



2022

ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT (ESIA) FOR NYARUGURU-HUYE-GISAGARA WATER SUPPLY SYSTEM (WSS)

UNDER THE IMPLEMENTATION OF RWANDA NATIONAL INTEGRATED WATER SUPPLY AND SANITATION MASTER PLANS (RNIWSSMP)



**JOINT VENTURE
STUDI
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TABLE OF CONTENT

TABLE OF CONTENT	ii
LIST OF FIGURES	vi
LIST OF TABLES	vii
ACRONYMS, ABBREVIATIONS AND SYMBOLS	viii
EXECUTIVE SUMMARY	x
CHAP I: INTRODUCTION	1
1.1. Origin of the project	1
1.2. Project overview	2
1.3. Project justification	4
1.3.1. Status of WSS in Nyaruguru district	4
1.3.2. Status of WSS in Huye district.....	5
1.3.3. Status of WSS in Gisagara district.....	6
CHAP II: OBJECTIVES AND SCOPE OF ESIA	8
2.1. General Objective	8
2.2. Specific Objectives	Error! Bookmark not defined.
2.3. Scope of the work	8
CHAP III: APPROACH AND METHODOLOGY	<i>Error! Bookmark not defined.</i>
3.1. Environmental and social assessment in line with national legislation	9
3.2. Screening outcome in respect of national EIA guidelines	10
3.3. Screening outcome in respect of AfDB’s ISS and OSs	11
3.4. Field visit at the project site	13
3.5. Tasks and approach to develop the ESIA	13
3.6. Primary data collection	14
3.7. Secondary data collection	14
3.8. Source of construction materials	44
CHAP IV: PROJECT DESCRIPTION	16
4.1. Background of the project	16
4.2. Water resources/intake structure	17
4.2.1. One Water Intake on Akanyaru river	17
4.2.2. Raw water intake structure.....	18
4.2.3. Raw water pumping station.....	19
4.3. Water Treatment Plant and Quality of Treated Water	22
4.3.1. Water Treatment Plant (WTP).....	22
4.3.2. Quality of Treated Water	23

4.4. Water treatment process.....	27
4.4.1 General design principles	27
4.4.2. Aeration.....	27
4.4.3. Coagulation	27
4.4.4. Storage of Aluminium Sulphate.....	29
4.4.5. Health Hazards and Disposal of Waste Solution and Sludge.....	29
4.4.6. Use of Aluminium Sulphate	30
4.4.7. Rapid Mixing.....	30
4.4.8. Flocculation.....	31
4.4.9. Sedimentation.....	31
4.4.10. Rapid Sand Filtration	31
4.4.11. Disinfection	32
4.5. Transmission mains.....	32
4.5. Water tanks	33
4.6. Water Supply/Distribution Pipes	35
4.7. Collection and Valve Chambers.....	37
4.7.1. Closure and control valves	37
4.7.2. Surge relief valves	40
4.7.3. Air valves	41
4.7.4. Washouts.....	42
4.7.5. Access track.....	42
4.8. Access roads and trenches	42
4.9. Land Ownership.....	43
4.9. Investment cost.....	44
CHAP V: POLICY, LEGISLATIVE AND ADMINISTRATIVE REQUIREMENTS	46
5.1. Relevant policies.....	46
5.2. Relevant national legal framework	50
5.3. AfDB's OSs applicable to the proposed project	54
5.4. International and regional conventions	56
5.4.1. United Nations Convention on Biological Convention of 1992	56
5.4.2. The BONN Convention	56
5.4.3. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)	56
5.5. Institutions relevant to the development of Nyaruguru-Huye-Gisagara WSS.....	57
5.5.1. Ministry of Infrastructure (MININFRA).....	57
5.5.2. Ministry of Environment (MoE).....	57
5.5.3 Water and Sanitation Corporation Limited (WASAC Ltd).....	58
5.5.4. Rwanda Utility Regulatory Authority (RURA)	58
5.5.5. Rwanda Environmental Management Authority (REMA).....	58
5.5.6. Rwanda Water Resource Board.....	59
5.5.7. National Land Authority (NLA).....	59
5.5.8. Rwanda Development Board (RDB)	59
5.5.9. Rwanda Standards Board (RSB).....	59
5.5.10. Ministry of Local Government (MINALOC).....	60
5.5.11. Ministry of Finance and Economic Planning (MINECOFIN)	60
5.5.12. Ministry of Health (MOH)	60

5.5.13. Ministry of Education (MINEDUC).....	60
5.5.14. Ministry of Agriculture (MINAGRI).....	60
5.4.15. Nyaruguru, Huye, and Gisagara districts.....	60
CHAP VI: DESCRIPTION OF THE BASELINE ENVIRONMENT	61
6.1. Biophysical environment	61
6.1.1. Topographical Characterization.....	61
6.1.2. Hydrology.....	64
6.1.3. Raw water quality.....	65
6.1.4. Quantity (average discharge).....	66
6.1.5. Biodiversity in Akanyaru river/valley.....	66
6.1.6. Existing projects up and downstream and other water users.....	67
6.1.7. Climate and Rainfall.....	67
6.1.8. Fauna in Nyaruguru, Huye, and Gisagara districts	70
6.2. Socio- economic environment	71
6.2.1. Demographic characterization.....	71
6.2.2. Employment, source of revenues and poverty level.....	72
Education.....	72
6.2.3. Health care.....	73
6.2.4. Transport.....	74
6.2.5. Existing WSS in Nyaruguru, Huye, and Gisagara districts	75
CHAP VII: STAKEHOLDER CONSULTATION AND PARTICIPATION	79
7.1. Objectives.....	79
7.2. Analysis of project’s affected people (PAPs)	79
7.3. Approach and consulted people	82
7.4. Key findings from consultations.....	83
7.4.1. Project appreciation	83
7.4.2. Existing challenges.....	83
7.4.3. Potential risks and impacts	84
7.5. ESIA disclosure	86
CHAP VIII: ANALYSIS OF ALTERNATIVES	87
8.1. Zero scenario.....	87
8.2. Proposed project scenarios	87
8.2.1. Alternative I: One water intake on Akanyaru river	87
8.2.2. Alternative II: Two water intakes on Akanyaru river.....	88
8.3. Selection of preferred scenario.....	89
CHAP IX: POTENTIAL ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS	91
9.1. Assessing significance of impacts.....	91
9.2. Duration of Impacts	91
9.3. Potential impacts.....	92
9.3.1. Positive impacts.....	92
9.3.2. Negative impacts during the preparation phase.....	93
9.3.3. Negative impacts during the construction phase.....	94

9.3.4. Negative impacts during the operational phase.....	96
CHAP X: PROPOSED MITIGATION MEASURES.....	98
10.1. Mitigation measures for the preparation phase.....	99
10.2. Mitigation measures for the construction phase.....	102
10.3. Mitigation measures for the operational phase.....	106
CHAP XI: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP).....	108
11.1. Introduction.....	108
11.2. ESMP for the preparation phase.....	109
11.3. ESMP for the construction phase.....	114
11.4. ESMP for the operational phase.....	120
CHAP XII: ENVIRONMENTAL AND SOCIAL MONITORING PLAN (ESMonP).....	123
12.1. Introduction.....	123
12.2. Institutional arrangement and roles.....	123
12.2.1. WASAC.....	123
12.2.2. Rwanda Development Board (RDB).....	124
12.2.3. Rwanda Environment Management Authority (REMA).....	124
12.2.4. Supervising firm/ consultant.....	124
12.2.5. Local Community.....	125
12.3. Organization of the WSS users and general maintenance.....	125
12.4. Environmental and social monitoring plan for the preparation phase.....	127
12.5. Environmental and social monitoring plan for the construction phase.....	131
12.6. Environmental and social monitoring plan for the operational phase.....	139
CHAP XIII: GRIEVANCE REDERESS MECHANISM.....	142
13.1. Grievance Redress Mechanism (GRM).....	142
13.2. Types of Grievances and feedbacks.....	142
CHAP XIV: ENVIRONMENTAL AND SOCIAL CLAUSES.....	145
14.1. Environment, health, and safety.....	145
14.1.1. Gender based Violence.....	146
14.1.2. Labor influx.....	146
14.1.3. Road.....	146
14.1.4. Movement of trucks and construction machinery.....	147
14.1.5. Traffic safety measures.....	147
14.1.6. Access across the construction site and to frontages.....	147
14.1.7. Noise and dust control.....	147
14.1.8. Waste disposal.....	148
14.1.9. Protection of the existing installations.....	148
14.1.10. Protection of trees and other vegetation.....	148
14.1.11. Physical cultural resources.....	148
14.1.12. Clearance of the site after project completion.....	149
14.1.13. Worker health and safety.....	149

14.1.14. Site construction safety and insurance.....	150
14.2. Environmental and social monitoring by the contractor.....	151
14.3. Environmental and social liabilities of the contractor	152
14.4. Grievance mechanism for workers	153
CHAP XV: CONCLUSIONS AND RECOMMENDATIONS	155
15.1. Conclusions	155
15.2. Recommendations	156
-	Grievance
.....	157
BIBLIOGRAPHY	158
LIST OF ANNEXES	161
ANNEX 1: CHANCE FINDS PROCEDURE.....	161
ANNEX 2: ESIA team.....	162
ANNEX 3: List of PAPs.....	163

LIST OF FIGURES

Figure 1: Example of scrapper bridge	19
Figure 1: Example of vertical axis pump	21
Figure 2: Different arrangements of vertical axis pump	22
Figure 3: Layout of the proposed WTP	23
Figure 5: Dosing Arrangement for Alum.....	30
Figure 6: Rapid Sand Filtration – Open Gravity type	32
Figure 4: Scheme of the transmission main of the proposed Nyaruguru-Huye-Gisagara WSS	33
Figure 5: Optimized architecture of the proposed water transmissions and associated infrastructure	35
Figure 6:Example of installation of a round box valve	39
Figure 7:Example of installation of a valve box.....	40
Figure 8: Unstable terrain in Nyaruguru District	62
Figure 9: Akanyaru river (Intake zone)	65
Figure 10: Flora characteristic of the project area	69
Figure 11: Arboretum de Ruhande	70
Figure 12: Photo of different fauna species in Ruhande Arboretum	70
Figure 13: Different schools located in the project area.....	73
Figure 14: Healthcare facilities located in the project area	74
Figure 15: Existing water tank in Kibeho Sector, Nyaruguru District	77
Figure 16: PAPs consultations at village level	83
Figure 17: Conceptual scheme of alternative 1	88
Figure 18: Conceptual scheme of alternative 2	89

LIST OF TABLES

Table 1: Sectors located in project area	3
Table 2: Water balance in Nyaruguru district	4
Table 3: Water balance in Huye district	5
Table 4: Potential water resources for water supply in Huye district	5
Table 5: Water Balance in Gisagara district.....	6
<i>Table 6: Tasks and activities carried during the ESIA study.....</i>	13
Table 7: Estimated cost of the proposed project.....	16
Table 8: Location of the project	17
Table 9: Conceptual scheme of water intake at Akanyaru river	18
Table 10: Coordinates of the raw water intake	19
Table 10: Physicochemical requirements according to the EAS 12:2018	24
Table 11: Limits for inorganic contaminants according to EAS 12:2018	25
Table 12: Limits for organic contaminants according to EAS 12:2018	26
Table 13: Microbiological limits according to EAS 12:2018	26
Table 15: Types of coagulants	28
Table 16: Advantages and disadvantages of some coagulants.....	29
Table 14: Required infrastructure for the proposed WSS	37
Table 15: Diameters of the air valves according to the diameter of the pipe	41
Table 16: Minimum washout size	42
Table 17: Total Investment Cost for the development of Nyaruguru-Huye-Gisagara WSS	44
Table 18: Policies applicable to the proposed project.....	47
Table 19: Relevant National legal framework applicable to the project.....	51
Table 20: AfDB Environmental and social assessment categories and relative requirements	55
Table 21: Identification of PAPs.....	82
Table 22: Explanation and interpretation of significance rating for impacts	91
Table 23: Positive impacts from the proposed project	92
Table 24: Environmental and Social negative impacts during preparation phase	93
Table 25: Environmental and Social negative impacts during construction phase.....	94
Table 26: Environmental and Social impacts during operational phase	96
Table 27: Environmental and Social Management Plan during preparatory phase	109
Table 28: Environmental and Social management plan during construction phase	114
Table 29: Environmental and Social management plan during operation phase.....	120
Table 30: Environmental and Social Monitoring Plan for preparation phase	127
Table 31: Environmental and Social monitoring plan for construction phase	131
Table 32: Environmental and Social monitoring plan for operational phase	139
Table 33: Levels and members of GRCs	143

ACRONYMS, ABBREVIATIONS AND SYMBOLS

AfDB	:	African Development Bank
AWF	:	African Water Facility
CESMP	:	Contractor Environmental and Social Management Plan
DN	:	Diameter Nominal
EA	:	Environmental Assessment
EAS	:	East African Standards
EIA	:	Environmental Impacts Assessment
EIRR	:	Economic Internal Rate of Return
EMP	:	Environmental Management Plan
ESAPs	:	Environmental and Social Assessment Procedures
ESG	:	Environmental, Social and Governance
ESIA	:	Environmental and Social Impacts Assessment
FRAP	:	Full Resettlement Action Plan
GHG	:	Greenhouse Gases
GoR	:	Government of Rwanda
GPS	:	Global Positioning System
GRCs	:	Grievance Redress Committees
GRM	:	Grievance Redress Mechanism
HIV/AIDS	:	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IL	:	Impact Level
ISS	:	Integrated Safeguards System
km	:	Kilometer
LTMC	:	Long-Term Marginal Cost
m³/day	:	Cubic Meters per day
MCDA	:	Multi-Criteria Decision Analysis
MINAGRI	:	Ministry of Agriculture and Animal Resources
MINECOFIN	:	Ministry of Finance and Economic Planning
MINEDUC	:	Ministry of Education
MININFRA	:	Ministry of Infrastructure
mm	:	Millimeter
MOH	:	Ministry of Health
n/a	:	Not applicable
NLA	:	National Land Authority
NST1	:	National Strategy for Transformation 1
NTU	:	Nephelometric Turbidity Unit
OHS	:	Occupational Health and Safety
OSs	:	Operational Safeguards
PAPs	:	Project's Affected People
pH	:	Potential of Hydrogen
PWDs	:	People With Disabilities
RDB	:	Rwanda Development Board
RFA	:	Rwanda Forestry Authority
RLMUA	:	Rwanda Land Management and Use Authority

RMF	:	Roads Maintenance Fund
RNIWSSMP	:	Rwanda National Integrated Water Supply and Sanitation Master Plans
RSB	:	Rwanda Standards Board
RTDA	:	Rwanda Transport Development Agency
RURA	:	Rwanda Utility Regulation Authority
RWB	:	Rwanda Water Board
Rwf	:	Rwandan Francs
SDGs	:	Sustainable Development Goals
STD	:	Sexually Transmissible Diseases
WASAC	:	Water and Sanitation Corporation
WRM	:	Water Resource Management
WSS	:	Water Supply System
WTP	:	Water Treatment Plant

EXECUTIVE SUMMARY

Background information

The Government of Rwanda (GoR) has made significant progress in extending water supply and sanitation services in two past decades, however, preserving these gains and best practices from the national water and sanitation programmes, while strengthening decentralized implementation capacities, remains a challenge. In this context, the Government of Rwanda (GoR) prepared a project whose objective is to provide the GoR with long-term 25-year Master Plans including 10-year investment plans for Water Supply and Sanitation for the entire country that will allow the identification and implementation of effective water supply and sanitation projects. Capacity building activities will also be undertaken under the project. Accordingly, a grant Agreement worth of €1,950,894 was signed on 17th February 2017 between the African Development Bank (AfDB) and the Government of Rwanda (GoR) for the development of National Integrated Water Supply and Sanitation Master Plans (NIWSSMP), which will include, among others, the Feasibility Study and Detailed Design for Nyaruguru, Huye and Gisagara Water Supply System (WSS). The WSS intends to produce 24,000 m³/day from Akanyaru River to serve around 1,200,000 people living in those 3 districts.

The present ESIA report is developed as one of the environmental and social safeguard instruments required by the African Development Bank's Integrated Safeguards System (AfDB's ISS) for the development of Nyaruguru-Huye-Gisagara WSS Project, which is part of the structural actions established by the National Integrated Water Supply and Sanitation Master Plans (NIWSSMPs) of Rwanda.

Objectives of the project

The main objective is to ensure 100% access to clean water in parts of Huye and Nyaruguru districts and in all Gisagara district. The proposed project will contribute to enhanced hygiene and sanitation by reducing water borne diseases. This will also contribute towards reduction of poverty within the study area.

Objective of the study

The objective of this Environmental and Social Impacts Assessment (ESIA) study is to identify, predict, evaluate project's environmental and social impacts through a comprehensive assessment and propose respective mitigation measures.

Scope

It covers the 7 components of a Water Supply System (WSS) which are (1) water intake from Akanyaru river; (2) Water Treatment Plant (WTP) of a total capacity of treating 24,000 m³/day; (3) transmission pipeline of a total of 207 km (111 km and 96 km to be constructed under phase 1 and 2, respectively) crossing the districts of Nyaruguru, Huye and Gisagara and serving the 26 sectors of the project area; (4) 10 water tanks whose respective volumes range from 200 to 6,500 m³; (5) water distribution network of a total length of 1,481km to be constructed in 3 phases of respectively 236 km, 520 km, and 725 km; (6) collection and valve chambers; lifting pumping stations.

Methodological approach

Its methodological approach consisted in desk work reviewing national environmental protection legislations and African Development Bank's (AfDB) Integrated Safeguard System (ISS) and its Operational Standards (OSs). Biological, physical, and social economic investigations through literature review, field surveys, observations, mapping, stakeholder consultation, interview and questionnaires. Based on findings and considering adverse environmental and social impacts expected from the project, the construction of Nyaruguru-Huye-Gisagara WSS was classified under AfDB's risk category 1 of Bank operations that are likely to cause significant environmental and social impacts.

Policy, Legal and Institutional Considerations

Policies and strategies that are relevant to this project are Rwanda Vision 2050, National Environment and Climate Change Policy 2019, National Land Policy 2019, National Health Policy 2016, National sanitation policy 2016, National Policy for water resources management 2011, National Biodiversity Strategy and Action Plan 2016, Rwanda Biodiversity Policy 2011, National Poverty Reduction Strategy 2018- 2024, National Strategy for transformation (NST1, 2017-2024), National Occupational Safety and Health Strategy 2019, Environment Health Policy 2008, and National Strategy for Climate Change and Low Carbon Development 2011.

National legal framework applicable to the proposed project include the Constitution of the Republic of Rwanda 2003 as revised in 2015, the law on environment 2018, law governing land 2021, Rwandan law N° 58/2018 of 13/08/2018 on mining and quarrying operations, law relating to expropriation in the public interests 2015, law regulating labor in Rwanda 2018, law N°70/2013 of 02/09/2013 Governing Biodiversity in Rwanda, etc. Give that African Development Bank is the financial donor, its Integrated Safeguards System (ISS) will also apply to the project, and all 5 Operational Standards (OSs) of the Bank were found to be relevant to the proposed project.

Considering international conventions, Rwanda is signatory to different convention but the most relevant include the following; United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (1997) which deals with the management, utilization, and protection of transboundary watercourses. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), and United Nations Framework Convention on Climate Change (UNFCCC, 1992).

Description of the project

The Nyaruguru, Huye and Gisagara Water Supply Project is part of the structural actions established by the National Integrated Water Supply and Sanitation Master Plans of Rwanda.

The main objective is to ensure 100% access to clean water in parts of Huye and Nyaruguru districts and in all of Gisagara district. The proposed project will contribute to enhanced hygiene and sanitation by reducing water borne diseases. This will also contribute towards reduction of poverty within the study area through the improvement of socio-economic activities.

The Project is designed for the year 2050 and shall serve 26 sectors (7 in Nyaruguru district, 6 in Huye district and 13 in Gisagara district) all located in the Southern Province.

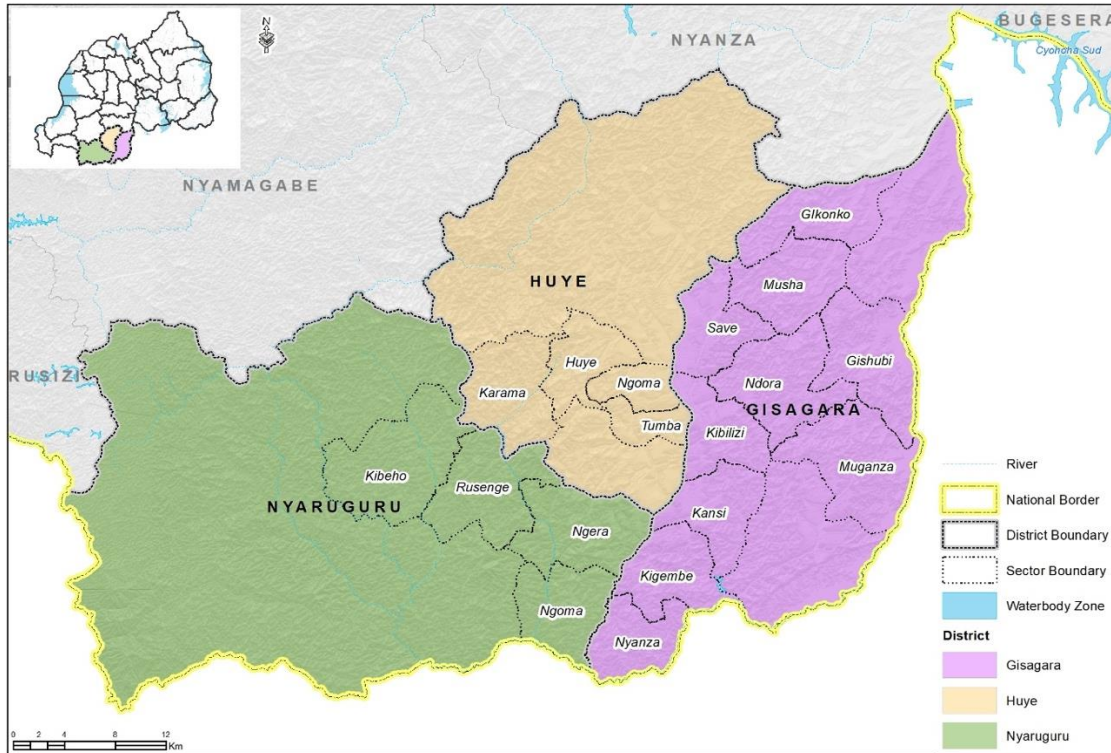


Figure 1: Map indication the location of the project

The estimate total cost of the proposed project is 220,360,890 USD, to be invested in 3 phases as following:

- Phase 1 (2024-2030): investment cost of 97,362,342 USD
- Phase 2 (2031-2040): investment cost of 59,858,855 USD
- Phase 3 (2041-2050): investment cost of 63,139,693 USD

Project impacts

The project will generate environmental and social positive and negative impacts which have been listed in this report according to the project phases (preparatory, construction, operational and decommissioning phase).

The predicted positive impacts include the following: employment and knowledge transfer opportunities, business opportunities, increase to public revenues/taxes for both central and local authorities from construction materials, drinking water quality improved for beneficiaries. Potential negative impacts shall include the following:

Pre-construction phase :

Bio-physical adverse impacts

- Loss of biodiversity and damage to ecosystem habitat while establishing the project camp sites
- Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers during establishment of the campsite.
- Soil erosion (excavated soil) while establishing the project campsite.
- Increased nuisance (noise, dusts and vibration) levels due to use of heavy machinery and earth moving equipment while establishing the project camp sites.

Socio-economic adverse impacts

- Loss of assets and crops by the local population while acquiring the land for the project,
- Potential risk of insecurity due to influx of job seekers.
- Conflicts among workers who temporarily settle with the local community and residents.
- Risk of spread of HIV/AIDS, STDs, and other communicable diseases due to people moving to the project area without their families

Construction phase :

Bio-physical adverse impacts

- Loss of biodiversity due to land and vegetation clearing,
- Preparation of trenches, laying of pipes and construction of reservoirs and pumping and treatment stations may cause Brutal spreading of materials in waterways and lowlands, and concrete laitance.
- Loss of land for quarry, borrow, and disposal spoil materials.
- Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.
- Generation of wastes from construction works and activities in the camp site.

Socio-economic adverse impacts

- Impacts related to nuisances (dust, noise, bad smell etc.),
- Impacts related to the community safety and workers health and safety.
- Risk of occupational injuries and/or accidents and deterioration of workers' health

Operation and maintenance phase:

Bio-physical adverse impacts

- Change of current environmental flow,
- Risks associated with water abstraction (withdrawal) such as water quantity and quality, hydrological pattern of Akanyaru river, potential conflicts from different users of Akanyaru river water.
- Foul smelling from toilets installed at the site and sludge from water treatment processes.
- Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.

Socio-economic adverse impacts

- Risks associated with water abstraction (withdrawal) such as water quantity and quality, hydrological pattern of Akanyaru river, potential conflicts from different users of Akanyaru river water
- Impacts related to the abstraction of transboundary water resources that might affect neighboring countries
- Risk of occupational injuries and/or accidents and deterioration of workers' health.

Decommissioning phases:

- Generation of wastes including hazardous waste from demolition
- Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.
- Biodiversity loss and habitat deterioration during decommissioning activities
- Loss of jobs and all business opportunities related to the project
- Degradation of water quality in Akanyaru river
- Soil erosion (excavated soil during decommissioning of the project)

Socio-economic adverse impacts

- Damage to crops while removing pipes and other equipment
- Loss of public revenues/taxes for both central and local authorities

Stakeholder consultations

Public consultation meetings were held in all the villages visited and located in the project's direct area of influence as well as at District level where key project stakeholders were invited.

At village level, with support from chiefs of villages, meetings were held at cell offices bringing together people from concerned villages. Consultations started from 06/09/2022 and ended on 23/09/2022.

At district level, in collaboration with District one stop centers, the consultation meetings were organized on 19 and 20th October 2022. Districts invited all stakeholders in water and sanitation including Water, Sanitation and Hygiene board (District WASH Boards), private rural WSS operators, representative of WASAC at district & provincial level, development partners like World Vision.

In general, the project was appreciated by all interested stakeholders as it will contribute to the national target of covering the whole country with access to clean water and thanked the Government of Rwanda for promoting modern households in their villages. However, the following concerns were raised and noted:

- The quality of water considering the existence of a hydropower plant located upstream of the proposed intake location.
- WASAC should request water permit to ensure the water allocation is effective and efficient.
- Owners of assets and crops to be affected by the project expressed their concern in regards to possible delay in payment of the compensation and requested that works should start after paying all affected people. There should be compensation for the land used for the pipeline, because when you want to construct on that land, it become a long process to relocate the pipe. They also suggested that the calculation of the compensation should be based on the maximum rate provided by the law
- District officials raised the concern about the location of the water treatment plant considering the topography of the area (steep slope)
- Project beneficiaries suggested that project should provide public water taps for people who don't have means to get water connected to their home.

- There was a concern in regards to some people who don't have land title at the moment but which is being processed in the land centers.

Environmental and Social Management Plan

An ESMP spanning over preparation, construction and operational phase was developed. Given that construction activities shall be conducted in 3 phases dated 2024-2030, 2031-2040, and 2041-2050, the proposed Environmental and Social Management Plan (ESMP) will be suggestive for each phase, however, the contractor shall have the obligation of developing and updated Contractor's Environmental and Social Management Plan (CESMP) for each phase just before the commencement of construction works. This will help the client, WASAC, to cater for environmental and social safeguard costs for each phase.

The following are summary of the proposed mitigation measures:

- Develop a resettlement action plan (RAP)
- Ensure that all affected persons received fair and just compensation as per the national law and AfDB Integrated Safeguards System.
- Biodiversity and ecosystem restoration by protecting some ecosystem where applicable, planting indigenous plant in the reserved green space.
- Ensure appropriate consultations (including water users from the neighboring country) are conducted and water extraction permit is issued before construction work starts.
- Ensure that all workers have adequate accommodation facilities (lodging, food, sanitation, sport and other entertainment,). The contractor shall develop specific workers accommodation plan.
- Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets) and ensure they know how to use them.
- Conduct regular health and safety trainings & awareness (health and safety induction training, quarterly trainings and daily H&S morning briefing). The contractor shall develop a training program which shall include health and safety, HIV/AIDS, conflict and grievance resolution training sessions.

- Avail first aid kit on-site (1kit/km), train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.
- Avail tout-riquer chantier insurance covering the entire construction site (during construction & demolition) and facility insurance for the WTP (during operational phase).
- Ensure that all workers have an employment contracts and medical insurance.
- Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law
- Fence the construction site where possible to avoid unauthorized entries and sensitize the workers to avoid conflicts.
- The consultant suggests considering only renewable energy where applicable in the project and encourages the use of machinery and equipment with low emissions of GHG.
- Establish grievance resolution mechanism.
- Ensure that all wastes are sorted from source and send for reuse, recycle or disposal.
- The contractor shall develop plans to eliminate or minimize nuisances; by scheduling works between 7 am and 5 pm, use of well-maintained vehicles and machinery, spread water on soil to minimize dusts.
- The excavated soil should be transported to approved dumping site but meanwhile, they shall be protected against erosion.
- The WTP shall be equipped with fire extinguishing facilities and a team of fire marshals shall be trained on fire fighting.

In the proposed ESMP, the approximative cost for implementing environmental and social safeguard measures is 22,400,000 Rwf and 46,800,000 Rwf, respectively for the preparation and construction phase. The cost of implementing ESMP during the operational phase shall be catered for by WASAC through its ordinary budget. The cost for the implementation of the environmental and social monitoring plan (ESMonP) shall be covered the contractor and the supervising firm through their respective contractual budget.

ESMP implementation arrangements

As the project proponent, WASAC shall play the overall coordination role for the project, it include coordination and monitoring of performance of implementation of the project, risk management, monitoring & evaluation, and disclosure of information, developing and managing performance agreements. Other entities which have responsibilities in the implementation of the project include the following:

- **Rwanda Development Board (RDB):** RDB shall review and approve the ESIA Reports and issue ESIA certificate.
- **Rwanda Environment Management Authority (REMA):** to monitor implementation of environmental and social management plan (ESMP).
- **Supervising firm/ consultant:** ensure effective implementation of ESMP and provision of monthly report.
- **Contractor:** Development and implementation of contractor environmental and social management plan (C-ESMP).
- **Local community** shall support by participating and providing information in regards to any environmental, social issue, initiative and activity.

On both sides (contractor and supervising firm) shall ensure that qualifying staffs (3); Environmental Safeguard Specialist, Health and Safety Specialist and Social safeguard specialist are hired.

CHAP I: GENERAL INTRODUCTIONS AND STUDY BACKGROUND

1.1. Origin of the project

The Government of Rwanda (GoR) has made good progress in extending water supply and sanitation coverage during the past few years, under clear political commitment to three complementary sets of targets: the Economic Development and Poverty Reduction Strategy (2012), Millennium Development Goals (2015 and Vision 2020). However, preserving these gains and best practices from the national water and sanitation programmes, while strengthening decentralized implementation capacities, remains a challenge. Private operators working in rural areas are often not yet fully professionalized. District staff may have appropriate levels of education but are short of specific Public Private Partnership (PPP) and Water Supply and Sanitation (WSS) field experience. This situation calls for a comprehensive capacity-building programme that targets both districts and private operators' staff. Additionally, although the Water and Sanitation Corporation (WASAC) and its predecessors have made significant efforts towards developing water supply and sanitation master plans for various parts of the country with varying degrees of detail to guide the achievement of universal access to water supply, national comprehensive water supply and sanitation plans still do not exist. It is against this background that the Government of Rwanda (GoR), through WASAC, has applied to African Development Bank (AfDB) for funding to support the development of water supply and sanitation master plans. The AfDB proposes to support the GoR in developing national masterplans that will guide the development of water and sanitation projects going forward (AWF, 2016).

The GoR has received funds from AfDB to finance the “Rwanda National Integrated Water Supply and Sanitation Master Plans Project (RNIWSSMP)”. The WASAC is the Implementing Agency. The project will be jointly financed by African Development Bank and the Government of Rwanda. The overall objective of the project is to provide the GoR with long-term 25-year Master Plans including 10-year investment plans for Water Supply and Sanitation for the entire country that will allow the identification and implementation of effective water supply and sanitation projects. Capacity building activities will also be undertaken under the project.

From the 24 May 2022 to the 09 June 2022, WASAC disseminated the provisions of NIWSSMP to showcase the various water supply and sanitation's projects that will be implemented in various provinces. The dissemination was conducted at provincial level through meetings with various stakeholders that include the Governors, Mayors, Vice mayors, district water engineers, Sector executives, Governor and WASAC Branch managers in the respective provinces. All the participants in these consultative meetings gave their inputs on the master plans for consideration (WASAC, 2022).

The main objective of these NIWSSMP is to provide the Government of Rwanda with long term Master plans up to 2050 and 10 years' investment plans for water supply and sanitation that will allow the identification and implementation of effective development of water supply and sanitation infrastructure and services. The project contains two main project outputs which are the National Comprehensive Water Supply and Sanitation Master Plans including an approved list of prioritized and integrated water supply and sanitation investment projects agreed by all stakeholders, and the second one will be Training to stakeholders in relevant areas to improve their capacity to sustainably manage and implement water supply and sanitation projects and systems (WASAC, 2022) (WASAC, 2022).

The project was sponsored by the AfDB through a Grant Agreement worth € 1,950,894 signed between the Bank and the Government of Rwanda on 17th February 2017. The money will be used for the development of National Integrated Water Supply and Sanitation Master Plans and the Feasibility studies identified under Master Plans which include, among others, the Feasibility Study and Detailed Design for Nyaruguru, Huye and Gisagara Water Supply System (WSS), which aims to produce 78,000 m³/day from Akanyaru River to serve around 1,200,000 people (WASAC, 2022).

The study was awarded to JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK as an addendum to the contract to develop National Integrated Water Supply and Sanitation Master Plan, which subcontracted Eric MURERA (EIA Lead Expert) and Emile HABIMANA (EIA Lead Expert) to conduct Environmental and Social Impact Assessment (ESIA) as integral part of the assignment.

1.2. Project overview

The Nyaruguru, Huye and Gisagara Water Supply project is part of the structural actions established by the National Integrated Water Supply and Sanitation Master Plans of Rwanda, and its main objective is to ensure 100% access to clean water in parts of Huye and Nyaruguru districts and in all Gisagara district. The proposed project will contribute to enhanced hygiene and sanitation by reducing water borne diseases. This will also contribute towards reduction of poverty within the study area through the improvement of socio-economic activities (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

The Feasibility Study and Detailed Design of Nyaruguru, Huye and Gisagara WSS demonstrated that the proposed WSS will extend through 26 sectors (7 sectors in Nyaruguru district, 6 sectors in Huye district, and 13 sectors of Gisagara district), as presented in the following table (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022):

Table 1: Sectors located in project area

District	Number of sectors	Sectors
Nyaruguru	7	Cyahinda
		Kibeho
		Munini
		Ngera
		Ngoma
		Nyagisozi
		Rusenge
Huye	6	Gishamvu
		Huye
		Karama
		Mukura
		Ngoma
		Tumba
Gisagara	13	Gikonko
		Gishubi
		Kansi
		Kibilizi
		Kigembe
		Mamba
		Muganza
		Mugombwa
		Mukingo
		Musha
		Ndora
		Nyanza

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1.3. Project justification

The development of Nyaruguru-Huye-Gisagara WSS is justified by the water supply deficit in all 3 districts as described in following sections.

1.3.1. Status of WSS in Nyaruguru district

Nyaruguru district is poor in terms of spring water. Most of the springs are drying up and do not allow for a reliable future exploitation to meet the water demand. In terms of surface water, Nyaruguru district is bordered by a large river called Akanyaru. This river has the potential to supply part of Nyaruguru district.

By 2050, the water deficit, in Nyaruguru district, will be 27,399 m³/day (1,142 m³/h). The table below presents the water balance in Nyaruguru district.

Table 2: Water balance in Nyaruguru district

Water Supply System	Discharge (m ³ /day)	2025	2030	2035	2040	2045	2050
Rural WSS (Springs)	1,756	1,756	1,756	1,756	1,756	1,756	1,756
Total water supply capacity (m ³ /day)		1,756	1,756	1,756	1,756	1,756	1,756
Total water demand (m ³ /day)		18,445	14,563	17,228	20,521	24,386	29,155
Water Balance (m ³ /day)		-16,689	-12,807	-15,472	-18,765	-22,630	-27,399
Water Balance (m ³ /h)		-695	-534	-645	-782	-943	-1,142

In addition, potential dams have been identified by Rwandan Water Board in Nyaruguru district. These dams could be used for water supply. The water supply master plan envisaged:

- The exploitation of the Akanyaru river to provide water to Cyahinda, Kibeho, Munini, Ngera, Ngoma, Nyagisozi and Rusenge sectors.
- Taking benefit from the potential dam identified in the Ruheru sector to supply the Busanze, Nyabimata and Ruheru sectors.
- Exploiting the potential dam identified in the Kivu sector to supply the Mata, Muganza, Ruramba and Kivu sectors.

1.3.2. Status of WSS in Huye district

By 2050, the water deficit, in Huye district, will be 36,157 m³/day (1,507 m³/h). The table below presents the water balance in Huye district:

Table 3: Water balance in Huye district

Water Supply System	Discharge (m ³ /day)	2025	2030	2035	2040	2045	2050
Systems (urban and rural springs)	8,964	8,964	8,964	8,964	8,964	8,964	8,964
Kadahokwa (Kadahokwa Dam)	8,500	8,500	8,500	8,500	8,500	8,500	8,500
Mpanga System (Bishya Dam)	350	350	350	650	650	650	650
Total Water Supply Capacity (m³/day)		17,814	17,814	18,114	18,114	18,114	18,114
Total Water Demand (m³/day)		23,878	22,408	27,828	34,576	43,098	54,271
Water Balance (m³/day)		-6,064	-4,594	-9,714	-16,462	-24,984	-36,157
Water Balance (m³/h)		-253	-191	-405	-686	-1,041	-1,507

It must be noted that the water supply system in Mbazi sector is characterized by a surplus until the year 2050. To fill the water gap by 2050, three water resources have been identified that can be mobilized to reinforce the existing water systems and supply the areas not covered by the network. The table below presents the identified water resources and areas to be supplied:

Table 4: Potential water resources for water supply in Huye district

Water Resources	Location (District)	Areas To be supplied
Bishya Dam	Nyanza	Kinazi – Rusatira – part of Rwaniro
Myogo river	Nyamagabe	Simbi – Kigoma - Maraba
Akanyaru river	Nyaruguru	Karama – Gishamvu – Mukura – Huye – Ngoma – Tumba – Mbazi

It is planned to implement the following facilities:

Myogo Water Supply System:

- Raw water intake and pumping station, on the Myogo river, with a capacity of 5,500 m³/day.
- Water Treatment Plant with a capacity of 5,500 m³/day.
- Treated water pumping station with a capacity of 5,500 m³/day.
- Transmission pipe with a diameter of 200 mm.
- Main storage tank with a capacity of 2,400 m³.
- Distribution facilities (storage tanks, networks, public taps, private connections).

Bishya Water Supply System:

- Raw water intake and pumping station, on the reservoir of Bushya Dam, with a capacity of 3,500 m³/day.
- Water Treatment Plant with a capacity of 3,500 m³/day.
- Treated water pumping station with a capacity of 3,500 m³/day
- Transmission pipe with a diameter of 200 mm.
- Main storage tank with a capacity of 1,500 m³.
- Distribution facilities (storage tanks, networks, public taps, private connections).

Akanyaru Water Supply System:

- Raw water intake and pumping station, on the Akanyaru river, with a capacity of 28,000 m³/day.
- Water Treatment Plant with a capacity of 28,000 m³/day.
- - Treated water pumping station with a total capacity of 28,000 m³/day.
- - Transmission pipe with a diameter of 500 mm.
- - Main storage tank with a capacity of 12,000 m³.
- Distribution facilities (storage tanks, networks, public taps, private connections).

It should be noted that rural water systems will not be abandoned and will continue to serve the rural population.

1.3.3. Status of WSS in Gisagara district

By 2050, the water deficit, in Gisagara district, will be 27,856 m³/day (1,161 m³/h). The table below presents the water balance in Gisagara district:

Table 5: Water Balance in Gisagara district

Water Supply System	Current Discharge (m³/day)	2025	2030	2035	2040	2045	2050
Rural WSS (Springs)	3,652	3,652	3,652	3,652	3,652	3,652	3,652
Total Water Supply Capacity (m³/day)		3,652	3,652	3,652	3,652	3,652	3,652
Total Water Demand (m³/day)		20,035	15,828	18,718	22,238	26,382	31,508
Water Balance (m³/day)		-16,383	-12,175	-15,066	-18,586	-22,730	-27,856
Water Balance (m³/h)		-683	-507	-628	-774	-947	-1 161

Gisagara district is poor in terms of spring water. Most of the springs are drying up and do not allow for a reliable future exploitation to meet the water demand. In terms of surface water, Gisagara

district is bordered by a large river called Akanyaru. This river has the potential for future water mobilization for the water supply of Gisagara district.

It is planned to implement the following facilities:

- Raw water intake and pumping station, on the Akanyaru river, with a capacity of 28,500 m³/day.
- Water Treatment Plant with a total capacity of 28,500 m³/day.
- Treated water pumping station with a total capacity of 28,500 m³/day.
- Transmission pipe with a nominal diameter of 500 mm.
- Main storage tank with a total capacity of 12,000 m³.
- Distribution facilities (tanks, networks, public taps, private connections).

It should be noted that rural water systems will not be abandoned and will continue to serve the rural population.

CHAP II: ESIA METHODOLOGY AND APPROACH

2.1. ESIA Objective

The main objective of this study is to carry out a comprehensive environmental impact assessment for the proposed infrastructure development activities and proposed respective mitigation measures.

The specific objectives include:

- Establishment of the project's potential environmental and social impacts and propose measures to mitigate them;
- Assessment of the impacts of alternatives and advise the design consultant accordingly; and
- Determine the actions required by WASAC, beneficiary districts (Nyaruguru, Huye and Gisagara) and other stakeholders to satisfactorily address the environmental and social impacts that might arise as a result of project implementation.
- Comply with national standardized process for development authorization.
- To protect specific natural environment from potentially significant and avoidable impacts caused by development projects.
- To invoke environmental consciousness and responsibility for all development activities in Rwanda.
- To facilitate efficient and modern development activities whilst considering the needs of present and future generations.

2.3. Scope of the work

The present ESIA report will identify potential adverse environmental and social impacts that may arise from the development and construction of Nyaruguru-Huye-Gisagara WSS and will propose appropriate mitigation measures that align with the Rwanda environmental legislation as well as the AfDB Group's Integrated Safeguards System (ISS) and its 5 Operational Safeguards (OSs).

In fact, environmental and social assessment shall include the project's area of influence (both upstream and downstream), a comprehensive scoping of the project's components (water resources/intake structures, water treatment plants, transmission mains, water tanks, water supply/distribution networks, water pipes/mains, and collection and valve chambers (L. Tuhovčáka, 2014), consideration of alternatives, and assessment of cumulative impacts, where relevant, as recommended by AfDB's ISS (AfDB, 2013).

2.4. Environmental and social assessment in line with national legislation

The development of the present report followed the Environmental Impacts Assessment (EIA) process in Rwanda, which consists of the following 5 steps (REMA, 2006):

- 1) Project brief preparation: the purpose of a project brief is to provide information on the proposed activity to establish whether the project will have possible and significant impact on the environment and on human welfare, and thus determine the level of EIA necessary in accordance with national laws and regulations. A project brief was prepared and submitted to Rwanda Development Board (RDB) for report clearance and issuance of certificate.
- 2) Screening: is a process of determining Impact Level (IL) of proposed project in respect of general guidelines and procedure for environmental impact assessment in Rwanda, which then determines whether an EIA is required or not. Screening enables classification/categorization of proposed projects according to their IL as follows:
 - **IL 1**: Projects not requiring further environmental assessment. Projects in this category are believed to have minimal adverse impacts, which can easily be identified through a project brief, and mitigation measures can be integrated in the design of the project without necessarily requiring a detailed EIA.
 - **IL 2**: Projects not requiring a full EIA but necessitate further level of assessment (some assessment needed): projects in this category are believed to have adverse and reversible environmental impacts and mitigation and management measures can be incorporated into the project. The EIA process for these projects is like that of IL3 projects.
 - **IL 3**: Projects requiring a full EIA. This category involves projects for which it is evident that there will be significant and adverse environmental impacts whose mitigation measures cannot readily be prescribed, and consequently, must undergo a complete EIA process.

The proposed project of constructing Nyaruguru-Huye-Gisagara WSS falls under IL 3, thus requiring developing a full EIA.

- 3) Scoping and consideration of alternatives is intended to establish important issues to be addressed in the study and eliminate the irrelevant ones. It is the responsibility of the project

developer and/or EIA expert in consultation with key stakeholders. Project alternatives are discussed under chapter 8.

- 4) Baseline data collection & analysis of initial state: baseline data describes status of existing environment at a location before intervention of the proposed project. Site-specific primary data on and around project site should be collected by Environmental Assessment (EA) expert conducting the environmental impact study to form a basis for future environmental monitoring. Baseline conditions are discussed under chapter 6 of this report.
- 5) Impact prediction & analysis of alternatives: impact prediction is a way of forecasting the environmental consequences of a project and its alternatives. For every project, possible alternatives should be identified by the EA expert, and they should cover both project location and process technologies. Alternatives should then be ranked for selection of the most optimum environmental and socio-economic benefits to the community. For the selected alternative/option, a mitigation plan should be drawn up and supplemented with an Environmental Management Plan (EMP) to guide the developer in environmental conservation. While alternatives are discussed under chapter 8, potential project's impacts are identified in chapter 9, mitigation measures proposed under chapter 10, their management plan under chapter 11, and the monitoring plan discussed under chapter 12.

2.5. Screening outcome in respect of national EIA guidelines

Environmental screening of development projects in Rwanda is done in respect of the Ministerial Order No 001/ 2019 of 15/04/2019 establishing the list of projects that must undergo environmental impact assessment, instructions, requirements, and procedures to conduct environmental impact assessment (Government of Rwanda, 2019). The annex 1 to this ministerial decree lists industry activities for which a full EIA should be developed before project implementation. The annex 2, provides a list of works, activities and projects that must undergo a partial EIA.

Though the ministerial order doesn't list WSS projects among those that should undergo either a full or a partial EIA, the annex 5 of the Biodiversity Inclusive Guidelines for EIA for water resources management projects in Rwanda lists water resource management (WRM) projects that may be considered for EIA. They include dams, rivers, and water resources projects that might consist in rivers diversions and water transfer between catchments, surface and groundwater abstraction,

drilling and motorized water pumping, construction and operating gravity water schemes, construction of water reservoirs, drainage canals and conveyance pipe laying, etc (REMA, 2021).

Given that the proposed project shall comprise (1) water transfer between catchments, (2) surface water abstraction, (3) motorized pumping, (4) gravity water scheme operations, (5) construction of water reservoirs, among other, the EA team recommended developing a full EIA for the proposed project of construction of Nyaruguru-Huye-Gisagara WSS.

2.6. Screening outcome in respect of AfDB's ISS and OSs

The construction of Nyaruguru-Huye-Gisagara WSS shall be financed by the AfDB through AWF. Therefore, AfDB's ISS and applicable OSs shall be triggered by this project.

At project level, borrowers or clients are responsible for conducting the environmental and social assessment (Strategic Environmental and Social Assessment, or SESA, or Environmental and Social Impact Assessment, or ESIA) and for developing, as an integral part of project documentation, an appropriate plan for managing possible impacts. AfDB's environmental and social staff in operations support the due diligence process and ensure that borrowers and clients are fully aware of Bank policies and procedures, while the Bank's Compliance and Safeguards function ensures that deliverables and the compliance process are properly conducted to ensure good quality. During the screening, AfDB's operations staff and the borrower (or client) shall screen the project for environmental and social impacts—including climate change impacts, potential adaptation and mitigation measures, and the vulnerability of populations and their livelihoods—to determine the specific type and level of environmental and social assessment. The screening is carried out in accordance with the Bank's Environmental and Social Assessment Procedures (ESAPs) (AfDB, 2013).

During the scoping, the process considers the size, processes, site design, construction and expansion sequencing and any new infrastructure for transportation, energy, communications, and public health, including drinking water; wastewater collection, treatment, and disposal; waste management; raw materials used; sources and means of access; releases to the environment; and any plans for pollution control and minimization. During the scoping phase, the assessment determines the range of likely potential risks and impacts and determines whether specific requirements of the Bank's

OSs apply. The assessment covers, in an integrated way, all relevant direct and indirect environmental and social risks and impacts, including those specifically covered in OSs 2-5. Potential impacts include physical (e.g., geology and soils, surface and groundwater resources, air resources and climate, noise and vibration, prominent vista and aesthetic features), biological (e.g., flora, resident and migratory fauna, ecosystems, endangered and threatened species and their habitats and protected areas, poaching), socioeconomic and cultural (e.g., livelihood, resettlement, community social structure, gender, vulnerable groups, health, safety, cultural property, ecosystem services), and transboundary and global impacts, including greenhouse gas emissions and vulnerability to climate change effects. It discusses potential adaptation and mitigation measures (AfDB, 2013).

The EA team screened the project in respect of the 5 OSs of the Bank. The 5 OSs of the Bank are:

- OS1: Environmental and social assessment.
- OS2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.
- OS3: Biodiversity and Ecosystem Services.
- OS4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency.
- OS5: Labor Conditions, Health, and Safety.

OS1 sets out the Bank's overarching requirements for borrowers or clients to identify, assess, and manage the potential environmental and social risks and impacts of a project, including climate change issues; while OSs 2-5 support the implementation of OS1 and set out specific requirements relating to different environmental and social issues, including gender and vulnerability issues, that are triggered if the assessment process reveals that the project may present certain risks (AfDB, 2013).

Project risks categorization follows the principle of using the appropriate type and level of environmental and social assessment for the type of operation. The proposed project of construction of Nyaruguru-Huye-Gisagara WSS was classified under Category 1 of Bank operations likely to cause significant environmental and social impacts. This is mainly because the project shall induce significant and/or irreversible adverse environmental and/or social impacts and will require a Full

Resettlement Action Plan (FRAP) under the provisions of the Bank’s policy on involuntary resettlement (AfDB, 2013).

2.7. Field visit at the project site

Field visit of the EA team took place on different dates; 10,11, 24 and 25 September 2022 in Nyaruguru, Huye, and Gisagara districts.

2.8. Tasks and approach to develop the ESIA

Table 3 describes tasks, approaches and deliverables as carried out during conducting this ESIA study.

Table 6: Tasks and activities carried during the ESIA study

TASK & ACTIVITIES	APPROACH
Task 1: Project site reconnaissance	Field work, observation, and mapping.
Task 2: Set the methodological approach	Desk work to prepare the methodological approaches of the ESIA development assignment.
Task 3: ESIA Scoping	Desk work, field surveys, interviews to identify key issues for the ESIA preparation.
Task 4: Review of policies, regulatory framework applicable to the project	Desk work to review national environmental legislation, AfDB’s ISS and OSs, international treaties, conventions, and agreements related to this project.
Task 5: Analysis of the project components and activities	Field surveys, interviews to local population and project affected people (PAPs).
Task 6: Collection of the biophysical and social economic and cultural baseline information	Biophysical, biological, and social economic investigations (literature review, field surveys, observations, mapping, interview, questionnaires,) to identify the background environment.
Task 7: Impact identification, impact analysis and impact significance and occupational Safety & Health concerns	Desk work, identifying, analysis and mapping the project impacts and their significance to the communities and environment.
Task 8: Analysis of mitigation measures	Desk work to identify and analysis of the project mitigation measures.

TASK & ACTIVITIES	APPROACH
Task 9: Analysis of alternatives (sites, material, construction technology, waste management techniques).	Desk work, field surveys to analyze the project alternatives in terms of project sites, construction technologies or management of wastes and work schedule.
Task 10: Environmental and Social Management Plan (ESMP) and Environmental and Social Monitoring Plan (ESMonP)	Desk work compiling expected impacts from proposed activities, anticipated mitigation measures, management and monitoring indicators, responsibility, frequency, and cost. The ESMP will also detail the management for the storm water, waste, topsoil, dumping areas, quarry, campsites and borrow sites.
Task 11: Preparation and presentation of the Draft Report	Desk work compiling the ESIA report and its disclosure to the client (WASAC), AfDB, and other key project stakeholders.
Task 12: Preparation and presentation of final report	Desk work, revising the draft report according to the input from the client and key project stakeholders.
Task 13: Submission of final report and issuance of certificate of approval by the Rwanda Development Board	Submission of the Final ESIA Report to RDB for final review and approval and issuance of the Clearance Certificate.

3.6. Primary data collection

Data was collected from primary and secondary sources. Primary data collection involved site assessment surveys with appropriate survey tools such as camera, GPS, observation to qualify and quantify perceived impacts of the project on population, existing infrastructures, land use, and prevailing sensitive environmental receptors including surface and ground waters; animal breeding sites, feeding grounds. This was carried out with specific focus on biophysical environment (flora, fauna, topography and soil, climate and rainfall, geology, etc.), socio-economic and cultural environment (population, land use, sources of income, employment, goods and services, cultural/historical sites).

3.7. Secondary data collection

Secondary data collection involved review of relevant policies, strategies and regulations related to buildings, infrastructures, national socio-economic surveys, education, and environmental impact assessment.

Policies, laws, and regulations that are relevant to the project are reviewed under chapter 5 of the present report. Reviewed documents include AfDB's ISS and OSs, and other applicable national legislations.

CHAP IV: PROJECT DESCRIPTION

4.1. Background of the project

The Nyaruguru-Huye-Gisagara WSS Project is part of the structural actions established by the National Integrated Water Supply and Sanitation Master Plans (NIWSSMPs) of Rwanda. The main objective is to ensure 100% access to clean water in parts of Huye and Nyaruguru districts and in all Gisagara district. The proposed project will contribute to enhanced hygiene and sanitation by reducing water borne diseases. This will also contribute towards reduction of poverty within the study area through the improvement of socio-economic activities (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

In this perspective WASAC has attributed to the Consultant STUDI INTERNATIONAL/LANDMARK/IDEA CONSULT, as part of a complementary study to the NIWSSMP and its addendum of the feasibility study and detailed design of Nyaruguru-Huye-Gisagara WSS. The total investment cost for the development of Nyaruguru-Huye-Gisagara WSS is about **220,360,890 USD** as detailed in the table below (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022):

Table 7: Estimated cost of the proposed project per phase

Facility	Estimated cost per phase (in USD)		
	2024 - 2030	2031 - 2040	2041-2050
Water Intake	840 000	840 000	840 000
Water Treatment Plant	6 000 000	6 000 000	6 000 000
Pumping Stations	10 935 033	943 538	730 603
Tanks	2 115 000	4 960 000	4 845 000
Transmission Pipes	42 650 808	8 357 542	0
Distribution Pipes	11 763 748	26 003 021	36 268 572
Private connections	2 352 750	4 550 887	6 219 905
Junction Structures	444 581	384 988	0
Access Track	7 000 000	0	0
Land acquisition	560 986	11 202	0
Total	84 662 906	52 051 178	54 904 081
Miscellaneous (15%)	12 699 436	7 807 677	8 235 612
Total	97 362 342	59 858 855	63 139 693

The project will be in the Southern Province and concerns 26 sectors (7 in Nyaruguru district, 6 in Huye district and 13 in Gisagara district) as presented in the following table:

Table 8: Location of the project

District	Number of sectors	Sectors
Nyaruguru	7	Cyahinda
		Kibeho
		Munini
		Ngera
		Ngoma
		Nyagisozi
		Rusenge
Huye	6	Gishamvu
		Huye
		Karama
		Mukura
		Ngoma
		Tumba
Gisagara	13	Gikonko
		Gishubi
		Kansi
		Kibirizi
		Kigembe
		Mamba
		Muganza
		Mugombwa
		Mukingo
		Musha
		Ndora
		Nyanza
		Save

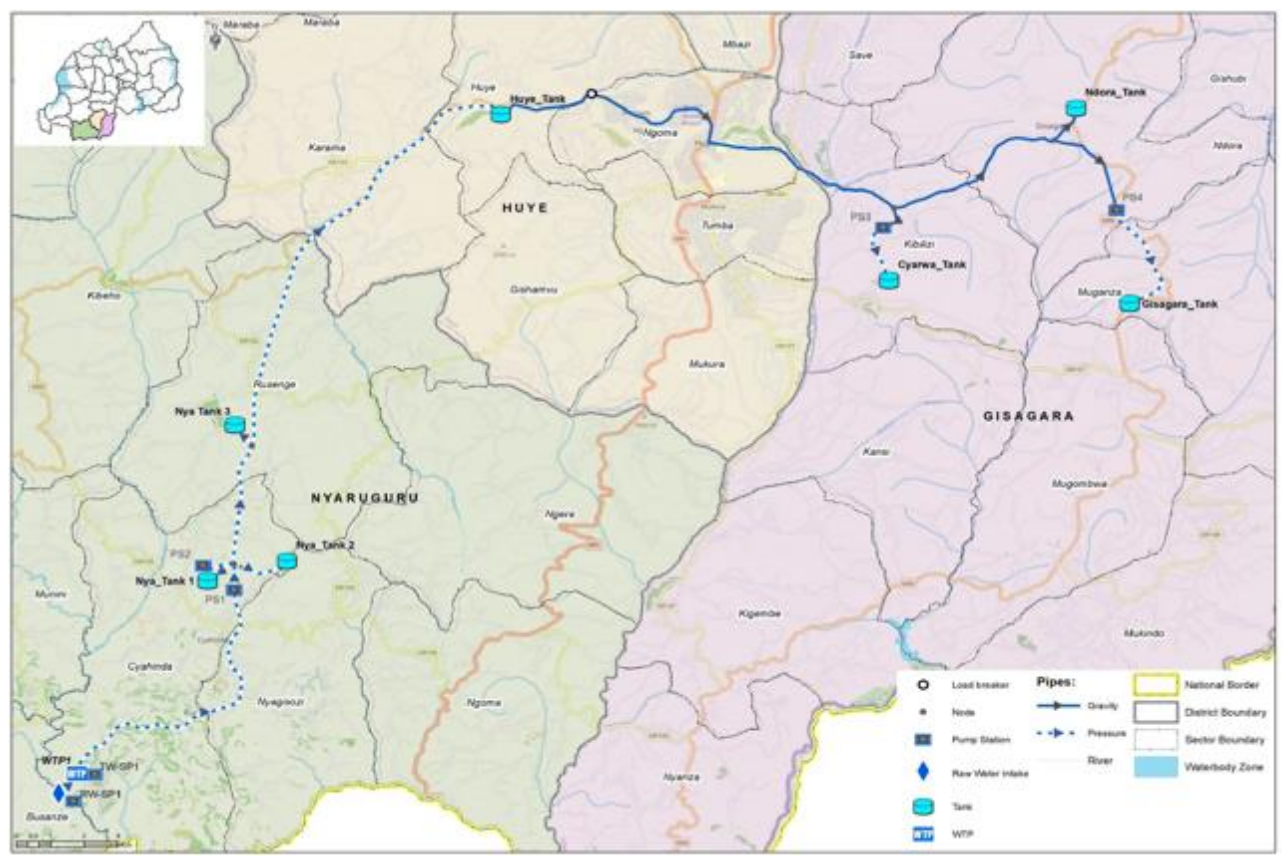
4.2. Water resources/intake structure

4.2.1. One Water Intake on Akanyaru river

A single transmission pipeline shall cross Nyaruguru, Huye and Gisagara districts and shall serve the 26 sectors forming the project area. This transmission pipe will conduct water from an intake located on the Akanyaru Upper between the Ntaruka Hydropower Plant and the Akanyaru multipurpose dam. It will be laid on the left bank of the river. The pipeline section between the intake and Huye will be a discharge system with three intermediate discharge tanks installed at high points to supply the areas of Munini, Cyahinda, Nyagizosi, Ngoma, Ngera, Rusenge, Kibeho, Kigembe and Nyanza. The total volume to be supplied is about 8,100 m³/day by 2030 and 18,000 m³/day by 2050.

At Mont of Huye, a new discharge tank will be implemented. It will ensure the water supply of the existing distribution tanks in Huye city and will supply the transmission line that continues towards Gisagara (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

Table 9: Conceptual scheme of water intake at Akanyaru river



The transmission pipe between Huye and Gisagara will transfer, by 2050, a flow of 21,370 m³/day and will be equipped with two connection points at Kibirizi and Ndora. They will be used to supply the planned discharge tanks at Cyarwa and Ndora. The end point of the transmission system will be a discharge tank that will be used to control the water supply in the sectors of Muganza, Mugombwa and Mukingo (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

4.2.2. Raw water intake structure

The raw water intake will be located on the Akanyaru Upper between the Ntaruka Hydropower Plant and the Akanayaru multipurpose dam. It will be on the left bank of the river. The table below, presents the coordinates of the water intake:

Table 10: Coordinates of the raw water intake

Facility	X (m)	Y (m)	Z (m)
Water Intake	785596.00 m E	9691252.00 m S	1,698

The intake structure will consist of a submerged weir that will raise the water level in the Akanyaru river and subsequently ensure a gravity flow into the grit chamber. The grit chamber is equipped with mechanical coarse screens at the inlet and fine screens at the outlet. Also, a mobile scraper bridge will be installed to ensure the cleaning of the sludge in the chamber.



Figure 2: Example of scrapper bridge

The water is discharged into the suction basin and then delivered to the treatment plant by pumping. The water loss consists of water leakage from various facilities from the intake point through the water treatment plant, process water consumed during water treatment, sludge, evaporation etc. and its volume differs depending on the condition of respective facilities, the method of water treatment etc. During the period of high turbidity of the river, the water intake must have a capacity larger than the peak day flow by a ratio of 1.25. The capacity of the water intake is 87,620 m³/day by 2050.

4.2.3. Raw water pumping station

A vertical axis pump in wet pit is the type of pumping station recommended by the feasibility study for raw water pumping. The main parameters that differentiate various available vertical axis pumps are the design features of the bowl and the impeller, and the method of lubrication incorporated in the pump design-oil-lubricated ones are preferred while the water to be pumped contains fine sand particles. When the water is meant for drinking purposes, it is desirable to use water-lubricated pumps as the oil-lubricated ones loose some oil into the water that is being pumped. However, in cases where the pump is expected to remain idle frequently, it is desirable to use an oil-lubricated pump because the rubber bearings of water-lubricated pumps can get out of shape and damaged. So far as the bowls are concerned, one looks for the efficiency guaranteed by the manufacture far over the concerned range of pumping heads and specified discharge (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

The type of the pump shall be in conformity with the following (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022):

- It shall satisfy the design discharge and the total lift and exert high efficiency within the operational range.
- No cavitation shall occur at the design suction head.
- The pump shall be determined examining the method of operation, and merits and demerits related to maintenance, dismantling and servicing etc. of the pump.

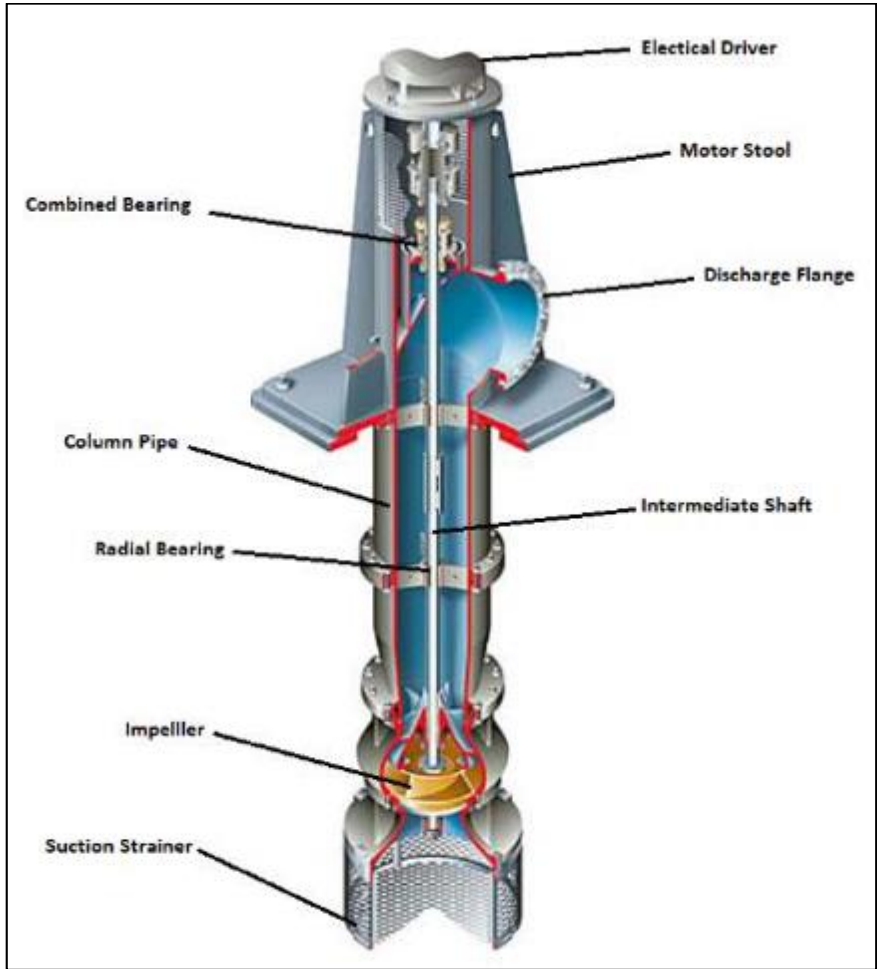


Figure 3: Example of vertical axis pump

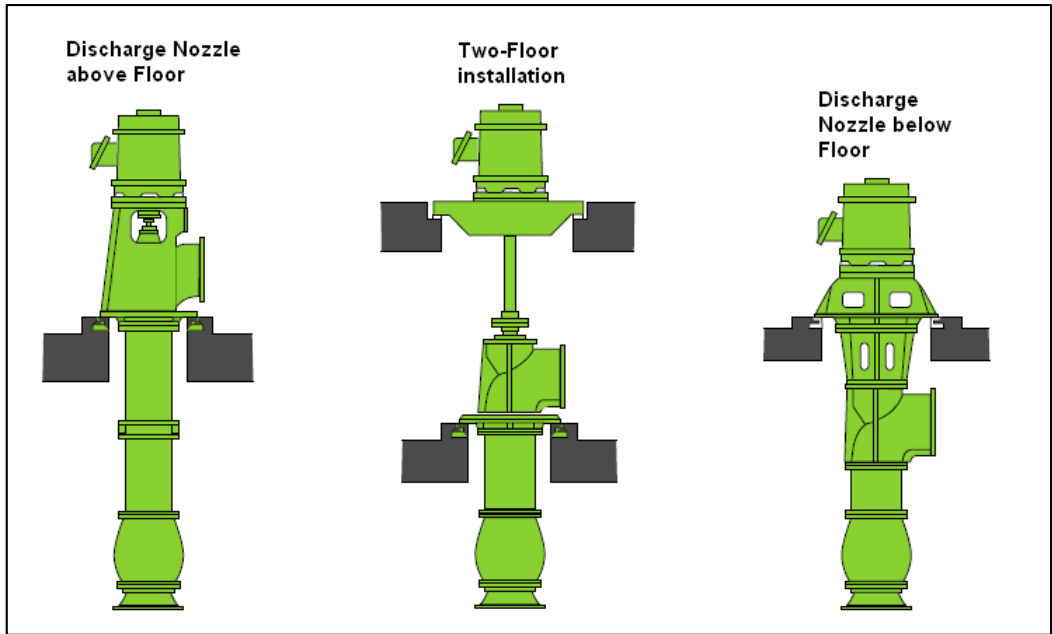


Figure 4: Different arrangements of vertical axis pump

4.3. Water Treatment Plant and Quality of Treated Water

4.3.1. Water Treatment Plant (WTP)

The adopted treatment process will consist of a classic **Coagulation - Flocculation – Decantation -Filtration - Disinfection process**. The different stages and components of the treatment process are:

- A pre-chlorination at the level of the water intake on the river.
- A headworks to receive the raw water.
- Upstream of the decanters, we plan a coagulation-flocculation stage, which aims at optimizing the decantation by the constitution and the consolidation of the flocs. This treatment will be carried out by injection of coagulant in a fast-mixing structure, possibly completed according to the quality of water by the injection of polymer type flocculant with a slow agitation.
- The sludge extracted from the decanters will be sent by gravity or by pumping to a thickener then to a drying bed.
- The pH correction by lime injection will be implemented as needed at the raw water inlet.
- A lamella decantation stage optimized by the implementation of a sludge recirculation according to the needs.
- An oxidation, if necessary, of manganese with air or chlorine in the clarified water at the outlet of decanters.

The final capacity of the proposed WTP will be 72,000 m³/day of treated water, with an average daily flow of 3,000 m³/h. The implementation of the WTP will be carried out in several phases according to the water demand. For operation and maintenance convenience, the configuration of the plant phase 1, will be organized in two independent lines for the inlet, flocculation and decantation works. The raw water intake structures and the pipe between the intake and the WTP can be sized for the final phase. The nominal capacity of the new treatment plant is fixed to 24,000 m³/day of produced drinking water, expandable to 72,000 m³/day in several stages. Thus, the following phasing is proposed:

- First phase: 24,000 m³/day in 2 lines of 12,000 m³/day each.
- Second phase: 24,000 m³/day in one line.
- Third phase: 24,000 m³/day in one line.

The operating regime of the plant during the day should preferably be at steady flow. The actual loss rate will depend on the quality of the raw water, the maximum losses rate must be less than 2 %. The volume of treated water is counted excluding filter backwashing water and plant service water. The plant will be able to accept a hydraulic overload of 25 % when the turbidity of the raw water is at most equal to 100 NTU (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).



Figure 5: Layout of the proposed WTP

4.3.2. Quality of Treated Water

Water from the intake shall be treated to meet the standards of potable water in terms of physicochemical characteristics, inorganic and organic contaminants, and microbiological

requirements of the EAS 12:20218 (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

Potable water shall comply with the physicochemical characteristics given in the table below:

Table 11: Physicochemical requirements according to the EAS 12:2018

Parameter	Treated potable water limit	Natural potable water limit
Colour, TCU*,max.	15	50
Turbidity,NTU,max.	5	25
pH	6.5–8.5	5.5-9.5
Conductivity, μ S/cm, max.	1500	2500
Suspended matter, mg/l	Not detectable	Not detectable
Totaldissolved solids, mg/l,max.	1000	1500
Total hardness, as CaCO ₃ ,mg/l,max.	300	600
Aluminium, (Al),mg/l,max.	0.2	0.2
Chloride, (Cl),mg/l,max.	250	250
Total Iron (Fe),mg/l,max.	0.3	0.3
Sodium, (Na),mg/l,max.	200	200
Sulphate (SO ₄),mg/l,max.	400	400
Zinc (Zn),mg/l,max.	5	5
Magnesium, (Mg), mg/l,max.	100	100
Calcium, as (Ca),mg/l,max.	150	150
Potassium(K), mg/l,max.	50	50

Potable water shall comply with the limits of inorganic contaminants given in table below:

Table 12: Limits for inorganic contaminants according to EAS 12:2018

Contaminant	Treated potable water limit (mg/l)	Natural potable water limit (mg/l)
Arsenic (As)	0.01	0.01
Cadmium (Cd)	0.003	0.003
Lead (Pb)	0.01	0.01
Copper (Cu)	1.000	1.000
Mercury (total as Hg)	0.001	0.001
Manganese (Mn)	0.1	0.1
Selenium (Se)	0.01	0.01
Ammonia (NH ₃)	0.5	0.5
Total Chromium (as Cr)	0.05	0.05
Nickel (Ni)	0.02	0.02
Cyanide (CN)	0.01	0.01
Barium (Ba)	0.7	0.7
Nitrate (NO ₃ -)	45	45
Boron (Boric acid)	2.4	2.4
Fluoride (F)	1.5	1.5
Bromate (BrO ₃)	0.01	0.01
Nitrite (NO ₂ ⁻ -N)	0.9	0.9
Molybdenum (Mo)	0.07	0.07
Phosphates (PO ₄ ³⁻)	2.2	2.2
Free residual Chlorine	0.2- 0.5*	Absent
Uranium	0.03	0.03

* Under conditions of epidemic diseases, it may be necessary to increase the residual chlorine temporarily.

Potable water shall comply with the limits of organic contaminants given in table below:

Table 13: Limits for organic contaminants according to EAS 12:2018

Contaminants	Limit (µg/lmax.)
Aromatics	
Benzene	10
Toluene	700
Xylene	500
Polynucleararomatichydrocarbons	0.7
Chlorinated Alkanes and Alkenes	
Carbon tetrachloride	2
1,2-Dichloroethane	30
1,1-Dichloroethylene	0.3
1,1-Dichloroethene	30
Tetrachloroethene	40
Phenols	2
2,4,6-Trichlorophenol	200
Tri halomethanes	
Chloroform	30
Pesticides	
Aldrin/Dieldrin	0.03
Chlordane(total)	0.3
2,4- Dichlorophenoxy acetic acid	30
DDT(total)	1
Heptachlor and Hepta chlor Epoxide	0.03
Hexa chloro benzene	1
Lindane BHC	2
Methoxychlor	20
Surfactants (reacting with methylene Blue)	200
Organic matter	3

Potable water shall comply with the microbiological limits given in table below:

Table 14: Microbiological limits according to EAS 12:2018

Type of micro-organism	Limit
Total viable counts at 22 °C, CFU/ml, max.	100
Total viable counts at 37 °C, CFU/ml, max.	50
Total coliforms, CFU/100ml	Not detectable
<i>Escherichia coli</i> , CFU/100ml	Not detectable
<i>Staphylococcus aureus</i> , CFU/100ml	Not detectable
Sulphite reducing anaerobes, CFU/100ml	Not detectable
<i>Pseudo monasaeruginosa</i> fluorescence, CFU/100ml	Not detectable
<i>Streptococcus faecalis</i> , CFU/100ml	Not detectable
<i>Shigella</i> , per100ml	Not detectable
<i>Salmonella</i> , per100ml	Not detectable
<i>Giardia</i> , per100ml	Not detectable
<i>Cryptosporidium</i> per 100ml	Not detectable

4.4. Water treatment process

4.4.1 General design principles

General design principles of the WTP considered designing a WTP for continuous 24-hour operations. All major process units (chemical feeders, mixing basins, flocculation tanks, sedimentation tanks and filters) which require frequent servicing or cleaning should be provided at least in duplicate. Sedimentation tanks and filters should preferably be provided in triplicate, in order to limit the temporary overloading when one unit is being serviced or cleaned to 50% .

4.4.2. Aeration

The treatment process will also comprise aeration, which is the process whereby water is brought into intimate contact with air for the following purposes:

- Increasing the oxygen content of the water.
- Reducing the carbon dioxide content of the water.
- Removing hydrogen sulphide, methane, and other volatile organic compounds responsible for imparting tastes and odours.
- Removing iron and manganese responsible for imparting tastes and discoloration.

Generally, there is no need for special provisions to be made for the aeration of surface water with the aim of reducing high contents of iron and/or manganese. The contents of iron and manganese as found in the surface waters in Rwanda are usually in a form that can easily be removed by coagulation, flocculation, sedimentation and filtration. However, aeration may be required to increase the oxygen content of waters abstracted from large storage reservoirs.

4.4.3. Coagulation

Coagulation can be considered to be the first stage in the formation of precipitates of finely divided, suspended and colloidal matter in water, induced by the addition of special chemicals called “coagulants”. The commonest coagulant in Rwanda is aluminum sulphate, commonly called alum. Coagulant chemicals are in two main types including primary coagulants and coagulant aids. Primary coagulants neutralize the electrical charges of particles in the water which causes the particles to clump together well as coagulant aids add density to slow-settling flocs and add

toughness to the flocs so that they do not break up during the mixing and settling processes. Primary coagulants are always used in the coagulation/flocculation process while coagulant aids, in contrast, are not always required and are generally used to reduce flocculation time.

Chemically, coagulant chemicals are either metallic salts (such as alum) or polymers. Polymers are manmade organic compounds made up of a long chain of smaller molecules. Polymers can be cationic (positively charged), anionic (negatively charged) or nonionic (neutrally charged). The Table below, shows some of the common coagulant chemicals and lists whether they are used as primary coagulants or as coagulant aids.

Table 15: Types of coagulants

Chemical Name	Chemical Formula	Primary Coagulant	Coagulant Aids
Aluminum sulfate (Alum)	$Al_2(SO_4)_3 \cdot 14 H_2O$	X	
Ferrous sulfate	$FeSO_4 \cdot 7 H_2O$	X	
Ferric sulfate	$Fe_2(SO_4)_3 \cdot 9 H_2O$	X	
Ferric chloride	$FeCl_3 \cdot 6 H_2O$	X	
Cationic polymer	Various	X	X
Calcium hydroxide (Lime)	$Ca(OH)_2$	X*	X
Calcium oxide (Quicklime)	CaO	X*	X
Sodium aluminate	$Na_2Al_2O_4$	X*	X
Bentonite	Clay		X
Calcium carbonate	$CaCO_3$		X
Sodium silicate	Na_2SiO_3		X
Nonionic polymer	Various		X

The table, below, presents the advantages and the disadvantages of some coagulants

Table 16: Advantages and disadvantages of some coagulants

<i>Name</i>	<i>Advantages</i>	<i>Disadvantages</i>
Aluminum Sulfate (Alum) $Al_2(SO_4)_3 \cdot 18H_2O$	Easy to handle and apply; most commonly used; produces less sludge than lime; most effective between pH 6.5 and 7.5	Adds dissolved solids (salts) to water; effective over a limited pH range.
Sodium Aluminate $Na_2Al_2O_4$	Effective in hard waters; small dosages usually needed	Often used with alum; high cost; ineffective in soft waters
Polyaluminum Chloride (PAC) $Al_{13}(OH)_{20}(SO_4)_2 \cdot Cl_{15}$	In some applications, floc formed is more dense and faster settling than alum	Not commonly used; little full scale data compared to other aluminum derivatives
Ferric Sulfate $Fe_2(SO_4)_3$	Effective between pH 4–6 and 8.8–9.2	Adds dissolved solids (salts) to water; usually need to add alkalinity
Ferric Chloride $FeCl_3 \cdot 6H_2O$	Effective between pH 4 and 11	Adds dissolved solids (salts) to water; consumes twice as much alkalinity as alum
Ferrous Sulfate (Copperas) $FeSO_4 \cdot 7H_2O$	Not as pH sensitive as lime	Adds dissolved solids (salts) to water; usually need to add alkalinity
Lime $Ca(OH)_2$	Commonly used; very effective; may not add salts to effluent	Very pH dependent; produces large quantities of sludge; overdose can result in poor effluent quality

4.4.4. Storage of Aluminium Sulphate

Aluminium sulphate should be stored in a secured, cool, dry, well-ventilated area, removed from oxidising agents, alkalis, most metals, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills (if in a solution form). Large storage areas should have appropriate fire protection and ventilation systems.

4.4.5. Health Hazards and Disposal of Waste Solution and Sludge

Aluminium sulphate is categorised as a slightly corrosive, irritant and hazardous substance. This product has the potential to cause adverse health effects with over exposure. Use safe work practices to avoid eye or skin contact and inhalation. It may hydrolyse (with addition of water) to sulphuric acid, a strong tissue irritant. If released to water, aluminium salts will slowly be precipitated as aluminium hydroxide. This may lower the pH of waterways with toxic effects to aquatic organisms.

It is not expected to bio-accumulate. Plants may experience chronic toxicity at around 25 ppm. Before disposal, neutralise the solution with lime, weak alkali or similar. For small amounts absorb with sand or similar and dispose of to an approved landfill site.

4.4.6. Use of Aluminium Sulphate

Two solution tanks, one for mixing and the other for dosing, between them holding 48 hours of supply, should be provided. The solution strength should be in the range of 5 - 10%. The solution tanks could be equipped with hand agitators as shown in Figure below.

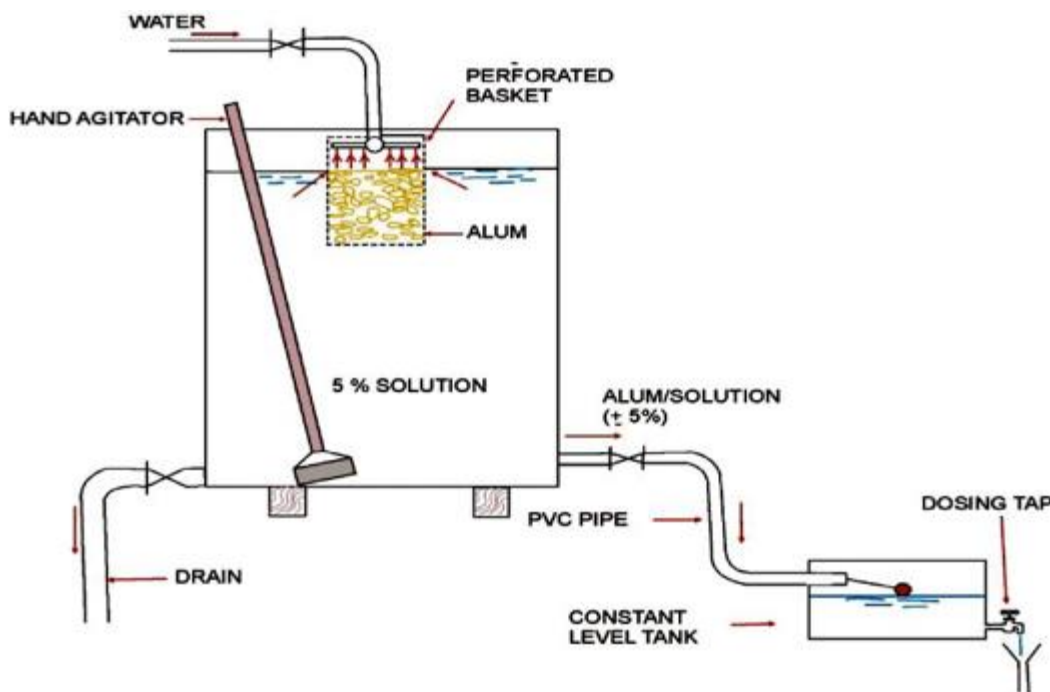


Figure 6: Dosing Arrangement for Alum

If the alkalinity of the raw water is low, the pH can be appropriately adjusted by adding soda ash in the correct proportions, as determined after carrying out laboratory experiments called “jar tests”. The strength of the soda ash solution required is usually in the range of 1 - 10%. The solution tanks for soda ash should also hold a total of 48 hours of supply. The chemical solutions should be fed into the raw water by means of gravity dosers, floating balls or other similar simple devices. Dosing pumps should be used only in exceptional cases.

4.4.7. Rapid Mixing

Rapid mixing aims at the immediate dispersal of the entire dose of chemicals throughout the mass of the raw water. To achieve this, it is necessary to agitate the water violently and to inject the chemicals in the most turbulent zone, in order to ensure their uniform and rapid dispersal. In our case, the mechanical rapid mixers are the most suitable. They are considered for discharges more than 300 m³/hr and where the head loss is to be minimized. The detention period in the mixing device should be between 20 and 120 seconds.

4.4.8. Flocculation

Flocculation can be considered to be the stage consequent to coagulation, where the precipitates of finely divided suspended and colloidal matter in water agglomerate to form larger clusters called “flocs” which can then be removed readily by sedimentation and/or filtration. Flocculation is achieved by the process of gentle and continuous stirring of the coagulated water. A number of factors determine the rate of flocculation including particle size, basin and nature of mixing devices, electrolyte concentration, water temperature, pH value, time of flocculation, size of mixing etc.

The feasibility study opted for the mechanical flocculators. They should have a peripheral velocity of 0.9 m/s in the first chamber reducing gradually to 0.1 m/s in subsequent chambers.

4.4.9. Sedimentation

The equipment of settling tanks with inclined PVC slats spaced a few cm apart, allows to considerably reduce the surface of the decanters and to improve the treatment. Today, it is a widespread process in treatment plants.

4.4.10. Rapid Sand Filtration

Rapid sand filters are used as part of a multiple-stage treatment system. They are widely used and most preferred option of water filtration because of their high capacity of water production from smaller land areas compared to slow sand filters. Rapid sand filtration uses relatively coarse sand with an effective grain size in the range of 0.4 to 1.2 mm as the filter medium. The filtration rates are relatively high, generally in the range of 5 to 15 m³/m²/hour. Construction details of a typical (open gravity type) rapid sand filter as shown in Figure below.

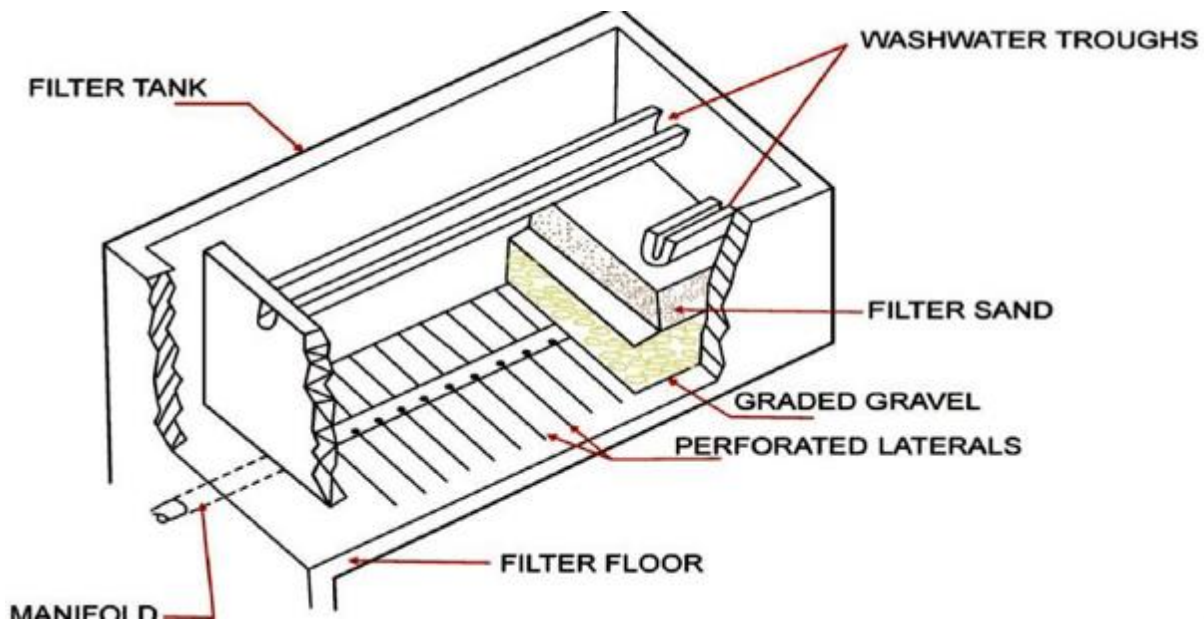


Figure 7: Rapid Sand Filtration – Open Gravity type

4.4.11. Disinfection

The single most important requirement for drinking water is that it is free from disease-causing (pathogenic) micro-organisms. Processes such as storage, coagulation, flocculation, sedimentation and filtration reduce, to varying degrees, the bacterial content of water. However, these processes are not sufficient to provide bacteriologically safe water. Final disinfection is therefore needed. Disinfection is often the only treatment process required in small water supply schemes, especially those based on groundwater sources and springs. All piped water supply schemes serving several households are to be designed with facilities for disinfecting the water before distribution to the consumers.

It is important that pipelines are designed in such a way as to facilitate disinfection. Disinfection is needed when the pipeline is used for the first time, and later when taking the pipeline back into service after carrying out repairs on it. The usage of a particular disinfectant and its dosage should be carefully determined, preferably under laboratory conditions, since overdose of these could easily be harmful to human beings and the environment.

4.5. Transmission mains

A single transmission pipeline crossing the districts of Nyaruguru, Huye and Gisagara and serving the 26 sectors of the project area. The branch of the pipeline between the intake and Huye will be a

discharge system with three intermediate discharge tanks to be installed at high points to supply the areas of Munini, Cyahinda, Nyagizosi, Ngoma, Ngera, Rusenge, Kibeho, Kigembe and Nyanza. The total volume to be supplied in these areas is about 7,360 m³/day by 2030 and 18,000 m³/day by 2050. At Mont of Huye, a discharge tank will be built. It will dominate the distribution tanks in the city of Huye and will feed the transmission line that continues towards Gisagara. The transmission pipe between Huye and Gisagara will transfer, by 2050, a flow of 21,370 m³/day and will be equipped with two connections points at Kibirizi and Ndora. They will be used to supply the planned discharge tanks at Cyarwa and Ndora. The end point of the transmission system will be a discharge tank that will be used to control the water supply in the sectors of Muganza, Mugombwa and Mukingo (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

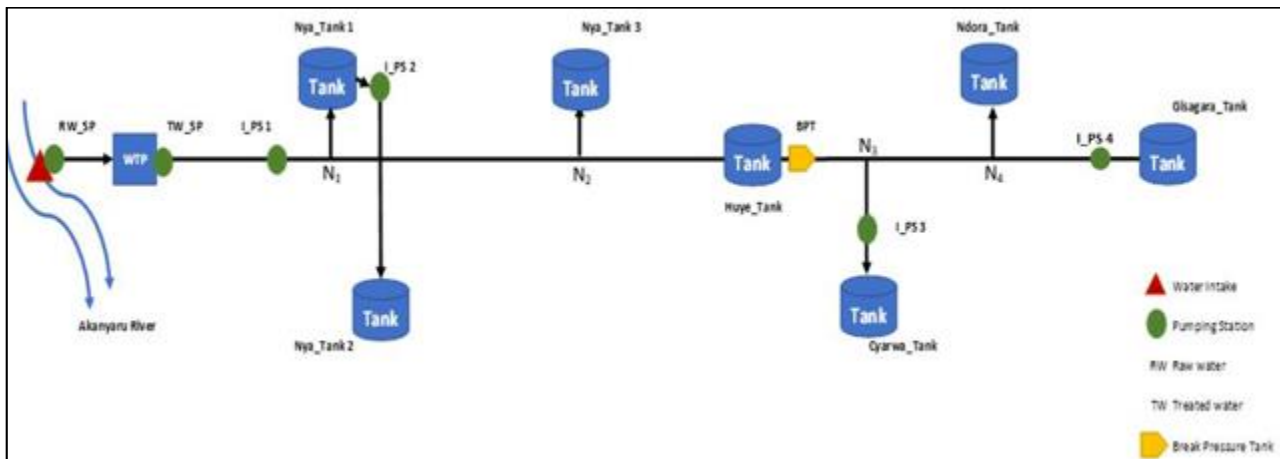


Figure 8: Scheme of the transmission main of the proposed Nyaruguru-Huye-Gisagara WSS

4.5. Water tanks

The storage reservoir is to provide for fluctuations in consumer demand during the day, without having to design the treatment plant and pumping mains to match peak flow. Furthermore, the storage provides for a constant residual pressure and flow to the consumers. It also provides a reserve capacity for firefighting and allows time for repairs and essential maintenance upstream of the storage to be made without interrupting flow to the consumers. For the estimation of the storage capacity, the consultant considered 42% of the maximum day demand. This ratio was approved in the “Master Plan stage”. Indeed, this value can reach 100% for small towns and rural areas but it is

rare to exceed 30% in urban areas (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

Reservoir sites should be selected such that they are on stable ground, not threatened by landslides or erosion. Level ground sites are preferable because they simplify excavation work. The design of storage reservoir foundations must be based on proper evaluations of ground bearing capacities. Reinforced concrete storages are used to store clean water for release on demand. They are usually made of concrete reinforced with steel bars or steel mesh, although some low-cost construction techniques use bamboo or other materials to reinforce the concrete. Storages may also be made of masonry, or ferrocement. Chemical additives are often mixed with the concrete to make it more impermeable to water. Reinforced concrete Storages are built at the site on a solid foundation. If the base is not solid enough, another site should be chosen, or arrangements made to stabilize the construction (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

To protect the water from contamination, the reservoir is covered with a roof, usually made of reinforced concrete, but other materials can be used. In the top of the tank an aeration pipe with a screen allows fresh air to circulate in the tank but keeps rodents and insects out. A manhole in the roof allows access to the tank for cleaning and repairs. Water flows into the reservoir through an inlet pipe above the water level in the reservoir. This prevents back-flow and allows the water to be heard entering the tank. At this point, a chlorine solution is often added for disinfection. Outlets are built a little above the floor of the reservoir, which has a slope pitched down towards one point with a washout pipe for flushing (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

The size and cost of proposed tanks are as follow:

- 1) 200 m³: 100,000,000 Rwf.
- 2) 300 m³: 130,000,000 Rwf.
- 3) 500 m³: 160,000,000 Rwf.
- 4) 1000 m³: 210,000,000 Rwf.
- 5) 1500 m³: 220,000,000 Rwf.
- 6) 2000 m³: 230,000,000 Rwf.
- 7) 3000 m³: 330,000,000 Rwf.

- 8) 5000 m³: 730,000,000 Rwf.
- 9) 6000 m³: 780,000,000 Rwf.
- 10) 7000 m³: 880,000,000 Rwf.

4.6. Water Supply/Distribution Pipes

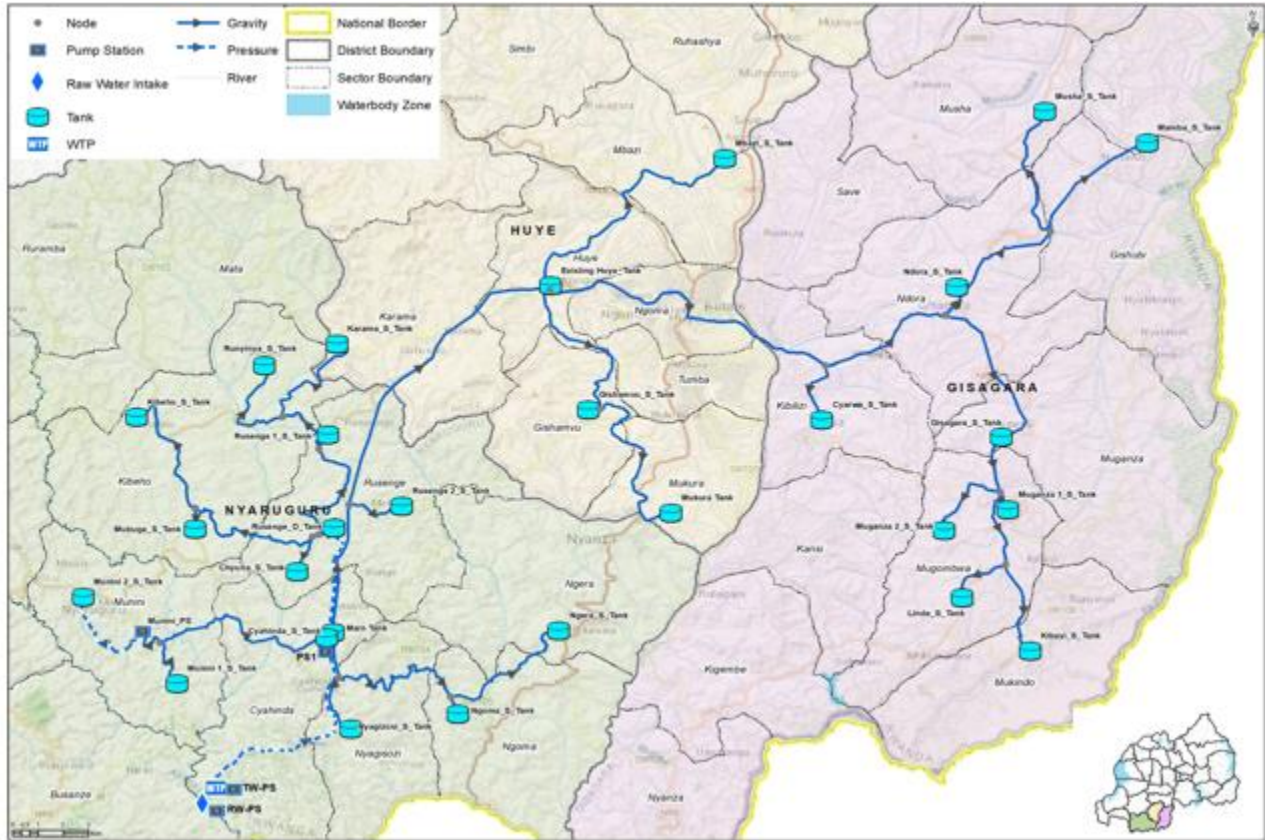
Water distribution pipes of the proposed project have a total length of 1,481km, which will be constructed in 3 phases of 236km, 520km, and 725km, respectively. For transmission lines, the selection of possible routes was based on certain criteria.

The most important criterion was to minimize the impact of length and pumping height on the costs. Other criteria considered when selecting a potential route include the distance from residential areas, agricultural fields, avoidance of river crossings, avoidance and minimization of main road crossings and avoiding steep and rocky areas in the mountains. Given the topology of the roads in the project area, the diameter (≥ 700 mm) and nature (ductile iron or steel) of the transmission lines, it will be appropriate to create a straight right-of-way for the transmission line. This will minimize the number of anchor blocks. An operating track should be created along the pipeline to facilitate maintenance and repair interventions (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

For the distribution network, where the diameter of the pipes is less than 400mm, the following rules must be respected:

- In case distribution mains are laid in the public road, the location and depth of laying shall be in conformity with the Road Law and the related regulations, and subject to coordination with the administrator of the road.
- In case distribution mains are laid across or in the vicinity of other buried objects, more than 0.3 m of space shall be provided between them.
- Anti-floating measures shall be provided where the groundwater level is high or expected to become high.

Figure 9: Optimized architecture of the proposed water transmissions and associated infrastructure



Following infrastructure will be required for the construction of Nyaruguru-Huye-Gisagara WSS.

Table 17: Required infrastructure for the proposed WSS

Infrastructure	Unit capacity	Total no. of units	2024 – 2030	2031 – 2040	2041 – 2050
Water Intake	24000 m ³ /d	3	0	0	0
WTP	24000 m ³ /d	3	0	0	0
RW_PS	203 l/s	5	00	0	0
TW_PS	203 l/s	5	00	0	00
I_PS 1	37 l/s	3	00	0	
I_Munini PS	13 l/s	2		00	
Main Tank	2500 m ³	6	0	00	000
Rusenge_D Tank	600 m ³	3	0	0	0
Ngoma_S Tank	500 m ³	3	00		0
Ngera_S Tank	1500 m ³	1	0		
	1000 m ³	2		0	0
Kibeho_S Tank	600 m ³	3	0	0	0
Mubuga_S Tank	100 m ³	3	0	0	0
Chyuna_S Tank	100 m ³	5	00	0	00
Huye Tank	5000 m ³	1			0
Mbazi_S Tank	1500 m ³	1	0		
	1000 m ³	2		0	0
Cyarwa_S Tank	500 m ³	1		0	
	1000 m ³	2	0		0
Ndora_S Tank	1000 m ³	2	0		0
Gisagara_S Tank	1000 m ³	1	0		
	2000 m ³	2		0	0
Nyagizosi_S Tank	1000 m ³	1		0	
Cyahinda_S Tank	600 m ³	2		00	
Munini 1_S Tank	200 m ³	1		0	
Munini 2_S Tank	250 m ³	3		00	0
Rusenge 1_S Tank	200 m ³	3		00	0
Runyinya_S Tank	300 m ³	3		00	0
Karama_S Tank	250 m ³	2		0	0
Rusenge 2_S Tank	250 m ³	2		0	0
Gishumvu_S Tank	200 m ³	3		00	0
Mukura_S Tank	500 m ³	3		0	00
Mamba_S Tank	2000 m ³	1		0	
	300 m ³	2			00
Musha_S Tank	500 m ³	1		00	0
Muganza 1_S Tank	200 m ³	3		00	0
Muganza 2_S Tank	100 m ³	3		00	0
Linda_S Tank	100 m ³	3		00	0
Kibayi_S Tank	500 m ³	3		00	0
Transmission pipes		207 km	111 km	96 km	
Distribution Network		1,481 km	236 km	520 km	725 km
Private connections (u)		131,240	23,530 m	45,510 m	62,200 m

4.7. Collection and Valve Chambers

4.7.1. Closure and control valves

Valves shall be installed at the beginning and terminal points of the water main, at the junction well, both ends of inverted siphon, water main bridge etc.; and it is desirable to install them every 1 km to 3 km on the water main in the case of a long water main. Valves shall always be installed at the upper and lower ends of a long slope with a large difference in elevations. The torque of the closure valve becomes large at the moments of opening from the complete closure and right before closing to a complete closure. The higher the water pressure working on the valve disc, the bigger the torque; and the bigger the pipe diameter, the larger the torque (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

Therefore, for valves of diameter of larger than 400 mm with water pressure of more than 0.4 MPa, it is needed to attach a valve of much smaller diameter (bypass) to the main valve to open the smaller valve prior to the operation of the main valve to send water to the downstream side of the main so that the pressure difference between both sides is reduced; and that the operation of the main valve become easier. All throttling valves shall be gate valves. Isolating valves up to and including DN 300 shall be gate valves, and valves larger than DN 300 shall be butterfly valves except where otherwise specifically required (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

Valves shall always be installed at the branching points from trunk mains, both ends of a water main bridge and a siphon, near branching points for drainage pipe; and they shall be installed at branching points and intersections of submains depending on the composition of the submains network. Valve boxes are provided for valves on trunk distribution mains of a diameter larger than 400 mm. In case the boxes are installed under a road with busy traffic of automobiles, the boxes shall have a sturdy structure which can withstand such a condition. The valve box shall be so designed that the replacement of the valve can be made. Step irons with strong resistance to corrosion shall be planted inside the box so that safe access to the valve can be secured for inspection and maintenance. Round valve boxes are used for valves of a diameter smaller than 350 mm. Foundation with crushed stones is provided; the box is placed on it and sufficient compaction of backfill shall be made so that the operation of the valve is not hindered due to its leaning. An example of the round valve box is shown in figure below.

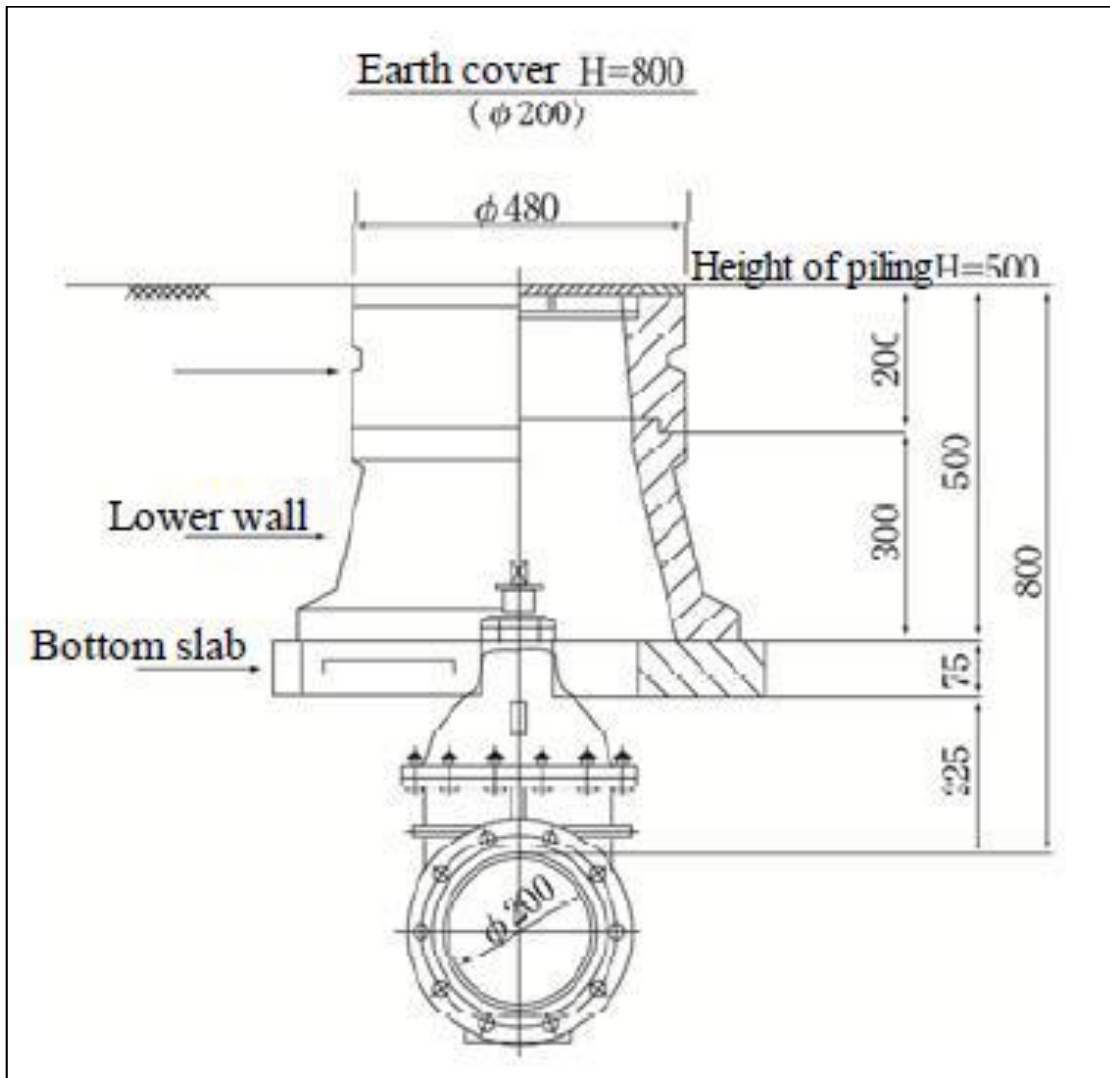


Figure 10: Example of installation of a round box valve

Since the water mains around the valve box move in different ways from the box at the times of uneven ground subsidence and liquefaction of the ground, and so there is high possibility of accidents, appropriate measures shall be made to secure the stability of the mains. An example of the valve box is presented in figure below.

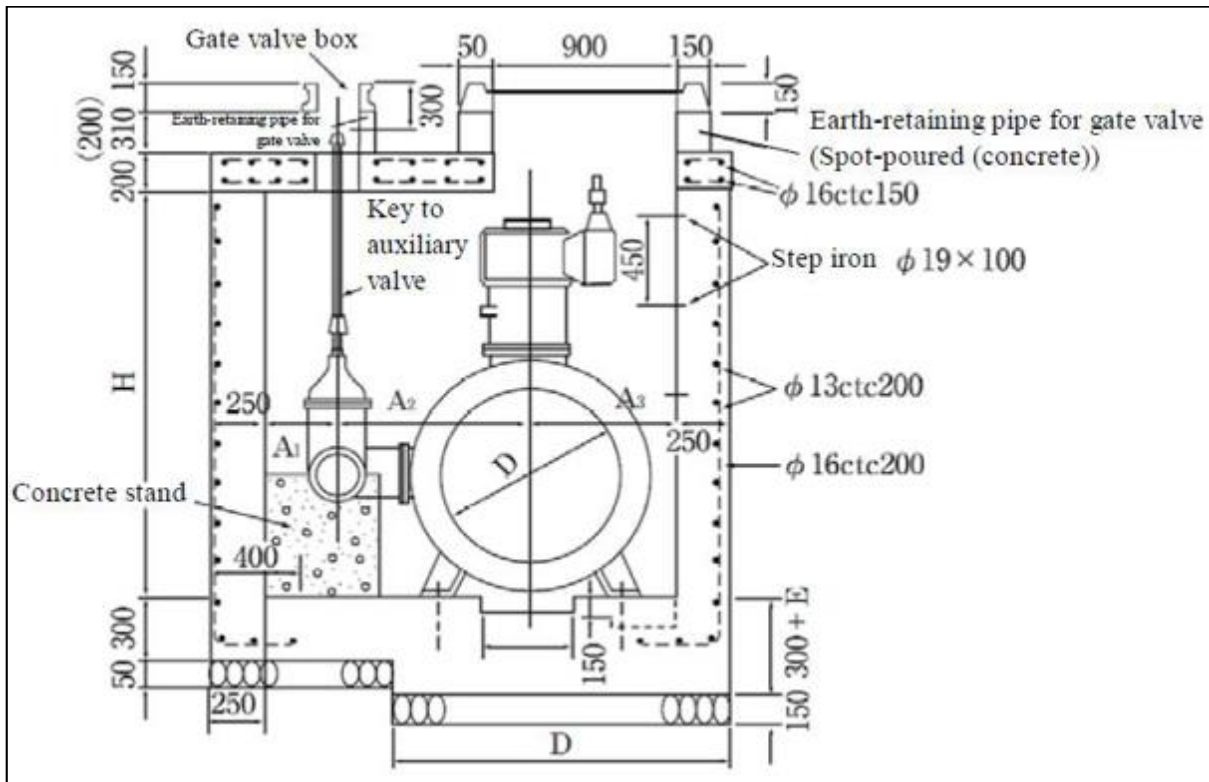


Figure 11: Example of installation of a valve box

4.7.2. Surge relief valves

Surge Relief Valves are usually installed on gravity transmission mains in areas where surge pressure is likely to occur, especially immediately upstream of isolation and control valves. The pressure values considered are the following:

- Maximum operating pressure of the network.
- Set pressure of the valve: Pressure at the beginning of opening.
- Overpressure: Pressure increase in relation to the set pressure to reach the maximum flow rate evacuated.

The setting value of the spring is given by the maximum operating pressure measured at the location where the valve will be installed, increased by 5 to 10%. The DN of the device is determined according to the maximum flow rate of the pipe where the valve is located. For protection immediately upstream of an isolation valve, only 30% of the pipe flow rate is considered, as this is

related to the valve closing time (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

4.7.3. Air valves

The air valve is an ancillary facility to discharge air, which separates from water, and inhale air into the water main when water is drained from it. For this reason, the air valve is indispensable to be installed at convex points of water mains where air accumulates the most easily. The air valve is also needed when filling and draining water in and from the water main. In case the length of the water main is large and there are no convex points along the main, air valves are installed to properly regulate time required for filling and draining water. Since valves are installed at a 1 to 3 km interval in case the water main is long, air valves shall always be installed in-between the valves. In this instance, it is convenient to install the air valve close to the valve at the highest point of the water main in case the main is vertically inclined only to one direction (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

As service pipes are connected to the distribution submains, air in the mains is discharged from the tap in some cases. Hydrants can also be used for inhaling and exhausting air when the water main is filled with water, or water is discharged from it. For this reason, there is no need to install air valves in-between valves on distribution submains; and it is a common practice to install them at the water main bridge, bridge piggybacked water main, and at locations where air tends to accumulate. The sizing criterion is based on the case of a rupture or dislocation of the pipe joint, which must not generate a negative pressure in the pipe greater than 4 mCE. The air valve must therefore be able to admit an air flow rate equal to the leakage rate for this maximum pressure drop. The type of air valve depending on the diameter of the pipe, the nominal diameter of the air valve is defined according to the following table (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022):

Table 18: Diameters of the air valves according to the diameter of the pipe

Pipe Diameter (mm)	Air valve Diameter (mm)
100-300	60
350-600	100
700	150
800 - 1000	200
> 1000	2 x 200

4.7.4. Washouts

Washouts shall be fitted at all low points. Minimum spacing of 2 km for washout chambers shall be observed. For large diameter mains the washout tee shall be an invert tee to evacuate water and any settled deposits from the pipeline. In the absence of relevant reference in Rwanda, the criteria for minimum washout branch diameters of washouts are adopted from Kenya Water Practice Manual as presented in the table below (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

Table 19: Minimum washout size

Main Pipeline Diameter	Washout Branch Diameter
Up to 300 mm	80 mm
400 - 600 mm	100 mm
700 - 1000 mm	250 mm
1100 mm & larger	300 mm

4.7.5. Access track

Access and service tracks are recommended from existing main roads to scheme infrastructure. The access tracks are designed to be at least 7 m wide and meet the Rwandan code for similar classes of tracks (JV STUDI INTERNATIONAL/IDEA CONSULT/LANDMARK, 2022).

4.8. Access roads and trenches

The pumping station and the proposed WTP will be approximately 160 kilometres, by road, southwest of Kigali, the capital city of Rwanda. In all 3 districts (Nyaruguru, Huye, Gisagara), roads network to the site of the pumping station and the proposed WTP comprise paved and unpaved national roads, district roads, and earthen roads.

Access and service tracks are recommended from existing main roads to scheme infrastructure. The access tracks are designed to be at least 7 m wide and meet the Rwandan code for similar classes of tracks. The cost of constructing an access track is 100,000 RWF per m². In case distribution mains are laid in the public road, the location and depth of laying shall be in conformity with the Road Law and the related regulations, and subject to coordination with the administrator of the road.

Pipelaying will comprise both trench and trenchless pipelaying. This type of pipe laying is suitable for crossing under main roads without recourse to an open trench and without disrupting the activity on the surface. It is expected that the preparation of trenches shall disturb natural wildlife habitat, affect crops and properties. A separate FRAP was developed and has addressed all issues related to resettlement and compensation, and 237 PAPs have been identified and shall be compensated accordingly.

4.9. Land Ownership

The development of the proposed project will require acquiring lands, mainly for the construction of WTP. In addition, physical assets will be affected and should be compensated before the project starts. They include but not limited to houses, crops (coffee trees, banana plantation, forest trees like Eucalyptus and Grevillea, cassava trees, avocado trees, beans, etc.).

From this background and in respect OSs of the Bank, a Full Resettlement Action Plan should be developed to cater for all matters related to involuntary resettlement including land acquisition, population displacement and compensation.

4.9. Investment cost

The total investment cost for the development of Nyaruguru-Huye-Gisagara WSS is about **220,360,890 USD**. It is detailed in the table below:

Table 20: Total Investment Cost for the development of Nyaruguru-Huye-Gisagara WSS

Facility	Estimated cost per phase (in USD)		
	2024 - 2030	2031 - 2040	2041-2050
Water Intake	840 000	840 000	840 000
Water Treatment Plant	6 000 000	6 000 000	6 000 000
Pumping Stations	10 935 033	943 538	730 603
Tanks	2 115 000	4 960 000	4 845 000
Transmission Pipes	42 650 808	8 357 542	0
Distribution Pipes	11 763 748	26 003 021	36 268 572
Private connections	2 352 750	4 550 887	6 219 905
Junction Structures	444 581	384 988	0
Access Track	7 000 000	0	0
Land acquisition	560 986	11 202	0
Total	84 662 906	52 051 178	54 904 081
Miscellaneous (15%)	12 699 436	7 807 677	8 235 612
Total	97 362 342	59 858 855	63 139 693

4.10. Source of construction materials

The construction input for this project will include stones, sand, bricks, gravels, cement for mortar and concrete, steel metals and/or steel structures (columns, rafters, and purlins), aggregates for concrete and for construction of water treatment plant (WTP), water tanks and other infrastructure, sanitary materials (pipes, taps, sanitary ware, fittings, water supply pipes, etc.), timbers, wiring and conduits and other related material, etc. All these materials, especially quarry (sand, stones, etc.) and forest products (timbers and young trees) should be only sourced from licensed individuals and firms.

4.11. List of chemicals and estimated dosages

The following table lists the chemicals to be used to achieve the specified final quality of pre-treated water. The estimated dosages are indicative, the sizing of the dosing equipment will be justified according to the quality of the raw water.

Table 21: Chemicals to be used

Dosing point and chemical product	Role	Estimated dosage					
		Average			Maximum		
		g/m ³	Kg/h	Kg/d	g/m ³	Kg/h	Kg/d
Calcium hypochlorite (C1)	Chlorination	2	2.1	50.4	5	5.25	126
Liquid polyamine coagulant (C2)	Coagulation	10	10.5	252	20	21	504
Polyelectrolyte (C3)	Flocculation	0.05*	0.52	10.5	0.1*	0.1121	2.5
Hydrated lime (C4)	Correct pH	10	1.05	252	20	3.15	504
Calcium hypochlorite (C5)	Disinfection	1		25.2	3		75.6
Polyelectrolyte (C6)	Thickening	0.2*			0.4*		

(*) mg of dry solid

C1: Outlet of the aeration waterfall

C2: Coagulation unit

C3: Flocculator inlet

C4: Outlet of the aeration waterfall

C5: Filter inlet (optional)

C6: Thickener inlet

Chemicals will be stored in appropriate areas. Alumina sulphate, polyelectrolyte, and lime will be stored in the chemicals building for decanting. Calcium hypochlorite will be stored in a separate room

The planned chemical storage layout shall include sufficient area to store chemicals needed for at least 3 months. Quantities are based on average dosage and maximum flow.

For aluminum sulphate, lime and calcium hypochlorite drums, the transfer is carried out by pallet truck and then by hoist to the storage area of the dissolution tanks. The solid reagent is poured into these tanks by a bag emptying system.

The handling of the polyelectrolyte does not require any special equipment because of the small daily quantities to be used. The bags will be emptied manually into hoppers equipped with a dispersion system.

CHAP V: POLICY, LEGISLATIVE AND ADMINISTRATIVE REQUIREMENTS

This chapter will discuss the project implementation of the proposed project, which shall be governed by a wide range of legislative instruments including policy documents, laws, orders, regulations, and guidelines. Also, institutions relevant to the proposed project are discussed.

5.1. Relevant policies

Policies and strategies that are relevant to this project are summarized in the following table.

Table 22: Policies applicable to the proposed project

Policy and strategy	Objective	Relevance
Rwanda Vision 2050	To build a nation in which pressure on natural resources, particularly on land, water, biomass, and biodiversity, has significantly been reduced and the process of environmental pollution and degradation has been reversed.	During the project implementation, the contractor and local communities will be sensitized to efficiently manage natural resources and environment.
National Environment and Climate Change Policy, 2019.	The main objective of the National Environment and Climate Change Policy is to make Rwanda a nation that has a clean and healthy environment, resilient to climate variability and change that supports a high quality of life for its society.	The project will promote the provisions of this law through supplying water to population living in Nyaruguru, Huye, and Gisagara.
National Land Policy 2019	The overall objective of the national land policy is to strengthen land administration and management to ensure optimal allocation and use of land.	The project will respect mechanisms which guarantee land tenure security. Where not possible, fair compensation will be provided.
National Health Policy 2016	One of the objectives of Rwanda Health Sector Policy is to improve the quality of life and demand for services in the control of disease. The policy identifies the most common illnesses because of unhealthy living or working environment.	The project will comply with this policy by ensuring health safety and the good working conditions and implement awareness programme on HIV/AIDS, STD, Malaria, to workers and the public.
National sanitation policy, 2016	The policy provides for decentralization in line with the national decentralization policy, institutional aspects, integrated watershed management, monitoring and assessment and participatory approach to water and sanitation among other sectoral reforms in Rwanda.	As part of the project, the water supply infrastructures will bring an answer to sanitation problems in the project area.
National Policy for water resources management 2011	The water policy aims at fair and sustainable access to water, improvement of the management of water resources	The project activities will ensure that water abstraction from Akagera river conforms to the sustainable yield and to institute measures

Policy and strategy	Objective	Relevance
		to facilitate the conjunctive use of groundwater and surface water.
National Biodiversity Strategy and Action Plan, 2016	This strategy defines the objectives and priorities for the conservation and sustainable management of biodiversity. The plan includes hillsides and wetlands and protected areas as some of the areas that need to be conserved.	The project activities will avoid practices that destroy the biodiversity and protected areas.
Rwanda Biodiversity Policy, 2011	The goal of this policy is to conserve Rwanda’s biological diversity, to sustain the integrity, health and productivity of its ecosystems and ecological processes, whilst providing lasting development benefits to the nation through the ecologically sustainable, socially equitable, and economically efficient use of biological resources.	The project will avoid destruction of natural resources through avoidance of vegetation clearance and prohibited practices such as improper waste dumping that may pollute the nearby wetlands.
National Poverty Reduction Strategy, 2018- 2024	The National Poverty Reduction Strategy identifies the transformation of priority areas including human development which covers the actions of improving living conditions of the poor, economic infrastructure, governance, development of the private sector and the institutional reinforcement.	This project is in line with the stated policy as it will transform the socio-economic development of people.
National Strategy for transformation (NST1, 2017-2024)	The NST1 picks up from where the Economic Development and Poverty Reduction Strategy (EDPRS 2) left off and continues to accelerate the transformation and economic growth with the private sector at the helm. With this new strategy, Rwanda’s public policy will focus on developing and transforming Rwandans into a capable and skilled people ready to compete in a global environment.	This project is in line with the NST1 as it will transform the human development by giving jobs and will contribute into more improved education infrastructure.
National Occupational Safety and Health Strategy, 2019	It aims at providing a framework for coordination of OSH activities among public, private, employees organizations and civil society institutions	This policy will govern implementation of the project by establishing safety and health

Policy and strategy	Objective	Relevance
		standards at workplace and ensure compliance with occupational safety and health standards.
Environment Health Policy, 2008	The overall objective of the Environmental Health Policy is provision of adequate environmental health services to all Rwandans with their active participation.	This project will comply with this policy by providing good environmental, social, health and safety working conditions to workers and neighboring residents.
National Strategy for Climate Change and Low Carbon Development, 2011	This Strategy is the first attempt at plotting a climate resilient and low carbon development pathway for Rwanda. It is the start of a continuous process which is described in the Enabling Pillars, and it will be implemented through the Programmes of Action	This project will contribute to the achievement of the goals by achieving socio-economic development (roads and drainages in this project) that is resilient to economic, social, and environmental shocks related to population growth and climate change.

5.2. Relevant national legal framework

National legal framework applicable to the project are summarized in table below.

Table 23: Relevant National legal framework applicable to the project

Law/Regulation/ Order	Objective	Relevance to this project
The Constitution of the Republic of Rwanda, 2003 as revised in 2015	The Constitution makes clear the right to property that it will not be encroached upon except in public interest. The constitution further specifies that everyone has the right to live in a clean and healthy environment and everyone has the duty to protect, safeguard and promote the environment.	The development of the proposed project will comply with the Constitution by implementation of applicable laws (Law in expropriation, labor, Environment) and will ensure social economic development and comply with environmental laws. Also, the project will abide by the provision of this related to management and use land on shores of rivers.
Law N°49/2018 of 13/08/2018 determining the use and management of water resources in Rwanda	This law determines the use and management of water resources in Rwanda.	The use of water resources in different activities and installations susceptible to modify the flow or the level of water or to degrade their quality, or to threaten waterrelated ecosystems, wetlands and the environment are subjected to water use permit. Withdrawing water from Akanyaru river will require a permit issued by the RWB.
Law on Environment 2018	This law determines modalities for protecting, conserving, and promoting the environment.	Given the nature of this project, it is classified under projects to undergo a full EIA before obtaining authorization for its implementation. This report serves as proof of compliance to the requirements of this law.
Law governing land 2021	This law determines modalities of acquisition, registration, allocation, possession, transfer, management, and use of land.	This law will inform and guide the process of involuntary resettlement including land acquisition, population displacement and compensation.

Law/Regulation/ Order	Objective	Relevance to this project
Rwandan law N° 58/2018 of 13/08/2018 on mining and quarrying operations.	The law applies to the activities of exploration, mining, trading, and processing of minerals and quarry. The law specifies that the quarry operations are conducted only by a person who has been granted a license in accordance with this Law	The use of quarry products during project development shall comply with the provisions of this law. Only quarry operators with valid licenses shall be authorized to supply construction materials.
Law relating to expropriation in the public interests, 2015	This law determines procedures relating to expropriation in the public interest.	Project development will affect lands and properties, especially when acquiring land for pipes laying, erecting infrastructures (WTP, tanks, etc.). Since the project is in the public interest, this law will be applied during the compensations of PAPs.
Law regulating labor in Rwanda, 2018	The Law regulate the employment in the public and private sector and specifies many issues including those related to OHS, occupational accidents or disease, right to salary, social security, protection against workplace discrimination, protection from forced labor, etc.	Project development will abide with this law by ensuring conducive working conditions. All forms of discrimination will be avoided during recruitment of workers.
Law governing the preservation of air quality and prevention of air pollution in Rwanda, 2016	This Law determines modalities for preservation of air quality and prevention of air pollution in Rwanda.	As per this law, the project will implement measures aimed at the preservation of air quality as well as all elements or activities likely to affect air quality or pollute the atmosphere in the project areas by spraying water at any area with high dust emissions.
Ministerial Order 2018 determining modalities of establishing and functioning of	This order determines modalities of establishing and functioning of occupational health and safety committees.	As a good practice, health and safety will be given a priority by ensure regular toolbox meetings on health and safety during construction. Health and safety committees will

Law/Regulation/ Order	Objective	Relevance to this project
occupational health and safety 2012		be established and governed by this ministerial order during project implementation.
Rwanda Building Code, 2019	The purpose of this Code is to establish the minimum requirements to safeguard the public health, safety, and general welfare. This is done through regulating, controlling, and monitoring the design, construction, quality of materials, use and occupancy, location, maintenance, sanitation, lighting and ventilation, energy conservation, and safety including measures to protect life and property from fire and other hazards attributed to the built environment, for all buildings and related non-building structures in Rwanda.	The project is classified as a building project hence will be following the Rwanda building Code
Law N° 064/2021 of 14/10/2021 governing biological diversity, 2021	The purpose of this law is to conserve, manage, protect and promote biological diversity.	This project will promote protection and conservation of biological diversity, and promote the coexistence between humans and wildlife.
General Biodiversity Inclusive Guidelines for Environmental Impact Assessment in Rwanda	These guidelines inform the development of EIA report in Rwanda.	These guidelines have guided the EA team during the development of this ESIA report.
Biodiversity Inclusive Guidelines for EIA for water resources management projects in Rwanda, 2021	These guidelines inform the development of EIA reports of water resources projects, including water supply projects in Rwanda.	These guidelines have guided the EA team during the development of this ESIA report.

5.3. AfDB's OSs applicable to the proposed project

Environmental and social sustainability is key to economic growth and poverty reduction in Africa. The AfDB's Strategy for 2013-2022 emphasizes the need to assist regional member countries in their efforts to achieve inclusive growth and transition to green growth. In addition, the Bank is committed to ensuring the social and environmental sustainability of the projects it supports. The ISS is designed to promote the sustainability of project outcomes by protecting the environment and people from the potentially adverse impacts of projects (AfDB, 2013). The safeguards aim to:

- Avoid adverse impacts of projects on the environment and affected people, while maximizing potential development benefits to the extent possible.
- Minimize, mitigate, and/ or compensate for adverse impacts on the environment and affected people when avoidance is not possible.
- Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks (AfDB, 2013).

The Integrated Safeguards Policy Statement establishes the essential principles on which the Bank's approach to safeguarding is based. Consequently, the Bank has adopted five Operational Safeguards (OS), thus limiting their number to the minimum necessary to achieve its objectives and ensure the optimal functioning of the ISS:

- **Operational Safeguard 1: Environmental and Social Assessment** - This overarching OS governs the process of determining the environmental and social category of a project and the resulting environmental and social assessment requirements.
- **Operational Safeguard 2: Involuntary Resettlement - Land Acquisition, Displacement and Compensation of Populations** - This OS consolidates the political conditions and commitments set out in the Bank's policy on involuntary resettlement and incorporates several enhancements intended to increase the operational effectiveness of these conditions.
- **Operational Safeguard 3: Biodiversity and Ecosystem Services** - This OS sets goals for conserving biological diversity and promoting the sustainable use of natural resources. It also translates the political commitments contained in the Bank's policy on integrated water resources management and operational requirements.

- **Operational Safeguard 4: Prevention and Control of Pollution, Greenhouse Gases, Hazardous Materials and Efficient Use of Resources** - This OS covers the full range of impacts related to pollution, waste, and key hazardous substances, for which there are international conventions in force, as well as comprehensive industry-specific or regional standards, which are enforced by d 'other multilateral development banks, for the inventory of greenhouse gases.
- **Operational Safeguard 5: Working Conditions, Health, and Safety** - This OS sets out the Bank's requirements of its borrowers or clients regarding workers' conditions, rights, and protection from abuse or exploitation. It also ensures better harmonization with most other multilateral development banks.

The AfDB Environmental and Social Assessment Procedure (ESAP) divides projects into four categories as presented in the following table.

Table 24: AfDB Environmental and social assessment categories and relative requirements

Environmental and social Assessment Category	Requirements
Category 1	Projects that are likely to have significant and irreversible environmental and social impacts and that require a full ESIA
Category 2	Project that are likely to have detrimental and site-specific environmental and social impacts that can be minimized by the application of mitigation measures included in an ESMP.
Category 3	Projects that shall not induce any adverse environmental and social impacts and do not need further action.
Category 4	Projects involve investment of Bank's funds through Financial Intermediaries (FIs) in projects that may result in adverse environmental or social impacts. Specific requirements for these projects include an assessment of FI capacities to handle environmental and social considerations.

Given that all OSs are applicable to the proposed project and considering that a Full Resettlement Action Plan (FRAP) was developed for this project to comply with OS2; the AfDB's ISS classifies the development of Nyaruguru-Huye-Gisagara WSS under Risks Category 1.

5.4. International and regional conventions

Rwanda being a signatory to some of the international and regional conventions that are relevant to the proposed project, it is imperative to review some of the conventions which may be considered during the implementation of the project.

5.4.1. United Nations Convention on Biological Convention of 1992

The three goals of the convention are to promote the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. Rwanda being a signatory of this convention it is supposed to work towards the achievement of the three goals. The convention calls for the adoption of national strategies, plans and programmes for the conservation and sustainable use of biological diversity into their relevant sectoral and cross-sectional plans, programmes, and policies. One of the tools that are prescribed for the management of biodiversity is environmental assessment. The article 14 of the convention deals with impact assessment and minimizing of adverse impacts of activities that are likely to cause significant adverse effects on biological diversity. This convention has been signed by Rwanda on 10/06/1992 and ratified on 18/03/1995.

5.4.2. The BONN Convention

The Bonn Convention signed on 23 June 1979 is related to conservation of migratory species of wild animals and was authorized to be ratified by Rwanda by the law N°35/2003 of 29 December 2003. Its provisions will be followed during the development of Nyaruguru-Huye-Gisagara WSS.

5.4.3. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)

The CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international treaty aiming to prevent species from becoming endangered or extinct because of international trade. Any trade in protected plant and animal species should be sustainable, based on sound biological understanding and principles. This convention shall be followed during the development of Nyaruguru-Huye-Gisagara WSS.

5.5. Institutions relevant to the development of Nyaruguru-Huye-Gisagara WSS

The Institutional framework for Water Supply and Sanitation in Rwanda is well placed in the sector policy, which was approved by the Cabinet in 2016, as well as the Sector Strategic Plan 2018-2024. The Water and Sanitation Sector is guided by the Vision 2050 which is about ensuring high standards of living for all Rwandans; improve quality of life, modern infrastructure, and transformation for prosperity. Water and sanitation sector play a critical role in ensuring targets of the Vision 2050, National Strategy for Transformation (NST 2018/19-2023/24) as well as SDGs (2030) targets are attained. For this to happen, adequate investment in water and sanitation infrastructure, providing sanitation facilities and promoting hygiene at every level is a prerequisite.

The water and sanitation strategic plans are expected to be implemented for another period of six years from 2018-2024 in line with achieving broad water supply and sanitation targets of at least basic water supply services for 100% of people by fast-tracking implementation of strategic investment program as well as achieving at least basic household sanitation coverage for 100% of households. The most relevant institutions are described below:

5.5.1. Ministry of Infrastructure (MININFRA)

The lead ministry for water and sanitation service providers in Rwanda is the Ministry of Infrastructure (MININFRA). The Ministry has the responsibility to initiate programs and to develop and rehabilitate the national transport infrastructure network, including water supply component. It also participates in the initiation of programs and strategies that aim to increase access to water and sanitation services.

5.5.2. Ministry of Environment (MoE)

The MoE ministry is in charge to develop environmental policies and procedures and to protect natural resources (water, flora, fauna, and land). The Organic Law defines all instructions for environmental impact assessment for projects, programs, plans and policies.

5.5.3 Water and Sanitation Corporation Limited (WASAC Ltd)

The Water and Sanitation Corporation LTD (WASAC) created by the Law N°87/03 of 16 August 2014. This company is an arm of the Ministry of Infrastructure charged with implementation of Water and sanitation policy, programmes, and projects, as well as provision of water and sewerage services in urban areas. The mission of WASA is to provide quality and affordable water and sanitation services.

This agency will play a critical role in both the implementation of the project and during the environmental process to get the clearance of the ESIA report from RDB.

5.5.4. Rwanda Utility Regulatory Authority (RURA)

Water and Sanitation Services in the country are regulated by Rwanda Utility Regulatory Authority (RURA), which reports to the Office of Prime Minister. This structure was created in 2001 by the Law N°39/2001 of 13 September 2001, replaced by Law N°09/2013 of 01 March, 2013 establishing RURA and fixing its missions, powers, organization and functioning. The Regulator Issues Operation Licenses to Service providers and has the responsibility to approve tariff that is equitable and affordable. The existence of the regulator is meant to facilitate consumers to access affordable and quality water and sanitation services as well as ensuring a level playing ground among service providers.

5.5.5. Rwanda Environmental Management Authority (REMA)

REAM agency was established in 2014 under supervision of the Ministry of the Environment and Natural Resources. It is in charge for regulating waste management sector and to reinforce environmental laws, regulations, guidelines, and standard in Rwanda. Its missions, organization and functioning are defined by the Law N°63/2013 of 27 August 2013.

Concerning Strategic Environmental Assessment (SEA), REMA is required by law to supervise the environmental assessment requirements in development policies, plans and programs.

5.5.6. Rwanda Water Resource Board

This agency was created from the Rwanda Water and Forestry Authority, which became two separate structures the Rwanda Water Resource Board (RWB) and Rwanda Forestry Authority (RFA). The new body is responsible for advising Government and implementing policies and laws for natural water resources management. It is also in charge to support districts in the management of natural water resources. This agency has a major role in setting standards and regulations for the management of natural water resources.

5.5.7. National Land Authority (NLA)

National Land Authority (NLA) is responsible to establish and operate an effective land administration system that secure land ownership, encourages investment in land to improve socio-economic conditions and reduce poverty in Rwanda. NLA is also responsible to develop methods and technics that ensure the protection of land resources.

5.5.8. Rwanda Development Board (RDB)

The RDB was created by the Organic Law N°53/2008 of 02 September 2008 and its main mission is reviewing and approving EIA reports for proposed projects and programmes before their implementation, this responsibility was assured by REMA before the creation of this new structure.

5.5.9. Rwanda Standards Board (RSB)

Rwanda Standards Board (RSB) established by the Law N°50/2013 of 28 June 2013 in charge to establish and publish national standard and to disseminate technical regulations and to participate in monitoring standardization at national, regional, and international level. It provides the following functions:

- Establish and publish national standard.
- Provide legal, scientific, and industrial metrology service.
- Represent the country at the regional and international standardization organizations.
- Organize training programs in standardization, metrology and conformity assessment.

5.5.10. Ministry of Local Government (MINALOC)

The MINALOC Ministry is a key element in the decision-making process, particularly through its role in the management of the territory and its presence in the districts and urban areas. It also connects other ministries and government agencies with administrative entities such as provinces, districts, and sectors.

5.5.11. Ministry of Finance and Economic Planning (MINECOFIN)

Formed in March 1997 from the joining of two Ministries: Finance and Planning, MINECOFIN is the author of the Vision2020 of Rwanda. MINECOFIN is responsible for the coordination of the national budgeting, planning, and financing framework.

5.5.12. Ministry of Health (MOH)

The MOH is in charge to improve the health in Rwanda by enhancing general well-being of the population and through interventions reducing poverty.

5.5.13. Ministry of Education (MINEDUC)

The MINEDUC is in charge to develop a skilled human capital required for socioeconomic development in the country by ensuring equitable access to quality education and promoting science and technology. MINEDUC is an important partner to integrate water supply and sanitation aspects in educational programmes.

5.5.14. Ministry of Agriculture (MINAGRI)

The MINAGRI is responsible for agriculture, livestock, soil and land management and rural water resources. It is a key partner for water supply to agriculture (irrigation, coffee washing stations, etc.) and livestock.

5.4.15. Nyaruguru, Huye, and Gisagara districts

They are responsible for providing access to basic services, such as roads, water, sanitation, and waste management. During the implementation of the project, all 3 districts will support WASAC, especially during resettlement.

CHAP VI: DESCRIPTION OF THE BASELINE ENVIRONMENT

6.1. Biophysical environment

6.1.1. General topographical characterization of the project area

Based on a DEM of 10 m x 10 m resolution, the topographical characterization of the project area leads to identify the high altitudes on which can be implemented the storage facilities.

- Nyaruguru district is generally characterized by the Congo-Nile Crest mountains in the west and west northern parts of the district, with the peak at 2,767 m of altitude. These high mountains start from Nyungwe National Park in the Sectors of Ruheru, Nyabimata, Muganza and Kivu, and continue towards the volcanoes area in the North of the country, with some peaks branching towards the northeastern part of the District in the Sectors of Ruramba and Mata to form a mountainous ridge known as “IBISI” culminating at 2,300 m asl.
- Due to very steep slope, the project area in Nyaruguru district is characterized by erosion, landslides and unstable terrain which become worse when there is construction activities which involve excavation and soil cutting. We will recommend to avoid unstable terrain during construction of the WSS.





Figure 12: Unstable terrain in Nyaruguru District

- The district of Huye is located on a central plate with a topographic unit of collinear type in its central part, in the East and the South. It occupies the tabular tops of the hills with an average altitude of 1700 m; it goes down up to 1450 m towards the farm from Songa. In its Western part, it rises as one move towards the West to culminate with more than 2000 m at the top of the Huye mount. Bottoms melt marshy are located at an altitude of 1650 m.
- Gisagara altitude average ranges from 1,470 to 1,780 m asl, and a relatively moderate slope varying from 0 to 45% whereby 85% of the area has the slope ranging between 0 to 30% while the proposed main urban center of Ndora is located on undulating hills with a few lowlands as the rest of the district.

6.1.2. Site specific topographic surveys

Sites specific topographic surveys were conducted by the consultant team during the months of September and October 2022. The surveys were specific to sites for the water intake, the raw water pumping station, the water treatment plant, the tanks and the pipelines.

The objective was to collect topographic data allowing on one hand to altimetrically set the structures of the facilities and on the other hand to minimize the expenses by avoiding at most the constraints (earthworks, constructions, networks of the concessionaires etc.).

The topographical survey results are compiled in Drawings folder annexed to the detailed design report. However, the following summarizes the finding collected from different sites;

Table 25: Topographic characterization of specific sites

#	Site	Topographic characterization
1	Water Treatment Plant Site	The site selected has an area of 8 hectares with an average slope of 25% SE-NW. The topographic survey conducted shows that the site has a significant difference in altitude, the highest point is 1875 m and the lowest point is 1830 m.
2	The section from Raw Water Pumping Station (RW-PS) to water treatment plant (WTP)	The slope of the natural terrain exceeds 20% over a length of 467 m.
3	The section from WTP to Gasasa Main Tank.	The slope of the natural terrain exceeds 20% over a length of 758 m.
4	The section from Gasasa Main Tank to Gisagara_S Tank	The slope of the natural terrain exceeds 20% over a length of 6,149 m.
5	The section N3 – Cyarwa_S Tank	The terrain in that area is generally flat, the slope doesn't exceed 20%. The highest range between 15% to 20% on length of 240 m.
6	The section N4 – Ndora_S Tank	The highest slope ranges from 10% to 15% over only 42 m. It doesn't exceed 20%.
7	The section N2 – Existing Huye Tank	The slope of the natural terrain exceeds 20% over a length of 227 m
8	The section Gasasa Main Tank – Ngera_S Tank section	The slope of the natural terrain exceeds 20% over a length of 1,560 m.
9	Section of N_Ngoma – Ngoma_S Tank section	The slope of the natural terrain exceeds 20% over a length of 151 m.
10	The section of Gasasa Main Tank – Rusenge_D Tank	The slope of the natural terrain exceeds 20% over a length of 1910 m
11	The section of Rusenge_D Tank – Kibeho_S Tank section	The slope of the natural terrain exceeds 20% over a length of 530 m.
12	The section of N_Cyuna – Cyuna_S Tank section	The highest slope ranges from 10% to 15% over only 42 m. It doesn't exceed 20%.
13	Section of N_Mubuga – Mubuga_S Tank	The slope of the natural terrain exceeds 20% over a length of 177 m.
14	Huye Tank – Mbazi_S Tank section	The slope of the natural terrain exceeds 20% over a length of 525 m.

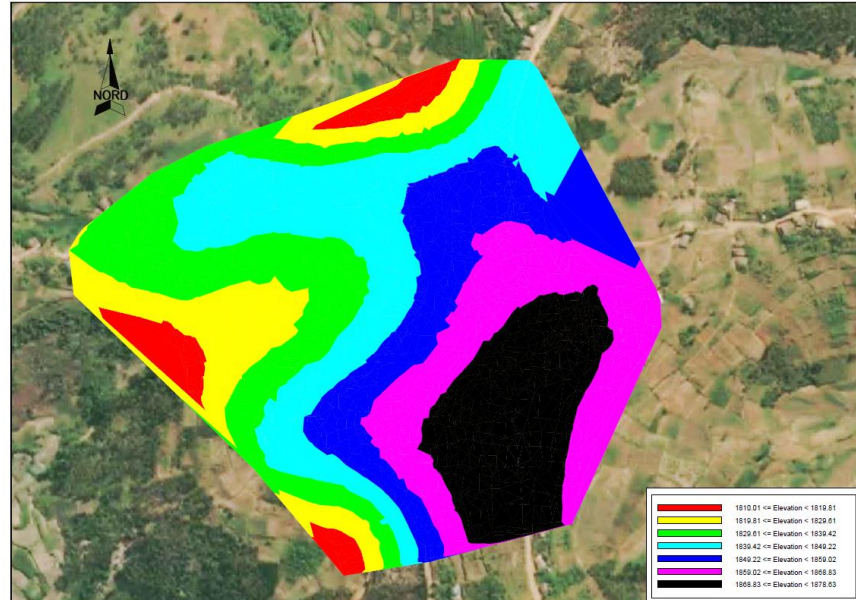


Figure 13: Elevation of the proposed site for Water Treatment Plant.

6.1.3. Geotechnical characterization of the project sites

The geotechnical investigations have been conducted to characterize the soil and subsoil materials, soil bearing capacity, ground stiffness and soil classification.

The investigation area is dominated by clayey silt and silty sand layers. For some boreholes, there was found a roc completely weathered (silty sand with mica or sandstone particles) at the depth varying between 0.0 m and 6,5m. No groundwater was encountered within the highest depth measured (10 m).

6.1.4. Hydrology

The hydrological network of the three district has in common Akanyaru river which passes through Nyaruguru and Gisagara. Even if the river doesn't pass directly in Huye District, there many streams from Huye District which flows in Akanyaru river through Migina River.

Nyaruguru District is composed of a network of internal rivers that would suffice the water resources need in the district as well as the neighboring Districts. The following main river network includes: Nshili river, Giswi river, Simbuka river, Akanyaru river, Migendo rivers, Rwerere River, Kaburantwa river.



Figure 14: Akanyaru river (Intake zone)

Huye District water network comprises various streams. In the West is Kadahokwa stream which flows from the North to South; in the central region is Rwamamba. There is also a big valley called Rwasave drained by Kihene which flows from North to South. All these streams flow towards Migina which is a tributary of Akanyaru River. In the North-West, there is a river of Mwogo which discharges into Nyabarongo River.

For Gisagara District, the hydrology is made up two rivers: Akanyaru rivers which surrounds Gisagara on 80 km to boarder Rwanda and Republic of Burundi and Migina that borders District with Nyaruguru and Huye Districts on west side. Inside Gisagara District, there are many springs which give stream that flow down to these rivers.

6.1.5. Raw water quality

Two samples were taken for analyzing from the proposed water intake Akanyaru River in March and June 2022. Raw water quality was analyzed at the Central Laboratory of WASAC in Kigali. Two aspects should be highlighted:

- Turbidity is high (about 2000 NTU in March and 1000 NTU in June) and as only 2 values are available, reference is made also to the nearest stream “Kadahokwa” operated by WASAC for the water supply of Huye city.

- Over a full year starting July 1, 2017 and ending June 30, 2018, it was noted that turbidity remains below 113 NTU for 80% of the time and exceeds the value of 1000 NTU only in 5% of the time. The maximum recorded is 3 822 NTU. However, it is observed that during the same month, we can have turbidity peaks 10 times higher than the average. This means that the treatment plant must be very resilient to variations in the Total Suspended Solids (TSS) load so that production is never interrupted.
- The chemical composition of the raw water complies with the regional standard RS-EAS 12: 2018 third edition, in force in Rwanda, except for the aluminum and manganese contents which are respectively 0.725 mg/l and 2.08 mg/l in excess of this standard and of the WHO recommendations.
- The conventional treatment process is able to remove excess aluminum and manganese from the raw water because they are already in a suspended solid form or the manganese is easily oxidized during the process.

6.1.6. Quantity (average discharge)

The Akanyaru River is the main tributary of the Nyabarongo River. It rises in the western highlands of Rwanda and Burundi, flows east and then north along the border between those countries before joining the Nyabarongo River. The Akanyaru River average discharge is 21 m³/s, based on measurements from a monitoring weir between 1957 and 1985. The discharge follows the seasonality of precipitation and is highest in April (29 m³/s) and lowest in August (16 m³/s) (Nyirakamana, 2015).

6.1.7. Biodiversity in Akanyaru river/valley

Akanyaru marshland is an area of great biodiversity, particularly of birdlife. There are records of at least 54 bird species with wetland habitats in the swamp region. These include migrant Malagasy pond heron, pallid harrier and great snipe. Lesser kestrel have been seen. The near threatened papyrus gonolek is present as is the vulnerable papyrus yellow warbler. The sitatunga, an antelope, is found in the swamps (REMA, 2009) (ICPAC, 2009).

According to Birdlife international, the following list indicates the species found in the Akanyaru wetland which are on the current IUCN Red List

1. Papyrus Gonolek *Laniarius mufumbiri*
2. Carruthers's Cisticola *Cisticola carruthersi*
3. Papyrus Yellow Warbler *Calamonastides gracilirostri*
4. White-winged Swamp-warbler *Bradypterus carpalis*
5. Black-lored Babbler *Turdoides sharpei*
6. Red-chested Sunbird *Cinnyris erythrocerus*
7. Northern Brown-throated Weaver *Ploceus castanops*
8. White-collared Oliveback *Nesocharis ansorgei*
9. Papyrus Canary *Crithagra koliensis*¹

6.1.8. Existing projects up and downstream and other water users

The presence of dams, especially upstream of the water intakes, can impact the water supply at these points. Ntaruka Dam (Ntaruka Hydropower Project) is located on the Akanyaru river in the Southern Province in the Nyaruguru District, between Munini and Nyagisozi Sectors. Given that the water intake is located about 5 km downstream of the future dam, the turbine flow (12.6 m³/s) has the same recurrence as the water supply flow. Except for the months of turbinning (6 months), the level of the intake will be set on the months without turbinning. The intake level is set on the most unfavourable month to guarantee the water withdrawal, i.e., the month of July and the intake level is 2.72 m³/s.

Akanyaru Dam (Akanyaru Multipurpose Dam) is a planned dam across the Akanyaru River, at the international border between Rwanda and Burundi. The dam will create a reservoir with storage capacity of 333,000,000 cubic metres. The water is expected to supply drinking water to an estimated 614,200 people in both countries. The reservoir is also expected to provide irrigation water to an estimated 12,474 hectares (30,820 acres) of agricultural land in Burundi and Rwanda, benefitting an estimated 24,948 farmers. The dam will also host Akanyaru Hydroelectric Power Station, with generating capacity of 14.5 MW (19,400 hp).

6.1.9. Climate and Rainfall

¹ <http://datazone.birdlife.org/site/factsheet/akanyaru-wetlands-iba-rwanda/details>

The project area composed of the three districts (Nyaruguru, Huye and Gisagara) have a sub-equatorial temperate climate with very little difference between district which is mainly due to topographical variations.

The landscape of Nyaruguru district influences the climate and rain fall. The rainfall in the ditrict of Nyaruguru varies between 1,000 and 1,250 mm and the temperature varies between 12°C and 25°C which is averaged to almost 19°C. In general, the district climate is characterized by four seasons namely the great dry season starting from June to August, the great rain season that commences from March to May, then the small dry season which begins from Mid-January to February and lastly the small rain season which ranges from September to mid-January.

Huye District is characterized by sub equatorial temperate climate with an average temperature fluctuating around the 20°C. Like in the rest of the country, it has four climatic seasons; long rainy season (Mid-February –May), long dry season (June-Mid September), short rainy season (Mid-September-December) and short dry season (January- Mid February). The average annual rainfall is 1,160 mm. it has succession of irregular seasons which vary to rainy to dry seasons: Season A starts in September and ends in December, is characterized by many rains especially in December. Season B that starts in January and ends in June has many rains in April. Season C which is a dry season starts with July and ends with September. Average annual temperatures generally oscillate around 200 c with amplitudes changing between 150 c and 200 c and annual rainfalls of about 1200 mm

6.1.10 Flora in Nyaruguru, Huye, and Gisagara districts

Based on field observation, the project area has numerous plant species including coffee trees, banana plantation, forest trees like Eucalyptus and Grevillea, cassava trees, avocado trees, beans, etc. During the resettlement, compasation shall be carried out in respect of national expropriation law and the AfDB's OS3



Figure 15: Flora characteristic of the project area

The flora of the project area is also characterized by the **Arboretum of Ruhande** which is located at Ruhande Hill - hence it is called “*The Arboretum of Ruhande*”.

The Arboretum covers a surface of about 200 hectares and is subdivided into 454 plots. Each plot covers a surface of 50 m by 50 m (25 acres) with one or more species making up their respective tree layer. More than 500 different plant species represent the biodiversity of the Arboretum.

Few literature have captured the composition of the fauna population of the arboretum and they don't precise the species of those animal living in the arboretum, they just indicate that some animal species like monkeys, birds, bats, and many insects are found in the arboretum of Ruhande..

In the regards to the current management of the arboretum; the research Project initiated by the Rwanda-Center and Office for Africa-Cooperation titled: “*Conservation of Biodiversity and Natural Resources and Climate Protection by Sustainable Agriculture and Forestry at Cyamudongo Forest*” indicates that in 1962 when Rwanda became independent, the Arboretum fell under the responsibility of the National University of Rwanda. Due to a lack of scientists and structures, the Arboretum was neglected and natural regeneration transformed it into bushland. In 1970, the Arboretum was split into a smaller part for the University and a bigger part for the Rwanda Agricultural Research Institute (ISAR), the successor of the INEAC. Research activities were then restarted and expanded. After several restructuring processes within the last 10 years, the Arboretum of Ruhande is nowadays managed by the Rwanda Forestry Authority (RFA).²

² <https://arboretum.cyamudongo-rwanda.de/arboretum>

The Nyaruguru-Huye-Gisagara WSS pipeline shall pass at the edge of the arboretum boundaries and necessary due diligence shall be observed to prevent damage to species in the arboretum.

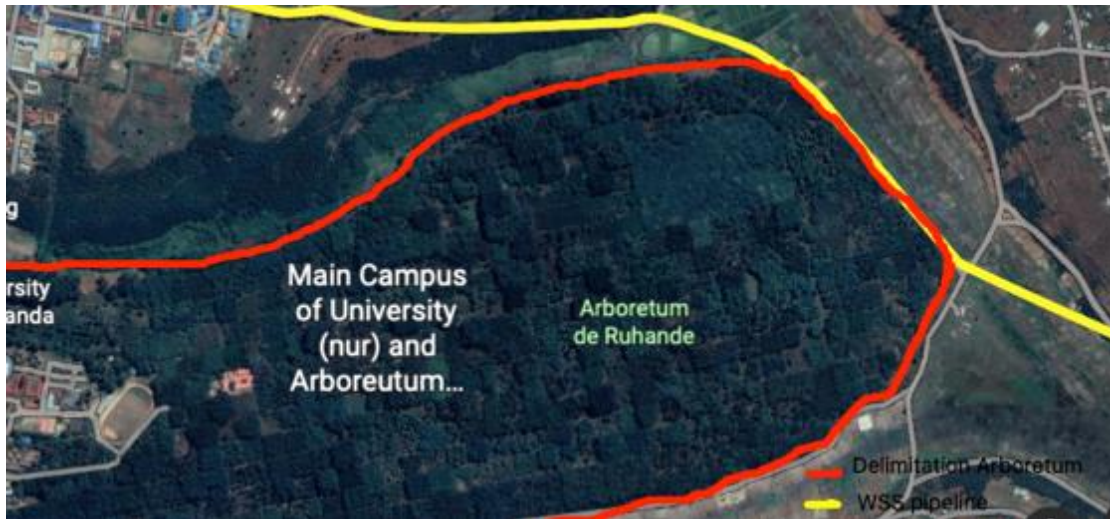


Figure 16: Arboretum de Ruhande



Figure 17: Photo of different fauna species in Ruhande Arboretum

6.1.11. Fauna in Nyaruguru, Huye, and Gisagara districts

The Rwanda Biodiversity Information System (RBIS) and the Global Biodiversity Information Facility (GBIF) identified in Nyamagabe, Huye, and Nyaruguru districts (UR-RBIS, 2022):

- 2,452 species of a birds including the Black Sparrowhawk (*Accipiter melanoleucus*), the Sedge Warbler (*Acrocephalus schoenobaenus*), The Black Crake (*Amaurornis flavirostra*), African Openbill (*Anastomus lamelligerus*), etc.
- 52 species of fish including *Amphilius jacksonii* Boulenger, *Astatoreochromis alluaudi* Pellegrin, *Clarias liocephalus* Boulenger, *Labeobarbus acuticeps*, dark stonebasher (*Pollimyrus nigricans*), etc.
- 22 species of odonates including *Brachythemis leucosticta* Burmeister, *Orthetrum julia* Kirby, *Palpopleura portia* Drury, *Platycypha caligata* Selys, *Pseudagrion kersteni* Gerstaecker.
- 73 species of amphibians including *Afrixalus quadrivittatus*, *Amietia nutti*, *Hyperolius castaneus*, *Hyperolius cinnamomeoventris*, *Hyperolius kivuensis*, *Hyperolius laterali*, etc.
- 8 species of reptiles including Vervet monkey (*Chlorocebus pygerythrus*), Olive baboon (*Papio Anubis*), African grass rat (*Arvicanthis niloticus*), The black rat (*Rattus rattus*) Boehm's bush squirrel (*Paraxerus boehmi*), etc.

The fauna located in the project area shall be preserved in respect of national biodiversity policy and legislations and in respect of AfDB's OS3 on Biodiversity and Ecosystem Services.

6.2. Socio- economic environment

6.2.1. Demographic characterization

- The current population of Nyaruguru District is estimated at 352,499 inhabitants of which 9,639 live in urban areas and 342,860 are in rural areas. The sectors, included in the project area, have a total population of 176,922 inhabitants of which only 5.5% is urban. The Kibeho sector is the most populated in the project area with a population of 28,106 inhabitants. It is the only sector with an urban population. It is estimated at 9,639 inhabitants.
- The current population of Huye District is estimated at 392,992 inhabitants of which 83,272 live in urban areas and 309,720 are in rural areas. The sectors, included in the project area, have a total population of 171,111 inhabitants. The two sectors Ngoma and Tumba cover the major urban part of the project area. They include 89,234 inhabitants of which 11.2% of population is rural.

- The current population of Gisagara District is estimated at 385,977 inhabitants of which 8,156 live in urban areas and 377,821 are in rural areas. The Mamba sector is the most populated in the project area with a rural population of 41,552 inhabitants.

6.2.2. Employment, source of revenues and poverty level

- The Labor Force Survey Annual Report 2020, indicates that Nyaruguru work rate is 79,4% this includes a formal employment of 50.1% and subsistence agriculture corresponding to 29.3%. According to 5th Rwanda Population and Housing Census (PHC-5, 2022), the number of private agricultural households in Nyaruguru District is 65,613 correspond to a percentage of 88.9% and the prevailing produced crop is bean (85%) followed by sweet potato (80.8%).
- Huye District scores among Districts with a considerable high rate of employment where 84.4% of the population are employed. However, statistics reveal that the bigger number of population is involved in informal sector (56.2%) than formal (43.8%). On the other hand, the unemployment rate is lower (12.7%) than that of the national level (17.4%). The inactivity rate is also at 14% while wage non-farm is at 22.9% compared to the wage farm that is at approximately 11%³. This revealed that the bigger part of the population in Huye District practice agriculture at a rate of 78%. Employment sector in Huye District was also further found to be dominated by informal sector (52.6%), these being some of the key reasons for the unemployment rate to increase, and District revenues to stay at a low level.
- According to the Labor Force Survey Annual Report 2020, Gisagara District overall work rate is 85% of the resident population aged 16 years and above, this work rate considered the population who work in subsistence agriculture at a percentage of 37,6%.

Education

- Nyaruguru district is facing a real problem of inadequate schools. There are 120 kindergarden schools, an average of one school by sector. The number of teachers is equal to that of the existing school facilities (120) with a ration of 69 children / teacher. The district has 73 primary schools with 901 classrooms, including 272 classrooms rehabilitated and 371 to

³ Huye District Development Strategy (2018-2024)

rebuild. The total number of students is 65,625 which lead to a ration of 72.8 students per class. This number exceeds by far the standards of UNESCO.

- Huye is home to several academic institutions, including the largest university, National University of Rwanda. Due to the large number of university students and student-centered activities in the city, Huye is also referred as a university town. Huye is home to several academic institutions, including the largest university, National University of Rwanda. Due to the large number of university students and student-centered activities in the city, Huye is also referred as a university town.
- Gisagara District education sector possesses Nursery Schools, Primary Schools, Secondary Schools, Higher Education Institutions, Professional and Vocational Schools.
 - 1 university
 - 50 Secondary schools.
 - 10 Technical and Vocational Education and Training.
 - 95 Primary schools.
 - 73 Nursery schools.



Figure 18: Different schools located in the project area.

6.2.3. Health care

- Nyaruguru district has a great number of health centers though some areas are still experiencing a serious problem of access to health care. Among the 14 sectors of the district, 4 sectors (Ngera, Ngoma, Rusenge and Kivu) have no health center. The population of these sectors must make great distances to reach a health center.

- The Huye district has one referral hospital, one district hospital, 19 health centres, 9 health posts, 2 private clinics, 2 private polyclinics and a prison dispensary 15. The nearby district of Gisagara (14 km away) have 2 District hospitals and several health centres.
- Gisagara District Healthcare sector is organized from Hospitals, Health Centers, and Health Posts. It has 2 hospitals, 15 Health Centers, and 47 Health Posts.



Figure 19: Healthcare facilities located in the project area

6.2.4. Transport

- Nyaruguru: The lack of road is one of the problems that inhibit the economic development of the Nyaruguru district.
- Huye: There are 358 roads with a total length of 219.674 km within the urban limit of Huye city. The roads can be classified as follows:
 - 2 Paved national road (length = 12.247 km).
 - 1 Unpaved national road (length = 4.274 km).
 - 4 District Roads (length = 13.607 km).
 - 1 Tarmac roads other than national/district road (total length = 1.075 km).
 - 311 gravel/earthen roads (total length = 173.944 km).
- According to District report of road the length of the road network is 1281.9 Km, including the Footpaths., the road network is subdivided into four categories, namely:
 - National Roads: 66.85 km.
 - District Road Class 1: 105.5 km.

- District Road class 2:380.5km.
- Paths: 729 km.

6.2.5. Existing WSS in Nyaruguru, Huye, and Gisagara districts

- **NYARUGURU:** The access to an improved water source is estimated at 58.60 % of which 11.43 % is the percentage of the population that benefit safely managed. The access rates to basic and limited water supply service are 33.34 % and 13.83 % respectively. Nyaruguru district has 7 tourist sites; the most important are those of Kibeho and Nyungwe National Park. The water supply systems in Nyaruguru project area are of the rural type. They supply water collected from springs. The water supply facilities in the Nyaruguru project area are as follows:

- 33 springs.
- 12 rural water supply systems.
 - 2 pumping systems.
 - 10 gravity systems.

- **HUYE:** The access to an improved water source is estimated at 50.90% of which 11.20% is the percentage of the population that benefit from safely managed service. The access rates to basic and limited water supply service are 23.26 % and 16.44 % respectively. The Huye, Ngoma, Tumba and Mukura sectors are supplied by 6 water sources namely: Kadahokwa dam, Kidogo Spring, Nyamasharaza spring, Kabakene spring, Nyakagezi spring and Wimana spring. The discharge capacity of each water source is as follow:

- Kadahokwa: 6,000 m³/day.
- Kidogo spring: 600 m³/day.
- Nyamasharaza spring: 720 m³/day.
- Kabakene spring: 480 m³/day.
- Nyakagezi spring: 168 m³/day.
- Wimana spring: 216 m³/day.

The Kadahokwa WTP is the only water treatment plant in Huye, it treats the water taken from the Kadahokwa dam within a capacity of 600,000 m³. The plant was upgraded in 2015

to its current production capacity of 6,000 m³/day and has not yet reached its design capacity of 8,500 m³/day.

The existing water network includes 5 storage tanks and a network of pipes with a total length of 122,754 m. WASAC recently executed the following works:

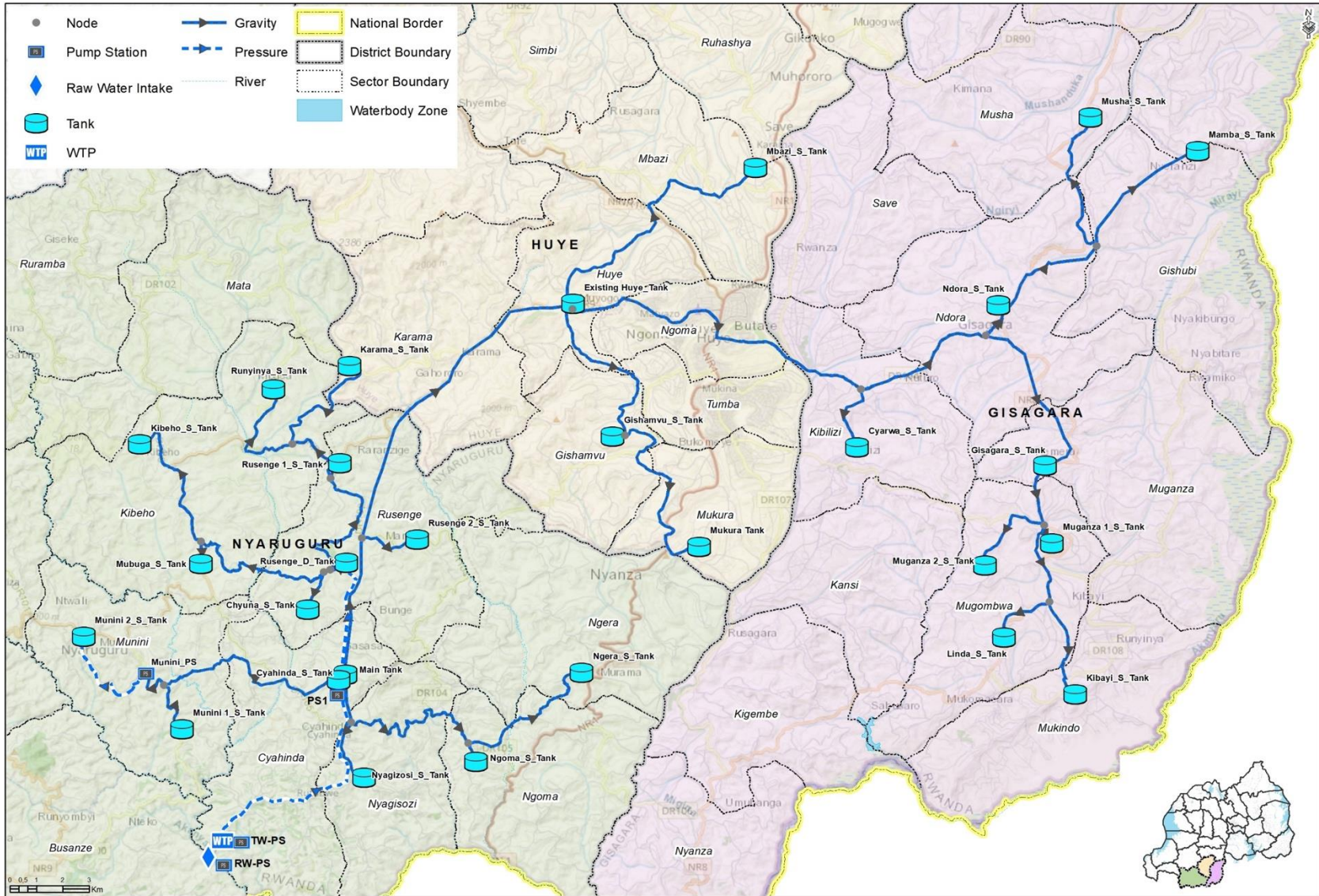
- Construction of main supply and distribution network, including 11.9 km of new pipeline and the rehabilitation of 151.3 km of the distribution network.
- Construction of two reinforced concrete reservoirs, 2,000 m³ at Kanazi Hill and 1,000 m³ at the industrial park.
- The water losses are estimated at 48.50 % in 2020.

- **GISAGARA:** The access to an improved water source is estimated at 49.90 % of which 8.48 % is the percentage of the population that benefit from safely managed service. The access rates to basic and limited water supply service are 28.34 % and 13.07 % respectively. The water supply systems in Gisagara District are of the rural type. They are scattered throughout the district and supply water collected from springs. The total capacity of springs is about 3,650 m³/day. The water supply facilities in the Gisagara district are as follows:

- 29 springs.
- 25 rural water supply systems.
- 12 pumping systems.
- 13 gravity systems.



Figure 20: Existing water tank in Kibeho Sector, Nyaruguru District



CHAP VII: STAKEHOLDER CONSULTATION AND PARTICIPATION

7.1. Objectives

The main objective of the stakeholder's consultation is to inform and consult the project stakeholders on the project benefits and impacts. The purpose of the meetings and public consultations was to:

- Collect the views of the population about the proposed WSS.
- Inform beneficiaries about the proposed WSS project.
- Seek views, suggestions, concerns, fears, and issues from the community about the proposed project.
- Inform beneficiaries about the benefits and the negative impacts of the proposed project.
- Obtain suggestion from public on possible ways that they feel potential negative impacts can be effectively mitigated.
- Inform the design of the proposed project.

7.2. Public consultations

Public consultation meetings were held in all the villages visited and located in the project's direct area of influence as well as at District level where key project stakeholders were invited.

At village level, with support from chiefs of villages, meetings were held at cell offices bringing together people from concerned villages. Consultations started from 06/09/2022 and ended on 23/09/2022.


At district level, in collaboration with District one stop centers, the consultation meetings were organized on 19 and 20th October 2022. Districts invited all stakeholders in water and sanitation including Water, Sanitation and Hygiene board (District WASH Boards), private rural WSS operators, representative of WASAC at district & provincial level, development partners like World Vision.

The following list indicate dates, location, PAPs, local populations, authority and development partners who attended the consultative meetings.

Table 26: Consultation meeting and participation (number & gender)

#	Dates	Location	Number of participants	Photo
1	22/09/2022	District: Gisagara Sector: Muganza Cell: Remera	Total: 21 Male 16 Female 5	
2	22/09/2022	District: Gisagara Sector: Kibirizi Cell: Muyira	Total: 8 Male: 4 Female 4	
3	22/09/2022	District: Gisagara Sector: Ndora Cell: Dawe	Total: 4 Female: 2 Male: 2	
4	22/09/2022	District: Huye Sector: Huye Cells: Muyogoro, Nyakanazi	Total: 15 Male: 10 Female: 5	
5	22/09/2022	District: Huye Sector: Huye Cell: Sovu	Total: 7 Male: 4 Female: 3	

6	23/09/2022	District: Nyaruguru Sector: Ngoma Cell: Kiyonza	Total 7 Male: 4 Female: 3	
7	23/09/2022	District: Nyaruguru Sector: Kibeho Cell: Mubuga	Total 8 Male: 7 Female: 1	
8	23/09/2022	Nyaruguru Rusenge Cyuna	Total: 14 Male: 8 Female: 6	
9	19/10/2022	Nyaruguru District Head office	Total: 8 Male: 8 Female: 0	
10	20/10/2022	Gisagara District Head office	Total: 6 Mae: 6 Female: 0	

11	20/10/2022	Huye District Head office	Total: 14 Male: 13 Female: 1	
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7.3. Analysis of project's affected people (PAPs)

The following table briefly describes identified PAPs (disaggregated by gender) whose land and/or assets will be affected during the construction phase. Their exhaustive list is given in annex 3.

Table 27: Identification of PAPs

#	District	Total PAPs	Female	Male
1	Nyaruguru	160	42	118
2	Huye	55	21	34
3	Gisagara	57	20	37
	Total	272	83	189

In general, 272 people shall have their assets (land and/or crops) affected by the project, and in respect of national expropriation law and AfDB's ISS they should be compensated. A specific FRAP was prepared as a separate document to serve this purpose.

7.4. Approach and consulted people

Consultations were held during site visits conducted from 6-29 September 2022 with PAPs whose assets (lands and/or assets) will be affected during project development through individual and public consultations.

For individual consultations, a questionnaire was developed and used as interview guide to all PAPs. The questionnaire facilitated in collection of socio-economic characteristics data of PAPs but it contained also a consultative part on the perception of the project and the attitude of the PAPs towards the compensation options.

Public consultation meetings were held in all the villages visited and located in the project's direct area of influence as well as at District level where key project stakeholders were invited. At village level, with support from chiefs of villages, meetings were held at cell offices bringing together people from concerned villages.



Figure 21: PAPs consultations at village level

7.4. Key findings from consultations

7.4.1. Project appreciation

All consulted PAPs and other stakeholders positively appreciated the project, insisting on its contribution to the general development of the targeted area. Continual supply of clean water will promote hygiene and consequently prevent proliferation of diseases. The following were the most repeated benefits that the project would bring to the community:

- ✓ The project would promote hygiene to the community
- ✓ The project will prevent us to go fetch unclean water from marshlands which are also far from our homes.
- ✓ Water from marshland would always make us sick.
- ✓ We appreciate the project because the existing quantity we receive is not enough.

7.4.2. Existing challenges

In regards to existing water supply system challenges, we received the following feedback:

- ✓ The existing water supply system does not cover all the population

- ✓ The existing water supply is not available to consumers 24 hours per day. It is intermittent water supply system with consequences related to contamination, and availability of clean water to the population.
- ✓ The quality of water is not good when it has been a while without cleaning of the tanks.
- ✓ The personnel in charge of water taps (who sell water at the water kiosk on behalf of the private operator) are not always available and they don't communicate their availability schedule.

7.4.3. Potential risks and impacts

- ✓ The project would take water from Akanyaru River which is transboundary water and there may be conflict if the project reduce the quantity of water usually used in agriculture, household activities, water used by environment in general. Therefore, there should be equitable water sharing between the existing use and the project.
- ✓ There is potential risk to damage private properties especially crops, forests and houses.
- ✓ There is potential risk to disturb biodiversity and cause damage to habitat in wetland, forest etc....
- ✓ There will be risk of traffic accident as some works will take place on the existing national roads, other asphalt roads and earth rural roads.
- ✓ Risk of conflicts between affected people and contractor over damage to properties and land use.
- ✓ Risk of conflict between local community and the imported skills over potential employments.
- ✓ Community Health and safety risks as the contractor will be involved in works that may create hazard to the community: opened & abandoned cuts and pits, heavy truck, machinery and increased movement of vehicle in the community area.

7.4.4. Concern

Apart from the above the following were the concern raised during consultations

Table 28: Concerns & responses

Opinions, appreciations and/or concern	Discussion
<p>Participants raised the issue regarding resettlement and compensation communication to PAPs. Insisting that the consultant should not communicate to PAPs about expropriation as this may attract people to develop new construction or plants more trees as they know that they shall be compensated</p>	<p>Participants were informed that among the message communicated to PAPs, there was the eligibility cut-off date after which PAPs cannot claim additional assets which were established after the eligibility cut-off date. Additionally, the participants are not willing to provide information without knowing the purpose of the survey.</p>
<p>Participants raised concern about the quality of water at the intake considering the following issues: Nyaruguru is erosion-prone area which increase water pollution by soil. There is an hydro-power plant under construction would affect the quality of water when in operation</p>	<p>There shall be protection of the water intake area by putting terraces and planting trees on hills around the intake. There shall be quality monitoring of the water from the hydro-power plant to ensure there is no contamination from the hydro-power plant</p>
<p>The population in Gisagara need their own water treatment plant and the whole WSS. The water distributed from Nyaruguru is not always continuous as the pipes are most of the time broken.</p>	<p>The study considered that option but it was found that there is no possible source intake. The existing river (Akanyaru) is within the boundary with the country of Burundi. There shall be big tanks installed in Gisagara which can serve the population during the time there is a water shortage from Nyaruguru.</p>
<p>The feasibility report should be shared to all stakeholders for a proper planning at the district level</p>	<p>The final report shall be disclosed to all key stakeholders.</p>

There shall be nuisances from the water treatment plant by noise, bad smells.	The water treatment plant shall reserve a buffer zone between its boundary and the nearest habitations
Nyaruguru hills are prone to landslides and may increase maintenance works.	Measures to protect the WSS route like planting trees and terraces will be recommended and implemented.
Social issues related to labor and speculative influx mainly during construction of the WTP in Cyahinda, Nyaruguru District	The contractor shall develop an environmental and social management plan before start of works.
The participants raised issue in regards to transmission pipes which are designed to pass through un-constructed residential plots, which became an issue when the owner want to start construction.	The design shall avoid pipes which pass through un-constructed residential plots but will prioritize alternative which pass near other infrastructures like road.

7.5. ESIA disclosure

Public disclosure of ESIA report is a requirement of the AfDB's ISS. WASAC will make available copies of this ESIA report on WASAC website and at its headquarters' office. Copies will be also shared with RDB and REMA for monitoring purposes. The GoR will also authorize AfDB to disclose this ESIA report.

CHAP VIII: ANALYSIS OF ALTERNATIVES

8.1. Zero scenario

Firstly, we considered the option of doing nothing (not WSS developed). In fact, several profitable services would be missed if this option is taken. Profitable services include drinking water supply, jobs creation, business opportunities, income increase for residents will be missed. The “do nothing option” would seem to be an irresponsible decision towards sustainable development and was therefore rejected.

8.2. Proposed project scenarios

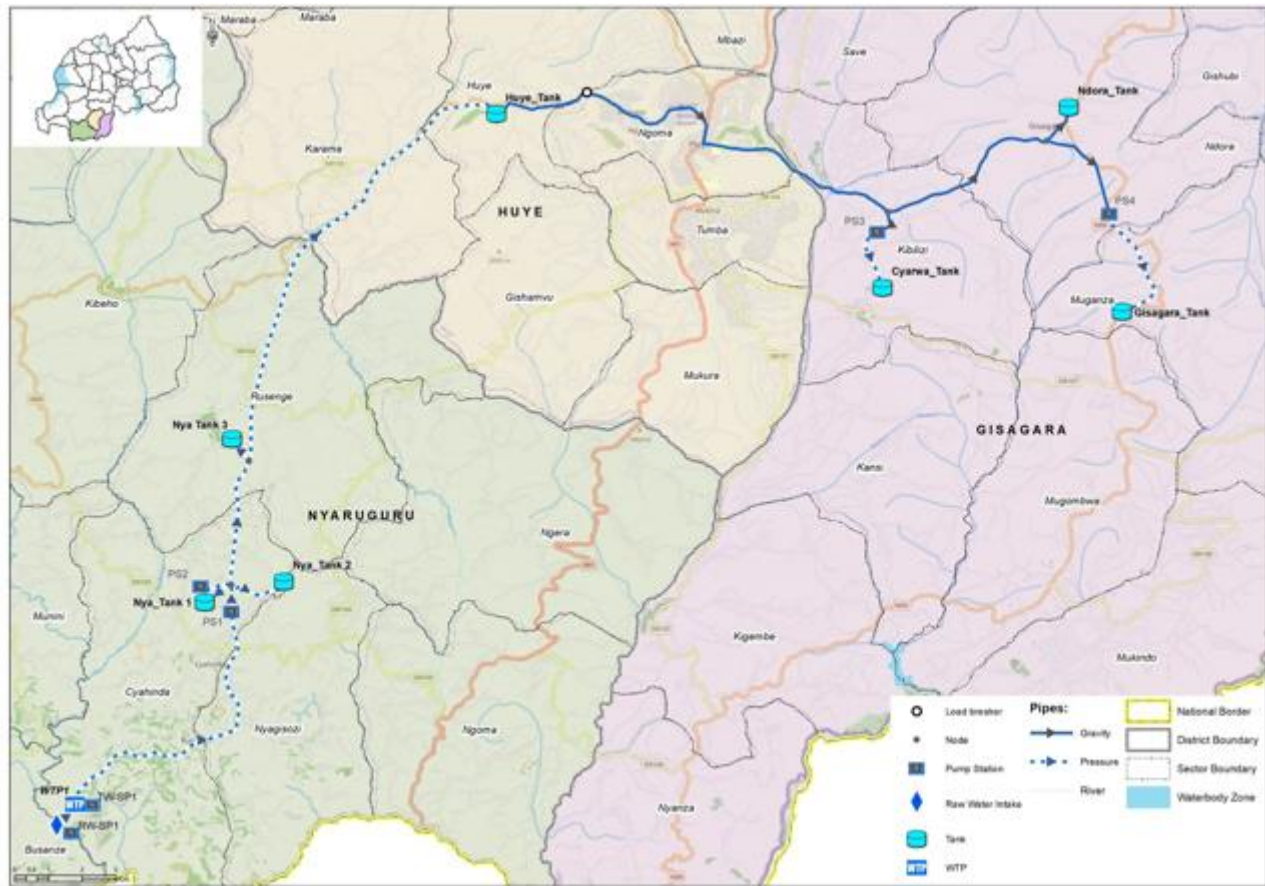
The RNIWSSMP – Development of Nyaruguru-Huye-Gisagara WSS proposed 2 feasible scenarios.

8.2.1. Alternative I: One water intake on Akanyaru river

Alternative 1 consists in implementing a single transmission pipeline crossing Nyaruguru, Huye and Gisagara districts and serving the 26 sectors forming the project area. This transmission pipe will conduct water from an intake located on the Akanyaru Upper between the Ntaruka hydropower plant and the Akanyaru multipurpose dam. It will be laid on the left bank of the river. The pipeline section between the intake and Huye will be a discharge system with three intermediate discharge tanks installed at high points to supply the areas of Munini, Cyahinda, Nyagizosi, Ngoma, Ngera, Rusenge, Kibeho, Kigembe and Nyanza. The total volume to be supplied is about 8,100 m³/day by 2030 and 18,000 m³/day by 2050.

At Mont of Huye, a new discharge tank will be implemented. It will ensure the water supply of the existing distribution tanks in Huye city and will supply the transmission line that continues towards Gisagara. The transmission pipe between Huye and Gisagara will transfer, by 2050, a flow of 21,370 m³/day and will be equipped with two connection points at Kibirizi and Ndora. They will be used to supply the planned discharge tanks at Cyarwa and Ndora. The end point of the transmission system will be a discharge tank that will be used to control the water supply in the sectors of Muganza, Mugombwa and Mukingo.

Figure 22: Conceptual scheme of alternative 1

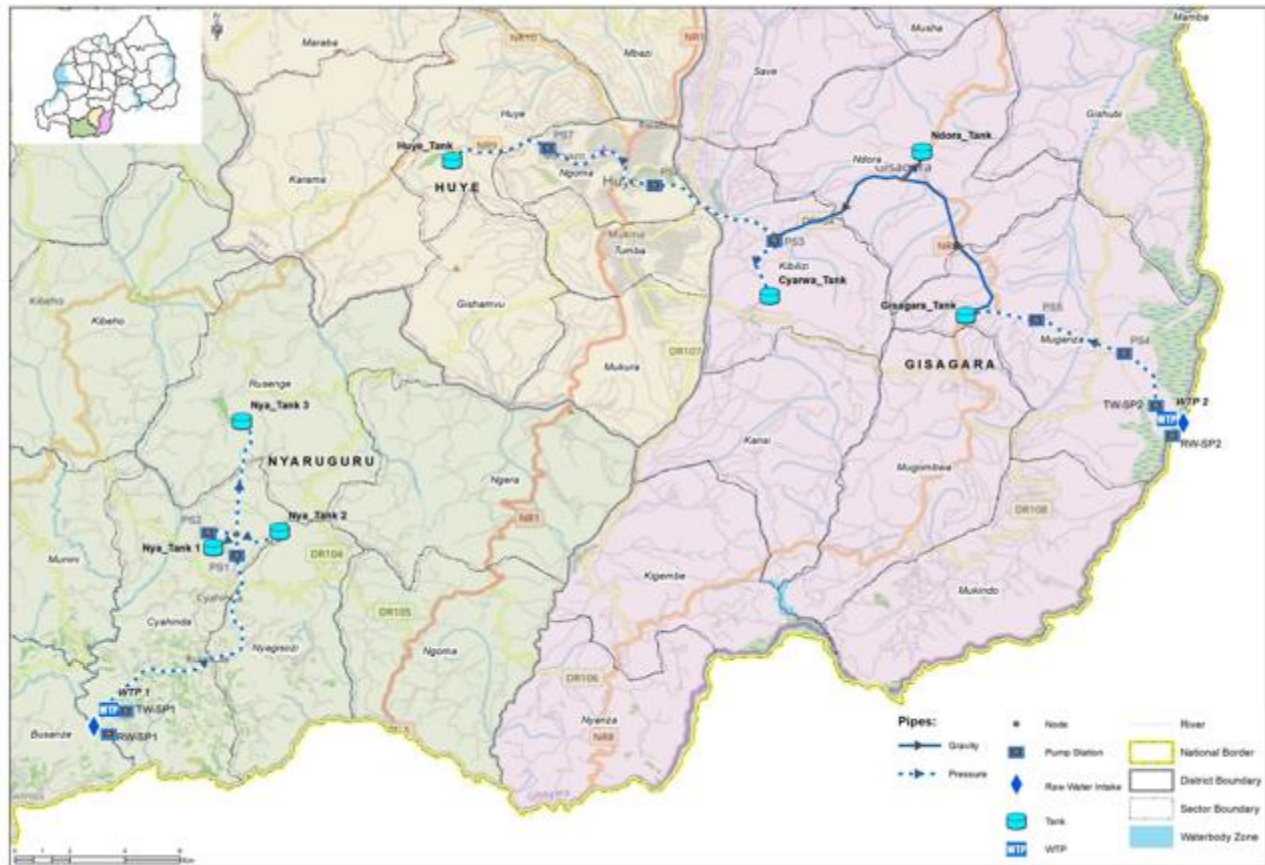


8.2.2. Alternative II: Two water intakes on Akanyaru river

Under this alternative, two water intakes were proposed. The first one is in Nyaruguru district, in the same location proposed for alternative I. It will serve the districts of Nyaruguru and 3 other sectors in Gisagara. The total volume to be supplied in these areas is about 8,100 m³/day by 2030 and 18,000 m³/day by 2050.

The second water intake will be implemented on the Akanyaru river in Muganza sector. It will be located downstream the Akanyaru multipurpose dam, on the left bank of the river and will be designed to fill the water gap in Gisagara and Huye project areas by 2050. The volume is estimated to be 13,600 m³/day by 2030 and about 52,100 m³/day by 2050.

Figure 23: Conceptual scheme of alternative 2



8.3. Selection of preferred scenario

Seven criteria were applied to carry out an objective evaluation of the two alternatives. Assessed criteria are:

- 1) Technical criteria: duration of works, energy required, securing water supply.
- 2) Financial criterion: Long-Term Marginal Cost (LTMC).
- 3) Economic criterion: Economic Internal Rate of Return (EIRR).
- 4) Environmental and Social Impacts: Loss of agricultural land, impacts on the natural environment.

These criteria were classified into two groups, one favoring the preference of alternative 1 and the other one supporting the alternative 2. The EIRR, LTMC, and energy criteria contributed positively to first ranking of alternative 1. The duration of works criteria has a very slight effect on the

preference of the alternative I. Criteria related to securing water supply, impact on natural environment and loss of agricultural land were in favor of alternative 2.

A multi-criteria decision analysis (MCDA) was conducted applying PROMOTHE GAIA Software, a preference function that belongs to the family of the outranking methods for multicriteria decision aid. The results of PROMOTHE GAIA Model reveal the following:

- The EIRR significantly affects the degree of preference of the alternative 1. The LTMC and Energy criteria have a moderate effect on the choice of the alternative I.
- The preference of the alternative II depends mostly on the impacts on the natural environment and the securing of water supply criteria.
- The loss of agricultural land has a neglected effect on either alternative.

As a result, the alternative I was selected.

CHAP IX: POTENTIAL ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

This chapter will assess potential environmental and social risks and impacts associated with the development of Nyaruguru-Huye-Gisagara WSS. This will include risks and impacts as per the requirements of the national legislation and AfDB’s ISS.

9.1. Assessing significance of impacts

From field observation, it was observed that the proposed project will have positive impacts and pose environmental and social risks and impacts. Risks and impacts are classified differently according to their degrees and duration and their assessment was done by assigning their weights. Weights assigned to the impacts depend on the importance of the impacts at the project site, and varies from: *Important/High, Moderate/Middle* or *Small/Low*.

Table 29: Explanation and interpretation of significance rating for impacts

Significance of risks and impacts	Implication of negative impacts on the project
Low	Negligible
Moderate	Non-negligible effects. Effects are serious enough to cause serious concerns. Change to the project should be considered.
Important	Unacceptable or automatic fatal flaw effects. The project should not proceed unless design is changed so that the significance of these impacts is reduced to acceptable levels.

9.2. Duration of Impacts

Risks and impacts are also classified according to their effect in time: *Temporary* or *Permanent*. Permanent changes are those which are irreversible (e.g., permanent land gaining). Temporary environmental effects are those defined as short-term (less than three years) or medium-term (three to ten years).

9.3. Potential impacts

9.3.1. Positive impacts

Positive impacts of the proposed project are various and diverse in nature. The project is expected to increase and create employment opportunities among the local communities, which will be casual laborers and skilled labor on-site. During site preparation and construction, employment will be generated for several categories of workers including engineers, casual laborers, skilled and unskilled workers, as well as suppliers of goods and services. Other long-term employment opportunities would, however, result from an expanded local economy from people involved in operation and maintenance of the WSS.

Table 30: Positive impacts from the proposed project

Impact	Significance	Duration
– Job opportunity for local people and gender balance enhancement in terms of employment benefits.	Important/High	Temporary and permanent.
– Knowledge transfer to local people.	Important/High	Temporary.
– Possibility of business hiring equipment.	Moderate/Middle	Temporary.
– Selling foodstuff and other materials.	Moderate/Middle	Temporary.
– Increase income for the population working for the project.		Temporary and permanent.
– Possibility of savings for workers.	Important/High	Temporary and permanent.
– Increase to public revenues/taxes for both central and local authorities from construction materials.	Important/High	Temporary and permanent.
– Drinking water quality that meets national, regional, and international quality indicators.	Important/High	Permanent.

9.3.2. Negative impacts

During preparation, construction and operation phases, potential negative risks and impacts on humans and environment are expected and they should be avoided or mitigated with appropriate measures. The following table gives a list of potential environmental and social impacts that may arise from the development of Nyaruguru-Huye-Gisagara WSS.

Table 31: Environmental and Social negative impacts during preparation phase

Impact's receptor	Negative Impacts	Significance	Duration
Human (Anthroposphere)	Conflicts from different users of Akanyaru river water arising from water abstraction competition	Moderate/Middle	Permanent
	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Important/High	Temporary
	Assets loss including 6 houses and living conditions of farmers due to damage of crops belonging to 231 PAPs	Important/High	Permanent
	Risk of wages payment arrears.	Important/High	Temporary
	Risk of violation of child rights.	Moderate/Middle	Temporary
	High expectation of local communities in relation to jobs.	Low/Small	Temporary
	Potential risk of insecurity due to influx of job seekers.	Low/Small	Temporary
	Conflicts among workers who temporarily settle with the local community and residents.	Low/Small	Temporary
	Risk of not considering people with disabilities	Low/Small	Temporary
	Increased noise and vibration levels due to use of heavy machinery and earth moving equipment.	Moderate/Middle	Temporary
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Moderate/Middle	Temporary
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Moderate/Middle	Temporary

Impact's receptor	Negative Impacts	Significance	Duration
	Poor hygiene and sanitation	Low/Small	Temporary
	Risk of insecurity at the project site	Low/Small	Temporary
Animals, plants, and biodiversity (Biosphere)	Loss of biodiversity due to vegetation clearance, earth movement and blasting during site preparation.	Important/High	Temporary
	Crops loss (coffee, banana, cassava, beans, Eucalyptus, Grevillea, etc.)	Important/High	Temporary
Air (Atmosphere)	Dust pollution from the use of heavy machinery and earth moving equipment.	Moderate/Middle	Temporary
	Foul smelling from toilets installed at the site.	Low/Small	Temporary
Water (Hydrosphere)	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Low/Small	Temporary
Land (Geosphere)	Land acquisition	Important/High	Permanent
	Erosion and excavated soil during construction of WTP	Important/High	Temporary
	Preparation of trenches, laying of pipes and construction of reservoirs and pumping and treatment stations may cause Brutal spreading of materials in waterways and lowlands, and concrete laitance.	Low/Small	Temporary
	Loss of land for quarry, borrow, and disposal spoil materials.	Important/High	Temporary
	Dust emissions from movement of trucks and heavy-duty equipment to and from the project area, as well stockpiling of earth materials.	Important/High	Temporary
Climate change	Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.	Low/Small	Permanent

9.3.3. Negative impacts during the construction phase

Table 32: Environmental and Social negative impacts during construction phase

Impact's receptor	Negative Impacts	Significance	Duration
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Important/High	Temporary
	Risk of wages payment arrears.	Important/High	Temporary
	Risk of violation of child rights.	Moderate/Middle	Temporary
	High expectation of local communities in relation to jobs.	Low/Small	Temporary
	Potential risk of insecurity due to influx of job seekers.	Low/Small	Temporary
	Conflicts among workers who temporarily settle with the local community and residents.	Low/Small	Temporary
	Risk of not considering people with disabilities	Low/Small	Temporary
	Increased noise and vibration levels due to use of heavy machinery and earth moving equipment.	Moderate/Middle	Temporary
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Moderate/Middle	Temporary
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Moderate/Middle	Temporary
	Poor hygiene and sanitation	Low/Small	Temporary
Animals, plants, and biodiversity (Biosphere)	Impact related to the laying of water pipes likely to affect some environmental characteristics in Nyaruguru, Huye, and Gisagara district.	Important/High	Permanent
Air (Atmosphere)	Dust pollution from the use of heavy machinery and earth moving equipment.	Moderate/Middle	Temporary
	Foul smelling from toilets installed at the site.	Low/Small	Temporary
Water (Hydrosphere)	Risks associated with water abstraction (withdrawal) such as water quantity and	Important/High	Permanent

Impact's receptor	Negative Impacts	Significance	Duration
	quality, hydrological pattern of Akanyaru river, etc.		
	Impacts related to the abstraction of transboundary water resources that might affect neighboring countries.	Important/High	Permanent
	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Low/Small	Temporary
Land (Geosphere)	Loss of land for quarry, borrow, and disposal spoil materials.	Important/High	Temporary
	Dust emissions from movement of trucks and heavy-duty equipment to and from the project area, as well stockpiling of earth materials.	Important/High	Temporary
Climate change	Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.	Low/Small	Permanent

9.3.4. Negative impacts during the operational phase

Table 33: Environmental and Social impacts during operational phase

Impact's receptor	Negative Impacts	Significance	Duration
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Important/High	Temporary
	Risk of wages payment arrears.	Important/High	Temporary
	Risk of violation of child rights.	Moderate/Middle	Temporary
	High expectation of local communities in relation to jobs.	Low/Small	Temporary
	Risk of not considering people with disabilities	Low/Small	Temporary
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Moderate/Middle	Temporary

Impact's receptor	Negative Impacts	Significance	Duration
	Poor hygiene and sanitation	Low/Small	Temporary
	Risk of insecurity at the project site	Low/Small	Temporary
Air (Atmosphere)	Foul smelling from toilets installed at the site.	Low/Small	Temporary
Land (Geosphere)	Road construction and/or maintenance with the potential of affecting WSS infrastructure.	Low/Small	Permanent
	Management of sludge from the WTP	Important/High	Permanent
Water (Hydrosphere)	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Low/Small	Temporary
Climate change	Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.	Low/Small	Permanent

CHAP X: PROPOSED MITIGATION MEASURES

This chapter proposes measures to avoid or mitigate any potential adverse environmental and/or social risks or impacts associated with the proposed project.

10.1. Mitigation measures for the preparation phase

The present section focuses on mitigation measures proposed for the preparation phase.

Impact's receptor	Negative Impacts	Proposed mitigation measures
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).
		Avail first aid kit on-site, train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.
		Avail tout-risque chantier insurance covering the entire construction site.
		Ensure that all workers have medical insurance.
	Assets loss including houses and living conditions.	Conduct a FRAP to assess all compensation requirements including PAPs and compensation costs.
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.
	Establish, train, and operationalize Grievance Redress Committee (GRC).	

Impact's receptor	Negative Impacts	Proposed mitigation measures
	Potential risk of insecurity due to influx of job seekers.	Fence the construction site where possible to avoid unauthorized entries.
	Conflicts among workers who temporally settle with the local community and residents.	Sensitize residents and workers to avoid conflicts.
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.
	Increased noise and vibration levels due to use of heavy machinery and earth moving equipment.	Avoid noise that exceed 80decibels.
		Operated heavy machinery and earth moving equipment between 07:00AM – 05:00PM.
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Sensitize workers and residents on prevention of HIV/AIDS, STDs, and other communicable diseases.
		Distribute condoms to workers as solicited.
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize contractor and workers on SH and GBV and enforce and sensitize code of conducts.
Poor hygiene and sanitation	Clean the site and sensitize workers on personal hygiene and sanitation.	
Risk of insecurity at the project site	Put in place flag men and security guards to ensure that activities are carried out in secured environment.	
Animals, plants, and biodiversity (Biosphere)	Loss of biodiversity due to vegetation clearance, earth movement and blasting during site preparation.	Avoid disturbing wildlife habitat during works.
		Replant trees and grasses where possible.
	Crops loss (coffee, banana, cassava, beans, Eucalyptus, Grevillea, etc.)	Compensation of cleared crops and trees replanting.

Impact's receptor	Negative Impacts	Proposed mitigation measures
Air (Atmosphere)	Dust pollution from the use of heavy machinery and earth moving equipment.	Limit traffic within working hours, starting from 7:00AM to 5:00PM Sensitize vehicle drivers, machinery operators to switch off engines not being used. Watering dusty areas. Use of equipment and automobiles that have certification of good working conditions from "National Automobile inspection centre" to reduce noise or exhaust fumes emissions.
	Foul smelling from toilets installed at the site.	Clean toilets on a continual basis.
Water (Hydrosphere)	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Avoid septic pit to reach water table level and clean toilets on a continual basis.
Land (Geosphere)	Land acquisition	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and local administration in all compensation process.
	Loss of land for quarry, borrow, and disposal spoil materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and local administration in all compensation process.
Climate change	WSS infrastructure threatened by erosion and stormwater.	Construct climate-resilient infrastructure.

Impact's receptor	Negative Impacts	Proposed mitigation measures
	Risk of increased greenhouse gas (GHG) emissions from heavy machinery and earth moving equipment and amplified vulnerability to climate change.	Encourage the use of machinery and equipment with low emissions of GHG.

10.2. Mitigation measures for the construction phase

The following table summarizes mitigation measures to be implemented during the construction phase.

Impact's receptor	Negative Impacts	Proposed mitigation measures
Human (Anthroposphere)	Conflicts from different users of Akanyaru river water arising from water abstraction competition	Every water user should respect his water abstraction level and seek water abstraction license from the RWB before any activity is undertaken.
	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).
		Avail first aid kit on-site, train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.
		Avail tout-riquer chantier insurance covering the entire construction site.
	Ensure that all workers have medical insurance.	
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.

Impact's receptor	Negative Impacts	Proposed mitigation measures
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection. Establish, train, and operationalize Grievance Redress Committee (GRC).
	Potential risk of insecurity due to influx of job seekers.	Residents will be given the priority during workforce selection. Establish, train, and operationalize Grievance Redress Committee (GRC).
	Conflicts among workers who temporarily settle with the local community and residents.	Sensitize residents and workers to avoid conflicts.
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.
	Increased noise and vibration levels due to use of heavy machinery and earth moving equipment.	Avoid noise that exceed 80 decibels. Operated heavy machinery and earth moving equipment between 07:00AM – 05:00PM.
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Sensitize workers and residents on prevention of HIV/AIDS, STDs, and other communicable diseases. Distribute condoms to workers as solicited.
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize contractor and workers on SH and GBV and enforce and sensitize code of conducts.

Impact's receptor	Negative Impacts	Proposed mitigation measures
	Poor hygiene and sanitation.	Clean the site and sensitize workers on personal hygiene and sanitation.
	Risk of insecurity at the project site.	Put in place flag men and security guards to ensure that activities are carried out in secured environment.
Animals, plants, and biodiversity (Biosphere)	Laying of water pipes likely to affect some environmental characteristics in Nyaruguru, Huye, and Gisagara district (crops uprooted, landscape change, etc.).	Conduct a FRAP to assess all compensation requirements including PAPs and compensation costs.
Air (Atmosphere)	Dust pollution from the use of heavy machinery and earth moving equipment.	Limit traffic within working hours, starting from 7:00AM to 5:00PM
		Sensitize vehicle drivers, machinery operators to switch off engines not being used.
		Watering dusty areas. Use of equipment and automobiles that have certification of good working conditions from "National Automobile inspection centre" to reduce noise or exhaust fumes emissions.
Water (Hydrosphere)	Risks associated with water abstraction (withdrawal) such as water quantity and quality, hydrological pattern of Akanyaru river, etc.	WASAC shall ensure that water abstracted from Akanyaru river shall not compromise water quality, quantity, and hydrological pattern required for the survival of ecosystems.
	Impacts related to the abstraction of transboundary water resources that might affect neighboring countries.	WASAC shall seek a permit to abstract water as transboundary resources.

Impact's receptor	Negative Impacts	Proposed mitigation measures
	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Construct septic pits in way that excreta will not enter in contact with water bodies.
Land (Geosphere)	Erosion and excavated soil during construction of WTP	Plant trees and grasses to stabilize embankments and construct stone masonry and water channels to fight erosion.
	Preparation of trenches, laying of pipes and construction of reservoirs and pumping and treatment stations may cause brutal spreading of materials in waterways and lowlands, and concrete laitance.	Stockpile soil to avoid spread and refill pipe ways after laying waterpipes.
	Loss of land for quarry, borrow, and disposal spoil materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and local administration in all compensation process.
	Dust emissions from movement of trucks and heavy-duty equipment to and from the project area, as well stockpiling of earth materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and local administration in all compensation process.
Climate change	WSS infrastructure threatened by erosion and stormwater.	Construct climate-resilient infrastructure.
	Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.	Encourage the use of machinery and equipment with low emissions of GHG.

10.3. Mitigation measures for the operational phase

The following table summarizes mitigation measures to be implemented during the operational phase.

Impact's receptor	Negative Impacts	Proposed mitigation measures
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	<p>Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).</p> <p>Avail first aid kit on-site, train some people on techniques of handling injured people.</p> <p>Checking daily if the materials are in good conditions before starting the activities.</p> <p>Ensure that all workers have medical insurance.</p>
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.
		Establish, train, and operationalize Grievance Redress Committee (GRC).
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize workers on SH and GBV and enforce and sensitize code of conducts.
	Poor hygiene and sanitation	Clean the site and sensitize workers on personal hygiene and sanitation.

Impact's receptor	Negative Impacts	Proposed mitigation measures
Air (Atmosphere)	Foul smelling from toilets installed at the site.	Clean toilets on a continual basis.
Water (Hydrosphere)	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Construct septic pits in way that excreta will not enter in contact with water bodies.
Land (Geosphere)	Road construction and/or maintenance with the potential of affecting WSS infrastructure.	WASAC to coordinate with RTDA and Road maintenance Fund (RMF) to share information on the location of water pipes to ensure they are protected during road-related works.
	Management of sludge from the WTP	Avail a permitted site to stockpile sludge from the WTP and ensure it doesn't reach into the surrounding environment.
Climate change	WSS infrastructure threatened by erosion and stormwater.	Construct climate-resilient infrastructure.
	Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.	Encourage the use of machinery and equipment with low emissions of GHG.

CHAP XI: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

11.1. Introduction

An Environmental and Social Management and Monitoring Plan (ESMP) has been developed for the proposed project and will be implemented during the preparation, construction and operation phases by the contractor, project developer (WASAC), and relevant implementing agencies. These agencies include REMA, Nyaruguru, Huye, and Gisagara districts.

Given that construction activities shall be conducted in 3 phases dated 2024-2030, 2031-2040, and 2041-2050, the following ESMP is indicative for each phase, however, it is highly recommended that WASAC will ensure every contractor develops an up-to-date Contractor's Environmental and Social Management Plan (CESMP) for each phase just before the commencement of construction works. This will help the client, WASAC, to cater for environmental and social safeguard costs for each phase.

The proposed ESMP provides responsible parts, timelines, and the cost for the implementation of mitigation measures.

11.2. ESMP for the preparation phase

Table 34: Environmental and Social Management Plan during preparatory phase

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).	Contractor	Before works start	6,000,000
		Avail first aid kit on-site (1kit/km), train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.	Contractor	Before works start	5,000,000
		Avail tout-risque chantier insurance covering the entire construction site.	Contractor	Before works start	5,000,000
		Ensure that all workers have medical insurance.	Contractor	Before works start	n/a
	Assets loss including houses and living conditions.	Conduct a FRAP to assess all compensation requirements including PAPs and compensation costs.	WASAC	Before works start	Feasibility study budget
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.	WASAC Districts Contractor	Before works start	200,000
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen	WASAC Districts	Before works start	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
		(16) years as recommended by the Rwanda labor law.	Contractor		
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.	WASAC Districts Contractor	Before works start	n/a
		Establish, train, and operationalize Grievance Redress Committee (GRC).	WASAC Districts Contractor	Before works start	n/a
	Potential risk of insecurity due to influx of job seekers.	Fence the construction site where possible to avoid unauthorized entries.	WASAC Contractor	Before works start	Construction budget
	Conflicts among workers who temporally settle with the local community and residents.	Sensitize residents and workers to avoid conflicts.	Districts Contractor	Continual	n/a
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.	Contractor Districts	Continual	n/a
	Increased noise and vibration levels due to the use of heavy machinery and earth moving equipment.	Avoid noise that exceed 80decibels.	Contractor Districts	Continual	n/a
		Operated heavy machinery and earth moving equipment between 07:00AM – 05:00PM.	Contractor Districts	Continual	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Sensitize workers and residents on prevention of HIV/AIDS, STDs, and other communicable diseases.	Contractor Districts	Continual	n/a
		Distribute condoms to workers as solicited.	Contractor Districts	Continual	200,000
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize contractor and workers on SH and GBV and enforce and sensitize code of conducts.	Contractor Districts	Continual	n/a
		Prepare codes of conduct to be signed by all workers.	WASA Contractor Districts	Before works start	1,200,000
	Poor hygiene and sanitation	Clean the site and sensitize workers on personal hygiene and sanitation.	Contractor	Continual	1,200,000
	Risk of insecurity at the project site	Put in place flag men and security guards to ensure that activities are carried out in secured environment.	Contractor	Continual	Workers' remuneration costs
Animals, plants, and biodiversity (Biosphere)	Loss of biodiversity due to vegetation clearance, earth movement and blasting during site preparation.	Avoid disturbing wildlife habitat during works.	Contractor	Continual	n/a
		Replant trees and grasses where possible.	WASAC Contractor	Before construction works start	FRAP costs
	Crops loss (coffee, banana, cassava, beans, Eucalyptus, Grevillea, etc.)	Compensation of cleared crops and trees replanting.	WASAC Contractor	Before construction works start	FRAP costs

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
Air (Atmosphere)	Dust pollution from the use of heavy machinery and earth moving equipment.	Limit traffic within working hours, starting from 7:00AM to 5:00PM	Contractor	Continual	n/a
		Sensitize vehicle drivers, machinery operators to switch off engines not being used.	Contractor	Continual	n/a
		Watering dusty areas.	Contractor	Continual	2,400,000
		Use of equipment and automobiles that have certification of good working conditions from "National Automobile inspection centre" to reduce noise or exhaust fumes emissions.	Contractor	Continual	n/a
	Foul smelling from toilets installed at the site.	Clean toilets on a continual basis.	Contractor	Continual	1,200,000
Water (Hydrosphere)	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Avoid septic pit to reach water table level and clean toilets on a continual basis.	Contractor	Continual	n/a
Land (Geosphere)	Land acquisition	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and	WASAC Contractor	Before construction works start	FRAP costs

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
		local administration in all compensation process.			
	Loss of land for quarry, borrow, and disposal spoil materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and local administration in all compensation process.	WASAC Contractor	Before construction works start	FRAP costs
Climate change	WSS infrastructure threatened by erosion and stormwater.	Construct climate-resilient infrastructure.	WASAC Consultant (feasibility study) Contractor	During feasibility study and construction phase	Construction costs
	Risk of increased greenhouse gas (GHG) emissions from heavy machinery and earth moving equipment and amplified vulnerability to climate change.	Encourage the use of machinery and equipment with low emissions of GHG.	Contractor	Continual	n/a
SUBTOTAL COST 1:					22,400,000

11.3. ESMP for the construction phase

Table 35: Environmental and Social management plan during construction phase

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
Human (Anthroposphere)	Conflicts from different users of Akanyaru river water arising from water abstraction competition	Every water user should respect his water abstraction level and seek water abstraction license from the RWB before any activity is undertaken.	Districts, WASAC, RWB	Before works start	n/a
	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).	Contractor	Wear and tear replacement	12,000,000
		Avail first aid kit on-site, train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.	Contractor	Before works start	Covered during the preparation phase.
		Avail tout-risque chantier insurance covering the entire construction site.	Contractor	Before works start	Covered during the preparation phase.
		Ensure that all workers have medical insurance.	Contractor	Before works start	Covered during the preparation phase.

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.	WASAC Districts Contractor	Before works start and on continual basis as needed	200,000
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.	WASAC Districts Contractor	Before works start	n/a
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.	WASAC Districts Contractor	Before works start	n/a
		Establish, train, and operationalize Grievance Redress Committee (GRC).	WASAC Districts Contractor	Before works start	n/a
	Potential risk of insecurity due to influx of job seekers.	Residents will be given the priority during workforce selection.	WASAC Contractor	Before works start	Construction budget
		Establish, train, and operationalize Grievance Redress Committee (GRC).	Districts Contractor	Continual	n/a
	Conflicts among workers who temporally settle with the local community and residents.	Sensitize residents and workers to avoid conflicts.	WASAC Districts Contractor	Before works start	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.	Contractor Districts	Continual	n/a
	Increased noise and vibration levels due to use of heavy machinery and earth moving equipment.	Avoid noise that exceed 80 decibels.	Contractor Districts	Continual	n/a
		Operated heavy machinery and earth moving equipment between 07:00AM – 05:00PM.	Contractor Districts	Continual	n/a
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Sensitize workers and residents on prevention of HIV/AIDS, STDs, and other communicable diseases.	Contractor Districts	Continual	n/a
		Distribute condoms to workers as solicited.	Contractor Districts	Continual	1,000,000
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize contractor and workers on SH and GBV and enforce and sensitize code of conducts.	Contractor Districts	Continual	n/a
		Prepare codes of conduct to be signed by all workers.	WASA Contractor Districts	Before works start and continual	Covered during the preparation phase.
	Poor hygiene and sanitation.	Clean the site and sensitize workers on personal hygiene and sanitation.	Contractor	Continual	1,200,000

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
	Risk of insecurity at the project site.	Put in place flag men and security guards to ensure that activities are carried out in secured environment.	Contractor	Continual	Workers' remuneration costs
Animals, plants, and biodiversity (Biosphere)	Laying of water pipes likely to affect some environmental characteristics in Nyaruguru, Huye, and Gisagara district (crops uprooted, landscape change, etc.).	Conduct a FRAP to assess all compensation requirements including PAPs and compensation costs.	WASA	Before works start and continual	Feasibility study costs
Air (Atmosphere)	Dust pollution from the use of heavy machinery and earth moving equipment.	Limit traffic within working hours, starting from 7:00AM to 5:00PM	Contractor	Continual	n/a
		Sensitize vehicle drivers, machinery operators to switch off engines not being used.	Contractor	Continual	n/a
		Watering dusty areas.	Contractor	Continual	6,400,000
		Use of equipment and automobiles that have certification of good working conditions from "National Automobile inspection centre" to reduce noise or exhaust fumes emissions.	Contractor	Continual	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
	Foul smelling from toilets installed at the site.	Clean toilets on a continual basis.	Contractor	Continual	1,200,000
Water (Hydrosphere)	Risks associated with water abstraction (withdrawal) such as water quantity and quality, hydrological pattern of Akanyaru river, etc.	WASAC shall ensure that water abstracted from Akanyaru river shall not compromise water quality, quantity, and hydrological pattern required for the survival of ecosystems.	WASAC	Before construction works start	WASAC Ordinary budget
	Impacts related to the abstraction of transboundary water resources that might affect neighboring countries.	WASAC shall seek a permit to abstract water as transboundary resources.	WASAC	Before construction works start	WASAC Ordinary budget
	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Construct septic pits in way that excreta will not enter in contact with water bodies.	Contractor	Before construction works start	25,000,000
Land (Geosphere)	Loss of land for quarry, borrow, and disposal spoil materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure	WASAC Contractor	Before construction works start	FRAP costs

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
		participation of owners and local administration in all compensation process.			
	Road construction and/or maintenance with the potential of affecting WSS infrastructure.	WASAC to coordinate with RTDA and Road maintenance Fund (RMF) to share information on the location of water pipes to ensure they are protected during road-related works.	WASAC, RTDA, RMF	Operational Phase	RTDA and RMF budget
	Dust emissions from movement of trucks and heavy-duty equipment to and from the project area, as well stockpiling of earth materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and local administration in all compensation process.	WASAC Contractor	Before construction works start	FRAP costs
Climate change	WSS infrastructure threatened by erosion and stormwater.	Construct climate-resilient infrastructure.	WASAC Consultant (feasibility study) Contractor	During feasibility study and construction phase	Construction costs

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
	Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.	Encourage the use of machinery and equipment with low emissions of GHG.	Contractor	Continual	n/a
TOTAL COSTS					46,800,000

11.4. ESMP for the operational phase

Table 36: Environmental and Social management plan during operation phase

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).	WASAC	Before operational phase starts	WASAC ordinary budget
		Avail first aid kit on-site, train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.	WASAC	Before operational phase starts	WASAC ordinary budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
		Ensure that all workers have medical insurance.	WASAC Workers	Before operational phase starts	WASAC ordinary budget
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.	WASAC	Before operational phase starts	WASAC ordinary budget
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.	WASAC	Before operational phase starts	n/a
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.	WASAC	Before operational phase starts	WASAC ordinary budget
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.	WASAC	Before operational phase starts	WASAC ordinary budget
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize workers on SH and GBV and enforce and sensitize code of conducts.	WASAC	Before operational phase starts	WASAC ordinary budget
	Poor hygiene and sanitation	Clean the site and sensitize workers on personal hygiene and sanitation.	WASAC	Before operational phase starts	WASAC ordinary budget
Air (Atmosphere)	Foul smelling from toilets installed at the site.	Clean toilets on a continual basis.	WASAC	Before operational phase starts	WASAC ordinary budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Responsible party	Timeline	Cost (Rwf)
Water (Hydrosphere)	Environmental pollution of water bodies due to human excreta and other wastes generated by the project workers.	Construct septic pits in way that excreta will not enter in contact with water bodies.	WASAC	Before operational phase starts	WASAC ordinary budget
Land (Geosphere)	Road construction and/or maintenance with the potential of affecting WSS infrastructure.	WASAC to coordinate with RTDA and Road maintenance Fund (RMF) to share information on the location of water pipes to ensure they are protected during road-related works.	WASAC, RTDA, RMF	During operational phase	RTDA and RMF ordinary budget
	Management of sludge from the WTP	Avail a permitted site to stockpile sludge from the WTP and ensure it doesn't reach into the surrounding environment.	WASAC, WTP operator	During operational phase	WTP operational budget
Climate change	Risk of increased greenhouse gas (GHG) emissions and amplified vulnerability to climate change.	Encourage the use of machinery and equipment with low emissions of GHG.	WASAC	Before operational phase starts	WASAC ordinary budget

CHAP XII: ENVIRONMENTAL AND SOCIAL MONITORING PLAN (ESMonP)

12.1. Introduction

The benefits of environmental and social monitoring plan fall in three general categories: (1) to audit mitigation measures, (2) to refine impact assessment methods, and (3) to improve project outcomes through adaptive environmental management. First, monitoring determines whether responsible agencies have implemented the proposed mitigation measures and whether these measures were effective; second, it compares the actual effects of a project to its predicted effects; and third, monitoring improves project outcomes through adaptive environmental management.

12.2. Institutional arrangement and roles

For this project WASAC will play the oversight role. The oversight will include coordination and monitoring of performance of implementation of the project, risk management, monitoring & evaluation, and disclosure of information, developing and putting in place performance agreements, etc. Agencies that will play a key role in implementing environmental and social safeguards recommendations are RDB in charge of issuance of ESIA certificate and REMA in charge of monitoring the implementation of the ESMP.

It is worth noting that the contractor (to be procured), the supervising firm (to be procured), WASAC, Nyaruguru, Huye, and Gisagara districts will play a key role in the implementation of the project ESMP. The success in implementation of the project ESMP will highly depend on their joint efforts. The contractor and the supervising consultant shall have permanent staff (environmentalist and health and social safeguard officer), with the required skills and experience.

12.2.1. WASAC

WASAC strives to provide quality, reliable, and affordable water and sewerage services through continuous innovations and envisions to be the most sustainable Water and Sanitation Utility in Africa, exceeding stakeholder's expectations. WASAC has the responsibilities to manage the water and provide sanitation services in in Rwanda and under this project, it will be fully involved in implementing the Environmental and Social Monitoring Plan of this report as a national agency in charge of the operational phase.

12.2.2. Rwanda Development Board (RDB)

RDB shall review and approve the ESIA Reports and issue ESIA certificate.

12.2.3. Rwanda Environment Management Authority (REMA)

REMA shall:

- a) Monitor and supervise the implementation of the environmental and social impact assessment and any other environmental study.
- b) Monitor and assess development programs to ensure compliance with the laws on environment during their preparation and implementation.

The contractor shall:

- a) Be responsible for developing a contractor's ESMP (CESMP) to achieve the environmental specifications contained herein and the relevant requirements contained in the certificate of approval issued by RDB.
- b) Be responsible for the overall implementation of the CESMP in accordance with the provisions of the ESIA and its conditions of approval issued by RDB.
- c) Ensure that all third parties who carry out all or part of the contractor's obligations under the Contract comply with the requirements of the ESIA and CESMP and work closely with WASAC, Nyaruguru, Huye, and Gisagara districts.
- d) Develop a CESMP that comprises actions for the rehabilitation of borrow pits, dumping sites and quarries.
- e) Contracting staff and provide them with PPEs.
- f) Ensure the health and safety of both workers and communities.
- g) Restore the borrow pits and quarry to the near previous condition.
- h) Conduct awareness programmes for HIV/AIDS, STDs, and other transmissible diseases.

12.2.4. Supervising firm/ consultant

The consultant will be responsible for issuing instructions to the contractor and where environmental considerations call for action to be taken. The consultant Environmental Officer from the supervising firm shall submit monthly reports to WASAC and concerned districts on the progress of implementation of ESIA provisions. In case of emergency of GBV, there should be a report within 24 hours. The supervising consultant will be responsible for the monitoring, reviewing, and verifying

of compliance with the ESIA and CESMP and conditions of the certificate of approval by the Contractor. His duties in this regard will include, inter alia, the following:

- Confirming that the certificate of approval and all permits required (ESIA certificate, permits for establishment of borrow pits, dumpsites, quarries, etc.) are following national regulations and AfDB's ISS.
- Monitoring and verifying that the CESMP, conditions of approval are always adhered to and acting if specifications are not followed.
- Monitoring and verifying that environmental and social risks and impacts are prevented or kept to minimum.
- Reviewing and approving method statements, to ensure that the environmental and social specifications contained in the CESMP, and the certificate of approval are adhered to.
- Monitoring the undertaking by the contractor of environmental awareness training for all new personnel on site during construction and for maintenance activities during operation.
- Ensuring that activities on site comply with all relevant environmental legislation.
- Ordering the removal of personnel and/or equipment not complying with the specifications of the CESMP and/or the certificate of approval.
- Undertaking a continual internal review of the CESMP and submitting any changes to WASAC and concerned districts.
- Recommend additional environmental protection measures, where deemed necessary.
- Providing report back on any environmental issues during site meetings.
- Submit the status of the CESMP implementation on monthly, quarterly basis and at the end of the project.

12.2.5. Local Community

Local communities will be mostly affected by project impacts. The local community shall:

- a) Provide information on violation or non-compliance to environmental requirements,
- b) Participate in and provide information on the effectiveness of grievance resolution.

12.3. Organization of the WSS users and general maintenance

In respect of the provisions of the National Water Supply Policy (2016), it is advised to involve districts in asset management. WASAC is advised to work with each district's water board in the management of WSS infrastructure and to position that district board as the contact point for water user committees, as the consumers' voice, as well as for reports and complaints received at lower decentralized levels (village to sector level).

Also, the beneficiaries of water supply services shall be actively involved in identification, planning, design and project implementation, and water users' committees should be actively involved in M&E of water service levels provided by service providers. In particular, they will choose the service level that responds to their needs. User associations/committees shall be involved in the oversight arrangements and shall have the role to represent consumer interests and user rights; their rights and obligations will be firmly established in the contractual and regulatory arrangements. The general maintenance of WSS infrastructure shall be under the responsibility of WASAC in coordination districts.

12.4. Environmental and social monitoring plan for the preparation phase

Table 37: Environmental and Social Monitoring Plan for preparation phase

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).	Counting of workers with PPEs at the site.	Number of PPEs	Daily	Contractor. Supervising firm.	Contractual budget
		Avail first aid kit on-site (1kit/km), train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.	Counting the number of first aid kit provided per the area under construction. Verification of training records.	Number of first-aid kits	Daily	Contractor	Contractual budget
		Avail tout-risque chantier insurance covering the entire construction site.	Verification of the insurance document.	Copy of insurance	Daily	Contractor	Contractual budget
		Ensure that all workers have medical insurance.	Verification of medical insurance documents.	Copy of medical insurance	Daily	Contractor. Supervising firm.	Covered by workers

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
	Assets loss including houses and living conditions.	Conduct a FRAP to assess all compensation requirements including PAPs and compensation costs.	Verification of the approved FRAP report	FRAP report	Once before starting of the works	Contractor. Supervising firm.	Contractual budget
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.	Verification of contracts.	Number of signed contracts	Daily	Contractor. Supervising firm.	Contractual budget
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.	Request IDs of job seekers before contracting or engaging them in the work.	Identity cards of workers	Daily	Contractor. Supervising firm.	Contractual budget
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.	Verification of the number of local residences employed in the project.	Number of residents hired	Weekly	Contractor	n/a
		Establish, train, and operationalize Grievance Redress Committee (GRC).	Verification of the GRCs operations and reports.	Number of established GRC	Weekly	Contractor	n/a
	Conflicts among workers who temporally settle with the local	Sensitize residents and workers to avoid conflicts.	Verification of sensitization sessions	Number of sensitization	Monthly	Contractor	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
	community and residents.		report/records of participation	campaign organized			
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.	Counting the number of PWDs who requested jobs and those who have been employed.	Number of PWDs recruited	Monthly	Contractor	n/a
	Increased noise and vibration levels due to the use of heavy machinery and earth moving equipment.	Avoid noise that exceed 80 decibels.	Measure the noise level at the construction site.	Noise level report	Daily	Contractor. Supervising firm.	n/a
		Operated heavy machinery and earth moving equipment between 07:00AM – 05:00PM.	Verify the working hours for the construction activities.				
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Sensitize workers and residents on prevention of HIV/AIDS, STDs, and other communicable diseases.	Verify the sensitization session report /records and participate in some of the sessions (sample of 3	Number of sensitization campaign organized	Monthly	Contractor. Supervising firm.	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
			sessions among 10 sessions				
		Distribute condoms to workers as solicited.	Verify records of the quantities of condoms distributed	Number of condoms distribution sessions	Monthly	Contractor. Supervising firm.	n/a
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize contractor and workers on SH and GBV and enforce and sensitize code of conducts.	Verify the sensitization session report /records and participate in some of the sessions (sample of 3 sessions among 10 sessions	Number of sensitization campaign organized	Monthly	Contractor. Supervising firm.	n/a
		Prepare codes of conduct to be signed by all workers.	Verify the signed code of conduct documents.	Number of staff with signed codes of conduct	Weekly	Contractor. Supervising firm.	Contractual budget
	Poor hygiene and sanitation	Clean the site and sensitize workers on personal hygiene and sanitation.	Verification of the cleanliness of the site and the cleaning plan.	Cleaning schedule in place	Daily	Contractor. Supervising firm.	Contractual budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
	Risk of insecurity at the project site	Put in place flag men and security guards to ensure that activities are carried out in secured environment.	Check the flagman availability.	Number of flagmen in place	Daily	Contractor	Contractual budget
Animals, plants, and biodiversity (Biosphere)	Loss of biodiversity due to vegetation clearance, earth movement and blasting during site preparation.	Avoid disturbing wildlife habitat during works.	Verification of established list of wildlife to be protected and check its implementation measures.	Number of wildlife protected	Daily	Contractor	n/a
		Replant trees and grasses where possible.	Verify the number of planted trees. m ² of soil covered with planted grasses	Number of planted trees. m ² of soil covered with planted grasses	Monthly	Contractor	n/a

12.5. Environmental and social monitoring plan for the construction phase

Table 38: Environmental and Social monitoring plan for construction phase

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
Human (Anthroposphere)	Conflicts from different users of Akanyaru river water arising from water abstraction competition	Every water user should respect his water abstraction level and seek water abstraction license from the RWB before any activity is undertaken.	Verification of the quantity of water withdrawal in m ³ .	Quantity of water withdrawal in m ³ .	Daily	WTP operator, RWB	n/a
	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).	Verification number of PPEs Provided	Number of PPEs	Daily	Contractor. Supervising firm.	Contractual budget
		Avail first aid kit on-site, train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.	Verification of the number of first-aid kits provided.	Number of first-aid kits	Daily	Contractor	Contractual budget
		Avail tout-riquer chantier insurance covering the entire construction site.	Verification of medical insurance documents	Copy of insurance	Daily	Contractor	Contractual budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
		Ensure that all workers have medical insurance.	Verification of medical insurance documents	Copy of medical insurance	Daily	Contractor. Supervising firm.	Covered by workers
	Assets loss including houses and living conditions.	Conduct a FRAP to assess all compensation requirements including PAPs and compensation costs.	Verification of the approved FRAP report	FRAP report	Daily	Contractor. Supervising firm.	Contractual budget
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.	Verification of signed contracts	Number of signed contracts	Daily	Contractor. Supervising firm.	Contractual budget
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.	Request IDs of job seekers before contracting or engaging them in the work.	Identity cards of workers	Daily	Contractor. Supervising firm.	Contractual budget
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.	Verification of the number of local residences employed in the project.	Number of residents hired	Weekly	Contractor	n/a
		Establish, train, and operationalize	Verification of the GRCs	Number of established GRC	Weekly	Contractor	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
		Grievance Redress Committee (GRC).	operations and reports.				
	Potential risk of insecurity due to influx of job seekers.	Residents will be given the priority during workforce selection.	Verification of the number of local residences employed in the project.	Number of residents recruited	Monthly	Contractor Supervising firm	n/a
		Establish, train, and operationalize Grievance Redress Committee (GRC).	Verification of the GRCs operations and reports.	Number of GRCs established	Monthly	Contractor Supervising firm	n/a
	Conflicts among workers who temporally settle with the local community and residents.	Sensitize residents and workers to avoid conflicts.	Verify the sensitization session report /records and participate in some of the sessions	Number of sensitization campaign organized	Monthly	Contractor	n/a
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.	Counting the number of PWDs who requested jobs and those who have been employed.	Number of PWDs recruited	Monthly	Contractor	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
	Increased noise and vibration levels due to use of heavy machinery and earth moving equipment.	Avoid noise that exceed 80 decibels.	Measure the noise level at the construction site.	Noise levels recorded	Daily	Contractor Supervising firm	n/a/
		Operated heavy machinery and earth moving equipment between 07:00AM – 05:00PM.	Verify the working hours for the construction activities.	Noise levels recorded	Daily	Contractor Supervising firm	n/a/
	Risk of spread of HIV/AIDS, STDs, and other communicable diseases.	Sensitize workers and residents on prevention of HIV/AIDS, STDs, and other communicable diseases.	Verify the sensitization session report /records and participate in some of the sessions (sample of 3 sessions among 10 sessions	Number of sensitization campaign organized	Monthly	Contractor. Supervising firm.	n/a
		Distribute condoms to workers as solicited.	Verify records of the quantities of condoms distributed	Number of condoms distribution sessions	Monthly	Contractor. Supervising firm.	n/a
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize contractor and workers on SH and GBV and enforce and sensitize code of conducts.	Verify the sensitization session report /records and participate in	Number of sensitization campaign organized	Monthly	Contractor. Supervising firm.	n/a

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
			some of the sessions (sample of 3 sessions among 10 sessions)				
		Prepare codes of conduct to be signed by all workers.	Verify the signed code of conduct documents.	Number of staff with signed codes of conduct	Weekly	Contractor. Supervising firm.	Contractual budget
	Poor hygiene and sanitation.	Clean the site and sensitize workers on personal hygiene and sanitation.	Verification of the cleanliness of the site and the cleaning plan.	Cleaning schedule in place	Daily	Contractor. Supervising firm.	Contractual budget
	Risk of insecurity at the project site.	Put in place flag men and security guards to ensure that activities are carried out in secured environment.	Check the flagman availability.	Number of flagmen in place	Daily	Contractor	Contractual budget
Animals, plants, and biodiversity (Biosphere)	Laying of water pipes likely to affect some environmental characteristics in Nyaruguru, Huye, and Gisagara district (crops	Conduct a FRAP to assess all compensation requirements including PAPs and compensation costs.	Verification of the approved FRAP report	Report of FRAP implementation	Monthly	Contractor. Supervising firm.	Contractual budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
	uprooted, landscape change, etc.).						
Air (Atmosphere)	Dust pollution from the use of heavy machinery and earth moving equipment.	Watering dusty areas.	Verify the quantity of water sprayed per day and interview local population about the perception in regards to dust pollution.	Dust quantity, Number of complaints from the population. Perception report.	Daily	Contractor Supervising firm	n/a/
	Foul smelling from toilets installed at the site.	Clean toilets on a continual basis.	Check the cleanliness of the toilets. Check the cleaning plan and compliance.	Number of cleanings per day	Daily	Contractor. Supervising firm.	Contractual budget
Land (Geosphere)	Loss of land for quarry, borrow, and disposal spoil materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national	Verification of the approved FRAP report and its implementation monitoring reports.	Report of FRAP implementation	Monthly	Contractor. Supervising firm.	Contractual budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicator	Frequency		
		expropriation law. Ensure participation of owners and local administration in all compensation process.					
	Road construction and/or maintenance with the potential of affecting WSS infrastructure.	WASAC to coordinate with RTDA and Road maintenance Fund (RMF) to share information on the location of water pipes to ensure they are protected during road-related works.	Verify the report and actual effects on field.	Number of road maintenance reports	Quarterly	RTDA, RMF, WASAC	Ordinary budget
	Dust emissions from movement of trucks and heavy-duty equipment to and from the project area, as well stockpiling of earth materials.	Ensure that PAPs are compensated. Fair compensation at full replacement cost of properties and lands to be based on the AfDB ISS and national expropriation law. Ensure participation of owners and local administration in all compensation process.	Watering dusty areas.	Verify the quantity of water sprayed per day and interview local population about the perception in regards to dust pollution.	Dust quantity, Number of complaints from the population. Perception report.	Daily	Contractor Supervising firm

12.6. Environmental and social monitoring plan for the operational phase

Table 39: Environmental and Social monitoring plan for operational phase

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicators	Frequency		
Human (Anthroposphere)	Risk of occupational injuries and/or accidents and deterioration of workers' health.	Provide Personal Protective Equipment (PPEs) to all workers (e.g., helmets, dust masks, gloves, safety glasses, boots, and high visibility jackets).	Verification number of PPEs Provided	Number of PPEs	Daily	Contractor. Supervising firm.	Contractual budget
		Avail first aid kit on-site, train some people on techniques of handling injured people. Checking daily if the materials are in good conditions before starting the activities.	Verification of the number of first-aid kits provided.	Number of first-aid kits	Daily	Contractor	Contractual budget
		Ensure that all workers have medical insurance.	Verification of medical insurance documents	Copy of medical insurance	Daily	Contractor. Supervising firm.	Covered by workers
	Risk of wages payment arrears.	Develop contracts between workers and the contractor.	Verification of signed contracts	Number of signed contracts	Daily	Contractor. Supervising firm.	Contractual budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicators	Frequency		
	Risk of violation of child rights.	Ensure that the minimum age for admission to employment is sixteen (16) years as recommended by the Rwanda labor law.	Request IDs of job seekers before contracting or engaging them in the work.	Identity cards of workers	Daily	Contractor. Supervising firm.	Contractual budget
	High expectation of local communities in relation to jobs.	Residents will be given the priority during workforce selection.	Verification of the number of local residences employed in the project.	Number of residents hired	Weekly	Contractor	n/a
	Risk of not considering people with disabilities	Recruit people with disabilities to carry out tasks that they can do.	Counting the number of PWDs who requested jobs and those who have been employed.	Number of PWDs recruited	Monthly	Contractor	n/a
	Risk of Sexual harassment (SH) and abuse, Gender Based Violence (GBV).	Sensitize workers on SH and GBV and enforce and sensitize code of conducts.	Verify the sensitization session report /records and participate in some of the sessions (sample of 3 sessions among 10 sessions)	Number of sensitization campaign organized	Monthly	Contractor. Supervising firm.	n/a
	Poor hygiene and sanitation	Clean the site and sensitize workers on personal hygiene and sanitation.	Verification of the cleanliness of the site and the cleaning plan.	Cleaning schedule in place	Daily	Contractor. Supervising firm.	Contractual budget

Impact's receptor	Negative Impacts	Proposed mitigation measures	Monitoring			Responsible	Cost (Rwf)
			Methodology	Indicators	Frequency		
Air (Atmosphere)	Foul smelling from toilets installed at the site.	Clean toilets on a continual basis.	Check the cleanliness of the toilets. Check the cleaning plan and compliance	Cleaning schedule in place	Daily	Contractor. Supervising firm.	Contractual budget
Land (Geosphere)	Road construction and/or maintenance with the potential of affecting WSS infrastructure.	WASAC to coordinate with RTDA and Road maintenance Fund (RMF) to share information on the location of water pipes to ensure they are protected during road-related works.	Verify the submitted reports and actual situation on field.	Number of reports	Quarterly	RTDA RMF	Ordinary budget
	Management of sludge from the WTP.	Avail a permitted site to stockpile sludge from the WTP and ensure it doesn't reach into the surrounding environment.	Verification of the availed site for sludge.	WTP reports	Daily	WASAC, WTP operator	Operational budget

CHAP XIII: GRIEVANCE REDERESS MECHANISM

13.1. Grievance Redress Mechanism (GRM)

The purpose of the GRM is to record and address any complaints that may arise during the implementation phase of the project. As the GRM works within existing legal and cultural frameworks, it is recognized that the GRM will comprise community level, project level and national judiciary level redress mechanisms.

For this project of developing Nyaruguru-Huye-Gisagara WSS, Grievance Redress Committees (GRCs) will be created to facilitate the water supply project to receive and resolve grievances raised by local communities, employees, and other affected stakeholders whenever they perceive a negative impact arises from the project's activities. WASAC and concerned districts (Nyaruguru, Huye, and Gisagara) will receive any type of community feedback, but some will be referred to other mechanisms for resolution. For example, grievances that allege GBV, SH, corruption, coercion, or major and systematic violation of rights and/ or policies are normally referred to organizational accountability mechanisms, administrative or judicial bodies for formal investigation.

13.2. Types of Grievances and feedbacks

There are various grievances that are likely to occur during the implementation of proposed WSS project. Grievances or forms of feedback that might arise from water supply project include:

- a) Grievances related to land acquisition, land boundaries, assets valuation and compensation and loss of sources of income or livelihood.
- b) Misunderstandings between PAPs and the contractor regarding access arrangements.
- c) GBV- related grievances and other social issues.
- d) Tensions between workers and residents.
- e) Grievances arising from construction work including nuisances generated during construction such as noise, dust, vibration, workers' disputes, etc.
- f) Misuse of funds.
- g) Complaints about misbehavior of project staff.
- h) Complaints about procurement by contractors.
- i) Complaints about contractor performance

Table 40: Levels and members of GRCs

No	GRC Levels	GRCs members
1)	Site level	<p>A minimum of one GRC at site level shall be established in each cell and will be composed of three people: (1) the representative of casual workers, (2) the representative of the contractor, and the (3) representative of the supervising firm.</p> <p>GRCs shall be established in respect of construction sites delineated in agreement with the contractor and the supervising firm, and there might be more than one GRC per cell as needed.</p>
2)	Cell Level	<p>The GRC at cell level will be elected during community consultation meetings to be held between the district, sector officials, and PAPs. The PAPs will select and vote five (5) candidates: President, Vice President and a Woman Representative, Youth representative as well as representative of People with Disability.</p> <p>The woman representative will serve as the <i>Committee Secretary</i>. The Village Leader representative, representatives of cell council and mediators as well as the cell Executive Secretary of where construction activities are implemented will be part of the elected Committee.</p> <p>Note: GRC of workers shall include representative of casual labor, contractor, and supervising firm</p>
3)	Sector Level	<p>The GRC at sector level will comprise 8 members; the Sector Executive Secretary who will be the President, the Social Protection Officer who will be the Vice President, Representatives of sector council who will be secretary, National Women Council, National Youth Council, Representative of PWDs, sector mediators, Land officer.</p>
4)	District Level (Nyaruguru, Huye, and Gisagara)	<p>The committee will be composed of 7 members namely the Vice Mayor in charge of Social Affairs who will be the President, District Director of One Stop Centre who will be the Vice President, Directors of Social Development and Good Governance who will be secretary, Representative of Social affairs commission in the district council, Representatives of National Women and Youth Councils as well as Representative of PWDs.</p>
5)	WASAC Level	<p>The GRC committee will be composed of members of WASAC Senior Management of which the Director General will be the chair; and Public Relations and Communications Officer will be the Secretary.</p>

It is worth stressing that the Communities and individuals who believe that they are adversely affected by the project may submit complaints to existing project-level GRM. However, the project level process will not impede affected person access to the legal system. If a complainant is not satisfied with the resolutions at all project levels, he/she will be allowed to take the matter to the appropriate legal or judicial authority as per the Rwandan laws.

CHAP XIV: ENVIRONMENTAL AND SOCIAL CLAUSES

Most environmental and social impacts of this project result from activities directly under the control of contractors and will be mitigated directly by the same contractors. Therefore, ensuring that contractors effectively mitigate programs activities related impacts is the core of mitigation strategy. This will be done by ensuring that the environmental and social management of programs activities are mandatory parts of activities works contracts. The client will incorporate standardized environmental and social clauses in tender documentation and contract documents, so that potential bidders are aware of environmental and social performance requirements expected from them, are able to reflect that in their bids, and required to implement the clauses for the duration of the contract.

The client will enforce compliance by contractors with clauses covering four issues:

- 1) Environment, Health, and Safety (EHS).
- 2) Environmental and social monitoring by contractor.
- 3) Environmental and social liabilities.
- 4) Grievance mechanism for workers.

14.1. Environment, health, and safety

The purpose of the environment, health, and safety (EHS) clauses for contractors is to define minimum standards of construction practice acceptable by the AfDB's ISS. The clauses will be concluded in the bidding documents and contracts. Contractor Environmental and Social Management Plan (CESMP) prior to start implementing the project, each contractor must prepare and submit a CESMP to the supervision firm and client for approval. The CESMP will provide a detailed explanation of how the contractor will comply with the project the EHS clauses for contractors and demonstrate that sufficient funds are budgeted for that purpose and sufficient capacity is in place to oversee, monitor and report on CESMP performance.

The CESMP must include specific mitigation measures based on the project environmental and social management plan, the final design, the proposed work method statements, and the nature of the project site. The CESMP should include management plans that cover following issues:

14.1.1. Gender based Violence

The Contractors must address the risk of GBV, through:

- Mandatory and frequent training and awareness raising for the workforce about refraining from unacceptable conduct toward local community members, specifically women.
- Informing workers about national laws that make SH and GBV a punishable offence which is prosecuted.
- Introducing a Worker Code of Conduct as part of the employment contract, and including sanctions for non-compliance (e.g., contract termination).
- Adopting a policy to cooperate with law enforcement agencies in investigating complaints about GBV.
- Avoid child labor: the contractor must not employ workers below the age of 16.

14.1.2. Labor influx

Where contractors and workers come from outside the local area, contractors will need to maintain labor relations with local communities through labor's codes of conduct.

14.1.3. Road

To carry out the construction works, it may be necessary to close or divert certain specified roads, either permanently or temporarily during the construction period. The contractor should arrange diversions for providing alternative route for transport and/or pedestrians. After breaking up, closing, or otherwise interfering with any street or footpath to which the public has access, the contractor shall make such arrangements as may be reasonably necessary so as to cause as little interference with the traffic in that street or footpath during construction of the rehabilitation works as shall be reasonably practicable. Wherever the construction works interfere with existing public or private roads or other ways over which there is a public or private right of way for any traffic, the contractor shall construct diversion ways wherever possible.

14.1.4. Movement of trucks and construction machinery

The contractor moving construction materials and waste shall take strict measures to minimize littering of roads by ensuring that vehicles are licensed and loaded in such a manner as to prevent falling off or spilling of construction materials and by sheeting the sides and tops of all vehicles carrying mud, sand, other materials, and debris. Construction materials should be brought from registered sources in the area and debris should be transferred to assigned places in the landfill with documented confirmation.

14.1.5. Traffic safety measures

The contractor shall provide, erect, and maintain such traffic signs, road markings, barriers and traffic control signals, lights and such other measures as may be necessary for ensuring traffic safety around the rehabilitation site. The contractor shall not commence any work that affects the public motor roads and highways until all traffic safety measures necessitated by the work are fully operational.

14.1.6. Access across the construction site and to frontages

In carrying out the construction works, the contractor shall take all reasonable precautions to prevent or reduce any disturbance or inconvenience to the owners, tenants or occupiers of the adjacent properties, and to the public generally. The contractor shall maintain any existing right of way across the whole or part of the construction site and both public and private access to adjoining frontages in a safe condition and to a standard not less than that pertaining at the commencement of the contract. If required, the contractor shall provide acceptable alternative means of passage or access to the satisfaction of the persons affected.

14.1.7. Noise and dust control

The contractor shall take all practicable measures to minimize nuisance from noise, vibration and dust caused by heavy vehicles and construction machinery. This includes respecting normal working hours (07:00AM-05:00PM) in or close to residential areas, maintaining equipment in a good working order to minimize extraneous noise from mechanical vibration, creaking and squeaking, as well as emissions or fumes from the machinery shutting down equipment when it is not directly in use using

operational noise mufflers. The contractor shall provide a water tanker, and spray water when required to minimize the impact of dust by limiting the speed of vehicles used for construction.

14.1.8. Waste disposal

The contractor must agree with the concerned districts about arrangements for the disposal of construction wastes. In consultation with the districts, sectors and cells authorities, the contractor shall select a dumping site and landfill for the disposal of all project wastes. The contractor will take measures to avoid soil and groundwater contamination by the project waste.

14.1.9. Protection of the existing installations

The contractor shall properly safeguard all buildings, structures, works, services or installations from harm, disturbance, or deterioration during the construction period. The contractor shall take all necessary measures required for the support and protection of all buildings, structures, pipes, cables, drains and other apparatus during the concession period, and to repair any damage occurs in coordination with the district and other stakeholders.

14.1.10. Protection of trees and other vegetation

The contractor shall avoid loss of trees, crops, and damage to other vegetation wherever possible. Adverse effects on green cover within or in the vicinity of the construction site shall be minimized. The contractor will restore vegetative cover, where feasible.

14.1.11. Physical cultural resources

The contractor will train construction crews and supervisors to spot potential archaeological finds. In the event of a potential find, the chance find procedure (see annex 1) will be implemented. The contractor will inform the Supervising Firm and the District who will in turn liaise with the Institute of National Museums of Rwanda (INMR) for quick assessment and action.

Institute of National Museums of Rwanda (INMR) is responsible for recovering these items. Chance find procedures will be used as follows:

- a) Stop the construction activities in and around the chance find.
- b) Delineate the discovered site or area.

- c) Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the equivalent take over.
- d) Notify the supervisory Engineer who in turn will notify the responsible local authorities (the district) and the Ministry of Culture (MYCULTURE) within 24 hours or less.
- e) Responsible local authorities and the General Authority of Antiquities will be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists of the Institute of National Museums of Rwanda (INMR) (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values.
- f) Decisions on how to handle the finding shall be taken by MYCULTURE and INMR. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration, and salvage.
- g) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by INMR.
- h) Construction work could resume only after permission is given from in INMR and MYCULTURE concerning safeguard of the heritage.
- i) Relevant findings will be recorded in AfDB Implementation Supervision Reports, and Implementation Completion Reports will assess the overall effectiveness of the project's cultural property mitigation, management, and activities, as appropriate.

These procedures must be referred to as standard provisions in construction contracts, when applicable, during project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed.

14.1.12. Clearance of the site after project completion

The contractor shall clear up all working areas both within and outside the rehabilitation site and accesses as work proceeds and when no longer required for the carrying out of construction works. All surplus soil and materials, sheds, offices, and temporary fencing shall be removed, post holes filled, and the surface of the ground restored as near as practicable to its original condition.

14.1.13. Worker health and safety

To avoid work related accidents and injuries, the contractor will:

- Provide occupational health and safety training to all employees involved in project works.

- Provide protective masks, helmet, safety belts and safety shoes, safety goggles, as appropriate.
- Ensure availability of first aid kits.
- Provide employees with access to toilets and potable drinking water.
- Train workers regarding the handling of hazardous materials if any.
- Inspect the work sites to reduce the risk of injury to workers, and all works are subject to written approval by the supervising firm to be provided before implementation of work.
- Provide safety training to all workers as well as appropriate safety equipment.
- Provide fully insulated installation tools, instruments and equipment including where applicable safety protection equipment such as belts, pulleys, chains, flywheels, couplings, projecting set screws, shaft keys, and other rotating parts, so located that any person can come in proximity thereto, shall be fully enclosed and properly guarded. And engine local control panels shall be "dead format" and shall have suitable barriers or screens, wherever necessary, to protect personnel from contacting live electrical parts during normal routine use, and removable panels that, when removed will expose live electrical parts, shall have necessary warnings.

14.1.14. Site construction safety and insurance

Further to enforcing the compliance of environmental management, the contractor is responsible of providing insurance for construction workers, staff present at the construction site, and the insurance requirements and clauses are stated in the bidding documents complying to the labor law.

14.2. Environmental and social monitoring by the contractor

Nyaruguru, Huye, and Gisagara districts will require that the contractor monitors, keeps records and reports on the following environmental and social issues for the project. The application of this requirement will be proportionate to the activities and to the size of the contract, in manner acceptable by the AfDB:

- Safety: hours worked, recordable incidents and corresponding root cause analysis (lost time incidents, medical treatment cases), first aid cases, high potential near misses, and remedial and preventive activities required (for example, revised job safety analysis, new or different equipment, skills training, and so forth).
- Environmental incidents and near misses: environmental incidents and high potential near misses and how they have been addressed, what is outstanding, and lessons learned.
- Major works: those undertaken and completed, progress against project schedule, and key work fronts (work areas).
- Environmental and social requirements: noncompliance incidents with permits and national law (legal noncompliance), project commitments, or other E&S requirements.
- Environmental and social inspections and audits: by contractor, engineer, or others, including authorities: to include date, inspector or auditor name, sites visited, and records reviewed, major findings, and actions taken.
- Workers: number of workers, indication of origin (expatriate, local, foreigners), gender, age with evidence that no child labor is involved, and skill level (unskilled, skilled, supervisory, professional, management).
- Training on Environmental and social issues: including dates, number of trainees, and topics.
- Footprint management: details of any work outside boundaries or major off-site impacts caused by ongoing construction—to include date, location, impacts, and actions taken.
- External stakeholder engagement: highlights, including formal and informal meetings, and information disclosure and dissemination—to include a breakdown of women and men consulted and themes coming from various stakeholder groups, including vulnerable groups (e.g., PWDs, elderly, children, etc.).

- Details of any security risks: details of risks the contractor may be exposed to while performing its work—the threats may come from third parties external to the project.
- Worker grievances: details including occurrence date, grievance, and date submitted; actions taken and dates; resolution (if any) and date; and follow-up yet to be taken—grievances listed should include those received since the preceding report and those that were unresolved at the time of that report.
- External stakeholder grievances: grievance and date submitted, action(s) taken and date(s), resolution (if any) and date, and follow-up yet to be taken. Listed grievances should include those received since the preceding report and those that were unresolved at the time of that report. Grievance data should be disaggregated by gender.
- Major changes to contractor’s environmental and social practices.
- Deficiency and performance management: actions taken in response to previous notices of deficiency or observations regarding Environmental and social performance and/or plans for actions to be taken.

14.3. Environmental and social liabilities of the contractor

The contractor will be legally and financially accountable for any environmental or social damage or prejudice caused by their staff, and thus are expected to put in place controls and procedures to manage their environmental and social performance. A breakdown for the cost of noncompliance for each mitigation measure will be enclosed in bidding documents. These will include mitigation measures to be included in the contract and deductions for environmental noncompliance will be added as a clause in the Bill of Quantities (BOQ) section. Environmental penalties shall be calculated and deducted in each submitted invoice.

Any impact that is not properly mitigated will be the object of an environmental and social notice by the client. For minor infringements and social complaints, an incident which causes temporary but reversible damage, the contractor will be given a notice to remedy the problem and restore the environment. No further actions will be taken if the project supervision engineer confirms that restoration is done satisfactorily. For social notices, the project supervision engineer will alert the contractor to remedy the social impact and to follow the issue until solved. If the contractor does not comply with the remediation request, work will be stopped and considered under no excused delay.

If the contractor hasn't fixed the environmental and/or social impact during the allotted time, the project supervision engineer will stop the work and give the contractor a notification indicating a financial penalty according to the non-complied mitigation measure that was specified in the bidding document. No further actions will be required if the project engineer sees that restoration is done satisfactorily.

Otherwise, if the contractor hasn't remedied the situation within one day, any additional day of stopping work will be considered no excused delay. The environmental notifications issued by the project supervision engineer might include one or more environmental penalty. In the event of repeated noncompliance totaling 5% of the contract value, the project supervision engineer will bring the environmental and social notices and the deduction history to procurement to take legal action.

14.4. Grievance mechanism for workers

Members of GRC for workers shall include representative of casual labor, contractor, and supervising firm. If grievance is not resolved within one week, district labor inspector will be invited in order to solve unresolved issues.

The contractor will put in place a GRM for their workers that is proportionate to their workforce, according to the following principles:

- Provision of information: all workers should be informed about the GRM at the time they are hired, and details about how it operates should be easily available, for example, included in worker documentation or on notice boards.
- Transparency of the process: workers must know to whom they can turn in the event of a grievance and the support and sources of advice that are available to them. All line and senior managers must be familiar with their organization's grievance procedure.
- Keeping it up to date: the process should be regularly reviewed and kept up to date, for example, by referencing any new statutory guidelines, changes in contracts or representation.
- Confidentiality: the process should ensure that a complaint is dealt with confidentially.
- While procedures may specify that complaints should first be made to the workers' line manager, there should also be the option of raising a grievance first with an alternative manager, for example, a human resource (personnel) manager.

- Non-retribution: Procedures should guarantee that any worker raising a complaint will not be subject to any reprisal.
- Reasonable timescales: procedures should allow for time to investigate grievances fully but should aim for swift resolutions. The longer a grievance is allowed to continue, the harder it can be for both sides to get back to normal afterwards. Time limits should be set for each stage of the process, for example, a maximum time between a grievance being raised and the setting up of a meeting to investigate it.
- Right of appeal: A worker should have the right to appeal to UNOPS or national courts if he or she is not happy with the initial finding.
- Right to be accompanied: in any meeting or hearing, the worker should have the right to be accompanied by a colleague, friends, or union representative.
- Keeping records: written records should be kept at all stages. The initial complaint should be in writing, if possible, along with the response, notes of any meetings and the findings and the reasons for the findings.
- Relationship with collective agreements: grievance procedures should be consistent with any collective agreements.
- Relationship with regulation: grievance processes should be compliant with the national employment code.

CHAP XV: CONCLUSIONS AND RECOMMENDATIONS

15.1. Conclusions

It was noticed that Nyaruguru district is poor in terms of spring water and most of the springs are drying up and do not allow for a reliable future exploitation to meet the water demand. In terms of surface water, Nyaruguru district is bordered by a large river called Akanyaru. This river has the potential to supply part of Nyaruguru district. In Huye district, three water resources that can be mobilized to reinforce the existing water systems have been identified to supply the areas not covered by the network. These are Myogo, Bishya, and Akanyaru WSS. Regarding Gisagara, the district is poor in terms of spring water and most of the springs are drying up and do not allow for a reliable future exploitation to meet the water demand. But Gisagara district is bordered by a large river called Akanyaru. This river has the potential for future water mobilization for the water supply of Gisagara district.

By 2050, it is estimated that the water deficit, in Nyaruguru, Huye, and Gisagara districts will be 27,399 m³/day (1,142 m³/h), 36,157 m³/day (1,507 m³/h), and 27,856 m³/day (1,161 m³/h), respectively. With the proposed project of treating 72,000 m³ of drinking water per day, it is likely that water demand shall be met in the part of Nyaruguru and Huye, and in the entire Gisagara district.

The positive impacts of developing Nyaruguru-Huye-Gisagara WSS include:

- Job opportunity for local people and gender balance enhancement in terms of employment benefits.
- Knowledge transfer to local people.
- Possibility of business hiring equipment.
- Selling foodstuff and other materials.
- Increase income for the population working for the project.
- Possibility of savings for workers.
- Increase to public revenues/taxes for both central and local authorities from construction materials.
- Drinking water quality that meets national, regional, and international quality indicators.

However, the project will also have negative impacts that should be given serious consideration and attention to preserve the environment and the population. These include involuntary land acquisition, erosion and excavated soil management, management of users of Akanyaru river water, sludge management from the operations of the WTP, potential damages to properties, traffic and work accidents, emission of dust, gas and production excavated soil wastes, storm water generation and erosion, noise, and vibration. The implementation of the project works can also be associated with increased risks of spread of HIV/AIDS and STDs, and other infectious diseases. Mitigation measures for those impacts were proposed in the environmental and social management plan (ESMP) to prevent, avoid, minimize, and compensate all significant project negative effects on the physical, ecological and socio- economic environments.

This ESIA report has demonstrated that the implementation of this project can contribute to improved livelihood, hygienic and sanitation conditions of refugees and host-communities while implementing corrective measures/actions to existing project/activities and through mitigating negative impacts of the newly proposed project and activities.

15.2. Recommendations

Most environmental and social impacts of the project will result from activities directly under the control of contractors and will be mitigated directly by the same contractors. Consequently, ensuring that contractors effectively mitigate project activities related impacts is the core of the project's mitigation strategy. This will be done by ensuring that the ESMP activities are mandatory parts of activities works contracts. The client will incorporate standardized environmental and social clauses in tender documentation and contract documents, so that potential bidders are aware of environmental and social performance requirements expected from them, are able to reflect that in their bids, and required to implement the clauses for the duration of the contract. The client will enforce compliance of contractors with clauses covering four issues:

- Environment, Health, and Safety (EHS).
- Environmental and social audit action plan and environmental and social management by contractor.
- Environmental and social liabilities.

- **Grievance** mechanism for workers.

The contractor will strictly implement EHS measures including:

- Prevent or minimize environmental and social impacts associated with surface water withdrawal in respect of regional agreements on management of transboundary waters.
- Prevent or minimize environmental health issues associated with operation of water distribution systems to maintain adequate pressure to protect water quality in the system.
- Conduct regular inspection and maintenance of WSS and protect surface water intake.
- Meet national performance indicators of drinking water quality.
- All lands or properties to be affected by the project activities should be properly compensated via willing buyer and willing seller approach prior to construction works.
- The contractor should observe all construction practice standards by using environmentally friendly equipment to minimize negative impacts.
- Unnecessary disturbance to the surrounding habitats should be strictly avoided and the footprint of the impact should be kept at the minimum.
- Excavated and waste materials should be disposed in appropriate dumpsite or to be reused in landscaping for restoration of camps, quarry and borrow areas.
- No construction works shall be carried out during the night hours to avoid noise and vibration pollutions to the community living in the vicinity of the project site. Measures should be taken ensure that noise level emanating from machinery, vehicles and noisy construction activities are kept at minimum for safety, health and protection of workers and residents in the vicinity of the project.
- Make sure all workers and personnel have PPEs and health insurance.
- Sensitize staff on prevention of HIV/AIDS, STDs, and other infectious and as well as GBV and SH.
- Implement all environmental, health and safety measures detailed in the ESMP.

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LIST OF ANNEXES

ANNEX 1: CHANCE FINDS PROCEDURE

Institute of National Museums of Rwanda (INMR) is responsible for recovering these items. Chance find procedures will be used as follows:

- j) Stop the construction activities in and around the chance find.
- k) Delineate the discovered site or area.
- l) Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the equivalent take over.
- m) Notify the supervisory Engineer who in turn will notify the responsible local authorities (the district) and the Ministry of Culture (MYCULTURE) within 24 hours or less.
- n) Responsible local authorities and the General Authority of Antiquities will be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists of the Institute of National Museums of Rwanda (INMR) (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values.
- o) Decisions on how to handle the finding shall be taken by MYCULTURE and INMR. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration, and salvage.
- p) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by INMR.
- q) Construction work could resume only after permission is given from in INMR and MYCULTURE concerning safeguard of the heritage.
- r) Relevant findings will be recorded in AfDB Implementation Supervision Reports, and Implementation Completion Reports will assess the overall effectiveness of the project's cultural property mitigation, management, and activities, as appropriate.

These procedures must be referred to as standard provisions in construction contracts, when applicable, during project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed.

ANNEX 2: ESIA team

No	NAMES	POSITION	EMAIL	PHONE
1)	Emile HABIMANA	Lead Expert RAPEP/EA/210	habimana.emile@gmail.com	+250788692296
2)	Eric MURERA	Lead Expert RAPEP/EA/034	ericmurera@gmail.com	+250787110267

ANNEX 3: List of PAPs

#	Names	District	Sector	Cell	Village	Quality	Sex	Phone/ID
1	Kamaraba Bernadette	Gisagara	Muganza	Remera	Taba	Owner	Female	07 1194770005518056
2	Bizumuremyi Amos	Gisagara	Muganza	Muganza	Muganza	Pouse	Male	078256391 / 1198380051493029
3	Habanabakize Theoneste	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0783739050 / 1199480236006085
4	Mbarushimana Simion	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0788455913 / 11958000048020
5	Kamere Claver	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0789281549 / 1195680056111031
6	Cooperative Kohamumu	Gisagara	Muganza	Muganza	Urusaro	Cooperative		,0788455913
7	Mwumvaneza Claver	Gisagara	Muganza	Remera	Taba	Owner	Male	0783653497 / 1198080047768031
8	Niyonsaba Anemarie	Gisagara	Muganza	Remera	Akajyanama	Owner	Female	
9	Mukarushema Speciose	Gisagara	Muganza	Remera	Taba	Owner	Female	0783653497/0786565073 / 1195270012548062
10	Cahinyeretse Emmanuel	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0782806542 / 1198080047787020
11	Karimunda Laurent	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0788215589 / 1197580107022127
12	Nshimyrayo Innocent	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0722610857 / 1198480054630169
13	Havugimana Daniel	Gisagara	Muganza	Remera	Taba	Owner	Male	0791214949 / 1198380062725035
14	Ntabomenyereye Jean Marie Vianney	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0787250362 / 1199180034859049
15	Surwumwe Celestin	Gisagara	Muganza	Remera	Taba	Owner	Male	0786697827 / 1197780032078024
16	Ntegama herazo Emmanuel	Gisagara	Muganza	Remera	Taba	Owner	Male	0780462152 / 1198280057551037
17	Singirankabo Vicent	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0780562545 / 1199780052247059
18	Ntazinda Kaliste	Gisagara	Muganza	Remera	Taba	Owner	Male	0788929348 / 119768002970048027
19	Ntaki rutimana Celestin	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	,1196480072961011
20	Mujawamariya Anosiatha	Gisagara	Muganza	Remera	Akajyanama	Owner	Female	0791210996 / 1196870023336069
21	Waseme Zakayo	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	0786617639 / 1199580071297067
22	Nyiramatabaro Aporonia	Gisagara	Muganza	Muganza	Amajori	Owner	Female	0784899448 / 1198170048100064
23	Nsanzumuhire Marcel	Gisagara	Ndora	Gisagara	Gisagara	Owner	Female	078581574 / 1197470029353034

24	Nyirandegeye Domitilla	Gisagara	Ndora	Gisagara	Gisagara	Owner	Female	
25	Ntagwabira Vianney	Gisagara	Kibirizi	Muyira	Nyagisozi	Owner	Male	0789512530 / 1196780068788052
26	Sakwe Flexi	Gisagara	Kibirizi	Muyira	Nyagisozi	Owner	Female	,1198470053337041
27	Ndayambaje Emmanuel	Gisagara	Kibirizi	Muyira	Nyagisozi	Owner	Male	0783106981 / 1198780044908076
28	Sakwe Flexi	Gisagara	Kibirizi	Muyira	Nyagisozi	Owner	Male	0783192372 / 119780037824093
29	Nyirsendabanga Marie Claire	Gisagara	Kibirizi	Muyira	Nyagisozi	Owner	Male	0725996180 / 11981800047059028
30	Nsaguye John	Gisagara	Kibirizi	Muyira	Nyagisozi	Owner	Male	0791281571 / 1194780005317085
31	Bizinde Pascal	Gisagara	Ndora	Gisagara	Rutonde	Owner	Male	0788674071 / 1197980041887028
32	Nyirabashyitsi Pascasia	Gisagara	Ndora	Gisagara	Nyimidando	Pouse	Female	0787333028 / 1196070018371085
33	Nyirabahizi Pitenia	Gisagara	Kibirizi	Muyira	Nyagisozi	Spouse	Female	
34	Hategekimana Isac	Gisagara	Ndora	Dawe	Gitwe	Owner	Male	0786442959 / 1196180014717064
35	Nyirangendahimana Colotilida	Gisagara	Ndora	Dawe	Gitwe	Owner	Female	0784104904 / 1197570009525023
36	Kabaganwa Viviane	Gisagara	Ndora	Dawe	Gitwe	Owner	Female	0787706683 / 1195970018300041
37	Mukeratabaro Jean Pierre	Gisagara	Ndora	Dawe	Gitwe	Owner	Male	0780615947 / 1198380053143002
38	Bigirimana Felecien	Gisagara	Ndora	Gisagara	Kabuga	Owner	Male	0785686443 / 11948800028020022
39	Niyonkuru Seka	Gisagara	Kibirizi	Muyira	Nyagisozi	Owner	Male	0785277581 / 1197580013134031
40	Bahinga Augustin	Gisagara	Ndora	Dawe	Gitwe	Owner	Male	
41	Karenzi James	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	0786441274 / 119680023551002
42	Kayitare Sylvestre	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	0783315365 / 1199280103872126
43	Kayitare Augustin	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	0784175215 / 1195080012021036
44	Rutihunza Celestin	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	,0783066742
45	Ahishakiye Marthe	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	0782374246 / 119407007913092
46	Kanamugire Philemon	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	0782374246/0725051129 /1196080022141088
47	Kanamugire Philemon	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	0782374246/0725051129 /1196080022141088
48	Karimuvumba Theogene	Nyaruguru	Rusenge	Chyuna	Kiramutsa	Owner	Male	
49	Mukagahima Grastia	Nyaruguru	Rusenge	Chyuna	Kiramutsa	Owner	Famale	,1197070030932012

50	Dusabemungu Marcel	Nyaruguru	Rusenge	Chyuna	Kiramutsa	Owner	Male	
51	Kalisa Clement	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Male	,1196580023091010
52	Sitefaniya	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Famale	,1197270063382127
53	Mugemanyi Patrice	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Male	,119658005483118
54	Habi mana Venuste	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Male	
55	Bapfakurera Velonique	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Famale	
56	Mukamudogo	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Famale	
57	Kayitana	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Male	
58	Nyami nani Tanance	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Famale	
59	Ndagije Joseph	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Male	
60	Mukakinani Ignes	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Famale	
61	Nyami nane Ignence	Nyaruguru	Rusenge	Chyuna	Miko	Owner	Famale	
62	Murangira	Nyaruguru	Kibeho	Mubuga	Umurambi	Owner	Male	0726314848 /
63	Ngendahimana Joseph	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Male	074768166 / 1197380032983098
64	Rwandanga Vincent	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Male	0785316146 / 1195780017244066
65	Mukamudenge Vestine	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Famale	0786289908 / 1195770017239019
66	Ngirinshuti Jean Pierre	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Male	0723000202 / 1199080053945099
67	Sebukura Venuste	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Male	0785316146 / 1196580050756013
68	Mukashema Immacule	Nyaruguru	Ngoma	Kiyonza	Mwumba	Owner	Famale	,1196570022425194
69	Bucyana Marc	Nyaruguru	Ngoma	Kiyonza	Mwumba	Owner	Male	0781067332 / 1196680064552033
70	Ujeneza Beatrice	Nyaruguru	Ngoma	Kiyonza	Mwumba	Owner	Famale	0785316146 / 115770017233061
71	Nduwamungu Alex	Nyaruguru	Ngoma	Kiyonza	Mwumba	Owner	Male	0789017398 / 1195680017159005
72	Mbangukira Celestin	Nyaruguru	Ngoma	Kiyonza	Mwumba	Owner	Male	0727167364 / 1199380133649275
73	Kayitare Deo	Nyaruguru	Ngoma	Kiyonza	Mwumba	Owner	Male	,119518009359097
74	Bunyenzi Zayosi	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Male	0786676230 / 1194780006869037
75	Murara Justin	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Male	0786528975 / 1195180009288085
76	Niwemugeni Angelique	Nyaruguru	Kibeho	Gakoma	Viro	Owner	Famale	,0782163206
77	Mukagasenga Donatil	Nyaruguru	Kibeho	Gakoma	Viro	Spouse	Famale	,0789920963

78	Yamuremye Romani	Nyaruguru	Rusenge	Mamba	Kabuye	Spouse	Male	
79	Ntegamaherazo Emmanuel	Nyaruguru	Rusenge	Mamba	Kabuye	Spouse	Female	
80	Nyamdwi Thomas	Nyaruguru	Rusenge	Mamba	Kabuye	Spouse	Male	,0781274807
81	Sentwari	Nyaruguru	Rusenge	Mamba	Kabuye	Owner	Male	
82	Nyirakanani	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Female	,1195470014521047
83	Ndangiwenayo Frderick	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Male	0787481143 / 1197680105002166
84	Ntawukuriryayo Alexis	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Male	,1196580022492057
85	Butoyi Etienne	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Male	,1195080012511090
86	Nzamwita Tomas	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Male	,1197180025483042
87	Nzamwita Tomas	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Male	,1197180025483042
88	Mukashyaka Violent	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Female	,1196270025853039
89	Nkundwa Alvera	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Female	
90	Renza ho Danathe	Nyaruguru	Ngoma	Rubona	Nyamirama	Owner	Male	0781269820 / 1195080012593071
91	Nzabandora Felien	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,1198680057831008
92	Iyakaremye Theoneste	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1198180055470062
93	Kaberuka Innoncent	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1199280017700020
94	Mukamurenzi Claudine	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1198880056813006
95	Sebarinda Vincent	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1196780022475032
96	Muhi manakazi Bonifride	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Female	,1197170073599022
97	Ndayisenga Joseph	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,1196480023421049
98	Mukanzigiye Johanita	Nyaruguru	Cyahinda	Rebero	Rebero	Owner	Male	,119830060047082
99	Rekeraho Athanas	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1194880008823035
100	Mvuyekure Innoncent	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1196480023406008
101	Nkurunziza Faustin	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1195780016714057
102	Ndi ndabahizi Damascene	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1196280024706075
103	Ruretabaro Marc	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1196880027892048
104	Muhi manakazi Bonifride	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Female	,119717003599022
105	Uwi mana Triphine	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Female	,1197180024487000

106	Sebanane Celestin	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,11991800432208065
107	Bizi mana Vianney	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1198380060059044
108	Niyonizeye Angelique	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Female	,1198770055078078
109	Karuta Emmanuel	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1195780051809007
110	Rubibi Martin	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,1197380032145095
111	Nzeyimana Bertin	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,1199580135030040
112	Ntitanguranwa Vincent	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,1198180055485171
113	Bucumu Jean Bosco	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,1198880056731019
114	Tegejo Augustin	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1199380043255058
115	Ndabananiye Callixte	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	,1198180055563024
116	Nyiraremera Cansilde	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Female	,1197770036832028
117	Niyonsaba Marie Grace	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Female	,1197470033507077
118	Museruka	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1198680057833082
119	Umazekabiri Callixte	Nyaruguru	Cyahinda	Busanza	Amajori	Owner	Male	,1198080042467024
120	Twagiramungu Desire	Huye	Mbazi	Remera	Rweramenyo	Owner	Male	,119518005691060
121	Mukabaseruka Florence	Huye	Mbazi	Bugangu	Kigarama	Owner	Female	,1194770005666011
122	Hanyurwabake Cassie	Huye	Mbazi	Bugangu	Kigarama	Owner	Male	,1195080007849079
123	Havugarurema Mercule	Huye	Mbazi	Bugangu	Kigarama	Owner	Male	,1195380008530016
124	Cyiza Francois	Huye	Mbazi	Bugangu	Mwuriire	Owner	Male	,1198480194055016
125	Mukeshimana Seraphine	Huye	Mbazi	Bugangu	Kigarama	Owner	Male	,1197380024386014
126	Twagiramungu Desire	Huye	Mbazi	Bugangu	Kigarama	Owner	Male	,119518005691060
127	Nyirahirwa Jeannette	Huye	Mbazi	Bugangu	Mwuriire	Owner	Female	,1198480194055016
128	Ntabudakeba Madeline	Huye	Ngoma	Remera	Gatoki	Owner	Male	,1193570003096075
129	Ntampaka Marc	Huye	Mbazi	Remera	Kinyana	Leasehold	Male	,1198180042115041
130	Mundanikure Alvera	Huye	Mbazi	Bugangu	Gitwa	Owner	Female	
131	Mboneyuhagaze Jean De Dieu	Huye	Ngoma	Remera	Gatoki	Owner	Male	
132	Ndizihiwe Gaston	Huye	Huye	Sovo	Karambo	Owner	Female	
133	Ndayisenga Joseph	Huye	Huye	Sovo	Karambo	Owner	Male	,1194880005670066

134	Nahimana Busige Theophile	Huye	Huye	Sovo	Karambo	Owner	Male	,1196780016726015
135	Mukabutera Adelice	Huye	Huye	Sovo	Karambo	Owner	Female	,1197570024453074
136	Bitabakana Louis	Huye	Mbazi	Matunda	Akagera	Owner	Male	,1196180012145040
137	Mukarukundo Clarisse	Huye	Huye	Muyogoro	Akaruzi	Owner	Female	,1198770189269080
138	Ukobukeye Francois	Huye	Huye	Muyogoro	Akaruzi	Owner	Male	,1198280047922025
139	Mukamuganga Saidath	Huye	Huye	Muyogoro	Akaruzi	Owner	Female	,1195970014299067
140	Ayinkamiye Marie Josee	Huye	Huye	Muyogoro	Akaruzi	Owner	Female	,1195970014300081
141	Sibomana Regis	Huye	Huye	Muyogoro	Akaruzi	Leasehold	Female	,1196070014241072
142	Niyomugabo Kaitan	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1197380023291088
143	Ntakerutimana Emmanuel	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1198780038548127
144	Mugiraneza Jean Baptist	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1198580044354044
145	Uwizeyimana Olive	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1199780210555046
146	Kanamugire Daniel	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1194980005336064
147	Nyiraminane Eugene	Huye	Mbazi	Bugangu	Kigarama	Owner	Female	,1199670224637095
148	Havugimana Jean	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1195880012475040
149	Ngamije Appolinaire	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1198580044415068
150	Mukantwari Velarie	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Female	,1197480024014052
151	Ngamije Appolinaire	Huye	Huye	Nyakagezi	Nyarunazi	Owner	Male	,1198580044415068
152	Kayigema Domistocratie	Huye	Huye	Nyakagezi	Nyarunazi	Leasehold	Male	,119680020791042
153	Basabose Mathias	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	
154	Hicahinyeretse Emanuel	Gisagara	Muganza	Remera	Akajyanama	Owner	Male	
155	Musoni Isac	Gisagara	Muganza	Muganza	Amajori	Owner	Male	1194380003728056
156	Ntirenganya Jevenal	Gisagara	Muganza	Muganza	Amajori	Owner	Male	
157	Nyandwi Louise	Gisagara	Muganza	Muganza	Amajori	Owner	Female	
158	Barihiga Augustin	Gisagara	Muganza	Muganza	Amajori	Owner	Male	
159	Yiriwahandi Innocent	Gisagara	Ndora	Gisagara	Kabuga	Owner	Male	1198280059631030
160	Rutikanga John	Gisagara	Ndora	Gisagara	Kabuga	Owner	Male	,0784316905
161	Macumi Alphonse	Gisagara	Ndora	Gisagara	Kabuga	Owner	Male	,0790064664

162	Twagirayezu Joseph	Gisagara	Ndora	Gisagara	Kabuga	Owner	Male	,0739710148
163	Ruzindanwa Benoit	Gisagara	Ndora	Gisagara	Kabuga	Owner	Male	,0789775282
164	Nyiramanto Marie Terese	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Famale	,0782996850
165	Yankurije Vestine	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Famale	
166	Rusine	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Male	
167	Thaciana	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Famale	,0726012174
168	Kubwimana	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Famale	,0787148426
169	Doresera	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Famale	
170	Secumi	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Male	
171	Bititayeho Joseph	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Male	,0785166929
172	Gasonga Anacreth	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Male	,07823439011
173	Mugema na Jean	Gisagara	Ndora	Gisagara	Nyimidando	Owner	Male	
174	Nyirabakunzi Pheneace	Gisagara	Kibirizi	Ruturo	Agatongate	Owner	Famale	,0739800478
175	Shema Albert	Gisagara	Kibirizi	Ruturo	Agatongate	Owner	Male	,0786114909
176	Hategekimana Emanuel	Gisagara	Kibirizi	Muyira	Impinga	Owner	Male	
177	Ahigejeje Claudine	Gisagara	Kibirizi	Muyira	Impinga	Owner	Famale	,0791706370
178	Nyirahabiyambere Cecile	Gisagara	Kibirizi	Muyira	Impinga	Owner	Famale	,0790013127
179	Safari	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Male	,0735313872
180	Nyiramisago Jaennine	Nyaruguru	Ngera	Murama	Nyarugano	Owner	Famale	,0791077258
181	Habukwiye Athanas	Nyaruguru	Kibeho	Mubuga	Mubuga	Owner	Male	,0783415065
182	Mihigo Bosco	Nyaruguru	Ngoma	Kiyonza	Mwumba	Owner	Male	,0791536418
183	Ukobizaza Crisostone	Nyaruguru	Kibeho	Mubuga	Mubuga	Owner	Male	,0786212910
184	Nyirakamana Agnes	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Famale	,0723328963
185	Mukayirangwa Francine	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Famale	,0784576889
186	Mukamurerwa Eugenne	Nyaruguru	Kibeho	Mubuga	Mubuga	Owner	Famale	
187	Rupari Marc	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Male	,0726239336
188	Niyonzi ma Venust	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Male	,0791706370
189	Gashugi Tharise	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Male	788795509

190	Butera John	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Male	,0782906357
191	Bikorimana Marc	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Male	,0785501036
192	Kakurwayesu Thomas	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Male	,0789605075
193	Uwimana Aiphonsine	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Famale	,0780723346
194	Mukamurenzi Celine	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Famale	,07831933471
195	Ndayibasa Deo	Nyaruguru	Kibeho	Mubuga	Uwintobo	Owner	Male	788795509
196	Ntarinda Atoine	Nyaruguru	Busenge	Chyuna	Chyuna	Owner	Male	,0780723346
197	Baganineza Emanuel	Nyaruguru	Cyahinda	Rutobwe	Kanyinya	Owner	Male	,0789289969
198	Bakinahé Patrice	Nyaruguru	Cyahinda	Muhambara	Rebero	Owner	Male	
199	Bimhenyimana Damascen	Nyaruguru	Rusenge	Chyuna	Kiramutsa	Owner	Male	
200	Biziyaremye Reveriane	Nyaruguru	Cyahinda	Muhambara	Busanza	Owner	Famale	,0783949439
201	Bampire Cecile	Huye	Huye	Muyogoro	Akaruza	Owner	Famale	
202	Byukusenge Claudine	Nyaruguru	Rusenge	Chyuna	Chyuna	Owner	Famale	,0789116133
203	Uwiragiye Costante	Nyaruguru	Cyahinda	Muhambara	Rutombwe	Owner	Male	,0783131819
204	Gasingirwa Damascen	Nyaruguru	Rusenge	Chyuna	Chyuna	Owner	Male	,0788576171
205	Habimana Desire	Nyaruguru	Cyahinda	Rutobwe	Kanyinya	Owner	Male	
206	Nyirimanzi Etienne	Nyaruguru	Cyahinda	Rutobwe	Kanyinya	Owner	Male	,0790228213
207	Nyirabahire Eugénie	Nyaruguru	Rusenge	Chyuna	Kiramutsa	Owner	Famale	
208	Nzugize Faustin	Nyaruguru	Cyahinda	Rutobwe	Munyinya	Owner	Male	,0789210494
209	Gakwaya Narsise	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	,0789637717
210	Mutiganda Gerard	Nyaruguru	Rusenge	Mariba	Kabuye	Owner	Male	,0790061269
211	Harerimana Gaspard	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	,0786590355
212	Mukangwije Judith	Nyaruguru	Rusenge	Cyuna	Cyuna	Owner	Famale	,0786951201
213	Kajabe Portais	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	,0785208833
214	Kalisa Christian	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	,0722366141
215	Ndagijimana Leonard	Huye	Mbazi	Mutunda	Akagera	Owner	Male	
216	Mugabekazi Leoncie	Huye	Huye	Muyogoro	Akaruza	Owner	Famale	,0784960473
217	Bukeratabaro Marc	Nyaruguru	Cyahinda	Muhambara	Busanza	Owner	Male	,0782166094

218	Munyankindi	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	,0783177247
219	Nahimana Deo	Huye	Mbazi	Mwurire	Gitwe	Owner	Male	
220	Musigirwa Laurent	Nyaruguru	Kibeho	Kibeho	Sinayi	Owner	Male	
221	Dusabemungu Narcise	Nyaruguru	Rusenge	Cyuna	Kiramutsa	Owner	Male	
222	Mutangana Samuel	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	
223	Ndayisaba Joseph	Nyaruguru	Cyahinda	Muhambara	Busanza	Owner	Male	
224	Nsazebwimo Vianney	Nyaruguru	Cyahinda	Muhambara	Busanza	Owner	Male	
225	Nahayo Athanas	Nyaruguru	Rusenge	Cyuna	Kiramutsa	Owner	Male	
226	Nteziryayo Philip	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	
227	Nkurunziza Innocent	Nyaruguru	Cyahinda	Muhambara	Byanone	Owner	Male	
228	Nyandwi Stephaney	Huye	Mbazi	Bugangu	Kigarama	Owner	Male	
229	Zirimabaga Leodomil	Nyaruguru	Rusenge	Ranzige	Akabacura	Owner	Male	
230	Cyiza Speciose	Gisagara	Muganza	Remera	Taba	Owner	Female	
231	Muhorakeye Minique	Gisagara	Muganza	Muganza	Urusaro	Owner	Female	
232	Ntabugibudakeba Maderine	Huye	Ngoma	Remera	Gatoki	Owner	Female	
233	Mbonuhageze Jean De Dieux	Huye	Ngoma	Remera	Gatoki	Owner	Male	
234	Nyiraminani Bernadeth	Huye	Huye	Muyogoro	Akaruza	Owner	Female	
235	Mukamuganga Francine	Huye	Huye	Muyogoro	Shuni	Owner	Female	
236	Kabarisa Innonent	Huye	Huye	Muyogoro	Shuni	Owner	Male	
237	Ecole Scondaire Mutunda	Huye	Mbazi	Matunda	Kinyana	Owner		

ANNEX. 4: List of species of flora characterizing Arboretum of Ruhunde

<i>Abutilon mauritanium</i> (Malvaceae)	<i>Anisopappus africanus</i> (Asteraceae)	<i>Bidens pilosa</i> (Asteraceae)
<i>Acacia abyssinica</i> (Fabaceae)	<i>Annona muricata</i> (Annonaceae)	<i>Biophytum helenae</i> (Oxalidaceae)
<i>Acacia longifolia</i> (Fabaceae)	<i>Annona myristica</i> (Annonaceae)	<i>Bischofia javanica</i> (Phyllanthaceae)
<i>Acacia mangium</i> (Fabaceae)	<i>Antherotoma</i>	<i>Bothriocline glomerata</i> (Asteraceae)
<i>Acacia mearnsii</i>	<i>naudinii</i> (Melastomataceae)	<i>Bothriocline longipes</i> (Asteraceae)
<i>Acacia melanoxydon</i> (Fabaceae)	<i>Anthocleista</i>	<i>Bothriocline ugandensis</i> (Asteraceae)
<i>Acalypha racemosa</i> (Euphorbiaceae)	<i>schweinfuthii</i> (Gentianaceae)	<i>Brachiaria dictyoneura</i> (Poaceae)
<i>Acalypha spec.</i> (Euphorbiaceae)	<i>Anthoxantum nivale</i> (Poaceae)	<i>Brachiaria humidicola</i> (Poaceae)
<i>Acalypha volkensii</i> (Euphorbiaceae)	<i>Apiaceae spec</i> (Apiaceae)	<i>Brachiaria jubata</i> (Poaceae)
<i>Acanthus polystachyus</i> (Acanthaceae)	<i>Araucaria angustifolia</i> (Araucariaceae)	<i>Brachiaria leersioides</i> (Poaceae)
<i>Achyranthes aspera</i> (Amaranthaceae)	<i>Araucaria bidwillii</i> (Araucariaceae)	<i>Bridelia micrantha</i> (Phyllanthaceae)
<i>Acrocarpus fraxinifolius</i> (Fabaceae)	<i>Araucaria</i>	<i>Calliandra calothyrsus</i> (Fabaceae)
<i>Adenia bequaertii</i> (Passifloraceae)	<i>cunninghamii</i> (Araucariaceae)	<i>Callitris calcarata</i> (Cupressaceae)
<i>Adenostemma cafferum</i> (Asteraceae)	<i>Araucaria durandi</i> (Araucariaceae)	<i>Callitris glauca</i> (Cupressaceae)
<i>Aframomum mala</i> (Zingiberaceae)	<i>Aristida adoensis</i> (Poaceae)	<i>Callitris preissii</i> (Cupressaceae)
<i>Agave sisalana</i> (Agavaceae)	<i>Arthropteris orientalis</i> (Tectariaceae)	<i>Callitris robusta</i> (Cupressaceae)
<i>Ageratum conyzoides</i> (Asteraceae)	<i>Asparagus africanus</i> (Asparagaceae)	<i>Callitris spec</i> (Cupressaceae)
<i>Alangium chinense</i> (Cornaceae)	<i>Asplenium aethiopicum</i> (Aspleniaceae)	<i>Camellia sinensis</i> (Theaceae)
<i>Albizia grandibracteata</i> (Fabaceae)	<i>Asplenium elliotii</i> (Aspleniaceae)	<i>Canna indica</i> (Cannaceae)
<i>Albizia gummifera</i> (Fabaceae)	<i>Asplenium friesiorum</i> (Aspleniaceae)	<i>Capparis fascicularis</i> var
<i>Albizia lebbek</i> (Fabaceae)	<i>Asplenium mannii</i> (Aspleniaceae)	<i>elaegnoides</i> (Capparaceae)
<i>Alchemilla kivuensis</i> (Rosaceae)	<i>Asplenium mildbraedii</i> (Aspleniaceae)	<i>Capsicum annum</i> (Solanaceae)
<i>Alectra sessiliflora</i> (Orobanchaceae)	<i>Asplenium stuhlmannii</i> (Aspleniaceae)	<i>Carapa wohllebenii</i> (Meliaceae)
<i>Alnus acuminata</i> (Betulaceae)	<i>Asteraceae spec</i> (Asteraceae)	<i>Cardamine africana</i> (Brassicaceae)
<i>Aloe macrosiphon</i> (Asphodelaceae)	<i>Bambusa grandiflora</i> (Poaceae)	<i>Cardamine trichocarpa</i> (Brassicaceae)
<i>Alternanthera</i>	<i>Bambusa spec.</i> (Poaceae)	<i>Casuarina</i>
<i>pungens</i> (Amaranthaceae)	<i>Bambusa vulgaris</i> (Poaceae)	<i>cunninghamiana</i> (Casuarinaceae)
<i>Amphicarpaea africana</i> (Fabaceae)	<i>Barleria ventricosa</i> (Acanthaceae)	<i>Casuarina distyla</i> (Casuarinaceae)
<i>Aneilema</i>	<i>Basella alba</i> (Basellaceae)	<i>Casuarina equisetifolia</i> (Casuarinaceae)
<i>aequinociale</i> (Commelinaceae)	<i>Berkheya spekeana</i> (Asteraceae)	<i>Casuarina montana</i> (Casuarinaceae)
<i>Aneilema johnstonii</i> (Commelinaceae)	<i>Bersama abyssinica</i> (Francoaceae)	<i>Casuarina suberosa</i> (Casuarinaceae)
<i>Aneilema spekei</i> (Commelinaceae)	<i>Bidens grantii</i> (Asteraceae)	<i>Casuarina torulosa</i> (Casuarinaceae)

Cedrela serrata (Meliaceae)
Cedrela toona (Meliaceae)
Celosia
anthelminthica (Amaranthaceae)
Ceropegia denticulata (Apocynaceae)
Cestrum elegans (Solanaceae)
Chamaecrista mimosoides (Fabaceae)
Chlorophytum
comosum (Anthericaceae)
Chrysophyllum
gorungosanum (Sapotaceae)
Cissus comifolia (Vitaceae)
Cissus integrifolia (Vitaceae)
Cissus kilimandscharica (Vitaceae)
Cissus lamifolia (Vitaceae)
Cissus rotundifolia (Vitaceae)
Citrus limon (Rutaceae)
Clematis simensis (Ranunculaceae)
Clerodendrum buchholzii (Lamiaceae)
Clerodendrum johnstonii (Lamiaceae)
Coelachne auquieri (Poaceae)
Coffea eugenioides (Rubiaceae)
Colocasia esculenta (Araceae)
Combretum baoma (Combretaceae)
Combretum molle (Combretaceae)
Combretum orophilum (Combretaceae)
Commelina africana (Commelinaceae)
Commelina diffusa (Commelinaceae)
Commelina spec (Commelinaceae)
Commicarpus
grandiflorus (Nyctaginaceae)
Conyza gouanii (Asteraceae)
Conyza hochstetteri (Asteraceae)
Conyza newii (Asteraceae)

Conyza pallidiflora (Asteraceae)
Cordia africana (Cordiaceae)
Cordia alliodora (Cordiaceae)
Corymbia calophylla (Myrtaceae)
Corymbia citriodora (Myrtaceae)
Corymbia eximia (Myrtaceae)
Corymbia ficifolia (Myrtaceae)
Corymbia gummifera (Myrtaceae)
Corymbia maculata (Myrtaceae)
Corymbia torelliana (Myrtaceae)
Crassocephalum
montuosum (Asteraceae)
Crassocephalum paludum (Asteraceae)
Crassocephalum rubens (Asteraceae)
Crassocephalum
sarcobasis (Asteraceae)
Crassocephalum
vitellinum (Asteraceae)
Crepis rueppellii (Asteraceae)
Crossandra massaica (Acanthaceae)
Crotalaria cylindrica (Fabaceae)
Crotalaria fischeri (Fabaceae)
Crotalaria incana (Fabaceae)
Crotalaria laburnifolia (Fabaceae)
Crotalaria orientalis (Fabaceae)
Crotalaria polysperma (Fabaceae)
Crotalaria scassellatii (Fabaceae)
Croton macrostachys (Euphorbiaceae)
Croton megalocarpus (Euphorbiaceae)
Cupressus arizonica (Cupressaceae)
Cupressus funebris (Cupressaceae)
Cupressus lindreyi (Cupressaceae)
Cupressus lusitanica var.
benthamii (Cupressaceae)

Cupressus robusta (Cupressaceae)
Cupressus sempervirens
fastigiata (Cupressaceae)
Cupressus torulosa (Cupressaceae)
Cuscuta kilimanjari (Convolvulaceae)
Cyanotis barbata (Commelinaceae)
Cyathula uncinulata (Amaranthaceae)
Cynoglossum
amplifolium (Boraginaceae)
Cynoglossum
lanceolatum (Boraginaceae)
Cyperus spec (Cyperaceae)
Cyperus spekii (Cyperaceae)
Cyphomandra betacea (Solanaceae)
Cyphostemma bambuseti (Vitaceae)
Cyphostemma jurceum (Vitaceae)
Cyphostemma
kilimandscharicum (Vitaceae)
Cyphostemma maranguense (Vitaceae)
Cyphostemma ukerewense (Vitaceae)
Deinbollia borbonica (Sapindaceae)
Desmodium adscendens (Fabaceae)
Desmodium repandum (Fabaceae)
Dichondra repens (Convolvulaceae)
Dichrocephala
chrysanthemifolia (Asteraceae)
Dichrocephala integrifolia (Asteraceae)
Didymodoxa caffra (Urticaceae)
Didymodoxa spec (Urticaceae)
Digitaria abyssinica (Poaceae)
Digitaria brazzae (Poaceae)
Dioscorea bulbifera (Dioscoreaceae)
Dioscorea dumetorum (Dioscoreaceae)
Dioscorea quartiniana (Dioscoreaceae)

Dioscorea schimperiana (Dioscoreaceae)	Eucalyptus camaldulensis (Myrtaceae)	Eucalyptus radiata (Myrtaceae)
Diplachne caudata (Poaceae)	Eucalyptus cinerea (Myrtaceae)	Eucalyptus redunca (Myrtaceae)
Disperis anthoceros (Orchidaceae)	Eucalyptus cladocalyx (Myrtaceae)	Eucalyptus regnans (Myrtaceae)
Disperis kilimanjarica (Orchidaceae)	Eucalyptus cloeziana (Myrtaceae)	Eucalyptus resinifera (Myrtaceae)
Disperis reichenbachiana (Orchidaceae)	Eucalyptus crebra (Myrtaceae)	Eucalyptus robusta (Myrtaceae)
Dissotis brazzae (Melastomataceae)	Eucalyptus delegatensis (Myrtaceae)	Eucalyptus rubida (Myrtaceae)
Dissotis ruandensis (Melastomataceae)	Eucalyptus diversicolor (Myrtaceae)	Eucalyptus rudis (Myrtaceae)
Dodonaea viscosa (Anacardiaceae)	Eucalyptus dives (Myrtaceae)	Eucalyptus saligna (Myrtaceae)
Dombeya bagshawei (Malvaceae)	Eucalyptus dunnii (Myrtaceae)	Eucalyptus sideropholia (Myrtaceae)
Dombeya burgessiae (Malvaceae)	Eucalyptus eugenioides (Myrtaceae)	Eucalyptus sideroxylon (Myrtaceae)
Dombeya torrida (Malvaceae)	Eucalyptus fastigata (Myrtaceae)	Eucalyptus sieberi (Myrtaceae)
Doryopteris kirkii (Pteridaceae)	Eucalyptus globulus (Myrtaceae)	Eucalyptus smithii (Myrtaceae)
Dovyalis macrocalyx (Salicaceae)	Eucalyptus gomphocephala (Myrtaceae)	Eucalyptus viminalis (Myrtaceae)
Dracaena fragrans (Ruscaceae)	Eucalyptus goniocalyx (Myrtaceae)	Eucalyptus viridis (Myrtaceae)
Dracaena steudneri (Agavaceae)	Eucalyptus grandis (Myrtaceae)	Eucalyptus tereticornis (Myrtaceae)
Drymaria cordata (Caryophyllaceae)	Eucalyptus johnstonii (Myrtaceae)	Eucalyptus urophylla (Myrtaceae)
Dryopteris athamantica (Dryopteridaceae)	Eucalyptus leucoxyton (Myrtaceae)	Eugenia capensis (Myrtaceae)
Dryopteris pentheri (Dryopteridaceae)	Eucalyptus longifolia (Myrtaceae)	Eugenia uniflora (Myrtaceae)
Ekebergia capensis (Meliaceae)	Eucalyptus macarthurii (Myrtaceae)	Eulophia streptopetala (Orchidaceae)
Elaphoglossum kivuensis (Pteridaceae)	Eucalyptus maidenii (Myrtaceae)	Euphorbia grantii (Euphorbiaceae)
Emilia discifolia (Asteraceae)	Eucalyptus marginata (Myrtaceae)	Euphorbia pulcherrima (Euphorbiaceae)
Entandrophragma excelsum (Meliaceae)	Eucalyptus melliodora (Myrtaceae)	Euphorbia schimperiana (Euphorbiaceae)
Eriosema juronianum (Fabaceae)	Eucalyptus microcorys (Myrtaceae)	Euphorbia tirucalli (Euphorbiaceae)
Eriosema robustum (Fabaceae)	Eucalyptus microtheca (Myrtaceae)	Euphorbiaceae (Euphorbiaceae)
Eriosema scioanum (Fabaceae)	Eucalyptus moluccana (Myrtaceae)	Faurea saligna (Proteaceae)
Eriospermum abyssinicum (Eriospermaceae)	Eucalyptus nolis (Myrtaceae)	Ficus asperifolia (Moraceae)
Erythrina abyssinica (Fabaceae)	Eucalyptus obliqua (Myrtaceae)	Ficus elastica (Moraceae)
Erythrocca fischeri (Euphorbiaceae)	Eucalyptus oreades (Myrtaceae)	Ficus exasperata (Moraceae)
Eucalyptus acmenioides (Myrtaceae)	Eucalyptus paniculata (Myrtaceae)	Ficus sur (Moraceae)
Eucalyptus albens (Myrtaceae)	Eucalyptus patens (Myrtaceae)	Ficus thonningii (Moraceae)
Eucalyptus amygdalina (Myrtaceae)	Eucalyptus pellita (Myrtaceae)	Ficus vallis-choudae (Moraceae)
Eucalyptus anceps (Myrtaceae)	Eucalyptus pilularis (Myrtaceae)	Flacourtia indica (Salicaceae)
Eucalyptus andreana (Myrtaceae)	Eucalyptus polyanthemus (Myrtaceae)	Fuerstia africana (Lamiaceae)
Eucalyptus botryoides (Myrtaceae)	Eucalyptus punctata (Myrtaceae)	Galinsoga parviflora (Asteraceae)

Gliricidia maculata (Fabaceae)
Gliricidia sepium (Fabaceae)
Gloriosa superba (Colchicaceae)
Gouania longispicata (Rhamnaceae)
Grevillea banksii (Proteaceae)
Grevillea robusta (Proteaceae)
Gynura scandens (Asteraceae)
Habenaria lehae (Orchidaceae)
Hagenia abyssinica (Rosaceae)
Hallea stipulosa (Rubiaceae)
Harrisonia abyssinica (Rutaceae)
Harungana madagascariensis (Clusiaceae)
Harveya helenae (Orobanchaceae)
Hedera cf helix (Araliaceae)
Hibiscus calyphyllus (Malvaceae)
Hibiscus diversifolius (Malvaceae)
Hibiscus flavifolius (Malvaceae)
Hibiscus fuscus (Malvaceae)
Hibiscus reekmansii (Malvaceae)
Hibiscus spec (Malvaceae)
Hibiscus vitifolius (Malvaceae)
Hovenia dulcis (Rhamnaceae)
Hydrocotyle mannii (Araliaceae)
Hydrocotyle sibthorpioides (Araliaceae)
Impatiens burtonii (Balsaminaceae)
Indigofera brevicalyx (Fabaceae)
Ipomoea batatas (Convolvulaceae)
Ipomoea involucrata (Convolvulaceae)
Ipomoea mauritiana (Convolvulaceae)
Ipomoea ochracea (Convolvulaceae)
Ipomoea tenuirostris (Convolvulaceae)
Isachne mauritania (Poaceae)
Jacaranda mimosifolia (Bignoniaceae)
Jasminum fluminense (Oleaceae)
Juglans mollis (Juglandaceae)
Juniperus spec. (Cupressaceae)
Justicia flava (Acanthaceae)
Justicia pinguior (Acanthaceae)
Justicia spec. (Acanthaceae)
Justicia striata (Acanthaceae)
Kalanchoe crenata (Crassulaceae)
Kalanchoe laciniata (Crassulaceae)
Keetia gueinzii (Rubiaceae)
Kohautia coccinea (Rubiaceae)
Kotschya aeschynomeneoides (Fabaceae)
Kyllinga appendiculata (Cyperaceae)
Kyllinga spec. (Cyperaceae)
Kyllinga stenophylla (Cyperaceae)
Lablab purpureus (Fabaceae)
Lablab scabra (Fabaceae)
Lactuca grandiflora (Asteraceae)
Lactuca inermis (Asteraceae)
Laggera brevipes (Asteraceae)
Laggera elatior (Asteraceae)
Laggera pterodonta (Asteraceae)
Lantana camara (Verbenaceae)
Lantana trifolia (Verbenaceae)
Leonotis ocymifolia (Lamiaceae)
Leptadenia hastata (Apocynaceae)
Leucaena leucocephala (Fabaceae)
Leucas bracteosa (Lamiaceae)
Leucas martinicensis (Lamiaceae)
Ligustrum lucidum (Oleaceae)
Liparis bowkeri (Orchidaceae)
Loxogramma abyssinica (Polypodiaceae)
Ludwigia stolonifera (Onagraceae)
Lysimachia ruhmeriana (Primulaceae)
Macaranga kilimandscharica (Euphorbiaceae)
Maesa lanceolata (Myrsinaceae)
Maesopsis eminii (Rhamnaceae)
Magnistipula butayei (Chrysobalanaceae)
Malva verticillata (Malvaceae)
Mangifera indica (Anacardiaceae)
Margaritaria discoidea (Phyllanthaceae)
Markhamia lutea (Bignoniaceae)
Maytenus tetraphylla (Celastraceae)
Melaleuca leucadendra (Myrtaceae)
Melanthera scandens (Asteraceae)
Microcelia bulbocalcarata (Orchidaceae)
Microcoelia globulosa (Orchidaceae)
Microglossa densiflora (Asteraceae)
Microglossa pyriformis (Asteraceae)
Mikania cordifolia (Asteraceae)
Milicia excelsa (Moraceae)
Millettia laurentii (Fabaceae)
Mimulopsis solmsii (Acanthaceae)
Momordica foetida (Cucurbitaceae)
Momordica friesiorum (Cucurbitaceae)
Mondia whitei (Apocynaceae)
Monechma subsessile (Acanthaceae)
Morus alba (Moraceae)
Mussaenda arcuata (Rubiaceae)
Myrsine melanophloeos (Myrsinaceae)
Nephrolepis undulata (Nephrolepidaceae)
Nervilia adolphi (Orchidaceae)
Nervilia gassneri (Orchidaceae)
Newtonia buchananii (Fabaceae)
Ocimum lamifolium (Lamiaceae)
Ocimum lanuginosum (Lamiaceae)
Oeceoclades saundersiana (Orchidaceae)

Oldenlandia corymbosa (Rubiaceae)
Olea welwitschii (Oleaceae)
Oleandra distenta (Oleandraceae)
Oplismenus hirtellus (Poaceae)
Oxalis latifolia (Oxalidaceae)
Oxalis obliquifolia (Oxalidaceae)
Oxytenanthera abyssinica (Poaceae)
Pancovia golungensis (Sapindaceae)
Panicum eickii (Poaceae)
Panicum maximum (Poaceae)
Parinari excelsa (Chrysobalanaceae)
Parochetus communis (Fabaceae)
Paspalum conjugatum (Poaceae)
Passiflora edulis (Passifloraceae)
Pavonia urens (Malvaceae)
Pellaea spec. (Pelleaceae)
Pellaea viridis (Pteridaceae)
Pennisetum purpureum (Penicetumceae)
Pentarrhinum insipidum (Apocynaceae)
Pentas pubiflora (Rubiaceae)
Perotis patens (Poaceae)
Persea americana (Lauraceae)
Peucedanum aculeolatum (Apiaceae)
Peucedanum runsoricum (Apiaceae)
Phaulopsis imbricata (Acanthaceae)
Phoenix reclinata (Arecaceae)
Phyllanthus fischeri (Phyllanthaceae)
Phyllanthus muellerianus (Phyllanthaceae)
Physalis peruviana (Solanaceae)
Phytolacca dodecandra (Phytolaccaceae)
Pilea johnstonii (Pteridaceae)
Pilea rivularis (Pileaceae)
Pilea tetraphylla (Urticaceae)
Piloselloides hirsuta (Asteraceae)
Pimpinella keniensis (Apiaceae)
Pinus ayacahuite (Pinaceae)
Pinus caribaea (Pinaceae)
Pinus elliotii (Pinaceae)
Pinus hartwegii (Pinaceae)
Pinus kesiya (Pinaceae)
Pinus longifolia (Pinaceae)
Pinus montezumae (Pinaceae)
Pinus patula (Pinaceae)
Pinus pseudostrobus (Pinaceae)
Pinus radiata (Pinaceae)
Pittosporum mildbraedii (Pittosporaceae)
Pittosporum virdiflorum (Pittosporaceae)
Pityrogramma calomelanos (Pteridaceae)
Plectranthus lanuginosus (Lamiaceae)
Plectranthus sylvestris (Lamiaceae)
Pleopeltis macrocarpa (Polypodiaceae)
Pluchea dioscorides (Asteraceae)
Podocarpus falcatus (Podocarpaceae)
Podocarpus gracilior (Podocarpaceae)
Podocarpus latifolius (Podocarpaceae)
Podocarpus milanjanus (Podocarpaceae)
Polygala albida (Polygalaceae)
Polygonum salicifolium (Polygonaceae)
Polygonum setosulum (Polygonaceae)
Polyscias fulva (Araliaceae)
Prunus africana (Rosaceae)
Prunus aretta (Rosaceae)
Prunus salasii (Rosaceae)
Psidium guajava (Myrtaceae)
Psophocarpus lancifolius (Fabaceae)
Pteridium aquilinum (Dennstaedtiaceae)
Pteris buchananii (Pteridaceae)
Pteris pteridoides (Pteridaceae)
Pteris spec. (Pteridaceae)
Pterolobium stellatum (Fabaceae)
Pterygota mildbraedii (Malvaceae)
Pycnostachys stuhlmannii (Lamiaceae)
Quercus petraea (Quercaceae)
Quercus suber (Fagaceae)
Rangaeris muscicola (Orchidaceae)
Rhoicissus tridentata (Vitaceae)
Rhus longipes (Anacardiaceae)
Rhus natalensis (Anacardiaceae)
Rhynchelytrum repens (Poaceae)
Rhynchosia minima (Fabaceae)
Ricinus communis (Euphorbiaceae)
Rubia cordata (Rubiaceae)
Rubia cordifolia (Rubiaceae)
Rubus apetalus (Rosaceae)
Rubus pinnatus (Rosaceae)
Rubus steudneri (Rosaceae)
Rumex kilimandscharica (Polygonaceae)
Rumex usambarensis (Polygonaceae)
Sansevieria bagshawei (Ruscaceae)
Sapium ellipticum (Euphorbiaceae)
Sarcostemma viminalis (Apocynaceae)
Schinus molle (Anacardiaceae)
Schrebera alata (Oleaceae)
Secamone stuhlmannii (Apocynaceae)
Sechium edule (Cucurbitaceae)
Senecio hochstetteri (Asteraceae)
Senna occidentalis (Fabaceae)
Senna orientalis (Fabaceae)
Senna spectabilis (Fabaceae)
Sesamum calycinum (Pedaliaceae)
Sesbania sesban (Fabaceae)
Setaria megaphylla (Poaceae)

Sida rhombifolia (Malvaceae)
Sigesbeckia abyssinica (Asteraceae)
Sinarundinaria alpina (Poaceae)
Smithia eliottii (Fabaceae)
Solanecio cydoniifolius (Asteraceae)
Solanecio handiensis (Asteraceae)
Solanecio mannii (Asteraceae)
Solanum aculeatissimum (Solanaceae)
Solanum hastifolium (Solanaceae)
Solanum incanum (Solanaceae)
Solanum mauritanum (Solanaceae)
Solanum nigrum (Solanaceae)
Solanum renschii (Solanaceae)
Solanum sessilistellatum (Solanaceae)
Solanum spec (Solanaceae)
Solanum terminale (Solanaceae)
Sonchus schweinfurthii (Asteraceae)
Spathodea campanulata (Bignoniaceae)
Spermaceoce princiae (Rubiaceae)
Spilanthes mauritiana (Asteraceae)
Sporobolus africanus (Poaceae)
Stephania abyssinica (Menispermaceae)
Sterculia acerifolia (Malvaceae)
Strombosia scheffleri (Olacaceae)
Symphonia globulifera (Clusiaceae)
Synadenium grantii (Euphorbiaceae)
Syncarpia procera (Myrtaceae)
Syzygium guineense (Myrtaceae)

Syzygium samarangense (Myrtaceae)
Syzygium zambalaw (Myrtaceae)
Taccazea apiculata (Apocynaceae)
Tagetes minuta (Asteraceae)
Tarenna orientalis (Rubiaceae)
Tarenna pavettoides (Rubiaceae)
Tecoma stans (Bignoniaceae)
Tecomaria capensis (Bignoniaceae)
Tephrosia elata (Fabaceae)
Tephrosia lurida (Fabaceae)
Terminalia mollis (Combretaceae)
Terminalia superba (Combretaceae)
Tetraclinis articulata (Cupressaceae)
Tetradenia multiflora (Lamiaceae)
Tetradenia riparia (Lamiaceae)
Thuja orientalis (Cupressaceae)
Thunbergia fischeri (Acanthaceae)
Tinospora caffra (Menispermaceae)
Tinospora orophila (Menispermaceae)
Tipuana tipu (Fabaceae)
Tithonia diversifolia (Asteraceae)
Tragia brevipes (Euphorbiaceae)
Tragia repens (Euphorbiaceae)
Trema orientalis (Cannabaceae)
Trifolium baccarinii (Fabaceae)
Tristania conferta (Myrtaceae)
Tristemma mauritanum (Melastomataceae)
Triumfetta brachyceras (Malvaceae)

Triumfetta cordifolia (Malvaceae)
Triumfetta pavettoides (Malvaceae)
Triumfetta rhomboidea (Malvaceae)
Triumfetta tomentosa (Malvaceae)
Vernonia amygdalina (Asteraceae)
Vernonia biafrae (Asteraceae)
Vernonia brachycalyx (Asteraceae)
Vernonia caffra (Asteraceae)
Vernonia galamensis (Asteraceae)
Vernonia karaguensis (Asteraceae)
Vernonia spec (Asteraceae)
Vernonia syringifolia (Asteraceae)
Vernonia urticifolia (Asteraceae)
Veronica abyssinica (Veronicaceae)
Vigna heterophylla (Fabaceae)
Vigna parkeri (Fabaceae)
Vigna vexillata (Fabaceae)
Virectaria major (Rubiaceae)
Vitex doniana (Viticoideae)
Waltheria indica (Malvaceae)
Widdringtonia cupressoides (Cupressaceae)
Widdringtonia schwarzii (Cupressaceae)
Widdringtonia whytei (Cupressaceae)
Zanthoxylum gillettii (Rutaceae)
Zehneria caffra (Cucurbitaceae)
Zehneria scabra (Cucurbitaceae)
Zehneria spc (Cucurbitaceae)

