditional medicine (Photo 19). Similarly, fruits of species such as Carica papaya, Citrus limon, Mangifera indica, Terminalia catappa are also collected and used by the local populations.



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Photo 19: A Khaya senegalensis plant debarked at the fairground

Regulation service: In addition to the direct services derived from the trees in the project's right-of-way to satisfy their needs by the population, they intervene in the functioning of the urban environment. Indeed, these trees locally create a mild microclimate that is sought after by local populations in sunny weather for shelter. They are involved in the purification of the air by ridding it of CO2 and releasing O² through the phenomenon of photosynthesis. They are also involved in the storage of atmospheric carbon and contribute to the fight against climate change on a more global scale. Support service: In the project area, although there are no natural ecosystems to serve as habitat for animal species, the row trees encountered as well as the tree gardens play the role of substitute habitat for avian fauna, bats and insects.



Socio-cultural service: In addition to the greening function of the landscape, trees play an essential role in the landscape beauty in the project's right-of-way. In particular, the trees in the tree gardens encountered in the project area play an important role in maintaining the mental and physical health of the population. These public tree gardens are in particular places of rest and relaxation for the population (Photo 20).



Photo 20: Socio-cultural services provided by the trees in the project area (rest and relaxation sites for the population).

In short, it appears that the trees in the project's right-of-way play several roles and are useful to the population for several reasons (collection of plant organs, storage of atmospheric carbon, modification of the microclimate, provision of shade, nesting and resting habitat for avian/bat species, etc. It is clear that the destruction of trees will have consequences for the various functions and services that trees provide to local populations, and avoidance measures and additional reforestation must be the option to be prioritised.

5.2.6.2.7. Plant species requiring special attention Some plant species identified on the various axes deserve special attention because of their conservation status at the international and national levels, but also with regard to their status according to Law No. 93-009 of 2 July 1993 on the forest regime in Benin (Table 28).



Plant species	IUCN International Conservation Status	IUCN International Conservation Status	Protection status under forest legislation ⁵
Albizia spp			Protected
Borassus aethiopum			Protected
Elaeis guineensis			Protected
Eucalyptus NT camal	dulensis Guaiacum of	ficinale EN Khaya sene	galensis VU EN
Protected Terminalia	superba VU Protecteo	1	

Table 28: Species with special conservation and protection status

Source: Field data, CECO-BTP June 2022

In the grip of the Guaiacum officinale project, classified as an endangered species internationally on the IUCN Red List, requires special attention for its sustainability. Unfortunately, this species does not belong to the local flora and must be abandoned in reforestation programs despite its status.

The Khaya senegalensis species deserves very special attention in view of its conservation status both locally and internationally. It belongs to the local flora and is one of the species to be promoted in urban reforestation programmes. It is one of the species with the largest diameters and heights encountered on the various axes and has a very high carbon storage capacity.

In addition, Eucalyptus camaldulensis, an internationally Near Threatened (NT) species and Terminalia superba, classified as vulnerable (VU) on Benin's Red List also deserve special attention.

From a regulatory point of view, the species Elaeis guineensis, Khaya senegalensis, Albizia spp, Borassus aethiopum, Terminalia superba recorded on the various axes are prohibited from felling except in cases authorized by the Forestry Administration according to Law No. 93 - 009 of

02 July 1993 on the forest regime in Benin.

5.2.6.2.8. Determination of the presence of critical habitats Along the project right-of-way, no natural habitat has been identified. It could be concluded that in the project right-of-way, the destruction of vegetation is not likely to result in the loss of critical conservation habitats. However, the trees distributed along the axes provide several services and their destruction will be accompanied by the loss of these services and the loss of individuals of certain species of flora already threatened. In addition, the habitat of the open water fringe of the channel under the two bridges is a critical habitat for conservation because it is located between the sea and the mainland as a natural outlet.

⁵ Law No. 93 - 009 of 2 July 1993 on the forest regime in Benin



5.2.6.3. Wildlife encountered in the project right-of-way area 5.2.6.3.1. Diversity of fauna species The assessment of the composition and diversity of the fauna of the various roads investigated shows a diversity of animal species of 60 species spread over 33 families and 6 zoological groups (Table 29). This diversity is not static and fixed. It varies according to the migration seasons of many species. This is the case for avifauna and fish. This highlights that the area of the project is an animal migration area belonging to different zoological groups. As a result, the developments to be made in the context of asphalting must take this reality into account so as not to destabilize the migration and breeding area functions of these species.

Class	Number of species	Number of families	
Bird	42	22	
Mammal	4	3	
Crustacean	3	3	
Reptile	1	1	
Amphibians	2	2	
Pisces	8	2	

Table 29: Diversity of animal species in the project area

Source: Field data, CECO-BTP June 2022

5.2.6.3.2. Mammalian fauna composition of the different roads in the lot1 Four (04) species of mammals have been recorded along the roads concerned (Table 30). Only one species of rodent (Rattus rattus) is found along two highways. It is a very commensal rodent found around garbage heaps or urban garbage and feeding on the remains of human food. Bats are the most widespread mammals along these roads, including Neoromicia nanus, an insectivore that is very common in the city of Cotonou. Fruit bats play two important ecological roles, namely pollinator of fruit trees and dispersers of seeds and seeds of trees (zoochory) in the city of Cotonou. Insectivores control large populations of insect pests, especially mosquitoes in the city of Cotonou. It is easy to understand that the conservation of these bats in the city of Cotonou and therefore along these roads is very important.

Family	Species	French name	Roads concerned
Muridae	Mastomys natalensis	Black rat (rodent)	Ax1, Ax4
Pteropodidae	Epomophorus gambianus	Fruit bat	Ax1, Ax3, Ax5
Pteropodidae	Eidolon helvum	Fruit bat	Ax1, Ax3, Ax5
Vespertilionidae	Neoromicia nanus	Insectivorous	Ax1, AX2, Ax3,
		bat	Ax4, Ax5, Ax6, Ax7

Table 30: Diversity of mammals along highways

Source: Field data, CECO-BTP June 2022



5.2.6.3.3. Composition of water and terrestrial avifauna of the roads of Lot 1 • Composition and diversity Forty-two (42) species of birds divided into 22 families have been recorded along the various roads surveyed (Table 9). The avian fauna is therefore the most represented and diversified zoological group along the roads of Lot 1. Avifauna is therefore one of the main fauna bio-indicators on which we must base ourselves to define restoration or corrective actions after the construction of the structures. It is noticeable that the species richness by family varies from 1 to 4 species. The Cuculidae and the Alcedinidae are the most represented families with 4 species. They are followed

respectively Columbidae, Estrildidae (3 species). Table 31 presents the bird species recorded.

Table 31: Systematic overview of the bird species recorded along the roads of lot 1 as well as their migration status.

N° S	N° Scientific name Roads French name Family Status concerned				
1	Phalacrocorax Afric	can cormorant Phalac	crocoracidae R Ax2	africanus	
2	Egretta garzetta Eg	rette garzette Ardeida	ae R/IA/P Ax2		
3	Bulbucus ibis Ax1,	, Ax2, Ax3, Heron Ca	ttle Egrets Ardeidae	e R/IA Ax5 /	Ax1, Ax2, Ax3,
4	Milvus migrans Bla	ck Kite Accipitridae R	/IA/P Ax4, Ax5, Ax6	6, Ax7	
5 K Co	aupifalco Hawk Accipitr llared Dove Columbidae	idae R Ax2, Ax3, Ax5 semitorquata R Ax6	monogrammicus S	treptopelia	Ax1, Ax3, Ax5, 6
7	Streptopelia vinacea	Collar Dove Columbic	dae R Ax1, Ax3, Ax4	4, Ax5, Ax6	, Ax7
8	Streptopelia sene	galensis Turtle Dove	Columbidae R Ax1,	Ax3, Ax4,	Ax5, Ax6
9	Psittacula krameri Ri	ing-necked Parakeet	Psittacidae R Ax3,	Ax5	
10	Poicephalus senegalu	s Parrot youyou Psitta	acidae R Ax3, Ax5		
11	Crinifer piscator Tou	uraco grey Musophag	idae R Ax1, Ax3, A	x5, Ax6	
12	Clamator levaillantii	Hello from Levaillant	Cuculidae	AI	Ax3, Ax5
13	Chrysococcyx klass	Hello from Klass	Cuculidae	R/AI	Ax1, Ax3, Ax5, Ax6
14	Chrysococcyx caprius	Hi didric	Cuculidae	R/AI	Ax1, Ax3, Ax5, Ax6
15	Centropus senegalensis	Senegalese coucal	Cuculidae	R	Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7
16	Tyto alba	Barn Owl	Tytonidae	R	Ax3
17	Telacanthura ussheri	Ussher's Swift	Apodidae	R	Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7



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18	Cypsiurus parvus	Swift	Apodidae	R	Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7
19	Apus affinis	House Swift	Apodidae	R	Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7
20	Alcedo leucogaster	White-bellied Kingfisher	Alcedinidae	R	Ax3, Ax5
21	Ispidina picta	Pygmy kingfisher	Alcedinidae	R/AI	Ax1
22	Halcyon senegalensis	Senegalese kingfisher	Alcedinidae	R/AI	R Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7
23	Ceryle rudis	Magpie kingfisher	Alcedinidae	R	Ax1 Ax1, Ax2,
24	Hirundo smithii	Long-tailed Swallow	Hirundinidae	R/AI	Ax3, Ax4, Ax5, Ax6, Ax7 Ax1, Ax2,
25	Hirundo senegalensis	Swallow of the mosques	Hirundinidae	R/AI	Ax3, Ax4, Ax5, Ax6, Ax7 Ax1, Ax2,
26	Pycnonotus barbatus	Garden bulbul	Pycnonotidae	R	Ax3, Ax4, Ax5, Ax6, Ax7 Ax3, Ax5 Ax3,
27	Turdus pelios	Greyish thrush,	Turdidae	R	Ax5 Ax3, Ax5
28	Anthreptes gabonicus	Brown sunbird,	Nectariniidae	R	
29	Cyanomitra obscura	Olive riddlebird,	Nectariniidae	R	
30	Corvinella corvina	Yellow-billed corvinella	Laniidae	R	Ax3, Ax5
31	Corvus albus	Magpie crow	Corvidae	R	Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7
32	Ptilostomus afer	African	Corvidae	R	Ax1, Ax3, Ax5
33	Passer domesticus	Piacpiac House Sparrow	Passeridae	R	Ax1, Ax3, Ax5
34	Ploceus nigerrimus	Black weaver from Vieillot	Ploceidae	R	Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7
35	Ploceus cucullatus	Weaver Constable	Ploceidae		Ax1, Ax2, Ax3, Ax4, Ax5, Ax6, Ax7
36	Lagonosticta senegala	Amaranth from Senegal	Estrildidae	R	Ax3, Ax5
37	Lonchura cucullata	Capuchin nonnette	Estrildidae	R	Ax3, Ax5

Lonchura bicolor

Vidua macroura

Thalasseus

sandvicensis

Vanellus spinosus

Pluvialis squatarola

38

39

40

41

42

Capuchin two-tone

Pin-tailed Whydah

Sandwich tern

Black-bellied plover

Spurred lapwing

R= Resident, IA = Inter-African Migrant, P= Palearctic

Estrildidae

Viduidae

Sternidae

Charadiidae

Charadiidae

R

R

Ρ

R

Ρ

Ax3, Ax5

Ax3, Ax5

Ax3, Ax5

Ax1

Ax1

Ax1


- Migratory status of bird species recorded on water and land on the roads of Lot 1
 The avian species recorded in the area of the various roads in Lot 1 are
 predominantly resident species (39 species). Migratory species with the status of
 inter-African (9 species) and Palearctic species (4 species) are not negligible. These
 migratory species temporarily visit the coastal regions in general and the wetlands of
 Cotonou. This reveals that the space containing the roads of Lot 1 of the city of
 Cotonou is contained in a migration district of international importance. This shows
 the importance of integrating this area into a global policy for the conservation and
 management of migratory birds to ensure their long-term sustainability.
- Analysis of the diversity and physiognomy of the avifauna by road axes of lot 1

The composition and diversity of bird species recorded along the roads of lot 1 are respectively:

- 26 species for axis 1,
- 16 species for axis 2,
- 35 species on axis 3,
- 14 species on axis 4,
- 34 species for axis 5,
- 18 species on axis 6 and,
- 13 species for axis 7

It emerges from these results that axes 3 (Place du souvenir-Carrefour 3 banks) and 5 (Carrefour 3 banks-Carrefour Air Afrique) are those that concentrate the highest wealth in avifauna. This situation is linked to the fact that along the axes there is a diversity of woody and herbaceous plants (fruit trees) and the presence of numerous hut gardens related to these axes. The existence of these particular urban ecosystems also attracts insects and promotes the presence of both frugivorous and insectivorous birds and nectariniidae. This leads to the conclusion that after the construction of the structures, it is absolutely necessary to carry out a specific urban forestry operation made up of various species of melliferous plants along the axes. This will make it possible to create specific ecosystems that promote the subservience of various categories of terrestrial fauna in the city. This will increase urban ecosystem and ecological services.

Then, by looking at the composition and diversity of roads according to the different roads, we can easily conclude that:

- the avifauna of the roads of lot1 is composed of a dominant species of land birds (90%) and only 10% of water species are confined to a small portion of the lagoon of axis1 (Ancien pont-Carrefour SOBEBRA-Carrefour OPT PK3- Carrefour le Bélier). This water avifauna is formed by species such as :P halacrocorax africanus, Egretta garzetta, Ispidina picta, Ceryle rudis, Thalasseus sandvicensis, Vanellus spinosus, Pluvialis squatarola;



- the urban avifauna of the roads (1, 3, 5 and 6) of lot 1 is dominated by species of forest, field and fallow birds such as Bulbucus ibis, Kaupifalco monogrammicus, Poicephalus senegalus, Crinifer piscator, Clamator levaillantii, Chrysococcyx klass, Chrysococcyx caprius, Tyto alb, Streptopelia semitorquata, Psittacula krameri, Turdus pelios, Anthreptes gabonicus, Cyanomitra obscura;
- the urban avifauna of the roads of lot 1 is also made up of ubiquitous "all-purpose" species provided that there are trees and human feed such as: Milvus migrans, Pycnonotus barbatus, Streptopelia vinacea, Streptopelia senegalensisHalcyon

release financial resources to monitor migratory waterbirds for at least a period of 3 years in order to collect and analyse data on the impact of the project the urban avifauna of the roads of Lot 1 is also made up of aerial passers-Tinus.
 planktophase, which are also ubiquitous bird species, but which very rarely land above a fixed habitat. They are mainly swallows and swifts: Hirundo smithii, Hirundo senegalensis, Telacanthura ussheri, Cypsiurus parvus, Apus affinis.

In short, the physiognomy and diversity of avifauna identified along the roads of Lot 1 are reference state indicators that must be used for monitoring (biomonitoring) during the works and after the work has been carried out. To this end, considering the situation of the avifauna in this sector, which is contained in the Ramsar site 1018 where the project will be carried out, the following precautions should be taken at the technical level to minimize the impacts after the completion of the works on the avifauna on a joint basis.

These precautions are:

- maintain the representativeness of all pre-existing natural habitats along the roads after their completion to ensure not only the sustainability of habitats and the migration of the area's traditional ecosystems to ensure the biodiversity of the resident avian fauna and their reproductive ecology;

birds, but also the increased chances of maintaining services

on migratory birds. Such projects will be entrusted to laboratories specializing in ornithology in conjunction with the Beninese Agency for the Environment, which is the Ramsar focal point in Benin.

• Composition and diversity of amphibians on the roads of Lot 1

Two (02) species of amphibians divided into 2 families have been identified and recognized by the populations as present along the roads of lot 1. These are Buffo buffo and Hemisus marmoratus (Table 29).



Table 32: Amphibian species identified

Scientific name	French name	Family	Roads concerned
Buffo buffo	Common toad	Bufonidae	Ax1
Hemisus marmoratus	African Hemise	Hemissotidae	Ax1

Source: Field data, CECO-BTP June 2022

Photo 21 shows an amphibian species found along the road alignments of Lot 1.



Photo 21: Hemisus marmoratus Source: Field data, June 2022

• Composition and diversity of reptiles on the roads of Lot 1

Only one (01) species of reptile is encountered along the roads of Lot 1. This is the common agama (Agama agama- Agamidae). It is a ubiquitous saurian found along all the roads.

• Composition and diversity in itchyofauna of the aquatic ecosystems of the roads of Lot 1 This assessment is strictly carried out in the portion of the Cotonou channel of Axis 1 which is a brackish ecosystem between the Atlantic Ocean and Lake Nokoué. Thus, the ichthyological fauna of this sector of the road axis of lot 1 reveals 8 species of fish (Table 30). Photos 22, 23 and 24 show the images of Sarotherodon melanotheron and three species of crustaceans respectively.



Zoological Group	Family	Species Hemichromis
	Cichlidae	bimaculatus Hemichromis
		fasciatus Sarotherodon
		melanotheron Tilapia
Fish		guineensis Clarias agboyiensis
	Claridae	Clarias grariepinus Elops
		senegalensis Megalops
		atlanticus Cardiosoma
		armatum Melicertus kerathurus
	Gecarcinidae	Callinectes amnicola
Crustaceae	Penaeidae	
	Portunidae	

Table 33: Inventory of the ichthyofauna of the Cotonou lagoon

Spring : Field data, CECO-BTP June 2022



Photo 22 : Sarotherodon melanotheron Photo 23 : Bank crab (Cardiosoma armatum) Shot: Lougbégnon, 2022 Shot: Lougbégnon, 2021



Photo 24: Swimming crab specimens: Callinectes amnicola Source: Field data, June 2022

, 2022



5.2.6.3.4. Rare or threatened wildlife species requiring special attention along the project ecosystems

In the right-of-way strip of the main roads of Lot 1, only the Youyou Parrot (Poicephalus senegalus) is a locally threatened species, but it is of least concern at the international level (Table 31). There are no wildlife under high threat status in the right-of-way area of the highways of Lot 1.

Table 34: Species of fauna with special conservation status in the project area

IUCN National IUCN International Taxonic GroupBirds Poicephalus senegalus VU LC

Legend: LC = Least Concern; UL = Vulnerable

5.2.6.3.5. Use of wildlife species by populations living near the project right-of-way area

• Use of fauna species by the populations The field surveys carried out indicate that 2 species of mammals, 25 species of birds and all species of water fauna (fish and crustaceans) are hunted or fished by the populations living near the city of Cotonou for various uses.

• Diversity and use of animal species in food The respondents use almost all of these animal species for food purposes, with a strong preference for eating fish and crustaceans (100%), birds (43%) and a low frequency of consumption of mammals (65%). It is inferred that fish and birds are the most exploited animal species and the most valued for consumption. They are eaten directly in smoked or fried form or used in the preparation of various sauces.

• Diversity and use of animal species in traditional medicine The animal species hunted along the roads are also used for medicinal purposes by the local populations. These populations use birds (65% of respondents), mammals (75% of respondents) and reptiles (5% of respondents) to treat certain diseases. Fish are not exploited for healing. The organs of all these species used for traditional medicine are used to cure or treat various diseases within the riparian populations.



5.2.7. Environmental issues of the receiving environment

5.2.7.1. Climate change and associated risks Beyond average or normal values, the various climatic parameters are subject to mutations, in line with the overall trend. In view of their impact on the natural components and socio-economic conditions of the populations, the changes that affect rainfall and temperature with the associated risks, particularly floods and corollaries, have attracted attention.

5.2.7.2. High rainfall instability

The irregularity of the annual totals is one of the characteristics of the rainfall variability in the receiving environment of the project (Figure 26). There is an alternation of surplus and deficit years without any apparent periodicity. The 1950s and 1960s were marked by a high incidence of surplus years, unlike the 1970s and 1980s, which were more affected by deficit situations. As for the 90s and 2000s and 2010s, they are rather contrasted without dominating one type of year.



Figure 26: Highlighting the interannual variability of rainfall Source: CECO-BTP, June 2022

The 10 rainiest years are: 1957, 1962, 1963, 1968, 1979, 1987, 1988, 1993, 1997 and 2010. These years are characterized by surpluses, high offal and a high concentration of rainfall during rainy months such as June and September (Figure 27) with the associated risk of flooding. During the month of June alone, for example, the rainfall can exceed 500 or even 600 mm (as in 2009 and 2010).





Figure 27: Monthly distribution of rainfall in surplus and deficit years

Source: CECO-BTP, June 2022

This poor distribution of rainfall, combined with the hydrogeological context and the high human concentration, induces socio-environmental consequences, in particular floods and their corollaries. The sizing of rainwater drainage structures should take into account cases of heavy rainfall.

In addition to the poor temporal distribution, the city of Cotonou is also prone to extreme rainfall events, which are generally exceptional rainfall events. They refer either to a daily rainfall that gives rise to a quantity of water loaded with risks such as rainfall exceeding 40 mm (Figure 27). These types of rainfall are capable of causing flooding and/or land erosion.



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Figure 28 shows the upward trend in the number of these risk-laden events for both environmental components and human activities. The frequency of occurrence of these rains is higher during the 1990s, 2000s and 2010s and the record value is observed in 2010 (24). Typically, these types of rains occur during the rainy months when the ground is already wet, which increases the associated risks of flooding and its consequences. Table 35 provides more details on the extreme rainfall events recorded in Cotonou.

Height Du Recorded	ration Direction Minutes) e (mr	Dates Events \ n)	Vater Event	Wind Observations (Ho	ur and
June 20, 1962	Rain	4:30 p.m.	191.5	Rain from dawn and afternoon	WSW
July 12, 1975	Rain	12:50 p.m.	193.8	Rainy and very cloudy weather all day	SW
June 3, 1982	Rain with thunderstorm	11 a.m.	148.6	Very overcast sky with presence of Cb	WSW
April 11, 1992	Heavy thunderstorm rain	5:25 a.m.	132.2	Very cloudy sky, Presence of Cb in	ENE

Table 35: History of extreme rainfall events in Cotonou



				All sectors NW/SW	
13 July 2006	Rain	7:18 a.m.	129.5	Rain from dawn and afternoon	WSW
June 27, 2010	Heavy thunderstorm rain	4:40 a.m.	178.9	Rainy and very cloudy weather all day	SW

Data source: Houndakinnou 2005, supplemented by Kouton 2011

The data in Table 32 show that in Cotonou the heavy rains occurred during the months from June to July. They are linked to monsoon activities (20 June 1962, 12 July 1975, 3 June 1982, 13 July 2006 and 27 June 2010) and to the passage of easterly flows (April 11, 1992). These events are accompanied by catastrophic floods, especially since they occur during the rainy season when the soils are already wet.

Moreover, in view of the topographical base of the city, extreme rainfall will only increase the water level in the ground, especially in the rainy season. This implies the consideration of a large layer of tar for the coating of the existing lanes for better protection of the latter against flooding. 5.2.7.3. Thermal warming trend

The evolution of the thermal values (maximum, average and minimum) of the receiving environment (Cotonou synoptic station), analysed by the linear regression method, is illustrated in Figure 29.



Figure 29: Evolution of temperature values (maximum, minimum and average) Source: CECO-BTP, June 2022

Figure 29 shows that temperatures are trending upwards overall. Thus, maximum



temperatures varied from 29.8 to 31.60 °C, an increase of 1.80 °C respectively between 1953 and 2018. As for the minimum temperatures, they have increased from 23 to 25.5 °C; an increase of 2.5°C and 2.5°C everywhere. This trend is more pronounced in terms of minimum temperatures. The largest increases began in the 1970s and continued steadily until the 2000s (Figure 30).



Figure 30: Decadal evolution of average temperatures in Cotonou Source: CECO-BTP, June 2022

As for the maximum values, they began to increase at the end of the 1950s (between the 1950s and 1960s, the increase reached 0.6 °C). After that, there was a kind of respite during the 1970s and 1980s (the value went from 30.3 to 30°C, a decrease of 0.3°C). On the other hand, the 1990s and 2000s were characterized by an increase in maximum thermal values. The minimum temperature values have increased more than the maximum values. These findings are consistent with those found at the global, regional and national scales (IPCC, 2014, Lawin et al., 2013).

Ultimately, the tendency towards thermal warming is unequivocal in the receiving environment of the project. The largest increases began in the 1970s and continued steadily until the 2000s. The Pettiit test also confirms this trend and makes it possible to identify the years of rupture (Figure 31).



Figure 32: 31: Evidence of stationarity breaks in temperature evolution Spring : CECO-BTP, June 2022

The Pettitt test made it possible to observe a break in the evolution of the minimum temperature in 1985. This break, which is highly significant at the 95% threshold, indicates that from that date on, the minimum temperature values began to evolve in the direction of increase. As for the maximum values, they also experienced a break in stationarity in 1992. It is also a highly significant break at the 95% threshold, which shows that the maximum values are also increasing.

The results obtained by the linear regression method and the Pettitt test show that the receiving environment has undergone thermal heating since the 1970s. This warming concerns more the minimum values where the increase is more marked. The comparative analysis of the thermal regime in relation to the dates of rupture makes it possible to know the months most affected by warming (Figure 32).



Comparative evolution of monthly thermal values around the years of rupture Source: CECO-BTP, June 2022

Figure 32 confirms that minimum temperatures are the most affected by the increase in values. All the minus of the year are concerned and the strong increases concern the months of February, March, April, June, July, August, October and November where the increases vary between 0.7 and 1.3°C after the dates of ruptures. Although the differences are not pronounced, maximum temperatures have also increased during these months. Such an increase, which is part of the current global warming, is not without direct and/or



indirect consequences on natural components and human settlements.

5.2.7.4. Strong Oscillation of Maximum Wind Speeds

Even if the city of Cotonou is not in the area of influence of the 7 cyclonic basins conducive to very dangerous winds (depressions, tropical storms, hurricanes, typhoons and cyclones) defined by the World Meteorological Organization (WMO), the fact remains that it does record risky winds from time to time (Figure 33).

The analysis of Figure 33 shows a high variability in maximum speeds. Extreme values were observed in 1962 (29 m/s for the high value) and 2007 (13 m/s for the lowest value). These speeds correspond to 105 and 47 km/h respectively. ^{Cotonou}





According to the Beaufort scale used by Allé et al. (2013), winds of speed reaching 90 km/h and more are qualified as "storms" and are capable of damaging the roofs of houses, uprooting trees, etc. Damage is greater when associated with heavy rainfall, as is sometimes the case in the receiving environment. Even if the analysis does not show a significant trend, it is still noted that 8 of the 10 highest values are recorded during the last 3 decades (1990, 2000 and 2010). The increase in violent winds, which are therefore fraught with risks, in recent decades is worrying in view of the fragility of certain natural ecosystems and human settlements in the environment, especially when they are accompanied by heavy rainfall.

These results show that the development of road infrastructure will have to take into account the climatic context characterized by high rainfall instability in a context of rising temperatures associated with the occurrence of strong or violent winds. The climatic future



of the city of Cotonou is also not very reassuring insofar as the IPCC (2013) predicts more or less profound changes in climate parameters by 2050/2100 in all regions of the world.

5.2.7.5. Future climatic physiognomy of the environment There is a high level of confidence that temperatures will increase in the West African region. In contrast, there is low consensus on the direction and magnitude of potential changes in precipitation. Climate change is likely to lead to increased carbon storage in forests and increased vegetation productivity in most of West Africa. However, this increase could be limited by changes in land use. It is also anticipated that ecosystems will move northward in central and eastern West Africa. The data obtained from the least pessimistic RCP 4.5 model and the most pessimistic RCP 8.5 (Representative Concentration Pathway) made it possible to establish the evolution of annual rainfall amounts at future horizons in the project's receiving environment.

Table 36 illustrates the temperature and rainfall values according to the types of projection to 2080.

Table 36: Future climate physiognomy by scenarios used

Scenarios Temperatures Temperatures Minimum maximum rainfall

RCP4.5 Increase Increase No clear trend; increase in the range from 0.8 to 1.6°C from 0.2 to 0.8°C frequency of extreme values

RCP8.5 Increase Increase No clear trend; increase in the from 1.1 to 2.6°C from 0.5 to 1.5°C frequency of extreme values Increase Increase Increase in annual totals in the range of 30 to SAH from 0.8 to 1.4 °C from 0.3 to 0.6°C 50%; high concentration of rainfall during wet months; high occurrence of extreme events

Sources: Data processing and bibliographic synthesis

The data from the model outputs under the 2 chosen scenarios do not indicate a clear trend in the annual rainfall totals at the level of the four poles concerned. This result is the result of the high instability of rainfall compared to historical data. However, the risk of extreme values (heavy rainfall with or without high winds) is high. In addition, there is the occurrence of multifaceted droughts (insufficient rainfall, dry spells, late start and/or early end of rain).

As far as temperatures are concerned, they will experience a fairly significant increase, especially in the minimum values. The current trend of thermal warming will thus be confirmed. The SAH projections, on the other hand, indicate, in addition to thermal warming, an increase in annual rainfall totals of up to 50% compared to the current average, associated with a high concentration of rainfall during the wet months, not to mention the increased risk of extreme rainfall events. According to this scenario, years similar to 2010, characterized by heavy rains and gigantic floods, will multiply by 2080.



5.2.7.6. Development of the Cotonou Access Roads and Crossings (ATC) as a factor in strengthening the resilience of the population to current and future climatic conditions A reliable road network can help promote the African economy and ensure that every inhabitant of the region has access to economic opportunities and services. For historically strategic reasons, many of the world's major cities are located in areas exposed to major geological and meteorological hazards, for example, on the coast, in floodplains (as in the case of Cotonou), or in tectonically active areas. In many cases, urban areas are exposed to additional sources of low-level hazards resulting from inadequate land use or mismanagement of natural resources (Turnbull 2013). Of course, climate plays an important role in influencing the way of life in communities, but it also influences the way of building and the development of municipalities and regions. The municipality of Cotonou in general and the roads to be repaired in particular are not immune to these realities. Thus, planning with climate change in mind promotes the gradual adjustment of communities to the expected impacts while limiting disruptions to living environments and socio-economic activities (Ouranos, 2010). In view of the damage suffered by the population during the various rainy seasons, the decision to repair and develop the access roads and crossings of Cotonou (ATC) (Plate 2) comes at the right time to significantly increase the resilience of local populations in the face of recurrent rainfall extremes.



Plate 2: Overview of part of the track on the sections Place du souvenir - crossroads 3 banks and old bridge at the SOBEBRA crossroads Source: Field data, June 2022

This could only be the case because today's climate change will force municipalities to make important choices, as planning for public safety, land use planning, environmental management or economic development must now be considered in light



of the risks posed by a changing climate. Fortunately, there are effective ways to adapt new roads and modify existing ones to make them more resilient.

5.3. Socioeconomic characteristics of the study environment 5.3.1. General information about the city of Cotonou The social environment of the Zone of Influence (ZI) of the project provides a description of the relevant basic socio-economic conditions in the IZ and in a wider study area including the Commune of Cotonou and the Littoral Department.

The description of the social reference state is organized into several subsections:

- Administrative and governance structure;
- Population and demographic profile;
- Land use and ownership;
- Economy and employment; Subsistence activities;
- Education;
- Health;
- Community Safety; and,
- Infrastructure and services (including housing, water and sanitation, energy, roads and transport, telecommunications).

5.3.2. Administrative governance structure in Benin

Since the various decentralization reforms in Benin in 1999, Benin has had an administrative configuration organized into three territorial levels: (12 departments), intermediate (77 communes/municipalities) and local (546 districts). The arrondissements are in turn subdivided into communities (called villages for rural communities and neighborhoods for urban communities).

For the basic objective, the socio-economic context will refer to the national level (Beninese territory), the departmental level (Atlantic), the intermediate level (Commune of Cotonou) and the local level (the seven districts crossed by the ATC Lot 1 project).

The distribution of Benin's administrative structure and responsibilities is described below:

- Department: the departmental level represents the State in the territory. It is headed by a prefect, chosen by the ministries, who is responsible for ensuring the application of the national guidelines in the municipalities covered by the department.
- Municipalities/Municipality: The municipality is administered by an elected council, chaired by the mayor. The mayor, as well as the heads of the districts, are elected by their peers within the municipal council in the presence of the prefect of the department. It functions as a decentralized unit of the State, in particular through the use of its own budget, separate from that of the State, and through the use of its own competences, as well as those shared or delegated by the State. Since 2003, municipalities have been



given powers in the areas of environmental management and spatial planning, including the issuance of permits and permits. They are also responsible for sanitation and waste management and are responsible for defining their own development plan.

• Arrondissements: they have infra-communal bodies comprising a district head and a district council. The borough head reports directly to the mayor and is appointed by the elected councillors who represent the borough on the municipal council. All development and investment projects launched by the municipality must first consult the borough council.

Populations can be organized in villages or in urban neighborhoods, as noted above. The community level is the main unit of community governance within which life in rural or urban areas is organized. The village or urban district chief, or development association leader, represents the community to the public authorities and reports directly to the district chief. From a global perspective, municipalities and boroughs provide basic infrastructure, collect taxes, and implement plans and programs for the effective development of the borough. Each borough has an assembly whose members are elected by the citizens of their region, in order to make them directly accountable to the people they serve.

In addition, Law No. 2013-05 on the creation, organization, attributions and functioning of local administrative units in Benin sets the following characteristics for the territory of the communities:

- The village may not have less than one thousand (1,000) inhabitants. However, existing villages with less than one thousand (1,000) inhabitants retain their village status;
- The village is made up of one or more groups of permanent settlements in a rural environment, called hamlets. It includes the entire population that resides there;
- One or more localities located at least five (5) kilometres from the capital of the village to which they belong may be established as a village even if their combined population does not reach one thousand (1,000) inhabitants;
- The urban district is composed of one or more groups of permanent settlements in an urban environment. It includes the entire population of the population residing there and may not be less than seven thousand (7,000) inhabitants.

The commune of Cotonou, with 13 districts, covers an area of 79 km², was originally created on the initiative of King Ghézo of Abomey in 1830 for needs mainly related to the slave trade for which Kutonu, now Cotonou, served as a transit and embarkation point. It is bordered to the north by Lake Nokoué, to the south by the Atlantic Ocean, to



the east by the commune of Sèmè-Kpodji and to the west by the communes of Abomey-Calavi and Ouidah.

5.3.3. Population and demographic profile of the host municipality

5.3.3.1. Socio-demographic data of Benin This section presents the demographic context of the Project as summarized in Figure 34 which focuses on secondary data acquired in the most recent demographic census undertaken in Benin: the 2013 Population Census (RGPH-4). The available demographic data mainly reach the national and departmental level and partially the local level (Communes and Arrondissements).

In 2013, Benin's population was 10.01 million (estimated for 2019 at 11.8 million people), with a density of 87 inhabitants/km² and an annual growth rate of 3.5% when comparing data from the 2002 and 2013 censuses. The most densely populated areas are located in the expanding urban areas located near the coast (RGPH-4).

In 2013, the fertility rate in Benin was 4.8 children per woman, however recent data from the World Bank's database shows a decrease in this trend, with a rate per woman in 2019 of 3.6 6. Almost half of the population (46.7%) is under the age of 14, reflecting a young population with a low proportion of people over the age of 60, with life expectancy estimated at 62 years (both men and women) in 2013. At the national level, the gender ratio shows a slightly higher proportion of the female population at 51.2 per cent.

⁶Crude birth rate (per 1,000 population) - Benin | Data (worldbank.org)





Figure 34: National demography (2018 projection) Source: RGPH-4, 2013

The number of households in the country is estimated at 1.8 million, with the average household size being 5.5 people. People living in rural areas (rate of 6.1 members per household) have a higher average household size than the population in urban areas (5.0 members per household) (RGPH4-2013).

5.3.3.2. Socio-demographic data of Cotonou With Law No. 2013-05 of 27 May 2013 "on the creation, organization, allocation and functioning of Local Administrative Units in the Republic of Benin" deliberated and adopted on 15 February 2013 by the National Assembly, the Commune of Cotonou has thirteen (13) Districts and one hundred and forty-three (143) city districts (INSAE-RGPH 4, 2013). The population of the entire Commune of Cotonou was 679,012 inhabitants (INSAE- RGPH4, 2013) compared to 665,100 inhabitants in 2002 (RGPH3, 2002). According to the results of the first two censuses of 1979 and 1992, the population of this Commune was 320,332 inhabitants and 536,827 inhabitants respectively.

Figure 35 shows the demographic projection of the urban area of Cotonou from 2013 to 2035.



Figure 35: Population projection of the urban area of Cotonou Source: CECO-BTP June 2022, (Based on data from the World Bank, United Nations, census, GeoNames).

The observation of Figure 35 shows that in 2035 the population of Cotonou will reach 1,055,000 inhabitants. There has been a demographic dynamic over the last few decades and it is also observed at the level of all the districts of the municipality, as shown in Figure 36 below. 120000 97920 100000 69991 75336 80000 5796261668 57691 68486



Figure 36: Population by Arrondissement in the Commune of Cotonou in 2013 Source: CECO-BTP, June 2022, (Based on RGPH4 data)

It appears from this figure that the seven districts to which lot 1 of the ATC project in Cotonou belongs represent administrative, commercial and residential areas.

In this area, the proportion of the working population likely to need jobs is around 68.2% of the population.

5.3.3.3. Birth and fertility in Cotonou The results of RGPH 4 give an overview of the birth and fertility rates in the Commune of Cotonou (Table 37).



Table 37:	Birth a	nd fertility	in the	Commune	of Cotonou
	Difficition	i a i ci unity		Commune	

TOPICS	RATE	
	BENIN	COTONOU
Total Fertility Rate (children per woman)	4,8	3,7
Total Total Fertility Rate TGFG (%)	52,7	120,1
Crude birth rate (TBN) (‰)	36,4	33,6
Average age at childbearing (in years)	28,2	29,0
Crude Reproduction Rate (girls per woman) 2		

Source: CECO-BTP, June 2022, (Based on RGPH4 data)

The crude birth rate in Cotonou in 2013 was 33.6 per thousand compared to 36.4 per thousand at the national level. The general fertility rate is 120.1 per thousand compared to 52.7 at the national level, and the average age at childbearing is 29 years in Cotonou. As for the total fertility rate, it is 3.7 children per woman in the project's childcare setting. Fertility is influenced by the place of residence. More and more, women have begun to change their fertility behaviour.

5.3.3.4. Migration around Cotonou

According to RGPH4 data (INSAE, 2013) the proportion of the foreign population in the Littoral is 8.5%. Almost all of the foreign population in the Littoral department comes from Africa. The three main countries of origin of foreigners are: Niger (28.5%), Nigeria (23.3%) and Togo (21.1%) as shown in Figure 37.



Figure 37: Distribution of the foreign population of the Commune of Cotonou in 2013 Source: INSAE -RGPH4, 2013.

Apart from this sub-regional immigration, it is noted that the internal migration balance has been negative in the commune of Cotonou since 2002. In 2013, internal immigrants accounted for two-thirds of the immigrants in the last five years in this municipality. The fluctuation over time is as follows.



		•		
LOT	'N°	AT	⁻ C-	0



Figure 38: Migration flows in Cotonou from 1992 to 2013 Source: RGPH, 2, 3 and 4

It can therefore be seen from this figure that Cotonou receives the largest internal migratory flow from Benin. About 52% of these people are men, 14% are under 20 years old; 74% (between 20 and 64 years old) are of working age. The proportion of people aged 65 and over is 12%. Overall, nearly 2/3 are looking for a job at the Autonomous Port of Cotonou and elsewhere.

5.3.3.5. Socio-cultural groups in Cotonou As far as social organization is concerned, according to RGPH4 data, in general in the commune of Cotonou, the three ethnic groups of considerable demographic importance are: the Fon and related groups (\approx 57%), the Adja and related groups (\approx 18%) and the Yoruba and related groups (\approx 11%). The other Christians and Celestials are 12% and 6% respectively (Figure 39).





Figure 39: Percentage distribution of religions Source: INSAE data, RGPH4, 2013.

Mainly, in the port area, the population is cosmopolitan and includes different sociolinguistic components of Benin and of various nationalities. The fishing community within the port and those living near the port to the east are the Xwlà, Xwéda, Toffin.

5.3.3.6. Religious practice in Cotonou On the religious level in the commune of Cotonou, we have Catholicism (57.8%), Islam (14.2%), celestial Christianity (7.8%), other Christians (4.4%) and other religions (15.8%). These religious practices are found in more or less the same proportions at the level of all the arrondissements.

In the port area, apart from imported religions (Christianity, Islam, etc.), our exchanges with the actors carrying out their activities in the project host environment revealed that a significant number of the port population discreetly engages in traditional religious practices, endogenous practices often presented as incompatible with Christianity or Islam. When certain difficulties arise (illnesses, danger of death, various blockages, etc.), we meet these people who do not hesitate, at night or during weekends, to visit the witch doctors for various rituals.

There is even an association of endogenous religion in the field of sea fishing. At the fishing port, for example, the fishermen associate endogenous religion with their activities. It is a way for them to seek fulfillment and profitability.

In the port area, we can therefore observe certain deities such as: Edan, Agboviagban (water fetish), Adja-Tado, Sakpata, Vénavi, Edan-Malènou-Agajoux, Xhèvièzo, Dan houènyon, and many other deities.

Investigations have revealed that the deity Dan houènyon is the very first fetish that was installed in this place. They are also deities such as Adjakanlinmabou Tado, Agoué, Hêviosso, Manlênou, Sakpata, Gou and Mami Wata.



But on the project site inside the Autonomous Port of Cotonou, there is no mention of the presence of any deity that could be impacted by the work.

5.3.3.7. Characteristics of housing in Cotonou The characteristics of the urban fabric of the city of Cotonou in general present a set of dwellings and highlight several types: administrative housing, residential housing of different standards and planned housing, scalable housing (residential building), spontaneous housing and precarious or unhealthy housing.

Three main tenure statuses characterize households in Cotonou, as shown in Figure 40:



Figure 40: Tenure status of households in Cotonou Source: INSAE 2013 data, RGPH4)

Figure 40 shows that the majority of heads of households are tenants (53%) in the city of Cotonou. This could be explained by the problem of obtaining land in Cotonou, but also by the low incomes of most households in Cotonou.

From the point of view of form, houses as a whole in Cotonou are characterized by two types of construction: row houses (85%) and detached houses (10%). Villas and buildings are very few in number and represent only 5% for each type.

The direct area of influence of the project is entirely urban and this is reflected in the housing of the households. The PDC2 data confirm this observation. In terms of urban planning, Cotonou has a checkerboard plan. Land use shows that the city is 90% serviced (Mairie de Cotonou, PDC2, 2017). There is an urban dynamic characterized by the increase in built space and the densification of the urban fabric. This situation has led to the establishment of specific habitats that must integrate the urban fabric of the city. The fieldwork as part of this study made it possible to distinguish all types of real estate construction in Cotonou. The latter are made of modern materials and grouped together.



Some are permanent and others can be dismantled. They are mostly roofed, slab, tiled or straw when you are close to the ocean or the lagoon.

5.3.4. Administrative and economic data of the ATC project's intervention districts Lot 1 of the Cotonou Access and Crossings (ATC) project covers the 1st , 4th , 5th , 7th and 12th

Districts of Cotonou. In terms of city districts, there are seventeen (17) that are impacted by the project.

5.3.4.1. Demographic data of the neighbourhoods crossed by the ATC project Table 38 provides the demographic data of the neighbourhoods crossed by the ATC project.

Table 38: Demographics of the neighbourhoods through which the CTA project passes

Demographics Boroughs Neighborhoods	
Men's Female Total Dandji 3547 3695 7242	
Tanto 2987 3211 6198	
1 st Nvènamèdé 1569 1702 3271 Tokplégbé 3255 3276	
6531 Finagnon 2119 2389 4508	
4 Fifadji Houto 869 864 1733 Guinkomey 544 678 1222	
Tokpa Hoho 418 452 870	
5Gbédokpo 810 942 1752 Xwlacodji Kpodji 550 532 1082	
Mifongou 573 603 1176	
7 Enagnon 1,716 1,897,3613	
12Ahouanlèko 1303 1006 2309 Les Cocotiers 697 625	
1322	

Source: INSAE 2013, RGPH4, cahier des villages du Littoral

The data in Table 38 show the population numbers by neighbourhood bordering the axes of Lot 1 of the ATC project.

5.3.4.2. Educational infrastructure As part of the fieldwork of this RAP, five (05) educational

infrastructures are identified in the streets of Lot 1 of the ATC project. Details are presented in the table

39.

Table 39: Educational infrastructure identified in the targeted areas

Axis	Educational institution
Old bridge-crossroads SOBEBRA- Carrefour OPT PK3-Carrefour le Bélier	Inter-Regional University of Industrial Engineering, Biotechnology and Applied Sciences (IRGIB-Africa) Our Lady of the Beatitudes School Complex
	Benin School of Technical and Industrial Sciences (ESTIB)
	Institut Supérieur les Cours Sonou (LCS).



Carrefour Cheminot-passage Complexe scolaire catholique père Planqué supérieur Steinmetz

Source: field data, CECO BTP, June 2022

From the analysis of Table 39, it appears that four (04) private institutions of higher education are located along the Ancien pont-Carrefour SOBEBRA - Carrefour OPT PK3-Carrefour le Bélier axis. On the Carrefour Cheminot-Passage Steinmetz axis, the Père Planqué Catholic school complex is located on the edge of this axis.

5.3.4.3. Living environment and sanitation within the Commune The sanitation of the living environment in the Commune of Cotonou and specifically the maintenance of axes 3 Banques-Carrefour Air Afrique, Carrefour Air Afrique-Ancien Pont ; Carrefour Cheminot-Steinmetz overpass; Carrefour Marche Saint Michel Carrefour NASUBA - Steinmetz Interchange-Carrefour Notre Dame and Troisième Pont - Carrefour SOBEBRA is now at the Société de Gestion des Déchets et de la Sanitaire du Grand Nokoué (SGDSN). This company aims to:

- Old bridge- SOBEBRA crossroads-OPT PK3 crossroads -Le Bélier crossroads, crossroads

- ensuring or arranging for the collection, sorting and recycling of waste; Treat and
- recover waste, in particular the deconditioning of household waste, the shredding
 of clutter, the elimination and recovery of waste and all related operations; carry
 out the transport or even the transhipment of waste with a view to its disposal by
- incinerator or outside the incinerator or in a landfill site; assist local authorities in the implementation of the best waste management and environmental preservation solutions; carry out in conjunction with the local authorities all
- operations relating to health, in particular the maintenance of urban roads, sweeping and staking of public roads and squares, and the cleaning of gutters
- Promote compliance with environmental protection rules in the areas of recycling, recovery and clean technologies
- participate directly or indirectly in all industrial, commercial or financial, movable or real estate activities or operations.

As part of the ATC project, the SGDS-GN is called upon to collect solid waste at all phases of its implementation.

5.3.4.4. Source of water supply in the city of Cotonou The population of the city of Cotonou consumes water from the public distribution network of the National Water Company of Benin (SONEB). In Cotonou, the drinking water coverage rate increased from 92.7% in 2011 to 91.7% in 2015. The analysis of these coverage rates reveals a slight deterioration in the level of drinking water coverage over the period. This deterioration can be explained by a demand that is higher than supply, the high costs of drinking water supplied by SONEB, a deterioration in the living conditions of the population



(inability to subscribe) and an extension of residential areas (need to extend the network). Despite this, the city has performed well above the national average, which has remained below 75% over the entire period (Cotonou, 2017, Communal Development Plan (PDC), p. 89).

5.3.4.5. Dominant socio-economic activities According to the results of the RGPH4 carried out by INSAE, trade, catering, accommodation (40.5%), "other services" (24.7%) and "manufacturing industries" (14.6%) are the predominant branches of activity in Cotonou. Despite its urban character, the Commune of Cotonou has 413 agricultural households out of the 154346 households in the City, i.e. 0.27%.

The most prominent crop production is intensive market gardening which is practiced on eight (08) large sites located in the heart of the city concentrating 87.9% of the agricultural areas and 86.87% of the producers, the largest of which are: Houéyiho, occupied since 1972 with 15 ha or 41.84% with a workforce of 334 producers (59% of the total); Coconut trees occupied since 1982 with an area of 4 ha or 11.15% with 27 farmers or 4.76% and ONEPI (Office National d'Edition de Presse et d'Imprimerie), occupied since 1980 on 2.5 ha with 42 producers (7.40%).

The secondary sector in the city of Cotonou is relatively small (20.3%) but is highly concentrated in the agri-food sector (SERHAU-SA/DPDM/MCOT, 2006; INSAE, 2016). This sector of activity also takes into account the artisanal activities of welding, ironwork, sculpture, basketry, etc. These companies are scattered throughout the city and discharge various effluents into the environment, the management of which remains a major problem. Cotonou is home to many markets of local and national importance, a central market of international reference: the Dantokpa market and a business center in Ganhi. Commercial activities are oriented towards domestic consumption as well as imports and exports. There are 38 secondary markets in Cotonou. Trade activities are mainly oriented towards Nigeria. Finally, Benin is also considered a transit country for the countries of the hinterland (Niger, Burkina Faso and Mali) from the Autonomous Port of Cotonou (PAC). These economic activities are marked by a predominance of the informal sector (Cotonou, 2017, Plan de développement communal (PDC), p. 39).

• Floriculture The cultivation of ornamental plants is practised along the main arteries and close to the residential areas of high-ranking civil servants, especially expatriates. These are often exogenous plants installed in pots on about 60 m2 per person. Prices vary between 50 and 400 FCFA, sometimes it goes up to 1000 FCFA per plant, for production costs on average of 250 to 700 FCFA.

• Livestock farming In the city of Cotonou, various domestic animal species are raised. These include cattle, sheep, goats, pigs, rabbits and grasscutters and a variety of poultry (chickens, ducks, pigeons and other birds). But, it should be noted that with urbanization, the breeding of large cattle is pushed to the outskirts of the city. The development of these activities contributes to the resolution of many social problems



(unemployment, food insecurity, insufficient income) and contributes to the recovery of household waste.

Fishing and fish farming

In Cotonou, several types of fishing are practiced:

- Artisanal sea fishing practiced by about 952 fishermen, of whom only 412 are Beninese (43.28%) and the rest are Ghanaians (51.68%) and Togolese (5.04%) using 272 pirogues, 170 of which are motorized. Its annual production is estimated at about 931.77 tons with a variation of plus or minus 361 tons;
- inland fishing, mainly practiced in Lake Nokoué by about 3800 fishermen using various gears. Its average annual production is 1629.52 tons;
- industrial sea fishing, which, despite an average annual production of 663 tonnes, or 36.38% of the national tonnage, shows a downward trend of 0.01% per year. There is also fish farming, especially through the "acadja" parks and other fish holes.

• Handicrafts and processing of agricultural products The secondary sector in the city of Cotonou is relatively small (20.3%) but is heavily concentrated in the agri-food sector (SERHAU-SA/DPDM/MCOT, 2006; INSAE, 2016). This sector of activity also takes into account the artisanal activities of welding, ironwork, sculpture, basketry, etc. These companies are scattered throughout the city and discharge various effluents into the environment, the management of which remains a major problem.

The development of activities for the processing of finished or semi-finished agricultural products using traditional or improved techniques (small processing units for various fruit juices, spices and other disseminated juices) occupies an important place. In addition to the predominant food industry, other activities in the secondary sector include wood, rubber and plastics processing, printing, the chemical industry, construction and public works.

• Trade Cotonou is home to many markets of local and national importance, a central market of international reference: the Dantokpa market and a business center in Ganhi. Commercial activities are oriented towards domestic consumption as well as imports and exports. There are 38 secondary markets in Cotonou. Trade activities are mainly oriented towards Nigeria. Finally, Benin is also considered a transit country for the countries of the hinterland (Niger, Burkina Faso and Mali) from the Autonomous Port of Cotonou (PAC).



The sale of smuggled gasoline: fueled by the proximity of Nigeria. According to a study in 2001, the city of Cotonou had a concentration of about 5000 fuel dealers who get their supplies from illegal importers. These resellers supply 70% of consumers.

In the Commune of Cotonou, 40.5% are occupied by trade, catering and accommodation activities. The economy in the arrondissements and neighbourhoods is more oriented towards activities with low technological added value requiring little capital:

- almost all economic activities are one-person;
- the share of commercial activity is constantly increasing;
- the enterprise (formal and not one-person) is marginalized.

The construction of drainage structures and the rehabilitation of roads under this sub-project will enable the actors of the trade sector to increase their income.

• Transport In Cotonou, transport activities are based on an improved road network and a wide variety of means of transport. The particularity of this sector in the city of Cotonou is the ever-increasing development of individual transport (motorcycle taxis) which accelerates the phenomenon of urban sprawl (INSAE and MTPT, 2005).

The construction of drainage structures and the sanitation of roads within the framework of this sub-project will enable the actors of the transport sector to improve their service to the population.

• Telecommunications Interpersonal communication between the inhabitants of the municipality is ensured by public and private telephone lines. The lines are served by the conventional telephone network or GSM (MTN, MOOV). The inhabitants of the commune get their information thanks to frequency modulation (FM) broadcasts on several radio stations, the most listened to of which are: CAPP FM, Soleil FM, Golf FM; Radio Planète, Maranatath and on television channels whose channels are watched: Golf TV, ORTB, CANAL 3, DIASPORA TV, E-TELE.

• Tourism

The city of Cotonou has a coastline with picturesque beaches but whose tourist value is diminishing due to coastal erosion, especially to the east of the city. Cotonou concentrates most of the reception potential (reception and accommodation sites).

• Unemployment rate In Benin, the labour force participation rate of the population aged 15 and over is 67.9%, while broad unemployment is estimated at 2.3% in 2015. These rates are lower than what was obtained in the 2011 and 2010 editions, at 72.0% and 75.5%, respectively. The participation rate is 75.9% for men and 60.7% for women. In the municipality of Cotonou, the overall activity rate of those aged 15 and over is 66.9%, while the unemployment rate in the broad sense of the 15-64 age group is estimated at 6.1%. The implementation of this sub-project will contribute to the reduction of the unemployment rate in the beneficiary neighbourhoods and districts.



5.3.4.6. Monetary and non-monetary poverty in the Commune of Cotonou This note focuses on the results of the Harmonized Survey on Household Living Conditions (EHCVM) carried out in the eight (08) WAEMU member states between 2018 and 2019. Table 37 shows the incidence of non-monetary poverty in the Littoral Department in 2019.

Table 40: incidence of income poverty in the Littoral Department in 2019

Incidence of income poverty (P0) Incide 2019	ence of income poverty in 2015 (P0) in
Coastal 23.5 18.9 Benin 39.3 38.5	

Source: INSAE, EMICoV 2015, EHCVM 2019

Compared to 2015, the incidence of monetary poverty decreased in the Littoral Department (Commune of Cotonou) (-4.6 points).

The situation of non-monetary poverty in the Littoral Department between 2015 and 2019 is presented in Table 41.

Table 41: incidence of non-monetary poverty in the Littoral Department between 2015 and 2019

	Incidence of non-monetary poverty Incidence of non-moneta	ary
	poverty (P0) in 2015 monetary poverty (P0) in 2019	
Coastal 21.5	5 18.6 Benin 28.7 26.1	

Source: INSAE, EMICoV 2015, EHCVM 2019

From a non-monetary point of view, poverty is understood through a composite index of living standards. This indicator reflects the general comfort in which households live (housing, possession of durable goods and hygiene). This form of poverty affected 26.1% of the Beninese population in 2019 compared to 28.7% in 2015. In the Littoral Department (Commune of Cotonou), non-monetary poverty affected 18.6% of the population in 2019 compared to 21.5% in 2015. The data shows that between 2015 and 2019, non-monetary poverty decreased.

5.3.4.7. Gender-based violence in the Commune of Cotonou Violence against women and children is noted in the city of Cotonou. They are characterized by the presence of economically exploited children, abused children, disabled children and sexually abused children. This violence is very rarely denounced at the level of the police stations and Social Promotion Centers of the commune because the victims fear the consequences of the denunciations. Gender-based violence in the Commune of Cotonou is captured by secondary data from the Ministry of Social Affairs and Microfinance (MASM) through the Integrated System of Family, Women and Children Data (SIDoFFE).

Table 42 describes the types of violence experienced by women and girls living in Cotonou



Table 42: Gender-based violence in the Commune of Cotonou from January 2016 to 31	
December 2021	

Indicators	Total Sex Male*	Total female	18 – 59 years old	Over 60 years	Total
Number of cases of gender-based violence handled	73	548	600	21	621
Number of cases of gender-based violence referred to the OPJ or the court	7	79	93	1	86
Number of cases of gender-based violen cases of physical violence received 5 95	ce referred 100 0 100	to health	training 0 17	18 0 17 Nun	nber of
Number of cases of sexual violence rece	ived 0 24 2	4 0 24 Nu	mber of case	s of econom	nic
violence received 23,190 216 9,213					
Number of cases of violence 63,397,451 Number of cases of violence against the	10,460 psy property 4	/chologica 45 56 8 49	l or moral vio) or cultural v	lence receiv iolence rece	ed ived
Number of cases of gender-based violen Total number of cases of kidnapping and	ce received kidnappind	d in the structure that occu	uctures of 26 rred 0 8 8 0 8	,108,129 9,1 3	34 care
Total number of cases of violence relate	ed to 0 10 8	levirate re	ecorded 2 10		
Total number of harassment cases identified	0	880	8		

Source: <u>https://sidoffe-ng.social.gouv.bj/sidoffepublic/stats</u> accessed on June 14, 2022 at 10:30 a.m.

The data in Table 42 present the situation of gender-based violence from 1^{January} 2016 to 31 December 2021. It appears that the total number of cases relating to gender-based violence treated is 621. When looking at the sex of the victim, the data show that 548 are female. In terms of types of violence, 397 women were subjected to psychological or moral violence compared to 63 men. The number of cases of physical violence received is 75 for women in the 18-59 age group. The number of cases of psychological or moral violence received is 600 for women in the 18-59 age group. Over the same period, 100 cases of physical violence were received by the competent services. The number of cases of psychological or moral violence soft psychological or moral violence were received is 353 over the period under study. Between 2016 and 2021, 134 cases of gender-based violence were received in care facilities.

5.3.5. Socio-economic impact of the project on the host environment

The right-of-way of the linear areas identified by this project for development includes private and socio-community assets that will not be able to remain there during the implementation phase of the project.



5.3.5.1. Characteristics of the properties located on the Ancien Pont -Carrefour SOBEBRA - Carrefour OPT PK3 - Carrefour Le Bélier

Type of property	Area/ linear (m²/m)	Number
Apatam	5	1
Awning	1766	128
Terrace 1500 SBEE Cabin 50	0 Access	1
Staircase 8 Synthetic Turf 1 0	Generators 15	1
Fence Wall 606(m) Parking L	ot 1560 Terrace	2
2047 Building Access Ramps	6793	5
		2
		24
		2
		32
		158
Total 14801		356

Table 43: Characteristics of the assets affected by the project on Axis 1

Source: field data, CECO BTP, June 2022

5.3.5.2. Characteristics of properties located on the Carrefour 3 Banques – Carrefour Air Afrique axis

Table 44 Characteristics of the assets affected by the project on Axis 2

Surface area Type of	[*] property (m ²) Number
Tiled terrace 30 1 Guest p	arking 800 ´	Access
ramp to 50 1 buildings		
Total 880 3		

Source: field data, CECO BTP, June 2022

5.3.5.3. Characteristics of properties located on the Carrefour Air Afrique-Ancien Pont axis

Table 45: Characteristics of the assets affected by the project on Axis 3

Type of property	Area/ linear (m²/m)	Number
Awning	44	5
Phone booth	5	1
Mobile display	150	2
Garden	50	1
Enclosure wall	283 (m)	7
Parking lot	83	1



Building ramps	455	20
Terrace	55	1
Total	1125	38

Source: field data, CECO BTP, June 2022

5.3.5.4. Characteristics of the properties located on the Carrefour Cheminot-Passage supérieur axis

Table 46: Characteristics of the assets affected by the project on Axis 4

Property type Area/ linear (m²/m)		Number
Terrace 28 Tile access ramp 6 broken Fence wall		2
195 Mobile display 6		1
		1
		1
Total 235		4

Source: field data, CECO BTP, June 2022

Characteristics of the properties located on the Carrefour Marche 5.3.5.5. Saint Michel Carrefour NASUBA-Échangeur Steinmetz-Carrefour Notre Dame axis

Table 47: Characteristics of the assets affected by the project on Axis 5



Source: field data, CECO BTP, June 2022

5.3.5.6. Characteristics of the properties located on the Third Bridge - Junction axis SOBEBRA

Table 48: Characteristics of the assets affected by the project on Axis 6

Type of property	Area (m²)	Number
Awning	116	21
Mobile display	115	3
Customer parking	145	1



Flower bed	15	1
Building ramps	1325	18
Terrace	976	12
Total	2692	56

Source: field data, CECO BTP, June 2022

5.3.5.7. Public property impacted on the Carrefour Marche Saint Michel Carrefour NASUBA-Carrefour Steinmetz-Carrefour Notre Dame axis

Table 49: Characteristics of the assets affected by the project

Allocated assets by axis Nur	mber
Wardrobe 46 Cabin 26 Cour	nter 24 Total 96

Source: field data, CECO BTP, June 2022

5.3.5.8. Public goods impacted on the Carrefour Marche Saint Michel Carrefour NASUBA-Échangeur Steinmetz-Carrefour Notre Dame axis

Table 50: Characteristics of the assets affected by the project

Allocated assets by axis Number	
BEN AFRICA Booth	24
Optical fiber	348
Concrete power pole	270
Wooden power pole	20
Total	662

Source: field data, CECO BTP, June 2022

5.3.5.9. Properties impacted on the Carrefour Marche Saint Michel Carrefour NASUBA-Échangeur Steinmetz-Carrefour Notre Dame axis

Table 51: Characteristics of the assets affected by the project

SONEB structure affected Number	
Fire hydrant 12 Hose 96 Total 108	

Source: field data, CECO BTP, June 2022

The data shows that the work of the ATC project will reach 362 PAPs composed of 113 women and 249 men. These PAPs are responsible for 986 people, consisting of 462 women and 524 men. When looking at the specifics of dependents, they are counted as children aged 5 to 13, 175 female and 185 male. As for children under 1 year of age, PAPs have 16 female and 16 male children. The target of children aged 5 to 13,



PAPs have 175 female and 185 male. Children aged 14 to 17 are 94 are female and 99 are male. There are 287 adult female dependents of PAPs and 191 adult men. PAPs in the 36-45 age group represent 38.67% of all PAPs surveyed. PAPs between the ages of 46 and 55 make up 24.31%. PAPs between the ages of 26 and 35 are 22.65% and 8.56% for PAPs aged 56 to 65. PAPs aged 18 to 25 and over 65 represent 4.70% and 1.10% respectively. In terms of marital status, monogamous married PAPs represent 70.44% of all PAPs surveyed. Single PAPs are 22.38%. Polygamous married PAPs with two (2) wives are 3.59%. The results show that PAPs who have a secondary level constitute 30.94%. Those with a higher level of education represent 30.66%. PAPs who have never been to school represent 23.48% and those with primary level are 14.36. Literate PAPs are 0.55%.

The results show that seven out of ten PAPs (72.93%) are traders. 22.10% of PAPs are craftsmen. PAPs that use property within the ATC project right-of-way as a base for industry and housing constitute 2.21% and 1.10%, respectively. They are 1.66% of PAPs who are involved in various activities. Of the various studies carried out by the PAPs, it appears that those with a daily profit of between 500 and 2000 CFA francs represent 31%. The PAPs who earn between 2001 and 5000 CFA francs from their activity constitute 22%. They are 13% of PAPs who have a daily profit of between 5001 and 10000 FCFA. The PAPs who make a daily profit of between 20,000 and 25,000 CFA francs are 8%. The PAPs who earn more than 65000 FCFA are 8%. PAPs earning between 10,001 and 15,000 CFA francs and 40,000 to 45,000 CFA francs are 3% and 5% respectively.

5.3.5.10. Trees located in the CTA project right-of-way along the axes

Axis Name	Linear (KM)	Number	Percentage (%)
A1 (Old SOBEBRA-Carrefour bridge)	6,725	238	34,4
OPT PK3-Carrefour le Berlier)			
A2 (Third bridge-SOBEBRA crossroads)	2,4	73	10,5
A3 (Place du souvenir-Carrefour 3 Banks)	2,5	190	27,5
A4 (Carrefour	1,9	81	11,7
NASSOUBA-Steinmetz-Carrefour Notre			
Dame interchange)			
A5 (Carrefour 3 Banques-Carrefour Air Afrique)	1,1	41	5,9
A6 (Carrefour Air Afrique-Ancien pont)	0,5	24	3,5
A7 (Carrefour Cheminot-passage supérieur	1,0	23	3,3
Steinmetz)			
Public space		22	3,2
Total	16,125	692	100,0

Table 52: Number of trees impacted by the project



Source: field data, CECO BTP, June 2022

June 2022



5.3.6. Human Rights, Social Integration and Gender in Benin 5.3.6.1. Mapping Human Rights in Benin

A preliminary study report on the human rights situation prepared on Benin by the ERM-AID consortium of firms in 2020, as part of an Environmental and Social Impact Assessment (ESIA), described the context and framework of human rights in Benin and identified and assessed the risks of the project for human rights.

The human rights context in Benin has been assessed by international institutions and non-governmental organizations. Amnesty International's 2020 country profile on Benin highlights a range of rights that have been put at risk, including the unjustified restriction of the rights to freedom of expression and peaceful assembly; the unjust prosecution, harassment and intimidation of journalists and medical professionals; excessive use of force by police during protests and enforcement of public health restrictions; and discrimination against women, minorities, and harassment and violence against LGBTI people (Amnesty International, 2020).

Other important human rights issues highlighted by the U.S. Department of State include: "Unlawful or arbitrary killings, harsh and dangerous conditions of detention, rape and violence against girls and women, with inadequate government action on prosecution and accountability, and child labor" (U.S. Department of State, 2021).

In March 2020, the UN Committee on Economic, Social and Cultural Rights published its concluding observations on Benin's periodic review, in which it also expressed concern about local customs, which deprive women of their inheritance and property rights.

Below are the main findings on human rights issues in Benin that are briefly described. With reference to this study⁷ concerning the Human Rights Monitoring Study for more details on the context of Human Rights.

- Corruption and transparency The issue of corruption and its impact on human rights are important considerations to keep in mind when doing business in Benin. In 2020, Benin was ranked 83 out of the 180 countries surveyed in Transparency International's Corruption Perceptions Index (CPI), with a score of 41 out of 100 (Transparency International Org., 2020).
 - Labour rights The Constitution of Benin recognizes the right of workers to form and join trade unions, as well as the right to strike. In addition, the Labour Code also grants the right to collective bargaining and stipulates that collective agreements in the private sector may be signed for a fixed period

^{(&}lt;sup>7</sup>) **ERM-AID EXPERTISE (2022):** In-depth Environmental and Social Impact Study, project for the development and asphalting of the fishing road, Benin (phase 2): Adounko-Porte du Non-Retour section and related developments, SIRAT, ERM-AID EXPERTISE, 741p.


(up to 5 years) or indeterminate. Although trade unions must operate independently of the government and political parties, this is not always the case in practice. Government authorities can declare strikes illegal if they are considered a threat to public order or the economy and can require strikers to maintain minimum services.

Freedom of Assembly and Expression, and Use of Force – The Constitution and law in Benin provide for freedom of peaceful assembly, however, the U.S. Department of State emphasizes that the government responded to the COVID-19 pandemic by

putting in place certain restrictions to prevent political opponents from holding meetings and rallies. In addition, the authorities sometimes invoked "public order" to prevent demonstrations by opposition groups, civil society organizations and trade unions. Benin's security forces and armed forces have suppressed protests with excessive force, sometimes including live ammunition at protesters. In addition, on freedom of expression, the authorities continued to detain and prosecute journalists under certain provisions of the 2018 Digital Code that unduly restrict the right to freedom of expression.

Human trafficking, forced labour and child labour - Human trafficking has been identified in Benin. Human traffickers exploit domestic and foreign victims in Benin, and traffickers exploit Beninese victims living abroad. Trafficking in the country is mainly internal and involves Beninese children from low-income families. Vulnerable populations most at risk of trafficking in human beings often lack formal education or basic identity documents, including birth certificates and national identity documents. Some community and family members use the promise of education or employment to recruit Beninese children from rural northern areas to the more urban southern corridor and exploit them in forced labor in domestic servitude, markets, agriculture, and handicrafts.

5.3.6.2. Social Integration and Gender in the Project Area There is an increasing involvement of women in development activities. This involvement is reflected in most cases by their participation in the various information sessions according to the objectives. Through their income-generating activities, they represent a major economic force in the municipalities. They are also very active in social areas such as hygiene and sanitation and support for children's education and schooling. Usually, they wake up earlier, prepare the house and the children, prepare the meal and then go to their place of work (market or administration).

From the household to economic activities outside the household, there is a division of labour between men and women. In the household, it is accepted that the woman does the housework, supports the children, contributes to the household income. For other



activities, it is still reserved for women, which requires less physical effort. Mainly in the research sector, women are heavily involved in processing and marketing, but do not yet play a role commensurate with their dynamism, due to their lack of resources and their difficulties in accessing credit (lack of guarantee). They remain, however, potentially important economic players and of proven dynamism.

5.3.6.2.1. Socio-cultural norms in relation to the gender division of labour In the area of gender, inequalities still persist between men and women in terms of access to basic social services (education, health, social work), justice, resources (employment, finance, land, capacity building) and decision-making bodies. The Status of Women Index (WCI) has changed only slightly, from 0.596 in 2011 to 0.607 in 2015. There was a deterioration in economic power of 9.6%, from 0.732 to 0.662. In addition, the persistence of violence against women and girls is still relevant, despite the existence of the legal arsenal punishing the perpetrators of this violence (SNU Benin, 2018). 5.3.6.3. Gender-based violence is considered to be any act perpetrated against women, men, girls and boys on the basis of their sex, which causes or could cause physical, sexual, psychological, emotional or economic damage to them. This violence stems from unequal power relations between men and women. Indeed, the project will operate in an environment with a high human density, with very high levels of poverty. Several infrastructures frequented by women are located in the project's intervention area.

Benin's law prohibits rape, but enforcement is weak due to ineffective police, corruption among officials, and victims not reporting cases for fear of social stigma and reprisals. The law also prohibits sexual harassment and provides protection for victims, but sexual harassment was common in the workplace and in schools (U.S. Department of State, 2020)

Since the work will lead to an influx of workers out of Cotonou, the risk of Gender-Based Violence (GBV) exists and measures will have to be taken for the prevention and management of the cases that will arise. The most common known acts of GBV are rape, which implies sexual relations with viable people and accompanied by violence, threats (armed or not), use of trickery, use of coercive or coercive measures, and the effect of surprise. Cases of sexual harassment or abuse can be observed in the project's area of intervention.

5.3.6.4. Types of sexual behaviour prohibited in the project Any act of



sexual exploitation or abuse by project staff, including implementing and implementing partners, constitutes serious misconduct and may lead to the termination of the contract.

• Sexual exploitation Sexual exploitation is any exchange of money, shelter, food or any other property for a sexual relationship or favour by a person in a vulnerable situation. The following sexual violence is also included in the category of sexual exploitation. These are: rape, sexual slavery, forced prostitution, forced pregnancy, forced sterilization or any other form of sexual violence.

• Sexual abuse Sexual abuse is considered to be any use of threat or force on a person to obtain a sexual relationship or favor under conditions of forced or inequality.

In cases of exploitation and abuse, one uses one's dominant social or administrative position more than vulnerable people such as: People living with disabilities;

- Vulnerable people (old, sick);
- Minor children (under 18 years of age);
- Adults (subordinates, beneficiaries of the project, captives, drunkards, etc.); They are vulnerable because of their inability to discern, the impossibility of defending themselves, the lack of consent, the fear of the means that the perpetrator uses.

5.3.6.5. Measure against sexual violence in the project The project will integrate the necessary measures for the prevention and management of such violence on the project site.

- Preventive measures
- With the project's stakeholders:
- The code of conduct and the internal regulations of the companies involved will include explicit measures to prohibit any form of sexual exploitation and abuse by its employees;
- o Every stakeholder will need to understand that there is zero tolerance for sexual exploitation and abuse. He will sign the code of conduct and the internal regulations;
- o These provisions will be translated and posted in French and in the contractor's language of work (or original language).
- o Raising awareness among the various actors of the project.

• To the local populations The populations living in the immediate vicinity of the contractor's site will be informed of the existence of these rules, and in particular of the provisions relating to the prevention of sexual and gender-based violence.

- 5.4. Status of security challenges in Greater Nokoué
- 5.4.1. Security challenges of roads in Cotonou Based on



previous studies in this case, the document on urban mobility in the "Greater Nokoué" which, with the main objective of providing each of these five (05) cities making up Greater Nokoué, with an urban mobility plan for goods and people, integrates the interconnection of cities for a better management of urban and interurban movements in the Greater Nokoué agglomeration. According to this September 2020 document, although the majority of journeys continue to be made within the municipalities, the road network is increasingly solicited by the commuting flows generated by the phenomenon of periurbanisation, particularly on the main access routes to the centre of Cotonou. Abomey-Calavi is the municipality most affected by this phenomenon of commuting traffic, exchanges between the two municipalities are very intense. On the other hand, Greater Nokoué is only slightly affected by transit traffic, which remains very low.

According to the report on the Urban Mobility Plan (PMU December 2020), two-wheeler traffic accounts for three-quarters of traffic. In addition to the fact that the standard of living of the population generates a much higher rate of motorcycle ownership than for cars, it is the very large number of motorcycle taxis (or zémidjans), circulating everywhere in the city, that makes the traffic of two-wheelers so important. Indeed, the motorcycle taxi (zémidjan) is the main means of public transport in Greater Nokoué because of a relatively affordable fare for a large part of the population, an attractive offer in terms of travel time (motorcycles partly escape congestion) and flexibility (motorcycles can access the most damaged tracks and offer door-to-door service). Some road improvements exist to separate two-wheeler traffic from the rest of the traffic and thus improve its fluidity, but these devices are not generalized. The cohabitation of traffic is thus a source of congestion, but also a major issue of road safety.

In this context, other transport offers remain underdeveloped: minibuses only concern medium-distance inter-city transport, conventional taxis are very rarely subsidized, in particular due to a lack of funding (the population is willing to pay the price of a motorcycle taxi fare, which requires a public subsidy to ensure the financial balance of the activity). Due to the presence of the port in the city centre, the main roads of Cotonou and on the RNIE2 which serves the hinterland of the port. Traffic restrictions have been imposed on heavy goods vehicles to reduce their impact on the development of the city.

Freight traffic is important on

This has an effect on congestion during rush hour, but their presence is not without problems of road safety, linked to the often advanced age of these vehicles.

5.4.2. Level of Service (LOS) criterion is a term used to qualitatively describe the operating conditions of a road based on factors such as speed, travel time, manoeuvrability, delay and safety. The level of service of a facility is designated by a letter, from A to F, with A representing the best conditions and F the worst operating conditions.



For a road section, the calculation of the level of service is based on the ratio between the traffic supported by the section and the theoretical capacity of the section, which depends on its calibration and its environment (urban area with many intersections and interactions with local life or, on the contrary, a country road with very few intersections). Thus, this capacity (denoted C) is deducted from the functionality of the road and the number of intersections built per kilometre. Among the characteristics to be taken into account for the calculation, we can mention the existence of separate carriageways, the percentage of linear space for on-street parking, the density of traffic light intersections and intersections. As a result, the capacity per lane can be estimated based on a saturation rate of 2,000 vehicles per UVP channel/channel/hour).

Table 53: and on the assumption that an artery would receive 60% of the green time (0.6 x 2,000 = 1,200

The following Table 53 shows the level of service (LOS) for feeders based on the volume-to-capacity (V/C) ratio.

LOS T	raffic Conditions V/C	
А	Free traffic with uninterrupted manoeuvrability. Stopping times < 0.6 intersections are minimal Traffic without major constraints with a	at
	manoeuvrability of 0.6 to 0.7	
В	slightly limited. Stopping times at intersections are not annoying	
С	Relatively smooth traffic flow with stresses slightly 0.7 to 0.8 higher than that of LOS B. Conflict situations are beginning to be not for drivers Unstable traffic conditions. Small volume increases 0.8 to	iceable 0.9
D	produce substantial increases in delays and decreases in speed Dec traffic conditions with significant loss of time 0.9 to 1	graded
E	when approaching intersections and low average speeds.	
F	Very degraded traffic conditions with extremely > speeds 1 low due to congestion at intersections, time losses are very significant	

Highway Service Level

Source: Report of the mission to develop urban mobility plans for the cities of Greater Nokoue, AGETUR SA, PAURAD, SETEC-AFRIQUE Études, September 2020.

5.4.3. Level of service of the main roads in Cotonou The Greater Nokoué region is the agglomeration made up of the municipalities of Cotonou, Porto Novo, Abomey Calavi, Sèmè-Podji, and Ouidah. It represents an urban area that shares the same geographical continuity and territorial coherence as well as common logics and dynamics driven by Cotonou, the country's main economic centre. This favourable context encourages the State to develop specific actions there. As a result, the concentration of the study on the PMU takes Cotonou as the legitimate nucleus and these different roads or arteries as a benchmark. The most congested section of Cotonou is the one located on the Boulevard de l'Europe (RNIE1) between the Toyota junction and the interchange of the RNIE1 and RNIE2; these sections constitute a common trunk for a large part of the flows towards Abomey-Calavi and Ouidah.



• During the morning peak period, the volumes of traffic entering Cotonou from the west exceed 5,400 vehicles per hour on three (03) traffic lanes. This results in a V/C ratio of between 0.75 and 0.93 for the lanes used by motorists and between 1.85 and 2.0 for the lanes used by two (02) wheels. The associated level of service is therefore between E and F, and there are indeed congestion problems, significant queues and very low speeds in this sector. During the evening peak period, the volumes of traffic leaving Cotonou towards Abomey-Calavi exceed 4,600 vehicles per hour on three (03) traffic lanes, with a service level C for motorists and F for two-wheelers which have a V/C ratio between 1.71 and 1.78 corresponding.

For the section of the RNIE1 located west of the Godomey interchange with the RNIE2, the situation is less severe, but still presents significant congestion problems during the morning rush hour. Over this period, traffic to Cotonou exceeds 2,500 vehicles per hour on two (02) traffic lanes, i.e. a V/C of 0.80 which is equivalent to service level E.

Finally, the crossings of the lagoon are also major hard points: During the morning peak period, it is the east-west flows towards the centre of Cotonou that are predominant with 3,000 and 2,000 vehicles per hour respectively on the "Martin Luther King" and "Konrad Adenauer" bridges. In both (02) cases, the V/C ratio exceeds 0.8 and reflects a service level D.

 During the evening peak period, peak traffic is in the opposite direction with similar volumes. Traffic on the two (02) eastbound bridges exceeds 3,200 and 2,100 vehicles per hour respectively. The V/C ratio exceeds 0.9, i.e. a service level E.

Figures 41 and 42 show the traffic volumes and service levels on the main roads in Cotonou.





Figure 41: Traffic Volumes – Morning Peak Period – Cotonou Source: Report of the mission to develop urban mobility plans for the cities of Greater Nokoue, AGETUR SA, PAURAD, SETEC-AFRIQUE Etudes, Dec 2020.



Figure 42: Traffic Volumes – Evening Peak Period – Cotonou Source: Report of the mission to develop urban mobility plans for the cities of Greater Nokoue, AGETUR SA, PAURAD, SETEC-AFRIQUE Etudes, Dec 2020.



5.4.4. Road problems identified on the axes/arteries of Cotonou 5.4.4.1. Faulty vertical signage In general, the absence of road signs or signs in a state of destruction is a real problem observed in general on urban roads. Speed limit signs, no-parking and no-stop signs, school signs, and signs prohibiting manoeuvres such as U-turns have become very rare. These billboards have been damaged, not only because of accidents, but also because of the population who take them for advertising or election campaign billboards, in total ignorance of the usefulness of signage for moving vehicles.

Damaged signs are almost never replaced and, gradually, the network is stripped of vertical signage, which considerably reduces its legibility over time.



Plate 3: Some damaged signs indicating the failure of the vertical signage on the axes

5.4.4.2. Problems with the gutters The gutters built on either side of the road and sometimes under the central median are open in places, due to the displacement or destruction of the closing slabs. These accidental openings of the gutters represent situations of risk for pedestrians, especially at night.

During cleaning work, the slabs and other slabs are poorly laid, creating dangerous



situations, including for cars and two-wheelers. In addition, some gutters are at the same level as the road. As a result, there is no curb that would provide relative safety for vehicles in relation to the hazard posed by this opening, which has been observed to exist relatively long at the time of these studies. Unfortunately, gutter closing tiles are rarely repaired or replaced when damaged.



Plate 4: State of the sanitation works on the roads to be developed

5.4.4.3. Pedestrian safety The severity of pedestrian accidents is twice as high as the general severity of accidents in urban areas and, in 58% of cases, according to the PMU report, pedestrians are hit when crossing the road at intersections and especially on road sections. Observations on the ground have shown that pedestrian safety is at a very low level.

Most pedestrian crossings have disappeared and, even where they still exist, they are not systematically used by pedestrians, who are not aware of the importance of these markings. Those who also and seriously ignore pedestrian crossings are motorists who pay no attention to pedestrians on zebra crossings.



Plate 5: Pedestrian safety threatened by lack of substandard roads 5.4.4.4. Safety of motorised two-wheelers



Whether they are used for commercial purposes (motorcycle taxis) or as a means of personal transport, motorised two-wheelers are the most widespread mode of transport in Cotonou. Their number is difficult to estimate, but just by observing the traffic, you can see how large the number of motorised two-wheelers is. They facilitate the mobility of people in a context of almost no organized public transport at a reduced cost and where the average household income does not allow many people to easily acquire a car.



Photo 25: Motorized two-wheelers occupy an important place in traffic in Cotonou

Source: Field data, CECO-btp, June 2022

Most of the motorcycles on the road have a cylinder capacity of between 80 and 125 cm3, which, in view of the regulatory provisions governing the system of issuing driving licences in Benin, requires drivers to hold a driving licence. However, not all of them have a driver's license and some have therefore not received adequate training for driving on public roads. This results in a lack of knowledge of the highway code and behaviors exposing them to the risk of bodily accidents. The diagnosis made from statistical data confirmed their strong involvement in traffic accidents, being found in 80% of the physical accidents recorded in Greater Nokoué with more than 67% of deaths over the last five (05) years according to this report.

5.4.4.5. Lanes reserved for two-wheelers The most frequent and serious accidents involving two-wheelers result from their collisions with other vehicles (light and heavy vehicles). The reduction of accidents therefore involves separating the modes of transport with lanes reserved for two-wheelers, physically separated from the road used by other vehicles. However, the road network was not initially prepared for the



rapid development reached today by two-wheeled transport and, as a result, the existing lane rights-of-way do not allow for the easy development of lanes reserved for two-wheelers everywhere, but solutions have been implemented on the RNIE 1 and the RNIE 2 through cycle lanes, cycle paths and side alleys assigned to two-wheelers. Between Abomey-Calavi and Cotonou and at the crossing of Cotonou, side alleys have been set up on both sides for two-wheeler traffic.

Originally, these side alleys were not specifically intended for two-wheelers. They were designed to drain local traffic, all categories of vehicles combined, from adjacent streets, but the measure to use them as mandatory bike lanes is effective. As conflicts between two-wheelers and other categories of vehicles have been considerably reduced on these roads, accidents related to them have become very rare, remaining only at crossroads where crossings are inevitable.



Photo 26: Circulation of two-wheelers in the side alleys.

5.4.4.6. Behaviour of two-wheelers Observations in the field have made it possible to note various risky behaviours on the part of drivers of motorised two-wheelers in all the communes of Greater Nokoué and on the main arteries of Cotonou. These behaviours are encouraged by the relaxation of police controls.

Faced with this situation:

- a) Two-wheelers are increasingly abandoning cycle paths and preferring to ride on the main road in disregard of their safety;
- b) two-wheelers carry out dangerous overtaking manoeuvres, sometimes on long lines of vehicles;
- c) two-wheelers make reckless manoeuvres to merge into traffic;
- d) they sometimes drive in the opposite direction;
- e) they take shortcuts through the TPCs by using the pedestrian crossings. This manoeuvre is particularly dangerous, often resulting in fatal accidents;



f) two-wheelers carry bulky loads that endanger other drivers and do not allow them to circulate on cycle paths.



Plate 6: Oversized loads of the deux-rouxs, a source of accidents

5.4.5. Air quality issues in Greater Nokoué To date, anthropogenic pollutant emissions from southern West Africa are largely underestimated. Indeed, it is difficult to study the air quality of this region of Africa, as the monitoring and surveillance means put in place are too poorly developed. There is no air quality monitoring system and the network of weather stations is poorly developed and accessible. This results in significant gaps in estimating the true scale of the air pollution problem in this region of Africa. (Evans & al, 2018). However, studies and air quality measurement campaigns carried out as part of the mission on urban mobility in Greater Nokoué in 2020 have made it possible to consider the sectors and sources of these emissions as well as the most present pollutants. Indeed, there is no air quality monitoring and monitoring system in Benin. The observation that is made here is therefore not that of this territory between 2000 and 2018. By drawing out the generalities on air quality in Greater Nokoué, they tried to illustrate their remarks with figures when it seems relevant despite their anteriority.

To date, the most comprehensive air quality database in southern West Africa is the one produced by the DACCIWA1 project. It provides a general vision of the problem in this territory and provides data on air quality in our study area, in Cotonou, in 2016. The information that can be drawn about Cotonou from this study relates more particularly to air quality at the point of a site representative of road pollution.

In terms of air quality, two major findings emerge from this study:

- All countries in southern West Africa exceed the annual threshold limit of 10 µ m/g of PM2.5 set by the WHO. In Cotonou, the threshold limits on an average of 24 hours of 25 µ g/m3 is also frequently exceeded. These fine particles come from particles of desert dust in the Sahara, smoke particles induced by the burning of agricultural land or savannah in the region, as well as many other sources of anthropogenic pollution described below.
- The average annual concentrations of gaseous pollutants do not exceed the guidelines, but peaks are observed according to the seasons. Seasonality of



emissions is observed for both gaseous and particulate pollutants.

This last observation is essential. The seasonality of pollutant emissions is an important parameter to measure and monitor for a detailed knowledge of the air quality of a territory. Climate and seasons influence air quality, as the dispersion and transport of pollutants in the air depend on the state of the atmosphere and weather conditions (atmospheric turbulence, wind speed and direction, sunshine, atmospheric stability, rainfall, etc.).

Benin is characterized by a tropical to subtropical climate. Greater Nokoué, which is located in the south of Benin, is subject to a temperate sub-equatorial regime. The humidity level is generally high throughout the year. Two (02) seasons alternate: a dry season from November to May, characterized by the harmattan, a continental and dry wind from the Sahel, bringing dust from the desert and a monsoon season from April to October.

Graph 43 shows that the concentration of fine particles PM2.5 varies according to the season. During the dry season (or boreal winter), the concentration of fine particles PM2.5 is higher and far exceeds the WHO recommendations of 25 μ g/m3 per day.



Figure 43: Monthly average PM2.5 concentration observed in Abidjan and Cotonou (source: (Evans & al, 2018))

Source: Report of the mission to develop urban mobility plans for the cities of Greater Nokoue, AGETUR SA, PAURAD, SETEC-AFRIQUE Études, Sept 2020.

On the contrary, it is during the dry season that a peak in gaseous pollutants is observed in Cotonou that exceeds the WHO recommendations for air quality.

The observation of these phenomena of variation in the atmospheric concentration of pollutants is still poorly documented in the countries of southern West Africa. The DACCIWA project notes that it is not yet possible to give a long-term and generalizable analysis of this seasonal variation until new measurements are made on a regular basis.

However, some meteorological characteristics are already well known and can explain

these variations: The daily sunshine rate can explain more or less important ozone concentrations depending on the time of year since it results from the transformation of pollutants emitted by anthropogenic activities under the effect of strong sunshine (Airparif). In Benin, the highest daily sunshine rates recorded are during the long dry season between November and March (Boko, 1992). This factor can, in part, explain the peak in gaseous pollutants observed during this season.

During the dry season, harmattan brings desert dust particles from the Sahara that make up PM2.5. More generally, windy episodes are favourable to the dispersion of pollutants over a territory.

Regarding other air pollutants, a few studies provide an idea of the extent of pollution in the urban centers of Greater Nokoué, such as Cotonou. Although these data are relatively old and incomplete, they reflect a persistent reality of air pollution in Benin.

Thus, on the basis of the data provided in the 2007 World Bank report on air quality in Cotonou, we can see that in 2005, when the air quality decree had already been put in place in Benin, certain pollutants remained present in the ambient air at concentrations that were too high and dangerous.

5.4.5.1. Air pollution and the short- and long-term effects on populations According to WHO estimates, nearly 7 million deaths are currently attributable to the exposure of populations to air pollution worldwide each year. The African region is one of the regions, defined by the WHO, most affected by morbidity and mortality related to air pollution, with nearly 1 million deaths per year compared to 2 million in Southeast Asia and 500,000 in the European Region (WHO).

These premature deaths are linked to the development of pathologies favoured by the exposure of individuals to air pollutants both inside and outside buildings. The diseases causing premature deaths are mainly ischemic heart disease (34%), pneumonia (21%), stroke (20%), chronic obstructive pulmonary disease (19%) and lung cancer (7%) (WHO, 2020) Children, housewives exposed to high levels of indoor pollution and workers working outdoors and close to polluting activities are the three groups most affected by air pollution.

5.4.5.2. Genes and pathologies related to air pollution The penetration of pollutants into the respiratory system will depend on its diameter:

- Nasopharyngeal segment: particles with a diameter greater than 10 μ m and gas;
- Tracheobronchial segment: particles with a diameter between 2.5 and 10 $\,\mu$ m and gas;
- •



Lung segment: particles with a diameter of less than 2.5 μ m and gases. Once assimilated, the pollutants will act on the body at different scales and with different intensities depending on the time of exposure. The first reactions to the pollutant are on a macroscopic scale. They will lead to a repeated inflammatory reaction in the organs and the development of fibrosis. Fibrosis results in an increase in mucus secretions rich in defense and repair cells. Symptoms related to fibrosis are coughing, the appearance of conjunctivitis, sinusitis and dilation of the bronchi. In the long term, an individual exposed to pollutants can develop chronic pathologies such as asthma, chronic bronchitis or even lung cancer. UFPs (ultra-fine particles) can reach the bloodstream and affect all organs, particularly in the placenta or the brain, and lead to serious neurodegenerative diseases.

Reactions and the development of symptoms only take place at certain levels of air pollution and exposure time. Symptoms at the respiratory level are particularly noticeable during pollution peaks. The other reactions are at the microscopic level, that of the cells. These are reactions related to oxidative stress. These reactions take place regardless of the air pollution threshold, but do not necessarily give rise to symptoms. Oxidative stress damages the genetic material of cells, which can eventually cause cell death. Even more serious, the pollutants will act as triggers for an inflammatory reaction leading to damage to cell membranes. These reactions can lead to heart rhythm disorders and promote the development of respiratory pathologies.

At the level of blood vessels, damaged membranes are a place where cholesterol accumulates and circulates in the blood. The accumulation of cholesterol in the membranes is the cause of atherosclerosis, i.e. the formation of atherosclerotic plaque. In the long term, the formation of these plaques can be the cause of cardiovascular diseases that can lead to the death of the individual (stroke, heart attack).

In terms of the inflammatory response, oxidative stress is at the origin of an increase in sensitization to allergens and will promote the development of allergies, particularly to pollen.

Above, we have outlined the health consequences of air pollution in general. However, each pollutant impacts organisms in different ways. In the following paragraphs, we develop the effects of the main air pollutants on organisms.

• Nitrogen oxides (NOX) The main effects of nitrogen oxides on human health are manifested by impaired respiratory function, bronchial hyperreactivity in asthmatics and disorders of the immune system of the respiratory system. Nitrogen oxides are very irritating gases. The European Community classifies them as "toxic and irritating to the eyes and respiratory tract". They penetrate deep into the bronchial tree causing coughing, irritation, choking, sensitization of the bronchi to microbial infections, functional changes (decreased oxygenation). The relationship between NOx and



health descriptors (mortality, morbidity, etc.) is difficult to establish and demonstrate, because their content is strongly correlated with that of other pollutants.

 Particulate matter (PM) particles can irritate the lower respiratory tract and impair respiratory function (especially in children and sensitive people). The finer a particle, the higher its potential toxicity. PM10 can enter the lungs, but are retained by the upper airways, while particles smaller than 2.5 μ m penetrate deep into the respiratory tract and can reach the alveoli of the lungs. According to the WHO, so-called "ultra-fine" particles (particle diameter less than 0.1 µ m) are suspected of causing harmful effects on the cardiovascular system. The size of the particles and the depth of their penetration into the lungs determine the rate at which the particles are removed. Over the same period of time (24 hours), more than 90% of particles larger than 6 μ m are removed, while only less than 30% of particles smaller than 1 µ m are removed. One of the most dangerous properties of dust is to bind irritating or toxic gaseous molecules present in the atmosphere (sulphates, heavy metals, hydrocarbons). Thus, particles can have significant consequences on human health and be responsible for chronic lung diseases such as asthma, bronchitis, emphysema (the pulmonary alveoli lose their elasticity and rupture) and pleurisy (inflammation of the pleura, the membrane that surrounds each of our lungs). These effects (irritation of the respiratory tract and/or alterations in respiratory function) are observed even at relatively low concentrations. Some particles even have mutagenic and carcinogenic properties.

The studies published to date have led to the following conclusions regarding the acute effects of particulate matter:

- particles larger than PM10 have almost no effect.
- Coarse particles, such as fine particulate matter or ultrafine particulate matter, have an impact on mortality and morbidity. Their effects are largely independent of each other.

The coarse fraction of PM10 is more strongly correlated with cough, asthma attacks and respiratory mortality, while the fine fractions have a stronger impact on heart rhythm dysfunctions or on the increase in cardiovascular mortality. But the effects of fine particulate matter are not explained solely by those of ultrafine particles, any more than the effects of coarse particulate matter can be explained by those of fine particulate matter.

Given the concentrations and variations usually encountered today, coarse, fine and ultrafine fractions have effects of equal importance.

Effects on respiratory mortality are felt immediately or the day after exposure to a high particulate load. The effects on cardiovascular mortality are most noticeable after about 4 days. This means that the effect of coarse particles is felt immediately or very quickly



after exposure and that of fine and ultrafine particles is felt somewhat later (up to 4 days after the increase in charge). In addition, while the relative risk is greater for respiratory mortality, cardiovascular mortality claims more victims. People with lower respiratory tract disease, heart failure, and people over the age of 65 are at increased risk. Effects have been demonstrated by epidemiological, toxicological and clinical studies. The studies published to date provide the following picture for the chronic health effects of particulate matter:

- chronic effects are greater than acute effects;
- epidemiological studies have demonstrated the correlation between high PM10, PM2.5 or sulphate loads and increased mortality or morbidity;
- elemental carbon (diesel soot) has a high carcinogenic potential;
- There is (yet) no conclusive study that differentiates between the chronic effects of coarse particulate matter, fine particulate matter and ultrafine particulate matter in terms of mortality and morbidity.

• Carbon monoxide (CO) Carbon monoxide causes hypoxia (reduced oxygenation of the blood), because it binds to haemoglobin instead of oxygen. It also causes headaches, behavioral disorders, vomiting (it is a neurotoxin), sensory disorders (dizziness). It is also a myocardiotoxic. By attaching to the hemoglobin in the blood, carbon monoxide forms a stable molecule, carboxyhemoglobin, leading to a decrease in cellular oxygenation that is harmful to the central nervous system, heart, and blood vessels.

• Volatile organic compounds (VOCs): These compounds come from poor combustion of petroleum products (fuels) and the evaporation of fuels. The effects are very diverse depending on the pollutants: they range from simple olfactory discomfort to eye irritation (aldehydes), or even a reduction in respiratory capacity, to mutagenic and carcinogenic effects.

• Benzene (C6H6) Two cases of poisoning can be observed: ingestion poisoning and inhalation poisoning. Ingesting poisoning is characterized by digestive disorders, neurological disorders that can go as far as coma and inhalation pneumonitis. It should be noted that benzene is irritating when applied to the skin. In inhalation poisoning, neurological symptoms such as impaired consciousness, drunkenness, then drowsiness that can go as far as coma, and convulsions in very high doses. These symptoms appear in varying concentrations depending on the individual:

- At 25 ppm: no effect;
- from 50 to 100 ppm: headache and asthenia appear;
- at 500 ppm: the symptoms are more accentuated;
- at 3,000 ppm: the tolerance is only 30 to 60 minutes;
- at 20,000 ppm: death occurs in 5 to 15 minutes.



• Sulphur dioxide (SO2) Sulphur dioxide alters the child's respiratory function and exacerbates respiratory discomfort. Similarly, in asthmatic subjects, it disturbs the immunity of the respiratory system and lowers the trigger threshold. It is a cofactor of chronic bronchitis. Sulphur dioxide is a highly soluble gas. It is therefore 85-99% absorbed by the mucous membranes of the nose and upper respiratory tract. A small fraction attaches to the carbon particles and thus reaches the lower respiratory tract. It accentuates the intensity of bronchospasm in asthmatic subjects.

• Lead (Pb) In general, heavy metals have the property of accumulating in the body, which implies possible carcinogenic properties in the long term. Lead is a neurological, renal and blood toxicant. There are two types of lead poisoning: poisoning after inhalation (dust or smoke) or poisoning by ingestion (regurgitation or skin hygiene problems).

5.4.5.3. How does air pollution affect the populations in Greater Nokoué?

According to the WHO cited in the PMU in December 2020, in 2008 there were an estimated 1.3 million deaths due to air pollution each year worldwide. Sub-Saharan Africa had 82,000 of these individuals who died as a result of pathologies related to exposure to air pollutants. The air quality in Greater Nokoué is therefore an essential factor to be improved to ensure a better quality of life for its inhabitants.

By reducing the mortality rate and the development of pathologies related to air pollution, the Republic of Benin will also see the economic and social situation of its country improve. Indeed, the cost to the State of certain pathologies linked to air pollution has been determined. For example, the cost of treating respiratory infections is estimated at 600 million CFA francs per year and it is 20 billion CFA francs for the treatment of lead poisoning (SSATP, 2000). In all, a little more than 1.2% of the country's GDP was dedicated to the management of pathologies linked to air pollution in 2000.

This pollution concerns the entire population of Greater Nokoué. However, studies have shown that two categories of individuals are particularly affected in these regions: children and motorcycle taxi drivers (or "zémidjans").

In fact, studies conducted in 1999 by the Faculty of Science and Health of Benin showed that:

- More than 62% of drivers suffer from respiratory diseases;
- 70.7% of drivers suffer from damage to muscles and bones;
- 26.5% suffer from vision problems;
- 11.4% suffer from damage to the larynx.

Another study conducted in 2005 in Cotonou and in another Benin city with fewer sources of air pollution, Lokossa, shows how much of the activity of the Zemidjans is responsible for pollutant emissions. Drivers of zemidjans almost systematically present manifestations of



intoxication (presence of symptoms). It is estimated that drivers are 1.5 times more likely to experience these symptoms than non-drivers. The symptoms recorded by reporting are intoxication disorders such as conjunctival hyperaemia (18%), of which 12% are lacrimation, respiratory disorders (23%). In Lokossa, on the other hand, the reported disorders were lower: conjunctival hyperaemia (5.6%), nausea (32%) and other signs such as visual disturbances (4%). The frequency of disorders among non-drivers is lower in both Cotonou and Lokossa. On blood examination, the level of carbon monoxide in hemoglobin (HbCO) is abnormal in more than 66% of drivers. Motorcycle taxi drivers are also more likely to develop various long-term cancers and severe bronchitis due to the high concentration of benzene emissions from their vehicle. (Fourn & Fayomi, 2006).

These studies clearly show, as we will discuss later, that the road sector accounts for a significant share of air pollution in the cities of Greater Nokoué, seriously affecting drivers not equipped with air-filtering masks or vehicles equipped with technologies that limit the emission of pollutants that are highly harmful to individuals.



6. SUMMARIES OF THE MAIN ENVIRONMENTAL AND SOCIAL ISSUES RELATED TO THE IMPLEMENTATION OF THE PROJECT

The construction or development of road infrastructure in an area such as the urbanized one, on the coast of Cotonou, involves major and varied environmental, biodiversity, social and safety issues. The term "issue" should be understood here as what can be gained or lost in an intervention, and which is important enough to influence the decision of whether or not to proceed with the project. The main issues that the project could raise are environmental/ecological, socio-economic and safety.

6.1.Understanding the concept of issues

6.1.1. Environmental issues are major concerns raised by the project. They are also in line with the concerns and concerns of the communities involved. The identification of these issues makes it possible to know the components of the environment that deserve special attention. It allows for frank collaboration with the populations directly concerned and arbitration between the various stakeholders concerned in order to avoid or reduce the impacts on the environment as much as possible.

6.1.2. Socio-economic and community development In the project area, the socio-economic challenges are enormous and varied. Indeed, the implementation of the project requires rehabilitation on certain roads currently practiced, resulting in clearances, obstructions and a cyclical vulnerability of certain populations. This state of affairs causes losses of income and recreational activities

6.1.3. Security and health

Ultimately, the issue in " road safety and mobility " insists on improving the level of safety of the road network for all users in general and, in particular, for the most vulnerable users (pedestrians, cyclists and motorcyclists) of the project's axes.

6.2.Main issues of the Cotonou Access and Crossings (ATC) road development project

Depending on the elements of the environment and the activities of the project, the main issues that may arise from the implementation of the project are presented in Table 54.



Table 54: Main findings and challenges of the project



- Functional roads;
- Degradation of pavements;
- Vandalism of sanitation structures and signs;
- Presence of fires contrary to the standards;
- Absence of traffic lights, nor appropriate signs on certain outlying roundabouts;
- Congestion during peak hours in the morning and evening;
- On the different branches of the crossroads;
- Insertion of vehicles in an anarchic manner;
- Missing or poorly installed signage;
- · Presence of impassable islands at certain roundabouts and roundabouts;
- No synchronization of traffic lights;
- Illegal occupation of sidewalks by billboards and large trees;
- Mixed uses;
- Lack of parking space;
- Anarchic changes in corridors;
- Defective street lights in some sections of the axes;
- Some light control systems that are inoperative and require manual regulation by the police;
- Low level of safety of the road network for all users in general and, in particular, for the most vulnerable users (pedestrians, cyclists and motorcyclists).

Issues identified Negative issues identified Positive issues identified • Degradation of the access road (diversion); • Installation of roads that comply with standards and roads in a good state of practicability;



- Modification of the habits of road users;
- Loss of vegetation cover;
- Traffic accidents.

- Improvement of the level of safety of the road network for all users;
- Better traffic flows;
- Existence of parking;
- Reduction of traffic congestion on the city's main roads;
- Job promotions;
- Modification of the landscape.

Field observations/issues



Presence in the road right-of-way:

- socio-community goods and facilities (Apatam, Awning, Terrace, SONEB installation, SBEE cabin, access stairs, synthetic turf, generators, Fence wall, parking lot, terrace, building access ramps, electricity pole, etc.);
- socio-economic activities;
- public and private homes and institutions.

Issues identified

Negative issues identified	Positive issues identified
 Disruption of access to commercial and residential properties; Destruction of residential and related infrastructure; Destruction of socio-community property and public facilities; Disruption of economic activities and sources of income; Reduction in carbon sequestration due to the cutting of trees; restricting access to various workplaces; Temporary flooding of streets; Recording of cases of theft and acts of vandalism 	 Creation of temporary jobs for local populations; Improving urban mobility; Sustainability and viability of streets and their compliance with safety standards; Attractive living environment; Development of income-generating activities; Flood reduction; Creation of new economic and employment potential.



Field observations/issues



- Presence of large-diameter range trees and high carbon sequestration rate in the right-of-way of the identified tracks
- Presence of public gardens serving as a place of relaxation
- Use of trees, in this case bark, for medicinal purposes by the population

Issues identified

Negative issues identified Positive issues identified

- Destruction of trees located in the right-of-way
- Loss of habitat for animals dependent on the ecosystems to be destroyed;
- Creation of landscaping
- Attractive living environment
- Job creation
- Decrease in the rate of atmospheric carbon sequestration;
- Disruption of ecosystem services that provided the trees and ecosystems to be destroyed.

Field observations/issues

- Installation of technical bases and construction sites;
- Deployment and circulation of machinery, trucks and vehicles;
- Maintenance of machinery, trucks and vehicles;
- Recruitment of workers for construction sites;
- Host environment close to the coast with very shallow water table;
- Limited availability of space for the installation of technical bases.

Issues identified

Negative issues identified	Positive issues identified
 Dust emission due to the movement of machinery, trucks and vehicles; Noise production due to the movements of machinery, trucks, vehicles; the presence of a large number of users on the construction sites: 	 Creation of income-generating activities; Increased revenue; Job creation.



LOT N° ATC- ()

 Production of solid and liquid waste; 		
 Exposure of site users to the risks of 		
occupational and traffic accidents:		
 Exposure of site users to occupational 		
diseases		
Field observations/issu	les	
 Limited availability of space for installation of technical bases Development and operation of technical bases 		
Issues identi	fied	
Negative issues identified	Positive issues identified	
Difficulty in installing the technical bases or	Creation of income-generating from	
installing the bases in tight spaces and close	activities	
to homes	Increased revenue	
 Nuisance to neighbouring homes and 		
human installations		

Source: field data, CECO BTP, June 2022

7. ANALYSIS OF THE VARIANTS AND DESCRIPTION OF THE SELECTED VARIANT

7.1. Analysis of project variants and choice of preferential variant

The aim here is to analyze the different possibilities of implementing the resurfacing/strengthening/rehabilitation activities of the Cotonou Accesses and Crossings of Lot 1 within the framework of this project in order to achieve the main goal which is the improvement of the living environment of the populations and a general economic development of the country.

Indeed, having a quality living environment is an increasingly assertive concern. However, urban roads are a major element of this framework and today constitute an important support for activities, in particular, commercial activities. With the urban development observed today, urban roads cannot be designed, developed or operated in a monofunctionalist logic of transport infrastructures. It is a major element of urban richness and diversity and necessarily involves multiple approaches. In addition, after several years of developing the roads as an "all-car" system, there has now been a renewal of the principles with a consideration of the urban function (taking into account public spaces, mixed traffic, meeting areas ;), hence the need to set up facilities that meet the characteristics of the host locality.

7.1.1. Identification of variants

Redeveloping the roads and arteries of Cotonou involves working on the longitudinal profile, the cross-section and other related developments. In the case of this project, it is a question of redeveloping existing main urban roads connected to other secondary roads in a city with specific developments. The longitudinal profile for these roads identified for development has not been modified and is generally in line with the existing riverside entrance threshold dimensions, sometimes with some corrections to comply with urban road standards. So the different possibilities available for the realization are only on the installation of a cross-section in order to make these roads adequate with a safe fluidity.

However, the cross-section, the result of a choice, is based mainly on development objectives that are consistent with the assigned functions, the hierarchy of the railway network and the urban context. To achieve these objectives, mixing or separation is analysed by considering the advantages and disadvantages of each in relation to the context and current uses. However, as existing roads meet given functions, their redevelopment can be reduced to:

- A reconstruction keeping the same cross-section with some modifications (variant A) or
- A reconstruction with a total change of the cross-section (variant B)



7.1.2. Criteria analysed

The roads to be developed are urban arteries with an intense circulatory function. These are main roads, and in some cases even interurban roads. Circulatory function must therefore be clearly privileged. Separating the different road users is a priority. Pedestrians, motorcyclists and cyclists, motorists are separated. In addition, these are existing roads, so their redevelopment will take into account the existing developments to avoid unnecessary reconstruction of the entire road.

As all the roads in lot 1 to be redeveloped do not have the same characteristics, the type of development to be chosen will be specific to each road. The analysis for the best choice will therefore be carried out road by road and the type of development chosen must include the aspects of:

- user safety;
- the development of parking areas;
- the legibility of the road;

• the green space, "qualitative treatment of the right-of-way to offer an urban landscape"; the flow of traffic; Optimization of intersections;

• a reference speed of 50km/h that can go up to 70km/h (CEREMA recommendations) which makes it possible to reconcile the circulatory function (to encourage travel) and the urban function (to give an urban image); multimodal design.

In view of these constraints to be observed in the choice of the variant, the analysis criteria are presented as follows in Table 55:

Table 55: Criteria for Variant Analysis

CONSTRAINTS AN	CONSTRAINTS ANALYSIS CRITERIA				
	Adaptability to the type of traffic and the objectives of the area				
Traffic Flow/Safety Teo	chnical and Economic Compliance with				
Track Capacities					
	Cost of implementation				
Risk of destruction of	existing ecosystem Socio-Degree of disturbance to be				
recorded Environmer	tal Possibility of parking area and development of green				
space					

Source: field data, CECO BTP, June 2022

7.1.3. Some elements of assessment Capacity and number of lanes (CEREMA)



.500

To characterise the capacity of a lane, the most commonly used variable is the maximum throughput, generally expressed in vehicles per hour. This is the hourly traffic threshold beyond which the smallest incident is likely to lead to the formation of traffic jams.

The principles for estimating the capacity of a road in an urban environment are as follows:

- it is the junctions that determine the flow capacity and not the current cross-section.
- Contrary to some preconceived ideas, the flow rate is not proportional to the speed.

• a large number of other elements disrupt the flow: lateral occupations (parking, riverside activity, etc.), the presence of other slower users (cyclists), pedestrian crossings, etc. Table 56 gives orders of magnitude of maximum flow for some types of road.

 Table 56: Orders of magnitude of maximum throughput for some types of track

Type of urba	an road Char	acteristics I	Maximum 1	flow rate	e (*)	
Isolated from and 1,800 Cir	its surroundi rcular road, n	ngs (no sid o direct res	e parking, sident acce	no river ess).	side life,	Between 1
					(D (4 0 0 0

Lined with sidewalks, little local life, no parking, width of Between 1,000 and 1,500 lanes of at least 3 m vehicles per hour

Curbside Edged, Riverside Life, Inter-Neighbourhood Lane, Side Parking, Lower Lane Width Between 600 and 1,000

or equal to 3m vehicles/hour

Pavement lane, large riverside life, Between 400 and 600 neighborhood side parking, reduced lane width vehicles/hour

Source: CEREMA/Project technical file

• Capacity of roads to be developed In order to better assess the capacities of the roads targeted for development, the traffic study revealed the following results (Table 57):



Table 57: Traffic volume (TMJA) over the project horizon

Tap	Table 57. Traffic volume (TMJA) over the project horizon							
No. AXES MOTORCYCLESTOTAL NAV		TOTAL PL	UVP (Traffic normal + induced)	UVP (growth of Forte traffic or Optimistic: Top scenario)	UVP (growth of traffic Normal or Realistic: median scenario)	UVP (growth in Low or Traffic Pessimist: scenario tendential		
1 5	OLD BRIDGE - CROSSROADS SOBEBRA - CARREFOUR OPT PK3 - CARREFOUR LE BÉLIER	43 653	23 497	1 985	41 872	163 356	123 894	87 049
2 7	HIRD BRIDGE - CROSSROADS SOBEBRA	38 859	24 268	1 788	40 668	104 590	68 132	58 899
9 F	LACE DU SOUVENIR - CARREFOUR 3 BANKS	27 737	17 132	260	26 804	53 139	34 616	29 924
11	CARREFOUR MARCHE SAINT MICHEL - CARREFOUR NASUBA - STEINMETZ EXCHANGER - OUR HUB	37 427	17 141	275	30 042	77 264	50 331	43 510
14	CARREFOUR 3 BANKS - CARREFOUR AIR AFRIQUE	9 569	4 297	65	7 585	19 508	12 708	10 986
15	CARREFOUR AIR AFRIQUE - OLD BRIDGE	21 580	14 124	529	22 304	57 362	37 367	32 303
17	CARREFOUR CHEMINOT - UPPER PASSAGE OF STEINMETZ	26 454	19 845	2 115	32 804	84 368	54 959	47 511

Spring : Technical file Project, CECO BTP, June 2022



7.1.4. Comparison of the variants identified for each road 7.1.4.1. Street N°1 "Old bridge – SOBEBRA crossroads – OPT PK3 crossroads – Le Bélier crossroads"

6.725km long, the street "Ancien pont – carrefour SOBEBRA – carrefour OPT PK3 – Carrefour le Bélier" was for a long time the only one linking Cotonou East and Cotonou West. The Pk 0+000 is just down the bridge and finally at the eastern limit of the city of Cotonou, more precisely at the Bélier crossroads. The Old Bridge – SOBEBRA Crossroads section consists of a single 6m wide roadway that has been functioning as a counter-alley since the completion of the Third Bridge – SOBEBRA Crossroads section.

On the other hand, the Carrefour SOBEBRA – Carrefour le Bélier section is laid out as a double carriageway bordered by side alleys on part of its line. Indeed, the left-hand side alley is a conversion of the old road on the Cotonou – Sèmè road. At the time of the study, it is completely degraded or worse non-existent in places. The right-hand side alley is built on the Carrefour Japan Motors section at the Carrefour le Bélier; On this section, the administrative right-of-way is increased from 40m to 60m. The counter-alley is a single bidirectional roadway 6m wide. The two main carriageways are separated by a 1.5m wide TPC, and in a new jerzey wall.

There is a railway track after the left sidewalk. This railway line is separated from the road by a metal barrier that has been vandalized or destroyed in places.

Profile across Street N°1 "Old bridge – SOBEBRA crossroads – OPT PK3 crossroads – Bélier crossroads" -

Uid Bridge – SUBEBRA Crossroads S

Description

The current cross-section is composed of 1×2 lanes laid out with cobblestones and bitumen. The width of the road is 6m.

A car park with a parking lot is positioned, to the left of the road. This configuration removes the left sidewalk on this portion.



It should be noted that the right-of-way is part of that of the Third Bridge – SOBEBRA Junction road. The other particularity is the cobblestone construction of this section up to the height of the CONCERTO performance hall, i.e. about 0.541 km from Pk 0+000. The gutters are located on one side, sometimes on the left, sometimes on the right; At the edge of the car park, they are buried but visible. The right side of the road is made up of services and shops, which are generators of mobility. The road is lit by conventional double-cross street lamps located at the limit of the two lanes ("old bridge – SOBEBRA crossroads" and "Third bridge – SOBEBRA crossroads").

The width of the car park is 5m taking into account the width of the gutters which are an integral part of the parking area. This car park is located only on the "old bridge – La Roche crossroads" section. The rest of the section has no parking, while mobility generators are present.



Advantage:	 6m lane width imposing a reduced speed and consequently offering more road safety to users; presence of a parking area (only on the section from the old bridge to the La Roche crossroads; Pavement cleared; presence of alignment shaft; Street compatible with urban function.
Disadvantages	 mixed uses without declaring the street a 30 zone; Gradient paving stones; limited parking spaces; no parking zone between the Roche crossroads and the SOBEBRA
Capability analysis	 crossroads. Category: Inter-district road Single-carriageway waterfront section: Normal maximum capacity: 14,000 UVP/d; Maximum saturation capacity: 24,000 UVP/d; Current capacity from traffic counts; Current capacity: 15017 UVP/d; Projected capacity by 2037: 44,436 Duv/d. Currently, the axis does not suffer from congestion since the flow is below the saturation capacity (15,017 < 24,000). However, this limit will be reached in a 7-year traffic growth.
Variant Analysis	Features of each variant Criteria for analysis Variant Variant A (Same preferential cross-section with some (Total change of cross-section) modifications) Adaptability to the type of Adapted (imposes reduced traffic and speed objectives of the made A Adapter VA & VB of the area of its width of 6m) Fludity of the Good Good VA & VB traffic/safety Compliance with the Yes Yes VA & VB capacity of the track Cost of implementation High Very high VA Risk of destruction No No VA & VB of ecosystem present Degree of disturbance to high (due to the Lowest VA record long duration and Possibility of Yes parking zone and (with parking Yes VB of limited green space) Choice of VA variant
Conclusion	For this section, the existing cross-section perfectly meets the requirements of a service road located in zone 30. This profile is maintained with speed bump installations speed zone, road signs for the declaration of the 30 zone, renewal the separation system with the railway and the development of competing routes in order to lessen the traffic shock



Cross profile of Street N°1 "Old bridge – SOBEBRA crossroads – OPT PK3 crossroads – Bélier crossroads" -

Section Section SOBEBRA crossroads – Japan Motors crossroads

Description

The current cross-section of this section is composed of 2×2 lanes separated by a 1.5m wide TPC. Following the traffic lanes, a 3m wide emergency lane is positioned.

Each carriageway is 3.5m wide. On the side



To the left of the double carriageway, there is the presence of the old Cotonou-Sèmè road, currently downgraded as local traffic. Between the local traffic and the main road, there is a railway line whose entire segments of the rails are vandalized and washed away. Between the railway and the main road, there is a metal barrier serving as a separation.

It is noted that the railway right-of-way is currently occupied as a parking lot by local residents. The pavement is present on the right side with a width varying from 4m to 5m without the gutters. On the left side, on the other hand, it is practically reduced to the width of the existing gutter. It is more of a pedestrian refuge for crossing the road. The real sidewalk on the left side is located after the local traffic which is undeveloped or at least highly degraded. Its width at level varies from 3m to 5m. The section is crossed by three crossroads to which major axes converge. The environment is composed of a mix of production units, storage stores, services, shops and private dwellings. In the second line, there are more private homes.

•					
	 double carriageway allowing the flow of large flows; 				
 separation by a simple New Jerzey wall; Advantage: 					
Right-hand sic	lewalk cleared;				
U U	 the presence of an emergency lane, also used as a cycle lane; 				
	• presence of a metal barrier as a separator between the railway and the main track.				
	Street not compatible with the urban function;				
	 High risk of collision type LCV/2WD or HGV/2WD; 				
	No parking area;				
 Mixed uses; E 	visadvantages				
	Lack of green space;				
	 Wide lanes that can encourage high speeds; 				
	Congestion at intersections;				
	 No separation between the local traffic area and the railway track. 				
Category: Lan	e with a predominant circulatory function (2x2 lanes) Single-carriageway				
riparian sectio	n: Analysis- Maximum normal capacity: 96,000 uvp/d for the 2				
carriageways;	capacity- Maximum saturation capacity: 144,000 uvp/d for the 2				
carriageways.	Current capacity from traffic counts				
	- Current capacity: 41,872 uvp/d;				



	 Projected capacity by 2037: 123,894 u.p.d. Currently, the axis does not suffer from congestion since the flow is lower than the saturation capacity (41,872 < 96,000). Traffic on the project horizon always remained below the maximum capacity. The current utilization rate is.43.62% 			
	Analysis criteria Vari	Features of each v ant B Variant A (Same cross profile with of cross profile) change	ariant n some (Total change s)	Preferred variant
	Adaptability to traffic ty adapt to area	pe and objectives Less	suitable to	VB
Least Good tra track capacitie	ffic/safety Analysis Comp s Cost of construction Hig	liance with variants Les h Very high Risk of des	s compliant Yes truction No No	VB
ecosystem pre	sent Degree of disturband	ce to high register Possi	ibility of parking	VB
	o create green space on			GOES
				VA & VB
				VA & VB
				VB
VB Modification of the cross-section of the road to the main roads which will be maintained in the				
absence of the roads Conclus	 decommissioning and re- ion installation of meta reconstruction of local 	ecovery of the railway rig al barriers to isolate both al traffic on the left side	ght-of-way for the puin I local traffic and main and prohibition of 2V	rposes of urban in roads, VD traffic on this
	section.			

Profile across Street N°1 "Old bridge – SOBEBRA crossroads – OPT PK3 crossroads – Bélier crossroads" -

Japan Motors crossroads section – Le Bélier crossroads

Description The situation is identical to that on the section between the SOBEBRA junction and the Japan Motors junction, with the exception of traffic. The road reconstruction had been designed as an express road. It has fulfilled its function well



until a gradual downgrading in view of changes in the urban environment.



The other observation is the queue of heavy goods vehicles on one of the traffic lanes, especially when transferring goods to the stores located in the area. In doing so, traffic becomes painful for users. The 2WD traffic observed on this axis is also not negligible, although it does not primarily serve the above-mentioned mobility generators.

	 double carriageway allowing the flow of large flows; 					
	separation by a simple New Jerzey wall;					
	Right-hand sidewalk cleared;					
Advantage:	 the presence of an emergency lane, also used as a cycle lane; 					
	 the presence of a metal barrier as a separator between the railway track and the main track 					
	Presence of local traffic on the right side;					
	Presence of alignment trees on the right side.					
	Street more or less compatible with the urban function;					
	 High risk of collision type LCV/2WD or HGV/2WD; 					
	No parking area;					
	Mixed uses;					
Disadvantages	Insufficient green space;					
	 Wide lanes that can encourage high speeds; 					
	Congestion at intersections;					
	Sanitation facilities open to local traffic;					
	 No separation between the local traffic area and the railway track. 					
	Category: Lane with a predominant circulatory function (2x2					
	lanes) Single-carriageway riparian section:					
	Normal maximum capacity: 96,000 UVP/day for the 2 carriageways;					
	 Maximum saturation capacity: 144,000 UVP/day for the 2 					
Capability	carriageways. Current capacity from traffic counts					
analysis	Current capacity: 41,872 PSUs/d;					
	Projected capacity by 2037: 123,894 PPU/d.					
	Currently, the axis does not suffer from congestion since the flow is lower than the					
	saturation capacity (41,872 < 96,000). Traffic on the project horizon always remained					
	below the maximum capacity. The current utilization rate is.43.62%					
	Features of each variant					
	Variant A Variant Criteria Analysis Variant B					
	(Same cross profile (Total change of the preferential with					
	some modifications) cross profile)					
	Adaptability to traffic type and objectives Less suitable to adapt VB of the					
	area					
	area					
	Least Good VB Traffic/safety Compliance with the Least compliant Yes VB track					
Variant	capacities Cost of implementation High Very high VA Risk of destruction Yes					
Analysis	Yes VA & VB of ecosystem present Degree of disturbance to high High VA & VB					
	register Possibility of parking zone and No A create VB of green space Choice of					
	variant					



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		VB
	 Modification of the cross-section of the road to the main road 	ads which will be
	maintained in the absence of the decommissioning and recover	ery of the railway
	right-of-way for the purposes of urban roads;	
 installation of 	f metal barriers to isolate both local traffic and the roads Main conclus	sion;
	 reconstruction of local traffic on the left side will be completely re 	ebuilt and the one
	on the right side will be redeveloped to set up parking areas;	
	2WD traffic on this section will be prohibited.	

Source: Field data, June 2022.

7.1.4.2. Street N°2 "Third Bridge - SOBEBRA Crossroads" Rebuilt in 2005 as part of the construction of the third bridge over Lake Nokoué with funding from the KFW and the National Budget, this road has a cross-sectional type.

The first covering the area before the third bridge, is composed of a 2x2 lane, with a width of 3.5m for each lane. The two carriageways are separated by a TPC 3m wide, which houses a gutter for the rainwater drainage of the main carriageways. The left and right TPLs act as pedestrian refusals to facilitate the crossing of the road. A 5m side alley on the right side and 5.5m on the left side serve as connecting roads between the immediate surroundings and the main road.

The second cross-section concerns the section "after the third bridge - SOBEBRA crossroads". It is composed of x2 lanes of 3.5m wide each, adjoining a 3m emergency lane which acts as a cycle lane. This section of road has 6m wide local traffic on the left side. The right side has a two-way carriageway making up the Old Bridge-SOBEBRA crossroads axis. The two carriageways are separated by the railway path bordered by new jerzey walls.





composed of large spaces with no entrance facing the street; on the other hand, there are alleys that The sidewalk bottoms body with long inert fence wall; intersect this road;

	 2x2 lanes of 3.5m wide per lane; Hard shoulder/cycle lane; a TPC of 5m to 10m wide incorporating the railway track; Left local traffic of 6m after the TPL made up of the lateral gutter and green spaces. 		
Advantage:	 double carriageway for a large flow of flow; presence of sidewalk; presence of an emergency lane / cycle lane; presence of flower pots for landscaping; Presence of bidirectional local traffic; Isolation of the railway from the road; Landscaping. 		
Disadvantages	 high risk of collision type LC/2WD or HGV/2WD; no well-defined parking area; lack of green space; Wide lanes that can encourage high speeds. 		
Capability analysis	Category: Lane with a predominant circulatory function (2x2 lanes) Single-carriageway riparian section: - maximum normal capacity: 96,000 UVP/day for the 2 carriageways; - Maximum saturation capacity: 144,000 UVP/day for the 2 carriageways. Current capacity from traffic counts - Current capacity: 40,668 UVP/d; - Projected capacity by 2037: 120,331 PSU/d. Currently, the axis does not suffer from congestion since the flow is lower than the saturation capacity (40,668 < 96,000). Traffic on the project horizon always remained below the maximum capacity. The current utilization rate is 42.36%.		
	Features of each variant Criteria for analysis Variant Variant At (Same cross profile (Total change of the preferential with some modifications) cross profile)		
Variant Analysis	Adaptability to traffic type and objectives Suitable to Adapt VA & VB of the area Fluidity of the Good VA & VB traffic/safety Compliance with the Compliant Yes VA & VB capacity of the track Cost of implementation High Very high VA Risk of destruction No Yes VA of ecosystem present		



				-
LOT	N°	AT	C-	01

	Degree of disturbance to be recorded	High	Very high	GOES
	Possibility of parking area and green space	No	To be created	VB
	Choice of variant			GOES
The main function of this road is to transit between the west and east of the city of Cotonou. From this				
point of view, th	ne cross-section is perfec	tly sized for. The prese	nce of two-way local	traffic adds an
urban dimensio	on to this road. The lands	caped green spaces pro	omote the conviviality	y of uses.
	The current cross-sectio	n will be maintained wit	h the creation of gree	en spaces

Source: Field data, June 2022.

7.1.4.3. Street N°9 "Place du Souvenir - Carrefour 3 Banques" A decommissioned section of the former RNIE 1 route, the "Place du Souvenir - Carrefour 3 Banques" section is approximately 2.487 km long and is laid out in 2x2 lanes, each 3.5 m wide. It serves important institutions such as the Presidency of the Republic, the French Institute, the Embassy of France in Benin, the Chinese Cultural Center, the General Staff of the Beninese Armed Forces, the Central Bank of West African States (BCEAO), the Directorate of Emigration - Immigration, the Court of Appeal of Cotonou, and many others as well as banks and other services. The main sanitation is made up of a closed frame collector whose central position is used to serve as a TPC at the same time.



cross-section of this road is composed of 2 x 2 lanes separated by a 1.5m wide TPC made up of the central gutter. Each lane

carriageway is 3.5m wide.

It's a street lined with

only on duty. The lack of parking areas is noticeable especially at the level of services such as the Directorate of Emigration – Immigration (DEI) The variable right-of-way of the road from 22m to 24m, gives reduced sidewalks in some places.

Advantage:	double carriageway allowing the flow of large flows;
	Sidewalks available in places.
Disadvantages	 high risk of collision type LCV/2WD or HGV/2WD,
	no parking area;
	mixed uses;
	Lack of green space.


C	Category: Lane with a predominant circulatory function	on (2x2
la	anes) Single-carriageway riparian section:	
	- Normal maximum capacity: 96,000 uvp/d for	r the 2 carriageways
- Maximum satur	ration capacity: 144,000 uvp/d for the 2 carriageway	s. Analysis Current
capacity from ca	pacity traffic counts - Current capacity: 26,804 u.p.d	l;
	- Projected capacity by 2037: 61,135 u.d.	
C	Currently, the axis does not suffer from congestion	since the flow is lower than the
S	aturation capacity (26,804 < 96,000). Traffic on the	project horizon always remained
b	pelow the maximum capacity. The current usage rate	e is.28%
	Features of each varian	t
	Variant A Variant Analysis criteria (Same profile in Varian	nt B through (Total change in the
	preferred	
	with some modifications)	cross profile)
	Adaptability to traffic type and objectives Adapted N	Non Adapter VA of the
	area	
Flow Analysis of	Good VA & VB Traffic /Safety Variants Compliance	with Compliant VA & VB Track
Capacities Cost of	of Realization Very High VA Risk of Destruction Yes	Yes VA & VB Ecosystem Present
Degree of Disturb	bance to Very High VA & VB Register Choice of VA	Variant It is a street located in a
sensitive area, bo	ordered by services related to state security, as well	as the presence of embassies. It is
not desirable to h	have a parking area or an emergency lane.	
Conclusion The e	existing cross-section will therefore be maintained w	vith the installation of landscaping
(flower box on th	ne TPC and the planting of alignment trees in the sid	lewalks without compromising the
safety of the infra	astructure in the area).	

Source: Field data, June 2022.

7.1.4.4. Street N°11 "Carrefour Marché Saint Michel – Carrefour NASUBA – Échangeur Steinmetz – Carrefour Notre Dame" With a length of 1.94km, the street "Carrefour Marché Saint Michel – Carrefour Nasuba – Échangeur Steinmetz – Carrefour Notre Dame" is one of the busiest arteries in the city of Cotonou. It starts at the Saint Michel Market, which is one of the mobility generators. The Carrefour Marché Saint Michel – Carrefour Nasuba section is lined with shops on both sides frequented by users of the Dantopka and Saint Michel markets. On the other hand, its Carrefour Nasuba – Carrefour Notre Dame section is bordered by services and also shops frequented by a slightly more affluent and therefore less numerous clientele. The administrative footprint of the street varies from 36m to 40m.



Crossing Profile of Rue N°11 " Carrefour Marché Saint Michel – Carrefour NASUBA – Echange Steinmetz – Carrefour Notre Dame"

Description The current cross profile is composed of 2 x 2 lanes separated by a 4m wide TPC. Following the traffic lanes, a 2m wide emergency lane is positioned. Each carriageway is 3.5m wide. The car park located after the cycle lane is 3m wide with a



herringbone parking. The sidewalk occupies the rest of the administrative half-right-of-way. Its width varies from 4m to 6m. The gutters are buried on the section from the Carrefour Marché Saint Michel to the Carrefour Marché Missèbo. On the rest of the section, they are visible on the right side. The lighting in the double crosse floor lamp is axial.

• Wide TPC allowing U-turns without much difficulty; Advantage:

presence of a parking area;

- a wide pavement, compatible with the notion of a commercial environment;
- Presence of cycle lane.
 - street not compatible with the urban function;
 - high risk of collision type LC/2WD or HGV/2WD;

• herringbone parking causing traffic to stop during stopping or starting manoeuvres; Disadvantages lack of TAG channels;

- mixed uses without declaring the street a 30 zone;
- lack of green space;
- wide lanes that can encourage high speeds;
- Limited parking spaces.

Category: Inter-district road (2x2 lanes)

Single-lane waterfront section:

- Normal maximum capacity: 57,600 uvp/d for the 2 carriageways

- Maximum saturation capacity: 96,000 u.s.p./d for the 2 carriageways Analysis Current capacity from capacity traffic counts - Current capacity: 30,042 p.v.d.;

	- Projected capacity by 2037: 88,891 u.p./d Currently, the axis does not suffer from congestion since the flow is lower than the saturation capacity (30,042 < 57,600). Traffic on the project horizon always remained below the maximum capacity. The current utilization rate is.52.16%					
	Features of each variant					
Analysis of variants	Criteria for	⁻ analysis	Variant A Variant (Same cross profile with (Total change of the	some modifications)	Variant Preferential	



Adaptability to traffic type and objectives Not suitable to adapt VB of the area

Fludity of the Least Good VB Traffic/safety Compliance with the Compliant VA & VB Compliant Track capacities Cost of implementation High Very high VA Risk of destruction Yes Yes VA & VB of ecosystem present Degree of disturbance to High Very High VA & VB register Possibility of parking area and No A create VB of green space Choice of VB variant VB Although the street does not present any geotechnical disorder, as part of this work, the cross-section would be entirely taken over to give the urban dimension of this artery by integrating the development of green spaces, the repositioning and increase of parking spaces, the segregation of users to offer more safety to 2WD

Source: Field data, June 2022.

7.1.4.5. Street N°14 "Carrefour 3 Banques – Carrefour Air Afrique" With a length of approximately 0.7 km, this section of road was completely rebuilt in 2008. The current cross-section is composed of a single 7m carriageway with a single overhang. Over a distance of 700m, the gutter is lowered. The urban environment of the area has changed significantly over the past five years. It is built or under construction of public infrastructures such as the Mathieu Kérékou Garden, the Sahelo-Saharan Bank for Investment and Trade (BSIC).

Between Pk 0+500 and Pk final, the pavement is destroyed by the roots of existing trees. In this section, the gutter is raised by 20 cm in relation to the paved edges. To park, residents have built concrete ramps on the road to access the sidewalk.



Crossing Profile of Street N°14 "Carrefour 3 Banques – Carrefour Air Afrique"

Description

As can be seen in th photo opposite, the channels lowerestion to use the sidew as a parking area visitors to Mathieu Kéré garden.	e will walk a for the kou		
Advantage:	 urban roads; a single carriageway that encourages exchanges and requires a presence of sidewalk; presence of a few alignment trees. 	a reduced speed;	
Disadvantages	 No signage conducive to a 30 zone; anarchic parking of vehicles; Mixed use without declaring the street a 30 zone; Limited parking spaces. 		
Capability analysis	Category: Inter-district lane (1x2 lanes) Single-lane waterfront section: - Normal maximum capacity: 28,800 p.uv/d - Maximum saturation capacity: 48,000 UVP/d Current capacity from traffic counts - Current capacity: 7,585 puv/d; - Projected capacity by 2037: 22,444 u.s.p/d Currently, the axis does congestion since the flow is lower than the saturation capacity (7,588 on the project horizon always remained below the maximum capacity utilization rate is 26.34%.	s not suffer from 5 < 28,800). Traff y. The current	ïc
	Features of each variant Variant Analysis Criteria (SavariantsA Séction (Botal change in with some modifications) cross profile)	Preferential	
Variant Analysis	Adaptability to traffic type and objectives Adapted To Adapt to the area	GOES	
	Fluidity of the Bonne Bonne VA & VB traffic/safety Compliance with the Traffic Authorities VA & VB track capacities High cost of implementation Very high V	VA	



	-
LOT N° ATC- (21

	Risk of destruction of the existing ecosystem	No	Yes	GOES	
	Degree of disturbance to be recorded	High	Very high	VA & VB	
	Possibility of parking area and green space	Yes	To be created	VA & VB	
		Choice of variant		GOES	
The cross-section exists and will be maintained because the division currently makes administrative					
control is satisfactory. The single 7m carriageway allows overtaking and the Conclusion of the crossing					

of the light vehicles and HGVs, the lowered gutter offers the possibility of using the pavements as a parking area. However, safety arrangements will be integrated for the indication of a Zone 30.

Source: Field data, June 2022.

7.1.4.6. Street N°15 "Carrefour Air Afrique - Old Bridge" As one of the first streets to be developed and paved in the city of Cotonou, this axis underwent a final refreshment in 2009. The very variable footprint of the street and its essentially commercial function are undoubtedly the reasons for its development into a single roadway. Indeed, it consists of a single 8m wide street resulting from the resurfacing and pavement. It is observed that the occupation of the sidewalks has been by the private owners of the shops and businesses located along the road. The Notre Dame crossroads is managed by a set of more or less incomprehensible blocks.

Crossing profile of Rue N°15 "Carrefour Air Afrique

Description

The real problem with street is this the availability of adequate parking areas.

As can be seen in the photo opposite, the parking of vehicles is done in battle along the road, with others in



crenel. The road and the sidewalk are confused. The separation gutter is at the same level as the roadway, thus encouraging this confusion of users. The existing single carriageway is bidirectional with two lanes, each 3.5m wide. The presence of the railway represents a constraint that the current development has not visibly taken into account since there are no safety measures between the railway tracks and the road network. The position of the Steinmetz interchange at the Notre Dame crossroads is the other major constraint in the review of the sharing of the administrative right-of-way.

• urban roads Advantage: single carriageway favouring exchanges and requiring a reduced speed;

presence of sidewalk;



	presence of a few alignment trees;		
Disadvantages	 no signage conducive to a 30 zone; anarchic parking of vehicles; a multitude of blocks at the Notre Dame crossroads; mixed uses without declaring the street a 30 zone; lack of green space; limited parking spaces; the presence of the railway without ruling on its decommissioning. 		
Capability analysis	Category: Inter-district road (1x2 lanes) Single-carriageway waterfront section: - Normal maximum capacity: 28,800 p.uv/d - Maximum saturation capacity: 48,000 UVP/d Current capacity from traffic counts - Current capacity: 22,304 p.uv/d; - Projected capacity by 2037: 65,994 u.p./d Currently, the axis does not suffer from congestion since the flowes than the saturation (22,304 < 28,800). Traffic on the project horizon w capacity variants. The current utilization rate is .77.44%.	ation capacity vill be higher than the	
Analysis of maximum	Features of each variant Criteria of analysis (Same cross-section Variant B with some (Total change in Modifications) Cross Profile) Adaptability to traffic type and objectives Not suitable to adapt to area Fluidity of the Least Good Traffic/Safety Compliant but will Comply with the problems in a Conform capacities of the near future lane Cost of implementation High Very high Risk of destruction Yes Yes of ecosystem present Degree of disturbance to High High register Possibility of parking area and Yes To create green space Choice of variant	Preferred variantVBVBVBVBVBVA & VBVA & VBVA & VBVA & VBVA & VBVB	
	Tchiskstrfeenwitist princeny fulleteligy: eldet verile petrologies street. It will be redered clear, high-quality parking areas. declare the zone, "zone 30" which will make it possible to change the composition to pronounce if possible the decommissioning of the rails in favor of the road right Notre Dame intersection with a clear and precise readability.	signed to include of traffic and reduce it, -of-way, to review the	

Source: Field data, June 2022.

7.1.4.7. Street N°17 "Carrefour Cheminot – Passage supérieur de Steinmetz" Redeveloped at the same time as the construction of the third bridge in Cotonou, this road is an integral part of the access roads to this structure. It consists of 2x2 lanes of 3.5m width each. Each roadway, in addition to the traffic lanes, is also composed of an emergency lane that also serves as a cycle lane. The variable wide sidewalk is bilateral and is located after each carriageway.

One remark made along the left sidewalk is the closure of all the openings intersecting the roadway by DBAs. And this for the simple reason that this road must serve a high circulatory function.

But today, there are riverside developments with the opening of entrances facing the road, reducing its circulatory function every day. Another notable fact is the parking of HGV vehicles waiting for access to the Autonomous Port of Cotonou, on the left lane of the left carriageway.

The central gutter serves as a separation between the two carriageways.

Cross section of Rue N°17 "Carrefour Cheminot – Passage supérieur de Steinmetz"

Description

The current cross profile is composed of 2 x 2 lanes separated by a 2.5m wide TPC. Following the traffic lanes, a 2m wide emergency lane is positioned which also serves as a cycle lane.



Each carriageway is 3.5m wide. The sidewalk occupies the rest of the administrative half-right-of-way. Its width varies from 1m to 3m. The gutters are visible and positioned to serve as TPC. Above the central gutter, there are flower pots for landscaping. Battle along the track, with others in battlement. The road and the sidewalk are confused. The separation gutter is at the same level as the roadway, thus encouraging this confusion of users. The existing single carriageway is bidirectional with two lanes, each 3.5m wide. The presence of the railway represents a constraint that the current development has not visibly taken into account since there are no safety measures between the railway tracks and the road network. The position of the Steinmetz interchange at the Notre Dame crossroads is the other major constraint in the review of the sharing of the administrative right-of-way.

	Teview of the sharing of the daministrative right of way.
	 double carriageway for a large flow of flow;
	presence of sidewalk;
 presence of 	an emergency lane / cycle lane; Advantage:
	 presence of flower pots for landscaping;
	 closing of the primers to limit interconnections and consequently the risk of
	collision.



	etre et met eenen etikl	e with the weber from the			
	street not compatible with the urban function;				
	 high fisk of collision type LC/200D of HGV/200D, herringhene parking sources traffic to step during stepping or starting manageurroot. 				
	herringbone parking causing traffic to stop during stopping or starting manoeuvres;				
Disadvantages	 absence of TAG pat 	hways.			
Distavantages	 mixed uses without 	declaring the street a 30) zone:		
	 lack of green space: 		20110,		
	 wide lanes that can 	encourage high speeds	:		
	Limited parking space	ces.	,		
	Category: Lane with a pr	redominant circulatory f	unction (2x2		
	lanes) Single-carriagewa	ay riparian section:	,		
	- Normal maximu	im capacity: 96,000 uvp	/d for the 2 carriagev	vays	
	- Maximum saturation ca	apacity: 144,000 uvp/d f	or the 2 carriageways	S	
Capability	Current capacity from tra	affic counts			
analysis	 Current capacity 	y: 32,804 u.p./d;			
	- Projected capacity by 2	2037: 97,064 u.p./d Curr	rently, the axis does	not suffer from	
	congestion since the flow	v is lower than the satur	ration capacity (32,80	04 < 96,000).	
	Traffic on the project hor	izon always remained b	elow the maximum of	capacity. The	
	current usage rate is.34.	17%			
Features of each variant					
	Variant A Variant Analy	sis criteria (Same cross-	-section Variant B with	some (Total	
	change in the preferenti	al cross-section) modifica	tions) Adaptability to	the type of	
	traffic and the objective	es of the area			
		Not suitable	To be adapted	VB	
	Traffic flow/safety				
	······	Worse	Good	VB	
Variant		Compliant but will be			
Analysis	Compliance with	problematic in the	Compliant	VB	
	track capabilities	near future High			
	VOORtisk iofplæstrutetion	of the ecosystem prese	ent Very high		
$\boldsymbol{\langle}$		Vec	Vec	VA & VB	
		163	163		
	Degree of disturbance	High	High	VA & VB	
	to be recorded	i ngin	riigii	inta ve	
	Possibility of parking a	area and Yes			
	VA & VB of green	space Choice of VB va	riant To be created		
	Although the street does	not present any geotec	nnical disorder, as pa	art of this work, the	
Conclusion	by integrating the development of green spaces, the repositioning and increase of				
	by integrating the development of green spaces, the repositioning and increase of				
	parking spaces, and the	segregation of users to	oner more salety to	ZVVD.	

Source: Field data, June 2022.

In conclusion, each of the roads targeted for development will be redeveloped in accordance with the standards for the development of a lane and above all in accordance with the objectives of the road and the safety rules for a smooth flow and a safe crossing.



7.2. DESCRIPTION OF THE SELECTED PROJECT

7.2.1. Presentation of the selected variants

From the analysis of the variants made above, the solutions chosen appear to be the most economically profitable, ecologically viable and technically feasible. He introduces on the introduces of the solutions are the solutions and technically feasible.

7.2.1.1. Street N°1 "Old bridge – SOBEBRA crossroads – OPT PK3 crossroads – Carrefour le Bélier" This street has been divided into four axes. Table 58 presents the work to be carried out and the characteristics of each road after development:

Table 58: the works to be carried out and the characteristics of each road after the development of the street "Ancien Pont-carrefour SOBEBRA - carrefour OPT PK3 - carrefour le Bélier"

Axle Type	Characteristics Work to be carried	d out
Old bridge – crossroads SOBEBRA	removal of paving stones to be replaced by aspha stones with the rain grids; removal of paving stones replacementatile vantaigg: Zonte an asphalt ◆ concr Bettoride vel of road service; > A 2m wide pavement in terrazzo paving ston	alt pavement; replacement of paving at the level of the parking area and its rete surface Good traffic readability; • nes.
	Maintenance of the existing sanitation. Plant Reconstruction of the sidewalk.	ting of alignment trees;
Crossroads SOBEBRA – Japan Motors Carrefour	 > a two-lane two-lane two-way carriageway of 3m wide; > a 5m wide battle parking area; > On the right, a 2m wide pavement made of cobblestones terrazzos. Advantage: Removal of paving stones at the area Good readability of traffic; parking and its repl Improved level of road service; by concrete patered redevelopment of the green space; bituminous Maintenance of existing sanitation; reorgation Development of a parking lot on the right. Plane Reconstruction of the sidewalk. 	Lowering of the gutter slab; Demolition of the gutter over 200 ml in order to have sufficient height under the slab; replace the slabs with drain grids; a lacement avement s; anisation of the alignment \blacklozenge trees anting of alignment trees;
Carrefour Japan Motors	 the characteristics of the cross-section of the main carriageways are wide 	Construction of local traffic, existing network maintained, (2x 2 lanes of 3.5 m



- Le Bélier crossroads	 each, a 3m wide BAU, a TPC in DBA 1.5m wide) a 5.50m wide bidirectional local traffic. It makes it possible to contain 2WD traffic and at the same time allow access to the neighbouring houses; local traffic is bordered by a 2m wide parallel parking area; the railway right-of-way is maintained at 6.65m. it is separated from the road roads by wire mesh walls; local traffic lighting will be provided by conventional street lights mounted on existing SBEE poles. Advantage: No work related to the modification of the cross-profile except for the installation of the water wire curbs; Better level of road service; Safeguarding the railway right-of-way; Creation of a parking area; Development of bidirectional local traffic; Maintenance of existing sanitation; Local traffic lighting. 	•	improvement of local traffic, Construction of the mesh fence Installation of SHP lamps on existing SBEE posts, reorganization of existing alignment shafts. Planting of alignment trees; Creation of waterline kerbs; Reconstruction of the sidewalk.

Figures 44, 45, 46 and 47 show the cross-sections to be installed for each of these tracks





Figure 44: Cross section for the Old Bridge - Carrefour la Roche section



Source: CECO BTP technical document, May 2022

Top view section of the projected cross-section Crossroads section Carrefour la roche - Carrefour	roche – Carrefour
SOBEBRA Cross-section Cross-section Projected cross-section Crossroads section Carrefour la	SOBEBRA







Top-down section of the projected cross-section SOBEBRA - Carrefour section

Cross-section Projected cross-section Crossroads section SOBEBRA - Crossroads

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Figure 46: Cross-section for the Carrefour SOBEBRA - Carrefour Japan Motors section Source: CECO BTP technical document, May 2022



Figure 47: Cross section for the Carrefour Japan Motors – Carrefour Le Bélier section



Source: CECO BTP technical document, May 2022





7.2.1.2. Street N°2 "Third Bridge - SOBEBRA Crossroads" The works to be carried out and

the characteristics of the road are as follows in Table 59:

Table 59: the works to be carried out and the characteristics of each road after the development of the "Troisième Pont – Carrefour" street SOBEBRA »

Axle Type	Characteristics Work to be carried out	
Third Bridge – La	 Sharfectroistics of the affices and the international of the gutter shares to address with the international of the gutter shares to address to address of the address of the gutter of the possibility of lowering the gutter slabs will be appreciate the international of the gutter slabs will be appreciate the international of the gutter slabs will be appreciate the international of the gutter slabs will be appreciate the international of the gutter slabs will be appreciated to be address of the gutter slabs will be appreciated to be address of the gutter slabs will be appreciated to be address of the gutter slabs will be appreciated to be address of the gutter slabs will be appreciated to be address of the gutter slabs will be ad	
Roche Crossroads	considered to limit the phenomenon of ramps on the road observed all along the riverside side. Advantage: ♦ No work related to the modification of the cross-profile except for the installation of the water wire curbs; ♦ Better level of road service; ♦ Safeguarding the railway right-of-way; ♦ Maintenance of the existing sanitation.	
Carrefour La roche- Carrefour SOBEBRA	 Characteristics of the cross section of the carriage ways in the construction of the gutter slabs to prace cardian are impired and in the provident of the construction of the gutter slabs. Reconstruction of the gutter slabs will be considered to limit the phenomenon of ramps on the road observed all along the riverside side. Advantage: No work related to the modification of the water wire curbs; Better level of road service; Safeguarding the railway right-of-way; Maintenance of the existing sanitation. 	

Figures 48 and 49 show the cross-sections to be installed for each of the track sections

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Figure 48: Cross section for the section "Carrefour Troisième Pont – Carrefour La Roche" Source: CECO BTP technical document, May 2022





Figure 49: Cross section for the section "Carrefour La roche - Carrefour SOBEBRA" Source: CECO BTP technical document, May 2022



7.2.1.3. Street N°9 "Place du Souvenir – Carrefour 3 Banques" The works to be carried

out and the characteristics of the road are as follows in Table 60:

Table 60: the works to be carried out and the characteristics of each road after the development of the "Place du Souvenir – Carrefour 3 Banques" street

Axle Type	Characteristics	Work to be carried out
Axle Type Third Bridge – La Roche Crossroads	 Characteristics Maintaining the existing cross-section (2x2 tracks of 3.5m wide each, a central collector raised by 30cm and serving as a TPC with a width of 1.5m; Revegetation of the TPC using flower boxes. Advantage: No cross-profile modification; Separation of uses: beneficial for the safety of users; Maintenance of two separate carriageways: ensuring 	 Work to be carried out Removal of the slabs from the central gutter, implementation of a more aesthetic buffer grid in their place Implementation of flower boxes on the TPC Implementation of the alignment trees according to
	the flow of circulatory flow; ◆ Sufficient pavement width for the flow of pedestrian flow; ◆ Revegetation of the TPC at a lower cost; ◆ Maintenance of existing sanitation;	 he landscaper's prescriptions. Reconstruction of the sidewalk

Source: Field data, June 2022.

Figure 50 shows the cross-section to be installed for this track

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Top view section of the projected cross-section Carrefour Place du Souvenir – Carrefour Cross-section Projected cross-section Carrefour Carrefour 3 banks



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Figure 50: Cross profile for the section "Place du Souvenir – Carrefour 3 Banques" Source: CECO BTP technical document, May 2022

7.2.1.4. Street N°11 "Carrefour Marché Saint Michel – Carrefour NASUBA – Echangeur Steinmetz – Carrefour Notre Dame" The works to be carried out and the characteristics of the road are as follows:

Table 61: the works to be carried out and the characteristics of each road after the development of the street "Carrefour Marché Saint Michel – Carrefour NASUBA – Échangeur Steinmetz – Carrefour Notre Dame"

Characteristics Work to be carried out
 2 unidirectional two-lane carriageways of 3m of wide; of the existing TPC; installation of the
 > 2m wide central median; > 4m wide local traffic bordered by two zones parking facilities located on either side of local
 traffic; A 4m wide pavement made of terrazzo paving stones including solar street lights and arrays.
 Maintenance of two separate carriageways: ensuring and installing lighting for the flow of circulatory flow; solar at the level of this Width of the payament sufficient for the flow of the last padestrian
 Width of the pavement sufficient for the flow of the last, pedestrian flow; Greening of spaces.
♦ No reconstruction of the roadway, ♦
Maintenance of the existing sanitation, ♦
 > 2 two-lane unidirectional carriageways of 3m of wide, from the existing TPC; installation of the Removal of the DBS borudes
 2m wide central median, Local traffic from 4.40 m to 4.50 m wide bordered by
two parking areas located on either side of the local traffic,
 Maintenance of two separate carriageways: solar assurance at the level of the flow of the circulatory flow, last
 Sufficient pavement width for the flow of pedestrian flow, ◆ Greening of spaces, ◆ No reconstruction of the roadway, ◆ Maintenance of existing sanitation, ◆ Inexpensive modification of the existing profile,

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Figure 51: Cross section for the section "Carrefour Marché Saint Michel – Carrefour Missèbo Source: CECO BTP technical document, May 2022





Figure 52: Cross section for the section "Missèbo crossroads - Ciné VOG crossroads Source: CECO BTP technical document, May 2022



7.2.1.5. Street N°14 "Carrefour 3 Banques - Carrefour Air Afrique" The works to

be carried out and the characteristics of the road network are as follows:

Table 62: the works to be carried out and the characteristics of each road after the development of the "Carrefour 3 Banques – Carrefour Air Afrique" street

Axle Type	Characteristics Work to be carried out		
	> Strected find construction of the state of	on of sidewalks; Stump some	
Carrefour 3 Banques – Carrefour Air Afrique/ Section Pk 0+000– Pk 0+500	existing aggressive trees; Planting of selected new tr variable widths, max of 4,50m; the sidewarks or the road; > Planting of range trees in places	ees; to no longer damage either	
	 The solar lighting installed will be maintained; Advantage No profile changes; Reduced traffic speed; Multi-use of sidewalks (pedestrian traffic and parking area); Resumption of vegetation, preferably with non-aggressive trees; No reconstruction of the roadway; Maintenance of the existing sanitation. 	Implementation of speed moderation devices, ge: Area 30 recall.	
Carrefour 3 Banques – Carrefour Air Afrique/ Section Pk 0+500 – Pk Final	 Sthe existing cross of cliquidic maintained (a construction in the formation of the solar lighting installed wild be maintained; Advantage: Area 30 recall. No profile changes; Resumption of vegetation, preferably with non-aggressive trees; No reconstruction of the roadway; Maintenance of the existing sanitation. 	on of sidewalks; Stump some mage either the sidewalks or the road; Implementation of the system speed moderation,	

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Figure 53: Cross-section for the section "Carrefour 3 Banques - Carrefour Air Afrique Source: CECO BTP technical document, May 2022

Trottoir en pavés décoratif





Figure 54: Cross-section for the "Carrefour 3 Banques – Carrefour Air Afrique" section (final section) Source: CECO BTP technical document, May 2022



7.2.1.6. Street N°15 "Carrefour Air Afrique – Ancien pont" The works to be carried out and the characteristics of the road are as follows:

Table 63: the works to be carried out and the characteristics of each road after the development of the "Carrefour Air Afrique – Ancien pont" street

Axle Type	Characteristics Work to be carried out
	> The existing cross-section has been completely Complete
	reconstruction revisited: of the road with all its
	> A single two-way carriageway with 1x2 convenience lanes at
	3.5m wide each;
	> A 1.0m wide cycle lane;
	> Two 60° herringbone parking lanes on either
	side of the road to provide more parking
	> Two bilateral sidewalks of variable width
	with a minimum dimension of 3m, separated
Air Afrique	from the roads by aesthetic metal barriers, to
Rridge	better make pedestrians safer;
Section 1: Air	> The greening of the artery by planting trees
Africa Hub –	In alignments;
Notre Dame	by removing all the existing blocks.
Hub	Advantage: Profile more compatible with the
	street's commercial function; Better
	understanding of the roads; Development of
	parking areas; ♦ Reduced traffic speed; ♦
	Better protection of pedestrians; Encouraging pedestrian traffic: Becumption of conitation to
	ensure optimal drainage: Declaration and
	implementation of Zone 30.
	> The existing cross-section has been revised in Complete depth
	reconstruction: of the road with all its
	> A single two-way carriageway with 1x2 convenience lanes; each 3.5m
	A 1 0m wide cycle lane: the right:
	 At the level of the left side in the direction of the project: traffic
	Demolition of the 6m wide bidirectional local stations is planned. fuel on the
	edge of the With two parking lanes, one of which is on the track but which is
	located in a crenellation and the other in a crenellation; a side pavement of
	traffic main road after a 5m wide TPL in greenery:
	a and a date a on wae in 2 in greenery,
Section 1: Air	> On the right side, the development planned
Afrique –	in the rehabilitation studies of the Ganhi
Carrefour	market, namely a motorcycle parking lot with
crossroads	'green' intervals and a 2.5m wide sidewalk, is
(integration of	 The greening of the artery by planting trees
Ganni market	in alignments;
section in	> Reorganization of the Notre Dame crossroads

market car park by removing all the existing blocks. Advantage:

Integration of the developments
planned as part of the rehabilitation work of the
Ganhi market;

Profile more compatible with

the commercial function of the street;

Better
understanding of the roads

Local traffic
development;

Development of parking areas;

Reduced traffic speed;

Better protection of
pedestrians;

Encouraging pedestrian traffic;

Resumption of sanitation to ensure optimal
drainage;

Declaration and implementation of

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Section 1: Air Afrique – Carrefour Notre Dame (integration of the Ganhi market developments) - section in front of the market	 The existing cross-section has been thoroughly reviewed: A single two-way carriageway with 1x2 lanes at 3.5m wide each; A 1.0m wide cycle lane; On the left side in the direction of the project: 6m wide bidirectional local traffic is projected. With two parking lanes, one of which is herringbone and the other in battlement; a 2.5m wide side pavement. Local traffic is separated from the main carriageway after a 5m wide green TPL; On the right side, the development planned in the rehabilitation studies of the Ganhi market, namely a motorcycle parking lot with 'green' intervals and a 6m wide sidewalk, is maintained; The greening of the artery by planting trees in alignments; Reorganization of the Notre Dame crossroads by removing all the existing blocks. Advantage: Integration of the developments planned as part of the rehabilitation work of the Ganhi market; Profile more compatible with the commercial function of the street; Better understanding of the roads; Local traffic development; Development of parking areas; Reduced traffic speed; Better protection of pedestrians; Encouraging pedestrian traffic; Resumption of sanitation to ensure optimal drainage; 	 Complete reconstruction of the road with all its amenities; Offset of the carriageway to the right; Demolition of fuel stations along the track but which are located in the administrative right-of-way.
Section 1: Air Afrique – Notre Dame crossroads (integration of Ganhi market facilities) - section in front of the prefecture fence	 The existing cross-section has been thoroughly reviewed: A single two-way carriageway with 1x2 lanes at 3.5m wide each; A 1.0m wide cycle lane; On the left-hand side of the project: a car park with two parking areas, one in a herringbone and the other in crenellations. A 4m wide lane is built inside the car park to serve the parking areas; On the right-hand side, the gradual reduction in motorbike parking and the widening of the pavement; The greening of the artery by planting trees in alignments; Reorganization of the Notre Dame crossroads by removing all the existing blocks. Advantage: Consideration of the reduced footprint towards Pk 0+000 by a gradual drawdown of the main carriageway; Profile more compatible with the commercial function of the street; Better protection of pedestrians; Encouraging pedestrian traffic; Resumption of sanitation to ensure optimal drainage; Declaration and implementation of Zone 30. 	 Complete reconstruction of the road with all its amenities, Gradual folding of the main carriageway towards the intersection with Boulevard de la Marina; Demolition of fuel stations near the track but which are located in the administrative right-of-way.
Carrefour Air Afrique – Old Bridge	 > The existing cross-section has been completely redesigned: > A single two-way carriageway with 1x2 lanes 	• Complete reconstruction of the road with all its amenities

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Section 2:	at 3.5m in width each;	
Notre	> A 1.0m wide cycle lane;	
Dame – Old	> Two 60° herringbone parking lanes on either	
bridge	side of the road to provide more parking	
(removal of	space;	
the railway	> Two bilateral pavements of variable width with a	
inte)	minimum dimension of 9m, separated from the	
	loads by a loral barrier in the form of a nower box,	
	> The installation of public benches on the side	walks;
	> The greening of the artery by planting trees	
	in the alignments.	
	> Reorganization of the Notre Dame crossroads	
	by removing all existing blocks. Advantage: •	
	Decommissioning and removal of the existing	
	railway line, Profile more compatible with the	
	understanding of the road layout A Development	
	of parking areas A Reduced A traffic speed	
	Better protection of pedestrians	
	Encouragement of pedestrian traffic.	
	Resumption of sanitation to ensure optimal	
	drainage, Declaration and implementation of	
	Zone $30 \\le More conviviality with the installation$	
	of public benches.	
		Complete receptruction
	> The existing cross-section has been completely and prime due	of the road with all its
	completely redesigned.	amenities
	A single two-way carnageway with TX2 lapas at 2 Em wide each	
	alles at 5.511 wide each,	
	 A 1.011 wide cycle faile, Two C0° beging being here any king lange on either 	
	I wo ou herringbone parking lanes on either side of the read to provide more parking	
	side of the road to provide more parking	
	Space,	
	with a minimum dimension of 3m separated	
	from the roads by aesthetic metal barriers to	
	improve pedestrian safety.	
Carrefour Air	 Separation of the railway right-of-way by 	
Afrique - Old	wire mesh fences.	
bridge Section	> The greening of the artery by planting trees	
2: Carrefour	in alignments.	
Notre	> Reorganization of the Notre Dame intersection	
Dame – Old	by removing all existing islands. Advantage: •	
bridge	Isolation of the railway right-of-way for greater	
(Railway	safety; Profile more compatible with the	
maintenance)		
1	commercial function of the street, ♦ Better	
	commercial function of the street, ♦ Better understanding of the road, ♦ Development of	
	commercial function of the street, ♦ Better understanding of the road, ♦ Development of parking areas, Reduced ♦ traffic speed , ♦	
	commercial function of the street, ◆ Better understanding of the road, ◆ Development of parking areas, Reduced ◆ traffic speed , ◆ Better protection of pedestrians, ◆	

Resumption of sanitation to ensure optimal drainage, ◆ Declaration and implementation of Zone 30 ◆ More conviviality with the installation of public benches.

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Figure 55: Cross section for the section "Air Afrique Hub - Old Bridge/Section 1: Air Africa Hub - Notre Dame Hub" Source: CECO BTP technical document, May 2022









Figure 56: Cross section for the section "Carrefour Air Afrique – Ancien pont/Section 1: Carrefour Air Afrique – Carrefour Notre Dame (integration of the ganhi market developments) – section in front of the market car park" Source: CECO BTP technical document, May 2022



Figure 57: Cross profile for the section "Carrefour Air Afrique – Ancien pont/Section 1: carrefour Air Afrique – Carrefour Notre Dame (integration of the ganhi market developments) – section in front of the market" Source: CECO BTP technical document, May 2022





Figure 58: Cross profile for the section "Air Afrique Junction – Old Bridge/Section 1: Air Afrique – Notre Dame Junction (integration of Ganhi Market developments) – Prefecture Fence Section" Source: CECO BTP technical document, May 2022





Figure 59: Cross section for the section "Carrefour Air Afrique – Old bridge/ Section 2: Carrefour Notre Dame – Old bridge (removal of the railway tracks) Source: CECO BTP technical document, May 2022




Figure 60: Cross section for the section "Carrefour Air Afrique – Old Bridge/ Section 2: Carrefour Notre Dame – Old Bridge (Maintaining the Tracks) Source: CECO BTP technical document, May 2022

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7.2.1.7. Street N°17 "Carrefour Cheminot – Passage supérieur de Steinmetz" The works to be carried out and the characteristics of the road are as follows in Table 64:

Table 64: Works to be carried out and the characteristics of each road after the development of the street "Carrefour Cheminot – Passage supérieur de Steinmetz"

Axle Type	Characteristics	Work to be carried out
Carrefour Air Afrique – Old bridge Section 1: Carrefour Cheminot – Steinmetz overpass	 The existing cross-section has been maintained (two unidirectional carriageways with 2x2 lanes at 3.5m width for each lane, a 2m BAU also serving as a cycle lane, a straight pavement with a maximum width of 1m, and a wider left pavement. A central gutter acting as a TPC separating the two carriageways; Vandalized flower pots will be repaired for some, or replaced when the damage is significant; The maintenance of the GBA separators currently used to close the intersections between the primers and the main road. Advantage: No change of profile, Keeping the two carriageways separate, 	 Refurbishment or replacement of flower boxes on the TPC, Resumption of sidewalks

Source: Field data, May 2022

Figure 61 shows the cross-sections of this street.

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Figure 61: Cross section for the section "Carrefour Air Afrique - Old Bridge/ Section 1: Carrefour Cheminot - Steinmetz Overpass Source: CECO BTP technical document, May 2022

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7.2.1.8. Development to be carried out for the longitudinal profile With regard to the initial characteristics of the roads to be developed, the design of the longitudinal profile is made taking into account:

- the position of the transversal sanitation works;
- Surrounding TN profiles;
- the estimation of earth movements;
- minimum slopes to be granted with a view to good natural sanitation I,9;
- the moderation of steep gradients in order to have a maximum of 10%;
- the position of the plane curve for good coordination (a guarantee that visibility parameters are respected).

In general, the developments will take into account the existing ratings in order to generally agree with the threshold ratings entered from the riparians. Excavated material work is then preferred over backfill, which will be on a case-by-case basis. However, red line corrections must be made to comply with urban road standards.

7.2.1.9. Intersections Design standards In built-up areas, the development of the road in current sections is highly dependent on intersections; intersections often determine the circulatory capacity, they are the meeting point of several lanes and a place of conflict where the sharing of space between users is delicate. They also help to give rhythm to the space. These are strong elements of urban roads that can therefore lead to changes in the profile across the road, whether on the approach to the intersection or in the current section.

In conclusion, it is the crossroads that determine the flow capacity and not the current cross-section. The consistency between the cross-section and the flow capacity of the junctions must therefore be checked. The present study concerns existing urban roads, for which the intersections are already developed. The studies for a proposal for the developments therefore focused on the verification of capacities, the coherence of the types of intersections and the modes of operation. Some basic rules:

- Ordinary flat intersections are not allowed as soon as there are 2 lanes in the same direction in the current section. They are only possible on two-way carriageways with 2 lanes and when traffic is not too heavy.
- Grade-separated intersections and intersections with central island lights are not the most relevant on the 2 two-way lanes.
- The choice of the type of intersection is made according to multiple criteria:
 - o urban context (position in the hierarchical network, in the district);
 - o coherence (on the axis, in the agglomeration);
 - o urban functions (landmark, landscape) determined in the objectives;
 - o Available rights-of-way;
 - o Preferred operating objective for a type of user;
 - o Capacity objectives chosen and type of traffic (high presence of HGVs, bicycles, pedestrians);

- o security objectives;
- o financial resources.
- For a roundabout with 4 branches, traffic can be considered to be unbalanced when secondary traffic is less than 20% of the main traffic. In any case, if the main traffic is more than 10 times the secondary traffic, the roundabout is probably not the solution;
- The functional aspects that contribute to the choice of the type of intersection (See table 65)

Type de carrefour	Circulation générale (somme des trafics entrant limites)	Piétons	Cyclistes	Transports collectifs
Priorité à droite	Limitė à <mark>9</mark> 00 uvp/h	Traversée	Favorable	À éviter en présence de ligne TC
CLP et stop	Limité à 1 200 uvp/h	avec un trafic de plus de 800 uvp/h sur	à faible trafic	Donner dans la mesure du possible la priorité à la rue empruntée par le TC
Giratoire compact et mini-giratoire	Limité à 1 500 uvp/h		À privilégier	Sous réserve de la giration des bus
Grand giratoire	Limité à 5 000 uvp/h		Non favorable aux cyclistes	Étude spécifique pour les sites propres de TC
Carrefour à feux	Fonction du nombre de voies	Favorable pour les axes à fort trafic	Favorable pour les axes à fort trafic	À privilégier pour les tramways ou lignes fortes de bus
PSGR	En théorie pour cha- que voie :1 800 uvp/h	Interdit aux piétons	Interdit aux cyclistes	Accès interdit selon le gabarit de l'ouvrage

Table 65: Main functional aspects that contribute to the choice of the type of hub

Source: CECO-BTP technical document June 2022.

NB: CLP: Give way; PSGR: Reduced Gauge Overpass; PSGN: Overpass to Normal Gauge.

• Inventory – diagnostics – recommendations For the diagnostic study of intersections, a total of nineteen (19) major intersections are identified on all the roads of the ATC Lot ATC 01 project and distributed as follows:

- from a topographical point of view, 02 types of intersections are noted:
 - o flat intersections: 99% of intersections are of this type;
 - o uneven intersections: only one intersection of this type was recorded at Steinmetz
- From a geometric point of view, several shapes are observed:
 - o roundabouts and roundabouts: this is the most common type, a total of 9 roundabouts and roundabouts are located on the various axes;

- o the ordinary plane crossroads in the shape of a 'cross': 8 existing intersections are of this configuration;
- o ordinary flat crossroads in the shape of a 'T': a crossing of this type is noted;
- o the ordinary 'X'-shaped flat junctions: only the Air Afrique junction is of this choice.

From the analysis of the characteristics of the different intersections, we retain:

- > all the roundabouts encountered are classified as large roundabouts;
- the geometric designs of the roundabouts of the "Ancien pont Carrefour Le Aries" suffer from oversizing of the ring,
- the geometric designs of the roundabouts on the "Ancien pont Carrefour Le Bélier" axis show variations in the width of the ring;
- still on this axis, the entry and exit lanes are oversized and lack separations if the cycle lanes have to lead to the roundabout ring,
- > roundabouts generally have storage lanes that serve as stops for users,
- > the inlet and outlet radii are small;
- most branches of single-carriageway intersections do not have a traffic island when approaching the intersection,
- > the TPCs of the 2-carriageway branches sometimes overflow into the ring;
- > multiplicity of blocks at the Notre Dame crossroads,

> no supervision of TAG movements at ordinary level intersections of large rights-of-way, To make these intersections compliant and safe, the following activities will be carried out:

- > Correction of oversized rings by reducing widths and removing storage lanes,
- > Implementation of directional islands at the level of branches with single carriageways in accordance with standards and within the limits of the available rights-of-way,
- > Implementation of central islands at the level of the large ordinary flat intersections,
- > Folding of the BAU before insertion at the crossroads,
- In cases where the BAU is used as a cycle lane, then reduce the entry and exit lane of this cycle lane by inserting an island for pedestrian refuge.

Specifically, the characteristics of each roundabout are as follows:

Roundabout

SOBEBRA

- Three-branch roundabout
 + 1 branch only for the exit,
- Annular carriageway: 12m,
- Radius of the roundabout: 40 m
 Inner radius: 28 m
- North branch: 2x2 lanes with TPC.
- East Branch: 2x2 lanes with TPC,
- West branch: 2x2 lanes with TPC,
- South branch: 1x2 one-way lanes for exit
- Geometry of the baffled branches to reduce the speed before entering the roundabout
- Impassable central island,
- Presence of storage path in the ring

PK 3 roundabout

- 4-branch roundabout,
- Annular carriageway: variable from 6m to 12m
- Roundabout radius:29 m
- Interior radius: 17 m
- North branch: 1x2 lanes without island
- East Branch: 2x2 lanes with TPC,
- West branch: 2x2 lanes with TPC,
- South branch: 1x2 lanes without island
- Impassable central island,
- Presence of storage path in the ring



With a roundabout radius of 40m, this intersection is classified as a large roundabout. With a width of 12m for the ring, and an entry and exit lane of 10m; this roundabout is poorly designed and does not meet CEREMA standards. It is decided to:

- Draw the BAU before the crossroads, both at the entrance and at the exit,
- reduce the width of the ring to 9m by increasing the width of the central island
- reinforce the roundabout with traffic control lights to meet the capacity
- Removed the storage area in the ring.



With a roundabout radius of 29m, this intersection is classified as a large roundabout. With a width of 12m for the ring, and an entry and exit lane of 10m; this roundabout is poorly designed and does not meet CEREMA standards. It is decided to:

- Draw the BAU before the crossroads, both at the entrance and at the exit,
- reduce and standardize the width of the ring to 9m by increasing that of the central island and removing the island heads from the main branches
- reinforce the roundabout with traffic control lights to meet the capacity
- Removal of the storage path present in the ring
- provide directional islands on secondary branches

Ancient bridge - SOBEBRA crossroads - OPT PK3 crossroads - Bélier crossroads

Japan Motors Roundabout

- 4-branch roundabout,
- Annular carriageway: variable from 6m to 12m
- Roundabout radius:29 m
- Interior radius: 17 m - North Branch: 1x2 lanes

without island

- East Branch: 2x2 lanes with TPC,
- West branch: 2x2 lanes with TPC,
- South branch: 1x2 lanes without island
- Impassable central island,
- Presence of storage lane poorly



With a roundabout radius of 29m, this intersection is classified as a large roundabout. With a width of 12m for the ring, and an entry and exit lane of 10m; this roundabout in the ring is designed and does not meet CEREMA standards. It is decided to:

- Draw the BAU before the crossroads, both at the entrance and at the exit,
- reduce the width of the ring to 9m by increasing the width of the central island
- reinforce the roundabout with traffic control lights to meet the capacity
- Removed the storage area in the ring.
- Provide directional islands on the secondary branches of the roundabout



With a roundabout radius of 29m, this intersection is classified as a large roundabout. With a width of 12m for the ring, and an entry and exit lane of 10m; this roundabout is poorly designed and does not meet CEREMA standards. It is decided to:

- Draw the BAU before the crossroads, both at the entrance and at the exit,
- reduce the width of the ring to 9m by increasing the width of the central island
- reinforce the roundabout with traffic control lights to meet the capacity
- Removed the storage area in the ring.
- Provide directional islands on secondary branches

Slaughterhouse roundabout

- 3-branch roundabout,
- Annular carriageway: variable from 6m to 12m
- Roundabout radius:29 m
- Interior radius: 17 m
- North branch: 1x2 lanes without island
- East Branch: 2x2 lanes with TPC,
- West branch: 2x2 lanes with TPC,
- South branch: 1x2 lanes without island
- Impassable central island,
- Presence of storage path in the ring

Le Bélier roundabout

- 4-branch roundabout,
- Annular carriageway: variable from 6m to 12m
- Roundabout radius:29 m
- Interior radius: 17 m - North Branch: 1x2 lanes

without island

La Roche roundabout - 6-branch roundabout.

corners (R = 18.50 m)

TPC.

Rectangular roundabout of dimensions:
 L = 86 m, W = 38 m, rounded at the north corners (R = 20 m) and at the south

Annular carriageway: 11.45m;
North branch: 1x2 lanes without island,
East branch: 2x2 lanes with TPC,
West Branch: 2x2 lanes with

- South-west branches: 1x2

them and the crossroads;

Impassable central island,

South Branch: 2x2 lanes with TPC
 Geometry of the west and east

branches in the form of a chicane

to avoid a large deflection between

lanes with islands

- East Branch: 2x2 lanes with TPC,
- West branch: 2x2 lanes with TPC,
- South Branch: 2x2 lanes with TPC
- Impassable central island,
- Presence of a storage road, poorly



With a roundabout radius of 29m, this intersection is classified as a large roundabout. With a width of 12m for the ring, and an entry and exit lane of 10m; this roundabout in the ring is designed and does not meet CEREMA standards. It is decided to:

- Draw the BAU before the crossroads, both at the entrance and at the exit,
- reduce the width of the ring to 9m by increasing the width of the central island
- reinforce the roundabout with traffic control lights to meet the capacity
- Removed the storage area in the ring.

Third bridge - SOBEBRA crossroads



Roundabout of particular shape, solution of visibility problems and large deflections at the level of the branches.

Perfectly sized crossroads. No changes planned

Place du Souvenir - Carrefour 3 Banques

Carrefour plan ordinaire / SONEB

- 4-branch crossroads,
- No specialized TAG or DRT routes
- Presence of TPC on the main branches
- TPC stop before the intersection to facilitate TAG movement
- North branch: 1x2 lanes without island,
- East branch: 2x2 lanes with TPC,
- West Branch: 2x2 lanes with TPC,
- South branch: 1x2 lanes without island
- Perfect crossroads with crosses of the branches at right angles.

Crossroads of ordinary map / Military Navy

- 4-branch crossroads;
- No specialized TAG or TAD;
- Presence of TPC on the main branches:
- TPC stop before the intersection
- to facilitate movement TAG
- North branch: 1x2 lanes without island;
- East branch: 2x2 lanes with TPC,
- West Branch: 2x2 lanes with TPC:
- South branch: 1x2 lanes without island
- Perfect crossroads with It is the crossing of two inter-district roads, the ordinary crossroads of branches works perfectly and complies with standards.

right angles. No specific layout recommended



It is the crossing of two inter-district roads, the ordinary flat intersection works perfectly and complies with standards. No specific layout recommended

Ordinary map crossroads / Water Directorate

- 4-branch crossroads;
- No specialized TAG or
- TAD;
- Presence of TPC on the main branches;
- TPC stop before the intersection
- to facilitate movement TAG
- North branch: 1x2 lanes without island;
- East branch: 2x2 lanes with TPC,
- West Branch: 2x2 lanes with TPC;
- South branch: 1x2 lanes without island;
- Perfect crossroads with crosses of the branches at right angles.
- Perfect crossroads with This is the crossing of two inter-district roads, the ordinary flat crossroads works perfectly and complies with standards.

No specific layout recommended

Carrefour plan ordinaire / 3 Banks

- 4-branch crossroads;
- No specialized TAG or TAD:
- Presence of TPC on the main branches;
- TPC stop before the intersection to facilitate TAG movement
- North Branch: 2x2 lanes with TPC;
- East branch: 2x2 lanes with TPC,
- West Branch: 2x2 lanes with TPC;
- South branch: 2x2 lanes with TPC;



It is the crossing of two inter-district roads, the ordinary flat intersection works perfectly and complies with standards.

crossing of the branches in Given the large footprint of the crossroads, and to discipline the movements at right angles. of TAG, the following are retained:

to develop a crossable central island

Carrefour Marché Saint Michel – Carrefour NASUBA – Echangeur Steinmetz – Carrefour Notre Dame

Roundabout / Saint Michel market

- 4-branch roundabout;
- Annular carriageway: 11.50m;
- Radius of the roundabout: 26.50 m;
- Interior radius: 15 m; -North branch: 2x2 lanes with TPC:
- East Branch: 2x2 lanes with TPC;
- West branch: 2x2 lanes with TPC;
- South branch: 2x2 lanes with TPC;
- Roundabout with roundabout. crossing of the 'X';
- Impassable central island,
- Presence of storage track in the ring.

Ordinary Map/ Nasuba Crossroads

- 4-branch crossroads;
- No specialized TAG or DRT tracks with the exception of the TAG track on the southern branch;
- Presence of TPC on all branches
- TPC stop before the intersection to facilitate TAG movement;
- North branch: 2x2 lanes with TPC;
- East Branch: 2x2 lanes with TPC;
- West branch: 2x2 lanes with TPC,
- South branch: 2x2 lanes with TPC;
- Perfect crossroads with crosses of the branches at right angles.



With a roundabout radius of 26.50m, this intersection is classified as a large branches in With a width of 11.50m for the ring, and an entry and exit lane of 10m; that The roundabout is poorly designed and do not meet CEREMA standards. It is decided to:

- reduce the width of the ring to 9m by increasing the width of the central island
- review the entry and exit radii of the branches to facilitate insertions
- reinforce the roundabout with traffic control lights to meet the capacity
- Removed the storage area in the ring.



It is the crossing of two inter-district roads, the ordinary flat intersection works perfectly and complies with standards.

Given the large footprint of the crossroads, and to discipline the movements of the TAG, it is retained:

To develop a crossable central island.

Carrefour Marché Saint Michel – Carrefour NASUBA – Echangeur Steinmetz – Carrefour Notre Dame

Carrefour plan ordinaire / Missèbo

- 4-branch crossroads;
- presence of specialised TAG routes on the main branches (North and South branches);
- Presence of TPC on all branches;
- TPC stop before the intersection to facilitate TAG movement;
- North branch: 2x2 lanes with TPC;
- East Branch: 2x2 lanes with

TPC; It is the crossing of two inter-district roads, the ordinary flat crossroads

- West branch: 2x2 lanes works perfectly and complies with standards. with TPC; Given the large footprint of the crossroads, and to discipline the movements of the
- South branch: 2x2 lanes with TAG, it is retained:
- TPC; To develop a central island that can be crossed
- Perfect crossroads with crosses of the branches at right angles.

Ordinary crossroads "Lycée Coulibaly"

- 4-branch crossroads;
- presence of specialised TAG routes on the main branches;
- Presence of TPC on the main branches;
- TPC stop before the intersection to facilitate TAG movement;
- East & West branch: 1x2 lanes without island;
- South & North branches: 2x2 lanes with TPC;
- Perfect crossroads with crosses of the branches at right angles.





It is the crossing of two inter-district roads, the ordinary flat intersection works perfectly and complies with standards. No specific layout recommended

Carrefour Marché Saint Michel – Carrefour NASUBA – Echangeur Steinmetz – Carrefour Notre Dame

Carrefour plan ordinaire 'ex FITHEB'

- 4-branch crossroads;
- presence of specialised TAG routes on the main branches;
- Presence of TPC on the **main** branches;
- TPC stop before the intersection to facilitate TAG movement;
- East & West branch: 1x2 lanes without island,
- South & North branches: 2x2 lanes with TPC;
- Perfect crossroads with crosses of the branches at right angles.

Steinmetz Overpass

- Composed of 2x2 lanes.



It is the crossing of two inter-district roads, the ordinary flat intersection works perfectly and complies with standards. No specific layout recommended



Carrefour 3 Banques - Carrefour Air Afrique

Ordinary 'Air Afrique' crossroads

- 4-branch crossroads;
- no specialized routes TAG;
- all branches are single-carriageway;
- 'X' junction.



- Setting up directional islands at the level of secondary branches
- Provide a mini island that can be crossed on the main branch (Air Afrique – Old Bridge axis)

Carrefour Air Afrique – Old Bridge

Carrefour plan ordinaire 'Notre Dame

- Carrefour with 3 branches, one of which comes from the PSGN in Steinmetz;
- presence of specialised TAG lanes on all • branches;
- all branches are in 2x2 lanes as you approach the crossroads;
- 'T' junction;
- Multitudes of islands adding confusion.



- Review all blocks in order to simplify the intersection
- Provide a mini island that can be crossed on the main branch (Air Afrique – Old bridge axis)

Carrefour Cheminot - Steinmetz overpass

Steinmetz roundabout

- 4-branch roundabout;
- Annular carriageway: 10 m;
- Radius of the roundabout: 25 m;
- Interior radius: 15 m;
- All branches are in 2x2 lanes with TPC;
- Roundabout with crossing of the branches in a cross;
- Impassable central island.



With a roundabout radius of 25m, this intersection is classified as a large roundabout. With a width of 10m for the ring, and an entry and exit lane of 10m; this roundabout perfectly meets CEREMA standards

RAS

7.2.2. Project Implementation Activities

The development work of the Cotonou arteries and crossings on behalf of Lot 1 will be carried out in three (03) phases, namely: the preparation phase, the construction phase and the operation and maintenance phase of the structures.

7.2.2.1. Preparation phase This phase includes all the activities prior to the start of construction work on the structures. These are the activities to raise awareness among the population for the clearing of the project's rights-of-way, the relocation of the various networks (SBEE, SONEB and telephone) located on the right-of-way, the installation and development of technical bases and the identification and development of diversion routes.

7.2.2.2. Construction phase At this phase of the project, the rehabilitation of the arteries and crossings concerned is concerned. This phase includes the activities of supplying construction materials and equipment to the construction sites, the deconstruction and construction of roads as planned, the installation of signage and lighting equipment, the implementation of landscaping and then the withdrawal of the site and redevelopment of the technical bases

7.2.2.3. Operation and maintenance phase of the structures As its name suggests, this is the commissioning of the related structures and facilities once the developments have been completed and accepted. To ensure the sustainability of the facilities put in place, a maintenance programme will be set up, in particular for the flower garden trees, lighting and signage to be put in place.

All these activities of the project to be carried out constitute sources of impact for the various components of the environment, whose impacts will be identified, analysed and then evaluated in order to propose appropriate mitigation measures for a viable project from all points of view

7.2.3. Summary of activities, source of impact

Table 66 presents a summary of the impact activities by implementation phase

Table 66: Relationship between project activities and the main expected nuisances

Project Phase Impact Activities

Raising awareness am right-of-way and inform	ong the population for the clearing of property located in the ning stakeholders for the relocation of the networks Preparation		
phase Installation of technical bases and release of the roads to be developed			
Identification and deve	lopment of diversion routes Deployment of construction materials		
and equipment on the	axes Rehabilitation and development of the axes Installation of		
horizontal and vertical	signage and equipment construction phase Planting of alignment		
trees and installation of other landscaping			
Withdrawal of the site	and redevelopment of the technical bases		
Acceptance and comr	nissioning of the axes Operation and maintenance		
phase			

Source: CECO BTP fieldwork, June 2022

7.2.4. Types of waste to be generated on the site

The implementation of this road infrastructure development project will result in the production of several types of waste. They will be subject to a specific treatment method that complies with standards. Table 67 presents this waste and how it is managed.

Table 67: Type of site waste and its management method

N° C	N° CATEGORIES OF WASTE MANAGEMENT METHOD ENVISAGED			
1	Solid and Household Waste Solid and I Collected in specific bins and entrusted	Household Waste Collected in specific bins and entrusted to to to (DSM) (DSM) (DSM) approved structures for their disposal		
2	Non-hazardous waste (tyres and non-haz non-hazardous waste (tyres and waste, u used equipment, etc.)	zardous waste (tyres and sed equipment, etc.),		
3	Biomedical waste (MBW) Biome Collected in specific bins and sig their disposal	edical waste (MBW) Biomedical waste (MBW) gning of a contract with an approved structure for		
4	Used oil	Collected in drums placed on watertight platforms and then entrusted to approved management structures		
5	Rubble and frezat debris	Valued for the development of rural neighbourhood paths in collaboration with local elected officials		

Source: CECO BTP field data, June 2022

8. STAKEHOLDER ENGAGEMENT AND PUBLIC CONSULTATION

8.1. Reminder of the process of involving the public in the process of drawing up the ESIA/RAP

The participation of the public in the process of implementing the Resettlement Action Plan (RAP) of the people affected by the Cotonou Access and Crossings Development Project (ATC) Lot 1 was carried out in several stages ensuring a wide involvement of different actors, local populations likely to be affected as well as the beneficiary authorities.

Indeed, the public consultations carried out at the National Road Safety Centre (CNSR), the Directorate General for Environment and Climate (DGEC), the City of Cotonou as well as in the various Districts of the administrative jurisdiction of lot 1 of this project, were based on a communication strategy aimed at informing stakeholders on the activities that will be carried out during the implementation of the project. They took place in three stages:

- Step 1: Present to the stakeholders (beneficiary populations, local authorities, elders and notables of each locality, etc.) the context and the work to be carried out within the framework of the Cotonou Access and Crossings (ATC) road development project.
- Step 2: Present the schedule and arrangements for the Census of Persons Affected by the Project (PAP)
- Step 3: Outline the potential impacts (positive and negative) of the implementation of the project activities and some mitigation or enhancement measures.
- Step 4: Collect the opinions, concerns, grievances and recommendations of the various stakeholders.

8.2. Stakeholder engagement

8.2.1. Overview of the commitment of the project stakeholders and the objectives As part of the collection of the firm commitment of the stakeholders in the realization, management and benefit of the project, the consultations were aimed at raising awareness and then collecting the formal commitment of the stakeholders in the ESIA/RAP process. An overview of the key issues raised by stakeholders was summarized as well as an overview of the stakeholder engagement activities that will be undertaken in the future by the State during the construction and operation of the ATC 1 project.

A Grievance and Complaint Management (PMM) mechanism has also been developed as part of the ESIA process and is detailed in the Action and Resettlement/Compensation Plan that accompanies this ESIA report.

All commitments were carried out in a socially appropriate manner, involving people's representatives in the preparation of meetings and taking into account the participation of women.

Public participation in the environmental assessment process is a necessary phase to involve the beneficiary populations and any other stakeholders in the implementation of projects.

Stakeholder engagement is a key element of sustainable development and the ESIA process. It indicates that stakeholders interested in or affected by the development proposal are working to actively identify opportunities, risks and issues of concern. The main objectives of stakeholder engagement are:

- Ensure that adequate and timely information on the project is provided to stakeholders;
- Provide sufficient opportunities for stakeholders to express their opinions and concerns, and ensure that these concerns influence project decisions.
- establish a relationship and a form of communication between the project and the affected populations, in particular during the implementation phase of the project, and;
- Stakeholder engagement is a requirement of Benin's ESIA regulations. It is also a requirement of the many international financial partners, as it is recognized that the lack of stakeholder engagement can create significant risks for the development of a project.
- 8.2.2. Stakeholder Identification and Mapping

Stakeholders are defined as individuals or groups that may influence or be affected by the project, as described below:

A stakeholder means any person, group of persons or organisation on whom the Project (or activity) has a potential or actual impact, direct or indirect, positive or negative; or that has a potential or actual impact, direct or indirect, positive or negative on the Project (or activity).

8.2.3. Identification of Stakeholders The objective of stakeholder identification is to determine which organisations and individuals may be directly or indirectly affected (positively or negatively) by or have an interest in the project. This ongoing process involves regular reviews and updating of the stakeholder register as the project evolves.

Stakeholders identified at this stage as part of the engagement activities meet the following criteria:

- have an interest in the Project;
- could be affected by or influence the Project (negatively or positively); or,

• Could provide comments related to issues and concerns about the Project.

Table 68 provides an overview of the types of stakeholders identified for the purposes of the ESIA and the associated consultation process, and those affected by the CTA project.

Table 68: List of Categories of Stakeholders

Categories and Stakeholder Groups Link to	the Project	Stakeholders
Central Government (Ministries and Structures under supervision)	The Central Government has a major political importance for the project in terms of policy development, the allocation of permits or other official decisions, as well as the monitoring and enforcement of Beninese law at all phases of the project. The most important bodies within the Government of the Republic of Benin are the following: the Ministry of Infrastructure and SIRAT, which are the project owners.	 Competent Authorities Government of the Republic of Benin (Project Leader) Ministry of Infrastructure and Transport (MIT/ SIRAT SA) (Contracting authority) Directorate General of Infrastructure (DGI) General Directorate of Housing and Construction (DGHC) National Road Safety Centre (CNSR) Local Structures
Local Authorities (Regional, Communal and District s)	The municipalities and districts have basic infrastructure, collect taxes and implement plans and programmes for appropriate land use planning. Each district has a local council whose members are elected by the citizens and which makes them directly accountable to the populations they represent. Six (06) local authorities are concerned by the districts associated with the project: Arrondissement 1st , 2nd, 4th 5th 7th 12th in particular.	 Director of Technical Services of the Cotonou City Hall Heads of the 1st Arrondissements, 2nd, 4th⁻ 5th⁻ 7th⁻ 12th⁻ in particular; Local councillors of the^{1st} arrondissements. Arrondissements 1, 2, 4 5⁻ 7th⁻ 12th⁻ in particular; Departmental Directorate of Living Environment and Sustainable Development (DDCVDD) of the Atlantic and of the Littoral; Atlantic and Coastal Forest Inspectorate; Utility companies:
Representatives of Local Communities	These are the representatives of the neighborhoods at the level of the Arrondissements crossed by the project. They are key local figures.	Local Elected Officials: The Chiefs of the Neighborhoods of the 1st , 2nd, 4th [,] 5th ^{Arrondissements,} 7 [,] 12th [,] in particular.
	Organisations directly interested in or contributing through their activities to safety in relation to the project and its impacts	 Representative of the Association of Development Associations

Civil society groups such as community-based organizations	environmental and social issues, capable of influencing it directly or through public opinion.These organisations can also share useful data and ideas and become partners in the project in areas of common interest such as the identification of spaces for remote sites, the security of goods and people, etc.	 Representative of NGOs defending road safety Driver representative
Public/private companies that are also developing large-scale infrastructure projects or whose project activities depend	Public and private sector companies that may be directly or indirectly affected by the project and its activities.	 Benin National Water Company (SONEB) Beninese Electric Energy Company (SBEE)
on them Potentially affected communities/groups	Interest groups may be directly or indirectly affected by the proposed project and its activities. They will need to be kept informed of the Project in its design phase and of the planned activities, as well as the risks and benefits to themselves and their livelihoods. This will include taking into account the views and concerns of these key groups within the community, especially driver managers and representatives. In addition, vulnerable groups could also be affected by the project, in view of their precarious social or economic status, their low level of activity (capital, cost of activities) and their difficulty in accessing employment in connection with their precarious economic activities.	 Road users and Drivers' associations in Cotonou; General public (in particular road users within the Zone of Influence, which is of regional and national interest due to the arteries identified by the project).
Media	The local media generally exert greater influence on the project and can be called upon to influence the perceptions of local stakeholders towards it, but especially in the preparation and construction phase of the infrastructure.	 ORTB National Television CAPP FM radio TOKPA Radio

Spring: CECO-BTP, Fieldwork June 2022

8.3. Stakeholder Analysis

The systematic analysis of the stakeholders of the CTA project of Lot 1 allows for a better understanding of the concerns to develop an appropriate engagement approach. This action describes how different actors are assessed according to their anticipated level of interest and associated themes, as well as their role in processes that may affect activities. This mapping exercise was based on CECO-BTP's mastery of the project area, the Detailed Preliminary Design (APD) and the expertise of its associated consultants.

The stakeholder mapping was established on the basis of the following benchmarks:

• Influence on the Project: Influence refers to the power that the various actors have over the decisions made by or affecting the project. This power may take the form of formal control over the project's decision-making process, or it may be informal through opposition, blocking or authorizing the continuation of project operations. It is also important to map the stakeholders whose interests define them as such, because of their direct involvement in the project or what they would gain or lose. Understanding their level of interest can provide a better understanding of the motivations of the various stakeholders and how they could influence the project;

• Interest in the Project : Interest is understood to be the link between the stakeholders and the project. For example, they might have something to gain or lose from the execution of the project. Understanding their level of interest can provide a better understanding of the motivations of the various stakeholders and how they could influence the project.

The opinions of the various stakeholders are likely to change over time as the project evolves in its management life. The influence, interest and perceptions of the different actors will be reassessed and updated according to needs. In addition, all new players will be included in the analysis.

National and local authorities, given their important influence and interest, as well as institutions/agencies have requirements focused on the protection of the environment, compliance with applicable texts and laws, etc. The people whose activities and properties will be affected, as well as the populations located along the identified roads as a whole, will have a greater interest in social protection and their influence is considered medium. Users and populations at the local level have an interest in the project but their influence remains low to medium, generally focused on employment, the development of side roads and neighbourhoods, etc. The media must/can exert a great influence on the project, given the large audience they can reach depending on their audience.

8.4. Summary of the grievances and concerns expressed by the population, managers and authorities

The public consultations allowed the various stakeholders (populations, executives, local and municipal elected officials, etc.) concerned by the project to have access to technical information relating to the planned works, to have an idea of the activities, the likely impacts during the construction and operation phase of the roads as well as the Complaint Management Mechanism (MGP) during the implementation of the various works. These different actors also expressed their opinions, grievances or recommendations.

The summary of the various consultations is grouped here according to the actors by highlighting the questions, the answers provided and the recommendations of the latter.

The various lists and minutes are annexed to this report.

8.4.1. Consultation of the institutional actors of the National Road Safety Centre (CNSR)

It took place on Tuesday, May 25, 2022 in the conference room and was attended by 11 people.

A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 69.



Plate 7: Exchange session with the CNSR executives Source: CECO-BTP, May 2022.

Table 69: Summary of the public consultation at the CNSR

Actors	Summary of concerns and concerns raised	Responses to Concerns Expressed	Summary of grievances and recommendations
Managers and technical staff of the centre.	 Congratulations to the team in charge of the study of this ATC project for having included the CNSR among the actors to be consulted. Since then, the CNSR has not often been consulted in track construction projects. This is a serious mistake that consultants often make. The project should take into account the arrangements to be made for the planting of trees along the tracks The company in charge of the execution of this project should be aware of the speed calming tools in order to know the type of development to be put in place. The CNSR must be consulted beforehand for support in the context of a technical road safety report before the implementation of the project. For the installation of signs along the roads to be developed, materials adapted to the Beninese environment must be used in order to 	 The CNSR, being a road safety centre, must necessarily be consulted in the context of the studies of the road construction projects to collect recommendations for the necessary measures to be taken in the construction of the roads to guarantee a better safety of circulation for users. A team of experts is working on the arrangements to be made for the planting of trees along the tracks. Recommendations will be made in this study for the company to take adequate measures within the framework of the speed moderation tools to be put in place when the lanes are being developed. In the context of this project, the CNSR's support will often be requested on issues related to road safety prevention. Recommendations will be made to the company that will be responsible for carrying out the work on the types of panels to be used to avoid cases of theft. Adrangements will be made to separate the carriageways from the cycle paths in the implementation of the project. Adequate diversion plans will be identified and well maintained to allow the free movement of people during the development of the roads and crossings of Cotonou. 	 Made Conduct a road safety study to identify the issues that arise. Familiarize yourself with road safety standards for the planting of trees along the tracks Develop a detour plan and maintain the detour routes. Take measures to regulate local traffic on cycle paths.

Actors	Summary of the concerns and concerns raised to avoid cases	Responses to Concerns Expressed	Summary of grievances and recommendations
	 of theft of panels, especially aluminum. Provisions must be made to separate the carriageways from the cycle paths in the implementation of the project. Identify and maintain adequate secondary diversion plans 		made

Source: CECO-BTP, fieldwork June 2022

8.4.2. Consultation with the Directorate-General for the Environment DGEC/DPCE

The consultation with the Directorate-General for the Environment DGEC/DPCE took place on Tuesday, May 25, 2022 at the DPCE office and was attended by 7 people, including two women and five men.

A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 70.



Plank 8: Exchange session with the executives of the DGEC/DPCE Spring: CECO-BTP, May 2022.

Actors	Summary of the concerns and concerns raised Analyze the	Responses to Concerns Expressed	Summary of grievances and recommendations
Managers and Technical Staff	 linkage of this project with the existing development projects in the area (northern Cotonou bypass, western bank of Ganhi, port terminal, etc.) To approach all the competent services in the context of human mobility in Cotonou to collect the information necessary for the realization of this project. Propose adequate sanitation solutions to avoid hindering the normal operation of coastal protection structures Take into account existing previous geotechnical studies in order to propose developments in accordance with the geotechnics of each area Carry out the Action Plan for the resettlement of people affected by the project so as not to create frustration among the population. 	 The studies under this project will take into account studies on previous track projects for full harmonization. As the city of Cotonou is a major hub of human mobility, the experts of the studies will approach the competent services to collect the information necessary for the realization of this project. This project will not change the existing remediation plan. This project only concerns the development of access roads and crossings to Cotonou. The assets that are found in the project right-of-way will be inventoried and a compensation proposal will be made as part of this study 	made • Carry out the studies within the framework of the project taking into account the suggestions of the various stakeholders.
Spring: CECO-BTP, fieldwork June 2022			

Table 70: Summary of the public consultation at the DGEC/DPCE

8.4.3. Public consultation in the 4th District of Cotonou

The meeting in the^{4th} District of Cotonou took place on Tuesday, May 25, 2022 at the conference room of the said District and was attended by 46 people. A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 71.



Plate 9: Exchange session with the populations of the 4th Arrondissement Source: CECO-BTP, May 2022.

Actors	Summary of concerns and concerns		Summary of grievances
	raised	Responses to Concerns Expressed	and recommendations
Local elected officials, municipal councillors, populations	 The project should take into account the compensation of the people who will be affected, because on some projects currently being implemented, some people have not been compensated so far. The 4th arrondissement had not benefited from asphalting. This project should include this component in its implementation phase. During the execution of certain construction projects, it is sometimes noted that the local workforce is not integrated. The present project should take into account the local workforce as much as possible in its implementation. After the rehabilitation of the roads and crossings of Cotonou, it is necessary to analyze the types of tree plans to be planted. Because there are some trees that develop their roots too much and that contribute to the degradation of roads. This project should not make paved lanes at the level of cycle paths. Because motorcyclists abandon their lane, often fleeing the paid ones to find themselves in the lanes of passage of vehicles. This increases the risk of traffic accidents. 	 In the context of this project, there will be no buildings to be broken down, therefore there will be no people to move. It is certainly certain public and private assets that will be affected by the project. And the experts are hard at work on the feasibility study. The Cotonou access road and crossings project is different from the asphalting project. Here we are talking about road arteries and not secondary roads. In addition, it must be recognized that the asphalting project over time could not cover all the districts of Cotonou. We can't wait for other projects to satisfy the remaining districts. The present study will necessarily recommend that the local workforce be taken into account during the execution of the project. As part of this project, the cycle paths will also be paved and unpaid. Experts are working hard to analyse in depth the types of tree plans to be planted to avoid the destruction of pavements due to the development of plant roots. 	 Prioritize local labor when carrying out the work. Associate CAP FM radio for the awareness of the population and road users. Place suitable plants near the paths so that the development of their roots does not degrade the paths. To allow local residents to benefit from the excavated sand and the maintenance of secondary roads.
Spring: CECO	-BTP, fieldwork June 2022		

Table 71: Summary of the public consultation in the 4th District of Cotonou

8.4.4. Consultation with the Departmental Directorate for Living Environment and Sustainable Development (DDCVDD) Atlantique-Littorale

The meeting with the Departmental Directorate of Living Environment and Sustainable Development (DDCVDD) Atlantique-Littorale took place on May 27, 2022 in Abomey-Calavi at the office of the Departmental Director and was attended by six people.

A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 72.



Plate 10: Exchange session with the executives of the DDCVDD Atlantic-Littorale Source: CECO-BTP, May 2022.

Table 72: Summary of the session at the DDCVDD Atlantique-Littoral

Actors	Summary of the concerns and concerns raised	Responses to Concerns Expressed	Summary of grievances and recommendations made
Director and his collaborators	 To approach all the competent services in the context of human mobility in Cotonou to collect the information necessary for the realization of this project. Propose adequate sanitation solutions to avoid hindering the normal operation of coastal protection structures Take into account existing previous geotechnical studies in order to propose developments in accordance with the geotechnics of each area Carry out the Action Plan for the resettlement of people affected by the project so as not to create frustration among the population. 	 The studies under this project will take into account studies on previous track projects for full harmonization. As the city of Cotonou is a major hub of human mobility, the experts of the studies will approach the competent services to collect the information necessary for the realization of this project. This project will not change the existing remediation plan. This project only concerns the development of access roads and crossings to Cotonou. The assets that are found in the project right-of-way will be inventoried and a compensation proposal will be made as part of this study 	 Raising awareness among the population for good waste management during the implementation of the project Search for and identify a priori the places for the living quarters and the rubble deposit areas for a good connection for rainwater Think about the alignment of this project with the development projects underway in Cotonou for good overall management Ensure the management of socio-community and other services, including private works that are within the project's right-of-way

8.4.5. Consultation at the Cotonou City Hall

The high-level meeting with the municipal authorities of Cotonou took place on Friday, June 03, 2022 at the conference room of the said City Hall in the effective presence of the Second Deputy Mayor of Cotonou and the Executive Secretary (SE), in the presence of some District Chiefs and was attended by 16 people.

A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 73.



Plank 11: Exchange session with the executives of the Cotonou City Hall Spring: CECO-BTP, June 2022.

Table 73: Summary of the session at the Cotonou City Hall

 In this study, recommendations will be made to the City Hall in the recruitment during the execution of the work force in the recruitment during the execution of the population of Cotonou? What are the compensatory measures for the economic activities of the populations that will be affected by the project? Why do companies not involve local authorities at various levels will be called upon during the work for a better realization and management of the plans of the bypass roads as well as for a better realization and roften not suitable, very often the workers are not equipped; Maintenance aspect of sanitation structures; all the slabs are broken and often not suitable, very often the workers are not equipped; At the time of the flood, the Sodjéatime - Ciné-concorde crossroads axis was difficult to navigate. Why does the project not take this path into account? Some roads in Cotonou lack lighting. Does the project include a good road lighting plan? In this study, recommendations will be made for a solution is uncertained of the solution of the age of the solution of the age of the solution of the age of the solution of the cooperation that must prevail of the cooperation that must prevail between local authorities and companies; The ATC project for the moment does not take into account all the arteries of Cotonou. This project will provide a good plan for to add lighting plan? 	Actors	managers of the City Hall Summary of the concerns and concerns raised	Responses to Concerns Expressed	Summary of grievances and recommendations made
Source: CECO RTP. fieldwork June 2022	Municipal elected officials and technical	 Could the project give an important place to the local workforce in the recruitment during the execution of the works to benefit the population of Cotonou? What are the compensatory measures for the economic activities of the populations that will be affected by the project? Why do companies not involve local authorities for a better realization and management of the plans of the bypass roads? Maintenance aspect of sanitation structures; all the slabs are broken and often not suitable, very often the workers are not equipped; At the time of the flood, the Sodjéatinmè – Ciné-concorde crossroads axis was difficult to navigate. Why does the project not take this path into account? Some roads in Cotonou lack lighting. Does the project include a good road lighting plan? 	 In this study, recommendations will be made to the companies in charge of carrying out the work for priority to local labour with equal skills. A socio-economic survey is carried out as part of the study on the present project to identify all the people affected by the project so that compensatory measures can be taken into account during the implementation of the project. Local authorities at various levels will be called upon during the work for a better identification of bypass roads as well as for many other things within the framework of this project. A good recommendation will be made for better maintenance of sanitation works. The issue of rubble is very important but is the result of the cooperation that must prevail between local authorities and companies; The ATC project for the moment does not take into account all the arteries of Cotonou. This project will provide a good plan for road lighting. 	 Involve the City Hall in the recruitment of the local workforce by submitting to local elected officials the positions and profiles to be filled. Make rubble available to the local authorities for the needs of the municipality Approach private owners for the spaces of the technical base facilities Think about standardizing the layouts for a better investment in a sustainable development vision Submit bypass plans to authorities prior to implementation Integrate available mobility studies into the facilities To see as far as possible with the SGDS-GN the options for the maintenance of the gutters in collaboration with the Town Hall Respect the watering frequencies of the bypass roads and carry out their regular maintenance.

8.4.6. Public consultation in the 12th District of Cotonou

The meeting with the authorities of the 12th Arrondissement took place on Friday, June 03, 2022 at the conference room of the district and was attended by 9 people.

A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 74.





Plate 12: Session in the 12th District of Cotonou Source: CECO-BTP, June 2022

 Head of Arondissements, district chiefs Summary of the Summary of the What measures have been taken to limit speed on local traffic and cycle paths? What measures have been taken to limit speed on local traffic and cycle paths? Source: CECO-BTP, fieldwork June 2022 Note State 2022 	Actors	concerns and concerns raised	Answers the concerns expressed	Summary of grievances and recommendations made
	Head of Arrondissements, district chiefs Summary of the Source: CECO-F	 What measures is taken by the research firm to bring the information to the population? local residents; In the event that the successful bidder does not comply with the procedures, to whom can one complain; What will become of the women fruit sellers located at the level of ASECNA. What percentage of young people to be recruited per arrondissement or district that a board of directors can propose? What measures have been taken to limit speed on local traffic and cycle paths? How much excavated material would go to the local authorities for the closure of flooded roads in the streets. 	 Information on the project is currently being provided on the radios and investigators are on the ground; Excavation can be managed according to the facilitation that can be exist between the authorities and companies; For the execution of any development project, there is always a whole chain of intervention actors. So in the event that the company in charge of the work does not comply with the right procedures, complaints can be made to any chain of intervention actors. 	 Recruit town criers to bring information in the national language to the population affected by the project; Take steps to ensure that the company complies with procedures during the execution of the project; To find support measures for women fruit sellers located at the level of ASECNA; Distribute the quota in terms of labourers and workers that each arrondissement will have to offer; Take measures to limit speeds on local traffic and cycle paths; Involve the CA and QC for the identification of bypass plans and areas that can serve as a technical base; Manage the excavated material in agreement with the local authorities; Find a solution for the lighting of the Interchange – Cadjèhoun Mosque Crossroads section.

Table 74: Summary of the session in the 12th District of Cotonou

8.4.7. Consultation in the 1st District of Cotonou

The meeting with the local elected officials of the 1stArrondissement in the presence of the Deputy Mayor, Head of the District, was held on Thursday, June 09, 2022 at the Board office and was attended by 14 people, including two women and twelve men. A summary of the concerns expressed, grievances expressed and concerns raised is presented in table 75.



Plate 13: Session in the 1st District of Cotonou Source: CECO-BTP, June 2022
Table 75: Summary of the session in the 1st District of Cotonou

Actors	Summary of concerns and concerns raised	Responses to Concerns Expressed	Summary of grievances and recommendations
Head of Districting, Chiefs of Districts, Executives	 What measures have been taken to develop the bypass roads that will be degraded during the diversions? What will be the procedure for granting a technical base for companies? How will the assistance of local elected officials be taken care of during the execution of the work. Is SONEB involved in the project to avoid damage to the installations Have good measures been taken within the framework of this project for the relocation of SBEE equipment? How long does the project las How will the management of the excavated material work? Can the former already give his availability for the granting of a site for its management? 	 Arrangements are made in advance for the maintenance of the diversion lanes during the execution of the works. The granting of remote sites to companies is done by a lease contra The assumption of responsibility for the assistance of local elected representatives, especially with regard to awareness-raising, is always provided for in the project studies. For any development project of this kind, funds are always provided for the relocation and relocation of the companies' equipment The project will have an implementation period of between three and four years, but this does not mean that the project will last four years in a single district. It is already a real pleasure that the First Arrondissement proposes to grant a site for the management of rubble. This willingness is to be welcomed because identifying a site for rubble and excavated material is often a concern for the execution of work in Cotonou. 	 made ct Make a diversion plan and involve the local authorities in their development During the implementation of the project, involve the Heads of Districts to take into account their grievances Take measures for the relocation of electricity poles so that the population does not suffer. Involve SONEB and SBEE in the work The first arrondissement proposes to make available to companies a site for the storage and management of excavated material. Involve the district chiefs for mass awareness for frank, constant and permanent collaboration.
Spring: CECO-	DIP, HEIUWORK JUNE 2022		

8.4.8. Consultation in the 7th District of Cotonou

The consultation of the populations and local elected officials of the 7th arrondissement took place on June 03, 2022 in the conference room of the said Arrondissement and was attended by 30 people, including 7 women and 23 men. The attendance list and minutes of the meeting are annexed to this report



Plate 14: Session in the 7th District of Cotonou Source: CECO-BTP, June 2022

Actors	Summary of concerns and concerns raised	Responses to Concerns Expressed In this	Summary of grievances and recommendations
Chief of Districting, Chiefs, Districts, Populations	 The project should take into account the compensation of the people who will be affected, because on some projects currently being implemented, some people have not been compensated so far. During the execution of certain construction projects, it is sometimes noted that the local workforce is not integrated. The present project should take into account the local workforce as much as possible in its implementation. Does the project provide for the involvement of neighborhood chiefs for awareness-raising? This project should not make paved lanes at the level of cycle paths. Because motorcyclists abandon their lane, often fleeing the paid ones to find themselves in the lanes of passage of vehicles. This increases the risk of traffic accidents. 	 project, there will be no buildings to be broken and therefore there will be no people to move. It is certainly certain public and private assets that will be affected by the project. And the experts are hard at work on the feasibility study. The present study will necessarily recommend that the local workforce be taken into account during the execution of the project. The neighborhood chiefs are very essential in the system for raising awareness among the population during the execution of the project. So this study will focus on that. As part of this project, the cycle paths will also be paved and unpaid. 	 Prioritize local labor when carrying out the work. Involve the district chiefs during the execution of the work to raise awareness among the population and road users. To allow local residents to benefit from the excavated sand and the maintenance of secondary roads.

Table 76: Summary of the session in the 7th District of Cotonou

Source: CECO-BTP, fieldwork June 2022

8.4.9. Consultation in the 3rd District of Cotonou

The consultation in the^{3rd} Arrondissement took place on Wednesday, May 25, 2022 at the borough's conference room and was attended by 16 people, including 4 women and twelve men.

A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 77.



Plate 15: Exchange session with the populations of the 3rd Arrondissement Source: CECO-BTP, June 2022

Table 77: Summary of the session in the 3rd District of Cotonou

Actors	Summary of concerns and concerns raised Responses to	concerns expressed	Summary of grievances and recommendations
Head of Districting, Chiefs of Districts, Executives	 What measures have been taken to develop the bypass roads that will be degraded during the diversions? Are measures taken to compensate for the loss of economic activities that will be linked to the restriction of access during the execution of this project? How will the assistance of local elected officials be taken care of during the execution of the work. Have good measures been taken within the framework of this project for the relocation of SBEE equipment? 	 Arrangements are made in advance for the maintenance of the diversion lanes during the execution of the works. A team is in place to identify all the people who will be affected by the project. The assumption of responsibility for the assistance of local elected representatives, especially with regard to awareness-raising, is always provided for in the project studies. Arrangements are made within the framework of this study for the relocation of works and equipment as well as for their reinstallation 	 made The project should be completed within a reasonable time frame. Prioritize the local workforce. Take measures for the relocation of electricity poles so that the population does not suffer. Involve SONEB and SBEE in the work Involve the neighborhood chiefs for mass awareness for a frank, constant and permanent collaboration.

Source: CECO-BTP, fieldwork June 2022

8.4.10. Consultation with the General Management of the National Water Company of Benin (SONEB)

The meeting for information and opinions of SONEB took place on Wednesday, June 22, 2022 in Cotonou in the Conference Room of the Directorate and was attended by eight people. A summary of the concerns expressed, grievances expressed and concerns raised is presented in Table 78.



Plate 16: Discussion session with SONEB officials Source: CECO-BTP, June 2022

Table 78: Summary of the session at SONEB

Actors		Responses to Concerns Expressed	Summary of grievances and recommendations made
Frameworks Technical Staff and Summary of Concerns and Concerns Raised	 Is it possible that in the context of this study there is a mode of operation that consists of visiting the project right-of-way to better appreciate the networks that will be affected? What is the schedule for the project's activities? The study must include in the reports that there are movable and non-movable networks. 	 It would be a good thing for SONEB to make itself available to visit the right-of-way in order to better identify the networks that will be affected. There is no date yet for the start of activities as the project is currently in the study phase SONEB will help identify the networks that can be moved and those that cannot be moved for a good orientation of the studies within the framework of the project. 	 Make available to SONEB the plans and profile of the of each artery for evaluation; initiate a joint visit of the arteries between SONEB and the managers of CECO-BTP assessment and to carry out surveys in order to identify the networks located in the project area; SONEB will propose a significant quantitative challenge for the relocation of the networks at the expense of the project; Provide the project with SONEB with a short list of approved companies proposed for the relocation of the networks; Setting up a feedback system at SONEB; the relocation of the networks must necessarily precede the execution phase of the works to develop the tracks and supported by the project.

8.4.11. Summary of the recommendations of the various actors and populations

From the results of the various consultations with the various stakeholders, the following strong recommendations emerged:

- On the preservation of biodiversity
 - avoid cutting down large trees on the ATC project's arteries as much as possible. In the event that they are affected, make their compensation in large numbers;
 - Associate the services of the Calavi forest inspectorate and those of the Atlantic/Littoral Departmental Directorate of Living Environment and Sustainable Development for the implementation of the activities of the ESMP.
- On road safety activities
 - Familiarize yourself with road safety standards for the planting of trees on the edges of roads;
 - proceed with this project to harmonise the signage in the context of the traffic lights to be installed;
 - harmonise the facilities between cycle paths and local traffic according to the rights-of-way;
 - Adapt the materials used to make the panels to avoid vandalism.

• On the preservation of the safety and social welfare of the populations For the interests of the affected populations and the local residents, recommendations are made by the local authorities as well as the populations and other actors consulted. These are:

- Work with the Solid Waste Management Company (SGDS), SONEB and SBEE to preserve and or relocate the facilities/structures located in the project right-of-way and plan future facilities to reserve the spaces;
- o Involve the local authorities in the identification of bypass plans and involve them in their development and security;
- Involve the local authorities in the identification of excavated material storage areas and then in the management of the latter in order to use this excavated material/rubble for the maintenance of secondary roads;
- Prioritise the local workforce and involve the local authorities (Heads of Districts and CGs) who will make the lists available to companies;
- o Involve the district chiefs in mass awareness for a frank, constant and permanent collaboration

The first arrondissement proposes to make available to companies a site for the storage and management of excavated material.

Finally, with regard to the various damages to be caused to access ramps, fences, economic activities and/or possible floods affecting the population, technically and financially ensure compensatory measures for any damage caused by the project.

9. ENVIRONMENTAL ANALYSIS AND PROPOSAL OF MEASURES

This part takes into account all the techniques relating to the identification, description and assessment of the significance of the potential environmental impacts of this project. It leads to the proposal of mitigation and/or compensation and maximization measures.

9.1. Identification of the environmental components affected

On the basis of the methodological approach adopted and described in Chapter III of this report, the environmental assessment consisted, first, in determining the main parameters to be assessed based on the identification of the various components of the environment potentially affected by the project activities.

This identification is based on the application of Leopold's matrix (1971) and results from the cross-referencing of the activities marking each phase of the project (site preparation, construction of the gas depot, operation of the depot and dismantling of the repository) with environmental elements likely to be affected. This crossover reflects the reciprocal impact that one category of factors could have on the other.

Table 79 presents the result of the crossing and shows the environmental components that could be affected by the completion of the project. The sign (x) indicates the presence of negative/positive impact on the middle element.

Table 70: Leonold's Matrix Applied to the Pro	iect: Dotential Environmental Elements Affected
Table 79. Leopold'S Matrix Applied to the FTC	ject. Potential Environmental Elements Anected

		Environmental components potentially affected Natural												
				(biop	ohysical) E	Environme	ent Hu	man e	nvironment Soil					
				Water					Flo	ora nd			Lanc	lscape
Air Project Components				, victor				fauna						
	Sources of impact (activities)	Soil quality	Profile and slope	Runoff and infiltration	Surface water quality	Groundwater quality	Air quality	Soundscape	Cash	Habitat	Health and Safety	Economics	Field of view	Special elements
Preparation	Raising awareness among the population for the clearing of their property located in the right-of-wa and informing stakeholders for the relocation of th	y e										x		
	networks Installation of technical bases and release x-axes to be developed Identification and develop	se of ment					х	х	xx		х	х		
	of diversion routes		X				X				X	х		
	Deployment of x construction materials and equip	ment o	n the a	ixes			x				x	х		
	Rehabilitation and development of the axes x		х	×	x		x	x			x	x		
Construction	Installation of horizontal and vertical signage, light equipment and landscaping Withdrawal of the site	ing and							x	x	х	х		
	commissioning of the axes			x	х						x	x		
Exploitation				х							х	х	х	
	Operations and maintenance	Х					Х	Х			Х	Х		

The analysis of Table 79 shows that the various activities to be developed through the implementation phases of the present project, considered as sources of impact, affect the main components of the environment in various ways.

The elements of the physical environment most affected by the identified sources of impact are the soil (modification of its profile and slope), air (deterioration of its quality and noise pollution), flora and fauna (disturbance of the existing ecological balance and loss of certain species dependent on the environment).

Concerning the human environment, the aspects related to the health/safety of the populations of the environments hosting the project, to social and economic life will be strongly influenced during the road development works by the development of this activity in the locality.

Depending on the nature of the changes that affect the different elements of the environment, the effects can be described as negative or positive.

9.2. Analysis and assessment of the potential impacts identified

The sources of impact, represented by all the activities marking the different phases of project implementation, directly or indirectly, qualitatively or quantitatively affect the various components of the environment. The changes generated are either negative or positive in nature and significant or insignificant. The analysis of the potential impacts identified was carried out following the assessment of the damage according to the components negatively affected.

9.2.1. Positive impacts of the project and proposed measures

Undeniably, the implementation of this project for the development of access roads and crossings of Cotonou (ATC) will have real positive impacts for the local and surrounding population, and then for all users using the roads. All of these positive points will result in the improvement of living conditions, the improvement of the city's radiant appeal, the facilitation of traffic, the significant reduction of traffic congestion on the main roads of the city, the possibilities of job creation and business opportunities. Table 80 presents the positive impacts on the project.

Project phases: Preparation - Construction - Operation.				
Positive impacts identified Implications in the project area Max	imization measures			
 Development of green spaces and planting of trees along the developed environment axes 	 Periodic and rigorous maintenance 			
Improvement of the waste management system				
 Reduced risk of flooding in the city Attraction 				
Periodic maintenance radical improvem	ent of the beauty of the city			
Roads comply with standards and	rigor			

Table 80: Positive impacts of the project

Circulation	 Improved traffic in the city Traffic flow Reduction of traffic congestion on the city's main roads Safe transport 	 Regular monitoring and maintenance
Job creation	 Recruitment of the workforce for the execution of the work Strengthening and revitalizing trade routes 	 Prioritise local labour (with equal skills)
Human	 Increased satisfaction with the services provided to the population better security and social organization promoting the development of the localities concerned Opening up certain areas of the city 	 Regular follow-up and survey Regular maintenance of infrastructure

Spring : CECBTP, June 2022.

9.2.2. Adverse impacts on the biophysical components of the environment and proposed mitigation measures

9.2.2.1. On the ground and subsoil

Potential impacts	Description Characterization Importance Prepara	tion Measurements					
	Phase the release of the right-of-way Duration: roads						
Solid waste clutter on the ground	to be <u>developed</u> Temporary will generate enough Extent: rubble, scrap metal and Local Other solid object that Low will clutter the ground Intensity: Medium	 Sort the release debris and direct the recoverable waste to the recovery channels and dispose of the others in collaboration with the SGDS Recover excavated material and rubble waste for the development of neighbourhood streets in collaboration with local 					
Construction phase Generated by: elected officials							
Soil pollution by solid construction waste and excreta	 MSW to be produced from the Duration: made up of the permanent human presence on the site Lack of toilets Extent: on construction sites or Medium non-compliance with hygiene measure site users Intensity: Medium 	 Install bins for the pre-collection of solid waste and contract with the SGDS for its removal Equip the site with sex-mobile toilets and contract for their regular maintenance Raise awareness among users of the arrangements put in place for pre-collection and waste collection 					
Soil pollution by liquid waste (urine	It will come from: Duration: Average Permanent	- Equip the site with drums for the storage of liquid waste and					
& OIIS							

used oil.	poor management of	local		their removal by approved
grease, etc.)	used oils or extent:	ensure		structures
	bitumen scrap from			- Setting up sealed platforms
	accidental spills of			for handling hydrocarbons
	oils and			- Equip the site with absorbents
	• The absence of			for the management of
	toilets on	Interación		accidental spills
	construction sites or	Intensity:		- Equip the site with sex-mobile
	non-compliance with	Medium		toilets and contract for their regular maintenance
	hygiene measures by			- Raise awareness among site
				users about compliance with
				the hygiene and soil protection
				measures put in place
	It is due to the daily	Duration:		- Strictly comply with
Soil congestion	production of excess	Extent:		technical specifications in
and degradation	concrete and bitumen	Local	Average	the production of aggregates
by concrete and	or their manufacture	Intensity:		- Use bitumen residue
	not in accordance with	Medium		(waste) on defective
	technical specifications	One setien sheep		heighbourhood streets
	(Operation phase		
	The maintenance of	Duration:		- Contract with the equipment
	the lighting equipment	Ongoing		supplier for the collection of
Soil congestion	that will be put in place			end-of-life equipment
and pollution by	will generate waste of	Scope:		
waste electrical	used solar electrical	Local	Average	
equipment	equipment which will			
	lead to soil pollution in	Intensity:		
	the event of poor	Medium		
	management			

9.2.2.2. Impacts on water (runoff, surface and groundwater)

			-	•
Potential impacts	Description Charac	cterization Importa	nce Measure	s Construction Phase
Water pollution	The reconstruction of roads and the dismantling of technical bases will be a source of	Duration: Permanent		- Install bins for the pre-collection of solid waste and contract with the SGDS for its removal
	production of:MSD which, following poor management, will	Scope: Local	- Equip the site with s toilets and contract regular maintenance	- Equip the site with sex-mobile toilets and contract for their regular maintenance
by solid and liquid waste from constructionsites	be drained by runoff water to surface water present in the project's area of influenceOil and accidental oil spills	Intensity: Medium	Average	 Equip the site with drums for the storage of liquid waste and ensure its removal by approved structures Setting up sealed platforms for the handling of hydrocarbons and oils
	who in			

infiltrated into the basementof the roads The construction/rehabilitationof the roads The construction/rehabilitationPermanent Extinct: LocalFlooding of alleys, houses and infrastructureFlooding of alleys, houses and infrastructure	 Equip the site with absorbents for the management of accidental spills Equip the site with sex-mobile toilets and contract for their regular maintenance
Flooding of alleys, houses and infrastructure of the roads The construction/rehabilitation Duration: Permanent Flooding of alleys, houses malfunction during the entire construction Extinct: Local Av Duration: Permanent	- Raise awareness among site users about compliance with the hygiene and soil protection measures put in
in the right-of-way obstruction of certain water corridors by equipment and materials and the non-maintenance of diversion routes will be sources of this impact.	 Place Regularly maintain the detour routes Avoid the creation of water basins during the work Equip construction sites with water evacuation equipment in the event of flooding Respect the deadlines of the work Rigorously comply with the technical specifications (slope, longitudinal profile, etc.) of the market
Operation phase	
Flooding of alleys, houses and infrastructure in the road right-of-wayThis impact would occur due to non-compliance with the technical specifications (slope, longitudinal profile, etc.) of the contract in the development of roads (non-compliant sizing of structures)Duration: OngoingFlooding of alleys, houses and infrastructure in the road right-of-wayThis impact would occur due to non-compliance with the technical specifications (slope, longitudinal profile, etc.)Duration: OngoingIntensity: MediumAv	- Rigorously comply with the technical specifications (slope, longitudinal profile, etc.) of the market

9.2.2.3. Impacts on the air (air pollution and noise pollution)

The "air" component will be impacted at all phases of this project by noise, dust and exhaust gases from machinery, vehicles, and other rolling stock.

Potential impacts	Description	Characterization	Importance	Measurements			
Preparation Phase							
Air pollution by dust and exhaust gases It is due to the movements	of trucks and vehicles during the release of the right-of-way, the installation of technical bases and the development of diversion lanes	Duration: Temporary Scope: Local Intensity: Medium	Weak	 provide all users with PPE (masks) Periodically water potentially dusty traffic areas Use equipment in good working order 			

Noise	They will be felt by the lo population Temporary do works of Extent: release right-of-way of roads and of machinery for the dev the Intensity: construction roads of Low deviation w produce noise.	ocal uring the of the local movements elopment of n site and vhich will	Weak	 Provide all users with appropriate PPE (ear kits) and ensure that they are effectively worn. Respect rest hours in accordance with the labor code in force
		Construction phase	se	
Air pollution by	The movements of machinery and trucks/vehicles on the construction site will	Duration: Permanent		 Provide all users with PPE (masks) Periodically water potentially dusty traffic areas
dust and exhaust gases	raise dust and exhaust skins smoke and gases. These pollutants will contaminate the ambient	Scope: Local	Average	- Use equipment in good working order
air and degrade its quality locally. Almos		Intensity: Medium		Provide all users with appropriate
Noise pollution	phase, the noise that generates this nuisance will be produced by the movement of the machinery and the operation of the aggregate production machines (concrete, bituminous asphalt, etc.) and then the operation of the generator, welding workshops, mechanics, etc.	Duration: Permanent Scope: Local Intensity: Medium	Average	 Provide all users with appropriate PPE (ear kits) and ensure that they are effectively worn. Respect rest hours in accordance with the labor code in force Ensure the use of less noisy machinery and equipment
		Operation phase		
Noise	to the noise to be recorded on the roads. Businesses, institutions and homes near the roads will be the most affected It will be due to	Duration: Permanent Extent: Local Intensity: Medium Duration:	Average	- Setting up suitable landscaping (trees, flowers and others) along the roads
Air pollution by exhaust gases They will be due	the car traffic to be recorded on the roads in the operation phase. Enough fume exhaust gases will be recorded, which are pollutants that are harmful to the quality of the air breathed	Permanent Extent: Local Intensity: Medium	Average	- Setting up suitable landscaping (trees, flowers and others) along the roads

9.2.2.4. Impact on flora and fauna

Preparation phase							
	The implementation of the project would result in the loss of 692 feet of different tree species recorded on the	Duration: Permanent Extent: Local		 Destroy the trees just needed Carry out selective deforestation Take the tree cutting permit before the felling of the trees 			
Loss of vegetation cover and habitat for wildlife	axes identified for development. This loss would lead to the disappearance of habitat for the dependent fauna and the loss of all the ecosystem services that these trees would provide in the environment	Intensity: Medium	characterization	trees - Ensure maintenance to maturity of all the trees in the range and tree gardens to be set up - Ensure compensatory reforestation in the degraded areas of the commune of at least 2000 plants of local species such as Khaya senegalensis			
Loss ^{of the} Stock sequestration potential Of carbon existing	It will be due to the destruction of the 692 feet of trees identified on the roads to be developed. However, these species were strongly involved in the fight against climate change through their significant capacity to store atmospheric carbon, which varies from 1.5 to 36.87 tonnes	Duration: Permanent Scope: Local	Strong	 Destroy the trees just needed Carry out selective deforestation Prioritize trees with high carbon sequestration for landscaping Ensure maintenance until maturity of all the row and garden trees to be planted Ensure compensatory reforestation in the degraded areas of the municipality of at least 2000 plants of local species with a high rate of carbon 			

Fauna and flora are components of the environment that will be negatively impacted by the implementation of projects in the preparation phase only

9.2.2.5. Impacts on the landscape

Potential impacts	Description	Average	Importance	Measurements				
	Construction phase							
Degradation of the environment and visual quality	It will be caused by: The deterioration of borrowing areas and quarries for deposits to be exploited The movement of trucks and construction machinery; The non-redevelopment of	Duration: Ongoing Scope: Local	Strong	- Obtain materials from regularly authorised quarries or obtain all authorisations before the opening of quarries and				
		Intensity: Strong		 Comply with all environmental and social clauses in the opening and 				

technical bases at	project; the operation of a
the end of the	quarry and borrowing areas
	 Ensure a reorganization of the technical bases at the end of operation Conduct a dismantling audit of the technical bases and implement the recommendations before its release

9.2.3. Negative impacts on the human environment and proposal for measures

During the implementation of this project, negative impacts will be observed on the quality of life of human beings, in particular on the public health and safety of users and residents of each site of the roads to be developed.

9.2.3.1. Damage to public health

These are the assignments and/or cases of diseases that will be developed by the workers and/or local people during the conduct and implementation of the project work.

• Respiratory and similar diseases Respiratory and similar conditions are characterized by an infection of the respiratory tract and lungs. It manifests itself with clinical signs such as sneezing, coughing, fever, sore throat, and runny nose. They are caused by air pollution. Their influences are related to the nature of the pollutants in the surrounding air. Table 81 gives us more details on these and specifies the impacts that could be faced.

Table 81: Impacts of selected airborne pollutants on human health

Pollutants Health impacts

Migraines, irritations, decreased defences Immune nitrogen oxides (NOx), impaired lung functions, inflammation of the bronchi Anorexias, cardiovascular disorders, migraines, vertigo, Carbon oxides (COx) vision disorders Unburned hydrocarbons Eye irritations, coughs, carcinogenic actions (HC) Sensory irritations (hydrocarbons and formaldehydes); Organic compounds, cardiac (toluene, chloroform) and digestive disorders;

•	
Volatile (VOCs)	Carcinogenic (benzene) and mutagenic effects, are linked to chronic or intense exposures.
Lead (Pb)	Intoxication, growth disorders, anaemia
Dust (PM2, 5 and PM10)	Transport of pollutants in the lungs, tuberculosis, carcinogenic actions, Acute Respiratory Infections (ARI)
Noise (decibels)	Stress (elevation of adrenaline, heart rate and blood pressure): Cardiovascular diseases; Psychosomatic diseases (ulcers, colitis, etc.) Deafness (due to prolonged exposure.

As part of the delivery of this project, respiratory and allied assignments will be observed in all phases of the project.

Potential impacts	Description	Characterization	Importance	Measurements
	Preparation an	d construction ph	nases	
Development of respiratory and allied diseases	It will be generated by: - smoke from furniture respiratory diseases, dust raised by the handling of construction materials and the movement of machinery, trucks and vehicles on the site - direct inhalation of odours from certain products and materials during their handling on the construction site The exposure of site users and local residents to the various pollutants emitted during the work could lead to an increase in the prevalence rate of the respiratory diseases mentioned in the table above. This rate will depend essentially on the frequency of emission and the duration of exposure. These diseases will occur due to	Duration: Perm Scope: Local	Average	 provide all users with appropriate PPE and ensure to their effective wearing Water potentially dusty areas regularly Use equipment in good working order Prevent speeding by material transport trucks along the tracks Use equipment in good working order Ensure coverage of loads of trucks transporting construction materials and equipment
Development of other occupational diseases other than rolling	the unprotected exposure of users to noise pollution, a lack of general sanitation on construction sites (absence or toilets, rooms, poor waste management, etc.), handling of harmful products without precautions, the taking of non-ergonomic postures, etc. These attitudes are likely to be harmful to human health through the development of digestive, skin, ocular, auditory, carcinogenic diseases, etc.	Intensity: Medium	Average	 Provide all users with appropriate PPE and ensure that they are worn effectively Raise awareness among all site users about the respect of the protection and hygiene measures put in place Make a pre-employment medical examination for all workers and staff on the construction sites To subscribe to an insurance policy for staff and workers; Declare staff to the CNSS;
Increase in the prevalence of covid 19	The gathering of individuals with different health status on construction sites without respecting the barrier measures against covid 19 can cause this virus to develop.	Duration: Perm Extent: Local Intensity: Average	Average	 Raise awareness among site users for strict compliance with barrier measures against covid Equip construction sites with collective protection systems (hand-washing devices)

Increase in the prevalence of contagious diseases (STDS, STDS, HIV, AIDS, HEPATITIS, etc.) and unwanted pregnancies In a	space where individuals of diverse origins, opposite sexes and different statuses are grouped together with the aim of carrying out the project, a social mix will be created. This will help increase the likelihood of disease spreading and unwanted pregnancies in the environment.	Duration: Permanent Extinct: Local Intensity: Medium	Average	 Conduct awareness-raising sessions coupled with screening for these diseases and distribution of condoms Periodically raise awareness among users about contagious diseases (STD, STD, HIV, AIDS, HEPATITIS, etc.) and the consequences of unwanted pregnancy
	Opera	ation phase		
Development of noise-related diseases	They will be due to the noise that will be perceived by traffic passengers at intersections and traffic lights and users of companies, institutions and homes adjacent to the tracks. The effects of this noise will depend on the time of exposure of the victims, however through the effect of bioaccumulation, users who are frequently exposed to other sources of noise may develop the disease of deafness.	Duration: Permanent Scope: Local	Average	 Raise awareness among the population about the nuisances of abusive honking Setting up suitable landscaping (trees, flowers and others) along the roads
Development of respiratory and allied and skin diseases	It will be due to the car traffic to be recorded on the roads during the operation phase. Enough fume exhaust gases will be recorded, which are pollutants that are harmful to the quality of the air breathed	Duration: Permanent Scope: Local Intensity: Medium	Average	 Raise awareness among the population about the supply of quality hydrocarbons Prioritize trees with high carbon sequestration for landscaping

9.2.3.2. Public Safety Breaches

In the implementation of the activities of this project for the development of the access roads and crossings of Cotonou (ATC), the safety of people and property on all construction sites is of paramount importance. Indeed, it will be subject to permanent threats because of the various construction works, the various manipulations that will take place there, the regular movements of machines and the malfunction of certain machines. This will cause work and traffic accidents, then the destruction of property and in extreme situations, cases of trauma or even death.

Potential impacts	Description	Characterization	Importance	Measurements	
Preparation and construction phases					
Accident at work	They can be recorded:	Duration: Perm	Strong	 provide all users with appropriate PPE and ensure 	

	 when working at height without precautions (falling, slipping), using sharp objects, sharp objects, without 	Scope: Local		to their effective wearing - Setting up beacons, signs and safety instructions on construction sites
	 protection, etc. By the recklessness of the man or his disregard for the rules and safety instructions put in place for the work when handling machinery and chemicals malfunction of equipment and work equipment 	Intensity: high		 Equip construction sites with HSE agents collect and remove dangerous roughness such as nails, screws, pieces of iron, etc., immediately after stripping the formwork; Purchase health insurance for employees Report employees to the CNSS. Equip construction sites with well-equipped infirmaries Raise awareness among users about compliance with
	It will be generated by:	Duration:		safety instructions - Have a traffic plan on
Traffic accident	 the movements of machines, trucks and machines the absence or non-compliance with the traffic plan put in place Failure to comply with traffic laws Driver incivics the degraded state of the access roads etc. The fire is believed to be caused by: The install timest to the access to an approximate and the access to a state of the access roads etc. 	Permanent Extinct: Local Intensity: Strong Duration: Permanent Extinct: Local	Strong	 Inave a trainic plan on all construction sites and ensure that it is respected Raise awareness among drivers about respecting the highway code (speed limit, good health, no drinking and driving, etc.) Equip construction sites with HSE agents Ensure regular maintenance of access roads Declare staff to the CNSS. Equip construction sites with firefighting equipment and install it in accordance with the recommendations of GNSP Train users on the use of firefighting equipment
construction	- - acts of vandalism - etc.	Intensity: Medium	Average	 Have an Internal Operation Plan (POI) to Refresh periodically Raise awareness among staff to respect
	The implementation of this	Duration		safety measures
Loss of property and disruption of economic	all categories combined, of 362 Persons (PAP) in the	Perm Extent: Local	Strong	compensation for PAPs
activities and revenue sources	project area, including 113 women and 249 men.	Intensity: Strong		completed for the project

	Apart from the assets. the latter			
	will see their activity decrease			
	throughout the project phase			
	These inconveniences will have			
	to be componented for for a			
	to be compensated for for a			
	project			
	suffer at the construction sites and road users during	Duration:		- inform and sensitize the
	to: difficulties in accessing homes and workplaces	Permanent		population sufficiently in
		Extinct:		advance of the start of
		Local		the work for the individual
				measures to be taken
				 Install temporary access
Disruption				supports to homes
of Habits of	- Dust and noise emission			
socio-economic and				- Ensure regular
inconveniences/production	- The deterioration of			maintenance of detour
of inconvenience			Strong	
to households neighboring	accessitoads		Strong	
	- Disruption of population	Intensity:		- Periodically water
This is all the	mobility	Strong		potentially dusty traffic
nuisances that the	 interruption of water or 	Ŭ		areas
local populations	electrical energy			
	- etc.			- Inform the SONEB or
				the SBEE as soon as
				nossible in the event of
				possible in the event of
				damage to the pipes for
				immediate repair
				- Respect the deadline for
				the execution of the sites
	Opera	ation phase		
	will be caused by the	Duration:		- Raise awareness
	non-compliance with the highway	Permanent]	among users about the
	codes, the impatience and the	Extinct:		new road signs and
	civic-mindedness of the road users	Local		compliance with the
Traffic			Strong	highway code (speed
accident It	Ť		Caolig	limit, good health, no
		Intensity:		arinking and driving, etc.)
		Strong		- Ensure the regular
				maintenance of the
				lighting equipment
				installed

9.3. Summary of impacts and proposed measures for the project

Table 83 presents the summary of the potential impacts identified as well as the corresponding mitigation measures, following the environmental analysis carried out

PHASES		IMPACT		MEASUR	ES
ACTIVITIES	Positive	Creation	INFORTANCE	Attenuation	
1. Prepar	ation phase				
1.1. Raising awareness among population for the of their property located in the right-of-way and	1.1.a.1. Negative jobs Temporary	1.1.b.1. Loss of property and Business disruption economic and source Strength Generation	of	 1.1.b.1.1. Ensure Maximization Fair and prior compensation PAPs 1.1.b.1.2. Implement the RAP completed for the project 	1 1.a.1.1. Prioritizing local workforce with a equal competence
information of the actors for the relocation of the networks		1.1.b.2. Disruption of the full-time availability of networks (water, electricity, etc.) to the population of the	Averages	1.1.b.2.1. Inform the local population in advance of the temporary network shutdown programs that may occur 1.2.b.2. 2. Make arrangements to avoid multi-hour outages	
1.2. Installation of technical basics release of to be developed	1.2.a.1. Revenue jobs Temporary	 1.2.b.1. Disruption of the Socio-economic habits 1.2.b.2. Solid waste clutter on the ground 	Average	 1.2.b.1.1. Informing and raising awareness sufficiently the populations on the Start date of work for Weak individual arrangements to be made 1.2.b.2.1. Sort the release debris and direct the recoverable waste to the recovery channels and 	I. 2.a.1.1. Prioritizing local labour force and the equal competence axes
				dispose of the others in collaboration with the SGDS 1.2.b.2.2. Recover excavated material and rubble waste to	

Table 82: Summary of identified potential impacts and corresponding mitigation measures

			the development of neighbourhood streets	
			in collaboration with local elected officials	
1.2.b	.3. Noise		1.2.b.3.1. Provide all users with	
			appropriate PPE (ear kits) and ensure	
		Weak	that they are effectively worn.	
			1.2.b.3.2. Respect rest hours in	
			accordance with the labor code	
			in force	
1.2.b	.4. Air pollution by dust		1.2.b.4.1. provide all users with	
and e	exhaust gases		PPE (masks)	
	0	vveak	1.2.b.4.2. Water potentially	
			dusty traffic areas periodically	
1.2.b	.5. Loss of vegetation		1.2.b.5.1. Destroy the trees just	
cover	r and habitat for wildlife		needed and carry out selective	
			deforestation	
			1.2.b.5.2. Take the tree cutting	
			permit before the trees are cut	
			down	
			1.2.b.5.3. Ensure maintenance	
		Average	to maturity of all the row trees	
		ritorago	and tree dardens to be set up	
			and free gardens to be set up	
			10 h E 4. Enclure componentary	
			1.2.b.5.4. Ensure compensatory	
	· · · · · ·		reforestation in the degraded	
			areas of the commune of at	
			least 2000 plants of local	
			species such as Khaya	
			senegalensis	

1.2.b.6. Loss of the potential for sequestration of the existing carbon stock	Average	 1.2.b.6.1. Destroy the trees just needed and carry out selective deforestation 1.2.b.6.2. Prioritize trees with high carbon sequestration for landscaping 1.2.b.6.3. Ensure maintenance until maturity of all the row and garden trees to be planted 	
		1.2.B.6.4. Ensure compensatory reforestation in the degraded areas of the commune of at least 2000 plants of local species with a high rate of carbon sequestration	
1.2.b.7. Development of respiratory and allied diseases	Average	 1.2.b.7.1. equip all users with appropriate PPE and ensure that it is effectively worn 1.2.b.7.2. Water potentially dusty areas regularly 1.2.B.7.3. Use machines in good working order 	
1.2.b.8. Increase in the prevalence of covid 19.	Average	1.2.b.8.1. Raising awareness among site users for strict compliance with barrier measures against covid 1.2.B.8.2. Equip construction sites with collective protection systems (hand-washing devices)	

		1.2.b.9. Increase in the prevalence of contagious diseases (STDS, STDS, HIV, AIDS, HEPATITIS, etc.) and unwanted pregnancies	Average	 1.2.b.9.1. Conduct awareness-raising sessions coupled with screening for these diseases and distribution of condoms 1.2.b.9.2. Periodically raise awareness among users about contagious diseases (STD, STD, STD, HIV, AIDS, HEPATITIS, etc.) and the consequences of unwanted pregnancy 	
		1.2.b.10. Accident at work	Average	 1.2.b.10.1. Provide all users with appropriate PPE and ensure that they are effectively worn 1.2.b.10.2. Setting up markers, signs and safety instructions on construction sites Equip construction sites with HSE agents 	
		1.2.b.11. Accident from circulation	n Average	1.2.b.11.1. Have a traffic plan on all construction sites and ensure that it is respected 1.2.b.11.2. Raise awareness among drivers about respecting the highway code (speed limit, good health, no drinking and driving, etc.) 1.2.b.11.3. Equipping construction sites with HSE agents	
1.3. Identification and management of	1.3.a.1. Temporary job creation	1.3.b.1. Air pollution by dust and exhaust gases	Weak	1.3.b.1.1. provide all users with PPE (masks)	1. 3.A.1.1. Giving priority to local workers with equal skills

Routes diversions from				1.3.b.1.2. Water potentially dusty traffic areas periodically	
		1.3.b.2. Accident from Traffic	^m Average	 1.3.b.2.1. Have a traffic plan on all construction sites and ensure that it is respected 1.3.b.2.2. Raise awareness among drivers about respecting the highway code (speed limit, good health, no drinking and driving, etc.) 1.3.b.2.3. Equipping construction sites with HSE agents 	
		1.3.b.3. Disruption of		1.2.b.1.1. Set up orientation and	
		socio-economic habits	Average	information signs	
2. Construction phase	se				
2.1. Deployment on of materials, materials, construction, the axes of the and	2.1.a.1. Temporary job creation	2.1.b.1. Air pollution by dust and exhaust gases	Average	2.1.b.1.1. Provide all users with PPE (masks)2.1.b.1.2. Water potentially dusty traffic areas periodically	2.1.a.1.1. Giving priority to local workers with equal skills
				2.1.b.1.3. Use machines in good working order	
		2.1.b.2. Noise	Average	2.1.b.2. 1. Provide all users with appropriate PPE (ear kits) and ensure that they are effectively	
				worn.	

	2.1.b.2.2. Respect rest hours in accordance with the labor code in force
2.1.b.3. Development of respiratory and allied diseases	2.1.B.3.1. Provide all users with appropriate PPE and ensure that they are effectively worn 2.1.b.3.2. Water potentially dusty areas regularly
Average	2.1.b.3.3. Use machines in good working order 2.1.B.3.4. Avoiding speeding by material transport trucks along the tracks 2.1.b.3.5. Ensure coverage of loads of trucks transporting construction materials and equipment
2.1.b.4. Accident from Average	2.1.b.4.1. Have a traffic plan on all construction sites and ensure that it is respected 2.1.b.4.2. Raise awareness among drivers about respecting the highway code (speed limit, good health, no drinking and driving, etc.) 2.1.b.4.3. Ensure regular
	maintenance of access roads 2.1.b.4.5. Report staff to the CNSS.

2.2. Rehabilitation	2.1.a.1.	2.2.b.1. Soil pollution by		2.2.b.1.1. Install bins for the	2. 2.a.1.1. Giving priority
and development of	Temporary job	solid construction waste		pre-collection of solid waste and	to local workers with
roads	creation	and excreta		contract with the SGDS for its	equal skills
				removal	
				2.2.b.1.2. Equip the site with	
			Average	sex-mobile toilets and contract	
				for their regular maintenance	
				2.2.b.1.3. Raise awareness	
				among users of the arrangements	
				put in place for pre-collection and	
				waste collection	
		2.2.b.2. Soil pollution by		2.2.b.2.1. Equip the site with	
		liquid waste (urine & waste		drums for the storage of liquid	
		oil, grease, etc.)		waste and ensure its removal by	
				approved structures	
				2.2.b.2.3. Establish watertight	
				platforms for the handling of	
				hydrocarbons and oils 2.2.b.2.3.	
				Equip the site with absorbents	
				for the management of	
			Average	accidental spills	
				2.2.b.2.4. Equip the site with	
				sex-mobile toilets and contract	
				for their regular maintenance	
				2.2.b.2.5. Raise awareness among	
				site users about compliance with	
				measures put in place	
				measures put in place	

2.2.1	o.3. Crowding and		2.2.b.3.1. Strictly comply with	
degr	adation of the soil by		technical specifications in the	
cond	crete and bitumen		production of aggregates	
wasi	te	Average	55 5	
			22b32 Using bitumen residue	
			(garbage) on defective	
			neighbourhood streets	
2.2.8	o.4. Water pollution by		2.2.b.4.1. Install bins for the	
solic	l and liquid construction		pre-collection of solid waste and	
was	te		contract with the SGDS for its	
			removal	
			2.2.b.4.2. Equip the site with	
			sex-mobile toilets and contract	
			for their regular maintenance	
			2.2.b.4.3. Equip the site with	
			drums for the storage of liquid	
			waste and ensure its removal by	
		Average	approved structures	
		, tronage	2.2.b.4.4. Establish watertight	
			platforms for the handling of	
			hydrocarbons and oils 2.2.b.4.5.	
			Equip the site with absorbents	
			for the management of	
			accidental spills 2.2.b.4.6. Raise	
			awareness among site users	
			about compliance with the	
			hygiene and soil protection	
			measures put in place	

	2.2.b.5. Flooding of allevs.		2.2.b.5.1. Regularly maintain	
	houses and infrastructure in		detour routes	
	the road right-of-way		2.2.b.5.2. Avoid the creation of	
	5 ,		water basins during work	
			2.2.b.5.3. Equip construction sites	
			with water evacuation equipment in	
		Average	the event of flooding	
			22b54 Respecting the	
			deadlines of the work	
			22 h 55 Rigorously comply	
			with the technical specifications	
			(slope longitudinal profile etc.)	
			of the market	
	2.2 h 6. Air pollution by dust		2 2 h 6 1 Provide all users with	
	and exhaust cases		PDF (masks)	
	and exhaust gases		22h62 Water potentially	
		Average	dusty traffic areas periodically	
		Average	dusty traine areas periodically	
			22h63 Use machines in good	
			working order	
	2.2.b.7. Noise		2.2.b.7.1. Provide all users with	
			appropriate PPE (ear kits) and ensure	
			that they are effectively worn.	
			2.2.b.7.2. Respect rest hours in	
		Average	accordance with the labor code	
			in force	
			2.2.b.7.3. Ensure the use of less	
			noisy machinery and equipment	
	Ŧ			

2.2.b.8. Degradation of the		2.2.b.8.1. Obtain supplies of	
environment and visual		materials from regularly	
quality		authorised quarries or obtain all	
		authorisations before the	
		opening of quarries and	
		borrowing areas 2.2 h 8.2	
		Comply with all environmental	
	Strong	and social clauses in the	
		and social clauses in the	
		quarry and borrowing areas	
		2.2.0.8.3. Ensure a	
		redevelopment of the technical	
		bases at the end of operation	
2.2.b.9. Development of		2.2.b.9.1. Provide all users with	
respiratory and allied		appropriate PPE and ensure	
diseases		a cheville and che	
		dusty areas regularly	
		2.2.b.9.3. Use machines in	
	Average	good working order	
	, in or or go	2.2.b.9.4. Avoiding speeding by	
		material transport trucks along	
		the tracks	
		2.2.b.9.5. Ensure coverage of	
		loads of trucks transporting	
		construction materials and	
		equipment	
2.2 b 10 Disease		2.2.b.10.1. Provide all users with	
others Development	Average	appropriate PPE and ensure that	
		they are effectively worn	

respiratory Other that professionals		2.2.b.10.2. Raise awareness among all site users about compliance with the protection and hygiene measures put in place 2.2.b.10.3. Have a pre-employment medical check-up for all workers and staff on construction sites 2.2.b.10.4. To take out an insurance policy for staff and workers; 2.2.b.10.5. Declare staff to the CNSS;	
2.2.b.11. Increase in the prevalence of covid 19 2.2.b.12. Increase in the prevalence of contagious diseases (STDS, STDS, HIV, AIDS, HEPATITIS, etc.) and unwanted	Average	2.2.b.11.1. Raising awareness among site users for strict compliance with barrier measures against covid 2.2.b.11.2. Equip construction sites with collective protection systems (hand-washing devices) 2.2.b.12.1. Conduct awareness-raising sessions coupled with screening for these diseases and distribution of condoms 2.2.b.12.2. Periodically raise awareness among users about contagious diseases (STD, STD, STD, HIV, AIDS, HEPATITIS,	

2.2	.b.13. Accident at work		2.2.b.13.1. Provide all users with	
			appropriate PPE and ensure that	
			they are effectively worn	
			2.2.b.13.2. Setting up markers,	
			signs and safety instructions on	
			construction sites	
			2.2.b.13.3. Equipping construction	
			sites with HSE agents	
			2.2.b.13.4. Collect and remove	
			dangerous roughness such as	
			nails, screws, pieces of iron,	
		Strong	etc., immediately after stripping	
			the formwork;	
			2.2.b.13.5. Purchase health	
			insurance for employees	
			2.2.b.13.6. Declare employees	
			to the CNSS.	
			2.2.b.13.7. Equipping construction	
			sites with well-equipped infirmaries	
			2.2.b.13.8. Raise awareness	
			among users about compliance	
			with safety instructions	
2.2	b.14. Accident from	1	2.2.b.14.1. Have a traffic plan	
circ	culation		on all construction sites and	
			ensure that it is respected	
			2.2.b.14.2. Raise awareness	
			among drivers about respecting	
		Strong	the highway code (speed limit,	
		·	good health, no drinking and	
			driving, etc.)	
			2.2.b.14.3. Equipping construction	
			sites with HSE agents	
			2.2.b.14.4. Ensure regular	
			maintenance of access roads	

				2.2.b.14.5. Declare the staff to the CNSS.	
		2.2.b.15. Fire sites on the construction	Average	 2.2.b.15.1. Equip construction sites with firefighting equipment and install it in accordance with GNSP recommendations 2.2.b.15.2. Train users on the use of firefighting equipment 2.2.b.15.4. Have an Internal Operation Plan (POI) to be updated periodically 2.2.b.15.4.Raise awareness among staff to comply with safety measures 	
2.3. Installation of horizontal and vertical signage, lighting equipment and landscaping	2.3.a.1. Creation of temporary jobs	2.3.b.1. Accident at work	Average	2.3.b.1.1. Provide all users with appropriate PPE and ensure that they are effectively worn 2.3.b.1.2. Setting up markers, signs and safety instructions on construction sites	Average 2. 3.a.1.1. Giving priority to local workers with equal skills
	 2.3.a.2. Development of green spaces and planting of trees along the developed axes 2.3.a.2. Attractive living environment 	2.3.b.2. Accident Traffic		2.3.b.2.1. Have a traffic plan on all construction sites and ensure that it is respected 2.3.b.2.2. Setting up markers, signs and safety instructions on construction sites 2.3.b.2.3. Raise awareness among drivers about respecting the highway code (speed limit, good health, no drinking and driving, etc.)	2.3.a.2.2. Ensure maintenance to maturity of all the row trees and tree gardens to be set up

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2.4. Withdrawal of the site and redevelopment of the technical bases	2.4.a.1. Temporary job creation	2.4.b.1. Solid waste clutter on the ground	Weak	2.4.b.1.1. Ensure a daily collection of waste from the site by the SGDS2.4.b.1.1. Recover excavated material and recoverable waste	2. 4.A.1.1. Giving priority to local workers with equal skills
		2.4.b.2. Deterioration of the living environment	Average	2.4.b.2.1. Conduct a dismantling audit of the technical bases and implement the recommendations before its release	
		2.4.b.3. Job losses	Average	2.4.B.3.1. To dismiss employees in accordance with the labor code in force in the Republic of Benin	
3. Operation phase					
3.1. Acceptance and commissioning of axes	3.1.a.1. Improving the conditions for the movement of people and goods 3.1.a.2. Attractive living environment				3.1.a.1.1.Raisingawareness for the respectof the highway code3.1.a.1.2. Ensure propermaintenance ofstructures
3.2. Operation and maintenance	3.1.a.1. Temporary job creation	3.2.b.1. Soil congestion and pollution by waste electrical equipment	Average	3.2.b.1.1. Contract with the equipment supplier for the collection of end-of-life equipment	3. 2.a.1.1. Giving priority to local workers with equal skills
		3.2.b.2 Flooding of the Alleys houses and	Average	3.2.b.2.1. Strictly adhere to specifications	

Infrastructure in the road		(slope, longitudinal profile, etc.)	
3.2.b.3. Noise pollution	Average	3.2.b.3.1. Raise awareness among the entire population about the nuisance of abusive honking 3.2.b.3.2. Setting up suitable landscaping (trees, flowers and others) along the roads	
3.2.b.4. Development of respiratory and allied and skin diseases	Average	3.2.b.4.1. Raise awareness among the entire population about the supply of quality hydrocarbons3.2.b.4.2. Prioritize trees with high carbon sequestration for landscaping	
3.2.b.5 Traffic accident .	Strong	3.2.b.5.1. Raise awareness among users about the new road signs and compliance with the highway code (speed limit, good health, no drinking and driving, etc.) 3.2.b.5.2. Ensure the regular maintenance of the lighting equipment installed	
10. TECHNOLOGY RISK ANALYSIS

The objective of this chapter is to expose and analyze the risks associated with the redevelopment activities of the road sections of Lot 1 of the ATC project, which is the subject of this report. This lot, with a total linear length of 16.125 km, takes into account seven (07) major arteries, most of which represent functional or decommissioned sections of the RNIE 1.

The risk analysis concerns both the risks related to the implementation of this project and the occupational risks. These risks are described taking into account all phases of the project and must be analysed from a human and biophysical point of view, and above all by highlighting natural and technological risks.

This chapter describes all the safety measures that the Project Owner (MO) must take during the implementation of the project to ensure safe and healthy working conditions for workers, and to prevent, avoid or reduce risks and accidents. It presents the main risks and proposes means of prevention and emergency intervention in the event of these risks occurring during the construction phase. The employees of the Construction Company will be the most prone to these risks.

10.1. Reminder of the definition of risk

Risk is the combination of a hazard, its probability, its severity and its acceptability. Danger is a set of processes that unfolds the chain of events leading to an Unwanted Event (ENS) that can have an impact, generally destructive, on one or more possible targets i) an individual(s) ii) one or more populations, iii) one or more ecosystems, etc. The preferred targets in this study are occupational hazard personnel and the population affected by the work.

Probability is understood as the probability of a chain of events leading to the ENS. Severity is defined by the effect of ENS on targets. Finally, acceptability is understood as the acceptability of the ENS.

The risk analysis here consists of pointing out the main danger situations related to the implementation of the project;

- Describe unwanted events that may occur with consequences for the health of individuals and affected populations;
- estimate the probability of the SSE occurring and
- its acceptability.

This analysis precedes the proposal of prevention and protection measures adapted to each risk in order to achieve an acceptable level of residual risk. Probability levels are selected from "very unlikely" to "very likely" and severity levels from "low to very severe", as detailed in Tables 83 and 84.

Table 83: Risk Assessment Matrix

	Probability Scale (P)		Severity Scale (G)		
	Level	Meaning	Level	Effect	
	P1	Very unlikely	G1 / Low	Accident or illness without lost time	
	P2	Unlikely	G2 / Medium	Accident or illness with lost time	
Ta Ve	ble 84: P3 F ry probable	robable G3 / serio G4 / very serious	us Accident or illne: Fatal accident or illn	ss with permanent partial disability P4 ess	
Ī					

Spring : CECO-BTP, June 2022.

The cross-referencing of probability and severity illustrated by the following matrix gives the level of acceptability of the risk and consequently the level of priority for the implementation of measures to reduce the endangerment to an acceptable level. Priority 1 and 2 risks are taken into account.

Risk Assessment Matrix

Severity G1 G2 G3 G4 Pro	bability P1 P2	P3 P4	

Source: CECO-BTP, June 2022.

Priority Acc	eptability
1	High risk to be considered as a priority
2	Significant Risk to Consider
3	Acceptable Risk

Source: CECO-BTP, June 2022.

In the context of a road project, the presence of an asphalt mixing plant, which is a classified facility, presents risks related on the one hand to the equipment but also to the products it uses (fuel, diesel, bitumen, etc.) and which deserve to be taken into account.

10.2. Risk identification and analysis Risks of accidents are to be feared at the level of the Cotonou Access and Crossings (ATC) road development project, both at the level of the seven (7) above-mentioned axes as well as on the related roads (cycle paths, local traffic, parking areas and footbridges for

pedestrians). These potential risks exist both during the construction work phase and during the dismantling phase and the operation phase of the road sections to be developed.

Risk assessment therefore makes it possible to plan preventive actions at company level, taking into account priorities.

The analysis of the preparation, construction and operation activities of the road sections concerned suggests risks to the health and safety of the people working on the site, mainly and to a lesser extent for the local populations.

- During the construction phase (preparation and construction), there is a risk of work accidents and, to a lesser extent, the risk of traffic accidents linked to the presence of vehicles and machinery. In addition, there are health risks due to the inhalation of the smell of bitumen linked to the paving work. During dismantling, there is also a risk of job loss and possible risks of accident related to inappropriate handling of construction vehicles and machinery;
- In the operation phase, these accident risks will be mainly related to traffic.

The risk analysis makes it possible to identify the elements representing a danger in the context of the reinforcement work of the roads concerned, to describe any malfunctions that may be the cause of risks with significant consequences on the environment (natural and human), and then to specify the measures taken to reduce the negative effects.

10.2.1. Preparation and construction phases 10.2.1.1. Fire and explosion risk This is a serious risk of burns or injury to people as a result of a fire or explosion. They can cause material and bodily damage (to personnel) and even to the populations established in the area. In the context of this road project, the risks of fire and explosion are mainly related to the storage of products for which the potential hazards (flammability, explosiveness, toxicity, etc.) that they present must be qualified. The main products involved are:

- Hydrocarbons (diesel, fuel oil) used for the supply and operation of construction machinery and the asphalt plant;
- bitumen used for pavement surfacing (present at the asphalt plant).
- cement-enriched laterite;
- Occupational risks (various accidents and contamination, inhalation of volatile products, in view of the scale and size of the sites).

In addition, the origins of a fire on the construction site are varied and linked, among other things, to:

- short circuit at the level of electrical installations;
- human clumsiness such as forgetting a cigarette butt;
- collision between two vehicles;
- mixing of incompatible products or undifferentiated storage;

- the presence of a source of flames or sparks: Welding, incandescent particles, electrical sparks, etc.
- illegal siphoning of fuel by workers;
- etc.

These hazards and dangerous situations may well be encountered in the work area. The qualitative risk assessment indicates that this is a probable, serious and high-risk event.

10.2.1.2. Electricity risk

H'sisk of electrification or electrocution following contact with an electrical conductor or a live metal part. The sources of hazards and/or dangerous situations are:

- Accessible live bare conductor (deteriorated cables);
- overhead or underground lines;
- non-electrical accreditation of the personnel involved.

These hazards and dangerous situations may well be encountered on the construction site. Indeed, electrical networks have been identified in places at the level of the treated tracks.

10.2.1.3. Risk associated with the use of heavy vehicles, machinery, machinery and tools

The main sources of hazards associated with the use of large construction equipment and heavy vehicles are:

- the incompetence of drivers;
- mechanical failure, particularly of the brakes;
- the lack of panoramic vision from the driver's station;
- access to the cabins;
- the reversing alarm does not work;
- certain manoeuvres, in particular reversing;
- the reversal.

The people most exposed are naturally drivers, site staff, local residents and pedestrians. It is a probable event, of medium severity and therefore of a medium level of risk.

10.2.1.4. Noise-related risk This is a risk resulting from exposure to a high noise environment that can lead to irreversible hearing loss and generate health problems (memory, fatigue, etc.). Sources of noise-related hazards are:

- Continuous sound exposure to very high noise or very high impulse noise;
- Impairment of verbal and telephone communication;
- Alarm signals masked by ambient noise.

Noise is also one of the main dangers associated with the use of large machines and other machines and tools (jackhammer, etc.) that will be used on this site.

10.2.1.5. Risk related to vibrations These are austeocular, neurological or vascular risks resulting from the use of pneumatic tools or the driving of vehicles or machinery. The main risks associated with vibration can come from:

- pneumatic hand tools (pneumatic hammer, chipper);
- driving construction equipment (jackhammer, backhoe, compactor, etc.);
- Forklift driving.

Shocks and vibrations can be generated by different types of machinery found in a road construction site: Construction machinery, jackhammers, rock drills, grinders, percussive machines, compactors, etc.

10.2.1.6. Risk of falling This is a risk of injury caused by a person falling from the same level or from a height. The injury may result from the fall itself or from hitting a part of machinery or furniture. The risks of falling are related to:

- A slippery floor, for example due to a spilled product or soil moisture;
- A poorly lit area (especially during night work);
- The use of mobile devices (ladder, scaffolding);
- Access to upper parts.

These hazards and dangerous situations may well be encountered in the work area.

10.2.1.7. Risk related to handling At this level, it is necessary to distinguish the risks associated with manual handling from any other handling.

• Risk related to manual handling This is a risk of injury under certain conditions, occupational diseases resulting from physical exertion, crushing, shocks, repetitive movements, bad postures. It generally comes from:

Handling heavy loads;

Repetitive handling at a high rate

• Poor posture taken by staff (distant loads, bent back). These hazards and dangerous situations may well be encountered in the work area.

• Risk related to handling excluding manual handling The risk may be related to the operation and circulation of the equipment, the load handled and the environment. Sources of hazard can come from:

- Handling tools (unsuitable for the task to be performed; in poor condition, irregularly maintained; safety devices absent or ineffective during use).
- Operators (unusual, occasional; not authorised for the machines concerned; medical fitness not verified; inadequate personal protective equipment)
- Environment (lack of safety protocol; lack of traffic plan; handling at height).

These hazards and dangerous situations may well be encountered in the work area.

10.2.1.8. Risks related to collapses and falling objects This is a risk of injury that results from the fall of objects from storage, an upper floor or the collapse of material. The risks associated with collapses and falling objects can come from:

- Objects stored at height (storage rack);
- objects stacked on high heights;
- Bulk material;
- Rubble from demolitions.

These hazards and dangerous situations may well be encountered in the work area.

10.2.1.9. Risk related to traffic and travel This is a risk of injury resulting from a traffic accident inside or outside the work area. Inside the work area, this risk can be linked to excessive speed or lack of visibility during manoeuvres. Outside the company, it is linked to the constraints of deadlines, the desire to distinguish and unsuitable vehicles. In both cases, we can say that the vehicle is in poor condition (brakes, lighting, etc.).

http://or a project, climate change risks can manifest themselves in three ways, which are precipitation, temperature and flooding. These are: Risk of spread of Covid 19 and other health risks on the In terms of health, there are risks of the spread of Covid 19 and the transmission of STIs and emerging diseases linked to the presence of a temporary foreign workforce, generally composed of isolated young men, who tend to increase contact with young girls and women within the local population, in the work zones.

10.2.1.11. Risk of extreme and long-lasting climate shocks

and close or episodic and localized flooding. They will affect

Precipitation: the increase in precipitation, which could cause:

- An increase in environmental stress on the roads;
- Increased moisture infiltration;
- A weakening of gravel pavement structures (loss of strength, longevity problems, etc.);
- a short lifespan.

Temperature: The increase in temperature would cause:

- Softening of the surface courses (bleeding and rutting of the asphalt);
- The increase in the crack rate (aging of the bitumen).

Flooding: The increase in flooding causes:

• The increase in water washouts;

• The increase in loss of access For measures to combat the impacts of climate change, there is the fight against erosion and other revitalization measures.

10.2.1.12. Risk of social conflicts The work will potentially require local labour, which will constitute a

potential source of increased local income. On the other hand, the non-use of local labour during the work could lead to frustration or conflict, which can affect the smooth running of the work and social cohesion. In addition, the non-respect of local customs and customs by staff can lead to conflicts with the indigenous populations.

The hazards and SLAs or risks are presented for each phase of the project in Table 85 in order of decreasing probability and severity.

			Risł	< asses	sment
Ma	in situations of Undesirable eve	nt Proba- Gra- Accep- <mark>Danger No</mark>	. (ENS)	/ Risks	bility vity
tab	iility Short circuit at the level of e	electrical installations; human clum	nsiness	such a	s risk of
fire	and explosion forgetting a cigal	ette butt; which can lead to death	, collisi	on betw	een two
vel	nicles serious risk of burns or ; 1	mixture of products injury to pers	on; this	risk 3 3	3
inc	ompatible or storage not can ca	use differentiated damage; the pre	esence	of equi	pment and
bo	lies (for the source of flames or	personnel) and even for the spark	s: weld	ling, pa	rticles
ро	oulation established in the area.				
	incandescent, electric sparks; I	Risk related to electricity that can			
	cause electrification or bare co	nductor under energization			
	electrocution following an acce	ssible (deteriorated cables);			
	Contact with a driver				
2	overhead or underground powe	r lines or part 3 3; non-electrical a	authoriz	ation	
	of live metal; It is to staff interve	ning the cause of neurological di	sorders	and	
	power cut in the area.				
I				L	

Table 85: Risk Analysis of Project Preparation and Construction Phase Activities

3	The incompetence of the drivers; mechanical failure, including brakes; lack of all-round vision from the driver's seat; access to cabins; non-functioning of the reversing alarm; the reversal. Uncontrolled or poorly controlled movement of vehicles and construction equipment or their mobile parts (e.g. mechanical excavators, etc.) the presence of a	Risk related to the use of heavy vehicles, machinery, machines a tools that can cause death, 3 injuries, fractures, lesions, temporary or permanent sensor losses.	and y	3	
4	temporary foreign workforce, generally composed of young men isolated, tending to increase contact with young girls and women within the local population, in the work areas.	Risks of spreading Covid 19 and the transmission of STIs emerging diseases that can han the smooth running of the 3 task and social cohesion, loss of hun life if possible.	and m (s nan	3	
5	Continuous sound exposure to very high noise or noise Very high impulse; Impairment of verbal and telephone communication; Alarm signals masked by ambient noise.	Risk related to noise that can le to irreversible hearing loss and generate 3 health disorders (memory, fatigue, etc.);	ad	2	
6	Pneumatic hand tools (pneumatic hammer, chipper); the operation of construction equipment (hammers - bulldozers or bulldozers, track loaders, self-propelled motor graders, compactor etc.) ; of forklift driving. Shocks and vibrations can be generated by different types of machinery found on a road construction site.	Risks related to vibrations or austeocular, neurological or vascular risks 3 resulting from the use of pneumatic tools or the dr of vehicles or machinery.	ne iving	2	
7	Improper storage, handling, handling or transport of materials and materials (e.g. excavated material, rubble or backfill); handling of heavy loads; repetitive handling at a high rate; Poor posture taken by staff (distant loads, bent back).	Risk related to manual handling 3 Equipment or materials accidenta spilled on workers that can lead to suffocation, injuries, fractures, tra	lly o uma.	2	

		•	-		
8	Excessive speed or lack of visibility when manoeuvring. Constraints of deadlines, will to distinguish, unsuitable vehicles. Poor vehicle condition (brakes, lighting, etc.).	Risk related to traffic and travel. of injury resulting from a 3 2 traf inside or outside the work area.	It is a r fic acci	isk dent	
9	Presence of asphalt during the installation of road surfaces.	not identified Risk of inhalation of contact. This risk can cause hea irritation of the respiratory tract, disorders; bitumen is also 3 2 possible carcinogens for humans according to the International Agency for Research on Cancer (IARC).	or skin idaches sleep	\$,	
10	Absence or ineffectiveness of collective protections, and individual.	Vulnerability of workers that can death, 3 2 injuries, fractures, les temporary or permanent sensor	lead to ions, y losse:	s.	
11	Excessive working hours and access to water and hygiene unsuitable.	Exposure to heat or sun and exe fatigue at 3 2 the cause of sunst dehydration, metabolic disorder disorder.	cessive troke, s, atten	tion	
12	Severe drought episodes and close or episodic and localized flooding.	Risk of extreme and long-lasting shocks; They will significantly af resilience of the target commun	l climat fect the ities.	e 22	
13	Improper operation of construction vehicles and machinery	Exposure of drivers, passengers parties to injuries, 2 3 fractures, and, where applicable, damage destruction of property Pipe rup resulting in injuries or lesions.	and th trauma or ture 2 2	ird	
14	Existing pipes in service				
15	the non-use of local labour during the work.	The risk of social conflicts could lead to frustration or conflict, which can affect the smooth running of work and social cohesion.	1	4	
16	Objects stored at height (storage rack); Objects stacked on	Risks related to collapses and falling objects: It is a	1	4	

great heights; bulk material;	Risk of injury that results from		
Rubble from demolitions.	falling objects from storage, an upper floor, or collapsing		
	material.		

Spring: field data, CECO BTP, June 2022

10.2.2. Operation phase

The operation phase of the road includes all actions related to the commissioning and use of the infrastructure itself by users and other populations. Operation and maintenance concern everything related to the operation of the roads developed after they have been put into service.

Although essential for development, road infrastructure is a source of fatal accidents. From 2011 to 2020, the National Road Safety Center recorded the number of accidents recorded in the city of Cotonou, the average of the last ten years on the number of accidents is 2774 cases including 680 cases of serious bodily injury and 76 deaths per year. On average, road fatalities account for 3% of cases of bodily injury; 25% for serious injuries; and 38% for mild cases (Extracts from the 2011-2020 statistics of the National Road Safety Centre). These accidents are due to, among other things:

- speeding;
- the narrowness and deterioration of the current road;
- the reckless crossing of local residents;
- non-compliance with the traffic lanes of each road user;
- the congestion of the road at the weekly markets;
- The helmet ruffles the hair (especially in women);
- Unlit roads, especially at night;
- Non-functioning traffic lights;
- The headset prevents hearing (priority argument among motorcycle taxis);
- The helmet is bulky;
- Traffic corridors are in poor condition and/or paved
 Etc.

Table 86: Overall statistics of accidents, vehicles involved, types of bodily injury during the years 2011 to 2020

Year	Accidents	Vehicles	Killed	Serious injuries	Minor injuries
2011	3235	6487	98	852	1177
2012	3031	5990	78	905	1285
2013	3135	6085	91	885	1532
2014	3432	6634	100	976	1547
2015	3335	6467	86	907	1429
2016	3272	6338	77	739	1213

2017	3075	5976	68	563	896
2018	2317	4463	55	448	562
2019	2036	3846	62	343	598
2020	873	1680	40	185	253
Average over the last t years 2774 years	en	5397	76	680	1049
Percentage of fatalities	3%	25%	38%		

The main causes of accidental spills are related to equipment breakdown or human **The** for seeables growth²⁰ of the population in the project areas, of the means of transport and the motivations of users require the consideration of safety and fluidity measures in order to deal with the constraints of load breaks at the level of the districts crossed. All hazards must be taken into account when operating the developed axes. The main accident risks associated with this phase are:

- Road risks related to traffic (accident, collision);
- Spillage of petroleum products;
- Fire;
- Explosion;
- Flooding.

The development of the roads concerned and related tracks will make it possible to avoid accidents related to their poor condition. On the other hand, speeding will increase with the good condition of the roads.

10.2.2.1. Spill of petroleum products

Causal factors

Factors that can cause an accidental spill of petroleum products include:

- Overflow of tanks or other containers;
- Leaking valve or connection;
- An accident during transport;
- Machinery breakdown;
- The lack of manipulative professionalism.

The hazards and ENS or risks are presented for the operation phase of the project in summary table 87 in order of decreasing probability and severity.

Table 87: Risk Analysis of Project Operations Phase Activities

			Risk	assessn	nent
No	Main danger situations	Undesirable Event (ENS) / Risks	Probability	Engraved	Acceptability
1	Ovetherwconteisersoitseakage Fi	re or explosion that can lead to	death, 3	2	
	a valve or an injury, fracture, les accident during transport; A bre of professionalism manipulative of	sion, connection; A trauma akdown of machinery; Lack Non-respect of the corridor			
2	passage of each type Traffic ac injuries, on the identified axes f the signs of level vertical and he	cident can 3 2 of user during tra ractures, trauma by fall Failure t prizontal signage.	affic cau o compl	se y with	

Source: CECO-BTP, June 2022.

10.2.3. Dismantling phase

The risks at this level will be linked to the demolition or dismantling of buildings and construction elements, the release of the company's living quarters, and the liberation of the developed roads. In addition, there is the risk of frustration and social conflicts arising from the loss of employment, the risk of couples separating due to adultery and the dismissal of leaders for treason or incompetence.

10.2.3.1. Demolition or dismantling of structures/roads Demolition is an extremely dangerous operation. Whether by hand or by mechanical process, demolition presents several risks for both workers and the public. The main risks encountered are structural collapses, tilting of machinery, falls from heights, flow and circulation problems as well as risks induced by co-activity. In the case of total or partial demolition, risks will arise and will regularly cause accidents in practice. More specifically, these include:

- the risk of falling objects;
- the risk of people falling when working at height;
- noise and vibration from demolition machinery;
- nuisances due to dust;
- exposure to dangerous substances (asbestos, etc.); The hazards and ENS or risks are presented for the decommissioning phase of the project in summary table 88 in order of decreasing probability and severity.

			Risk	assessm	nent
No.	Main danger situations	Undesirable Event (ENS) / Risks	Probability	r Engraved	Acceptability
1	Demolition/disassembly	Risk of collapse of structures o rubble, tipping of machinery, fa heights, flow and circulation pro well as the 3 3 risks induced by all this could cause death, injur lesions, traumas, etc.	r falling Ils from oblems a coactiv ies, frac	as ity, tures,	
2	Noise and vibration from demolition machines	Risk related to noise that can lead to irreversible hearing loss and generate health problems (memory, fatigue, etc.) Risks related to vibration or 3 austeocular, neurological or va resulting from the use of pneu the driving of vehicles or mach	2 ascular matic to hinery.	risks ols or	
3	Dust Kicking	Respiratory diseases of worke falls 3 2 on the same level	rs, injuri	es by	
4	Job Loss	Risks of frustration and social c risk of separation of couples du	onflicts; e to adu	22 ultery	

Table 88: Risk Analysis of Project Decommissioning Activities

Source: CECO-BTP, June 2022.

To this end, strict safety and prevention measures must be taken.

10.3. Risk prevention

10.3.1. Prevention and protection against fire and explosion risks

- organise storage (provide separate storage areas for fuel, bitumen and diesel);
- set up detection and alarm means;
- Establish intervention and evacuation plans;

- have sufficient extinguishing resources (fire extinguishers, foam concentrates and pumping equipment) on the site to overcome a fire very quickly before it develops; and equip vehicles and equipment with functional fire extinguishers;
- train staff and train them in fire extinguishing;
- Conduct simulation exercises to verify the functionality of the device;
- prohibit smoking in well-specified places (near flammable liquid storage areas for example);
- Strengthen surveillance measures.

10.3.2. Prevention of risks related to electricity

- provide personal protective equipment adapted to the personnel working on the electrical installations;
- Hold work sessions with the SBEE to move all identified cables in the work area prior to earthworks;
- mark open power lines;
- Use power line detectors if possible.

10.3.3. Risk management related to the use of heavy vehicles, machinery and machinery

The main factors in reducing these risks are:

- ensure that drivers are properly trained;
- Perform proper maintenance and regular testing is necessary to reduce the possibility of brake failure.
- install and maintain appropriate systems for access to the cabins and, where appropriate, to other parts of large machinery;
- equip the machines with a protective structure associated with a seat belt to hold the driver in place in the event of a rollover, a system for viewing and signalling reverse, ergonomic access, adapted cabs and protection against falling objects.
- train staff in safety for the workplace;
- Draw up procedures for the use of the machines;
- ensure that personal protective equipment (PPE) is worn: helmets, safety boots, appropriate gloves, etc.

10.3.4. Prevention of noise-related risks

- ensure the use of PPE (earplugs, noise-cancelling headphones);
- Organise special medical surveillance for exposed workers.

10.3.5. Prevention of fall-related risks Fall-related risk prevention measures are subdivided into collective and individual protection measures:

Collective protection

- organize the movement of people (horizontal and vertical circulation);
- Maintain floors and mark slippery areas;
- clear and light the passages (especially for night work);
- train staff;
- Maintain fall arrest systems.

Personal protection

- Wear non-slip shoes;
- Use harnesses when climbing.

10.3.6. Prevention of Handling Hazards

10.3.6.1. Prevention of risks related to manual handling Measures to prevent risks related to manual handling are subdivided into collective and individual protection measures.

Collective protection

- Organize workstations to eliminate or reduce handling;
- use handling equipment: pallet trucks for example;
- equip the loads with gripping means: handles, for example;
- Train staff to adopt appropriate gestures and postures.

Personal protection

• Wear personal protective equipment (shoes, gloves, etc.).

10.3.6.2. Prevention of risks related to handling excluding manual handling Measures for the prevention of risks related to handling, excluding manual handling, are subdivided into collective and individual protection measures.

Collective protection

- organise storage (reserved spaces, storage methods adapted to the objects, width of aisles compatible with the handling equipment used);
- Limit storage heights.

Personal protection

• Wear personal protective equipment (safety shoes, helmets, etc.).

10.3.7. Prevention of risks related to collapses and falling objects

Measures to prevent the risks associated with collapses and falling objects are subdivided into collective and individual protection measures.

Collective protection

- use equipment and accessories that are appropriate for the task;
- regularly check the condition of the machines;

- limit use to trained and authorised persons only;
- ensure visibility conditions; apply appropriate working methods;
- define the necessary safety zones (in case of risk of collapse or falling rubble);
- close the site and put in place the necessary signage;
- Organize the movement of people and vehicles.

Personal protection

• Wear personal protective equipment (shoes, gloves, etc.)

10.3.8. Prevention of risks related to traffic and travel

Preventive measures are mainly the following:

- provide suitable vehicles;
- Periodically maintain the vehicles;
- Organize travel;
- ban drinking and driving and acquire breathalyzer tests for control;
- Do not make phone calls during the journey (answering machine system).

10.3.9. Prevention of risks related to the diesel depot area

- carry out preventive maintenance and inspection of tanks;
- train and raise awareness among those involved in the tanks;
- use well-sized storage basins;
- have an internal operation plan;
- Train staff in fire suppression and first aid

10.3.9.1. Hazards associated with gas oil Gas oil consists of paraffin-based, naphthenic, aromatic and olefin hydrocarbons, with mainly hydrocarbons of type C10 to C22. It may also possibly contain methyl esters of vegetable oils such as rapeseed oil methyl ester and biocides.

• Physico-chemical properties For a better analysis, a presentation of the physico-chemical characteristics is given in Table 89.

Colour: Yellow	Physical Condition: liquid at 20°C	Smell: characteristic
Safety information:		Value
Vapour pressure		< 10 hPa at 40°C
Point – Lighting		>55°C
Flammability Limits		Approximately 0.5 and 5% volume of vapor in the air
Solubility in water		Virtually immiscible
Relative density		0.82 to 0.845 at 15°C

Table 89 : Physico-chemical properties of gas oil

Risk phases:	Description	
R40	Carcinogenic effect unlikely.	
R51/53	Toxic to aquatic organisms, where it can cause long-term adverse effects to the aquatic environment.	
R65	Harmful: May cause lung damage if swallowed.	
R66	Repeated exposure can cause the skin to dry out.	

• Fire/explosion risk Diesel is a 2nd category flammable product (or category C according to the term used in the ICPE nomenclature). It is not very volatile, hence a low risk of ignition under normal storage conditions.

The risks inherent in incomplete combustion are the production of more or less toxic gases such as carbon monoxide (CO), carbon dioxide (CO2), polycyclic aromatic hydrocarbons, soot, etc. Thus, their presence in the atmosphere leads to a deterioration in air quality with the consequent health risks for the population and workers present on the sites where this product is used.

• Toxic risk Acute toxicity – local effects: High concentrations of vapours or aerosols can be irritating to the respiratory tract and mucous membranes.

Contact of diesel with the eyes causes burning sensations and temporary redness. In the event of accidental ingestion, the product may be aspirated into the lungs due to its low viscosity and give rise to inhalation pneumonitis that develops within a few hours (medical supervision essential for at least 48 hours).

There is also chronic or long-term toxicity with this product: Frequent or prolonged contact with the skin destroys the skin coating and can cause dermatoses with risk of secondary allergy. A carcinogenic effect has been suspected, but there is insufficient evidence. Animal application trials have shown the development of malignant tumors.

• Ecotoxic risk The product is inherently biodegradable. It is toxic to aquatic organisms and can cause long-term adverse effects to the aquatic environment.

10.3.9.2. Hazards associated with heavy fuel oil

• Product Description Heavy fuel oil (FOL) is a liquid product derived from various refinery fractions, usually residues. Its composition is complex and varies depending on where the crude oil comes from. Considered as substances, heavy fuel oils are made up of products of

paraffinic, naphthenic and aromatic. They may contain sulphur derivatives and organic acids.

• Physico-chemical properties Table 90 gives the characteristics of a heavy fuel oil with a low sulphur content.

Table 90 : Physico-chemical properties of heavy fuel oil

Physical condition: Smell: characteris	tic Colour: liquid yello	w at 20°C
Safety Information: Value		
Vapour pressure Negligible at usua	I temperatures Flash	point≥ 70°C Flammability limits
Approximately 0.5 and 5% by volun	ne of vapour in air Wa	ter solubility Immiscible Relative
density 0.93 – 1.05 Risk phases:	Description R45 May of	cause cancer
R52/53 Harmful to aquatic organi environment.	sms, may cause lon	g-term adverse effects to the aquatic

• Fire / explosion risk Heavy fuel oil can present risks of ignition or explosion under certain conditions related to the accidental release of vapours during storage and the presence of an ignition source (hot spots for example). In the event of a fire involving this type of fuel, the most often used means of extinguishing are: foam, CO2, powder and possibly sprayed water with the addition of wetting agent if possible. It is not recommended to use water in the form of a stick jet and the simultaneous action of foam and water on the same surface. As with diesel, its incomplete combustion can produce more or less toxic gases such as carbon monoxide (CO), carbon dioxide (CO2), polycyclic aromatic hydrocarbons, soot, etc. Their presence in the atmosphere promotes the deterioration of air quality and consequently health risks for the population.

• Toxic risk Acute toxicity – local effects: High concentrations of vapours or aerosols can be irritating to the respiratory tract, mucous membranes and eyes. Good conditions of use at temperature or physical condition at room temperature do not allow skin penetration.

Chronic or long-term toxicity: Prolonged and repeated inhalation of fumes, vapours or aerosols can lead to benign pulmonary fibrosis or even possible cancer of the respiratory system, although this has never been verified in epidemiological studies. Following prolonged and repeated exposure over a long period of time, characteristic skin lesions such as oil pimples or warts may develop, these may develop into malignant tumors. Prolonged and repeated contact with heavy fuel oils should be avoided. They contain polycyclic polyaromatic hydrocarbons, some of which have been shown to be carcinogenic in animal experimentation.

• Ecotoxic risk Heavy fuel oil is harmful to aquatic organisms and can cause long-term adverse effects on the aquatic environment. Given its physicochemical characteristics and the available biological data, it can be dangerous for terrestrial or aquatic fauna and flora. Like diesel, the product is inherently biodegradable, but its degradation is very slow.

10.3.10. Study of accidentology

The objective of this section is, of course, the different types of plausible accidents that can occur in the context of such activities. To this end, there was talk of investigations at the database level relating to this type of activity. A summary of some accidents that have occurred throughout the world is provided in Table 91 after consulting the BARPI database.

The objective of the analysis of these accidents that have occurred in the past is to highlight the "risky" operating procedures and procedures, in order to be able to propose preventive measures capable of limiting the risk: this practice is called "feedback".

CECO CONSTRUCTION/SIRAT

Table 91: Worldwide accidents related to the storage of heavy fuel oil and diesel (according to the BARPI database)

Accidents	Main consequences
14/03/81 – CHATEAUROUX (36) In a 9000 m3 depot (capacity of 18000 m3) of FOD/GO/petrol distributed in 9 tanks (6 fixed roofs and an internal screen toilet bowl fire of malicious origin is lit. Through the basin, the fire spread to the entire repository (domino tank) – Fall o basin). The gas phase of a GO tank explodes (roof opening). The free atmosphere of the internal merlon screen explode bottom rises and falls back on the merlon. The 900 m3 of super create a wave of pollution that submerges the embankn network (combustion, explosion, avoided pollution). The atmospheric leak (over 21 h) – Soil pollution requires the inter use of 200 m3 of foam concentrates. 7000 m3 of hydrocarbons were destroyed. The overall cost is estimated at 35 milli control strategy was not adequate in this case.	Large Bowl Fire Explosion), / fire of several tanks (effect a f a tank on the + 3500/4500 m2 of es, the seal/bottom weld tears, the nent and infiltrates the rainwater vention of 144 firefighters and the on francs. It seems that the
19/12/82 – TACOA (VENEZUELA) In a thermal power plant, the superheated gas phase (80°C instead of 65°C) of a 40,000 m ³ tank filled with 40% heavy f (ignition by 2 employees during gauging work). The ejected fixed frangible roof falls back into the 33,000 m ³ basin (= up higher at the basin fire). After 6 hours of tank fire, a boil over occurs. A fireball rises to more than 300 m, a wave of burn embankments (H=6m) ignition, UVCE, fire, Boil- and extends up to 400 m below. In the process, it flooded the basin wit greater than tank overpressure = upper roof opening = more than 20 days of tank fire), destroyed 60 vehicles located or injured access as well as 70 homes and 2/3 of the power plant. 160 people were killed, including 40 firefighters, and 500 total cost of the damage is estimated at 300 million francs. The only access road to the ferry, narrow and winding, passe with emergency vehicles, press and many onlookers. Forty thousand people, mainly slum dwellers, were evacuated by	uel oil (FO - PE=71°C) exploded Spreading, fight and interfection ing hydrocarbons submerges the Paffother tank of FO (basin fire = 1 the only track Many dead and 0 other people were injured. The es below the basin. It is crowded the army and rehoused in tents.

 $Flash _ Explosions/Fires$ $Falsh _ explosion occurs and a fuelled fire is$ $Falsh _ falsh = expl$

	Soil pollution – Deaths and injuries.
20/06/90 – USSR	Fire
A bolt of lightning struck a tank of fuel which ignited, causing the fire and the explosion of three other nearby tanks. Total capacity of the lost product: 11400 m3. The fire consumed about half of the product of the tanks that exploded and polluted the surrounding soil. About 65 tonnes of foam concentrate were used to put out the fire.	
15/07/2000 - CHATEAUPONSAC (87) In the depot of a fuel wholesaler, corrosion of the bottom of a 40 m ³ tank caused the leakage of 20 m ³ of heating oil into the retention basin, the drain port of which did not have a shut-off device. The fuel flows into the depot's rainwater network, which is equipped with a hydrocarbon separator (300 I retention capacity) that does not prevent the diesel from being spilled into the public E.P. network. Th GARTEMPE is polluted over 20 km. The firefighters installed 2 floating booms. Water catchments are not stopped but swimming is prohibited. An association files a complaint. The department's ICPE inspectorate sanctions various non-compliance with the regulations (tightness of retention tanks, checks of tanks, means of extinguishing in the event of fire) and inspects 40 similar depots. Numerous non-conformities (tightness of the unloading areas, volume of retention tanks, hydrocarbon separator) were highlighted.	Spreading by corrosion and β ollution

11/12/205 – BUNCEFIELD (UK) Explosions followed by a fire occur in the Buncefield oil depot, the fifth largest oil depot in Great Britain, storing 150,000 tonnes of fuels (petrol, diesel, kerosene). The first and largest explosion is classified at level 2.4 on the Richter scale. Two subsequent explosions occurred in the following minutes. 43 people were injured, most of them by shards of glass.

The 10 employees present on the site at the time of the accident are safe and sound. A gigantic blackish cloud containing irritants is spreading through southern England, affecting Brittany and Normandy and then moving west to Spain. 2000 people were evacuated and then returned to their homes the same evening. Firefighters brought the fire under control after 60 hours of fighting, but vapours from a tank spared by the fire ignited on 14/12/2005 in the South-

morning. This fire was contained by the emergency services who let it go out of itself. At the height of the crisis, 180 fire fighters were mobilized as well as 26 pumps and 20 vehicles. In total, 250 m³ of foam concentrate and 250,000 m³ of water were used, which raises fears of groundwater and surface water pollution. According to a French oil company that co-operates the depot, the clean-up, ignition, UVCE, fire of the site should amount to € 7.5 to 10 million; the reconstruction of the tanks would cost € 37 million and the value of the lost fuel € 52 million. Other companies located in the industrial zone have also suffered significant damage: about twenty companies employing 500 people have been destroyed, about sixty companies employing 3,500 people must carry out major work before any resumption of activity. The ignition of a flammable cloud likely formed from a large leak on a fuel tank or line (unidentified source) is believed to have caused the accident. The 1st explosion would have occurred at the site's car park but the ignition point has not been identified.

10.3.10.1. Feedback on the consequences of accidents The above list, which takes stock of some accidents, highlights the events that may be feared in the context of the storage of hydrocarbons (fuel oil, diesel, kerosene, etc.)

- Bowl fire,
- Tank fire,
- Bin explosion,
- Boil over.

Fire and explosion are the most spectacular and often the most serious accidents for hydrocarbon storage. However, they are not the most likely type of accident since, for these installations, more than one accident in two concerns the spreading of hydrocarbons, whether or not associated with another accidental event.

10.3.10.2. Feedback on the causes of accidents

The causes of an industrial accident are frequently multiple and difficult to establish. Moreover, their identification generally presupposes in-depth investigations which are carried out systematically only in the event of serious accidents or accidents that are a priori instructive. Finally, there is, in most cases, a wide margin of interpretation in the classification of causes. The main causes that have been identified for both the storage of fuel oil and diesel are:

- Hardware failure;
- human failure;
- malice;
- insufficient intervention;
- external accident.

10.4. Detailed risk analysis

The objective of this analysis is to verify the level of risk control for the facilities studied. It consists of systematically studying the possible scenarios. Then to look for their causes and to identify the preventive measures associated with them. Finally, to review the expected consequences, particularly for sensitive targets, and to identify the measures to control the consequences. Following this analysis, a level of severity and a level of probability are defined for each scenario and a level of risk is deduced (Table 92).

Table 92: Risk Matrix Factor Levels (P, G)

Probability scale (P) Severity		scale (G)	
Score	Meaning	Score	Meaning
P1 = improbabl e	 Never seen with installations of this type; Almost impossible with these kinds of installations. 	G1 = unlikely	 Minor impact on staff No downtime Low environmental impact.

P2 = rare de	 Already encountered in posits of this type; Possible in this reposito 	G2 = Pry minor	 Medical care for staff Minor damage Small loss of products Minor effects on the environment
P3 = Occ happen with	 Already encountered with installations of this type; asional but can occasionally installations of this kind 	G3 = important	 Personnel seriously injured (extended work stoppage) Limited damage Partial shutdown of operations Effects on the important environment
P4 = Arrive frequently	es two to three times a year in the establishment	G4 = critical	 Lifelong disabling injury, (1 to 3 deaths) Significant damage Partial shutdown of operations Significant environmental effects
P5 = Arrive constant ir times a ye	es several times a year with stallations (more than 3 ar)	G5 = catastrophic	 Several deaths Extensive damage Long production downtime

By combining the two levels (P, G), we form a matrix of risks considered acceptable or not. In a simple way, we have created a grid to evaluate the level of risk related to the operation of the depot by assigning them a color code ranging from green to red).

10.4.1. Presentation of the analysis results by "bow tie"

Three types of scenarios were studied, including the scenario of:

- Bowl fire,
- Bin explosion,
- Bin fire, Boil over.







Hazardous Events Loss of	Causes	Prevention	Р	Consequences	Consequence control	Ris	k Level G
integrity Ta Product Overfill of	 ank Corrosion or the tank Collision with a vehicle Internal deletion Overfilling 	 Tank inspection and monitoring procedure Tank filling procedure 	P2 I tank	₋eak on the storage	 Visual detection Retention basin 	G2	
Cricessel rinet fieobasin (see leak and temperature greater than the flash point or sufficient energy to initiate the fire	Work by pointLightning	 Open fire work procedure Prevention plan and fire permits Consideration of lightning risk Construction supervision Visual detection 	wate basi	er P2 G4 retention n fire	 Fire protection Mobile means of intervention 		
Hot boil-over	 Bin fire Presence of firefighting 	 Sufficient fire extinguishing facilities Presence of surge protector 	• Fo at th	rmation of a P2 fireball e bottom of the G4	 Implementation of tank procedures and equipment 		

Table 93: Summary of the Analysis and Presentation of Risk Levels

10.4.2. Detailed study of scenarios

The detailed study shows that two scenarios present risks that are significant but not unacceptable. These are the bin bin bin bin bin and the bin fire. It should be noted that within the framework of this project, a large part of the activities will take place along road sections. Some of these sections have the advantage of having gas stations, however the tracks are devoid of them. Also, companies could have to store quantities of fuel in the order of 20 to 30 m3 for the and the operation of the machines present on the site.

10.4.2.1. Description of the scenario A boil-over is a sudden foaming phenomenon involving atmospheric tanks and resulting from the transformation into steam of liquid water (water bottom, free water, emulsion) contained in a burning tank.

The bowl fire, on the other hand, can be due to a loss of containment of the tank and a fire that can be caused by lightning.

10.4.2.2. Boil-over requirements The following

conditions are required:

- the presence of water to be transformed into steam, which can be linked to the following causes:
 - The hydrocarbon naturally contains a small fraction of water that can migrate by density to the bottom of the tank (settling). It only takes about 1 cm of water at the bottom of the tank to expel its contents;
 - Penetration of rainwater through the vents;
 - condensation of air moisture due to tank respiration and day/night cycles;
 - introduction of cooling or extinguishing water in the event of a fire. the creation of a heat wave (or, in other words, a hot zone) that comes into contact with the water contained in the tank.

10.4.2.3. Possible effects The effects of such an accident can be felt at several levels, namely the installations themselves (risk of destruction of the cooling rings), the site personnel and the immediate environment. In addition, there can be effects such as:

- the formation of a fireball with the appearance of the effects of thermal radiation;
- the overflow and spreading of burning diesel outside the retention basin.

However, the quantities stored are not as large and the roads to be rehabilitated are more or less far from the homes.

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However, measures will have to be established to limit the risks, in particular by placing the remote sites and their equipment, in particular the asphalt plant in more or less less far from homes.

10.5. Prevention and Mitigation Measures

In view of the scenarios identified and the corresponding assessment of the consequences, the Consultant considered it necessary to make some recommendations to the successful bidder, in the direction of a good prevention and/or control of potential accidents, in particular a bowl fire, a tank fire, a boil-over or a tank burst. These recommendations are recorded in Table 94:

Table 94: Recommendations for the storage of fuel oil and diesel fuel oil

Mitigation measures Accident prevention measures

- 1. Preventive maintenance and inspection 1. Have an internal operation plan for the tanks (tanks + tanks) and the (calculation of the needs for related extinguishing equipment: water, foam concentrate and
- 2. Work permit and pumping procedures). Fire permit 2. Train staff in

extinction

- 3. Awareness of personnel and fire and first aid.
- 4. propiniations do and a construction of the second secon
- Tankers in good condition and a fire handler mastery of unloading procedures
 Have enough boxes for foam tankers that discharge the solution
- 6. Regular maintenance of the foaming trucks inside the tank to extinguish a possible tank fire.
- 7. Checking the tightness and the 5. Install foam weirs on the size of the retention tank and edge of the retention basin and which provide a retention for the tank will allow the foaming diesel solution to be spread over the entire basin.

The boil-over and the bowl fire emerge from the study as the accident scenarios that can have more or less significant consequences.

However, these two possible types of accidents can be avoided if appropriate measures are taken and respected as indicated in the table above relating to the storage of fuel oil and diesel.

10.5.1. Protection and signage of the site of the site Safety devices must be put in place on the sites to delimit the areas of the work and to inform the population explicitly of the work in progress,

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the risks associated with them as well as the safety instructions to be followed. A traffic plan will also need to be provided for the entrance and exit of the project site. Table 95 defines some of the safety warning devices on construction sites.

Mechanism Securing	Illustration image	Objectives
Signalling Tapes	00	Mark the perimeter of the worksite or intervention areas.
Marking cones		Mark the perimeter of the worksite or intervention areas.
Flexible Expandable Barriers Barriers		Temporarily mark the perimeter of the construction site or intervention areas.
Barriers on weighted pedesta	Is FFFF	Temporarily mark the perimeter of the construction site or intervention areas.
Traffic cone (fluorescent orange colour with reflective strip)		To be placed a few dozen meters from the perimeter of the work to signal the execution of the work.
Construction site signal tripods		Quickly indicate the areas of temporary construction site (to be placed a few dozen meters from the perimeter of the work, especially for trenches).

Table 95: Some Signalling Devices Related to Safety on Construction Sites

Panels speed limit.



Anticipate the slowing down of vehicle speed before accessing the perimeter of the work.

Source: CECO-BTP, June 2022

10.5.2. Occupational Risk Assessment

The assessment of occupational risks is used to plan preventive actions in the company, taking into account priorities.

Burns are the first risk, but headaches, nausea, eye or ENT irritation, and chronic respiratory diseases are common. In addition, the use of vibrating compaction machines, pushing and pulling forces for spreading and manual raking cause many musculoskeletal disorders. In view of these risks, it is imperative to ensure that staff are trained in the dangers of this sector of activity, to renew information on preventive actions, to provide appropriate personal protective equipment, and to implement enhanced medical surveillance to assess the impact of the potential risk on the health of bitumen workers.

• The risks associated with bitumen and its fumes Bitumen is a very viscous black material that comes from the fractional distillation of petroleum. Bitumen has replaced tar from the distillation of coal, as the latter is classified as carcinogenic (which can cause skin, lung and bladder cancer). Bitumen is used mainly for road surfacing, as a binder in asphalt, mixed with aggregates of varying sizes (artificial asphalt). It can also be used in roof waterproofing work. Bitumen is a complex product that can contain various additives such as products intended to fluidize bitumen and lower its viscosity.

Bitumen is solid at room temperature, and, to be used, it must be more or less heated depending on the processes used, which generates bluish fumes that cause occupational exposure and environmental pollution. Smoke emissions increase with the application temperature, low in coatings at 60°C "cold", higher in "warm" processes at 110°C, high with the "classic" process at 160°C or during waterproofing work at 240°C. Fluxed bitumen is bitumen softened by the addition of fluxing oil of petroleum or vegetable origin, to make surface coatings. Fluxed bitumen is increasingly being replaced, when application permits, by water-based bitumen emulsions that reduce fumes and are applied at lower temperatures.

The asphalt is spread with heavy means using a machine called a paver over large areas to be treated, then compacted by a road roller, or manually

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on small areas for road repairs, with shovels, rakes, wheelbarrows, compaction plates or vibrating rollers, the hot asphalt being brought in by truck.

Analyses by the IARC (International Agency for Research on Cancer) have not been able to establish a link between exposure to bitumen fumes and the various forms of cancer, and there is no table of occupational diseases relating to bitumen to date. However, bitumen contains, in much smaller quantities than tar, polycyclic aromatic hydrocarbons PAHs, the main source of smoke toxicity, which penetrate in the body transcutaneously and by the respiratory route. Although the toxicity of all PAHs is not known, several of them are classified by the IARC as probable carcinogenic (benzopyrene), or possible, and other substances may be implicated (naphthalene, polyaromatic sulphur, etc.).

The photo-toxicity of bitumen fumes, and especially that of tar, is thus maximized by the use of these materials outdoors, as the sunlight causes a photochemical skin reaction.

On the other hand, in work in covered car parks, it is the confinement that increases the atmospheric concentration of toxic substances and the risks associated with their inhalation. There is an exposure limit value for bitumen fumes, set at 5 mg/m3 for an exposure period of 8 hours/day. In addition, studies are still underway to assess the carcinogenic risk of bitumen by the International Agency for Research on Cancer (IARC).

The modes of exposure are:

- the dermal route by direct contact with bitumen and soiled clothing or tools,
- the transcutaneous route by contact with smoke, and the respiratory route by inhalation, is all the more important when the product is spread at high temperatures;
- Burns represent a significant risk due to contact with hot soil or splashing hot liquid. In addition, the proximity of a radiant and radiant heat source can lead to headaches, nausea, hypersweating, tachycardia, hypotension and, combined with high air temperatures, cause heat syncope;
- Upper and lower respiratory tract disorders: acute manifestations such as pulmonary and laryngo-pharyngeal irritations, or chronic respiratory manifestations (bronchitis, emphysema);
- Eye irritation (conjunctivitis) and skin irritation.

Other hazards of road surfacing work

• Collisions between workers and machinery are the cause of crushing of limbs;

- Vibrations transmitted to the limbs, pushing and pulling efforts, manual handling of heavy loads, cause multiple musculoskeletal disorders (MSDs): dorsolumbar spinal pain, traumatic injuries to the shoulder, elbow, ankle and foot, etc.
- Noise from machinery and the site environment (motorway, etc.) often exceeding 85 dB;
- Sunstroke and erythema, due to the prolonged action of solar radiation on the head and skin, heat cramps.

In addition, we have also tried to show in this study the jobs that are most affected, namely (Table 96):

Table 96: Workplace more affected

Risk Professions			
Workers in charge of stripping and digging.	 Cement dermatitis; Poor posture heavy loads; Absorption of silica dust and bitumen vapours. 		
Operator of heavy construction equipment (concrete mixers, loader excavators, • Heat stress, noise pollut	 Absorption of vapours and dust; repetitive movements, risk of falling; risk of accident, whole-body vibrations; ion, truckers, etc.) 		
Electrocution Technicians/Electricians; Absorption of vapours and dust; Risk of accident.			

Source: CECO-BTP, June 2022.

10.5.3. Means of preventing the risks of road paving work Faced with all these risks, it was considered useful to propose possible prevention measures to mitigate the potential impacts on workers and the population. Depending on the type of site, on large areas (motorway) or on small surfaces (pavement), the product used (fluxing oils, etc.), the process used (application temperature), the duration of exposure, the conditions of spreading (in the open air or in a confined environment, manual or mechanised), the technical and organisational characteristics are different, the risks are more or less significant and the means of prevention must therefore be adapted. Thus, in all cases, occupational exposure to asphalt is part of situations where the employer's assessment of the chemical risk is imperative and employers must organise appropriate collective prevention and require their employees to wear personal protective equipment.

Collective prevention

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It is a question of choosing the least dangerous additives and operating methods: Possibility of using rapeseed oil derivatives rather than petroleum oil for fluxing products, warm or "cold" asphalt in certain situations (in surface layers, finishes).

- Adaptation of workstations to reduce exposure to irritants, in particular through improved automation;
- Regular maintenance of the machines to reduce unwanted noise and unwanted vibrations;
- Vacuum up fumes when working in a confined environment;
- Favor the use of ergonomic mechanized equipment, to limit manual handling and awkward postures;
- Organize the work according to the following procedures:
 - Start the working day as early as possible, especially during wintering, to prevent the effects of heat and minimize joint UV exposure;
 - Work with your back to the wind;
 - Provide fresh drinking water and sanitary facilities near the site (changing rooms, toilets, washbasins and showers with workshop soaps for the hands), in order to guarantee regular washing of workers,

Work carried out at the edge of the traffic lanes:

- Signal and mark the site to prevent and limit the risk of road accidents.
- Carry out enhanced medical surveillance of employees exposed to bitumen (periodic visits at least annually, with pulmonary function examinations and chest X-rays, and bladder cancer screening).

Individual prevention

It is common to note on road construction sites that workers do not wear all the personal protective equipment (PPE) required to ensure their safety.

The employer must provide and ensure the proper use of PPE, any worker who refuses or refrains from using PPE, in accordance with the instructions, may be held liable and subject to sanctions.

All employees must be informed of the risks against which personal protective equipment protects them, the conditions of use, including instructions for the storage and maintenance of this equipment. He must also know his responsibilities in the event of non-compliance with the instructions for use.

For this reason, a training program is needed to enable workers to learn how to adjust and wear PPE, how to get maximum protection from it, and how to care for it.

Also, each employee must be well aware of the risks against which the

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personal protection protect it, the conditions of use, in particular the instructions for the storage and maintenance of this equipment. He must also know his responsibilities in the event of non-compliance with the instructions for use

To ensure the required knowledge, a training program is needed to enable workers to learn how to fit and wear PPE, how to get maximum protection from it, and how to care for it.

• To limit transcutaneous and dermal exposure:

Avoid splashes on the skin, for this purpose:

- Class 3 or 2 high-visibility signal vest

- Equip staff with non-flammable clothing covering the whole body with long sleeves and legs, gloves with cuffs to protect hands in contact with hot petrochemicals, safety boots or shoes, with heat-insulating soles and resistant to the aggressiveness of asphalt. Various personal protective equipment (PPE) must be made available to agents according to the risks to which they are exposed. Table 97 gives information on the PPE that must be available to site personnel.

Table 97: PPE Indications

Type of risks Observation equip by traffic Clothing or vests To m	ment/Comments person ake it possible to disting	al protection Risks of collisions ush fluorescent/reflective
vehicles from construction work	ers and to improve their	perception by motorists. Risk of
construction work on the treatm	ont plant. Dick of injury r	plated to Claves resistant to the
bondling of chicoto. Derforation		
nandling of objects. Perforations	s	
Risks related to exposure Chem	ical protective clothing (luel, body oils;
Gloves: lubrication, petroleum re	esidues Equipment from	the maintenance
of respiratory protection equipm	ent	
or respiratory protoction equipm	ont.	
point colvente etc.)		
, paint, solvents, etc.)		
Giare of Sume-Byestedy Says yalsoa	sses (can (tinted)	
cause falls in height). height).		
Dust hazards	Standardised mufflers	
	(e.g. EN 149 standard)	-
Risks of damage to welders'	Safety bezel or face	
evesight	shield	-
Cycolyni		

Source: CECO-BTP, June 2022.
10.5.4. Hygiene, health and safety of staff The company in charge of the work must, within the framework of the project, join an inter-company occupational medical service which will ensure recruitment visits and periodic control visits. It will also have a pharmaceutical first-aid box on the project site.

Operating and safety instructions will be given and commented on to each worker at the time of hiring, who must strictly observe the provisions. These instructions will be permanently posted at the logistics base and accessible to all staff.

10.5.5. Relief

The list of emergency telephone numbers will be displayed as well as the structure of the text to be read in the event of an accident (location, telephone number of the fire brigade or medical transport services, etc.). A first aid kit will be regularly checked and stocked and made available to staff.

Fire extinguishers, which are checked every six months, will be installed on the site during the work and placed in strategic, accessible and known places to all personnel.

10.6. Some security measures

To limit the risk of accidents or their effects, the following provisions must be implemented by the Company:

- Fencing the various bases and regulating access before the start of work;
- Setting up beacons and signage on the various construction sites to limit traffic accidents;
- organise storage (provide separate storage areas for fuel, bitumen and diesel);
- set up detection and alarm means;
- Establish intervention and evacuation plans;
- Provide the workforce with appropriate safety equipment (safety shoes, helmets, dust and noise masks, gloves, etc.);
- Carry out under constant supervision any handling of hazardous substances;
- Store hazardous substances in leak-proof containers in secure storage areas, protected from the elements. Keeping storage areas locked and controlling the inventory of these substances;
- Respect the speed limits, which are: 20 km/h on construction sites and quarries; 35 km/h in temporary diversions and 40 km/h in built-up areas;
- Erect barriers to prevent the public and strangers from entering the construction sites;

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- Establish vehicle traffic instructions inside construction sites and on the road under construction;
- Design and build site facilities, transportation, loading, unloading and storage of materials in a manner that does not compromise safety;
- To provide sufficient lighting to the site and its surroundings to prevent any risk of accident and to facilitate the intervention of the safety teams;
- Clean and make non-slippery in all circumstances by appropriate means (sanding or salting, etc.), scaffolding, passageways, bridges, platforms, stairs, steps, etc.;
- Arrange heating and lighting installations, as well as deposits of easily flammable or explosive materials in such a way as to prevent the dangers of fire, explosion and asphyxiation;
- Ban smoking in car parks and in premises where flammable or explosive materials are deposited or used;

PRECAUTIONS TO BE TAKEN

- 1. Announce the state of emergency by triggering the alarm;
- 2. Disable access regulation mechanisms;
- 3. Give instructions for the movement of vehicles and pedestrians specific to the emergency situation;
- 4. Alert the managers of the neighbouring mines;
- 5. Evacuate the danger zone;
- 6. Notify external organizations: Town Hall, Fire Brigade, Hospitals or health centers in the area;
- 7. Check if the premises are completely evacuated;
- 8. Provide first aid to victims;
- 9. Inform the victims' families;
- 10. Give the signal for the end of the alert;
- 11. Inform the media;
- 12. Take stock of the damage;
- 13. Establish a business resumption program.

11. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The purpose of the Environmental and Social Management Plan (ESMP) is to define and engage the responsibility of the promoter for the ecologically sustainable management of the impacts of its project by involving all the parties concerned during the life of the activity and, if possible, after the project.

Specifically, it aims to:

- bring the project into compliance with applicable national environmental and social legal requirements and international standards governing the activity;
- Describe the mitigation, compensation, enhancement and institutional measures required to prevent, minimize, mitigate or compensate for negative environmental and social impacts or to increase positive impacts;
- · Address capacity-building needs to improve environmental and social capacity;
- propose related developments to improve the environmental and social acceptability of the project;
- formulate indicators for monitoring impacts according to the phases of studies, work and operation of the infrastructures;
- propose monitoring measures to ensure the proper execution of mitigation and reclamation measures during the construction phase;
- estimate the investment and operational costs relating to the various measures proposed (mitigation/subsidy), the monitoring programme, consultations, complementary initiatives and institutional arrangements.

The impact assessment and the environmental and social measures required to mitigate and/or compensate for the negative impacts and optimize the recognized positive impacts on the environment are recorded in Table 98.

		RESPONSIBLE			
ACTIVITIES	INDIGATORS	TIMELINE	MONITORING FOLLOW-UP		COST (FCFA)
1.1.b.1.1. Ensure fair and prior compensation for PAPs	Number of complaints registered and processed	Preparation phase	Company/ SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
1.1.b.1.2. Implement the RAP completed for the project	 RAP Implementation Report Number of complaints registered and processed 	Preparation phase	Company/ SIRAT	 MC DDCVDD / AL Cotonou City Hall 	532. 892. 943
1.1.b.2.1. 1.2.b.1.1. Inform and sensitize the population sufficiently on the date of the start of the work for the individual measures to be taken and inform them in advance of the temporary network shutdown programs that may occur	 Number of past media communications Number of complaints registered and processed 	Preparation phase	Company /SIRAT	 MC DDCVDD / AL Cotonou City Hall 	РМ
1.2.b.2. 2. Make arrangements to avoid multi-hour outages	Number of complaints	Preparation phase	SBEE/SONEB	 MC DDCVDD / AL Cotonou City Hall 	-
1.2.b.5.1. 1.2.b.6.1. Destroy the trees just needed and carry out selective deforestation	Number of tree feet felled	Preparation phase	Company/SIRAT	 MC IF/AL DDCVDD / AL Cotonou City Hall 	-
1.2.b.5.2. Take the tree cutting permit before the trees are cut down	Existence of tree cutting permits	Preparation phase	Company/SIRAT	 MC IF/AL DDCVDD / AL Cotonou City Hall 	РМ
1.2.b.5.3. 1.2.b.6.3. Ensure maintenance until maturity of all trees	 Frequency of watering of the plans 	At all stages	• DDCVDD / AL E	• MC ntreprise/SIRAT	PM

			ACTIVITY		
MANAGERS	INDICATORS	IIMELINE	MONITORING	AFTERCARE	COST (FCFA)
alignment and tree gardens to be set up	 Success rate of planted plans 			 Cotonou City Hall 	
1.2.b.5.4.; 1.2.b.6.4.; 3.2.b.3.2.Ensure compensatory reforestation in the degraded areas of the commune of 2000 plants of local species such as Khaya senegalensis and other species with a high rate of carbon sequestration	 2000 plants, species with a high rate of carbon sequestration, planted and maintained in the municipality 	A all stages	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	60.000.000
1.2.b.6.2. Prioritize trees with high carbon sequestration in the landscaping to be implemented	 Rate of high carbon sequestration trees planted 	Preparation phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	
1.2.b.7.1.; 1.2.b.10.1.; 2.1.b.1.1.; 2.1.b.2. 1. ; 2.1.B.3.1.; 2.2.b.6.1.; 2.2.b.7.1.; 2.2.b.9.1.; 2.2.b.10.1.; 2.2.b.13.1.; 2.3.b.1.1. Provide site employees with appropriate PPE (helmets, mufflers, ear kits, coveralls) and ensure that they are effectively worn	 100% of employees are equipped and use appropriate PPE Rates of illnesses and accidents related to absence PPE 	All phases	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	56.000.000
1.2.b.7.2; 2.1.b.1.2. ; 2.1.b.3.2.; 2.2.b.6.2. 2.2.b.9.2. Water potentially dusty areas regularly	 Number of daily waterings Number of complaints registered and processed 	Preparation and construction	Company/SIRAT	 MC DDCVDD/AL Cotonou City Hall 	РМ
1.2.b.7.3.; 2.1.b.1.3.; 2.1.b.3.3.; 2.2.b.6.3.; 2.2.b.9.3. Use machines in good working order		Preparation and construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-

			ACTIVITY			
MANAGERS	INDICATORS	IIMELINE	MONITORING	AFTERCARE		
1.2.b.8.1.; 2.2.b.11.1. Raising awareness among site users for strict compliance with barrier measures against covid	 Number of awareness-raising activities conducted per week Number of covid cases detected on the construction site 	Preparation and construction phase	Company/SIRAT	 MC DDS/AL DDCVDD / AL Cotonou City Hall 	-	
1.2.B.8.2.; 2.2.b.11.2. Equip construction sites with collective protection systems (hand-washing devices)	 Availability of functional handwashing facilities 	Preparation and construction	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	1.050.000	
1.2.b.9.1. ; 2.2.b.12.1. Conduct awareness-raising sessions coupled with screening for these diseases and distribution of condoms	 Number of awareness-raising sessions organised per quarter Condom stock on site 	Preparation and construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	PM	
1.2.b.9.2.; 2.2.b.12.2. Periodically raise awareness among users about contagious diseases (STD, STD, STD, HIV, AIDS, HEPATITIS, etc.) and the consequences of unwanted pregnancy	 Number of awareness-raising sessions organised per quarter Number of complaints from pregnancies registered Condom stock on site 	Preparation and construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-	
1.2.b.10.2.; 1.2.b.1.1.; 2.3.b.1.2.; 2.2.b.13.2.; 2.3.b.2.2. Install markers, signs and safety instructions on construction sites and orientation and information signs for detour routes	 Existence of beacons Existence of a sufficient number of signs and safety instructions on construction sites; Number of accident cases recorded and processed 	Preparation and construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	2.000.000	
1.2.b.11.1.; 1.3.b.2.1.; 2.1.b.4.1.; 2.2.b.14.1.; 2.3.b.2.1. Have a traffic plan on all construction sites and ensure that it is respected	 Existence of a traffic plan posted and respected 	Preparation and construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-	

			ACTIVITIES		
RESPONSIBLE	INDICATORS	TIMELINE	MONITORING FOLLOW-UP		COST (FCFA)
	 Number of internal traffic accidents recorded Number of complaints registered and processed 				
1.2.b.11.2.; 1.3.b.2.2.; 2.1.B.3.4.; 2.1.b.4.2. ; 2.2.b.14.2. 2.3.b.2.3. 2.2.b.9.4. Raise awareness among drivers about respecting the highway code (speed limit, good health, no drinking and driving, etc.)	 Number of quarter-hours of safety carried out per week Number of traffic accidents recorded per week Number of complaints registered and 	Preparation and construction phase	Company/SIRAT	 MC DDCVDD / LY Cotonou City Hall 	-
1.2.b.11.3. 1.3.b.2.3.; 2.2.b.13.3.; 2.2.b.14.3. Equipping construction sites with HSE agents	 processed Existence of HSE agents on construction sites 	Preparation and construction	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.1.b.2.2. 2.2.b.7.2. Respect rest hours in accordance with the labor code in force	 Number of complaints registered and processed 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.1.b.3.5.; 2.2.b.9.5. Ensure coverage of loads of trucks transporting construction materials and equipment	 100% of material trucks are covered Number of complaints registered and 	Construction phase	Company/SIRAT	 MC DDCVDD/AL Cotonou City Hall 	-
2.1.b.4.3.; 2.2.b.5.1.; 2.2.b.14.4. Ensure regular maintenance of access roads and detours	 processed Number of complaints registered and processed 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.1.b.4.5. 2.2.b.10.5.; 2.2.b.13.6.; 2.2.b.14.5. Declaring staff to the CNSS	 CNSS card of each worker; 	Construction phase	Company/SIRAT	MC DDCVDD / AL	РМ

			ACTIVITY		
MANAGERS	INDICATORS	TIMELINE	MONITORING	AFTERCARE	COST (FCFA)
	 Number of complaints registered and processed 			 Cotonou City Hall 	
2.2.b.1.1. 2.2.b.4.1. Install bins for the pre-collection of solid waste and contract with the SGDS for its removal	 Existence of well-positioned bins Existence of regular pick-up contracts Number of complaints registered and 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall DDS /L (S/HAB) 	350.000
2.2.b.1.2. 2.2.b.2.4. 2.2.b.4.2. Equip the site with sex-mobile toilets and contract for their regular maintenance	 processed Existence of sex-mobile toilets on construction site Existence of maintenance contracts 	s Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall DDS /L (S/HAB) 	7.000.000
2.2.b.1.3.; 2.2.b.2.5.; 2.2.b.4.6.; 2.2.b.10.2.; 2.2.b.13.8. ; 2.2.b.15.4. Raise awareness among users of the measures put in place to comply with the hygiene, soil and water protection measures put in place and then on compliance with the safety instructions	 Number of awareness-raising sessions carried out per month Number of accident cases recorded 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.2.b.2.1.; 2.2.b.4.3. Equip the site with drums for the storage of liquid waste and ensure its removal by approved structures	 Number of drums installed for the construction site and depot Pickup Receipt/Contract Available 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	250.000
2.2.b.2.3.; 2.2.b.4.4.Establish watertight platforms for the handling of hydrocarbons and oils	 Existence of watertight platforms for the handling of hydrocarbons and oils 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-

			RESPONSIBLE		
ACTIVITIES	INDICATORS	TIMELINE	MONITORING FOLLOW-UP		COST (FCFA)
2.2.b.2.3.; 2.2.b.4.5. Equip the site with absorbents for the management of accidental spills	 Availability of absorbents for the management of accidental spills Number of complaints registered and 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	PM
2.2.b.3.1. ; 2.2.b.5.5. ; 3.2.b.2.1. Strictly comply with technical specifications in the production of aggregates and respect for the slope and longitudinal profile	 processed Reception/validation report of the materials produced 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.2.b.3.2. Using bitumen residue (garbage) on defective neighbourhood streets	 Number of streets benefiting from development Number of complaints registered and 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.2.b.5.2. Avoid the creation of water basins during work	 processed Number of complaints registered and processed 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.2.b.5.3. Equip construction sites with water evacuation equipment in the event of flooding	 Existence of water drainage equipment on the construction site Number of complaints registered and 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	РМ
2.2.b.5.4. Respecting the deadlines of the work	 processed Number of complaints registered and processed 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.2.b.7.3. Ensure the use of less noisy machinery and equipment	Number of complaints registered and processed	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-

			ACTIVITY		
MANAGERS	INDICATORS	IIMELINE	MONITORING	AFTERCARE	COST (FCFA)
2.2.b.8.1. Obtain materials from regularly authorised quarries or obtain all authorisations before the opening of quarries and borrowing areas	 Purchase Receipt/Material Supply Existence of operating permits for quarries to be exploited 	Construction phase	Company/SIRAT	 MC DDCVDD / AL DG-Mines Cotonou City Hall 	-
2.2.b.8.2. Comply with all environmental and social clauses in the opening and operation of a quarry and borrowing areas	 Environmental audit report Number of complaints registered and 	Construction phase	Company/SIRAT	 MC DDCVDD/AL DG-Mines Cotonou City Hall 	-
2.2.b.8.3. Ensure a redevelopment of the technical bases at the end of operation	 Number of complaints registered and processed 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	РМ
2.2.b.10.3. Have a pre-employment medical check-up for all workers and staff on construction sites	 100% of employees have a pre-employment medical examination record 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall DDS/L 	РМ
2.2.b.10.4.; 2.2.b.13.5. To take out an insurance policy for staff and workers;	 100% of employees have a health insurance card; Number of complaints registered and processed 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall DDS/L 	РМ
2.2.b.13.4. Collect and remove dangerous roughness such as nails, screws, pieces of iron, etc., immediately after stripping the formwork;	Number of cases of work accidents due to faulty cleaning of construction sites	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	-
2.2.b.13.7. Equipping construction sites with well-equipped infirmaries	Existence of a well-equipped infirmary	Construction phase	Company/SIRAT	MC DDCVDD / AL	-

			ACTIVITY			
MANAGERS	INDICATORS	IIMELINE	MONITORING	AFTERCARE		
	 Number of complaints registered and processed 			 Cotonou City Hall DDS/L 		
2.2.b.15.1. Equip construction sites with fire-fighting equipment and install it in accordance with the recommendations of the GNSP	 Existence of fire extinguisher, sandbox, etc. well positioned Number of cases of controlled fires 	Construction phase	Company/SIRAT	 MC GNSP DDCVDD / AL Cotonou City Hall 	РМ	
2.2.b.15.2. Train users on the use of firefighting equipment	 Number of trained personnel Number of tabletop exercises carried out per year Number of cases of controlled fires 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	PM	
2.2.b.15.4. Have an Internal Operation Plan (POI) to be updated periodically	 Existence of an updated internal emergency plan Number of training courses organised per quarter Number of tabletop exercises conducted per year 	Construction phase	Company/SIRAT	 MC DDCVDD / AL Cotonou City Hall 	PM	
2.4.b.2.1. Conduct a dismantling audit of the technical bases and implement the recommendations before its release	 Audit report on the dismantling of technical bases 100% of recommendations are implemented 	Construction phase	Company/SIRAT	 MC EBA DDCVDD / AL Cotonou City Hall 	PM	
2.4.B.3.1. To dismiss employees in accordance with the labor code in force in the Republic of Benin	 Number of complaints registered and processed 	Construction phase	Company/SIRAT	 MC DDTFP/AL DDCVDD / AL Cotonou City Hall 	-	

			ACTIVITY			
MANAGERS	INDICATORS	IIMELINE	MONITORING	AFTERCARE		
3.2.b.1.1. Contract with the supplier of the solar electrical equipment for the collection of the latter at the end of	Existence of contrac abduction	t Company/SIRAT operation	phase	 MC DDCVDD / AL Cotonou City Hall 	PM	
3.2.b.3.1. Raising awareness among the entire population about the nuisance of	 Number of awareness-raising carried out per semester 	abusive honking		 MC CNSR / NGOs DDCVDD / AL Cotonou City Hall 	РМ	
3.2.b.4.1. Raise awareness among the entire population about the supply of quality hydrocarbons	• Number of awareness-raising carried out per semester	Company/SIRAT operating	phase	 MC MEM DDCVDD / AL Cotonou City Hall 	РМ	
3.2.b.4.2. Prioritize trees with high carbon sequestration for landscaping	 Rates of high carbon sequestration trees in the landscaping implemented 	Company/SIRAT operation	phase	 MC IF/AL DDCVDD / AL Cotonou City Hall 	-	
3.2.b.5.1. Raise awareness among users about the new road signs and compliance with the highway code (speed limit, good health, no drinking and driving, etc.)	 Number of awareness-raising activities carried out per semester Number of accident cases recorded per month 	Company/SIRAT operation	phase	 MC CNSR DDCVDD / AL Cotonou City Hall 	PM	
3.2.b.5.2. Ensure the regular maintenance of the lighting equipment set up Company/SIRAT	Number of complaints registered and processed	operating phase		 MC DDCVDD / AL Cotonou City Hall 	РМ	
OVERALL	COST OF IMPLEMENTING TH	IE ESMP (EXCLU	JDING PM)		659.542.943	

12. ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAM

12.1. Environmental Monitoring Program

Environmental monitoring is an inspection, control and intervention activity aimed at verifying that all the requirements and conditions for the safety of people and installations and for the protection of the environment, are effectively complied with before, during and after the work. Within the framework of this project for the development of access roads and crossings of Cotonou (ATC) initiated by SIRAT SA, the monitoring will mainly focus on the following aspects:

- the implementation of the planned environmental and social measures;
- verification of the application of the environmental and social measures identified during the different phases of the project;
- Compliance with the laws and regulations in force: check that all legal provisions relating to elements of the environment (air, soil, water, fauna, flora, waste, etc.) are implemented as planned.

The responsibility for monitoring lies with the Contracting Authority (MO) / Delegated Contracting Authority (MOD) who is responsible for the efficient and effective application of environmental and social regulations. At the beginning of the project, it will draw up an environmental protection plan that will enable it to implement the measures recommended in the ESMP in a concrete manner. To be more operational, the MOD will have HSE agents on all sites who will be responsible for ensuring compliance with the technical environmental clauses after having listed the most delicate environmental constraints on its site, integrating environmental monitoring into the site log and serving as an interlocutor with the control mission and other services for monitoring activities on environmental issues.

12.2. Environmental monitoring program

Environmental monitoring is an activity of observation of short-, medium- and long-term measures that aims to determine the real impacts of the project that are of greatest concern compared to the impact prognostications made during the impact study in order to be able to make the necessary corrections to the recommended mitigation measures, if necessary.

During the works and operation phases, it will focus on the evolution of the sensitive characteristics of certain impact receptors affected by the project. These will include:

- soil degradation;
- the water quality of the ecosystem in operation;
- the degradation/restoration of flora;
- disturbance of wildlife;
- the health and safety of workers and the general population.

During the construction phase, the monitoring of social and environmental aspects will be carried out internally by the Control Mission assigned to the project and by external structures including the

Departmental Directorate of Living Environment and Sustainable Development/Atlantic-Littoral; the Departmental Directorate of Health/Littoral; the Cotonou City Hall; the General Directorate of Mines; the National Firefighters' Group, the National Road Safety Center and the Beninese Environment Agency, whose role will be to ensure the effective implementation of all environmental and social clauses and environmental protection actions.

12.3. Complaint Management and Grievance Mechanism

Several types of conflicts are likely to arise in the context of the implementation of this project. To prevent and achieve the effective management of complaints and grievances in terms of environmental and social management, a Complaint Management Mechanism (PMM) will be developed and implemented by SIRAT SA, the Project Owner (MO) of the project. Indeed, all road projects initiated by SIRAT SA will be specifically equipped with a MGP that will allow the monitoring of all social aspects of the projects. The aim is to set up a system to collect, resolve and address stakeholder concerns and complaints, as well as to use feedback from stakeholders to improve project responses.



CONCLUSION AND RECOMMENDATIONS

Initiated by the government through the Société des Infrastructures Routières et de l'Aménagement du Territoire (SIRAT SA), the project for the development of access roads and

Cotonou Crossings (ATC) changes the state of high degradability observed on the urban crossing road networks, makes them compliant with standards and facilitates safe mobility on these roads identified for the project.

However, although it is a project for the development and improvement of the living environment, it has been subject to an environmental assessment to ensure its environmental and social viability and sustainability. This testifies to the State's commitment to respecting the requirements it has set for itself. This environmental and social impact study carried out for this project has not only made it possible to highlight the positive and especially the negative impacts with the corresponding mitigation measures, but to provide the project with an Environmental and Social Management Plan (ESMP) and a Resettlement Action Plan (RAP) for the People who will be affected by the Project (PAPs). Thus, the implementation of this ESMP will require, without costs for Memory (PM), a financial cost of six hundred and fifty-nine million five hundred and forty-two thousand nine hundred and forty-three (659,542,943 FCFA) including one hundred and twenty-six million six hundred and fifty thousand (126,650,000 FCFA) for the environmental integration of activities on construction sites and five hundred and thirty-two million eight ninety-two thousand nine hundred and forty-three (532,892,943 CFA francs) for the implementation of RAP.

Compliance with these proposed environmental tools (ESMP & PAR) and the technical and social clauses that will be included in the specifications of the delegated project owner would constitute a guarantee for the sustainability of this project.

In addition, it is recommended that the Minister of Living Environment and Sustainable Development, when issuing the CCE, send a copy of it as well as the Environmental and Social Management Plan to all the structures mentioned and responsible therein, (especially the Cotonou City Hall) for the follow-up of the implementation of the management plan and the monitoring/surveillance program of this project with the person responsible for follow-up, the EBA.

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ANNEXES

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- Appendix 2 Minutes and attendance list of public consultations
- Appendix 3 Resettlement Action Plan (RAP)
- Appendix 4 Table of Contents

CECO CONSTRUCTION/SIRAT

APPENDIX 1. TERMS OF REFERENCE (TOR) OF THE MISSION



APPENDIX 3. RESETTLEMENT ACTION PLAN (RAP)



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