11 Impact Assessment & Mitigation

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11.1 Introduction

This chapter provides the assessment of the Project impacts and mitigation measures. It is structured as per the IHA guideline for Hydropower Environmental and Social Assessment and Management (IHA, 2021).

The chapter is broken down into topics which correspond to the receptors that make up the physical, biological and socioeconomic environment. In addition to the receptors, the topics of climate change vulnerability, greenhouse gas emissions and waste are also included.

The methodology used for the assessment is described in Chapter 3 – ESIA Process and Methodology. However, for ease of reading and to avoid cross-referencing, receptor specific criteria for sensitivity and impact magnitudes are provided in this assessment chapter.

To produce a concise document the assessment has been prepared avoiding repetition of detailed information from the Project Description (Chapter 4) and the Description of the Baseline Situation (Chapters 7 and 8). Therefore, the reader may need to refer to these chapter when more detailed information on impact producing activities and the affected environment is required.

General outlines of mitigation measures to reduce the magnitude of significant impacts are listed in the assessment. However, the reader should refer to the Environmental and Social Management Plan (ESMP) for more detailed descriptions of these measures, information on responsibilities and descriptions of tangible actions and processes for implementation.

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11.2 Climate Change Vulnerability

11.2.1 Introduction

The Project's climate vulnerability has been assessed by Tractebel during the feasibility study through the application of the Hydropower Sector Climate Resilience Guide (Tractebel, 2020c). Consideration is given to climate vulnerability risks associated with both hydrological inflows and flood risk.

The assessment of climate vulnerability of the Project follows the five-phase approach outlined in the Climate Resilience Guide:

- Phase 1: Screening of the Project Climate Risks.
- Phase 2: Initial Analysis.
- Phase 3: The Climate Stress Test.
- Phase 4: Climate Risk Management Plan.
- Phase 5: Monitoring, Reporting and Evaluation.

11.2.2 Phase 1: Screening of the Project Climate Risks

The screening of Project climate risks considered the geographic, regulatory, technical and socioeconomic conditions of the Project.

According to the Government of the Netherlands, 2019 (as cited in Tractebel, 2020c), DRC and Rwanda are estimated to be the most vulnerable to climate change in the Ruzizi Plain due to the high density in this region (2,000 people per km^2), a large dependency on natural resources and an agricultural productivity considered to be particularly low. Vulnerability indicators defined for the Great Lakes Region and Ruzizi Plain are presented in Figure 11-1 (next page).

Hydro-meteorological data collected for the study included Ruzizi II inflows, Lake Kivu water levels, Ruzizi I and II turbined flows, minimum and maximum temperatures, ground rainfall data, precipitation data, evapotranspiration, Intensity-Duration-Frequency (IDF) curves, land use and sedimentation rate at Ruzizi II.

Project uncertainties, beside climate change, were noted to be as follows:

Economic	Environmental & Social	Regulatory	Technical
Cost of debt	Requirements for environmental flows	Country and regional constraints on the operation of the project	Hydro-meteorological data uncertainty
Cost of equity	Development limitations identified in the ESIA	Details of the PPA	Geological data uncertainty
Electricity pricing	Regulatory changes	Regulatory constraints on power trading imposed by power pools	
Interest rate	Water use changes	Political instability	
Discount rate	Land use changes		

Precipitation, streamflow and temperature were identified to be key climate stressors.

A number of risks and opportunities were identified for further assessment in subsequent phases.

Hydropower generation, flood security, environmental and social, and economic performance metrics and criteria were defined.

Phase 1 concluded that climate change posed a threat to the Project and therefore the assessment continued to Phase 2 of the IHA guideline.

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Variable	Indicator	Year	Vulnerability level		
			Burundi	DRC	Rwanda
Environmental disasters	Drought	2010	high	high	high
		2030	high	high	high
	Floods and landslides	2010	moderate	moderate	moderate
		2030	high	moderate	moderate
	Storms	2010	low	low	low
		2030	low	low	low
	Wildfires	2010	low	moderate	low
		2030	low	moderate	low
Environmental disasters	Agriculture	2010	acute	high	acute
		2030	acute	severe	acute
	Fisheries	2010	high	severe	moderate
		2030	acute	acute	moderate
Health impact	Hunger	2010	severe	acute	high
		2030	severe	acute	high
Total climate (including the factors above + 15 others)		**2010**	**severe**	**severe**	**high**
		2030	**acute**	**acute**	**severe**

Source: Government of the Netherlands, 2019 (as cited in Tractebel, 2020c)

Figure 11-1 Vulnerability Indicators Defined for the Great Lakes Region and Ruzizi Plain

11.2.3 Phase 2: Initial Analysis

The initial analysis determined an appropriate methodology for the climate stress test conducted under Phase 3. A climate baseline scenario was defined – adopting a 30-year period (from 1976 to 2005) as recommended in the IHA guidelines. A performance baseline for the same period was also established.

Additional data using the future Coupled Model Intercomparison Project Phase 5 (CMIP5) temperature and precipitation projections was collected. Two 30-year time-periods were considered for the analysis of the future in the Ruzizi River basin: 2020-2049 and 2050-2079, for Near-Term and Long-Term future hydro-climatic conditions respectively.

The ranges of changes forming the framework for the sensitivity analysis are summarized in Table 11-1 for each parameter.

Table 11-1 Sensitivity analysis range of changes

Parameter	Sensitivity analysis range
Mean Annual Temperature	From 0°C to +4°C
Mean Annual Precipitation	From -10% to +50%
Inter-Annual Precipitation Variability	From -20% to +90%
Intra-Annual Precipitation Variability	From -20% to +80%

The IHA guidelines were followed in determining the approach to be applied to the climate stress test in Phase 3; a semi-comprehensive approach was chosen.

11.2.4 Phase 3: The Climate Stress Test

Using the outcomes of Phases 1 and 2, projected climate change for the Project area is based on downscaled IPCC CMIP5 data for both Near-Term (2020-2049) and Long-Term (2050-2079) futures for different pathway scenarios (RCP 4.5, RCP 6.0, and RCP 8.5). Projected change

in mean annual temperature, mean annual precipitation, inter-annual variability of precipitation, and intra-annual variability of precipitation have been assessed and "plausible thresholds/ranges" have been identified, as shown in Table 11-2.

Table 11-2 Climate Change Projections Plausibility Range

Parameter	Classification	2020-2049	2050-2079
Temperature	Most plausible	+1.2°C	+2.2°C
	Plausible	+0.9°C and +1.7°C	+1.5°C and +3.4°C
	Less plausible	+0.5°C and +1.8 °C	+1.2°C and +3.8°C
Precipitation	Most plausible	+2.7%	+5.2%
	Plausible	-2.9% and +11.7%	-2.0% and +19.2%
	Less plausible	-4.8% and +18.3%	-9.0% and +41.1%
Inter-annual variability	Most plausible	+7.4%	+14.9%
	Plausible	-2.8% and +21.5%	-0.1% and +31.6%
	Less plausible	-8.8% and +40.2%	-19.8% and +75.7%
Intra-annual variability	Most plausible	+5.4%	+8.8%
	Plausible	-2.5% and +17.3%	-1.8% and +28.0%
	Less plausible	-5.7% and +29.1%	-16.1% and +64.7%
Source: CIMP5 projection, Tractebel, 2020c			

A Hydropower Generation

Climate stress test results for hydropower generation based on combining climate change plausibility values with the hydrological model (Tractebel, August 2020) are shown in the following tables.

Table 11-3 Plausibility Thresholds for Cascade's Mean Energy with Projected Climate Changes

Classification	2020-2049			2050-2079		
	Original (GWh)	Alt. 1,130m (GWh)	Alt. 1,145m (GWh)	Original (GWh)	Alt. 1,130m (GWh)	Alt. 1,145m (GWh)
Baseline	1,219	1,426	1,542	1,219	1,426	1,542
Most plausible	1,210	1,415	1,530	1,210	1,415	1,530
Plausible	1,137 – 1,289	1,330 – 1,507	1,438 – 1,630	1,096 – 1,378	1,281 – 1,611	1,386 – 1,742
Less plausible	1,064 – 1,437	1,244 – 1,680	1,346 – 1,816	959 – 1,612	1,121 – 1,884	1,213 – 2,037
Source: CIMP5 projection, Tractebel, 2020c						

Table 11-4 Plausibility Thresholds of the Energy Guaranteed at 95% in the Cascade with Projected Climate Changes

Classification	2020-2049			2050-2079		
	Original (GWh)	Alt. 1,130m (GWh)	Alt. 1,145m (GWh)	Original (GWh)	Alt. 1,130m (GWh)	Alt. 1,145m (GWh)
Baseline	993	1,162	1,256	993	1,162	1,256
Most plausible	973	1,138	1,231	971	1,136	1,228
Plausible	904 – 1,041	1,057 – 1,217	1,143 – 1,316	869 – 1,149	1,016 – 1,343	1,099 – 1,452
Less plausible	838 – 1,203	980 – 1,406	1,060 – 1,521	752 – 1,415	880 – 1,655	951 – 1,790
Source: Tractebel, 2020c						

- The most plausible future energy production is comparable to the current baseline: i) projected differences are less than 1% for mean annual energy production; and ii) energy guaranteed at 95% is projected to reduce by approximately 2%.
- The plausible future energy production shows variation from the baseline: i) mean annual energy production is projected to change by between -7% and +6% in the Near-Term and -10% and +13% in the Long-Term; and ii) energy guaranteed at 95% is projected to change by between -9% and +5% in the Near-Term and -13% and +16% in the Long-Term.

B Sedimentation

Sedimentation of the Ruzizi III dam site is assumed to only depend on precipitation in the inter-catchment between Ruzizi II and Ruzizi III. Climate stress test for sedimentation is shown in the table below.

Table 11-5 Plausibility Thresholds of the Sedimentation Rate with Projected Climate Changes

Classification	2020-2049	2050-2079
	All designs (1,000 m^3/year)	All designs (1,000 m^3/year)
Baseline	204	204
Most plausible	209	214
Plausible	202 – 216	202 – 229
Less plausible	195 - 233	193 - 281
Source: Tractebel, 2020c		

For most of the projections, the Ruzizi III dam will be filled with sediments more quickly than with the sedimentation performance baseline. Efforts to block or remove sediments would need to be intensified in the future, and even more in the long-term compared to the short-term. In addition to increasing sedimentation, more frequent and intense precipitation events are likely to increase soil erosion, which could potentially increase the risk of landslide.

C Flood Security

The climate stress test also addresses flood security. The Clausius-Clapeyron equation has been used to relate projected changes in temperature to water-vapour holding capacity such that a projected 1 °C change in air temperature would lead to an increase of 10.5% in rainfall intensity:

- In the most plausible scenario, the 100-year return period flood is projected to increase by 23% in the Near-Term and 43% in the Long-Term, the check flood is similarly projected to increase by 15% and 28%.
- In the plausible scenario, the 100-year return period flood is projected to change by between 17% and 33% (Near-Term) and between 29% and 68% (Long-Term), and the check flood is projected to change by between 11% and 22% (Near-Term) and between 19% and 44% (Long-Term).

D Environmental Flows

Environmental flows to Ruzizi III are very small compared to the minimum discharge estimated for the baseline period (1976-2005). Inflows are not projected to change much in the future (most plausible scenario).

11.2.5 Climate Change Vulnerability Risks

As guided by the IHA guidelines, risks and opportunities due to identified climate stressors (precipitation and streamflow & temperature) were first identified during Phase 1 and updated in subsequent phases based on additional data collection and taking into account the sensitivity of the system to climate stressors.

Climate change risks are given for high / very high project identified risks:

- Change in precipitation and streamflow results in increased sediment loads that impacts reservoir storage and result in damage to gates and turbines.
- Change in precipitation and streamflow results in more intense floods that results in overtopping of the rockfill dam, and flooding of the powerhouse and access roads.
- Change in temperature results in increased air temperature that results in powerhouse equipment failure due to heat.
- Change in temperature results in increase evaporation from Lake Kivu resulting in reduced water availability for power generation.

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The risk of decreased inflows and impact on energy production is identified as a medium risk and on downstream users as a low / negligible risk.

11.2.6 Phase 4: Climate Risk Management Plan

Design modification measures that have been included in the 2021 Feasibility Study that would increase the resilience of the system are given as:

- Landslide security – the alternative dam site which avoids a landslide risk area has been adopted.
- Hydropower generation – increased equipment design capacity, turbining of environmental flows, increase in the size of power waterways and room made available for an additional turbine if needed.
- Flood security – additional tunnel and gated spillway / increase spillway weir width or lower weir elevation, powerhouse protection, and increase the elevation of the access roads.

Adaptation measures that are to be implemented include 1) structural adaptation measures to update the design of some components and 2) functional adaptation measures to update the operation of the Project. These are:

[M 1] Slope stability shall be monitored and if necessary, dam and reservoir bank protection features shall be constructed to protect structures from landslides.

[M 2] Hydro-meteorological data (temperature, precipitation, river flow) and sedimentation shall be monitored.

[M 3] Consider the use of alternative energy sources such as solar energy.

[M 4] Project infrastructure shall be monitored for damage (gates and turbines) and electrical equipment failures and regular maintenance of facilities undertaken.

[M 5] A sediment management system shall be developed and implemented that includes provision for watershed management to reduce erosion, and dredging of the reservoir, if needed.

[M 6] Revegetation of the river basin should be considered to improve infiltration, reduce sedimentation and minimise flooding of infrastructure.

[M 7] Changes in the energy generation schedule, hourly or seasonally, resulting in a change in grid requirements shall be monitored.

[M 8] A data management system that makes provision for proper storage of data, proper monitoring and formatting of metadata, documenting the full history of the data (e.g., who took the data, when and how) and preservation of raw data shall be implemented and maintained.

[M 9] The Climate Risk Assessment should be updated every 10 years as new data and projections become available, following the IHA Guidelines relevant at the time.

11.2.7 Phase 5: Monitoring, Reporting and Evaluation

In addition to the monitoring measures outlined above, performance monitoring and driver monitoring are recommended as presented in the table below.

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Table 11-6 Recommended Monitoring for Hydropower Generation and Flood Security

Function	Monitoring metric	Reporting frequency
Hydropower generation: performance monitoring	Power outages and availability limitations (days per month)	Daily
	Energy produced (GWh)	Monthly and annual
Hydropower generation: driver monitoring	Precipitation (mm)	Monthly
	Temperature (°C)	Daily (but monthly acceptable)
	Inflows (m^3/s)	Monthly
	Sedimentation rate in the river (m^3/s)	Twice and once a month for the high and low flow season respectively
	Sedimentation in the reservoir (hm^3)	Every 5 to 10 years
Flood security	Precipitation (mm)	Hourly
	Inflows (m^3/s)	Hourly
Landslide security	Risk location and volume (frequency and m^3)	Event based
Source: Tractebel, 2020c		

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11.3 Greenhouse Gas Emissions

11.3.1 Construction GHG Emissions

The Construction GHG emissions have been estimated using an approach that is in alignment with that developed by United Nations Educational, Scientific and Cultural Organization/International Hydropower Association (UNESCO/IHA) (2016).

The manufacture, transportation and installation of Project infrastructure can lead to emissions of GHG. These emissions are a one-off source of GHG that can be attributed to the services that the reservoir provides. The estimate of the construction phase GHG emissions provides an indicative estimate of the construction phase emissions which includes the manufacture of raw materials, transportation of materials to, from and around the site, and the energy use from plant use for installation of Project infrastructure. The assessment provides an order of magnitude level of accuracy, as the emissions are predicted to be small in comparison with the reservoir. The calculation of GHG emissions is based on a simple set of equations that relate the amount of material, plant or unit of transport to a GHG emission factor, along the following logic:

GHG Emissions = Amount of Consumption or Activity x Emission Rate per Unit of Activity

Material consumption is expressed in terms of volume or mass. Construction plant is expressed in terms of energy expressed as electricity use. Construction transport is expressed in terms of tonne-kilometre, which is a unit that combines the amount of material being transported over a distance. The calculation used in this assessment is as follows:

GHG =	Concrete (m^3) x concrete material Emission Factor (EF) ($kgCO2e/m^3$) + mass (tonne) x distance (km) x transport EF (kgCO2e/t.km) + concrete (m^3) x plant EF ($kgCO2e/m^3$)

Each unit of activity is combined with an Emission Factor (EF), which have been sourced from the following references:

- Materials:
  - The Inventory of Carbon and Energy (ICE) V2.0, The University of Bath, 2011
  - The World Bank Carbon Emissions Estimating Tool (CEET), 2014
  - The Civil Engineering Standard of Method and Measurement Fourth Edition (CESMM4), 2012
- Construction Transport
  - The Greenhouse Gas (GHG) Protocol
- Construction Plant
  - The Civil Engineering Standard of Method and Measurement Fourth Edition (CESMM4), 2012

The input data for construction GHG emissions are presented in Table 11-7 and emissions calculation and estimated emissions provided in Table 11-8.

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Table 11-7 Estimated Quantities of Construction Materials

Item	Type	Quantity	Unit
Upstream cofferdam			
Clay core	Earth and Rock	14,701	m^3
Filter/Drain/Transition	Earth and Rock	29,403	m^3
Rockfill	Earth and Rock	30,235	m^3
Rip rap	Earth and Rock	3,920	m^3
Dam			
Excavation - Open air - Soil	Earth and Rock	13,554	m^3
Clay core	Earth and Rock	162,463	m^3
Filter/Drain/Transition	Earth and Rock	64,019	m^3
Rockfill	Earth and Rock	635,620	m^3
Rip rap	Earth and Rock	90,206	m^3
LB platform			
Excavation - Open air - Soil	Earth and Rock	6,520	m^3
Excavation - Open air - Rock	Earth and Rock	58,680	m^3
Shotcrete - Open air	Concrete	94	m^3
Spillway			
Open air spillway - Inlet, weir, chute, energy dissipation			
Excavation - Open air - Soil	Earth and Rock	10,800	m^3
Excavation - Open air - Rock	Earth and Rock	97,200	m^3
Concrete - Open air - structural	Earth and Rock	8,581	m^3
Reinforcement steel	Steel	520	Tonnes
Bottom Outlet			
Inlet			
Excavation - Open air - Rock	Earth and Rock	7,139	m^3
Concrete - Open air - structural	Concrete	3,073	m^3
Reinforcement steel	Steel	292	Tonnes
Shotcrete - Open air (incl. wire mesh)	Concrete	41	m^3
Tunnel			
Excavation - Tunnel - Rock I-III	Earth and Rock	4,756	m^3
Concrete - Underground - Structural (incl. formwork)	Concrete	1,499	m^3
Reinforcement steel	Steel	229	Tonnes
Shotcrete - Underground	Concrete	236	m^3
Energy dissipation			
Excavation - Open air - Rock	Earth and Rock	954	m^3
Concrete - Open air - structural	Concrete	434	m^3
Reinforcement steel	Steel	33	Tonnes
Shotcrete - Open air	Concrete	9	m^3

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Table 11-7 Estimated Quantities of Construction Materials (*Cont.*)

Item	Type	Quantity	Unit
Diversion Tunnel			
Portals			
Excavation - Open air - Rock	Earth and Rock	8,739	m^3
Concrete - Open air - structural	Concrete	600	m^3
Reinforcement steel	Steel	36	Tonnes
Shotcrete - Open air	Concrete	43	m^3
Tunnel			
Excavation - Tunnel - Rock I-III	Earth and Rock	4,756	m^3
Concrete - Underground - Structural	Concrete	1,499	m^3
Reinforcement steel	Steel	229	Tonnes
Shotcrete - Underground	Concrete	236	m^3
Power waterways			
Power intake			
Excavation - Open air - Rock	Earth and Rock	7,258	m^3
Concrete - Open air - structural	Concrete	6,500	m^3
Reinforcement steel	Steel	389	Tonnes
Shotcrete - Open air	Concrete	34	m^3
Headrace tunnel			
Excavation - Tunnel - Rock I-III	Earth and Rock	138,750	m^3
Excavation - Tunnel - Rock IV-V	Earth and Rock	46,250	m^3
Concrete - Underground - Structural	Concrete	40,300	m^3
Reinforcement steel	Steel	1,900	Tonnes
Shotcrete - Underground	Concrete	3,920	m^3
Surge tank			
Excavation - Open air - Soil	Earth and Rock	19,825	m^3
Excavation - Open air - Rock	Earth and Rock	19,825	m^3
Excavation - Shaft - Rock	Earth and Rock	34,265	m^3
Concrete - Underground - Structural	Concrete	8,265	m^3
Reinforcement steel	Steel	248	Tonnes
Shotcrete - Open air	Concrete	145	m^3
Shotcrete - Underground	Concrete	1,011	m^3
Steel-lined tunnel and penstock			
Excavation - Open air - Soil	Earth and Rock	127,400	m^3
Excavation - Open air - Rock	Earth and Rock	54,600	m^3
Excavation - Tunnel - Rock I-III	Earth and Rock	3,848	m^3
Random fill	Earth and Rock	81,478	m^3
Concrete - Open air - structural	Concrete	5,149	m^3
Concrete - Underground - Structural	Concrete	1,558	m^3
Reinforcement steel	Steel	268	Tonnes
Shotcrete - Open air	Concrete	225	m^3

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Table 11-7 Estimated Quantities of Construction Materials (*Cont.*)

Item	Type	Quantity	Unit
Diversion Tunnel			
Shotcrete - Underground	Concrete	148	m^3
Access tunnel			
Excavation - Open air - Soil	Earth and Rock	10,000	m^3
Excavation - Open air - Rock	Earth and Rock	11,600	m^3
Excavation - Tunnel - Rock I-III	Earth and Rock	9,925	m^3
Excavation - Tunnel - Rock IV-V	Earth and Rock	1,080	m^3
Concrete - Underground - Structural	Concrete	3,270	m^3
Concrete - Underground - Backfill	Concrete	165	m^3
Reinforcement steel	Steel	100	Tonnes
Shotcrete - Underground	Concrete	275	m^3
Powerhouse			
Excavation - Open air - Soil	Earth and Rock	81,131	m^3
Excavation - Open air - Rock	Earth and Rock	50,387	m^3
Random fill	Earth and Rock	27,510	m^3
Rockfill	Earth and Rock	13,255	m^3
Rip rap	Earth and Rock	3,128	m^3
Concrete - Open air - backfill	Concrete	300	m^3
Concrete - Open air - structural	Concrete	17,000	m^3
Reinforcement steel	Steel	1,530	Tonnes
Steel - structural	Steel	110	Tonnes
Switchyard			
Random fill	Earth and Rock	48,500	m^3
Concrete - Open air - backfill	Concrete	2,400	m^3
Concrete - Open air - structural	Concrete	2,000	m^3
Reinforcement steel	Steel	100	Tonnes
Roads			
Earthworks	Earth and Rock	75,790	m^3
Excavation - Open air - Soil	Earth and Rock	45,898	m^3
Excavation - Open air - Rock	Earth and Rock	81,693	m^3
Fill	Earth and Rock	185,921	m^3
Subbase	Earth and Rock	31,818	m^3
Roadbase	Earth and Rock	31,565	m^3
Concrete - Lateral drainage channels	Concrete	5,010	m^3
Concrete - Drainage channels on slopes	Concrete	1,953	m^3
Gabions	Earth and Rock	39,024	m^3

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Table 11-7 Estimated Quantities of Construction Materials (*Cont.*)

Item	Type	Quantity	Unit
Diversion Tunnel			
Minihydro Civil Works			
Excavation - Open air - Rock	Earth and Rock	1,072	m^3
Concrete - Open air - backfill	Concrete	195	m^3
Concrete - Open air - structural (incl. formwork)	Concrete	2,955	m^3
Reinforcement steel	Steel	191	Tonnes

Source: TRACTEBEL, 2021a

Table 11-8 Estimated GHG Emissions from Construction

General	Earth and Rock	Concrete	Steel
Unit of Material (UoM)	m^3	m^3	Tonnes
Quantity	2,535,042	110,542	6,175
Material			
kg/UoM	2,300	2,300	7,566
Emission Factor (kgCO2e/UoM)	21.224	342	3,190
Transport			
Distance (km)	5	5	13,000*
Emission Factor (kgCO2e/t.km)	0.2035	0.2035	0.2035
Plant			
Emission Factor (kgCO2e/UoM)	1	5.07	0
kgCO2e	62,271,405	38,625,613	143,290,258
Total CO2e (tonnes)	244,187		
* A conservative estimate is assumed and corresponds to the distance between Rwanda and China			

11.3.2 Reservoir GHG Emissions

Reservoir GHG emissions comprise carbon dioxide (CO_2) and methane (CH_4) released as a result of the biodegradation of the flooded biomass. Emissions of GHGs from the reservoir have been estimated on a yearly basis over the 100-year operating life of the Project. The approach used for the estimation and key assumptions are described as follows:

- It is assumed that all the organic carbon present in the flooded soils is progressively biodegraded through an anaerobic biodegradation process producing CH_4. This is a conservative assumption as it is probable that some of the organic carbon may biodegrade aerobically producing CO_2. However, this assumption is made in order not to underestimate the emissions. It is assumed that carbon content of flooded soils is 12 kg/m^2, this is the high end of typical values recommended by the IHA G-Res tool v2.1 technical documentation (Prairie et al, 2017). It is assumed that all the carbon to a depth of 30 cm is biodegraded, as per IHA technical documentation.
- The is also assumed that all the organic carbon in the flooded above ground biomass biodegrades anaerobically producing CH_4. The quantity of organic carbon in the biomass has been calculated using the carbon content value of tropical mountain savanna vegetation quoted in the IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). Mountain savanna has a carbon content of 30 t/ha, but a value of 15 t/ha is used in the calculation to take into account that the vast majority of the reservoir area is cultivated, and that the crops will be harvested before reservoir filling, and that during the time between harvesting and reservoir filling the natural vegetation will only partially grow back. This is considered a conservative assumption.
- A hypothetical 5-year half-life is used as the time constant for the biodegradation of the soft biomass, i.e. 50% of the biomass has biodegraded in the first 5 years following inundation and 75% will have biodegraded after 10 years. A 20-year half-life is used as the

time constant for the biodegradation of the hard biomass. A 15-year half-life is used as the time constant for the biodegradation of the biomass in soils. The adapted hypothetical time constants are considered as precautionary. This is because when using these values, the theoretical amount of carbon dioxide produced during the operating life of the reservoir is maximised. Use of a faster decay rate would predict the same total amount of carbon dioxide produced during the operating life of the Project – though produced in a shorted time-period, which is probably not realistic. A longer decay rate would assume that not all the carbon was biodegraded in operating life of the Project, and this would minimise the potential amount of carbon dioxide that could be produced.

The evolution of the reservoir GHG emissions over a 100-year period is presented in Figure 11-2.

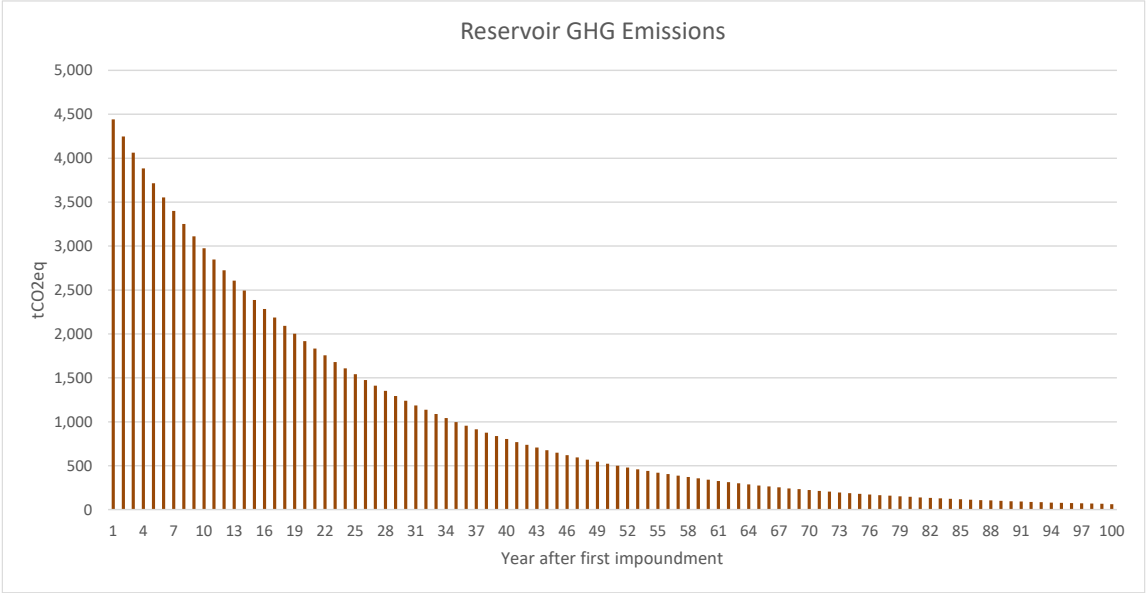


Figure 11-2 Reservoir GHG Emissions

11.3.3 Overall GHG Emissions

The overall GHG emissions covering the construction period and a 100-year operation period represents are presented in Table 11-9.

Table 11-9 – Overall Construction and Reservoir GHG Emissions Averaged over 100 Years

Parameter	Units	Value
Construction GHGs (Over 4 years)	Tonnes	244,187
Reservoir GHGs (over 100 years)	Tonnes	102,217
Combined GHGs	Tonnes	346,403
Average annual emission	Tonnes/year	3,464
Average annual emissions per m^2 of reservoir area	$gCO2eq/m^2$/year	6,928
Project emissions per unit of energy	gCO2eq/kWh	2.89
Typical Benchmark emissions per unit of energy*	gCO2eq/kWh	Ranging from 4-160
* (Special Report of the Intergovernmental Panel on Climate Change, 2012)		

The total combined emissions from construction and reservoir over the 100-year period are presented in the pie chart Figure 11-3 and a benchmarking comparison provided in Figure 11-4.

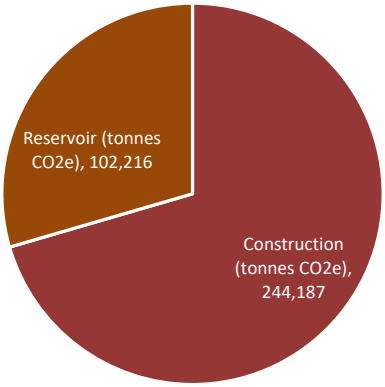
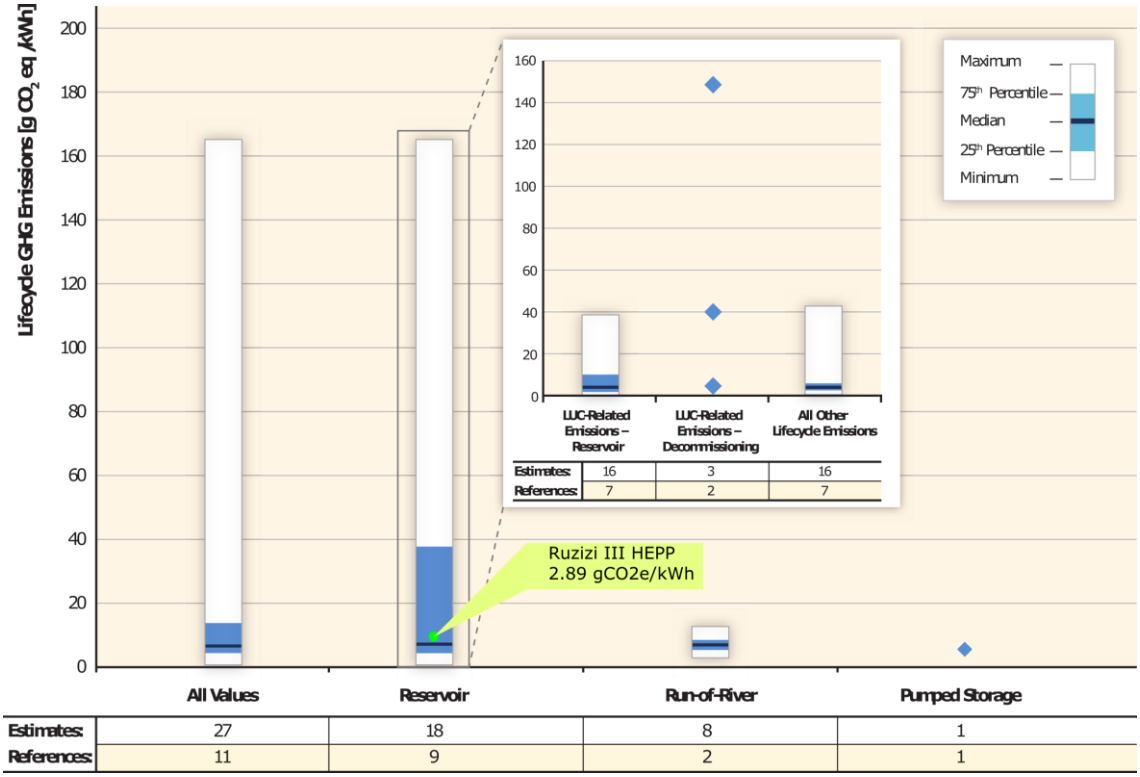


Figure 11-3 Construction and Reservoir GHG Emissions



	All Values	Reservoir	Run-of-River	Pumped Storage
Estimates:	27	18	8	1
References:	11	9	2	1

	LUC-Related Emissions – Reservoir	LUC-Related Emissions – Decommissioning	All Other Lifecycle Emissions
Estimates:	16	3	16
References:	7	2	7

Source: Special Report of the Intergovernmental Panel on Climate Change, 2012

Figure 11-4 Comparison of Project Emissions with Worldwide Benchmark Values

11.3.4 Comparison with Rwanda's National GHG Emissions and Worldwide Emissions

The Ruzizi III GHG emissions compared with Rwanda's national and worldwide emissions are presented in Table 11-10.

Table 11-10 – Project Emissions Compared with Rwanda's National and Worldwide Emissions

GHG Emissions	Emissions (million tonnes per year)	Percentage Project Emission
Ruzizi III HEPP emissions [a]	0.0035	-
Rwanda's National GHG emissions for the power sector for 2015 [b]	0.159	2.2%
Worldwide GHG Emissions [c]	52,000	0.000007%

Notes:

[a] Average over 100 years and including construction emissions

[b] Rwanda's Nationally Intended Nationally Determined Contributions (Rwanda 2020). The most recent data is from 2015.

[c] IPCC Fifth Assessment Report, 2015 (IPCC, 2021)

11.3.5 GHG Offsets Resulting from Project Implementation

The national GHG emission intensity (tCO2-eq per MWh) has been calculated for the situation when the Project has been implemented. The key figures are presented in Table 11-11 below and it can be seen that the project is expected to result in a 66% reduction in the national emission intensity for electricity production.

Table 11-11 – GHG Offset from Project Implementation

Source	MWh per year	GHG emissions (Mt CO_2-eq / year)	tCO_2-eq / MWh
Rwanda's National electricity production	600,000 [a]	0.159 [b]	0.27
Ruzizi III HEPP	1,197,000	0.0035	0.0029
Rwanda's National electricity production + Ruzizi III Project	1,797,000 [c]	0.16	0.09
Rwanda's National electricity production + Equivalent to Ruzizi III Project using Rwanda's current energy mix	1,797,000	0.48	0.27
Reduction c.f. emissions from Rwanda's energy mix	N/A	0.32[d] (66% reduction)	N/A
Reduction c.f. emissions from energy mix in Burundi, DRC and Rwanda	N/A	0.78	N/A

[a] Source: Rwanda Utilities Regulatory Authority (RURA). The most recent data is from 2016. However, data from 2015 as this is the year when the most recent GHG emission data is available.

[b] Source: Rwanda's Nationally Intended Nationally Determined Contributions (Rwanda 2020). The most recent data is from 2015.

[c] Source: Tractebel; 2021

[d] Equals emissions from Rwanda's electricity production including Ruzizi III power capacity with Rwanda's current energy mix (0.48) minus Rwanda's emissions with Ruzizi III in operation (0.16).

11.3.6 Impact Significance and Mitigation Measures

The total GHG emissions during construction are assessed to be 244,187 tonnes of equivalent carbon dioxide. Construction duration is expected to be 48 and 56 months and consequently, annual GHG emissions during construction are therefore predicted to be on average 61,046 tonnes of equivalent carbon dioxide.

During operation, emissions will be 1,033 tonnes per year on average with emissions decreasing from 4,500 to 3,500 tonnes per year over the first 10 years of operation.

The GHG emissions are assessed to be below the IFI thresholds of 100,000 tonnes per year which would trigger the need for the developer to publicly disclose GHG emissions on an annual basis and are therefore considered as not significant. However, as a good practice measure it is recommended that Scope 1 and Scope 2 GHG emissions are monitored during construction and included in REL's annual report, in addition the Project will explore the opportunities to benefit from carbon credits, these measures are referred to as:

[M 10] Good Practice measure to monitor Scope 1 and Scope 2 GHG emissions during construction and report the emissions in REL's annual environmental and social performance report and post on the Project's website.

[M 11] The Project undertake a separate study to explore the opportunities to benefit from carbon credits.

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11.4 Air Quality, Dust and Odour

11.4.1 Impact Producing Factors

Potential sources of alteration to ambient air quality during pre-construction and construction are equipment items of activities that emit air pollutant and dust, and which comprise:

- Fuel combustion emissions at worksites and construction accommodation camps from excavation and earth moving equipment and fixed-point sources such as power generators. These emissions typically comprise particulate matter, sulphur dioxide (SO_2) and oxides of nitrogen (NOx).
- Dust arising from land clearing and construction activities at work sites.
- Fuel combustion emissions and dust from construction related traffic.

Potential sources of alteration to ambient air quality during operation comprise the following:

- Fuel combustion emissions from fixed-point sources such as power generators or diesel-fuelled equipment at the dam site, powerhouse or operators' village during the operation.
- Fuel combustion emissions and dust from the road traffic during operation which will comprise vehicles used by employees and services to access the facilities for operational reasons, inspections and maintenance, and occasional deliveries.

11.4.2 Assessment of Receptor Sensitivity

The sensitivity of the air quality is considered to be low and medium, depending on the area affected, as per the criteria set out in the Table 11-12. The project works are undertaken in an area of low terrestrial biodiversity sensitivity and mostly in areas where agriculture is the predominant land use. Some sections or access roads pass through and close to residential areas which have medium sensitivity because the baseline air quality in the villages is probably degraded by the predominant use of wood burning for cooking and heating.

11.4.3 Impacts during Pre-Construction and Construction

The magnitude of the alteration to air quality for the different sources of impact are assessed using the criteria provided in Table 11-13. Air emission modelling has not been undertaken as there is insufficient project information available, so a qualitative approach has been applied. The assessment of the impacts and mitigation measures are provided in Table 11-14 and Table 11-15.

Table 11-12 Air Quality Sensitivity Criteria

Sensitivity	Sensitivity for human health		Sensitivity for protection of ecosystems/habitats
High	A zone or agglomeration designated as exceeding an air quality limit value; or Undesignated areas where concentrations are 85% or more of an air quality limit value.	And it is within an area where members of the public are regularly present; Or any hospital, school, nursing homes or similar facilities considered to be vulnerable to changes in ambient air quality concentrations.	Within an ecosystem or habitat type which is recognised to be of importance at an international level or is a critical habitat, as defined by the IFC, and where the habitat has the potential to be affected by baseline concentrations close to or above the air quality critical levels.
Medium	Areas not designated as exceeding the limit values and where baseline concentrations are between 50% to 85% of an air quality limit. And it is within an area where members of the public are regularly present;	Or at any hospital, school, nursing homes or similar facilities considered to be vulnerable to changes in ambient air quality concentrations.	Within an ecosystem or habitat type recognised to be of importance at a national scale and where the habitat has the potential to be affected by baseline concentrations close to or above the air quality critical levels.
Low	Areas not designated as exceeding the limit values and where baseline concentrations are between 15% to 50% of an air quality limit.	And is within an area where members of the public are regularly present.	Within an ecosystem or habitat type occurring outside of any designation, but which represent a typical example of the feature under consideration within the context of the ecological resource present within the country and is not likely to be affected by air quality levels.
Negligible	Areas not designated as exceeding the limit values and where baseline concentrations are less than 15% of an air quality limit.	Or is within an area where members of the public are not regularly present.	Within an ecosystem or habitat type which is either appreciably degraded / disturbed by human activity, have low diversity of common and widespread species or have high proportions of invasive / non-native species and would not likely to be affected by air quality levels

Table 11-13 Air Quality Impact Magnitude Criteria

Rank	Description
Major	Impact magnitude is major if the receptor is in the vicinity of the activity and the estimated emissions with respect to background air quality concentrations and likely dispersion may result in long-term elevated concentrations that exceed WHO air quality standards.
Moderate	Impact magnitude is moderate if the receptor is in the vicinity of the activity and the estimated emissions with respect to background air quality concentrations and likely dispersion may result in short-term elevated concentrations that are expected to be between 50% and 100% of WHO air quality standards.
Minor	Impact magnitude is minor if the receptor is in the vicinity of the activity and the estimated emissions with respect to background air quality concentrations and likely dispersion may result in short-term low magnitude concentration that are expected to be between 5% and 50% of WHO air quality standards.
Negligible	Impact magnitude is negligible if no detectable change in air quality is anticipated.

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Table 11-14 Potential Impacts - Air Quality & Odour during Pre-Construction/Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Fuel combustion emissions at worksites and accommodation camps from excavation and earth moving equipment and fixed-point sources such as power generators.	Transient alteration to air quality in the immediate vicinity of the reservoir, dam site and access road between the powerhouse and the work sites over a duration of 56 months. These Areas in the immediate vicinity are predominantly used for agriculture there are no residential areas.	Low	Moderate	Minor (NS)
	Transient alteration to air quality in the immediate vicinity of the powerhouse over a duration of several months. These areas in the immediate vicinity are predominantly used for agriculture. However, there is a village on the opposite side of the river (in DRC) within 170 m of the worksite. Air quality in the village may be considered as degraded from the predominant use of wood burning for cooking.	Medium	Minor	Minor (NS)
Dust arising from land clearing and construction activities at work sites.	Transient alteration to air quality in the immediate vicinity of the reservoir, dam site and access road between the powerhouse and the work sites over a duration of 56 months. These Areas in the immediate vicinity are predominantly used for agriculture there are no residential areas.	Low	Moderate	Minor (NS)
	Transient alteration to air quality in the immediate vicinity of the powerhouse over a duration of several months. These areas in the immediate vicinity are predominantly used for agriculture. However, there is a village on the opposite side of the river (in DRC) within 170 m of the worksite. Air quality in the village may be considered as degraded from the predominant use of wood burning for cooking.	Medium	Moderate	Moderate (S)
Fuel combustion emissions and dust from construction related traffic	Transient alteration to air quality in the immediate vicinity of access roads, some of which are adjacent to villages., where air quality may already be degraded by the predominant use of wood burning for cooking.	Medium	Moderate	Moderate (S)

Proposed mitigation measures for significant impacts are presented in the following table

Table 11-15 Mitigations & Residual Impacts - Air Quality & Odour during Pre-Construction/ Construction

Project Activity	Mitigation	Residual Impact		
		Sensitivity	Magnitude	Significance
Dust arising from land clearing and construction activities at work sites.	[M 12] The Contractor shall prepare and implement an Air Quality and Emissions Management Plan as part of the CESMP, which details measures to manage air emissions and dust. [M 13] The Contractor shall use equipment and adopt construction and transport methods with air emissions that do not exceed threshold emission values specified in Rwanda and DRC regulations or IFC EHS Guidelines, whichever is the most stringent. [M 14] The fleet of vehicles or equipment emitting combustion gases shall be maintained at the intervals and according to the methods specified by the manufacturer. The Contractor shall keep maintenance records.	Medium	Minor	Minor (NS)
Fuel combustion emissions and dust from construction related traffic		Medium	Minor	Minor (NS)

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11.4.4 Predicted Impacts during Operation

The magnitude of the alteration to air quality for the different sources of impact are assessed using the criteria provided in the Table 11-13. Air emission modelling has not been undertaken as there is insufficient project information available, so a qualitative approach has been applied. Assessment of potential impacts is presented in the following table.

Table 11-16 Potential Impacts - Air Quality & Odour during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Fuel combustion emissions from the fixed-point sources such as power generators at the dam site, powerhouse and operators' village	Minor alteration to the air quality in the immediate vicinity of the operator' village and the dam. These areas in the immediate vicinity are predominantly used for agriculture and there are no nearby residential areas	Low	Negligible - Minor	Minor (NS)
Fuel combustion emissions and dust from traffic along the dam access road and along the transmission line wayleave (for maintenance)	Minor intermittent and transient alteration to the air quality in the immediate vicinity of the access roads. The areas in the immediate vicinity comprise areas predominantly used for agriculture but with some discrete residential areas.	Medium	Negligible - Minor	Minor (NS)

The potential impacts are assessed to be Not Significant (NS) however, as a precautionary measure are proposed.

[M 15] Power generators at the operator's village will be designed to comply with IFC General EHS emission limit values and DRC/Rwanda emission limit values (whichever are the most stringent). Annual monitoring of the emissions will be performed to check conformity.

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11.5 Noise and Vibration

11.5.1 Impact Producing Factors

Potential sources of alteration to ambient noise and vibration levels during pre-construction and construction comprise the following:

- Noise from mobile and stationary machinery equipment at worksites that are for clearing of vegetation, site preparation, earthworks, excavation.
- Noise from temporary construction camps and accommodation camps from vehicles and stationary machinery equipment such as power generators and compressors.
- Noise and vibration from tunnelling activities – which will include some drill and blast operations.
- Noise from construction traffic movement along access roads.

Potential sources of alteration to ambient noise and vibration levels during operation comprise the following:

- Noise from operators' village (generators, compressors, occasional sirens and alarms).
- Noise from the powerhouse
- Noise from 220 kV substation and 220 kV transmission line.
- Noise from Project road traffic which will comprise vehicles used by employees and services to access the facilities for operational reasons, inspections and maintenance, and occasional deliveries.

11.5.2 Assessment of Receptor Sensitivity

The sensitivity of receptors to noise and vibration is primarily dependent upon the activities which take place at the receptor location. Locations where people rest or sleep are considered to be more sensitive. The sensitivity of the areas in the vicinity of the project activities is assessed to be between low and high, depending on the area affected, as per the criteria set out in the Table 11-17.

The project works are undertaken in an area of low terrestrial biodiversity sensitivity and mostly in areas where agriculture is the predominant land use. Some sections of access roads pass through and close to residential areas which have high sensitivity, and the powerhouse is situated 170 m from the village of Bugano in DRC which also has high sensitivity.

Table 11-17 Noise and Vibration Receptor Sensitivity

Sensitivity	Description
High	Locations used for rest, sleep and quiet reflection such as residential areas, hospitals, cemeteries, educational establishments and places of worship.
Medium	Locations used for work requiring concentration, such as offices.
Low	Locations used for recreation, industrial and agricultural activities
Negligible	Locations not regularly utilised

11.5.3 Predicted Impacts during Pre-Construction and Construction

The magnitude of the alteration to ambient noise and vibration levels for the different sources of impact are assessed using the criteria provided in Table 11-18.

Noise and vibration modelling has not been undertaken and a qualitative approach has been applied. Assessment of potential impacts is presented in Table 11-19.

Table 11-18 Noise Impact Magnitude Criteria

Magnitude	Description		
	Noise		Vibration
	Areas adjacent to worksites	Areas adjacent to access roads	
Major	Ambient noise levels exceed threshold value* by > 3 dB for > 1 month	Major increase in noise level which would be noticeable in the short, medium and long terms	Vibration level >10 mm/s Any exposure other than brief to this level is intolerable.
Moderate	Ambient noise levels exceed threshold value* by > 3 dB for < 1 month	Moderate increase in noise level which would be noticeable in the short and medium terms but possibly not in the long term	Vibration level ranges from 1.0 – 10 mm/s Vibration perceptible at a level sufficient to cause complaint
Minor	Ambient noise levels exceed threshold value* by < 3 dB for > 1 month	Minor increase in noise level which might be noticeable in the short term but possibly not in the medium term and not in the long term after a period of habituation	Vibration level ranges from 0.3 – 1 mm/s Vibration perceptible in residential surroundings
Negligible	Ambient noise levels exceed threshold value* by < 3 dB < 1 month	Negligible increase in noise level considered to be noticeable only when a subject is deliberately listening for a change. Such an impact would result from a 25% increase in traffic volume (assuming no change in speed or composition). May be noticeable in the short-term but not in the medium and long terms.	Vibration level ranges from 0.14 – 0.3 mm/s Vibration perceptible only in most sensitive situations
* The threshold value adopted is 55 dB LAeq, 8 hours during daytime and 45 dB Laeq, 8 hours during night-time (WHO outdoor noise guidance value for residential areas).			

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Table 11-19 Potential Impacts – Noise & Vibration during Pre-Construction/ Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Noise from mobile and stationary machinery equipment at worksites that are for clearing of vegetation, site preparation, earthworks, excavation.	Intermittent increase in ambient noise levels in the immediate vicinity of the reservoir, dam site and access road between the powerhouse and the work sites over a duration of 48-56 months. These areas in the immediate vicinity are predominantly used for agriculture there are no residential areas.	Low	Minor	Minor (NS)
	Intermittent alteration to ambient noise levels in the immediate vicinity of the powerhouse over a duration of several months. These areas in the immediate vicinity are predominantly used for agriculture. However, there is a village on the opposite side of the river (in DRC) within 500-600 m of the worksite, where noise levels could potentially exceed threshold values by >3 dB for short periods of <1 month.	High	Moderate	Major (S)
Noise from temporary construction camps and accommodation camps from vehicles and stationary machinery equipment such as power generators, compressors.	General increase in ambient noise levels in the immediate vicinity of the construction camps over a duration of 48-56 months. These areas in the immediate vicinity are predominantly used for agriculture there are no residential areas. However, noise levels may potentially exceed threshold values by >3 dB but for short periods of <1 month.	Low	Moderate	Minor (NS)
Noise and vibration from tunnelling which will include some drill and blast operations.	The headrace tunnel gallery will be excavated using drill and blast methods and there will be detectable levels of vibration and noise in the immediate vicinity of the tunnel entrance during excavation works. These areas are adjacent to land predominantly used for agriculture but there are no residential areas in immediate vicinity.	Medium	Minor	Moderate (S)
Noise from rock crusher	The use of rock crushers during the construction of access roads which pass close to residential areas can generate noise levels potentially exceeding threshold values by >3 dB but for short periods of <1 month for each noise sensitive location.	High	Moderate	Major (S)
Noise from the concrete batching plant	The batching plant is planned to be situated on the right bank (in DRC) opposite the construction camp. The batching plant is situated about 1.3 km from the nearest residential area (Bugano village of on the right bank in DRC).	Medium	Moderate	Moderate (S)
Noise from construction traffic movement along access roads.	There will be a significant volume of construction traffic moving along the dam access roads to/from the quarry, disposal areas and construction camp. It is expected that during the peak construction period there may be up to 50 trucks travelling along a stretch of road every day. The duration of the civil works is to be just over 3 years. The quarry access roads pass through and adjacent to residential areas and all the roads are adjacent to cultivated land where local people practice labour intensive	High	Moderate	Major (S)

Proposed mitigation measures for Significant (S) impacts are presented in the following table. Specific mitigation measures for impacts that are Not Significant (NS) are not proposed.

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Table 11-20 Mitigations & Residual Impacts – Noise & Vibration during Pre-Construction/ Construction

Project Activity	Mitigation and Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
Noise from mobile and stationary machinery equipment at the powerhouse worksite that are for site preparation clearing, earthworks, and construction.	[M 16] The Contractor shall prepare and implement a Noise & Vibration Control and Monitoring Plan as part of the CESMP. [M 17] Regular noise level monitoring will be performed during construction to demonstrate compliance with WHO noise guidelines and DRC and Rwanda noise level regulations. [M 18] The Contractor shall use equipment and adopt construction and transport methods so as minimise noise levels and prevent exceeding threshold values recommended by the DRC/Rwanda regulations and WHO recommendations. [M 19] Where communities are located close to worksites, access roads and public roads affected by construction traffic, the Contractor shall study, propose, implement and monitor the efficiency of all reasonable and practicable measures to minimize noise resulting from the activity and to minimize the acoustic nuisances to adjacent households during day and night. [M 20] Noise barriers or acoustic shields shall be considered if works are close to sensitive receptors and installed if monitoring detects noise levels at residential areas that exceed WHO noise guidelines and DRC and Rwanda noise level regulations. [M 21] Noise-intensive works such as piling, demolition, metalworking, and blasting (in quarries) will not be undertaken at night. [M 22] The Contractor shall monitor the vibration level at buildings nearest to the Works during activities which could generate offset vibration effects. The Contractor shall prepare a pre-construction condition survey for all buildings located within 1 km of any blasting activities (including photographs of existing situation). The condition survey will be used to assess the effect of blasting on structures and the scope of any remediation works necessary to repair the effects of blasting.	High	Negligible	Negligible (NS)
Noise and vibration from tunnelling activities – which will include some drill and blast operations.		High	Negligible	Negligible (NS)
Noise from the rock crushers		High	Minor	Moderate (S)
Noise from the concrete mixing plant		Moderate	Negligible	Negligible (NS)
Noise from construction traffic movement along access roads.		High	Negligible	Negligible (NS)

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11.5.4 Predicted Impacts during Operation

The magnitude of the alteration to ambient noise and vibration levels for the different sources of impact are assessed using the criteria provided in Table 11-18. Noise and vibration modelling has not been undertaken and a qualitative approach has been applied. Assessment of potential impacts is presented in Table 11-21 and mitigation measures and residual impacts are presented in Table 11-22.

Table 11-21 Potential Impacts – Noise and Vibration during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Noise from operators' village (generators, compressors, occasional sirens and alarms).	The operators' village will accommodate in the order of 50 persons. The camp is planned to be located on the left bank adjacent to the powerhouse. The camp is some 500-600 m from the Bugano village on the right bank (DRC). Equipment at the camp will include noise generating equipment items that without noise minimisation may have the potential to generate noise exceeding regulatory and WHO noise limit values.	High	Major	Major (S)
Noise from powerhouse operation	The above ground powerhouse is planned to be located on the left bank opposite the DRC Bugano village some 500-600 m from the powerhouse. The equipment at the powerhouse will include noise generating equipment items that without noise minimisation can be expected to have the potential to generate noise exceeding regulatory and WHO noise limit values.	High	Major	Major (S)
Corona noise from 220 kV switchyard	The switchyard is situated adjacent to the Bugano village. Equipment items such as transformers and the powerlines are a source of corona noise (an audible hissing sound). The noise will be a nuisance for people.	High	Minor	Moderate (S)
Noise from 220 kV transmission line.	The transmission line is situated adjacent to the Bugano village and crosses 7 km of cultivated land, crossing over the kamanyola-Bugarama road which is lined with residential houses. The noise will be a nuisance for people.	High	Minor	Moderate (S)
Noise from Project road traffic which will comprise vehicles used by employees and services to access the facilities for operational reasons, inspections and maintenance, and occasional deliveries.	During operation there will be only small volumes of traffic that will be mostly between the operators' villages and the dam site and powerhouse. This road is not a public road and does no pass through residential areas. There may be some limited traffic that passes through Bugarama to join the dam and powerhouse access road.	High	Negligible	Negligible (NS)

Proposed mitigation measures for Significant (S) impacts are presented in the following table

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Table 11-22 Mitigations & Residual Impacts – Noise and Vibration during Operation

Project Activity	Mitigation and Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
Noise from operators' village (generators, compressors, occasional sirens and alarms).	[M 23] Noise modelling study for the operators' village, powerhouse and substation will be carried out during the design phase and noise prevention measures included in the design as necessary to ensure that noise levels at the site boundary complies with WHO noise guidelines and DRC and Rwanda noise level regulations. [M 24] Noise level monitoring will be performed at the operator's village, powerhouse and substation during commissioning to check compliance with the owner's noise requirements. [M 25] Periodic noise level monitoring will be performed during operation at the powerhouse, operators' camp and substation to check compliance with WHO noise guidelines and DRC and Rwanda noise level regulations.	Low	Negligible	Negligible (NS)
Noise from powerhouse operation		High	Negligible	Negligible (NS)
Noise from the 220 kV switchyard and 220 kV transmission line.	[M 26] The transmission line and switchyard will be designed with features to minimise the corona affect.	High	Negligible	Negligible (NS)

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11.6 Soils, Groundwater and Surface Water

11.6.1 Impact Producing Factors

Potential sources of disturbance to soils during pre-construction and construction comprise the following:

- Worksite preparation works including removal of topsoil, levelling and terracing.
- Removal of topsoil and excavation of material from quarries and borrow areas.
- Excavation and earthworks for the construction of the dam foundations.
- Excavation and earthworks for the headrace tunnel, deviation tunnels, water inlet.
- Topsoil removal, levelling, earthworks for construction of access roads.

Potential sources of alteration to soil, groundwater and surface water quality during pre-construction and construction comprises the following:

- Pollution of soils and groundwater from accidental spills and leaks of hazardous substances stored at worksites and the construction camp.
- Alteration of Ruzizi River water quality from discharge of sanitary wastewater from the construction workers accommodation camp.
- Increased sediment loads in Ruzizi River from runoff from worksites and spoil disposal areas.
- Alteration of the Ruzizi River water quality from filling of the Ruzizi-III reservoir.

Potential sources of alteration to soil, groundwater and surface water quality during operation comprises the following:

- Alteration of the Ruzizi River water quality from operation of the Ruzizi-III reservoir.
- Alteration of Ruzizi River water quality from discharge of sanitary wastewater from the operators' village.
- Pollution of soils and groundwater from accidental spills and leaks of hazardous substances stored at dam site and powerhouse.
- Alteration of Ruzizi River water quality from runoff from areas polluted by accidental spills and leaks of hazardous substances stored at dam site and powerhouse.

11.6.2 Assessment of Receptor Sensitivity

The sensitivity of geology and soils receptors has been assessed as variable in the range negligible to high depending on the location of the Project activities as described by the criteria provided in Table 11-23.

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Table 11-23 Geology and Soils Sensitivity Criteria

Sensitivity	Soils	Groundwater / Surface Water	
		Description	Example
High	Highly vulnerable to physical disturbance, structurally prone to compaction or erosion, and taking >10 years to recover. Highly leachable and amenable to contamination. The soil provides a substrate that has the physical qualities and/or degree of productivity to support the development of important (in terms of nature conservation or concentration of biomass) and/or indigenous species of flora and fauna. The soil is intrinsically linked to the hydrological cycle; water is fundamental to its structure; and the soil plays a key ecosystem role in water regulation.	• Surface water or groundwater body with little or no capacity to absorb proposed changes or minimal opportunities for mitigation. • Receptor at high risk of depletion (surface waters levels falling or drying out; groundwater levels / yields falling) • Receptor at high risk of pollution • Receptor provides vital ecosystem services (fishery, flood conveyance capacity, sediment transport) • Receptor provides urban water supplies, major industrial abstraction or large irrigation supplies	• Pristine reach of river with natural flow, sediment and water quality regime • Spawning areas for important fishery • Springs vital for urban water supply • Water supply serving major industry or irrigation use • River reach receiving wastewater from urban area.
Medium	Vulnerable to physical disturbance but able to recover by mitigation measures within a period of 10 years. Moderately leachable. The soil provides a substrate that has the physical qualities and degree of productivity to support the development of species of flora and fauna in some abundance and levels of diversity. The soil has some capacity for water retention and regulation and plays some role in the hydrological cycle in terms of a degree of water regulation and as a substrate for channelling run-off.	• Surface water or groundwater body with some capacity to absorb proposed changes or limited opportunities for mitigation. • Receptor at medium risk of depletion (surface waters levels falling or drying out; groundwater levels / yields falling) • Receptor at medium risk of pollution • Receptor provides important ecosystem services (fishery, flood conveyance capacity, sediment transport) • Receptor used for local village water supply source, small industrial abstraction or minor irrigation scheme	• River reach or spring/well serving village, local industry or small irrigation user • Village wastewater disposal River reach supporting local fishery.
Low	Resilient to physical disturbance and/or impermeable to contamination. The soil constitutes no particular favourable substrate for the development of floral habitats, invertebrates and other fauna. The soil plays little or no role in the hydrological cycle or regulation of water.	• Surface water or groundwater body with some capacity to absorb proposed changes or moderate opportunities for mitigation. • Receptor already significantly modified from some aspect of natural condition • Receptor provides ecosystem services (fishery, flood conveyance capacity, sediment transport) • Receptor used for water supply to individual dwellings or farms	• River reach in a modified state due to existing use (eg existing dam/weir, gravel extraction) • Minor water use • Isolated wastewater disposal
Negligible	Temporary duration with no detectable impact. No perceptible change to the specific environmental conditions assessed.	> Surface water or groundwater body with considerable capacity to absorb proposed changes and/or good opportunities for mitigation. > Receptor already significantly modified from natural condition	> Aquifer that is confined where project works occur > River reach severely impacted by upstream dam

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11.6.3 Predicted Impacts during Pre-Construction and Construction

The magnitude of the disturbance to geology and soils for the different sources of impact are assessed using the criteria provided in Table 11-24. The assessment of the impacts from disturbance have been undertaken using a qualitative approach. The assessment of potential impact is provided in Table 11-25 and mitigation measures and residual impacts are presented in Table 11-26.

Table 11-24 Soils, Groundwater, Surface Water Impact Magnitude Criteria

Magnitude	Description		
	Soils	Groundwater / Surface Water	
		Typical Characteristics	Example of Features/Areas
Major	The potential for soil quality and/or physical structure to be permanently impacted. The area affected by the activity is predicted to be large (>100 ha).	• Surface water or groundwater body with little or no capacity to absorb proposed changes or minimal opportunities for mitigation. • Receptor at high risk of depletion (surface waters levels falling or drying out; groundwater levels / yields falling). • Receptor at high risk of pollution. • Receptor provides vital ecosystem services (fishery, flood conveyance capacity, sediment transport). • Receptor provides urban water supplies, major industrial abstraction or large irrigation supplies.	• Pristine reach of river with natural flow, sediment and water quality regime. • Spawning areas for important fishery. • Springs vital for urban water • Supply. • Water supply serving major • industry or irrigation use. • River reach receiving • wastewater from urban area. •
Moderate	The impact on soil quality and condition may recover through natural processes and the impact will be medium term (several years). The area affected by the activity is predicted to be a medium extent (>10 ha and < 50 ha)	• Surface water or groundwater body with some capacity to absorb proposed changes or limited opportunities for mitigation. • Receptor at medium risk of depletion (surface waters levels falling or drying out; • groundwater levels / yields falling) • Receptor at medium risk of pollution. • Receptor provides important ecosystem services (fishery, flood conveyance capacity, sediment transport). • Receptor used for local village water supply source, small industrial abstraction or minor irrigation scheme.	• River reach or spring/well serving village, local industry or small irrigation user • Village wastewater disposal • River reach supporting local • fishery.
Minor	The impact on soil quality and condition is predicted to recover rapidly through natural processes and the duration of impact is short (limited to the Construction Phase). The area affected by the activity is predicted to be a minor extent (<10 ha)	• Surface water or groundwater body with some capacity to absorb proposed changes or moderate opportunities for mitigation. • Receptor already significantly modified from some aspect of natural condition. • Receptor provides ecosystem services (fishery, flood conveyance capacity, sediment transport). • Receptor used for water supply to individual dwellings or farms.	• River reach in a modified state due to existing use (eg existing dam/weir, gravel extraction) • Minor water use • Isolated wastewater disposal
Negligible	No changes distinguishable from natural variability.	• Surface water or groundwater body with considerable capacity to absorb proposed changes and/or good opportunities for mitigation. • Receptor already significantly modified from natural condition.	• Aquifer that is confined where project works occur • River reach severely impacted by upstream dam.

Table 11-25 Potential Impacts – Soils, Groundwater & Surface Water during Pre-Construction/Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Physical Disturbance of Soils				
Worksite preparation works including removal of topsoil, levelling and terracing. Removal of topsoil and excavation of material from quarries and borrow areas.	Worksites, quarries, borrow areas, spoil disposal area and roads are situated mostly on land used for crop cultivation. The impact on livelihoods of the loss of agricultural land is assessed in the social impact (section 11.12). The soils are assessed to be of low sensitivity as they are no longer a substrate for natural floral habitats or other fauna and plays little or no role in the hydrological cycle or regulation of water.	Low	Moderate	Minor (NS)
Excavation and earthworks for the construction of the dam foundations.		Low	Moderate	Minor (NS)
Excavation and earthworks for the headrace tunnel, deviation tunnels, water inlet.		Low	Moderate	Minor (NS)
Topsoil removal, levelling, earthworks for construction of access roads.		Low	Moderate	Minor (NS)
Flooding of soils by reservoir impoundment		Low	Moderate	Minor (NS)
Groundwater, Surface Water and Soil Quality				
Pollution of soils and groundwater from accidental spills and leaks of hazardous substances stored at worksites and the construction camp.	Hazardous substances stored and handled by the Project will include chemical additives for concrete, small quantities of solvents and paints and larger quantities of diesel fuel, hydraulic fluids, lubricating oils (new and used). It can be expected that there will be several diesel storage tanks (typically in the order of 20-30 m^3 volume), vehicle refuelling areas, mobile power generators containing diesel and oils, and areas dedicated to the storage of chemicals and hazards wastes (such as used oils) stored in iso-containers and drums. In the absence of pollution prevention measures, accidental spills and leaks can be expected. The quantities potentially released will be variable and will depend on numerous factors. In the event of accidental leaks and spills the soils at the spill location will be polluted. The area affected will depend on the size of the spill. In the absence of clean-up, during rainfall some of the polluting substances will be carried away with runoff, and some will infiltrate into groundwaters with the rainwaters, leading to a pocket of polluted groundwater in the vicinity of the spill and which will progressively migrate. However, when considering that there will probably not be large inventories of hazardous substances at the project site, there is limited potential for extensive pollution of soils, groundwaters and surface water.	High	Moderate	Major (S)

Table 11-25 Potential Impacts – Soils, Groundwater & Surface Water during Pre-Construction/Construction (*Cont.*)

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Alteration of Ruzizi River water quality from discharge of sanitary wastewater from the construction workers accommodation camp.	The construction workers camp which will accommodate between 500 and 1,000 workers will generate sanitary wastewater. If the wastewater is not collected in an appropriate manner and is discharged into the Ruzizi River without appropriate treatment there will be alteration to the quality of the river water and exceedance of regulatory and Lender discharge limit values.	High	Moderate	Major (S)
Increased sediment loads in Ruzizi River from runoff from worksites and spoil disposal areas.	Runoff from worksites and disturbed areas will carry sediment into the Ruzizi River, possible increasing the sediment load in the river.	High	Minor	Moderate (S)
Alteration of the Ruzizi River water quality from filling of the Ruzizi-III reservoir.	The duration of reservoir filling is estimated by the feasibility study to be 12 days and during this time there will be release downstream of about 90% of the inflowing water. Once the reservoir is full the outflow will equal the inflow and the residence time of stored water will be less than 24 hours. In this	High	Minor	Moderate (S)

Proposed mitigation measures for significant impacts are presented in the following table.

Table 11-26 Mitigations & Residual Impacts – Geology & Soils during Pre-Construction/Construction

Project Activity	Mitigation and Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
Worksite preparation works including removal of topsoil, levelling and terracing and excavation work	[M 27] A soil, slope stability and erosion control plan will be developed and implemented by the EPC Contractor.	Low	Minor	Negligible (NS)
Pollution of soils, groundwater and surface water from accidental spills and leaks of hazardous substances stored at worksites and the construction camp.	[M 28] Construction site pollution prevention and protection plans, and measures will be developed and implemented for all worksites by the EPC Contractor. [M 29] Groundwater at construction worksite will be monitored monthly during construction. [M 30] Construction accommodation camps will be equipped with wastewater treatment facilities to ensure sanitary and domestic wastewater discharges are compliant with Burundi, DRC and Rwanda regulatory	High	Negligible	Negligible (NS)

Project Activity	Mitigation and Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
Worksite preparation works including removal of topsoil, levelling and terracing and excavation work	[M 27] A soil, slope stability and erosion control plan will be developed and implemented by the EPC Contractor.	Low	Minor	Negligible (NS)
Alteration of Ruzizi River water quality from discharge of sanitary wastewater from the construction workers accommodation camp.	discharge limits and IFC EHS guideline emission limit values. [M 31] The quality of wastewater discharges from construction worksites will be monitored to check conformity with discharge limit values. [M 32] During construction, erosion mitigation measures will be employed to prevent soil erosion and fluvial erosion when undertaking works on bare soil and banks and when working in the river (EPC Contractor).	High	Negligible	Negligible (NS)
Increased sediment loads in Ruzizi River from runoff from worksites and spoil disposal areas.	[M 33] Cofferdams and diversion tunnels used for construction works in the river will be designed to enable suspended sediment to be carried downstream while construction is taking place. [M 34] During construction, worksite surface erosion and effectiveness of control measures will be monitored by taking weekly fixed-point photos of cleared areas. [M 35] During the reservoir filling phase, bottom sluicing will be undertaken to maintain sediment throughflow as best possible and flows will be sufficient to transport the released sediment downstream to avoid siltation of instream habitats immediately downstream of the dam. [M 36] Environmental performance of the EPC Contractor will be monitored to check conformity with Project standards and non-conformities will be managed through a non-conformity management process.	High	Negligible	Negligible (NS)
Alteration of the Ruzizi River water quality from filling of the Ruzizi-III reservoir.		High	Negligible	Negligible (NS)

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11.6.4 Predicted Impacts during Operation

Table 11-27 Potential Impacts – Soils, Groundwater & Surface Water during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Alteration of the Ruzizi River water quality from operation of the Ruzizi-III reservoir.	Negligible alteration to reservoir water quality is expected. The progressive biodegradation of flooded biomass releasing nutrients including nitrogen, phosphorus and organic carbon is expected, but because the quantity of flooded biomass is very small compared to the quantity of water flowing through the reservoir, and the short residence time (<1 day) alteration to nutrient concentrations in the reservoir water will be negligible and probably less than intra-annual and inter-annual variations.	High	Negligible	Negligible (NS)
Alteration of Ruzizi River water quality from discharge of sanitary wastewater from the operators' village.	Discharge of untreated sanitary wastewater from the construction camp which accommodates approximately 100 employees could create a measurable alteration to the water quality of the Ruzizi.	High	Minor	Moderate (S)
Pollution of soils, groundwater and surface water from accidental spills and leaks of hazardous substances stored at dam site and powerhouse.	The extent and magnitude of the impacts will depend on the nature of the substance released and the quantity. The largest inventories of hazardous substance will be fuel, oils and used oils. In the event of accidental leaks or spills the soils in the immediate vicinity will be contaminated, but runoff would also be contaminated and could cause the pollution of nearby surface waters.	High	Minor	Moderate (S)

Proposed mitigation measures for significant impacts are presented in the following table

Table 11-28 Mitigations & Residual Impacts – Soils, Groundwater & Surface Water during Operation

Project Activity	Mitigation and Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
Alteration of Ruzizi River water quality from discharge of sanitary wastewater from the operators' accommodation camp.	[M 37] The operators' accommodation camp will be equipped with a sanitary and domestic wastewater collection and treatment facilities to ensure discharges comply with regulatory discharge limit values and IFC EHS guideline emission limit values. [M 38] Quality of wastewater discharges from the operators' accommodation camp will be monitored quarterly to check conformity with discharge limit values.	High	Negligible	Negligible (NS)

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Project Activity	Mitigation and Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
Pollution of soils and groundwater from accidental spills and leaks of hazardous substances stored at dam site and powerhouse.	[M 39] A Pollution prevention and control plan for the operation phase will developed and implemented. [M 40] Facilities for the storage and handling of hazardous substances at the dam site, powerhouse and switchyard will be designed with spill prevention and protection measures.	High	Negligible	Negligible (NS)

Although significant alteration to reservoir water quality is not expected, monitoring of water quality should be carried out and ant floating waste from Bukavu and carried into the reservoir by the river should be removed and managed in an appropriate manner (see Section 11.9). This measure is referred to elsewhere in the report as:

[M 41] Water quality impacts will be monitored and adaptively managed.

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11.7 Hydrology

The predicted hydrological impacts during pre-construction, construction, and operation have been assessed with reference to the baseline hydrology as described in the Hydrology section of the Environmental Baseline Situation chapter. This includes an assessment of the monthly inflows to Ruzizi II and the study area, an assessment of the study area hydrology including observed water levels and the hydrological and hydraulic characteristics of the study area, and a summary of flood risk at the Ruzizi III dam site. This assessment identified uncertainty / potential non-stationarity in hydrological conditions that would have an associated effect on impacts in the hydropeaking reach.

The main hydrology impacts are further explored in the Environmental Flow Assessment chapter. Particular emphasis is given to the impacts associated with the dewatered reach between Ruzizi III dam wall and the powerhouse tailrace, and the downstream hydropeaking reach extending to the border with Burundi. Consideration is also given to the possible effects of hydropeaking further downstream.

Importantly, the Environmental Flow Assessment related hydrological and hydraulic impacts to ecological and social context. Explicit consideration is given to geomorphology, aquatic ecology, terrestrial ecology, and social reliance. The resultant impacts of hydrological change on these receptors are considered more fully in associated sections of this chapter.

11.7.1 Impact Producing Factors

Potential sources of alteration to hydrology during pre-construction and construction comprise the following:

- Temporary river diversion.
- Reservoir filling.

Potential sources of alteration to hydrology during operation comprise the following:

- Normal powerhouse operation with peak and off-peak discharges.
- Diversion of the river through the headrace tunnel, creating a bypassed reach of the river with only the environmental flow and any flows from dam spillage.
- Sediment flushing operations.
- Bottom outlet testing.
- Reservoir spillage.
- Exception operating conditions.

11.7.2 Assessment of Receptor Sensitivity

The sensitivity of the hydrology receptor has been assessed as low as per the criteria provided in Table 11-23.

Table 11-29 Hydrology Sensitivity Criteria

Sensitivity of receptors	Description
High	• Surface water with little or no capacity to absorb proposed changes or minimal opportunities for mitigation. • At high risk of depletion (surface waters levels falling or drying out). • Provides vital ecosystem services (fishery, flood conveyance capacity, sediment transport). • Provides urban water supplies, major industrial abstraction or large irrigation supplies. • Is a spawning area for important fishery.

Sensitivity of receptors	Description
Medium	• Surface water with some capacity to absorb proposed changes or limited opportunities for mitigation. • Already experiencing some level of modification from some aspect of natural condition. • At medium risk of depletion (surface waters levels falling or drying out; groundwater levels / yields falling). • Provides important ecosystem services (fishery, flood conveyance capacity, sediment transport). • Used for local village water supply source, small industrial abstraction or minor irrigation scheme. • Serves village, local industry or small irrigation user. • Provides village wastewater disposal. • Supports local fishery.
Low	• Surface water with some capacity to absorb proposed changes or moderate opportunities for mitigation. • Already significantly modified from some aspect of natural condition. • Provides some ecosystem services (fisheries, flood conveyance capacity, sediment transport). • Used for water supply to individual dwellings or farms. • In a modified state due to existing use (e.g. existing dam/weir, gravel extraction). • Provides minor water use. • Provides isolated wastewater disposal.
Negligible	• Surface water with considerable capacity to absorb proposed changes and/or good opportunities for mitigation. • Receptor already significantly modified from natural condition. • River reach severely impacted by upstream dam.

The magnitude of the alteration to hydrology during pre-construction, construction, and operating for the different sources of impact are assessed using the criteria provided in Table 11-30.

Table 11-30 Hydrology Alteration Magnitude Criteria

Magnitude	Description
Major	Fundamental change to the specific environmental conditions assessed, resulting in long term or permanent change, typically widespread in nature. Would require significant intervention to return to baseline.
Moderate	Detectable change to the specific environmental conditions assessed, resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific environmental conditions assessed.
Negligible	No perceptible change to the specific environmental conditions assessed.

11.7.3 Predicted Impacts during Pre-Construction and Construction

The assessment of the impacts during pre-construction and construction from alteration to hydrology disturbance have been undertaken using a quantitative-qualitative approach and are as provided in Table 11-31.

No proposed mitigation measures for pre-construction and construction are required as no significant impacts have been identified.

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Table 11-31 Potential Impacts – Hydrology during Pre-Construction and Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Temporary river diversion	Diversion works undertaken in two-stage process. Stage 1 involves tunnelling through rock spur (no impact on river flows), Stage 2 involves damming the natural river and diverting flows through the diversion tunnels. Short, largely v. steep, reach (circa. 500-600 m) between cofferdam and diversion tunnel outlet will be bypassed. Construction flood (452 m^3/s) defined as combination of Ruzizi I powerhouse maximum flow (154 m^3/s), Ruzizi I spillway operating with one gate open (57 m^3/s) and 20-year return period flood from intervening catchment (241 m^3/s).	Low	Moderate	Minor (NS)
Reservoir clearing	Clearing of the reservoir footprint (46 ha) is required prior to reservoir filling. This activity is likely to result in increased sediment and debris movement in the river but is considered to have no direct impact on hydrology.	Negligible	Negligible	Negligible (NS)
Reservoir filling	Reservoir capacity at Full Supply Level (1145 mASL) is 7.72 Mm^3) which under average flow conditions (110 m^3/s) would take approximately 20 hours to fill. However, due to dam structure stability concerns, the reservoir is expected to take circa. 12 days to fill (an average flow rate of < 8 m^3/s), the remainder of the inflow would be diverted through the diversion tunnel. Short, largely v. steep, reach (circa. 500-600 m) between dam wall and diversion tunnel outlet will be bypassed; reservoir footprint will be progressively inundated. During reservoir filling, the 5.5-km-long dewatered reach downstream of the dam between the reservoir dam wall and powerhouse tailrace is potentially dewatered, in the same way as during operation.	Medium	Moderate	Moderate (S)*
* Mitigation measures are as for during operation, the mitigation measures and assessment of the residual impact are provided in Table 11-32.				

11.7.4 Predicted Impacts during Operation

The assessment of the impacts during operation from alteration to hydrology disturbance have been undertaken using a quantitative-qualitative approach and are presented in Table 11-32. The associated mitigation measures for required significant impacts are as given in Table 11-33.

Table 11-32 Potential Impacts – Hydrology during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Diversion of the river through the headrace tunnel, creating a dewatered reach (including during reservoir filling)	The circa. 5.5 km river reach between the reservoir dam wall and powerhouse tailrace – currently subject to hydropeaking effects due to the operation of Ruzizi II – is potentially dewatered under normal operating conditions.	Medium	Moderate	Moderate (S)
Normal powerhouse operation with peak and off-peak discharges	River flow and hydraulic conditions in the Ruzizi River downstream of the powerhouse tailrace will be subject to sub-daily fluctuations, that represent an incremental change to the fluctuations caused by the operation of Ruzizi-I and -II.	Medium	Moderate	Moderate (S)

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Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
	The impacts associated with the project are defined as the change in hydraulic conditions relative to the current baseline, i.e., those experienced due to the current hydropeaking operation of Ruzizi II. It is expected that power production ramp-up rates and ramp-down rates could potentially be faster for Ruzizi III than for Ruzizi II, but not exceeding threshold values for public safety and fish stranding. The impacts have been primarily assessed for the reach between the powerhouse tailrace and the Burundi border. Consideration has also been given to the possible impacts in the reach further downstream extending to Lake Tanganyika.. The impacts are more fully described in the Chapter 10 - Environmental Flow Assessment.			
Sediment flushing operations.	Sediment loading in the reservoir will require active sediment management in order to maintain active storage capacity. Any sediment flushing operations will result in a pulse of sediment laden water being released via the bottom outlet into the dewatered reach, with potential impacts on aquatic and terrestrial habitats and biodiversity, and community health and safety.	Medium	Moderate	Moderate (S)
Exception operating conditions.	Under normal operating conditions, the inflows to Ruzizi III reservoir will pass completely through the bottom outlet as environmental flow and, via the headrace, through the powerhouse and tailrace back into the Ruzizi River. Normal operating conditions are considered to be when inflows to Ruzizi III do not exceed circa. 160 m^3/s (equivalent to current 98% June non-exceedence flow). The bottom outlet has been designed to discharge 200 m^3/s at FSL which allows it to release without spill turbined flows in the event of powerhouse shut down. The bottom outlet has also been designed to discharge 110 m^3/s at a reservoir elevation of 1,120 mASL to allow inspection and maintenance of the power intake inlet structure at inflows up to the mean annual flow (110 m^3/s). The spillway has been designed to safely pass a design flood of 986 m^3/s and a safety evaluation flood of 1,420 m^3/s. The head above the spillway weir is estimated to be 3.6 m and 4.4 m respectively under these conditions. Peak flow estimates for floods of lower return periods in the intervening catchment are given by Tractebel[1] as 216-406 m^3/s (RP=10 yrs) and 427- 574 m^3/s (RP=100 yrs). Given an assumed 3 hour storm duration, this results in approximate flood volumes of 3.1-5.8 Mm^3 and 6.1-8.3 Mm^3 respectively. Depending on the timing of the intervening catchment flood events and reservoir levels in Ruzizi III, attenuation of the natural flooding may occur, and associated benefits/disbenefits could occur. Based on simplified 1D hydraulic modelling, flows in excess of circa. 160 m^3/s are expected to lead to floodplain inundation at various locations along the reach downstream of the powerhouse tailrace to the Ruhwa River.	Medium	Moderate	Moderate (S)

[1] Hydrology and Sedimentation Review (Tractebel, February 2020)

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Table 11-33 Mitigations & Residual Impacts – Hydrology during Operation

Project Activity	Mitigation & Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
Diversion of the river through the headrace tunnel, creating a dewatered reach.	Maintain a minimum environmental flow release in dewatered reach through reservoir bottom outlet. Sub-daily variation in flow and hydraulic conditions (wetted area, depth, velocity) replaced with conditions associated with environmental flow regime adopted (e.g., 10 m^3/s / approx. 9% MAF). The impacts are as described in the Environmental Flow Assessment chapter. [M 42] Implement monitoring of release from the bottom outlet using flow measurement / video evidence. Provide real-time open web portal to allow for stakeholder assessment of performance. [M 43] Publish annual report of bottom outlet flow release data. [M 44] Implement operational maintenance schedule to ensure full and correct functioning of bottom outlet monitoring & data publishing, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.	Low	Moderate	Minor (NS)
Normal powerhouse operation with peak and off-peak discharges	Reduce the impact of hydropeaking on sub-daily flow and hydraulic conditions in the hydropeaking reach at source (e.g., incorporate environmental and social constraints into the optimised operating rule curves, and/or incorporate river restoration techniques to increase attenuation, reduce variation of wetted area, depths, and velocities) at ecologically important locations. [M 45] Assess requirements for improved hydrological modelling of upstream and tributary catchments to reduce uncertainty inherent in current broad-scale assessment. [M 46] Assess requirements for improved hydrological and hydraulic characterisation of micro-/meso-scale habitat in hydropeaking reach to reduce uncertainty inherent in current broad-scale assessment. [M 47] Implement monitoring of powerhouse tailrace flow and flow / water levels at selected locations in the hydropeaking reach (between the powerhouse tailrace and the Burundi border) using flow measurement / radar / video evidence.. [M 48] Publish annual report of powerhouse / hydropeaking reach flow data. [M 49] Implement operational maintenance schedule to ensure full and correct functioning of powerhouse tailrace / hydropeaking reach monitoring & data publishing, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.	Low	Minor	Minor (NS)
Sediment flushing operations.	Sediment management mitigation options are required to minimise the downstream impacts of sediment flushing operations. The measures required are more fully considered in the subsequent Geomorphology and Sediment Transport section of this Impact Assessment & Mitigation chapter. Specifically	Low	Minor	Minor (NS)

Project Activity	Mitigation & Monitoring	Residual Impact		
		Sensitivity	Magnitude	Significance
	with regards to hydrological impacts, sediment flushing operations should expressly consider their potential for floodplain inundation. Mitigation measures should be implemented to assess the associated impacts of such releases. [M 50] Develop, agree with key stakeholders (e;g., ABAKIR), and implement a Dewatered Reach Sediment Management Plan that explicitly evaluates associated ecological and social functioning in the dewatered and further downstream reaches (including, *inter alia*, sediment transport and floodplain inundation). [M 51] Maintain regular, periodic releases from Ruzizi III reservoir (bottom outlet / spillway) to flush sediment in the dewatered reach. [M 52] Implement monitoring of sedimentation in the dewatered reach (between the powerhouse tailrace and the Burundi border) using periodic sediment sampling / aerial (drone) survey. [M 53] Publish annual report of sediment monitoring in the dewatered reach. [M 54] Implement operational maintenance schedule to ensure full and correct functioning of Dewatered Reach Sediment Management Plan, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.			
Exception operating conditions.	Powerhouse shutdown and / or power intake inlet structure inspection and maintenance may result in bottom outlet releases that lead to downstream floodplain inundation. Mitigation measures should be implemented to assess the associated impacts of such releases. A Reservoir Operation Plan should be developed that maximises the benefits associated with reservoir attenuation effects on low return period flooding (to be aligned with a Reservoir Sediment Management Plan). [M 55] Develop, agree with key stakeholders (e.g., ABAKIR), and implement a Reservoir Operation Plan (exception operating conditions and flood risk management) that explicitly evaluates associated ecological and social functioning in the dewatered and further downstream reaches (including, *inter alia*, sediment transport and floodplain inundation). [M 56] Publish annual report of Reservoir Operation Plan. [M 57] Implement operational maintenance schedule to ensure full and correct functioning of the Reservoir Operation Plan, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.	Low	Minor	Minor (NS)

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11.8 Geomorphology and Sediment Transport

11.8.1 Impact Producing Factors

The predicted geomorphology and sediment transport impacts during Ruzizi III pre-construction, construction, and operation have been assessed with reference to the baseline as described in the Geomorphology section of the Environmental Baseline Situation chapter. This includes a general area description and a reach-by-reach assessment of the geomorphological characteristics of: i) the reach from Lake Kivu to Ruzizi II; ii) the reach from Ruzizi II to Ruzizi III; iii) the Ruzizi III inundated area; iv) the reach from Ruzizi III to the powerhouse tailrace (the dewatered reach); v) the reach from the Ruzizi III powerhouse tailrace to the Border with Burundi (the hydropeaking reach); and vi) the reach downstream of the Burundi border. A review of sediment loading into Ruzizi III is also presented.

The main geomorphological and sediment transport impacts are further explored in the Environmental Flow Assessment chapter. Particular emphasis is given to the impacts associated with the dewatered reach between Ruzizi III dam wall and the powerhouse tailrace, and the downstream hydropeaking reach extending to the border with Burundi. The identified impacts are functionally related to the hydrological change drivers.

Potential sources of alteration to river channel geomorphology and sediment transport during pre-construction and construction comprise the following:

- Temporary river diversion.
- Runoff from worksites.
- Reservoir clearing.
- Reservoir filling.

Potential sources of alteration to river channel geomorphology and sediment transport during operation comprise the following:

- Normal powerhouse operation with peak and off-peak discharges.
- Diversion of the river through the headrace tunnel, leaving a bypassed reach of the river.
- Sediment flushing operations.
- Bottom outlet testing.
- Reservoir spillage.
- Exceptional operating conditions.

11.8.2 Assessment of Receptor Sensitivity

The sensitivity of the geomorphology and sediment transport receptor has been assessed as low as per the criteria provided in Table 11-34.

Table 11-34 Geomorphology and Sediment Sensitivity Criteria

Sensitivity of receptors	Description
High	• River channel with little or no capacity to absorb proposed changes or minimal opportunities for mitigation. • Provides vital ecosystem services (fishery, flood conveyance capacity, sediment transport). • Provides urban water supplies, major industrial abstraction or large irrigation supplies. • Is a spawning area for important fishery.
Medium	• River channel with some capacity to absorb proposed changes or limited opportunities for mitigation. • Already experiencing some level of modification from some aspect of natural condition. • At medium risk of depletion (surface waters levels falling or drying out; groundwater levels / yields falling).

Sensitivity of receptors	Description
	• Provides important ecosystem services (fishery, flood conveyance capacity, sediment transport). • Used for local village water supply source, small industrial abstraction or minor irrigation scheme. • Serves village, local industry or small irrigation user. • Provides village wastewater disposal. • Supports local fishery.
Low	• River channel with some capacity to absorb proposed changes or moderate opportunities for mitigation. • Already significantly modified from some aspect of natural condition. • Provides ecosystem services (fishery, flood conveyance capacity, sediment transport). • Used for water supply to individual dwellings or farms. • In a modified state due to existing use (e.g. existing dam/weir, gravel extraction). • Provides minor water use. • Provides isolated wastewater disposal.
Negligible	• River channel with considerable capacity to absorb proposed changes and/or good opportunities for mitigation. • Receptor already significantly modified from natural condition. • River reach severely impacted by upstream dam.

The magnitude of the alteration to geomorphology and sediment transport for the different sources of impact are assessed using the criteria provided in Table 11-35.

Table 11-35 Geomorphology and Sediment Transport Alteration Magnitude Criteria

Magnitude	Description
Major	Fundamental change to the specific environmental conditions assessed, resulting in long term or permanent change, typically widespread in nature. Would require significant intervention to return to baseline.
Moderate	Detectable change to the specific environmental conditions assessed, resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific environmental conditions assessed.
Negligible	No perceptible change to the specific environmental conditions assessed.

11.8.3 Predicted Impacts during Pre-Construction and Construction

The assessment of the impacts from alteration to geomorphology and sediment transport disturbance have been undertaken using a quantitative-qualitative approach. The assessment of potential impact is provided in Table 11-36.

Table 11-36 Potential Impacts – Geomorphology and Sediment Transport during Pre-Construction/Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Temporary river diversion	Diversion works undertaken in two-stage process. Stage 1 involves tunnelling through rock spur (no impact on river flows), Stage 2 involves damming the natural river and diverting flows through the diversion tunnels. Diversion works are expected to result in increased sediment load to the river. Normal sediment transport into the reservoir area for flows up to the construction flood (452 m^3/s) will occur: this includes sediment transport associated with the operation of the upstream Ruzizi II HEPP.	Medium	Moderate	Moderate (S)
Runoff from worksites	Runoff from worksites and disturbed areas will carry sediment into the Ruzizi River, likely increasing the sediment load in the river.	Medium	Moderate	Moderate (S)

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Vegetation clearing and in-channel civil works	Clearing of the vegetation from worksite is required prior to construction works. This activity may result in increased sediment and debris being transported into the river with runoff In-channel civil works may also cause localised increase in river sediment loads.	Medium	Moderate	Moderate (S)
Reservoir filling	Reservoir capacity at Full Supply Level (1,145 mASL) is 7.72 Mm^3) which under average flow conditions (110 m^3/s) would take approximately 20 hours to fill. However, due to dam structure stability concerns, the reservoir is expected to take circa. 12 days to fill (an average flow rate of < 8 m^3/s), the remainder of the inflow would be diverted through the diversion tunnel. Reservoir filling will result in localised reduced flow velocities and associated reduction in suspended sediment transport.	Medium	Moderate	Moderate (S)

Proposed mitigation measures and residual impacts for significant impacts are presented in Table 11-37.

Table 11-37 Mitigations & Residual Impacts – Geomorphology & Sediment Transport during Pre-Construction/Construction

Project Activity	Mitigation	Residual Impact		
		Sensitivity	Magnitude	Significance
Temporary river diversion	See also mitigations & residual impacts associated with Soils, Groundwater and Surface Water: [M 33] Cofferdams and diversion tunnels used for construction works in the river will be designed to enable suspended sediment to be carried downstream while construction is taking place.	Medium	Negligible	Negligible (NS)
Runoff from worksites	See also mitigations & residual impacts associated with Soils, Groundwater and Surface Water: [M 32] During construction, erosion mitigation measures will be employed to prevent soil erosion and fluvial erosion when undertaking works on bare soil and banks and when working in the river (EPC Contractor). [M 34] During construction, worksite surface erosion and effectiveness of control measures will be monitored by taking weekly fixed-point photos of cleared areas.	Medium	Negligible	Negligible (NS)
Vegetation clearing and in-channel civil works	See also mitigations & residual impacts associated with Soils, Groundwater and Surface Water: [M 32] During construction, erosion mitigation measures will be employed to prevent soil erosion and fluvial erosion when undertaking works on bare soil and banks and when working in the river (EPC Contractor).	Medium	Negligible	Negligible (NS)
Reservoir filling	See also mitigations & residual impacts associated with Soils, Groundwater and Surface Water: [M 35] During the reservoir filling phase, bottom sluicing will be undertaken to maintain sediment throughflow as best possible and flows will be sufficient to transport the released sediment downstream to avoid siltation of instream habitats immediately downstream of the dam.	Medium	Negligible	Negligible (NS)

11.8.4 Predicted Impacts during Operation

The assessment of the impacts during operation from alteration to geomorphological and sediment transport disturbance have been undertaken using a semi quantitative- semi qualitative approach and are presented in Table 11-38. The associated mitigation measures for significant impacts are given in Table 11-39.

Table 11-38 Potential Impacts – Geomorphology and Sediment Transport during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Normal operating conditions.	The normal operating conditions of Ruzizi III will replace the current conditions (functionally related to the existing hydropeaking operations of Ruzizi II) with conditions functionally related to: i) the reservoir footprint; ii) the dewatered reach between the bottom outlet and the powerhouse tailrace; and iii) the hydropeaking reach downstream of the powerhouse tailrace. These latter two change conditions are considered mor fully in subsequent defined project activities below. The reservoir footprint (the inundated area) will be subject to large variation in surface area, depths, and velocities on a sub-daily basis in response to both variations in seasonal inflows and to operational control of powerhouse releases (peaking and off-peaking conditions). Importantly, without active management, Ruzizi III reservoir will act as a sediment trap for both suspended sediment and bedload, and over time, sedimentation would likely occur, both reducing the live storage of the reservoir and starving downstream reaches of sediment and nutrients.	High	Major	Major (S)
Diversion of the river through the headrace tunnel, leaving a bypassed reach of the river.	The circa. 5.5 km river reach between the reservoir dam wall and powerhouse tailrace – currently subject to hydropeaking effects due to the operation of Ruzizi II – is potentially dewatered under normal operating conditions. This could result in the reach being starved of sediment and nutrients. The environmental flow regime adopted for this reach (see also hydrology predicted operational impacts) is likely to result in a large variation from the current geomorphological and sediment transport regime (that portion driven by the upstream flow regime).	Medium	Moderate	Moderate (S)
Normal powerhouse operation with peak and off-peak discharges.	The geomorphology and sediment transport impacts will be functionally related to the river flow and hydraulic conditions in the Ruzizi River downstream of the powerhouse tailrace, these will be subject to large sub-daily fluctuations, according to the operation of Ruzizi III. The impacts associated with the project are defined as the change relative to the current baseline, i.e., those experienced due to the current hydropeaking operation of Ruzizi II. The current and future operating rules for Ruzizi II and Ruzizi III are assumed to be those provided as optimised rules in the Feasibility Study. It is also assumed that power production ramp-up rates and ramp-down rates will be faster for Ruzizi III than for Ruzizi II (due to local operational conditions). The impacts have been assessed for the reach between the powerhouse tailrace and the Burundi border. The impacts are more fully described in the Environmental Flow Assessment chapter.	Medium	Moderate	Moderate (S)

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
	It is also noted that normal powerhouse operation may result in riverbed / bank erosion at the powerhouse tailrace restitution.			
Exceptional operating conditions.	Exceptional operating conditions are taken to occur whenever the reservoir spill is active occurring: i) when over a duration of greater than approx. 24 hours, inflows exceed the powerhouse flow and environmental flow regime releases (i.e., in flood conditions); and ii) during planned or accidental shutdown of the powerhouse intake and/or bottom outlet. Exceptional operating conditions without reservoir spill may also occur during planned or accidental shutdown of the powerhouse, where the bottom outlet is operated to maintain reservoir water levels below FSL. Exceptional operating conditions may result in localised riverbed / bank erosion at i) the spillway restitution and ii) the bottom outlet restitution due to erosional forces associated with the ski jump water jet(s).	Medium	Moderate	Moderate (S)

Table 11-39 Mitigations & Residual Impacts – Geomorphology and Sediment Transport during Operation

Project Activity	Mitigation	Residual Impact		
		Sensitivity	Magnitude	Significance
Normal operating conditions.	Identified mitigation measures include: i) Ensure the sustainable performance of reservoir active storage under normal and exceptional operating conditions, e.g., by sediment flushing and/or sluicing; ii) Provide periodic releases to support aquatic ecological value in the dewatered reach and/or flush sediment accumulation in the dewatered reach; iii) Prevent significant riverbed / bank erosion associated with the spillway, bottom outlet, and powerhouse tailwater restitutions. [M 58] Develop, agree with key stakeholders (e.g., other HEPP operators, ABAKIR), and implement Sediment Management Plan. [M 59] Publish annual report of Sediment Management Plan operations. [M 60] Implement operational maintenance schedule to ensure full and correct functioning of Sediment Management Plan, to include level of service agreements made with key stakeholders (e.g., other HEPP operators, ABAKIR) and recommendations for adaptive management variations.	Low	Minor	Minor (NS)
Diversion of the river through the headrace tunnel, leaving a bypassed reach of the river.		Low	Minor	Minor (NS)
Normal powerhouse operation with peak and off-peak discharges.		Low	Minor	Minor (NS)
Exceptional operating conditions.		Low	Minor	Minor (NS)

11.9 Wastes

11.9.1 Impact Producing Factors

The following types of waste are expected to be generated during Project construction:

- Spoil from tunnelling (this will be the most significant waste in terms of volume).
- Excavated spoil from creating foundations for the dam and buildings.
- Concrete and concrete washings from concrete batching plants.
- Iron and steel scrap.
- Non-ferrous scrap.
- Waste oil and lubricants from turbine installation and vehicle maintenance/repair.
- Oil contaminated rags from turbine installation and vehicle maintenance/repair.
- Packaging and pallets from deliveries.
- Domestic waste, including glass, plastics, paper and cardboard.
- Batteries.
- Fluorescent tubes.
- Timber.
- Paints and chemicals
- Tyres.

During the operational phase it is envisaged that the following types of waste will be generated:

- Oil contaminated rags from equipment maintenance/repair.
- Cement and concrete generated during maintenance.
- Chemical, paints, oils and fuels.
- Wood and timber.
- Ferrous and non-ferrous metals.
- Fluorescent tubes.
- Batteries.
- Plastic.
- Glass.
- Paper and cardboard.

11.9.2 Assessment of Receptor Sensitivity

In contract to the other types of impacts assessed in this impact assessment chapter, there is no assessment of receptor sensitivity for waste. This is because waste storage, management and disposal is considered as part of the Project design. The significance of impacts is assessed using the impact magnitude criteria provided in Table 11-40.

11.9.3 Predicted Impacts during Pre-Construction and Construction

The assessment of the impacts is presented the tables on the following pages.

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Table 11-40 Waste Impact Significance Criteria

Waste Management Option	Type of Waste		
	Inert	Non-hazardous	Hazardous
Suitable facilities or outlets available with sufficient capacity to manage the quantities of wastes generated	Negligible (Not Significant)	Negligible (Not Significant)	Minor (Not Significant)
Suitable facilities or outlets available but capacity to accept waste from project may be constrained due to size of facility or distance from site	Minor (Not Significant)	Moderate (Significant)	Moderate (Significant)
Facilities are unavailable or unsuitable; or means of management is uncertain.	Moderate (Significant)	Moderate (Significant)	Major (Significant)

Potential impacts are presented in the following table.

Table 11-41 Assessment of Potential Impacts – Wastes during Pre-Construction/Construction

Description of Waste	Potential Impact		
	Waste Type	Availability of Facilities	Significance
Excavation spoil	Inert	Unavailable	Moderate (S)
Concrete	Inert	Available but constrained	Moderate (S)
Concrete washings	Non-Hazardous	Unavailable	Moderate (S)
Iron and steel scrap non-ferrous scrap	Non-Hazardous	Available but constrained	Moderate (S)
General domestic waste, paper and cardboard, packaging, pallets, Glass, plastics and tyres	Non-Hazardous	Available but constrained	Moderate (S)
Oils and lubricants, oil contaminated rags, batteries, fluorescent tubes, paints and chemicals	Hazardous	Availability uncertain	Major (S)

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Table 11-42 Mitigations & Residual Impacts – Wastes during Pre-Construction/Construction

Project Activity	Mitigation	Residual Non-Hazardous Impact		
		Waste Type	Availability of Facilities	Significance
Excavation spoil	[M 61] The EPC Contractor will prepare a Site Waste Management Plan as part of the CESMP in alignment with GIIP and the Employers E&S Requirements. [M 62] The EPC Contractor will ensure that waste is segregated and stored on site according to GIIP, and a register of waste maintained. [M 63] The EPC Contractor will identify accredited third-party waste management facilities for the management of waste, including facilities for reuse and recycling. The facilities will be audited by the EPC Contactor to ensure compliance with GIIP and E&S requirements of the environmental permit. [M 64] Wastes that cannot be managed by offsite contractors will be managed by the EPC Contractor, and this may include construction of a landfill or installation of an incinerator. The design of these facilities will follow GIIP and environmental permits will be obtained. [M 65] The EPC Contractor make all the necessary arrangements for transport of waste that is not managed on-site to accredited offsite waste management facilities. A waste tracking system shall be implemented (waste manifests) and compliance with the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal. [M 66] If quality permits, the EPC Contactors will reuse excavation spoil material, such as for concrete formation, backfilling, foundations and road construction. Excess spoil will be disposed of at designated and specially designed spoil disposal sites and the necessary permits from local authorities obtained by the EPC Contractor. [M 67] The practice of disposing of inert spoil from road construction by side-casting is to be prohibited.	Inert	Available	Negligible (NS)
Concrete		Inert	Available	Negligible (NS)
Iron and steel scrap Non-ferrous scrap		Non-Hazardous	Available	Negligible (NS)
General domestic waste, paper and cardboard, packaging, pallets, Glass, plastics and tyres		Non-Hazardous	Available	Negligible (NS)
Oils and lubricants, oil contaminated rags, batteries, fluorescent tubes, paints and chemicals		Hazardous	Available	Minor (NS)

11.9.4 Predicted Impacts during Operation

During operation, the types of waste generated will be similar to that generated during the construction, but with smaller quantities. However, domestic trash from Bukavu and Goma which is carried by the Ruzizi River could accumulate in the Ruzizi III reservoir. The baseline situation is that the trash accumulates at the Ruzizi-I and II reservoirs, but similar problems of waste accumulation could occur at Ruzizi III. REL will manage the Project waste generated during operation using the same onsite and offsite facilities as those used by the EPC Contractor during construction. However, additional specific measures will be needed to manage the domestic trash. To this end, the following measures will be implemented:

[M 68] REL will conduct a waste management study to asses how to manage the domestic trash that accumulates in the Ruzizi III reservoir. REL will prepare a Waste Management Plan for the operation phase as part of the ESMP in alignment with GIIP and in coordination with local authorities and the operators of Ruzizi-I and -II.

[M 69] REL will ensure that waste is segregated and stored on site according to GIIP, and a register of waste maintained.

[M 70] REL will establish contracts with accredited third-party waste management facilities for the management of waste, including facilities for reuse and recycling and conduct regular audits to ensure compliance with GIIP and E&S requirements of the environmental permit.

[M 71] REL will make all the necessary arrangements for transport of waste that is not managed on-site to accredited offsite waste management facilities. A waste tracking system shall be implemented (waste manifests) and compliance with the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal.

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11.10 Aquatic Habitats and Biodiversity

11.10.1 Impact Producing Factors

Potential sources of impacts on aquatic habitats and biodiversity during pre-construction and construction comprise the following:

- Temporary river diversion resulting in a bypassed reach of river dry downstream from the site construction site.
- Sedimentation and potential pollution causing alteration to water quality of the Ruzizi River.
- Reservoir filling causing reduction in downstream flow and loss of aquatic habitat and connectivity.

Potential sources of impacts on aquatic habitats and biodiversity during operation comprise the following:

- Physical presence of the dam acting as a barrier to fish migration.
- Trapping of sediment in the reservoir reducing sediment transport downstream.
- Short-term (sub-daily to weekly) changes in river flow conditions caused by peak and off-peak discharges.
- Diversion of the river through the headrace tunnel, reducing flow in the 5.5 km bypassed reach between dam wall and powerhouse outlet.
- Periodic changes in flow conditions in the dewatered reach caused by bottom outlet testing, maintenance, sediment flushes or reservoir spillage.

The high rainfall and steep erodible slopes around the reservoir and dewatered reach increases the risks of high sediment inputs into the river.

The magnitude categories of the impacts on aquatic biodiversity are described in Table 11-43. The assessment of significance for pre-mitigation and residual impacts is presented in Table 11-45 with a summary of mitigation measures.

Table 11-43 Aquatic Habitat and Biodiversity Impact Magnitude Criteria

Magnitude (positive or negative)	Description
Major	Fundamental change to aquatic habitat conditions or biota resulting in long-term or permanent change, typically widespread. Adverse impacts would require significant intervention to return to baseline; and/or exceeds national standards and limits.
Moderate	Detectable change to the aquatic ecosystem or biota assessed resulting in long term or permanent changes at a local scale.
Minor	Detectable but minor change to the specific aquatic habitats or species assessed at a site or local scale and/or with temporary consequences.
Negligible	No perceptible change to the specific aquatic habitat or biota assessed.

11.10.2 Assessment of Receptor Sensitivity / Importance

The sensitivity of aquatic biodiversity receptors (or values) for this project is based primarily on the aquatic health of the ecosystem and presence of threatened, restricted-range or migratory species and/or habitats of high conservation value as categorised in Table 11-44.

In the case of the Project, the Present Ecological State (PES) of the aquatic habitats in the Project AoI were assessed as *Seriously Modified* based on low diversity and abundance of macroinvertebrates. These were mostly dominated by taxa tolerant of poor water quality with a high proportion of air breathers and predators, and indicator species typical of modified habitats. No threatened macroinvertebrates were confirmed or considered likely to occur. In

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addition, the aquatic plant community was dominated by a filamentous algae typical of polluted conditions and diatom composition also indicated elevated concentrations of nutrients and suspended sediments.

In the case of fish, the fish community of the Ruzizi River mainstem was dominated by indigenous species with a few alien species. The species community has undoubtedly changed from natural conditions primarily due to the peaking operation of upstream Ruzizi-I and -II hydropower plants over the last 50 years, pollution inputs, and some inundation of lotic habitats. However, there are several migratory fish species – mostly *Labeo/Labeobarbus* species - that continue to migrate up the Ruzizi River. Evidence for the presence of some fish species recorded historically (in the mid-1950s or until early 1980s) in the middle to upper Ruzizi River have not been confirmed in more recent surveys (e.g. *Acapoeta tanganicae* and *Labeobarbus leleupanus*) in the Project Area. Although the Ruzizi Basin would qualify as critical habitat for several fish species, none of the fish species confirmed in the upper and middle reaches of the Ruzizi River mainstem (i.e. the Project Area of Influence) in the past five years are considered threatened or restricted range or qualify this reach as critical habitat. The highly threatened Chiloglanis species are known predominantly from tributaries of the Ruzizi River outside the Project Area of Influence.

Table 11-44 Aquatic Habitat and Biodiversity Sensitivity Criteria

Conservation value (sensitivity)	Species Criteria	Habitat or Site Criteria
High	Areas or sites of importance for confirmed IUCN Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) species and restricted-range species (<50,000 km^2). Sites with globally, regionally or nationally significant concentrations of migratory or congregatory species.	IUCN Red-listed ecosystems that are classified as CR or EN. Internationally designated biodiversity areas including Nature Reserve and National Parks (IUCN Category I & II), UNESCO World Heritage Sites for biodiversity; recognised Key Biodiversity Areas (KBAs), Important Biodiversity Areas (IBAs), Ramsar Sites, Alliance for Zero Extinction (AZE) sites. Critical habitats of significant international ecological importance.
Medium*	Areas or sites with IUCN Near Threatened (NT) species, or possible but unconfirmed presence of VU, EN or CR species. Biome-restricted endemics (with EOO >50,000 km^2).	IUCN Red-listed ecosystems that are classified as VU. Nationally designated biodiversity areas e.g. Protected Areas, including Natural Monuments or Features (Cat III), Habitat or Species Management Areas (Cat IV), Protected Landscape (Cat V), or Protected area with sustainable use of Natural Resources (Cat VI); nominated or identified Key Biodiversity Areas (KBAs) (or equal status). Natural Habitat of significant ecological importance and/or high biodiversity with limited potential for substitution.
Low	IUCN Least Concern species of local or national importance. Nationally protected species, but not a significant population size and not of national importance.	Modified habitats with some functional ecological value.
Negligible	IUCN Least Concern species of no local or international importance.	IUCN Least Concern species. Species of no national importance.

* The aquatic biodiversity of the Ruzizi River is assessed to be of "medium" sensitivity. This is a precautionary approach because of the historical presence of potential restricted range fish species that could quality for Critical Habitat if they are confirmed to still be present in the project area and because of evidence of fish migration along the Ruzizi River. However, the rating has taken into account that the river has been modified by the hydropeaking operation of Ruzizi-I and -II hydroelectric schemes for the last 50 years.

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11.10.3 Predicted Impacts during Pre-Construction, Construction and Reservoir Filling

11.10.3.1 Predicted Pre-Mitigation Impacts - Construction

The main impacts of the construction phase on aquatic biodiversity are described below and will require mitigation, where feasible. These are summarised in Table 11-45.

A Impact of dewatering of diverted river reach on aquatic habitats and biota

A diversion tunnel will divert the Ruzizi River out of the main river over a distance of ~500-600 m to allow for dam construction. This will result in no flow in this short very steep and turbulent stretch and result in drying and loss of aquatic instream and marginal habitats and desiccation of any macroinvertebrates present. Since the aquatic habitats in the affected reach are considered Modified Habitat and macroinvertebrates exhibit low diversity and abundance this construction phase impact is considered non-significant. Fish will be unable to move through the diverted stretch and their upstream migration will be blocked during the construction period. The impact of the dam wall and reservoir as a permanent barrier to fish migration is covered in more detail in Section 11.10.4.

B Water quality impacts on macroinvertebrates and fish during construction

Construction will cause increased sedimentation and turbidity, and possibly increased contamination from minor hydrocarbon spills at and downstream of the dam and powerhouse construction sites.

- Water Pollution: Pollution events are likely to coincide with high rainfall-runoff events when contaminants will be washed into the river. This will reduce water quality conditions for aquatic biota for several kilometres downstream for the duration of the construction phase, attenuating with increasing distance downstream as contaminants become increasingly diluted, especially downstream of the Rubyiro and Ruhwa confluences located ~13 to 15 km downstream of the Ruzizi III dam site. Most fish guilds are likely to be affected to some degree except for the eurytopic tolerant guild (e.g. *Clarias gariepinus*). The toxicity to fish will depend on the size of any spills that may occur and concentrations in the receiving river. Most pollution events are likely to be sub-lethal. Fish populations are likely to adopt avoidance behaviour by moving away from affected areas and recolonisation from downstream refuges is expected following cessation of the contamination events. The impact is limited in spatial and temporal extent and is considered non-significant.
- Increased sedimentation: Runoff of sediment from construction sites, roads, unstable banks and excavated areas will generate increased sediment loads in the Ruzizi River. The degradation of water quality by high sediments releases into the river may be sporadic and associated with high rainfall-runoff events for the duration of the construction phase activities and until bare slopes may become stabilised through natural revegetation. Higher sediments loads will increase turbidity which may affect primary productivity in aquatic habitats through reduced light penetration, which could affect food availability for grazing macroinvertebrates. It may also impact negatively on predators that rely on sight for feeding such as dragonfly larvae. Deposition of mobilised sediments could also smother benthic habitats further downstream where the river velocity declines, and sediment is able to settle out during construction. However, since the macroinvertebrate community is depauperate, with low diversity and abundance, and few sensitive species (likely due to a long history of peaking operations from upstream HEPPs), construction impacts on macroinvertebrates are considered reversible and non-significant.

Turbidity also impairs prey capture by fish which will impact the invertivore guild of fish (e.g. *Enteromius* spp.) and the larval and juvenile phases of most other fish guilds. Suspended sediment increases abrasion of living tissue, removes mucous coating on gills, and clogs gill

rakers and filaments. This is likely to be sub-lethal but is expected to result in increase in stress levels and contribute to reduced growth rates and fecundity and fish condition. Fish are likely to move away from the affected areas downstream of the construction site. Recolonisation from downstream refuges is expected following cessation of activities. Avoidance of the construction affected reaches may also interrupt fish migrations for the duration of the elevated suspended sediment loading. Increased sediment deposition along river channel margins may also smother fish habitat and spawning areas possibly reducing fish recruitment. Although the upstream Ruzizi I and II HEPPs trap sediment, the extent of cultivation in the Ruzizi catchment below the Ruzizi II and occasional landslides on the steep slopes already result in increased sediment inputs especially after high rainfall events. Despite the sediment retention in upstream dams, it is likely that the fish community is already impacted by periodic high turbidity and that the fish species present are relatively resilient to seasonal increases in sediment levels. The impact is likely to be limited in spatial and temporal extent (in the order of 5-10 km during construction), and because fish species present are considered relatively tolerant of high suspended sediment loads, the impact is considered non-significant assuming good management practices are implemented to limit sediment inputs.

C Impacts on Aquatic Habitats and Macroinvertebrates (instream habitats) from Reservoir Filling

Reservoir inundation will flood ~2.3 km or 13 ha of open river habitat comprising a series of fast flowing rapids and riffles, and a ~1 km section of smooth water, possibly with pools that likely provide a refuge and resting area for fish moving up against high flow velocity. Some portions of the reservoir river reach are anastomosed with small islands separated by riffles. Most of the islands are cultivated and are of low biodiversity value as aquatic habitats. There are no off-channel wetlands or backwaters that serve as fish nursery or feeding areas and aquatic biodiversity (as reflected by macroinvertebrates) is depauperate, and already significantly impacted from upstream hydropeaking flows. Reservoir flooding will permanently inundate the aquatic habitats, and because the aquatic habitats are degraded and macroinvertebrate diversity is low, the impact on the aquatic ecosystem (excluding fish) is considered non-significant. Inundation impacts on rapid and riffle habitats for fish are described below.

D Impacts on Aquatic Habitats and Fish Species from Reservoir Filling

The reservoir filling has a duration of less than two weeks, and during this time there will be a reduction in the flow in the dewatered reach (see 11.7.3, Table 11-31). This will negatively influence the availability and suitability of aquatic habitats, due to the decreased water depth and velocity. In order to lower the significance of this impact, an environmental flow will be maintained during this period, in the same way as during operation.

Chiloglanis spp: The presence of threatened *Chiloglanis* species (*C. ruziziensis* and *C. asymetricaudalis*) in the Ruzizi River mainstem has not been confirmed and is likely to be low as a result of peaking flows from upstream hydropower dams. None were caught in mainstem during the 2021/2022 surveys in the Project AoI or during the CRBEC/CRSNE surveys over the past five years (except in tributaries). Since they are small-bodied bottom dwellers, it is considered more likely that they are present in the lower velocity riffles in tributaries to the Ruzizi where they have been recorded (e.g. Sange and Luberizi Rivers (DRC); and Kadjeke River, Burundi as well as the Ntandwe /Rubyiro Rivers (the latter where they were confirmed in 2022). Given the relatively localised loss of rapid and riffle habitat over 2.3 km in the reservoir and reduction in wetted area in the 5.5 km dewatered reach, and the likelihood that *Chiloglanis* are not present or rare in the mainstem, the impact of reservoir inundation on these threatened species is assessed as non-significant.

Migratory species: Several migratory fish of the *Labeo* and *Labeobarbus* genus, (e.g. *Labeobarbus altianalis. L. somereni; Labeo cylindricus*) occur in the Ruzizi River which migrate upstream to rapids spawn. Only one is threatened (*L. leleupanus* (VU) but which has not been confirmed in the Project AoI despite several surveys and was only recorded in main tributaries downstream of the project. Rapid and riffle habitats are considered important for spawning of migratory fish which are believed to move upstream to spawning grounds particularly when river

levels start to rise in the wet season. Some of the migratory species (e.g. *Labeobarbus / Labeo sp. such L. altianalis*) are relatively long-distance migrators that appear to migrate up to the Ruzizi II HEPP possibly from as far downstream as the Ruzizi floodplains at the northern end of Lake Tanganyika, a distance of approximately 80-100 km. However, migratory behaviour of fish in the Ruzizi is poorly understood and it is unknown the extent to which these species may migrate up other tributaries such as the Rubyiro and Ruhwa Rivers, and others, especially given the higher sediment loads carried by these rivers. It is suspected that the Ruzizi may be a preferential river for migration due to the relatively lower sediment loads carried as a result of sediment trapping in the upstream hydropower dams and presence of multiple rapids in the middle to upper reaches. Several migratory species (e.g. *L. altianalis, L. cylindricus and L. somereni* – all IUCN listed as Least Concern) have been confirmed in the fast flowing reaches of the Ruzizi River near and downstream of the Ruzizi II HEPP. In the context of the available rapid and riffle habitats in the 140 km Ruzizi River (from Lake Tanganyika to Ruzizi II HEPP), the direct inundation of 2.3 km of rapid / riffle habitats by the Ruzizi III HEPP on migratory fish is considered non-significant.

The impact of the barrier effect posed by the dam on fish migration including Critical Habitat qualifying fish is assessed under Operational Impacts in Section 11.10.4.

11.10.3.2 Mitigation Measures for Construction & Reservoir Filling Phase

Mitigation for impacts on aquatic habitats and fish during site preparation, construction and reservoir filling are mainly limited to measures to limit pollution and reduce erosion, water quality impacts and sedimentation and turbidity (see Sections 11.6 and 11.8). There is no mitigation possible for the inundation and loss of aquatic habitats during reservoir filling. Mitigation for impacts arising from construction of the dam wall, diversion tunnel and powerhouse in the river and other project infrastructure are also limited and these activities will inevitably result in increased sedimentation and turbidity of aquatic habitats during the construction period and until such time as bare riverbanks and adjacent construction sites are revegetated. The reduced flow in the dewatered reach during reservoir filling is mitigated by the release of the environmental flow in the dewatered reach, in the same way as during operation. Key construction mitigation measures to protect aquatic habitats and fish are as follows:

Prevention of sedimentation/increased turbidity

Partial mitigation of sedimentation impacts on aquatic habitats during construction can be achieved as follows:

- Discharge of the environmental flow into the dewatered reach downstream from the dam during reservoir filling.
- Riparian Buffer Zones. A riparian buffer zone of 50 m width (measured from the outer edge of the riparian zone) will be implemented within or adjacent to riparian habitats upstream and downstream of the cofferdams within which no vegetation should be removed other than necessary along the construction right of way.
- Clearance for community land uses. Measures to restrict additional clearance of land within at least 10 m of the riverbank for community agriculture shall be enforced around the reservoir and dewatered stretch. This shall form part of other sub-catchment management initiatives to limit erosion and sedimentation impacts on the Ruzizi River.
- Riparian Corridor. Measures will be implemented to prevent bank destabilisation and erosion to minimise sediment transport into rivers and streams. This could include construction of gabions, embankments / berms to limit sheet runoff from adjacent steep slopes in the reservoir catchment and create barriers to prevent landslide material entering the river course.
- Rehabilitation. Rehabilitation of disturbed areas outside (above) the reservoir full supply level will commence as soon as possible after construction work in temporary areas is completed with the aim of re-establishing indigenous vegetation and natural habitats. Seeding of grasses and monitoring and controlling alien plant invasion will be a priority, particularly along drainage lines.

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These measures are referred to elsewhere in this report as:

[M 72] A riparian buffer zone of 50 m around riparian habitats will be maintained in all construction works areas to restrict erosion and sedimentation and rehabilitation, and alien plant control will be applied after construction to re-establish natural vegetation (EPC Contractor).

[M 73] Community land use activities will be regulated within the 50 m buffer zone such that no new agricultural clearance will be permitted whatsoever within 10 m of the riverbank in the project's area of influence (reservoir and dewatered reach).

[M 74]. Protect the riparian corridor through implementing measures to reduce erosion and sediment inputs into river courses through construction of gabions, embankments, and/or berms.

11.10.3.3 Post-mitigation Impacts - Construction

Residual impacts of construction on aquatic habitats and biota are summarised in the following table (Table 11-45).

Construction phase impacts on aquatic habitats and biota will arise primarily from accidental pollution, and increased turbidity / sediment inputs, some of which can be adequately managed through good site practices (e.g. accidental spills), but some such as increased sedimentation / turbidity are inevitable and will be difficult to mitigate effectively. Taking into account the modified condition of the Ruzizi River due to upstream Ruzizi-I and -II hydropower operations and ongoing contamination from large riparian towns (Bukavu), pollution from accidental spills (if mitigated) is predicted to be of minor residual significance. Sedimentation impacts during the approximately 56-month construction phase period may have a moderate significance on downstream aquatic biodiversity but is expected to be ameliorated once construction is completed.

The most obvious direct impact of construction and reservoir filling will be the loss of aquatic and riparian habitats during reservoir filling which will inundate 2.3 km of river reach and cause a reduction in flow in the 5.5 km dewatered downstream reach. This stretch comprises extensive rapids and riffles which are considered of importance to migratory fish, in particular, and for which there is limited mitigation that can be applied. Although the affected river reach is relatively short the loss of these rapids is assessed as potentially significant for fish.

11.10.3.4 Impact Summary

The summary of impacts for pre-construction, construction and reservoir filling is provided in Table 11-45.

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Table 11-45 Summary of Impacts on Aquatic Habitats and Biodiversity during Pre-Construction/Construction & Reservoir Filling

Project Activity	Summary Description of Impact	Potential Impact				Residual Impacts		
		Sensitivity	Magnitude	Significance	Mitigation Measures	Sensitivity	Magnitude	Significance
Temporary river diversion resulting in a bypassed reach of river downstream from the site construction site.	Loss and desiccation of aquatic habitats and biota in a 500-600 m reach from water diversion	Low	Medium	Minor (Not Significant (NS))	Not applicable (impact not significant)	Low	Medium	Minor (NS)
Dam and Powerhouse construction	Pollution of river water from accidental spills on construction sites near the river may have short term localised impacts on aquatic habitats and macroinvertebrates and fish.	Medium	Low	Minor (NS)	See Section 11.6 (Soils, Ground Water and Surface water)	Medium	Low	Minor (NS)
	Increased sedimentation/ turbidity on the Ruzizi River water quality during construction on macroinvertebrates and fish causing smothering of benthic habitats, damage to fish gills and displacement of sensitive fish species to downstream reaches.	Medium	Medium	Moderate (S)	See Section 0 (Geomorphology and Sediment Transport) [M 72] A riparian buffer zone of 50 m around riparian habitats will be maintained in all construction works areas to restrict erosion and sedimentation and rehabilitation, and alien plant control will be applied after construction to re-establish natural vegetation (EPC Contractor). [M 73] Community land use activities will be regulated within the 50 m buffer zone such that no new agricultural clearance will be permitted whatsoever within 10 m of the riverbank in the project's area of influence (reservoir and dewatered reach). [M 74]. Protect the riparian corridor through implementing measures to reduce erosion and sediment inputs into river courses through construction of gabions, embankments, and/or berms.	Medium	Low	Minor (NS)
Reservoir filling	Inundation of aquatic habitats (rapids, riffles and pools) in 2.3 km (13 ha) of fast-flowing river and impact on macroinvertebrates and other non-fish biota.	Low	Medium	Minor (NS)	Not applicable (impact not significant and mitigation not feasible feasible)	Low	Medium	Minor (NS)
	Inundation of 2.3 km of fish habitats (rapid/riffles) of importance for migratory fish (e.g. *Labeo/ Labeobarbus* spp) for spawning.	Medium [a]	Medium	Moderate (S)	No mitigation feasible or possible	Medium	Medium	Moderate (S
	Dewatering of downstream Ruzizi River causing degradation of aquatic habitats and reduction in fish spawning and feeding habitats.	Medium [a]	Low	Minor (NS)	The reservoir filling has a duration of less than 2 weeks, and during this time there will be a small temporary reduction in the flow in the dewatered reach – because of the environmental flow released during reservoir filling. This will precede a greater degree of alteration of flow once operation starts.	Medium [a]	Low	Minor (NS)

11.10.4 Predicted Impacts during Operation

11.10.4.1 Potential Pre-Mitigation Impacts

A Water Quality Impacts on Aquatic Ecosystem, including Fish

The project impact on water quality during operation is assessed to be not significant (see Section 11.6) because of the short residence time in the reservoir (less than 24 hours) and the small quantity of flooded biomass in relation to the river flow. Lowering of dissolved oxygen levels in the Ruzizi River is not expected. Waste from upstream towns (e.g. Bukavu) is predicted to accumulate in the reservoir and the Project will remove and manage this waste on a routine basis (see Section 11.9). Consequently, it is unlikely that water quality impacts of the project will impact aquatic ecosystems and fish more than occurs under current baseline conditions.

B Impacts on Water Borne Pathogens and Diseases

- Reservoir: The creation of the reservoir is unlikely to increase the risk of spread of bilharzia snails, malarial mosquitos or blackflies which cause waterborne diseases. This is due to the daily fluctuating water levels in the reservoir (in the order of 12 m) which will expose the reservoir margins, causing desiccation of vegetation and any snails or insect larvae that try and establish in this zone. The potential project impact on waterborne diseases is therefore considered non-significant.
- Dewatered Reach: Downstream of the dam in the dewatered reach, reduced sediment and water flow and decreased water depth with higher temperatures may increase the prevalence of benthic algae and water weed which is likely to attract grazers such as bilharzia snails. This may result in an increase in the prevalence of bilharzia in nearby communities / water users, especially as the lower water flow in this reach may facilitate increased water contact with local residents, for fishing, washing, swimming, or water collection (if allowed to use this reach). Currently the rapid flow rate and fluctuating water levels associated with Ruzizi II hydropeaking operations presently precludes establishment of bilharzia snails in the Ruzizi River downstream of the existing HEPPs. This impact is potentially significant for local residents living/working close to or using the dewatered reach unless actively monitored and managed (e.g. through periodic release of freshets to scour accumulated sediment and create temporary conditions unsuitable for snails).

C Impacts on Fish Species from Dam Wall as Barrier to Fish Migration

There is evidence for fish migration through the Project AoI up to Ruzizi II HEPP (located approximately 14 km upstream) which is fitted with a fish pass that has not been operational for over 20 years (but which is due to be rehabilitated). Several migratory fish species were found to be impacted by fish stranding and harvesting by local residents at the spillway when spillage ceased, and more *Labeo/Labeobarbus* species were found in October/November surveys than August in 2021 (Sofreco 2021).

Although there is a fast-flowing cascade just below the proposed Ruzizi III HEPP in what will become the dewatered reach, the presence of increased abundance of migratory fish at Ruzizi II in the wet season survey (mainly *Labeobarbus altianalis*) suggests that the river is generally navigable by some migratory fish. Several of the migratory fish are believed to migrate up from the lower Ruzizi River, possibly from their spawning grounds on the floodplains at its inflow to Lake Tanganyika, ~90-130 km downstream of Ruzizi II HEPP. It is unknown whether fish preferentially migrate up the Ruzizi relative to other tributaries, but this is considered likely due to the lower turbidity and likely higher dissolved oxygen levels which are a key requirement for spawning fish such as *Labeo/Labeobarbus* species.

The Ruzizi III dam wall will stand at a height of 51 m and will prevent fish migration along the upstream 14 km stretch up to Ruzizi II HEPP, which is dominated by a series of rapids and riffles. The fast-flowing rapid cascade located immediately downstream of the dam wall likely already

restricts migration for some fish, particularly smaller-bodied migratory fish and thus it is likely that mainly the larger adult fish can access this middle-upper reach of the Ruzizi River for spawning. For those that do successfully navigate their way up to Ruzizi II HEPP, many fish are impacted by hydropeaking operations, which leaves fish stranded and subject to harvesting by local residents. In future, the reach upstream of Ruzizi III HEPP is also earmarked for Ruzizi IV HEPP, further negating the potential for fish migration in this reach (see Section 12 Cumulative Impacts).

Overall, the 'loss' of 14 km of river reach upstream of Ruzizi III HEPP as a result of the barrier effect represents a relatively small loss of available fish migration habitat as a result of the project although it comprises multiple rapids and riffles. There are extensive riffle habitats remaining downstream of the Ruzizi III HEPP in the 130 km reach to Lake Tanganyika, as well as alternative tributaries (albeit with higher sediment loads), and therefore the barrier effect of the dam wall on migratory fish is considered non-significant in the context of existing upstream HEPP operations. However, this impact is assessed in combination with the dewatered reach in Section D below.

D Impact of Minimum Flow in Dewatered Reach on Fish

The 5.5 km dewatered reach between the dam and the powerhouse will be subject to a minimum flow of 10 m^3/s (approximately 9% of the Mean Annual Flow (MAF)). While this volume of water is likely to maintain sufficient depth for fish migration (i.e. >0.3 m) over most of the reach, the width of wetted area of river course and water depth will be reduced which may result in some sections becoming more restricted and difficult for fish movement. In addition, some wider and shallower sections with riffles are expected to be subject to higher fishing intensity resulting in reduced migration and spawning success. Should fish migration be restricted in the 5.5 km dewatered reach, this impact when combined with the barrier effect restricting fish migration to the 14 km reach upstream of the reservoir may result in a combined 20 km reduction in accessible river for migratory fish. This reach is already subject to erratic hydropeaking releases and likely has reduced abundance of migratory fish compared to natural conditions. However, although there is still 123 km of Ruzizi River downstream to Lake Tanganyika with several affluent tributaries, the combination of physical reduction in rapid and riffle habitat for migratory fish and reduced survival through expected increased fishing pressures, could have a potentially significant incremental additional impact on fish migration if not mitigated. Monitoring and adaptive management (e.g. through river engineering and periodic release of freshets to reduce sedimentation and increase connectivity) is recommended to optimise conditions and enhance opportunities for fish migration in the dewatered reach. See Section 11.10.4.2 for mitigation requirements.

E Impact of Reservoir on Fish Community

The reservoir will permanently transform 2.3 km of flowing water (lotic) habitat to standing water (lentic) habitat. This transformation will have the following consequences on fish:

- The fish community structure in the reservoir will shift in favour of guilds and species better adapted to lake-like environments as well as to eurytopic (low oxygen) tolerant species such as *Clarias* and *Protopterus* spp. The new reservoir fish community is expected to resemble the upstream wetland-Lake Kivu fish communities more closely.
- The transition from river to a lake-adapted fish community structure is likely to follow a successional pattern with different species dominating at different post-filling stages. Not all rheophilic species (i.e. those adapted to flowing water) are likely to be lost, however; some lotic adapted species may still survive in the transitional reach at the upper end of the reservoir.
- Most indigenous fish are likely to decline in diversity and abundance. Cichlids and the eurytopic tolerant guilds of species may stay the same or increase, while the eupotamonic phytophilic guild of fish (such as some *Labeobarbus* species) are likely to decrease as they will have reduced access to suitable floodplain spawning habitats. Mormyrids and rheophilic species (riffle-adapted) such as some *Labeobarbus* species (and *Chiloglanis*, if present) are also unlikely to persist in the reservoir due to flooding of

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rapids and riffles. An increase in competition and predation by a more diverse and abundant cichlid community may impact the lotic parapotamonic guild (*Enteromius* barb community), which would also be impacted by the reservoir water fluctuations (of 12 m) and associated restrictions in natural establishment of riparian habitats.

Inundation and decomposition of terrestrial vegetation in the reservoir would release nutrients into the reservoir during and after the filling phase for several years and could result in a reduction on dissolved oxygen levels. Overall, inundation may result in an increase fish yield and productivity, at least in the first few months after filling, but low species diversity as the conditions will favour less sensitive fish species. Availability of food items would shift from benthic flow-dependent to zooplanktonic invertebrate taxa (although in relatively low numbers because of the short residence time of water in the reservoir). The higher secondary plankton production would be beneficial to young fish and increase recruitment of those species able to exploit the inshore reservoir habitat. Following filling, nutrient availability may decline as plant nutrients are exhausted and a species succession is likely with a possible 'trough' in productivity before new niches become occupied during the post-filling operational phase.

Given the reduced abundance of fish in the Ruzizi River as a result of the existing hydropower operation, the combined impact of the Ruzizi reservoir on aquatic habitats and the indigenous fish community and food base is considered non-significant.

F Impacts of Sub-daily Hydropeaking Flows on Aquatic Ecology in Downstream River Reaches

Maximum water level

During periods of peak flows there will be negligible incremental alteration to the maximum water level (depth), flow velocity and wetted area of the Ruzizi River downstream from the Project (see Section 11.7 Hydrology and Chapter 10 Environmental Flows Assessment). However, during off peak periods, minimum water levels will be lowered compared to current conditions during off peak flows from Ruzizi I/II. However, the degree of alteration decreases with distance downstream. At the confluence with the Ruhwa tributary (9 km downstream from the Project powerhouse), the minimum water levels will be approximately 20 cm lower than the current conditions, and 20 km and 40 km further downstream, the minimum water level are expected to be lowered by approximately 8 cm and 5 cm respectively. At the Rusizi National Park, the lowering of the minimum water level is expected to be negligible.

Regarding rates of change in water levels, downstream of the Project powerhouse, higher rates of river water level rise and fall (from peak and off-peak flow variations) are expected compared to current conditions, but the effect attenuates with distance downstream. Immediately downstream of the powerhouse, rates may be potentially 25% higher than current conditions. However, rates of change in water level will be negligible at the Rusizi National Park (over 80 km downstream) and less so at the outflow into Lake Tanganyika (130 km downstream). The rate of water level rise and fall in the 14 km immediately downstream from the project powerhouse may be in the order of 25 cm/hour or 0.5 cm per minute, which is lower than the threshold for fish stranding (>15 cm/minute).

Review of satellite imagery suggests that the activation of the floodplain in the Rusizi National Park area is caused by natural flood conditions in tributaries of the Ruzizi River (Ruhwa, Rubyiro and others), rather than elevated flows in the Ruzizi River mainstem. This is evidenced by imagery from December 2019 when there was widespread flooding in the region.

The hydropeaking mode of operation of Ruzizi-I, -II and future operation of Ruzizi-III are not expected to influence floodplain activation, since the maximum flow rate released from the Ruzizi III HEPP (150 m^3/s) is the same as the maximum flow rate currently released by the existing Ruzizi I and II HEPPs. It is noteworthy that the actual observed fluctuations in the Ruzizi River downstream in the Rusizi National Park and Ramsar site area appears to be buffered by a backwater effect from the inflow into Lake Tanganyika into the river.

In terms of determining operational impacts on aquatic biota, including fish, in the downstream reach, two aspects related to the proposed hydropeaking regime for the Project are relevant: (i) the lower than 'normal' minimum flow, and (ii) the rate of water level fall during ramp down.

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Lower minimum flow:

Based on the hydrological modelling done for this study (see Section 10.4), water levels downstream of the powerhouse are predicted to fluctuate approximately 1.66 m daily compared to current fluctuations of approximately 1.33 m as minimum water levels are predicted to be approximately 33 cm lower. This is no lower than water level during a dry year for baseline conditions. However, a lower minimum flow will result in a reduced wetted area of the river. This reduction is expected to affect mostly the wider and shallower riffle sections of the river downstream of Bugarama where fish, including those migrating upstream to spawn, may be restricted in upstream movement during part of the inter-peaking period when the river is at its lowest (i.e. around 4 am, according to the optimised operational scenario). Under this scenario, the reduction in flow and water depth is likely to occur in the middle of the night (from 10pm to 5am) when the scheme is not hydropeaking and the reservoir is filling. During the day, the river levels remain relatively high. Fish that may be constrained to sections of the river with low depth could be subject to increased fishing pressure but because this is likely to occur in the early morning hours this risk is reduced.

Sudden increases in flow associated with hydropeaking causes confusion and disrupts the daily routine movement patterns of fish. During peaking events, fish may seek hydraulic cover in deeper refuge areas, adopt a holding pattern and cease feeding. This will increase energetic costs to individual fish, disrupt normal foraging behaviours and reduce fish condition and readiness to spawn. Hydropeaking typically alters fish migration cues, causing a delay or disruption in seasonal spawning migrations and may lead to fish migrating at suboptimal periods for spawning, leading to reduced fish recruitment. However, although the river is already subject to hydropeaking flow variations and the maximum flow level will not alter with the Project, the incremental flow-related changes from hydropeaking on fish and reduction in baseflow is considered potentially significant and warrants monitoring and if necessary adaptive management. In addition, increased fishing pressure on fish to improve their survival in the shallower downstream reach during minimum flow conditions also warrants mitigation.

Ramp down rates:

Under the optimised scenario, the river levels are predicted to drop dramatically on ramp down, especially in the very dry to normal years, dropping between 6.5 cm/minute downstream of the powerhouse to 1.3 cm/min nearer the Burundi border over a 15-minute duration, coinciding with the duration over which it has been assumed that hydropeaking flow rates change due to changes in turbine operation.

Ramp down rates determine the risk of fish stranding. Fish stranding - the most widely documented hydropeaking impact on fish - is caused by down-ramping i.e., the rapid reduction in river flow following the closure of turbines at the start of off-peak demand periods. The changes in water levels resulting from these pulsed flows can result in fish being stranded on rapidly exposed shorelines (beach stranding), or in pools and depressions after the water has receded (entrapment) (Young *et al*. 2011). Although individual stranding events may not result in high mortality, the cumulative effect of frequent down-ramping can have a significant effect on fish mortalities (Young *et al*. 2011), with mortalities as high as 60% in a single season being estimated (Bauersfeld 1978). Young fish are especially susceptible to stranding because of their selection of shallow water, slow-flowing habitats along channel margins where flow ramping effects are likely to be felt more acutely. However, adult fish are also susceptible since they will move out of the main channel and into flow refugia along channel margins to avoid the high current speeds produced by up-ramping. Here they become vulnerable to stranding during the down-ramping phase (Halleraker *et al.* 2003). The effects of stranding are also likely to be more evident at night when many fish move into shallow water along the channel margins to feed. Down-ramping during the reproductive season and particularly during dry periods is likely to expose spawning nests or beds to drying, causing fish egg and larval mortality. During the up-ramping phase, fish eggs and larvae will be exposed to higher risks of being eroded from nests and spawning areas.

Several factors interact to increase the risk of fish mortality due to stranding (from Young *et al*. 2011):

- Channel morphology: a river channel with more side channels and depressions presents a higher risk than a steep-sided channel.
- Substrate type: stranding has been observed in all substrate types, but the risks of mortality are deemed higher with large substrate particle sizes.
- Down-ramping rate: an increased down-ramping rate reduces the time fish have available to escape into the main channel.
- Ramping Range: a higher ramping range (amplitude) has been shown to increase risks of stranding.
- Ramping Frequency: a higher frequency of ramping increases the number of times fish are exposed to the risk of stranding.
- Duration: a longer duration between ramping phases increases the risk of mortality, although some fish may be able to survive in pools between ramping phases.

Other factors that influence the risk of stranding and mortality due to stranding include the seasonal timing of hydropeaking, the photophase (day vs night), as well fish body size and species. Saltveit *et al*. (2001) reported that down-ramping rates of 90 cm/hr (1.5 cm/min) resulted in 60% stranding of juvenile fish, whereas Hallerraker *et al*. (2003) that stranding rates were reduced <10 cm/hour (0.15 cm/min). Moreira *et al*. 2019 reported down-ramping thresholds with the most frequently reported rates are those <0.4 cm/min (24 cm/hr), with the exception of European greyling (Auer *et al*. 2014) where rates as high as 3 cm/min (180 cm/hr) were recommended for larger juveniles.

The Ruzizi River in normal flow years is confined to a clearly defined channel with steep banks for considerable distance downstream of the powerhouse until the river widens further downstream of Bugarama. The amplitude of peaking fluctuations under Ruzizi III is predicted to attenuate downstream with the elevation range (i.e. difference between maximum and minimum flow elevations) predicted to drop from 1.66 m below the powerhouse to 1.08 m downstream of the Ruhwa (~15 km downstream of the dam). Ramp down rates over a 15-minute ramp down period are modelled to decline from 6.5 cm/min below the powerhouse to 1.3 cm/min downstream of the Ruhwa, and therefore potentially may remain within the threshold (>1 cm/min) that could cause fish stranding. However, this will need to be monitored to confirm if a 15-minute ramp down period may cause fish stranding (see ESMP).

Because the amplitude of peaking fluctuations in water level and experienced ramp-down rates will be considerably reduced 80 km downstream near the floodplains of the Ruzizi National Park, near Lake Tanganyika, it is highly unlikely that fish stranding will be a significant risk to fish inhabiting the lower floodplains.

The Environmental Flow Assessment (EFA) noted that water levels 60 km downstream of the Burundi/Rwanda border currently vary by up to 0.80 m on a daily basis (taking 4.5 hours to increase and 10 hours to decrease by this amount). It is predicted that downstream water level variation may increase by an additional 20 cm, taking 5 hours to increase, with a similar ramp up rate of 0.3 cm/min, and a slightly faster ramp down rate of 0.17 cm/minute (compared to current rate of 0.13 cm/minute). While these predictions are indicative and based on broad scale modelling with estimated (not measured) cross-sectional profiles, they do suggest that only a small incremental effect in rates of change of water level will be observed in the Rusizi National Park and Ramsar site. The rate of flow-related change will remain well under threshold values for fish stranding (of 1 cm/minute) and as such it is concluded that hydropeaking effects from Ruzizi III HEPP will present no significant transboundary impact. Given the slow incremental change in flow modelled for the downstream reach, the Project is not predicted to have significant impacts on aquatic habitats or fish species downstream within Burundi or affect the Rusizi National Park and Ramsar site (transboundary).

If found to be necessary based on fish monitoring results, impacts of water level fluctuations on fish could potentially be mitigated either by i) reducing the peak flow / off-peak flow ratio (at selected times of the day) and/or extending the duration of the ramp down period or ii) possibly, as a last resort, using river engineering solutions to increase in-river attenuation.

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G Impacts of Sediment Retention in the Reservoir on Fish

A large portion of the baseload sediment and its constituent nutrients carried by the Ruzizi River, much of which enters the river downstream of Ruzizi II HEPP, will be trapped in the Ruzizi III reservoir with mainly some suspended sediment passing through. Consequences of this sediment retention on the downstream river geomorphology is described in Section 11.8. Due to the current daily fluctuations in flow caused by upstream hydropower operations it is expected that bed scouring and armouring has already occurred and the potential for incremental bed and bank erosion will be localised. Some of the loss of sediment and nutrients trapped in the dam will be compensated by lateral inputs from the reservoir edge that are mobilised during daily water level fluctuations as well as inputs from sheet erosion and landslides. It is therefore expected that the impacts of sediment and nutrient retention in the reservoir on fish habitats and fish will be minimal.

It is most likely that sediment-related impacts on aquatic habitats and fish will arise in the dewatered reach as a result of sediment deposition from sheet erosion from agricultural plots or landslides. Depending on the extent of sediment deposition in the dewatered reach, under the proposed minimum flow of 10 m^3/s this may result in creation of gravel and sand bars which could create new aquatic habitats. However, if landslides occur this could result in blockage of the river channel, potentially causing back-flooding of the channel thereby restricting fish migration and smothering of aquatic habitats important for fish feeding and spawning.

Sedimentation inputs and fish use of the dewatered stretch will need to be monitored and adaptively managed, possibly through the release of freshets (mini-flood events) to clear sediment from the dewatered river channel. Overall, the pre-mitigation significance of sediment retention in the reservoir is considered non-significant, although there is a high degree of uncertainty in this due to the unpredictable nature of determining the extent of adverse lateral sediment inputs into the dewatered reach which could cause blockage and smothering of the river course.

H Project Impacts on Priority Fish

Five species of fish two threatened species of non-migratory *Chiloglanis* species (*C. ruziziensis* (CR) and *C. asymetricaudalis* (EN), and three migratory species (*Acapoeta tanganicae* (LC), *Labeo leleupanus* (VU), and *L. caudovittatus* (LC), have been identified as potential critical habitat qualifying species for the Middle Ruzizi River in the Critical Habitat Assessment. *Chiloglanis* species have not been confirmed in the Project Area of Influence (only tributaries e.g. Rubyiro and Ruhwa), but are of stakeholder interest. Of the migratory fish, *L. leleupanus* was recorded 34-km downstream in tributaries to the Ruzizi River, while *L. caudovittatus* has been recorded in the Middle – Upper Ruzizi River. Impacts on these species are described below.

H.1 Chiloglanis

The two *Chiloglanis* species – *C. ruziziensis* (CR) and *C. asymetricaudalis* (EN) are associated with rapid and riffle habitats in flowing rivers where they are adapted to living and grazing on the riverbed substrate for which they are adapted with a suckermouth. They are both range-restricted to the Ruzizi River Basin (although there are also distribution records for *C. asymetricaudalis* in Tanzania in a tributary west of Lake Tanganyika) and historical data records (pre-1990) confirm them to mainly be found in tributaries to the Ruzizi River. Only *C. asymetricaudalis* was found in the Rubyiro River in 2022 and neither species was recorded in the Ruzizi River mainstem either in surveys by Sofreco (2021/2022); CRBEC/CRSNE between 2018 and 2022; or by SLR (2022). However, despite the difficulty in sampling the river for these species in the high velocity flow, their presence in the mainstem Ruzizi River is doubtful especially given the history of hydropeaking over the past 50 years and, if present at all, these species are likely to occur in very low abundance relative to the tributaries.

Adverse impacts on these fish, if present, would potentially occur through i) habitat loss from inundation of 2.3 km of rapid and riffle habitat for the reservoir, and ii) fish stranding from ramp down and possible desiccation of shallow reaches of riffle habitats in dry years during inter-peaking periods when river levels drop to their lowest levels. However, if present, they could

potentially benefit from habitat improvement in the dewatered reach as a result of releasing a more stable, reduced velocity flow. This would depend on maintaining habitat condition and preventing significant sediment inputs and smothering by sediment and debris from dam construction and during operation.

Overall, since it is considered unlikely that *Chiloglanis* species are present in the Ruzizi mainstem or, if so, not in numbers that constitutes a regularly occurring stable and sustainable population, the potential impact on these threatened and endemic species are assessed as minor and non-significant. In addition, the Project will have no impact on these non-migratory species where they have been confirmed to occur in reasonable abundance in tributaries such as the Rubiyro River.

Mitigation measures for potential impacts on *Chiloglanis* (if present) and for the general fish community include water releases (freshets) from the reservoir to flush sediment out of the dewatered reach post-construction and at regular intervals (e.g. yearly or biannually) to improve habitat condition for fish. As described above, reducing peak / off-peak flow ratios and/or extending ramp down rates will assist with reducing the risk of fish stranding if this is confirmed to occur during monitoring. Fish monitoring is required to validate this prediction and determine additional protection measures for these species (which could include catchment protection measures for the Ribyiro River as an opportunity to achieve a net gain for this species if impacts are confirmed) as outlined in the framework BAP in the ESMMP.

H.2 Migratory fish

Impacts on migratory fish in general are described above and are applicable to the three migratory species considered as potential critical habitat qualifying species (*Acapoeta tanganicae, Labeo leleupanus* and *L. caudovittatus*). There are no recent published or available data for at least the last 20 years to confirm the ongoing occurrence of the first two species in the Ruzizi mainstem in the project AoI and available evidence suggests that they are more likely to be present either in Lake Tanganyika or the lower reaches of the Ruzizi River and its tributaries. Only *L. caudovittatus* (LC) has been confirmed in the Project AoI including near the Bugurama Bridge.

Since there is limited data to suggest that the Project AoI is of primary importance for the survival of these three migratory species and it is likely that that existing hydropower operations have already reduced their abundance and habitat quality, the incremental and direct impact of the Project on these migratory fish species is assessed as non-significant. However, given the presence of migratory fish in the middle to upper Ruzizi River (such as *Labeobarbus altianalis*), and potential for increased fishing pressures due to lower water levels in the dewatered reach and downstream of the powerhouse, mitigation will still need to be applied to minimise project risks on migratory fish. These include monitoring to confirm and identify impacts and potential adaptive management measures if required and appropriate such as applying reduced peak / off-peak flow ratios and/or slower ramp down rates. Measures to reduce fishing pressures on the river reaches where migratory fish are likely to congregate are also required.

I Project Impacts on Rusizi National Park and Ramsar Site

The Rusizi National Park and Ramsar Site is situated in the reach between 88 km and 130 km downstream of the Rusizi III HEPP dam and approximately 83-124 km downstream of the tailrace.

Under current baseline conditions with operation of Rusizi I and II HEPPs, based on recorded measurements taken in March 2023 approximately 120 km downstream of Rusizi III HEPP within the Rusizi National Park flow levels varied by 7-10 cm/day. Modelled predictions for Ruzizi III HEPP indicate that maximum flows levels will not change but that off-peak baseflow will be slightly lower than existing levels. Between the powerhouse and Ruhwa confluence (distance of ~10 km), the baseflow is predicted to decline from 33 cm lower than normal to 14 cm lower than normal. It is estimated that flow levels will decline on average about 1 cm/km with distance downstream (excluding flow contribution from inflowing tributaries). Under Ruzizi III HEPP, it is predicted that by the time the river reaches the Rusizi National Park starting at 80 km

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downstream, daily water level variation due to lower baseflows may be in the order of 10-15 cm/day i.e. slightly higher than current variation of 7-10 cm/day. The rate of rise and fall of the river will be marginally faster than existing baseline conditions but significantly less than the predicted ramp up rate of 6.8 cm/min and ramp down rate of 1.3 cm/min modelled for the Ruhwa confluence located approximately 60 km upstream of the Rusizi National Park.

Since migratory fish are able to swim up the Ruzizi River under the existing flow regime generated by hydropeaking of Ruzizi I and II HEPPs, and Ruzizi III HEPP will not change the maximum flow levels or velocity and will only cause a marginal change in flow variation 80 km downstream, there is no expected impact on the aquatic biodiversity of Rusizi National Park and Ramsar site. This includes the migratory fish such as *Labeobarubs leleupanus* (VU) and *Acapoeta tanganicae* which potentially qualify the lower Ruzizi River as critical habitat (for migratory species) and whose migratory movement patterns are not predicted to be affected as the flow variation rates by the time the water enters the Lower Ruzizi River will be within the threshold of 1 cm/min for fish. Given the natural variability of flow in the Ruzizi River due to seasonal rainfall events in the catchment, and the buffering effect created by backflooding of Lake Tanganyika into the lower Ruzizi River, the predicted change in flow rates in the Rusizi National Park are within the range of natural variation currently experienced by the aquatic biota of the river. This potential transboundary impact is therefore assessed as non-significant.

11.10.4.2 Mitigation Measures for Operation Phase

Mitigation for potential impacts on aquatic habitats and fish will need to be confirmed based on monitoring as outlined in Vol. IV ESMP. These include measures to mitigate water quality alteration (Section 11.6); sediment and geomorphological impacts (Section 11.8) and management of floating waste that accumulates in the reservoir (Section 11.9).

Development of aquatic water weed is not expected to occur in the Ruzizi Reservoir. However, should water weed be found to develop and spread, it will need to be managed and monitored as appropriate as described in Vol. IV ESMP.

Although spread of waterborne diseases is considered a low risk the following measures is proposed during operation. This measure is referred to elsewhere in the report as:

[M 75] Conduct monitoring of bilharzia host snails and blackflies, and prevalence of water borne diseases and identify control and management measures if required.

Box 1 – Fish pass: Although a fish pass was recommended in the earlier Sofreco ESIA (2021), a fish pass is not considered viable for this project. A fish pass, if effective, would enable upstream fish migration in the 14 km reach upstream of the reservoir to Ruzizi II HEPP which although equipped with a fish pass has not been operational for decades. This upstream reach will be further impacted by the Ruzizi IV HEPP if constructed and which would reduce the upstream reach of free-flowing river by an additional 7 km, leaving only 7 km of navigable river for fish migration.

A fish pass (or ladder/elevator) for a dam height of 51 m and for a hydropeaking project with dewatered stretch is not considered viable or feasible. This mitigation option for fish migration to access 7 to 14 km of river reach has not been considered further given the following factors: i) the poor understanding of the biology of migratory fish in Africa, ii) the lack of evidence from other dam projects in Africa that a fish pass or ladder over 50 m is viable, iii) the extensive and costly engineering works required to create a bypass channel given the steep terrain, iv) the peaking operation that will deter upstream fish movement, and v) the minimum flow proposed for the dewatered reach that would not provide sufficient attraction flows to stimulate fish to enter a fish pass, and vi) the river is already highly modified by existing HEPPs creating a cascade of barriers each of which reduce the efficiency of fish migration to a very low level.

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Box 2 – Trap and Haul: 'Trap and haul' is a potential conservation strategy to circumvent barriers to fish migration which are typically used for high value commercial fish species. It involves collecting fish and transferring and transporting fish and water in a transport tank on a truck or trailer, with release at sites above barriers. Trap and haul is considered unviable considering the i) multiple dam barriers upstream and low efficiency of any renovated fish ladders; ii) short distance between the upper most Ruzizi I HPP barrier and Lake Kivu (only 3 km); iii) steep terrain to transport fish upstream, and iv) location on a transboundary river where pressure from fishermen and community members may interfere with fish releases. Given the low potential benefits and viability of successful fish transfer, the 'trap and haul' method is not deemed to be a feasible mitigation strategy.

Minimum flow in dewatered reach

The national guidelines of DRC and Rwanda propose to maintain a constant minimum flow of 10 m^3/s in the 5.5 km dewatered reach during operation, i.e. approx. 9% of MAF. Because the river reach is already impacted by elevated and erratic peaking flows of upstream hydropower dams, this minimum flow is believed to be acceptable as long as the following additional mitigation is implemented:

- Maintain a minimum flow of 10 m^3/s at all times (regardless of the volume of inflow to the reservoir) and document this by means of automated flow monitoring and video evidence to allow transparency with international stakeholders including ABAKIR.
- Implement a minimum of biannual releases of "freshets" for a few consecutive days at a time that shall be timed to coincide with seasonal natural increases in flow with the aim of facilitating migration as well as clearing accumulated sediment from the dewatered reach. The volume of freshets required should be determined through a further modelling study but are assumed to be a minimum of 50 m^3/s for a few days.
- Conduct fish and fish habitat monitoring (i.e. sampling of gravel/riffle habitats) in the dewatered reach (commencing pre-construction) on a quarterly basis for the first three years after commencement of operation, and thereafter decreasing to biannual depending on results. This will be focussed on low flow periods (between peaking of upstream dams) to confirm ongoing presence of fish; document changes in fish community/structure and abundance, and to understand fish migration patterns. Data and monitoring reports shall be disclosed and made available to relevant institutions and lenders on a biannual basis and should not be considered confidential.
- Implement adaptive management depending on fish monitoring results which may include confirming timing and size of freshet releases and possible increased seasonal releases in the dewatered stretch; and feasible engineering solutions to improve river channel morphology for fish habitats and movement.

Due to the reduction of flow in the dewatered reach and potential for increased fishing pressures in the shallower pools that is expected to cause additional threats to fish, the following is proposed:

- Fence the powerhouse outlet area to restrict access by fishermen
- Enforce a no fishing exclusion zone in the dewatered reach and for 1 km downstream of the powerhouse outlet to improve fish spawning and dispersal ability
- Employ fish monitors / guards to enforce no fishing zones and to work with communities to improve use of sustainable fishing methods between Bugarama and the Ruhwa confluence.

These measures are summarised in this report as:

[M 76] Maintain a minimum flow of at least 10 m^3/s at all times (including during reservoir filling) with video evidence shared with ABAKIR and other stakeholders; and release freshets of at least 50 m^3/s over a few days on a biannual basis timed with rising river levels (volume to be confirmed through further modelling).

[M 77] Conduct fish monitoring and implement adaptive management based on results and disclose results to relevant institutions and lenders on a biannual basis.

[M 78] Implement and enforce a no fishing zone in dewatered reach and 1 km downstream of powerhouse and work with communities to improve sustainable fishing practices downstream of Bugarama.

Fish stranding in hydropeaking reach

[M 79] Implement fish monitoring to determine whether fish stranding occurs and determine additional mitigation if required (e.g. extended ramp down rates after each sub-daily peaking event to achieve a rate of water level drop of max. 3 cm/minute downstream of the powerhouse; or river engineering solutions to moderate flow fluctuations.

11.10.4.3 Potential Post Mitigation Impacts

Potential pre-mitigation and post-mitigation impacts of operation on aquatic habitats and biodiversity are summarised in Table 11-46.

Operation phase impacts on aquatic habitats and biota will arise primarily from

i) reduction of flow to 10 m^3/s in the dewatered reach which will reduce available aquatic habitats (through reduced wetted area) and may restrict fish movement, and which will increase fishing pressures in the shallower pools;
ii) daily fluctuations in water levels in the hydropeaking reach and lowered baseflow level which will result in an incremental increased disruption to fish behaviour and ecology, and
iii) the dam creating a barrier to fish migration and reservoir resulting in an altered fish community.

Although no formal hydrological modelling with measurements of bathymetric cross-sectional profiles was done for the downstream reach in Burundi, analysis performed for the EFA suggest that there will be very minor flow alteration extending into the floodplains of the Ruzizi National Park, and these fluctuations will be within baseline intra and inter-annual variations. Currently, water levels 60 km downstream of the Burundi/Rwanda border vary by 0.80 m on a daily basis, while under Ruzizi III HEPP operation they are predicted to increase to 1 m variation (5 hours to increase and 10 hours to decrease) (i.e. increase of approximately 20 cm). Here, ramp down rates would increase slightly from 0.13 cm/min to 0.17 cm/min (remaining well below rates that could cause fish stranding), while ramp down rates remain similar to baseline at about 0.3 cm/min. Maximum flow during peaking will be similar to current levels while minimum flow during off-peak periods may be slightly lower than current and compensated by inflows from other tributaries with increasing distance downstream.

All the residual impacts are rated as either Minor or Moderate Significance with none rated as High Significance. However, given the uncertainty regarding the hydrological modelling predictions for water levels and wetted area in the downstream reach combined with uncertainty on the extent and importance of fish migration fish monitoring will be required to confirm impacts and identify options for adaptive management. This will be particularly important for impacts related to sediment changes in the dewatered reach and fluctuating water levels in the hydropeaking reach. Other recommendations for more detailed hydrological modelling to confirm predictions are made in Section 11.7.

11.10.4.4 Impact Summary – Operational Phase

Proposed mitigation measures for significant impacts are presented in the following table (Table 11-46).

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Table 11-46 Mitigations & Residual Impacts – Aquatic Habitat & Biodiversity during Operation.

Project Activity	Summary Description of Impact	Potential Pre-Mitigation Impact			Mitigation Measures	Residual Impacts		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
Alteration of the Ruzizi River water quality.	Water quality impacts on aquatic ecosystem and fish: Water entering the reservoir will have a short residence time of <24 hours under hydropeaking operation, and therefore anoxic conditions are unlikely to develop so water quality impacts on fish in the reservoir or in the dewatered reach downstream are predicted to be minor.	Medium	Low	Minor	See Section 11.6.	Medium	Medium	Minor
Creation of reservoir with still water body and dewatered reach with reduced water flow.	Impact on water borne pathogens (e.g. malaria, bilharzia, sleeping sickness): Reservoir and dewatered reach will provide some improved habitat conditions for host vectors of water borne diseases, especially if water hyacinth is allowed to spread on the surface. The reservoir water level will fluctuate sub-daily by up to 20 m so this will to some extent discourage the establishment of bilharzia host snails on fringing vegetation. However, the low water level and slower velocity in the dewatered reach may promote malaria and bilharzia vectors to spread which may cause increased prevalence of these diseases in local communities using this river reach.	Low	Low	Minor	As for water quality above. [M 76] Maintain a minimum flow of at least 10 m3/s at all times (including during reservoir filling) with video evidence shared with ABAKIR and other stakeholders; and release freshets of at least 50 m3/s over a few days on a biannual basis timed with rising river levels (volume to be confirmed through further modelling).	Low	Low	Minor
Physical presence of the dam acting as a barrier to fish migration.	Impacts on Fish Species from Dam Wall as Barrier to Fish Migration: The dam wall of 55 m height will pose a barrier to fish migration of *Labeo/ Labeobarbus* species mainly, and will restrict access to flowing water rapids and riffles over a distance of ~14 km between the dam wall and Ruzizi II HEPP. This stretch appears to comprise potentially important rapids and pools for fish spawning but data to confirm its importance for migratory fish in comparison to lower reaches of the Ruzizi is limited.	Medium*	Medium	Moderate See Important Note* and boxes 1 & 2 in Section 11.10.4.2	No mitigation possible. Fish pass/ ladder is not considered viable for a dam of 55 m with low flow dewatered reach and peaking operation. Fish monitoring	Medium*	Medium	Moderate See Important Note* and boxes 1 & 2 in Section 11.10.4.2

Project Activity	Summary Description of Impact	Potential Pre-Mitigation Impact			Mitigation Measures	Residual Impacts		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
Presence of reservoir with still water	Impact of Reservoir on Fish Community: The fish community in the reservoir will favour fish adapted to a lake-like environment and will lead to a reduction in fish adapted to flowing water. More common and hardy fish will displace more sensitive fish species, and these are likely to include a higher abundance of alien fish species such as XX which may predate and outcompete smaller indigenous fish (especially if artificially introduced for aquaculture).	Medium*	Medium	Moderate See Important Note*	No mitigation possible. Monitoring is required to confirm change in fish community composition, including increase in alien fish species, and identify adaptive management measures if required.	Medium*	Medium	Moderate See Important Note*
Reduced water flow in dewatered stretch (5.5 km)	Impact of Reduced Flows in Dewatered Reach on Fish: Implementation of a minimum flow of 10 m^3/s in the 5.5 km dewatered reach will reduce available river wetted area and depth for fish, and possibly improve opportunities for increased fishing pressure in shallow reaches, resulting in reduced fish abundance and migration.	Medium*	Medium	Moderate See Important Note*	[M 76] Maintain a minimum flow of at least 10 m3/s at all times (including during reservoir filling) with video evidence shared with ABAKIR and other stakeholders; and release freshets of at least 50 m3/s over a few days on a biannual basis timed with rising river levels (volume to be confirmed through further modelling). [M 77] Conduct fish monitoring and implement adaptive management based on results and disclose results to relevant institutions and lenders on a biannual basis. This could include engineering solutions to improve fish habitat and continuity to assist movement, and confirm size and frequency of freshets. [M 80] Implement and enforce a no fishing zone in dewatered reach and 1 km downstream of powerhouse and work with communities to improve sustainable fishing practices downstream of Bugarama.	Medium*	Medium	Moderate See Important Note*
Sediment retention in reservoir and lateral sedimentation inputs in dewatered reach	Impact of Sediment and Nutrient Retention and Sediment Deposition in dewatered reach on fish: reduction of sediment in the dewatered reach will have a minimal incremental impact on aquatic habitats and fish from riverbed armouring and bank erosion. However, lateral sediment inputs from sheet erosion or landslides if severe and not managed may result in blockage and back-flooding in the river course, preventing fish migration and smothering habitats for fish feeding and spawning.	Medium*	Medium	Moderate See Important Note*	[M 76] Maintain a minimum flow of at least 10 m3/s at all times (including during reservoir filling) with video evidence shared with ABAKIR and other stakeholders; and release freshets of at least 50 m3/s over a few days on a biannual basis timed with rising river levels (volume to be confirmed through further modelling).	Medium*	Low	Minor

Project Activity	Summary Description of Impact	Potential Pre-Mitigation Impact			Mitigation Measures	Residual Impacts		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
Daily flow variations caused by peak and off-peak discharges and sediment related changes.	Impact of geomorphological changes from daily flow fluctuations on aquatic habitats and fish: frequent and high amplitude changes in flow may drive some localised erosion of mobile gravel and sandbars and possible slumping of riverbanks downstream of the powerhouse possibly leading to some sediment deposition in slackwater habitats. However, this is not expected to be severe as the banks are low angled and low in height and appear relatively stable, possibly having stabilised over time under the current hydropeaking regime from upstream HEPPs.	Medium*	Low	Minor	Monitoring is required to assess erosion and sediment changes induced by hydropeaking with adaptive management as required.	Medium	Low	Minor
Daily flow variations caused by peak and off-peak discharges	Impact of Sub-daily Hydropeaking Flows on Fish: Peaking operation will continue to have an incremental impact on fish through alteration of fish migration cues, but this is an ongoing impact of Ruzizi I and II HEPPs. There is some potential for fish stranding as a result of rapid ramp down rates although this is mitigated as the river is generally confined to the main river course with steep banks.	Medium*	Medium	Moderate See Important Note*	[M 79] Implement fish monitoring to determine whether fish stranding occurs and determine additional mitigation if required (e.g. extended ramp down rates after each sub-daily peaking event to achieve a rate of water level drop of max. 3 cm/minute downstream of the powerhouse; or river engineering solutions to moderate flow fluctuations.	Medium*	Low	Minor
Sediment flushing from bottom outlet of reservoir	Impact of Sediment Flushing on Fish: Sediment venting/sluicing from the dam via the bottom outlet will be done periodically (frequency to be determined) to reduce sediment build-up in the reservoir. This will result in a discharge of sediment rich and partially anoxic mud and water to the dewatered reach which may smother aquatic habitats unless managed correctly with sufficient water releases.	Medium*	Medium	Moderate See Important Note*	See Section 11.8	Medium*	Low	Minor

Project Activity	Summary Description of Impact	Potential Pre-Mitigation Impact			Mitigation Measures	Residual Impacts		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
Creation of reservoir & dewatered reach with minimum flow, and release of hydropeaking flows downstream	Project Impacts on Fish: Fish will be impacted by direct inundation of rapid/riffle habitats for the reservoir; reduced flow and possible increased sedimentation in the dewatered reach from lateral inflows possibly causing blockage and smothering of habitats; and ongoing but increased daily variability of flows in the downstream reaches, including sudden ramp down rates which could cause fish stranding. These impacts are incremental to the existing peaking regime of the Ruzizi River. In addition, lower baseflow in the dewatered reach and downstream of the powerhouse will increase fishing pressures on fish that may be unsustainable.	Medium*	Medium	Moderate See Important Note*	All the management measures in this table to mitigate impacts on water quality, sediment and geomorphology, and aquatic habitats are applicable to fish. [M 80] Implement and enforce a no fishing zone in dewatered reach and 1 km downstream of powerhouse and work with communities to improve sustainable fishing practices downstream of Bugarama	Medium*	Low	Minor
Altered flows on downstream	Project impacts on Rusizi National Park and Ramsar site: Hydrological changes in the lower reaches of the Rusizi River where it flows through the national park and Ramsar site and potential influences on the aquatic ecology were assessed to have little to no incremental impact relative to existing baseline conditions. Flows will remain within the range of normal variability 80-120 km downstream of the Ruzizi III HEPP and fish and other biota will continue to maintain lifecycles and migratory behaviour similar to current conditions.	High	Low	Minor	All the management measures in this table to mitigate impacts on water quality, sediment and geomorphology, and aquatic habitats are applicable to protection of the lower Ruzizi River and the ecology of the Rusizi National Park.	High	Low	Minor

***Important Note**

*Although the Ruzizi River in the Project AoI is considered 'modified habitat based on the aquatic status its sensitivity is rated as Medium due to the confirmed presence of several non-threatened but restricted range migratory fish that use the Ruzizi River to access upstream spawning grounds in rapids and riffles, although none are assessed to qualify as critical habitat in the Project AoI. The lower Ruzizi River in the National Park and Ramsar site is considered High sensitivity and likely to qualify for critical habitat.

Several impacts are assessed as moderate significance mainly due to the presence of migratory fish species. but many of these could be considered as non-significant in the context of the impacts caused by the existing hydropower projects (i.e. not all Moderate Impacts are considered 'Significant'). In addition, although the middle to upper Ruzizi River is not assessed as Critical Habitat a precautionary approach has been adopted in the assessment of fish impacts because of the uncertainty in fish migration and historic presence of threatened fish species.

11.11 Terrestrial Habitats and Biodiversity

11.11.1 Impact Producing Factors

Potential sources of disturbance to terrestrial habitat and biodiversity during pre-construction and construction are caused by land use changes required for:

- Site preparation.
- Construction of the dam wall and installation of permanent and temporary project facilities.
- Construction of access roads.
- Creation of the 220 kV Transmission Line wayleave.
- Reservoir impoundment.
- Creation of spoil disposal areas.
- Development of quarries and borrow areas.

Note: no quarries and borrow areas have been determined and assessed as part of this ESIA and will be assessed under a separate ESIA.

During the operation phase the primary source of impacts on terrestrial biodiversity will be i) the presence of the 220 kV Transmission Line and the maintenance of the Transmission Line wayleave, mainly through collision risk to birds, and ii) the presence of the dam infrastructure and flow-related impacts on terrestrial fauna dependent on the river course such as hippopotamus and birds.

The different levels of magnitude of the impacts on terrestrial biodiversity are described in Table 11-47 and different categories of sensitivity in Table 11-48. The assessment of impact significance and mitigation measures is presented in Table 11-49.

Table 11-47 Terrestrial Habitat and Biodiversity Impact Magnitude Criteria

Magnitude (positive or negative)	Description
Major	Fundamental change to terrestrial habitat or biota resulting in long term or permanent change, typically widespread (regional, national and international or transboundary in scale). Adverse impacts would require significant intervention to return to baseline; and/or exceeds national standards and limits.
Moderate	Detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific environmental conditions assessed.
Negligible	No perceptible change to the specific environmental conditions assessed.

11.11.2 Assessment of Receptor Sensitivity

The sensitivity of terrestrial biodiversity receptors (or values) is linked to the Ecological Importance (EI) of the receptor, e.g. habitats that have a high EI are considered to have higher sensitivity to construction and operational impacts of the Project than habitats with low EI (see Section 7 Environmental Baseline Situation).

Species of Conservation Concern (SCC) are also by default considered to have higher sensitivity than non-SCC. The sensitivity of the terrestrial ecology receptors is assessed to be between low and high, depending on species and habitat criteria (see Table 11-48).

The Project construction works will be undertaken in a mosaic of areas of low and medium terrestrial biodiversity sensitivity, with small patches of high sensitivity habitat (Hillslope

Grassland / Savannah) likely to be impacted. However, most of the construction phase impacts will take place in areas of low sensitivity where agriculture is the predominant land use.

Table 11-48 Terrestrial Habitat and Biodiversity Sensitivity Criteria

Conservation value (sensitivity)	Species Criteria	Habitat or Site Criteria
High	Areas or sites of importance for confirmed IUCN Critically Endangered, Endangered and Vulnerable species and restricted-range species (<50,000 km^2). Sites with globally, regionally or nationally significant concentrations of migratory or congregatory species.	IUCN Red-listed ecosystems that are classified as CR or EN. Internationally designated biodiversity areas including Nature Reserve and National Parks (IUCN Category I & II), UNESCO World Heritage Sites for biodiversity; recognised Key Biodiversity Areas (KBAs), Important Biodiversity Areas (IBAs), Ramsar Sites, Alliance for Zero Extinction (AZE) sites. Critical habitats of significant international ecological importance.
Medium	Areas or sites with IUCN Near Threatened (NT) species, or possible but unconfirmed presence of VU, EN or CR species. Biome-restricted endemics (with EOO >50,000 km^2).	IUCN Red-listed ecosystems that are classified as VU. Nationally designated biodiversity areas e.g. Protected Areas, including Natural Monuments or Features (Cat III), Habitat or Species Management Areas (Cat IV), Protected Landscape (Cat V), or Protected area with sustainable use of Natural Resources (Cat VI); nominated or identified Key Biodiversity Areas (KBAs) (or equal status). Natural Habitat of significant ecological importance and/or high biodiversity value.
Low	IUCN Least Concern species of local or national importance. Nationally protected species, but not of significant population size and not of particular national importance.	Modified habitats with some functional ecological value (e.g. fallow cultivated lands, degraded early-stage secondary shrublands).
Negligible	IUCN Least Concern species of no particular local or international biodiversity importance.	Habitats of no/little national biodiversity importance.

11.11.3 Potential Impacts during Pre-Construction, Construction & Reservoir Filling

11.11.3.1 Potential Impacts

Six impacts on terrestrial biodiversity were identified for the construction phase and are assessed in Table 11-49. The large proportion of Modified Habitat and associated faunal assemblages resulted in some impacts having a minor or negligible impact and thus requiring only limited or no mitigation actions besides standard good construction practice. A summary of the expected habitat losses for different project components is summarised in Table 4-21 in Chapter 4.7 (Habitat Status Assessment). The following impacts have Moderate significance and will require mitigation:

A Loss of Natural Habitat

A total of approximately 18 ha of largely Natural Habitat will be impacted by the Project infrastructure and construction works. Of this, 1.7 ha of High EI comprising Hillslope Grassland/Savannah occurs within the reservoir area. While Natural Habitat will be lost within the inundation zone, this is only a minor portion of the remaining habitat, and no threatened or restricted range flora species have been confirmed. The loss of this largely Natural Habitat is assessed as non-significant . The portions of habitats classed as Largely Natural Habitat in the Project AoI are generally small, fragmented areas which have been degraded through land use activities, but which still retain their native species composition and are not invaded by alien invasive species. They are typically surrounded by a mosaic of agricultural land or more degraded shrubland. No protected or internationally recognised areas are in the Project AoI with

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the nearest formally protected area being the Nyungwe Forest National Park (approximately 20 km upstream).

Of the 53.5 ha flooded by the reservoir, 32 ha or 60% comprises Cultivated /Secondary Shrubland mosaic, which when combined with the habitat losses from other project activities totals 154 ha, and which is assessed as non-significant from a biodiversity perspective.

B Loss of Species of Conservation Concern

The main habitat that is likely to support species of conservation concern (SCC) is Hillslope Grassland / Savannah, which potentially supports several highly threatened and restricted-range species, although none were confirmed despite targeted surveys in May 2024. A total of 18 ha of this habitat is located in the project infrastructure and reservoir areas including 1.7 ha in reservoir; 5.5 ha in transmission line RoW; 6.2 ha in access road corridors; and 4.8 ha in other project infrastructure sites. The main project activities with potential to impact flora SCC are aspects that will impact on Hillslope Grassland/Savannah: inundation of the reservoir would flood 1.7 ha while site clearance of the transmission line wayleave may impact 5.5 ha. While no SCC were confirmed during the five-day field survey in 2022 it is possible that some plant species, such as *Emilia subscaposa* and *Chlorophytum hirsutum*, may not have been flowering and thus overlooked. The supplementary survey undertaken during May 2024 confirmed the absence of flora SCC from the powerline route. If present within the landscape, the flora SCC are likely to be located within the inaccessible cliffs and slopes, and will therefore not be impacted by project infrastructure and activities. Given the fragmented nature of the habitats and the lack of SCC, this impact is assessed as non-significant.

C Introduction of invasive terrestrial alien plant species

The presence of a large number of invasive terrestrial alien plant species throughout the project area indicates that there is a significant seed bank of these species in the topsoil, increasing the risk of these species becoming established on ground cleared of vegetation during construction. Particularly aggressive invaders such as *Tithonia diversifolia, Lantana camara* and *Parthenium hysterophorus* will be the most likely species to become established. The project activities most likely to result in this impact are site preparation for construction of infrastructure, and transport of excavated material from quarries hosting these species, clearing of the access road and transmission line corridors, and creation of topsoil and spoil disposal areas. The potential impact of alien invasive species is considered significant and requires mitigation and monitoring to achieve a minor residual impact. This is especially pertinent to areas of Hillslope Grassland along the transmission line corridor, wherein invasive species encroachment will severely negatively impact the biodiversity value.

D Disturbance to fauna from Transmission Line Construction

The Transmission Line is routed mostly through modified habitat comprising cultivated fields, with only approximately 5.5 ha potentially affected within a 30 m wide wayleave. The number of fauna SCC potentially occurring in the entire Project area is low, but construction activities (e.g. blasting, if required) may impact on sensitive species including breeding birds of prey, some of which are still present in the project area. During 2022 a breeding pair of Rock Kestrels (*Falco rupicolus*) (listed as Least Concern by IUCN) was observed attending a nest on a cliff within the transmission line wayleave, and was confirmed again in 2024. This pair (or any others present) may abandon nest sites during construction activities depending on the seasonality of construction and type of noisy activities, especially blasting.

Construction impacts for the TL and associated access roads on such fauna is likely to have a Moderate impact pre-mitigation but will be non-significant with mitigation. The vulnerable areas for this impact along the TL route will be potential breeding habitat for birds of prey, which comprises mostly cliffs since there are few large trees on the slopes for raptors to breed in. Note: operation phase impacts of the TL are addressed below.

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E **Direct Mortality and Disturbance to Fauna from Increased Human Presence**

Responses to human-caused disturbances follow the same pattern that is used to evaluate a change in animal response to the risk of predation (Frid & Dill 2002). Consequently, prey may choose areas where there is less risk of being taken by a predator, thereby selecting certain habitats that are perceived as more secure. Essentially, this drives prey species displacement and alters species movement dynamics, essentially creating what is called a landscape of fear (Ripple & Beschta 2004, Brown & Kotler 2007). Furtive species are likely to be displaced with increased human presence.

Poaching is presently an impact within the region, specifically within the DRC territory of the PAOI, and an increase in the local human population may drive an increase in the demand for bushmeat. Poaching of mesocarnivores and primates that are important in maintaining ecosystem functioning by predating on potential pest species and dispersing seeds, respectively, will potentially have broader regional effects.

11.11.3.2 Mitigation Measures for Construction Phase

Proposed mitigation measures are presented in Table 11-49. Key mitigation measures for priority impacts are discussed in more detail below.

A **Loss of Natural Habitat**

The loss of any Natural Habitat, particularly Hillslope Grassland / Savannah, which has high EI, requires mitigation to minimise habitat losses and to achieve no net loss. This impact will mainly arise from reservoir inundation and site clearance for infrastructure, including the erection of pylons along the transmission line (TL) wayleave.

- Transmission Line: for the TL, avoidance of impacts on portions of remaining Natural Habitat can be achieved by locating pylons or towers and routing access tracks in degraded habitat where possible, and avoiding or minimising loss of Hillslope Grassland.
- Reservoir & Other Infrastructure: Where impacts on high EI habitat is unavoidable, such as the inundation zone (which contains only 1.7 ha of Hillslope Grassland Savannah), then habitat restoration in other areas of the reservoir sub-catchment should be prioritised to improve habitat condition and aid catchment management to minimise soil erosion and reservoir sedimentation. This could include restoration of overgrazed grassland and associated hillslope thickets in the reservoir catchment above the full supply level (especially in the 50 m buffer zone that will be acquired for the project), and removal of invasive alien plants from riparian thickets and wetlands. Such restoration of habitats in the reservoir sub-catchment will be sufficient to compensate for loss of the 18 ha of largely Natural Habitat. The specific measures and actions to be taken should be detailed in a restoration and monitoring plan prior to reservoir inundation. Measures could also include protecting riparian vegetation from agriculture and charcoal production by enforcing buffer zones (e.g. 50 m buffer from river margins and wetlands), thereby assisting with bank stability and biodiversity enhancement. The detailed design of project infrastructure within the project footprint shall aim to minimise loss of portions of largely Natural Habitat by prioritising use of degraded habitats where possible. Appropriate siting in more degraded areas will likely reduce the residual impact on Natural Habitat in terms of total hectares quantified, which is currently estimated at approximately 18 ha.

B **Loss of Species of Conservation Concern**

A walk-through of the transmission line route was undertaken during the May 2024 to determine the location of any threatened and/or restricted-range flora species, if any, to inform on micro-siting of pylons or the access roads. The priority species, *Emilia subscaposa, Chlorophytum hirsutum* and *Blepharis burundiensis* and *Bulbostylis longiradiata* were not located within the transmission line route. Note that although the entirety of the route could not be traversed due to these portions being inaccessible on foot due to the steep and unstable terrain, based on the

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observations made where access was possible, these species are unlikely to occur. Nevertheless, the Hillslope Grassland habitat should be impacted as minimally as possible, and if possible, the placement of pylons should not occur within it.

C Alien Plant Control

One of the most significant project-related impacts is alien plant invasion, which can be relatively easily mitigated. The first action should be the compilation of a Terrestrial Alien Invasive Plant Management, Monitoring and Control Plan (which should include an overview of key invasive species, description of control methods to be used and a schedule for plant monitoring and control actions). This should be followed by the training and equipping of a small team of staff to identify and eradicate any established populations of alien species throughout the construction phase and early operation phase. Import of material from quarries and borrow pits will be a key source of introduction of alien invasive plants and will be difficult to manage. Hence it will be important to monitor and control alien invasive plants on a continual basis where imported material is stockpiled and used. Note: quarries and borrow pits have not been assessed in this ESIA and will require separate assessment. Implementation of these measures should reduce the impact to non-significant.

D Transmission Line Construction Timing

Potential project impacts from transmission line construction on breeding raptors, especially cliff-breeding species, such as Rock Kestrels and Lanner Falcons (which were confirmed nesting on the cliffs in the TL corridor) can be minimised by confining as many noisy construction activities such as blasting to the period when raptors are least likely to be breeding, (i.e. Dec-May). The supplementary survey undertaken in May 2024 did not locate any specific nest sites. Nevertheless, construction activities that generate considerable noise and vibration should be prioritised outside of the raptor breeding season.

E Managing Human Presence

In order to reduce the impact of increased human presence from the potential 500-1,000 construction workers, Environmental Awareness Training is the primary mitigation measure. Staff must be made aware of 'no-go' areas (areas external to the working area) and that entering these areas will be considered a punishable offence. Staff are to be made aware of the importance of local biodiversity and that poaching and persecution (example killing of animals out of fear or superstition) or purchase of bushmeat is not permitted and will be made a punishable offence.

11.11.3.3 Residual Impacts

All terrestrial ecology impacts during construction are evaluated as negligible or minor post mitigation (i.e. non-significant).

The majority of terrestrial impacts can be mitigated through minimising habitat losses through optimised site design/layout and implementing good construction practice to minimise footprints, control alien invasion, and revegetate damaged areas. To achieve this pre-construction walk-through surveys are required for the transmission line to verify tower and access road locations in grassland habitat and near bird nesting cliffs, and for other infrastructure in the reservoir and powerhouse vicinity. It is expected that detailed design and infrastructure siting will reduce the size of the habitat losses calculated in this ESIA.

Compensation to achieve no net loss of the estimated hectarage of largely natural habitat for terrestrial biodiversity can be done through restoration of habitats around the reservoir and along the river course, and removal of alien species from wetlands and riparian zones. This will also yield benefits for reducing erosion and sedimentation in the reservoir.

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11.11.3.4 Impact Summary – Construction Phase

Note: since mitigation measures are applicable to several project activities these are defined for loss of natural habitat and species of concern and not by each project activity.

Table 11-49 Summary of Impact on Terrestrial Habitat & Biodiversity during Pre-Construction/Construction and Reservoir Filling

Project Activity	Summary Description of Impact	Potential Impact			Mitigation Measures	Residual Impact		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
Site preparation	Loss of natural habitat (riparian and hillslope habitat).	Medium	Low	Minor	Loss of Natural Habitat – Ruzizi III HEPP • [M 81] Construction work site planning shall seek to minimise impacts on vegetation and an Environmental Compliance Officer with ecological experience will oversee site clearance and ensure control measures are implemented (EPC Contractor). • [M 82] Construction site clearance activities will be implemented in a manner to minimise loss of vegetation by restricting footprints of vegetation removal, stockpiling and vehicle access (EPC Contractor). • [M 83] During construction, topsoil management will be implemented in accordance with a Topsoil Management Plan that defines the location, storage, size/shape and protection measures for topsoil stockpiles (EPC Contractor). • [M 84] Prepare and implement a Restoration and Rehabilitation Plan aimed at achieving no net loss of natural habitat in the reservoir sub-catchment area. Collect seed from native plants & propagate key species identified in the restoration plan in an off-site project nursery and implement progressive re-establishment of Natural Habitat wherever possible (EPC Contractor). Loss of Species of Conservation Concern [M 85] Conduct walk-through of construction area footprints prior to clearance to ensure no SCC present (low likelihood) (EPC Contractor) and micro-site infrastructure where possible if any SCC are found. Disturbance to fauna from blasting, particularly during breeding periods • [M 86] Although few breeding raptors are likely to be present, conduct a walk-through bird survey in breeding season to confirm presence of breeding birds, especially raptors and restrict blasting to periods outside of breeding season (Dec-May) where possible (EPC Contractor). Introduction of invasive alien plant species	Medium	Low	Minor
	Loss of Species of Conservation Concern.	Medium	Low	Minor		Medium	Low	Minor
	Introduction of invasive alien plant species.	Medium	Medium	Moderate		Medium	Low	Minor
	Increased human presence leading to displacement and mortality	Medium	Medium	Moderate		Medium	Low	Minor
Construction of the dam wall and installation of permanent and temporary project facilities	Loss of natural habitat (riparian and hillslope habitat).	Medium	Low	Minor		Medium	Low	Minor
	Loss of Species of Conservation Concern.	Medium	Low	Minor		Medium	Low	Minor
	Introduction of invasive alien plant species	Medium	Medium	Moderate		Medium	Low	Minor
	Disturbance to fauna (especially due to noise disturbance during blasting)	Medium	Low	Minor		Medium	Low	Minor
Development of quarries and borrow areas and spoil disposal areas	Loss of natural habitat (riparian and hillslope habitat).	Medium	Low	Minor		Medium	Low	Minor
	Introduction of invasive alien plant species	Medium	Medium	Moderate		Medium	Low	Minor
	Disturbance to fauna, particularly during breeding periods.	Medium	Low	Minor		Medium	Low	Minor
Construction of access roads	Loss of natural habitat (riparian and hillslope habitat).	Medium	Low	Minor		Medium	Low	Minor
	Introduction of invasive alien plant species	Medium	Medium	Moderate		Medium	Low	Minor
	Disturbance to fauna, particularly during breeding periods.	Medium	Low	Minor		Medium	Low	Minor

Project Activity	Summary Description of Impact	Potential Impact			Mitigation Measures	Residual Impact		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
					• [M 87] Develop and implement a Terrestrial Alien Invasive Plant Management, Monitoring and Control Plan for the HEPP and TL construction activities (EPC Contractor).			
Creation of the 220 kV Transmission Line wayleave	Loss of natural habitat (riparian and hillslope habitat)	High	Negligible	Negligible	Loss of Natural Habitat - Transmission Line • [M 88] Plan the location of pylons in degraded habitat wherever possible. • [M 89] Collect seed of typical natural grassland species for revegetating any cleared or damaged areas of Hillslope Grassland post-construction & propagate key species in off-site project nursery. • [M 90] Implement progressive re-establishment of Natural Habitat wherever possible in construction footprints. Loss of SCC - Transmission Line • [M 91] Conduct walk-through of the final confirmed pylon sites in Hillslope Grassland habitats to confirm presence of SCC to enable micro-siting of pylons or plant rescue if required. Introduction of invasive alien plant species - TL • [M 92] Implement terrestrial alien invasive plant management, monitoring and control measures along the TL wayleave and access routes during construction (EPC Contractor). Disturbance to birds, particularly during breeding periods. • [M 93] If possible, erect pylons and fit transmission lines between December and May, when few raptors are likely to be breeding.	High	Negligible	Negligible
	Loss of Species of Conservation Concern	High	Low	Moderate		Medium	Low	Minor
	Introduction of invasive alien plant species	Medium	Medium	Moderate		Medium	Low	Minor
	Disturbance to fauna, particularly during breeding periods	Medium	Medium	Moderate		Medium	Low	Minor
Reservoir impoundment	Loss of natural habitat (riparian and hillslope habitat)	Medium	Medium	Moderate	Loss of Natural Habitat • [M 94] Compile a Revegetation and Rehabilitation Plan aimed at achieving No Net Loss for the 41.8 ha of Largely Natural Habitat impacted by the Project. This should include restoration of degraded habitats in the reservoir sub-catchment above the full supply level and along the river course.. • [M 95] Implement restoration of priority habitats (Hillslope Grassland / Savannah) adjacent to the full supply level. Loss of SCC in Reservoir Impoundment • [M 96] Conduct walk-through of areas of Hillslope Grassland / Savannah, Riparian Thicket and Hillslope Thicket that will be inundated by reservoir to confirm presence, and rescue any threatened or restricted-range species that are found and can be translocated	Medium	Low	Minor
	Loss of riparian corridors for movement of fauna species	Low	Low	Minor		Low	Low	Minor
	Introduction of invasive alien plant species	Medium	Medium	Moderate		Medium	Low	Minor
	Loss of Species of Conservation Concern	Medium	Medium	Moderate		Medium	Low	Minor
	Loss of fauna through drownings	Low	Low	Minor		Low	Low	Minor

Project Activity	Summary Description of Impact	Potential Impact			Mitigation Measures	Residual Impact		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
					to similar habitat adjacent to the full supply level (i.e. buffer zone). Loss of fauna through drowning during reservoir inundation [M 97] Implement reservoir filling during lower flow, dry season periods or by regulating peaking flows from upstream hydropower plants in such a way to enable fauna (including smaller animals (e.g. snakes and other reptiles, rodents) to escape to higher ground.			

11.11.4 Predicted Impacts during Operation

11.11.4.1 Predicted Pre-Mitigation Impacts

The assessment of impact significance and mitigation measures for operational impacts on terrestrial ecology are provided below, with mitigation measures provided in Section 11.11.4.2.

A Mortality of birds in association with overhead transmission lines

Large birds such as birds of prey or waterbirds are relatively scarce in the project area, although a few species were observed during fieldwork, such as the migratory common buzzard (*Buteo buteo*), Wahlberg's Eagle (*Hieraaetus wahlbergi*) and Long-crested Eagle (*Lophaetus occipitalis*).. These species are perch-and-wait predators that will utilise the transmission line as a perching site. This will especially be prevalent within planar agricultural areas where prey is expected to be abundant. This increases the potential for electrocution by non-insulated energised components. This is due to contact with wing tips or streamers. In addition, these species as well as other raptor species recorded such as Lanner Falcons (*Falco biarmicus*) and Rock Kestrels (*F. rupicolus*) that are known to breed in the area, will potentially use the transmission line as a nesting site, thereby also causing the risk of electrocution.

A number of migratory non-raptor species as white stork (*Ciconia ciconia*) also potentially occur and could be impacted. These species are known to be vulnerable to collisions with overhead transmission lines (especially the narrower earth line) and to electrocution when perched on pylons. The area of highest risk will be where the transmission lines cross Natural Habitat in the hills in the western part of the route and this is where mitigation actions will be most needed, comprising approximately 7 km of the alignment.

B Degradation of Natural Habitat along the transmission line wayleave

Most degradation or loss of Natural Habitat will have taken place during the construction phase. However, ongoing vegetation clearance and maintenance of the transmission line wayleave could result in species composition and structural changes to vegetation communities, which would be most significant in the Hillslope Grassland / Savannah community. Further loss of biodiversity will occur if herbicides are used to maintain the RoW as a result of impacts on insect pollinators and other biota.

C Introduction of Alien Plant Species

The construction phase poses the highest risk for terrestrial alien species becoming established in and around the project area, including vegetation clearance of the transmission wayleave unless adequately mitigated throughout construction. Following construction and staff demobilisation, failure to monitor and control alien plants may result in ongoing spread of aliens that may have been introduced into the project area or through spread across cleared areas from adjacent land. Alien plant encroachment invades and displaces native species, and some species can be toxic to wildlife and other grazers (including domestic livestock).

D Impacts of Reservoir on Wildlife

Creation of a lacustrine (lake like) dam in place of a flowing river will change the faunal diversity and abundance in the future reservoir. Currently there are few water birds using the fast-flowing rapids along the river which is likely linked to low prey availability (macroinvertebrates and fish). Hippopotamuses are resident further downstream below Bugarama with crocodiles also present further down river, especially in Burundi. The reservoir water level is predicted to fluctuate by up to 9 m a day during operation which will restrict establishment of marginal vegetation along the edge of the water body. However, water birds may be attracted to the improved fishing in the reservoir and foraging habitat in the exposed muddy shoreline during drawdown. It is also possible that hippopotamus and crocodiles could move upstream of Bugarama and become established in the reservoir if they are not exposed to human risk (and

this may lead to social consequences through damage to crops on riverbanks and could restrict future fishing activities). These wildlife changes in the reservoir are considered a non-significant adverse impact on biodiversity.

E Impacts of Altered Flows on Downstream Wildlife

Flow alterations described in Section 11.7 and the EFA (in Chapter 10) will cause: i) significantly reduced flow in the 5.5 km dewatered reach during normal operations (non-flood periods) resulting in a shallower river with rapids and pools compared to the existing fast-flowing rapids, ii) similar maximum flow rates as existing but reduced off-peak baseflow elevation and velocity, and reduction in wetted bank area in downstream hydropeaking reaches, (which will mainly occur at night), and iii) increased rate of water level rise (ramp up) from around 7cm/min (existing) to 12 cm/min (future), and fall (ramp down) from around 0.8 cm/min (existing) to 6.5 cm/min (future, downstream the powerhouse). These hydrological effects will attenuate (decrease) with increasing distance downstream, buffered by inflows from other tributaries, and causing a minor change in water level downstream of the Ruhwa River. By the time the river reaches the Rusizi National Park and Ramsar site modelled results predict that the water level will be in the order of around 10 cm lower during off peak periods than current baseline conditions. Overall daily water levels are predicted to vary by a total of 1 m a day compared to the current conditions modelled prediction of 80 cm per day, 60 km downstream of the Burundi border. However, this modelled variation is further dampened by backflooding of Lake Tanganyika into the Ruzizi River which appears to account for the observed 7-10 cm variation measured 14 km upstream of the Ruzizi River mouth (where it enters the lake). This level of variation is within the elevation range typically experienced under existing conditions with the addition of variable seasonal rainfall.

Under these predicted flow conditions, there will be no or minimal observable impact on wildlife dependent on the downstream reaches in Burundi including the Rusizi National Park and Ramsar site and therefore no transboundary effects on wildlife are predicted. While minimum water levels will be lower, there will remain sufficient water depth and pools for hippopotamus and crocodiles, and therefore these water-dependent wildlife and waterbirds should be unaffected by the variation. The fact that the minimum water levels will occur at night when hippo are often out of the water on the banks or foraging further mitigates any potential impact of lower water levels during off peak periods. Therefore, this impact is evaluated as non-significant and no specific mitigation is required.

F Impacts of Altered Flows on Downstream Riparian Vegetation

The structural and compositional dynamics of riparian vegetation are dependent on the hydrological characteristics of a given system. The two types of riparian vegetation currently present in the downstream reach, namely Riparian Thicket and Riparian Wetland, will be impacted in different ways by the project-related changes to the river that are likely to occur. This is attributed to the differing ecological characteristics of the species in each habitat, such as the proportion of species requiring a constant wet bank or flow-dependent species. Riparian Wetlands have the higher proportion of these species and are thus more likely to be impacted as changes in depth and area of the river result in changes to the availability of a wet bank and accessibility of riparian species to flowing water. However, most of the alluvium within the downstream reach has been converted into agricultural areas. The remaining Riparian Wetlands are dominated by *Phragmites mauritiana*, and therefore this habitat type can rapidly recolonise new areas. Accordingly, the impacts to downstream riparian vegetation have been assessed as non-significant (Minor).

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11.11.4.2 Mitigation Measures for Operation

Proposed mitigation measures for significant impacts during operation are presented in Table 11-50.

A **Prevent mortality of large birds along transmission lines**

In order to lower the risk of large birds (e.g. raptors, waterbirds) colliding with overhead lines, purpose-designed bird flapper devices should be placed along the section of the route crossing ridges or elevated areas or in close proximity to cliffs or rocky outcrops where raptors are confirmed. Where feasible, another way of minimising the collision risk is to route the alignment along the side of hillslopes rather than along crests, since migrating and foraging raptors frequently follow ridge lines. In order to minimise the risk of electrocution, all pylons crossing these areas should be fitted with anti-perching devices (e.g. metal spikes) to discourage use of pylons by nesting or perching birds.

Figure 11-5 provides examples effective console designs that discourages birds from perching and nesting. In addition, a horizontal bar provides an alternative perching site away from energised components.

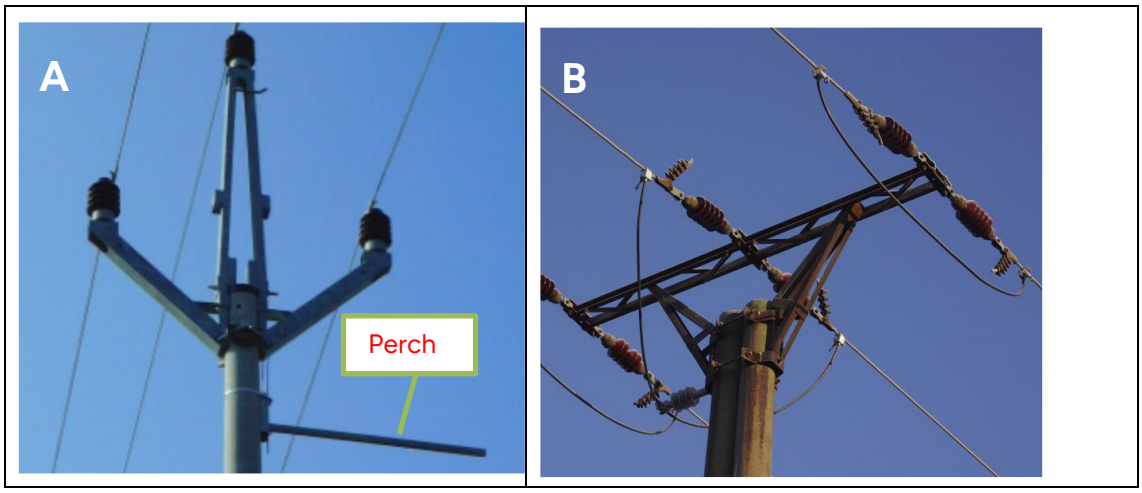

Figure 11-5 Photographs illustrating effective console designs for reducing the risk of electrocution. Source – RPS (2021).
A) The shape discourages birds from perching and nesting. The horizontal bar provides an alternative perching area away from energised components. B) Jumper wires placed under the cross-arm with fully insulated phase conductors.

The transmission line should be marked with bird diverters every 10 m along the westernmost section from the powerhouse across the ridges and slpes with Hillslope Grassland (approximately 4 km) to make the lines as visible as possible to collision-susceptible species. Shaw *et al.* (2021) demonstrated that large bird mortality was reduced by 51% (95% CI: 23–68%). Recommended bird diverters such as flapping devices (dynamic device) (Figure 11-6) and thickened wire spirals (static device) (Figure 11-6) that increase the visibility of the lines should be fitted along the transmission in priority areas, i.e., in areas of Natural Habitat. Static devices although considered less effective than dynamic devices are the preferred option due to reduced maintenance requirements.

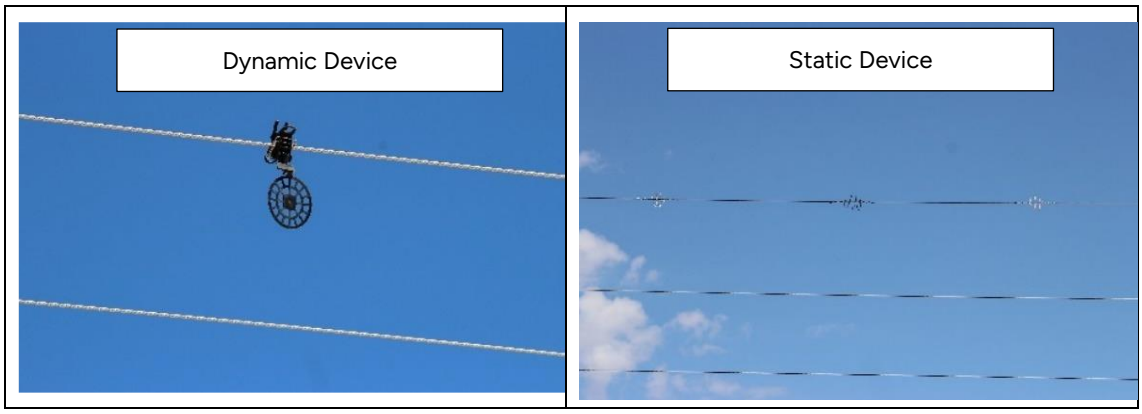

Figure 11-6 Photographs illustrating the various types of bird diverters that can be fitted on the transmission line to mitigate against bird collisions

B **Alien Plant Control**

As for the Construction Phase, a Terrestrial Alien Invasive Plant Management, Monitoring and Control Plan should be implemented during Operation – especially seasonally for the first two years or until such time as bare areas are revegetated and alien spread linked to project activities is effectively managed. This is expected to reduce the impact to non-significant.

C **Avoid habitat clearance for parts of transmission line wayleave**

Natural Habitat along the transmission line, especially Hillslope Grassland / Savannah habitat on steep slopes, should not be cleared in the wayleave but left as natural habitat as although these areas were not confirmed during the supplementary survey to contain plant SCC, these areas support an array of indigenous flora species not located in other habitats.

D **Protection of Reservoir Wildlife**

Local communities should be informed of the potential for hippopotamus and crocodiles to move into the reservoir and the associated increased risk of crop raiding and safety risks when working or fishing in the Project Area. They should be informed of the need to avoid harming wildlife and encouraged to protect them. Dam operational staff and security shall also be informed of the need to monitor for presence of wildlife and inform communities of the safety risks and requirement to protect wildlife.

11.11.4.3 Post-Mitigation Impacts

Post-mitigation impacts of operation on terrestrial ecology and their mitigation requirements are summarised in Table 11-50.

Project operation is predicted to have non-significant impacts on terrestrial fauna of negligible to minor residual significance following implementation of the mitigation measures, comprising alien invasive plant control and monitoring, erosion protection and revegetation, and mitigation for bird collision with powerlines.

11.11.4.4 Impact Summary – Operation Phase

The summary of impacts and mitigation measures for the operation phase are provided in the table overleaf.

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Table 11-50 Summary of Impacts on Terrestrial Habitats & Biodiversity during Operation

Project Activity	Summary Description of Impact	Potential Impact			Mitigation Measures	Residual Impact		
		Sensitivity	Magnitude	Significance		Sensitivity	Magnitude	Significance
Operation of the 220 kV Transmission Line	Mortality of large birds through collisions with overhead lines or electrocution while perching on pylons	Medium	Medium	Moderate	Bird collision and electrocution: • [M 98] Plan the TL route along the hillslopes rather than along the hill crests, which are often followed by raptors on migration and where collision risk is higher. • [M 99] Install bird diverters and anti-perching devices (e.g. metal spikes) along the section of the TL route crossing Natural Habitat and where bird collisions with the conductors can occur.	Medium	Low	Minor
Maintenance of the 220 kV Transmission Line wayleave	Degradation of habitat through clearance of vegetation along wayleave	High	Low	Moderate	Vegetation maintenance of transmission line wayleave [M 100] Avoid ongoing clearance of Natural Habitat along the wayleave, especially Hillslope Grassland / Savannah habitat on steep slopes unless necessary for safety reasons.	High	Negligible	Negligible
Restoration of Construction Areas	Introduction or spread of invasive alien species	Medium	Medium	Moderate	Spread of invasive alien species • [M 101] Implement a Terrestrial Alien Invasive Plant Management, Monitoring and Control Plan for the Operation Phase. • [M 102] Implement monitoring of erosion and rehabilitation / restoration success and implement additional measures if required to facilitate recovery of construction areas.	Medium	Low	Minor
Reservoir presence and operation	Attraction of increased waterbirds to fish and possible presence of hippopotamus and crocodiles in the new waterbody which may be at risk from local community members.	Medium	Low	Minor	Awareness of community members and wildlife monitoring [M 103]Inform local communities of potential for increased risk of hippopotams and crocodiles in the reservoir and related safety concerns and need to protect wildlife, and monitor and record wildife presence in the reservoir. This should be done by community liaision officers and environmental staff of REL or outsourced to external ecological consultants or reserarchers.	Medium	Low	Minor
Alteration in flows	Impacts of Altered Flows on Downstream Wildlife (including Rusizi National Park	Medium	Low	Minor	No mitigation required	Medium	Low	Minor
Alteration in flows	Impacts of Altered Flows on downstream riparian habitats	Medium	Low	Minor	Maintenance of EFlows as per Section 11.7	Medium	Low	Minor

11.12 Impacts on Local Communities' Livelihoods

This section focuses on the Project's impacts on local communities' means of livelihoods and economic activities. Data on economic and physical impacts is based on a preliminary census and asset inventory carried out in 2022. The figures provided in this section are therefore provisional and will be updated as part of the census and asset inventory update, which will be undertaken during the preparation of a Resettlement Action Plan.

Other social impacts are assessed in the following sections:

- Impacts on community Health and Safety, including risks related to the Project's vehicles traffic, are assessed in section 11.14.
- Impacts on occupational health and safety and labour conditions are assessed in section 11.13.3.
- Impacts on Cultural Heritage elements are assessed in Section 11.17.
- Impacts on ecosystems are assessed in Section 11.18.
- Jobs creation and associated indirect business opportunities during construction and operation are considered positive impacts. They are described in section 11.20.

11.12.1 Impact Producing Factors

As described in Section 8 – Social Baseline, the local communities' means of livelihood are predominantly based on crop farming. Fishing activities do occur but are not a main source of livelihood for the local communities. The impact producing factors for local communities' livelihoods are therefore mostly limited to the land acquisition process during pre-construction and construction, and to changes in the river flow during operation.

- During pre-construction: the land acquisition process and the involuntary resettlement process will occur before the start of any construction activity and will be limited to the Project's footprints.
- During construction, no construction activity will occur outside the Project's footprints. No new land acquisition is expected to occur. No impact on fishing activities or fish farming are expected during construction.
- During operation, the changes of the river flow are not expected to cause any discernible change for agricultural activities along the riverbanks, for fishing activities or for fish farming activities downstream of the powerhouse release.

11.12.2 Overview of Land Acquisition and Involuntary Resettlement Impacts

This section gives an overview of the impacts from land acquisition, including involuntary resettlement. These impacts are estimated in the Resettlement Policy Framework (Volume V of the ESIA). They are summarised hereafter for the readers convenience. It must be noted that these impacts are estimated at this stage, as some elements of the Project are yet to be defined (quarries). The Resettlement Policy Framework estimated the impacts based on a preliminary census of the affected persons. A census will be performed when Resettlement Action Plans are prepared. The impacts and the number of affected persons will then be updated.

Table 11-51 below presents an overview of the estimated impacts of the Project's land requirements. No community or collective properties are affected.

Table 11-51 Overview of Estimated Involuntary Resettlement Impacts

Country	Affected Households			
	All affected households (Physically and economically displaced)		Physically Displaced Only	
	Households	People*	Households	People*
DRC	1,546	13,928	50	485
Rwanda	703	4,015	0	0
Total both countries	2,249	17,943	50	485
* The number of individuals affected is an estimate, as some households did not declare how many members they had.				

A Physical Displacement

Physically displaced people are defined as people who will lose the residential structure (house) there are residing in on a permanent basis. During the preliminary census of 2022, 50 households were identified as affected by physical displacement (485[2] people or household's members), all in DRC. No physically displaced household has been identified in the future reservoir or the dam site. Table 11-52 below disaggregates the physically displaced people by Project component and gender of household's head.

Table 11-52 – Estimated Number of Physically Displaced People (2022 Preliminary Census)

Country	Project Components	All physically displaced households		Physically displaced women-headed households	
		Number of households	Number of physically displaced people*	Number of households	Number of physically displaced people*
DRC	LA X - Switchyard works, Disposal area 5 (DA5), Operator houses + REL sub office	11	93	3	25
	LA XI - Access Road	39	392	14	125
	Total DRC	*50*	*485*	*17*	*150*
Total Both Countries		*50*	*485*	17	150
** The number of individuals affected is an estimate, as some households did not declare how many members they had.*					

B Economic displacement

Economically displaced households are those affected by loss of land, assets or access to land or assets, leading to loss of income sources or other means of livelihood. Table 11-53 below gives their distribution by country and Sector or *Groupement* according to the preliminary census in 2022. No institutional stakeholder was identified as affected in 2022.

Overall, the Project will affect 207.51 ha of land. Table 11-53 gives summary of the number of households affected by economic displacement.

[2] The number of individuals affected is an estimate, as some households did not declare how many members they had.

Table 11-53 – Estimated Economic Displacement, Disaggregated by Country and Sector/Groupement (2022 Preliminary Census)

Country	Sector / Groupement	Number of economically displaced households	Number of economically displaced people*
Rwanda	Bugarama	367	1,952
	Nzahaha	336	2,760
Sub-total Rwanda		703	4,015
DRC	Kamanyola	599	5,597
	Karhongo	947	8,331
Sub-total DRC		1,546	13,928
Total both countries		2,249	17,943
* The number of people is only an estimate, as some households did not provide the number of households members			

An estimated number of 127 structures are affected, as indicated in Table 11-54. These structures include residential structure (houses) either occupied or abandoned, as well as non-residential structures (small barns or shelters used in fields). The occupied residential structures (houses) are those considered as physical displacement impact. One of the structures affected in a Church (in DRC). This impact is further described in Section 11.17 on Cultural Heritage.

Table 11-54 – Estimated Loss of Structures (Residential and Non-Residential)

Country	Sector / Groupement	Number of structures lost	Households losing structures*	
			Number	% of affected households
Rwanda	Bugarama	3	3	0.8%
	Nzahaha	5	3	0.9%
Sub-total Rwanda		8	6	0.9%
DRC	Kamanyola	116	51	8.5%
	Karhongo	3	3	0.3%
Sub-total DRC		119	54	3.5%
Total both countries		127	60	2.7%
* Some households own more than one structure				

The estimated loss of crops and trees are summarised in Table 11-55 below.

Table 11-55 Estimated Loss of Crops and Trees

Categories of crops or trees lost	Number of households losing crops or trees		Total area lost in ha (annual crops) Total number of perennial crops or trees lost	Average area lost in ha (annual crops) or number lost by households
	Number	% of affected households		
Annual crops	1,844	73%	154.1	0.08
Perennial crops	1,341	60%	240,895	180
Fruit trees	1,614	72%	167,384	104
Medicinal trees	1,454	61%	45,099	76
Timber trees	1,013	42%	94,930	191

11.12.3 Assessment of Receptor Sensitivity

The sensitivity of receptors is related to their socio-economic vulnerability. Vulnerability is measured by their capacity to cope with social impacts that affect their access to or control over additional or alternative social resources, ultimately affecting their wellbeing. Sensitive or vulnerable receptors generally have less means to absorb adverse changes, or to replicate beneficial changes to their resource base than non-sensitive or non-vulnerable receptors.

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A community's vulnerability might be measured in terms of its resilience to loss of community facilities, whereas an individual's vulnerability can be considered as their resilience to deprivation, loss of livelihood assets and/or opportunities (their job).

Impoverishment risks include landlessness, joblessness, homelessness, marginalisation, increased morbidity and mortality, food insecurity, loss of access to common property resources, and social de-structuring. The table below presents the guideline criteria used to categorise the sensitivity of receptors.

Table 11-56 Criteria for Determining Sensitivity

Sensitivity of receptors	Description
High	A highly vulnerable receptor with very little capacity and means to absorb socio-economic shocks and take advantage of opportunities.
Medium	A vulnerable receptor with some capacity and means to absorb socio-economic shocks and take advantage of opportunities.
Low	A non-vulnerable receptor with limited capacity and means to absorb socio-economic shocks and take advantage of opportunities.
Negligible	A non-vulnerable receptor with plentiful capacity and means to absorb socio-economic shocks and take advantage of opportunities.

As described in the baseline section and in the Resettlement Action Plan, all affected households are relying on farming activities for their subsistence, and 90% of them are also relying on crop farming as an income generating activity. Given the level of dependence on these resources, the sensitivity of these households to the impact of land acquisition is assessed as medium to high.

According to the information gathered during qualitative consultations, the Project selected the following five categories of vulnerability amongst the physically and economically displaced population:

- Women-headed households, defined as any household headed by a woman.
- Elder-headed households, defined as any household headed by a person over 65 years old living without any 18 to 64-year-old non-disabled household member.
- Disabled-headed households, defined as any household headed by a mentally or physically disabled person living without any 18 to 64-year-old non-disabled household member.
- Landless households, defined as any household without any land title, customary ownership right or customary usage right over the land plots cultivated by the household members (relying solely on sharecropping and renting).
- Historically Marginalised Households, defined as households including at least one person from the Historically Marginalised (Rwanda) / Batwa (DRC) Community (see Social Baseline).

As Table 11-57 illustrates, according to these criteria 38% of the surveyed households are vulnerable, with a percentage of vulnerability which is higher in DRC (47%) than in Rwanda (22%). Notably, 8% of surveyed households (11% in DRC and 2% in Rwanda) fall into more than one category of vulnerability. The two categories that tend to overlap the most are women-headed households and landless households: in DRC, where this trend is most evident, 9% of women-headed households are landless. Table 11-57 breaks the total percentage of vulnerable households down by category. As can be observed, the majority of the vulnerable population is made up of (i) women-headed households, the percentage of which is considerably higher in DRC than it is in Rwanda, and (ii) landless people, who are exclusively found in DRC.

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Table 11-57 Percentage of Households per Vulnerability Category

Vulnerability Category	Vulnerable Population out of all Surveyed Households (%)		
	Rwanda	Congo	All Households
Total Vulnerable Households	22%	47%	38%
Women-headed Households	13%	31%	25%
Elder-headed Households	1%	1%	1%
Disabled-headed Households	9%	3%	5%
Landless Households	0%	22%	15%
Historically Marginalised / Batwa Households	2%	1%	1%

All vulnerable households are considered of high sensitivity.

11.12.4 Predicted Impacts during Pre-Construction and Construction

The magnitude of an impact and its effects is the extent to which the impact results in a social receptor gaining or losing access to or control over socio-economic resources resulting in a beneficial or adverse effect on their wellbeing. Wellbeing refers to the financial, physical and emotional conditions.

The assessment of magnitude has been undertaken in two steps: (i) the impacts associated with the Project land acquisition have been identified; (ii), the magnitude of impacts and effects have been categorised based on consideration of the parameters listed below along with professional judgement:

- Duration of the impact
- Spatial extent of the impact
- Number of people or groups affected
- Likelihood

Table 11-58 Criteria for Determining Magnitude

Magnitude (positive or negative)	Description
Major adverse/beneficial	• A probable impact that affects the wellbeing of groups of many people or business entities within a widespread area and beyond the project life.
Moderate adverse/beneficial	• A possible impact that will likely affect either the wellbeing of a group of people or business entities beyond the local area of influence into the wider area of influence or continue beyond the project life.
Minor adverse/beneficial	• An impact that may affect the wellbeing of a small number of people and/or households or businesses, or occurs exceptionally, mostly within the project area of influence and does not extend beyond the life of the project.
Negligible	• An impact that is localised within the project's site boundary and is temporary or unlikely to occur with no detectable effects on the wellbeing of people or a business entity so that the socio-economic baseline remains consistent.

All land acquisition impacts will be permanent, as all lands will be acquired permanently. In the Transmission Line Right of way, the land will be cleared during construction, restriction of use will be applied during operation, and the affected households will continue their economic activities under the line during operation. The number of households to be affected is significant (2,249).

Therefore, the magnitude of land acquisition impacts is moderate to major adverse.

Potential impacts are presented in the following table.

Table 11-59 Potential Impacts – Physical & Economic Displacement during Pre-Construction/Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Land Acquisition (all Project's footprints)	2,249 households (17,943 people) economically displaced, including 50 households (485 people) physically displaced, losing means of livelihoods (lands, crops and trees)	Medium / High	Moderate to major adverse	Major (Significant)

Proposed mitigation measures for significant impacts are presented in the following table. The specific impacts which land acquisition may have on women's land tenure security are described in Section 11.16.1, including mitigation measures. Similarly, the impacts which land acquisition may have on rates of gender-based violence and harassment are described in Section 11.16.2.

Table 11-60 Mitigations & Residual Impacts – Physical & Economic Displacement during Pre-Construction/Construction

Project Activity	Mitigation	Residual Impact		
		Sensitivity	Magnitude	Significance
Land Acquisition (all Project's footprints)	[M 104] Implementation of the Resettlement Action Plan [M 105] Compensation of all affected lands and assets at full replacement costs [M 106] Assistance to physical resettlement [M 107] Livelihood Restoration Programme, including a transitional allowance. [M 108] Specific assistance for affected vulnerable households. [M 109] Local Area Development Plan Compensation or moving of the graves and church located in the Project acquired land plots, as defined in the Resettlement Action Plan.	Medium / High	Minor to Moderate	Minor See Note
Note: The significance is assessed as "Minor" based on the assumption that the mitigation measures will be effective. The REL E&S team has established a good relationship with PAPs through a continued consultation process. The land valuation process has confirmed a relatively low number of physically displaced households. These households have already been informed of the fact that they will be given the option to choose between replacement housing and cash compensation. Several PAPs have already expressed a preference for cash compensation, as this allows them flexibility and independence in designing their new home. Despite higher numbers of economically affected households, the number of grievances which have come out of the land valuation process are low and almost all have been resolved, except 1-2 which have been sent to the court.				

11.12.5 Predicted Impacts during Operation

No impact from Land acquisition is expected during the operation. Other potential impacts on the local communities' livelihoods could be related to the changes in the river flow.

No impact on agricultural activities are expected during operation (i) in the reservoir area, (ii) in the dewatered reach between the future dam and the powerhouse or (iii) downstream of the powerhouse.

- The creation of the reservoir at the start of operation is not expected to affect agricultural activities on its banks. There is no permanent irrigation system in this section of the Ruzizi River. Most farmers fetch water directly in the river with buckets.
- The reduction of the river flow in the dewatered reach is not expected to affect agricultural activities. There is no permanent irrigation system in this section of the river. Most farmers fetch water directly in the river with buckets. A small minority use mobile pumps with flexible pipes to water their crops during the summer period. These mobile pumps can be moved. These 2 ways of abstracting water from the river will not be affected.

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- Downstream of the Powerhouse, the river flow is not expected to change significantly compared to the existing situation. There is no permanent irrigation system in this section of the Ruzizi River.

No specific fisheries survey was performed in the Study Area. Based on the quantitative and qualitative socioeconomic information collected, fishing activities are not a primary source of income or livelihoods amongst the local communities. However, the households surveyed reported practising this activity regularly in the Ruzizi river: 39% of households in DRC and 13% in Rwanda declared that at least one of their members was fishing regularly. During operation, the lower and more regular flow in the dewatered stretch is likely to be more favourable for fishing activities. Downstream of the powerhouse release, as the changes in the river flow are not expected to be discernible fishing activities from current conditions, fishing activities are not likely to be affected in the short term. On the long term, as it should be easier to catch fishes, fishing activities may deplete the fish population. However, this is difficult to assess.

Fish Farming activities exist downstream of the powerhouse (one fish farm in Gatebe village in Rwanda, and several in DRC, close to the confluence with the Ruhwa River). As for fishing activities, these fish farms are not expected to be affected by a discernible deviation from current conditions during operation.

Potential impacts are assessed in Table 11-61below.

Table 11-61 Potential Impacts – Local Communities' Livelihoods during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Land Acquisition (all Project's footprints)	No impact anticipated during operation	Medium / High	No impact	No impact
Changes in the river flow downstream of the dam	Change in the availability of water used for irrigation of the agricultural fields along the banks of the Ruzizi.	Medium / High	negligible	Negligible (Not Significant)
	Change in the fish stocks, hence on fish catch be fishermen downstream of the dam.	Medium	Likely to be negligible	Likely to be Negligible (Not Significant)
	Change in the availability of water used for the fish farms downstream of the powerhouse in DRC and Rwanda.	Medium	negligible	Negligible (Not Significant)

No significant impact is anticipated during operation. As no data on local fisheries activity has been collected during the ESIA, the Project will monitor the fisheries activities downstream of the dam to confirm that no significant change occurs, and detect any unexpected impact, as defined in the table below

Table 11-62 Mitigations & Residual Impacts – Local Communities' Livelihoods during Operation

Project Activity	Mitigation	Residual Impact		
		Sensitivity	Magnitude	Significance
Land Acquisition (all Project's footprints)	[M 110] Monitoring of fisheries activities downstream of the dam to confirm the absence of any discernible change in fish catch because of the Project	Medium	Likely to be Negligible	Likely to be Negligible (Not Significant)

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11.13 Labour and Working Conditions

This section provides information on how REL will manage the following:

- Working conditions and management of worker relationships.
- Protecting the workforce.
- Occupational health and safety.
- Workers engaged by third parties.
- Supply chain.

Information on the management of labour and working conditions during the construction phase is provided in the subsection dealing with workers engaged by third parties.

11.13.1 Working Conditions and Management of Worker Relationships

11.13.1.1 Human Resources Policies and Procedures

REL has developed human resources policy for management of its employees. The policy is available for staff in English.

The policy includes the labour management principles that will be adopted and will include a commitment to comply with the following:

- Labour laws of Burundi, DRC and Rwanda.
- Lenders' policies on labour and working condition.

The accommodation camps for the Project's workers will be built and operated in line with the IFC-EBRD Guidance note on Workers' Accommodation. These commitments are referred to elsewhere in the E&S studies as:

[M 111] The Project's HR policy and labour management principles will align with Lenders' Policies and the labour laws of Burundi, DRC and Rwanda and be available in Kinyarwanda, English and French.

11.13.1.2 Employment

A Local Employment Objectives and Targets

REL requires that the EPC Contractor shall recruit construction workers from Burundi, DRC and Rwanda, with preference given to recruitment of workers from Project affected communities. Around 75% of workers will be unskilled. The Contractor shall use its best efforts to ensure that a minimum of 25% of these workers are from Burundi, 25% from DRC and 25% from Rwanda. Additionally, 15% of all employees (skilled and unskilled) will be women. These commitments are referred to elsewhere in the E&S studies as:

[M 112] The Project will set local employment objectives and targets.

[M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female.

B Communication of the Local Employment Objectives, Targets and Recruitment Process

The local employment objectives, targets and process will be communicated to local people by REL. The EPC Contractor's Recruitment Policy shall comply with the labour laws of Burundi, DRC and Rwanda and Lenders' Policies, and based on principles related to transparency, non-discrimination, fair treatment and equal opportunity. The content of the Recruitment Policy shall include, but not necessarily be limited to, the following:

- Statement of commitment to meeting Labour Laws of Burundi, DRC and Rwanda, ILO conventions and international guidelines with regards to recruitment and labour management, including non-discrimination and equal opportunities.
- Description of measures to be implemented by the Contractor to enhance employment opportunities for people for Project affected communities.
- Description of local recruitment process and job application procedure to be disclosed in French and English.
- Description of measures to ensure transparency of recruitment process and measures to ensure equal opportunities for all local people subject to appropriate skills.
- Description of measures to encourage women to participate in recruitment opportunities.
- Description of the disciplinary and dismissal process.
- The Contractor shall advertise all job vacancies locally.

The Contractor shall require their Subcontractors to adhere to their Recruitment Policy via the use of contractual clauses. These commitments are referred to elsewhere in this report as:

[M 114] The local Recruitment Policy will be communicated widely.

C Training

The EPC Contractor shall prepare and implement a program to provide skills training to employees recruited from Burundi, DRC and Rwanda with the objective of improving the productivity and skills of personnel. The programme shall be open to personnel designated by the Contractor but shall not involve fewer than 250 people. This commitment is referred to elsewhere in this report as:

[M 115] Construction phase training programme will be implemented by the EPC Contractor.

11.13.1.3 Workers' Organisations

The HR policies and labour management procedures developed by REL will include provisions to ensure the following:

- The Project will not seek to prevent by any means whatsoever the formation of worker organisations or any other legally-established worker group(s).
- The Project will comply with Labour Laws of Burundi, DRC and Rwanda and ILO convention concerning relations with authorised labour organisations and workers representatives.
- In the case of a stoppage of work or strike, REL will ensure that relevant managers, contractors, and other parties including Lenders are informed promptly so that appropriate engagement and action can be undertaken to resolve the issue and will arrange meetings with interest parties to resolve issues.

Additional information on the contents of the policies and procedures is provided in Vol. 3 – ESMMP. This commitment is referred to elsewhere in the E&S studies as:

[M 116] Provisions regarding allowance of workers' organizations and collective bargaining will be included in the Project's HR policy.

11.13.1.4 Non-Discrimination and Equal Opportunities

The Project's HR policy, labour management principles and labour management procedures will include provisions to ensure adherence to the principles of equal opportunities and fair treatment. There will be no discrimination with respect to employment, promotion, training, compensations, dismissal, wage and retirement on the basis of race, religion, language, ethnic identity, sexual orientation, faith, civil, social or economic status, disability, political opinion, participation in and membership in unions, pregnancy or military service. To promote the employment of women, the HR policy will include a target to recruit women for at least 15% of

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all staff positions. The project will monitor the number of positions offered to local community members and to women, throughout construction and operation. These commitments are referred to elsewhere in the E&S studies as:

[M 117] Provisions regarding non-discrimination and equal opportunities will be included in the Project's HR Policy.

11.13.1.5 Retrenchment

A workers' demobilisation plan will be prepared and implemented to mitigate the negative impacts of the decrease of jobs offered by the project at the end of the construction period (see section 11.13.4).

11.13.1.6 Workers Grievance Mechanism

REL will develop and implement a formal workers' Grievance Mechanism for all direct and sub-contracted employees that will follow legal requirements of Burundi, DRC and Rwanda and align with good international practice.

The grievance mechanism will allow workers to raise reasonable workplace concerns—including options for making anonymous grievances. The workers will be informed of the existence and functioning of the grievance mechanism at the time of hiring. REL will monitor the effectiveness of the employee grievance mechanism on regular basis.

The mechanism will involve an appropriate level of management and enable concerns to be addressed promptly in a transparent manner, and providing feedback to those concerned, without any retribution. The mechanism will not impede access to other judicial or administrative remedies that might be available under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.

Employee grievances will be registered and tracked by the HR management. Effective resolution of the employee grievances will also be monitored during labour audits. These commitments are referred to elsewhere in the E&S studies as:

[M 118] Workers' grievance mechanism will be implemented and monitored during labour audits.

11.13.2 Protecting the Work Force

11.13.2.1 Forced Labour and Child Labour

REL's HR policy and labour management principles will include a clear statement that there will be no forced labour and child labour. Measures to ensure that the EPC Contractor and its subcontractors adhere to the policy and principles are provided in section 5.6.4. This measure is referred to elsewhere in this report as:

[M 119] Project's HR Policy and labour management principles will clearly state that there will be no forced labour and child labour.

11.13.2.2 Labour Audits

During the construction phase, every 6 months an Independent Integrated Environmental, Social, Health and Safety Audit by an independent auditor will be organised and financed by REL. This audit includes labour issues. The audits will be conducted by certified external auditors. The labour component of the audit will include labour issues such as the use of local workforce, and a specific attention will be given to migrant workers and labour agents. In addition, the EPC contractor will need to provide REL with documentation demonstrating how subcontractors will be managed and how subcontractors will be required to comply with the EPC contractor's labour management commitments. This measure is referred to later in this report as:

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[M 120] REL will review the EPC contractor's subcontractors' management procedures prior to the start of construction and organise and finance 6-monthly Integrated Environmental, Social, Health and Safey audits by an independent auditor of the EPC Contractor and its subcontractors' working practices to check compliance with the Project's HR Policy, Labour laws of Burundi, DRC and Rwanda, and Lenders' labour management requirements.

11.13.2.3 Gender Based Violence and Harassment

The risk that the Project may contribute to Gender-based violence and harassment is envisaged in both Rwanda and DRC. Specific mitigation measures to deal with this risk are described in detail in Section 11.16.2.

[M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female.

[M 117] Provisions regarding non-discrimination and equal opportunities will be included in the Project's HR Policy.

[M 121] The EPC will develop a gender-sensitive recruitment strategy and communicate it to the local communities.

[M 122] REL will recruit two trained female Gender Officers (1 in Rwanda and 1 in DRC) to define and implement GBVH protocols. These protocols will apply to all Project workers, including contractors and sub-contractors. Communities will be made aware and trained regarding GBV aspects and the Workers' Code of Conduct, so that they know their rights and how to complain of needed.

[M 123] The EPC will develop and implement a workers' code of conduct, including GBVH policies, and mandatory training of all workers on sexual harassment and GBVH protocols

[M 124] The EPC contractor will develop an Occupational Health and Safety Management Plan which will gender and GBVH aspects, such as: gender-separate accommodation on camp, gender-separate lockable latrines and WASH facilities that are well-lit, conveniently located and easily accessible.

[M 125] The EPC will establish workers' safety committee which will include at least one trained female worker representative.

[M 126] The Workers' grievance mechanism and Community grievance mechanism will channel all GBVH complaints and store them on a separate database. REL's Gender Officers will be responsible for handling and solving these complaints.

[M 127] [M 145] REL's Gender officers will prepare and implement a Community Outreach Programme on Gender-based violence and harassment, to disclose the Project's GBVH protocols and reporting processes.

11.13.3 Occupational Health and Safety

The hazards to which workers may be exposed to during construction are expected to be as follows:

- Hazardous materials.
- Noise, dust and vibrations.
- Potential fire and explosion.
- Other general worksite hazards.
- Natural hazard events including seismic activity, volcanic activity and flood events.

The EPC Contractor will prepare and implement a Construction Health and Safety Plan, as well as a Community Health and Safety Plan in compliance with ISO 45001:2018 or equivalent. For this purpose, the EPC Contractor will recruit a very experienced and ISO 45001:2018 or equivalent Health and Safety Specialist. The Owner's Engineer will be responsible for the quality and adequate implementation of this Construction Health and Safety Plan will also hire for this purpose a very experienced and ISO 45001:2018 or equivalent Health and Safety Specialist (not a junior).

11.13.4 Workers Engaged by Third Parties

The workforce for the construction work will be recruited and managed by the EPC Contractor and their subcontractors. REL will ensure that the management of the labour and working conditions of these workers is implemented in alignment with labour laws of Burundi, DRC and Rwanda and Lenders' labour management requirements. The contractual labour management requirements reflect all the commitments listed in the previous section regarding:

- HR policies.
- Workers' organisations and collective bargaining.
- Workers' grievance mechanism.
- Non-discrimination and equal opportunities.
- Communication of the local employment objectives, targets and recruitment process.
- Training.
- Forced labour and child labour.

Management measures for occupational health and safety during construction under responsibility of the EPC contractor are presented in Table 11-63.

A workers' demobilisation plan will be prepared and implemented to mitigate the negative impacts of the decrease of jobs offered by the project at the end of the construction period. The key aspects of the scope are provided in Vol. IV ESMP.

Twenty-four months prior to the end of operations, the EPC Contractor shall prepare a Demobilisation Plan to anticipate significant job losses resulting from the Project's transition from construction to operation. The plan will be prepared and implemented in line with national law and good industry practice and based on the principles of non-discrimination and will reflect the Project's consultation with employees and their organizations, and eventually with the appropriate governmental agencies. This is referred to later in the report as:

[M 128] The EPC Contractor will prepare a detailed Demobilisation Plan and implement the plan at the end of the construction.

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Table 11-63 Potential Impacts – Occupational Health & Safety during Construction

Hazard	Description of the hazard	Management measures	Reference to ESMP
1. General	All hazards in general	> The EPC Contractor will establish and implement an appropriate Environmental and Social Management System (ESMS) in alignment with ISO 14001. The system will include occupational health & safety related plans, in compliance with ISO 45001:2018 or equivalent, that are included in the ESMP. > The EPC Contractor will prepare and implements a Construction Health and Safety Plan, as well as a Community Health and Safety Plan in compliance with ISO 45001:2018 or equivalent. > The EPC Contractor will recruit an experienced and ISO 45001:2018 or equivalent Health and Safety Specialist. > The Owner's Engineer should hire an experienced and ISO 45001:2018 or equivalent Health and Safety Specialist. > The occupational health and safety aspects of all work by the EPC Contractor will be in alignment with the requirements of EBRD's PR4, IFC's Performance Standards and the IFC General EHS guidelines. > The EPC Contractor will establish a workers' safety committee including worker representatives. > REL will recruit a health and safety team that is responsible for the supervision of the EPC Contractor and monitor health and safety performance.	[M 129] General construction phase occupational health and safety management measures.
2. Hazardous substances	The hazardous substances transported, stored and handled are expected to include (but not limited to) the following: > Diesel fuel for construction vehicles and machinery > Explosives for tunnelling and localised road widening work and access road construction > Lubricating oils > Used oils > Small amounts of diverse paints, solvent & chemicals > Transformer oil > Hazardous waste	> The EPC Contractor will prepare and implement a hazardous substances management plan, which will include (but not be limited to) the following: • Handling and storage conditions • Emergency procedures in case of a spill • Pollution control equipment to be installed at the storage sites: anti-pollution kits, extinguishers • Training of employees in charge of handling chemical substances and hazardous materials • Use of Personal Protective Equipment (PPE) and emergency measures in case of an incident > Hazardous substances will be transported to the site by licensed transport contractors in compliance with DRC, Rwanda and EU transport regulations. > Hazardous substances storage facilities will be designed by the EPC Contractor in alignment with national health and safety regulations of DRC and Rwanda and GIIP. > REL's health and safety team will review and validate the design of facilities from a health and safety perspective, and check the conformity of facilities and transport during construction.	[M 130] Construction phase hazardous substances management plan.

Table 11-63 Potential Impacts – Occupational Health & Safety during Construction (*Cont.)*

Hazard	Description of the hazard	Management measures	Reference to ESMP
3. Noise, dust and vibrations	Dust, noise and vibration may be caused by the following: > Traffic > General construction work > Blasting Inappropriately managed construction work may generate dust, noise and vibration at levels exceeding occupation health and safety threshold values. The blasting is carried out as part of the tunnelling work and for the new road construction.	> General measures listed under item [1] above. > The EPC Contractor will design facilities and develop execution plans, procedures and monitoring programmes to ensure that workers are not exposed to levels of noise, dust and vibrations that exceed DRC and Rwanda Occupational Health and Safety limit values and which are in alignment with IFC General EHS guidelines. > The EPC Contractor will provide workers with adequate PPE. > The EPC Contractor will develop and implement the following plans in compliance with DRC and Rwanda health and safety regulations and IFC General EHS guidelines: • Explosives management plan – included in the hazardous substances management plan • Air and dust control management plan • Noise and vibration control plan > The REL Health and Safety Team will review and validate the plans. > The REL health and safety team will check compliance with requirements during the construction work.	[M 131] Construction phase noise, dust and vibration management measures.
4. Fire and explosion	The fire and explosion hazard is represented by the transport, storage and handling of combustible, inflammable or explosive material. The principal combustible material is diesel fuel and the principle explosive material is the explosive used for blasting. Both these materials will be transported to worksite by road and stored in dedicated facilities. In the case of an accidental event workers may be affected by the consequences of the fire and/or explosion causing injury to people.	> General measures listed under item [1] above. > The EPC Contractor will implement measures to ensure that the fire and explosion risks are at acceptable levels in accordance with DRC and Rwanda health and safety regulations and IFC General EHS guidelines. These are expected to include (but not be limited to) the following: • Facilities will be designed in alignment with DRC and Rwanda safety standards and IFC General EHS guidelines • A risk assessment will be carried out in alignment with GIIP • Accidental event consequence calculation will be undertaken to confirm adequacy of safety distances • Facilities will be equipped with high integrity safety prevention and protection systems • Facilities will be equipped with emergency alarm systems • Facilities will be equipped with human and material resources for emergency response – including mobile and fixed fire-fighting equipment, ambulances, medical facilities, and medical staff • An emergency response to fire and explosion events will be included in the construction work's Emergency Preparedness Plan • Regular emergency response exercises will be organised > Regular fire & explosion safety audits will be undertaken by REL as part of the works supervision	[M 132] Construction phase fire and explosion management measures.

Table 11-63 Potential Impacts – Occupational Health & Safety during Construction (*Cont.)*

Hazard	Description of the hazard	Management measures	Reference to ESMP
4. Other general worksite hazards	> Electrical hazards: use of mobile power generators, electrical equipment > Mechanical hazards: present with (but not limited to) the use of fixed and mobile mechanical equipment for the construction of dam, buildings, infrastructure and mechanical hydraulic systems > Confined spaces: Workers involved in tunnelling will be working in confined spaces where there are risks of asphyxiation and rock falls > Deep and fast flowing water: there are risks associated with working on or near water such as the rivers or reservoirs for the workers constructing dams, weirs, other headworks facilities and tunnel outlet structures > Trips and falls: a general hazard that is present in general terms during construction work > Working at heights: this is a general hazard that is present in general terms during construction work > Extreme temperatures: the project area is subject to hot weather and heavy rain	> The EPC Contractor will establish and implement an appropriate Environmental and Social Management System (ESMS) in alignment with OHSAS 18001. The system will include occupational health & safety related plans that are included in the ESMP. > The occupational health and safety aspects of all work by the EPC Contractor will be in alignment with the requirements of lenders' health and safety requirements, and the IFC General EHS guidelines. > The EPC Contractor will establish a workers' safety committee including worker representatives. > REL will recruit a health and safety team that is responsible for the supervision of the EPC Contractor and monitor health and safety performance.	[M 129] General construction phase occupational health and safety management measures.
Natural hazards risks to workers during construction	> Risks of rock fall at the accommodation camps or at the worksites > Landslips whilst working in proximity to / operating quarries or disposal areas in the vicinity of areas of potential land instability	> Conduct a risk assessment for natural hazards for workers during construction, on all worksites, including construction camps: • Identification of natural hazards to workers during construction, for each worksite, including the construction camps • Definition of natural hazards mitigation measures for each worksite, including the construction camps	[M 133] Conduct a risk assessment for natural hazards for workers during construction.

Table 11-64 Potential Impacts – Occupational Health & Safety during Operation

Project Activity	Description of the Hazard	Management Measures	Reference to ESMP
1. General	All hazards in general	> The facilities will be designed and constructed in compliance with DRC and Rwanda health and safety regulations, GIIP and IFC General EHS Guidelines. > The facilities will be operated and maintained by REL in accordance with procedures developed in alignment with GIIP and IFC General EHS Guidelines. > REL will establish and implement an appropriate Environmental and Social Management System (ESMS) in alignment with OHSAS 18001 for the operation of the scheme. > REL will develop and implement a Health and Safety Plan addressing the health and safety hazards at the site and which are expected to encompass the same type of hazards as those addressed in construction. > REL will undertake regular health and safety risk assessments, monitor the implementation of the Health and Safety Plan and provide health and safety trainings to its employees during operation.	[M 134] General operation occupational health and safety measures: ESMS aligned with OSHAS 18001, Health and Safety Plan, Employee training.
2. Hazardous substances	Hazardous substances transported to and stored on the site are expected to include (but not limited to) the following: > Diesel fuel for diverse diesel-powered machinery such as cranes or small mobile back-up generators > Lubricating oils and hydraulic fluid > Used oils > Small amounts of diverse paints, solvent & chemicals > Hazardous waste	> General measures listed under item [1] above. > Hazardous substances will be transported to the site by licensed transport contractors in compliance with DRC and Rwanda transport regulations. > The site Health and Safety Plan (see item 1 above) will include management measures for chemicals and hazardous substances. It will be similar to the construction phase hazardous substances management plan, though adapted for smaller inventories and fewer materials.	[M 135] Operation phase hazardous substances management measures.
3. Noise	At the dam site, the main sources of noise are expected to be from mobile machinery such as cranes, motors for opening/closing gates, small mobile generators and compressors used for maintenance works, and equipment housed in machine rooms. These noise sources are of concern from an occupational health and safety perspective. At the powerhouse, the noise sources at the source are expected to include the following: > Turbines and generators > Transformers > Aeration conduit > Tailrace channel	> General measures listed under item [1] above. > Noise levels in work areas will comply with DRC and Rwanda Occupational Health and Safety limit values and which are in alignment with IFC General EHS guidelines. > For work in noisy areas, operators will be provided with suitable high-performance hearing protection devices. > Operator health checks will include checking of hearing. > Procedures will be prepared that make the use of hearing protection mandatory in areas with high noise. > Regular equipment noise monitoring will be undertaken. > Equipment will be regularly inspected and maintained to ensure that noise levels are minimised.	[M 136] Operation phase occupational noise exposure management measures.

Table 11-64 Potential Impacts – Occupational Health & Safety during Operation (*Cont.*)

Project Activity	Description of the Hazard	Management Measures	Reference to ESMP
4. Fire and explosion	The fire and explosion hazard is represented by the transport, storage and handling of combustible and inflammable substances. The principal combustible material is diesel fuel. This material will be transported to the site by road and stored in dedicated facilities. In case of an accidental event workers and communities may be affected by the consequences of the fire and/or explosion causing damage to property and/or injury to people.	> General measures listed under item [1] above. > EPC Contractor is required to implement measures to ensure that the facilities are designed fire and explosion risks are at acceptable levels in accordance with DRC and Rwanda regulations and IFC General EHS guidelines. > REL will maintain and operate the facilities in accordance with the recommendations of the designers.	[M 137] Operation phase fire and explosion management measures in compliance with NFPA.
5. Other general worksite hazards	> Electrical hazards: present in relation to (but not limited to) the electrical equipment at the dam site, powerhouse and switchyard. > Mechanical hazards: present with (but not limited to) the use of fixed and mobile mechanical equipment at the dam and powerhouse. > Confined spaces: Workers involved in inspection and maintenance may need to enter tunnels, inspection galleries within the dam structure, where there are risks of asphyxiation and rock falls. > Deep and fast flowing water: there are risks associated with working on or near water such as the rivers or reservoirs for the operating staff and maintenance workers. > Trips, falls: this is a general hazard that is present in many areas. > Working at heights: this is a general hazard that is present in some areas.	> The facilities will be designed and constructed in compliance with DRC and Rwanda health and safety regulations, GIIP and IFC General EHS Guidelines. > The facilities will be operated and maintained by REL in accordance with procedures developed in alignment with GIIP and IFC General EHS Guidelines. > REL will establish and implement an appropriate Environmental and Social Management System (ESMS) in alignment with OHSAS 18001 for the operation of the scheme. > REL will develop and implement a Health and Safety Plan addressing the health and safety hazards at the site and which are expected to encompass the same type of hazards as those addressed in construction. > REL will undertake regular health and safety risk assessments, monitor the implementation of the Health and Safety Plan and provide health and safety trainings to its employees during operation.	[M 134] General operation occupational health and safety measures: ESMS aligned with OHSAS 18001, Health and Safety Plan, Employee training.

11.14 Community Health and Safety

11.14.1 Health and Safety Hazards

Project facilities and activities that represent or could cause a community health and safety hazard during **pre-construction and construction** are described in Table 11-65.

Table 11-65 Hazards for Community Health and Safety during Construction

Hazard	Unwanted event	Communities / people potentially affected
Project structures and equipment – coffer dam in particular	Structural failure of the coffer dam may be caused by a natural hazard (seismic event, extreme flood), design error, or construction error	Downstream communities
Noise, dust, vibration generated by project activities	Offsite noise and dust levels exceed human health threshold values (defined by World Health Organization – WHO). Vibration may trigger landslides or damage houses	Communities situated near roads used by project traffic and project worksites
Hazardous substances transported, stored and handled by the project	Accidental loss of containment (leak, spillage, accident event) causing offsite effects such as overpressure, thermal or toxic effects	People in the immediate vicinity of the facilities where hazardous substance stored or handled and where the accident occurs
Worksites in general	Unauthorised entry by member of community, accident such as trip, fall, electrocution	Person(s) who made the unauthorised entry
Project traffic on public roads	Traffic accident	Road users or pedestrians
Communicable diseases present in the communities or brought by workers	Increased incidence of communicable diseases linked to the arrival of construction workers	Communities of villages in the Project area
Project impacts on water quality	Pollution from wastewater discharges, or accidental spillage or leaks of hazardous substances	Communities of villages in the Project area
Natural hazards	Project causes increased frequency or magnitude of naturally occurring events	Communities of villages in the Project area
	Natural hazard event impacts project structures / facilities causing a technological accident with offsite consequences	Communities situated near roads used by project traffic and project worksites
Security and human rights	Inappropriate behaviour with regard to local communities by contractor and/or security personnel	Community members employed by the project Communities in the Project area
Population influx	Pressure on existing health systems and community health and safety in general as a result of influx of opportunity seekers to the Project area	Communities of towns and villages in the Project area

Project facilities and activities that represent or could cause a community health and safety hazard during **operation** are described in the Table 11-66.

Table 11-66 Hazards for Community Health and Safety during Operation

Hazard	Unwanted event	Communities / people potentially affected
Dam structure	Structural failure of the Ruzizi-III. May be caused by natural hazards (seismic event, extreme flood), design error, or construction error. The dam break analysis is provided in Vol. III Annexes	Downstream communities
Hazardous substances transported, stored and handled by the project	Accidental loss of containment (leak, spillage, accident event) causing offsite overpressure, thermal or toxic effects	People in the immediate vicinity of the facilities where hazardous substance stored or handled
Noise from powerhouse	Exceedance of human health threshold values (defined by World Health Organization – WHO)	Communities situated near powerhouse
General hazards at project facilities (dam and powerhouse areas)	Unauthorised entry by member of community, accident such as trip, fall, electrocution…	Person(s) who made the unauthorised entry
Project traffic on public roads	Traffic accident	Road users or pedestrians
Waterborne diseases	No issues are expected	Communities of villages in the Project area
Impacts on water resources representing public health hazards	Pollution from wastewater discharges, or accidental spillage or leaks of hazardous substances	Communities of villages in the Project area
Natural floods	No increase in frequency or magnitude of natural flood flow expected	Downstream communities
Peak and off peak flows downstream from the Ruzizi-III powerhouse	Drowning	Person(s) who have ventured into the riverbed for recreational or other purposes
Periodic testing of the bottom outlet – releasing water into the Ruzizi from the dam causing a rapid change in river flow conditions.	Drowning	Person(s) who have ventured into the riverbed for recreational or other purposes
Influence of project on natural hazards	Triggering of landslide events Reservoir triggered seismicity	Communities of villages in the Project area
Influence of natural hazards on the project	Dam break	Downstream communities
Climate change	Increased frequency and magnitude of flood events, mudflows, debris flows, landslides – which impact the dam structure	Downstream communities
Electrical hazards represented by the physical presence of the 220 kV Transmission Line, 30 kV power line and the 220 kV substation.	Electrocution	Communities of villages in the Project area
Electromagnetic Radiation from the 220 kV Transmission Line.	Health effects of exposure to EMR The Electro Magnetic Frequencies (EMF) levels under the transmission line have been estimated and they are below the recommended threshold for community exposure considered by international standards[3]. In the Right of way, the Magnetic field values are expected to be	Communities living/working close to the transmission line

[3] The International Committee on Non-ionizing Radiation Protection (ICNIRP), in cooperation with the World Health Organization (WHO), has developed guidelines for the public and workers exposed to electromagnetic fields (ICNIRP, 1998). For the public, ICNIRP recommends exposure limits of 5.0kV/m for electric fields and 100μT (50Hz) for magnetic fields.
See International Commission on Non-Ionizing Radiation Protection. « Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 ghz) ». Health Physics 74, nº 4 (1998): 494-522.

Hazard	Unwanted event	Communities / people potentially affected
	below 15 µT (for a threshold value of 100 µT), and the electric fields are expected to be below 4 kV/m (between 0.5 kV: M and 4 kV/m, for a threshold value of 5 kV/m) *	
Presence of the reservoir and alteration to downstream hydrology	Increased prevalence of water-related diseases	Communities living/working close to the reservoir dewatered reach of the river
* Source: Studio Pietrangeli, 2019		

11.14.2 Health and Safety Management Measures

Health and safety management measures are described in Table 11-67.

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Table 11-67 Community Health and Safety Management Measures – Construction and Operation

Hazard	Description of the hazard	Management measures	Reference to ESMP
1. Project structures and equipment – the coffer dam in particular	Risks to the community linked to the safety of the coffer dams, and the hydraulic and seismic loads caused by flood events and seismic activity. In the event of a flood event or seismic event with loads exceeding the coffer design criteria, there may be a failure of the structure causing a flood event affecting downstream communities.	The Project will define the detailed coffer dam safety measures which should include as a minimum the following: > Coffer dam design criteria for seismic and hydraulic loading in alignment with the recommendations of the International Committee On Large Dams (ICOLD). > Landslide risk reduction measures – protection or avoidance measures. > Coffer dam construction methods will follow GIIP, quality assurance procedures will be followed to ensure that the dam is constructed as designed. > The stability of the coffer dam will be monitored. Regular visual inspections will be carried out. > The Emergency Preparedness Plan will include coffer dam emergency situations. The plan includes the results flood levels of the area in the event of the coffer dam break.	[M 138] Coffer dam design criteria for seismic and hydraulic loading will follow ICOLD guidelines and take into account findings of detailed natural hazard risk assessments. See measures listed for natural hazards [8].
2. Noise dust and vibration	Dust, noise and vibration potentially affecting communities may be caused by: > Road traffic > General construction work > Blasting and tunnelling Inappropriately managed general construction work may generate offsite dust, noise and vibration at levels exceeding public health and safety threshold values. The blasting is carried out as part of the tunnelling work and for some localized road construction works. Inappropriately managed blasting may cause rockfall that may cause damage to public or private property and may cause injury.	See section on Air Quality and Noise (section 11.4)	See section 11.4
3. Hazardous materials	The hazardous substances transported and stored at worksite are expected to include (but not limited to) the following: > Diesel fuel > Explosives > Lubricating / used oils / transformer oil > Small amounts of diverse paints, solvent & chemicals > Hazardous waste Accidental leaks or spills during transport, or during onsite handling and storage may have offsite consequences affecting communities. In the event of fire or explosion, there may be offsite consequences affecting local communities.	The offsite effects of accidental spills or leaks of hazardous materials or consequence of accidental events caused by hazardous substances – such as fire and explosion – are prevented through the same measures that are adopted for occupational health and safety (see Table 11-63 item [2]). In addition, a suitable safety distance will be adopted between onsite areas for storage and handling of hazardous substances and offsite residential areas. > Hazardous substance areas will have suitable safety signage > Fuels storage will have secondary containment with 110% capacity > Refuelling tanks will have double a skin > Fuels will be transported is designated vehicles only > Hazardous waste areas will be separated from other waste areas and secured	[M 139] Safety distances between onsite areas for storage and handling of hazardous substances and offsite residential areas.

Table 11-67 Community Health and Safety Management Measures – Construction and Operation (*Cont.*)

Hazard	Description of the hazard	Management measures	Reference to ESMP
4. Other hazards at worksites	Members of the community who enter construction sites without authorization or appropriate induction, safety equipment or site knowledge will be exposed to (i) electrical hazards (power supply service line, mobile power generators, electrical equipment), (ii) mechanical hazards (fixed and mobile mechanical equipment), (iii) chemical hazards (storage of hazardous materials), and (iv) physical hazards such as trips and falls.	The hazard is managed through the establishment of site a perimeter fence to prevent unauthorised entry. > The worksites will be guarded by a licenced security contractor. > All high voltage circuits will be secured to prevent unauthorised access > Camp areas will be well illuminated > All visitors and workers have a specific health and safety induction upon arrival to site > Work areas and offices will be maintained in a safe condition in accordance with the Project Health and safety Plan	[M 140] Control of access to worksites.
5. Traffic and road safety	Construction traffic will be using the roads passing through villages and residential areas and adjacent to cultivated lands. There will consequently be a significant increase in traffic. Local communities and especially children may not be familiar with such heavy traffic driving through their villages.	The EPC contractor will develop a Traffic Management Plan. The key aspects are listed below: > Best practice will be implemented speed limits, signage, driving rules, traffic marshals at key locations, drivers will be trained, alcohol and drug tests will be carried out and vehicle speed monitored using GPS devices. > Project-related traffic will be limited through residential areas at night, after agreement with the local authorities. > Specific attention will be made for schools, traffic marshals will be stationed at schools, project traffic will not travel in front of schools at school start and finish times. > The Traffic Management Plan will be communicated to the head of local communities and will be disclosed in local villages. > Road safety awareness and information will be provided to communities. > Local authorities will be informed prior to the movement of heavy exceptional convoys through residential areas. During operation the dam access road will be maintained by by REL	[M 141] Construction phase traffic management plan. [M 142] Public disclosure of the construction phase traffic management plan. [M 143] Local authorities given prior warning of the programmed arrival of heavy convoys. [M 144] Traffic hazard awareness campaigns organised for communities including school children. [M 145] The dam access road will be maintained for the duration of the HEPP's operating life.
6. Security and human rights	Inappropriate behaviour with regard to local communities by contractor and/or security personnel and/or public security forces.	A private security provider for the construction phase will be engaged by the EPC Contractor. When construction is completed, a smaller security force will be required and the Project Company will either engage a new security provider or extend the services of the service provider contracted for the construction. The main role of the security provider will be to guard the facilities – which will be fenced – and to control all people and vehicles entering and leaving the controlled areas. The management of the private security provider engaged to guard the facilities during construction and operation will follow the recommendations of the Voluntary Principles for	[M 146] Adherence to the Voluntary Principles on Security and Human Rights - and the International Code of Conduct for Private Security Service Providers including contractors and their subcontractors [M 147] Security services providers personnel to be

Hazard	Description of the hazard	Management measures	Reference to ESMP
		Security and Human Rights and the International Code of Conduct for Private Security Service Providers[4] The Project will ensure that security guards are trained with regard to the Project's goals to establish good relationships with local stakeholders. A training specific to security personnel will be developed and implemented l, which outlines appropriate conduct, engagement and appropriate use of force, ensure that security personnel receive and remain up to date on human rights and cultural sensitivity, as well as the Voluntary Principles on Security and Human Rights. In order to manage the interactions between the Project Company and the public security providers (local police forces), RAL is committed to adhering to the Voluntary Principles for Security and Human Rights. To this end it will liaise regularly with public security providers to ensure that they are informed about the Project and the Project Company's policy on human rights, in particular that force should be used only when strictly necessary and to an extent proportional to the threat and that the rights of individuals should not be violated. In the event of a national security situation, the Project will follow instructions given by the public security providers.	trained to comply with the Voluntary Principles on Human Rights and the International Code of Conduct for Private Security Service Providers [M 148] Cooperation with local police forces

[4] The EIB Standard 9 on Health, Safety and Security requires that the provision of private security to protect project workers, assets, communities and suppliers is consistent wit international human rights standards and principles, including include the Voluntary Principles on Security and Human Rights and the International Code of Conduct on Private Security Providers.
The Voluntary Principles on Security and Human Rights is a collaborative effort by governments, major multinational extractive companies, and NGOs to provide guidance to companies on tangible steps that they can take to minimize the risk of human rights abuses in communities. The principles documents provide guidance to companies in developing practices that maintain the safety and security of their operations while respecting the human rights of those who come into contact with security forces related to those operations. https://www.voluntaryprinciples.org/the-principles/
The International Code of Conduct for Private Security Service Providers (ICoC) is a set of principles for private military and security providers, created through a multi-stakeholder initiative convened by the Swiss government. This process involved and continuously involves representatives from private security companies, states, and civil society organizations. The code reinforces and articulates the obligations of private security providers particularly with regard to international humanitarian law and human rights law.

Table 11-67 Community Health and Safety Management Measures – Construction and Operation (*Cont.*)

Hazard	Description of the hazard	Management measures	Reference to ESMP
7. Community exposure to communicable disease	About 500-1,000 construction workers will be employed during peak, out of which at least 50% unskilled workers. Some workers may come from outside the region. However, some expatriated foreign workers can be expected. The presence of the temporary workers may potentially increase the incidence of communicable diseases, including STI/HIV and COVID-19.	The EPC Contractors will prepare and implement a health and safety plan which will include measures regarding the management of communicable diseases and management of community health. Key measures are listed below and more detail provided in Vol. IV ESMP. > Recruitment target of 25% from Burundi 25% from DRC and 25% from Rwanda for unskilled positions to reduce the number of workers from outside the region. > Construction workers will be accommodated in a worker accommodation camp, with controlled access. > In coordination with local health authorities, health awareness campaigns will be organised for those communities situated close to worker accommodation camps. > Construction workers (including subcontractors) will be subject to health screening. During induction, workers will be provided with health awareness training including with regard to sexually transmitted diseases. Periodic refresher training will be provided. > Free condoms will be available at the project's first aid and medical centres at the construction sites and construction camps. > REL will monitor the implementation of these measures by the EPC Contractor.	[M 149] Community health management measures included in the construction phase health and safety plan. [M 150] Monitoring by REL of the implementation of the community health management measures by the EPC Contractor.
8. Impacts on availability and quality of water resources representing health hazards	Water resources may be affected by the following: > Increased sediment loading in the Ruzizi River from earthworks and dewatering of tunnels. > Accidental spills and leaks from the storage and handling of hazardous materials may contaminate surface and groundwater. > Discharge of sanitary and domestic wastewater. If tunnelling spoil material contains sulphur bearing rock, there may be a risk of acid rock drainage and heavy metal leaching causing a change of river water pH and increased concentration of some heavy metals in the river water.	The EPC Contractor will prepare and implement a Construction ESMP that will include measures to prevent impacts on water resources availability and quality. Key measures are listed below and more detail provided in Vol. IV ESMP. > Sanitary and domestic wastewater will be collected and treated prior to discharges. All discharges will comply with Burundi, DRC and Rwanda discharge limits and limits defined by IFC General EHS guidelines. > Sediment traps will be used to prevent runoff with high sediment load draining from worksites to surface water. > Spoils from tunnelling will undergo geochemical testing to assess the risk of acid rick drainage and heavy metal leaching. If such risks are present, the spoil will be stored in a facility equipped to prevent contaminated runoff and seepage water from contaminating water resources. > Monitoring of wastewater discharges will be undertaken by the EPC Contractor – and periodic controlled by REL. > Monitoring of ambient surface and groundwater quality will be undertaken by REL and starting before construction work starts. Monitoring by the EPC Contractor will be undertaken during construction work and REL will make periodic controls. > The EPC Contractor will provide alternative sources of household potable water if wells or springs used by a household are affected by the Project.	[M 151] Technical measures to avoid impacts on water quality including from wastewater discharges, runoff and tunnelling spoils. [M 152] Disclosure of water monitoring results.

Table 11-67 Community Health and Safety Management Measures – Construction and Operation (*Cont.*)

Hazard	Description of the hazard	Management measures	Reference to ESMP
9. Natural hazards	The construction phase of the project is not expected to trigger natural hazard events such as seismic events, extreme flood events, mudflow or debris flow events. However, natural hazards events could potentially trigger technological accidents such as coffer dam break or loss of containment of hazardous substances causing explosion, fire or pollution that could affect local communities.	> Seismic studies have been undertaken to characterise magnitude and frequency of seismic events (see Section 7). Seismic criteria for the coffer dam have been defined. Additional seismic studies will be undertaken and seismic loading criteria for the coffer dam and other temporary structures will be revised if necessary. > Hydraulic studies have been undertaken to characterise frequency and magnitude of extreme flood events. Hydraulic loading and flood evacuation design criteria for the coffer dam have been defined. > Landslide risk assessment studies have been performed (see section 7. Additional studies will be undertaken and which will include assessment of the risk to temporary construction facilities, and definition of risk reduction measures. > The risk assessment for natural hazards for workers during construction will define the natural hazards mitigation measures for each worksite, including construction camps.	[M 153] Detailed design to include detailed seismic studies to complement the preliminary studies already performed and to confirm dam and coffer dam design criteria. [M 154] Coffer dam and diversion tunnel flood management criteria and procedure in detailed design. [M 155] Assessment of reservoir rim stability and analysis of hydraulic consequences. [M 156] Carry out detailed landslide risk assessment and include dam, coffer dam and temporary construction facilities in the assessment and include the findings into the Project design.

11.14.3 Project Induced In-Migration Health & Safety Risks

Large construction projects can attract new in-migrants. Depending on how it is managed and the baseline conditions, project-induced in-migration can have an adverse or a beneficial impact on local communities and the Project's performance. Potential new migrant stakeholder groups for this Project include:

- Returning family, extended family members and former residents – seeking improved living conditions and employment or opportunities to provide goods and services to the Project or local population.
- Camp followers - who are entrepreneurs arriving to capture business opportunities associated with the construction labour of the Project.
- Opportunistic migrants, Unskilled, semi-skilled or skilled people seeking direct or indirect employment or entrepreneurial opportunities.

To assess the risk and magnitude of (i) the project-induced in-migration and (ii) its potential impacts, the methodologies used are those defined in:

- The IFC handbook on Project-induced in-migration (IFC 2009).
- The World Bank Guidance Note on Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx (World Bank 2016).

The significance of the potential impacts from Project-induced in-migration depends on:

- The likelihood and anticipated magnitude of the influx.
- The absorption capacity or resilience of the host communities.
- The capacity of the project to manage the risks related to project-induced in-migration.

11.14.3.1 Assessment of Project-Induced In-Migration Magnitude

The importance of influx usually depends on several factors (IFC, 2009) depending on the Project characteristics as well as socioeconomics conditions of the area:

- The number of unskilled jobs offered locally by the Project.
- Accommodation strategy of Project's workforce.
- Accessibility of the Project area and its possible enhancement by the Project.
- Perceived opportunities to speculate on compensation during the Project's land acquisition process.
- Proximity with international borders and existence of transnational migrations.
- Level to employment in the area without the Project.
- Existing local patterns of migration.
- Proximity with important urban centres.

The table overleaf describes the assessment of each of the above factors, the likelihood and potential magnitude of influx in the Project's area.

Table 11-68 Assessment of Risks and Magnitude of Project Related In-Migration

Factors	Description of situation	Risk / Magnitude of influx
Number of unskilled jobs offered by the Project (jobs seekers moving to projects hoping to be hired are almost exclusively unskilled workers)	The Project will, at peak construction period, require between 500 and 1,000 workers. The whole construction period is estimated at between 48 and 56 months. Assuming a total of 1,000 workers is required, it is estimated that in the order of 120 will work as managers, 700 will be semi-skilled or skilled workers and 180 will be hired as unskilled workers. The EPC Contractor will largely communicate on the local employment targets and objectives to avoid a massive influx of job-seekers. The EPC Contractor will be required to have recruit local people for 100% of the unskilled workers. This will minimize employment opportunities for outsiders as scale of job-seeker influx depends on	Low risk / Low magnitude

Factors	Description of situation	Risk / Magnitude of influx
	perceived employment opportunities. There will be few opportunities for potential migrants as local people will be prioritised for skills development and employment and this may deter potential in-migrants.	
Accommodation of workforce (no accommodation means higher in-migration)	The construction camp will be designed by the EPC Contractor to accommodate the required peak number of workers (in the order of 500 to 1,000 workers), but possible that unskilled workers from Rwanda and DRC may be accommodated at the own homes.	Low risk / low magnitude
Accessibility of Project area (New accessibility means high in-migration)	The Project's sites are located in areas that are already accessible: they are close to national roads, both in Rwanda and DRC. The Project will upgrade existing roads and create new roads to access the dam.	Low risk / low magnitude
Perceived opportunities of speculation (high perceived opportunities result in high in-migration)	The land tenure is well established in the Project area (legal land tenure in Rwanda and customary land tenure in DRC). Few opportunities for potential migrants as local people are being prioritised for skills development and employment and this may deter potential in-migrants.	Low risk / low magnitude
Proximity with international borders (proximity can potentially result in higher risk of in-migration)	The Project is situated on the international border between DRC and Rwanda, and the border with Burundi is close. However, the borders are well monitored and controlled by the local police forces.	Medium risk / medium magnitude
Level of employment in the area (high level means less in-migration)	The large majority of the population is engaged in agriculture in the Project area (both in Rwanda and DRC). Very few formal employment opportunities are available outside the urban areas.	Medium risk / medium magnitude
Existing patterns of migration (tendencies to mobility means high risk of in-migration)	There is an existing tendency to mobility within the population both in Rwanda and DRC. However, people are usually moving mostly from rural areas to urban centres. The Project area has been subject to several refugees' population movements over the past 30 years.	Medium risk / medium magnitude
Proximity with urban centres (close means less risk of in-migration)	There are 2 urban centres close to the Project: - Bugarama Sector in Rwanda and - Kamanyola town in DRC	Low risk / low magnitude

Source: adapted from IFC 2009: "Projects and People: A Handbook for Addressing Project-Induced In-Migration"

The probability of project-induced in-migration is low to medium, and the possible magnitude of such influx would unlikely be significant.

Based on documentation collected on a wide array of Projects worldwide, the IFC (IFC, 2009) estimates that a Project's related in-migration could range between 3 to 10 times the number of people employed by the Project.

Given the fact that population movements have happened in the region, and as the risk is low to medium, it is estimated that potential in-migration should not exceed two to five times the number of unskilled workers. The number of these unskilled workers during construction would be about 180 at peak. Hence the order of magnitude of the influx could range from about 300 to 900 people, including the unskilled workers coming from outside the Project area employed by the Project.

11.14.3.2 Absorption Capacity of Local Communities

The impacts of Project-induced in-migration will depend on the absorption capacity of the communities where the influx would be located. These communities are likely to be those where the Project construction camp will be located. Only one construction camp is planned, in Rwanda. Its location is given in Figure 11-7 below. The villages or settlement which could

potentially be affected by the Project-induced in-migration are the closest to the Construction Camp (on both sides of the border):

- In Rwanda: Gatebe and/or Kabuzunzu villages in Bugarama Sector, which are located along the access road leading to the Construction Camp, and Nyagahanga village in Nzahaha Sector, from which an existing track is leading to the reservoir site, and then to the construction Camp,
- In DRC, Bugano, Kafunda and Nachihembe villages, which are either crossed by the access road leading to the bridge in front of the Construction Camp, or with an access to this access road.

Even if the predicted risk of in-migration is low, in the event of such influx happens, and given the conditions of public utilities, specifically health facilities, education, transports, water utilities, in the Project area and the local demography, it may have high impacts on the local communities. The communities potentially receiving the influx are considered to have a medium to high sensitivity:

- in Rwanda Gatebe and Kabuzunu villages are part of the urban setting of Bugarama sector, their sensitivity is assessed as medium,
- Nyagahanga village in Rwanda and Bugano, Kafunda and Nachihembe villages in DRC are located in rural areas, their sensitivity is assessed as high.

Table 11-69 below presents the comparison of the existing population in the 6 villages which are likely to receive the potential influx with the size of the influx. Two scenarios are considered: a low Project-induced in-migration (about 300 in-migrants) and a high Project-induced in-migration (about 900 in-migrants). Assuming the influx would be spread regularly within these 6 villages, it would represent:

- between 5 and 26% of the existing population in each village with a low in-migration, and
- between 13 and 65 % of the existing population in each village with a high in-migration.

Table 11-69 Influx Scenario Compared to the Existing Population in the Villages close to the Construction Camp

Settlements or villages closest to the Construction Camp		Estimated exiting population in 2021	Potential influx (low scenario - 300 migrants)		Potential influx (high scenario - 900 migrants)	
			Number of in-migrants	% of existing population	Number of in-migrants	% of existing population
Rwanda	Nyagahanga	648	50	8%	150	23%
	Gatebe	920	50	5%	150	16%
	Kabuzunzu	1,117	50	4%	150	13%
Total in Rwanda		2,685	150	6%	450	17%
DRC	Kafunda	300	50	17%	150	50%
	Bugano	230	50	22%	150	65%
	Nachihembe	900	50	6%	150	17%
Total in DRC		1,430	150	10%	450	31%
Total both countries		4,115	300	7%	900	22%

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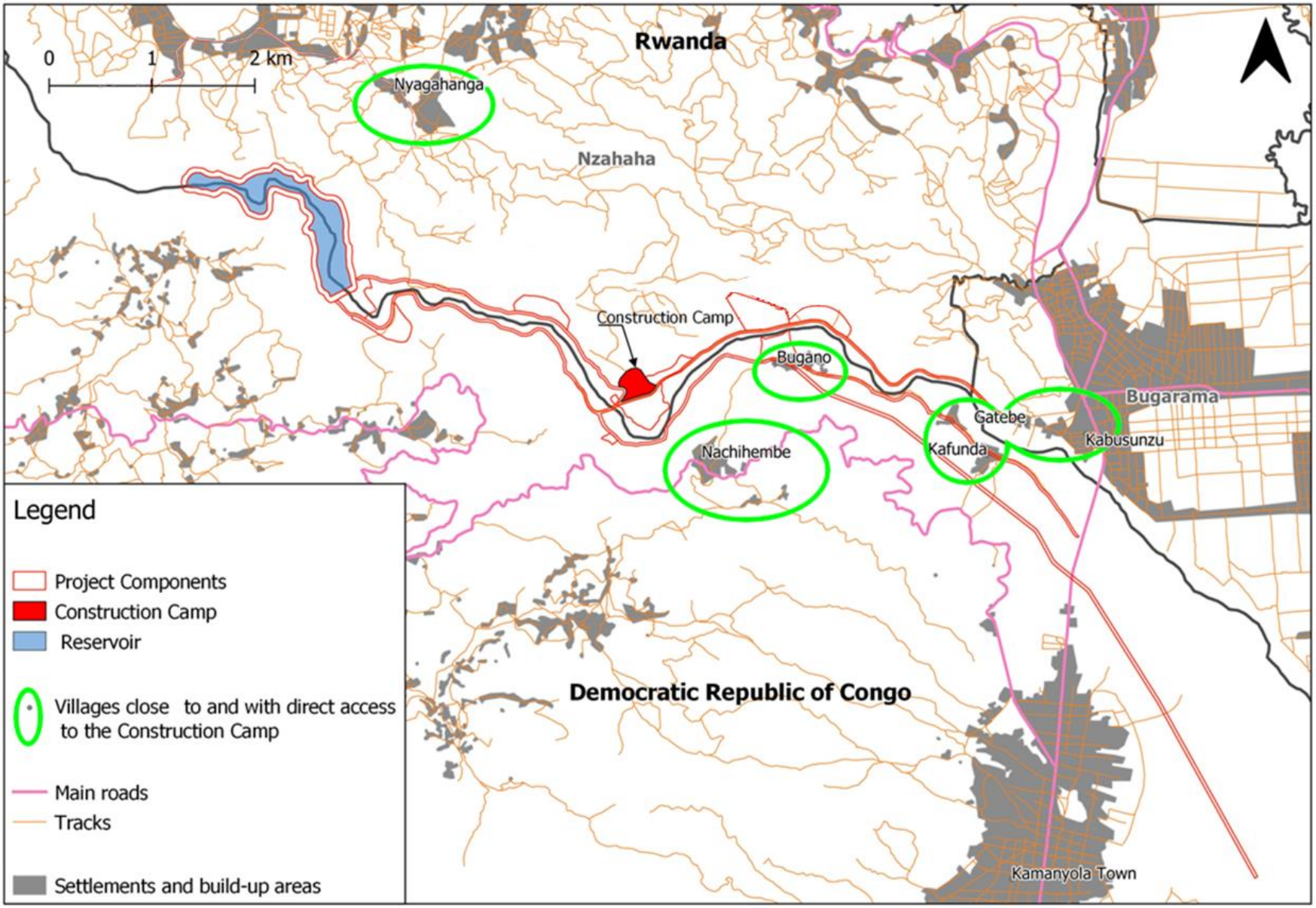

Figure 11-7 – Construction Camp and Potential Areas Targeted by Project-Induced In-Migration

11.14.3.3 Potential Impacts

Implications associated with Project's related in-migration could be serious if that risk would materialize. The potential impacts could be:

- Various types of anti-social behaviour (e.g. public drunkenness) or illicit behaviour.
- Pressure on social services, especially health facilities.
- Increase in sexually transmitted diseases.
- Local inflation of prices, including pressure on accommodation and rents.
- Gender-based violence.
- Increase in traffic and related accidents.

Given the estimated importance of the influx, the magnitude of these impacts would be minor to moderate. As the local social environment is considered of medium to high sensitivity, any of the impacts above is likely to be moderate.

11.14.3.4 Risks Factors Related to Influx Management

The World Bank Guidance Note on "Managing the risks of adverse impacts on communities from temporary project induced labour influx" (World Bank 2016) suggests that the potential impacts from Project-induced in-migration could be further exacerbated by the local social, institutional and organisational Project implementation situation. A high-risk situation required more stringent management measures than a low-risk one. The following criteria must be considered to assess if the Project's implementation situation increases the risks related to influx management or not:

- Institutional capacity of the implementing agency.
- Capacities of contractors regarding workers management and health and safety policies.
- Pre-existing social conflicts or tensions.
- Situation of local law enforcement.
- Prevalence of gender-based violence and social norms towards it in the community.
- Local prevalence of child and forced labour.

Table 11-70 below assesses the level of risk of the social, institutional and organisational context of the Project, in regard to the factors listed above.

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Table 11-70 Factors Increasing the Risks Related to Influx Management

Risk Factors	Description of situation	Importance of risk
Institutional capacity of the implementing agency	REL and the EPC contractor have a strong institutional capacity and are used to manage this magnitude of workforce.	Low risk
Capacities of contractors regarding workers management and health and safety policies	The EPC contractor applies the international standards regarding workers management and health and safety policies.	Low risk
Pre-existing social conflicts or tensions	As described in the socioeconomic baseline: - Rwanda currently enjoys high levels of political stability and general security. - The Project area in DRC, as well as the broader Sud-Kivu region, is characterized by the presence of armed groups. Over the past 30 years, a succession of armed conflicts took place in this region. The area around Kamanyola town, and the immediate vicinity of the Project appears to be less touched by the armed groups than other parts of the region.	Medium risk
Situation of local law enforcement	The situation of local law enforcement differs between Rwanda and DRC. In Rwanda, the public order is maintained through local security arrangements in the local communities, producing what has been described by scholars as a "*remarkably efficient information-gathering apparatus*"[5] coordinated with the authorities and police forces. In the Project area in DRC, there is limited law enforcement from Police forces outside Kamanyola town. Most low-level conflicts are managed and solved by the traditional authorities.	Medium to high risk
Prevalence of gender-based violence and social norms towards it in the community	As described in the socioeconomic baseline, gender-based violence is widespread both in Rwanda and DRC. Several example of gender-based violence and gender impacts from previous Projects' construction workforce have been reported (including unwanted pregnancies)	High risk
Local prevalence of child labour.	Increased opportunities for the host communities to sell goods and services to the incoming workers can lead to child labour to produce and deliver these goods and services, which in turn can lead to enhanced school dropout. School dropout and child labour are already occurring in the affected communities.	High risk
Source: adapted from World Bank 2016, "*Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx*"		

Based on the above criteria, the social, institutional and organisational context of the project does constitute a medium to high-risk environment for the management of Project-induced in-migration.

[5] Lamarque Hugh, "Policing small communities: Rwandan law enforcement and the co-production of security", Politique africaine, 2020/4 (No 160), p. 113-138. URL: https://www.cairn-int.info/journal-politique-africaine-2020-4-page-113.htm

11.14.3.5 Mitigation strategy

A **During construction**

Some of the mitigation measures already defined in previous sections will help to reduce and mitigate the risks and magnitude of the Project-induced in-migration and which are as follows:

[M 111] The Project's HR policy and labour management principles will align with Lenders' Policies and the labour laws of Burundi, DRC and Rwanda

[M 112] The Project will set local employment objectives and targets.

[M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female.

[M 114] The local Recruitment Policy will be communicated widely.

[M 119] Project's HR Policy and labour management principles will clearly state that there will be no forced labour and child labour.

[M 122] REL will recruit two trained female Gender Officers (1 in Rwanda and 1 in DRC) to define and implement GBVH protocols. These protocols will apply to all Project workers, including contractors and sub-contractors.

[M 123] The EPC will develop and implement a workers' code of conduct, including GBVH policies, and mandatory training of all workers on sexual harassment and GBVH protocols

[M 141] Construction phase traffic management plan.

[M 142] Public disclosure of the construction phase traffic management plan.

[M 149] Community health management measures included in the construction phase health and safety plan.

[M 150] Monitoring by REL of the implementation of the community health management measures by the EPC Contractor.

[M 146] Adherence to the Voluntary Principles on Security and Human Rights - and the International Code of Conduct for Private Security Service Providers including contractors and their subcontractors

[M 147] Security services providers personnel to be trained to comply with the Voluntary Principles on Human Rights and the International Code of Conduct for Private Security Service Providers

[M 148] Cooperation with local police forces

The Project will also prepare an Influx Management Strategy with the following objectives:

- Review of the existing operational responsibilities and management plans.
- Integration of selected influx management interventions into existing management plans.
- Monitoring and evaluation to assess their effectiveness.

This measure is referred later in this report as:

[M 157] Preparation and implementation of an Influx Management Strategy.

In addition of the measures already listed above, to mitigate risks of gender-based violence from the in-migrant workers amongst the local communities, the following measure will be implemented:

[M 158] REL Gender officers will prepare and implement a Community Outreach Programme on Gender-based violence and harassment, to disclose the Project's GBVH protocols and reporting processes.

B **During operation**

All the measures listed above are related to the construction period. Project-induced in-migration could potentially happen during the operation, as fishers attracted by the fishing potential of the newly created reservoir would settle in the villages around the reservoir. This is however difficult to anticipate. This will have to be monitored by the Project. Should any significant influx around the reservoir happen during operation, measures to address potential negative impacts will be defined to update the Influx Management strategy during operation.

These measures are:

[M 159] Monitoring on Project-induced in-migration around the reservoir during operation during the first years of operation

[M 160] Addressing potential negative social impacts of continued presence of project-induced influx during the first years of operation

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11.15 Human Rights

No standalone Human Rights Impact Assessment has been performed. The Lenders E&S policies do address impact on Human Rights, as a key topic mainstreamed throughout their E&S standards. Potential human rights impacts have been considered and mainstreamed throughout the impact assessment process. The Table 11-71 below provides an overview of the sections of the ESIA where the human rights have been considered. The human rights listed in this table are the international human rights provided under the International Bill of Human Rights[6], including the International Covenant on Economic, Social and Cultural Rights and the International Covenant on Civil and Political Rights (the ICESCR and ICCPR) and the Core ILO Conventions[7]. Human rights which are considered relevant for the Project activities are listed in Table 11-71.

Table 11-71 Human Rights in the ESIA

Human Rights	ESIA section(s) where these aspects are covered
Right to self-determination (ICESR) (*It includes the rights to pursue economic, social and cultural development, to dispose of a land's natural resources and not to be deprived of the means of subsistence.)*	Impacts on local communities' livelihoods Cultural heritage Ecosystem services
Right to life (ICCPR)	Labour and working conditions Communities health and safety Impacts on local communities' livelihoods
Right not to be subjected to torture, cruel, inhuman and/or degrading treatment or punishment (ICCPR)	Labour and working conditions Communities health and safety Impacts on local communities' livelihoods
Right not to be subjected to slavery, servitude or forced labour (ICCPR & ILO Conventions)	Labour and working conditions
Right to liberty and security of the person (ICCPR)	Labour and working conditions Communities health and safety
Right to liberty of movement (ICCPR)	Labour and working conditions Impacts on local communities' livelihoods

[6] The International Bill of Human Rights was the name given to United Nations General Assembly Resolution 217 (III) and two international treaties established by the United Nations. It consists of the Universal Declaration of Human Rights (adopted in 1948), the International Covenant on Civil and Political Rights (ICCPR, 1966) with its two Optional Protocols and the International Covenant on Economic, Social and Cultural Rights (ICESCR, 1966). The two covenants entered into force in 1976, after a sufficient number of countries had ratified them.

[7] The Core ILO Conventions are:
C29 Forced Labour Convention (1930)
C87 Freedom of Association and Protection of the Right to Organise Convention, 1948
C98 Right to Organise and Collective Bargaining Convention, 1949
C100 Equal Remuneration Convention, 1951
C105 Abolition of Forced Labour Convention, 1957
C111 Discrimination (Employment and Occupation) Convention, 1958
C138 Minimum Age Convention, 1973
C182 Worst Forms of Child Labour Convention, 1999

Human Rights	ESIA section(s) where these aspects are covered
Right to a fair trial (ICCPR) Right to recognition as a person before the law (ICCPR) Right to freedom of arbitrary or unlawful interference with a person's privacy (ICCPR)	Labour and working conditions The Project has prepared a Stakeholder Engagement Plan and a Grievance Redress Mechanism, see Chapter 6 Public Participation
Rights to freedom of opinion without interference and the right to freedom of expression (ICCPR)	Labour and working conditions The Project has prepared a Stakeholder Engagement Plan and a Grievance Redress Mechanism, see Chapter 6 Public Participation
Right to freedom of assembly (ICCPR) Right to freedom of association (ICCPR and ILO Conventions) Rights of protection for the child (ICCPR, ICESCR and ILO Conventions) Right to work (ICESCR) Right to enjoy just and favourable conditions of work (ICESCR and ILO Conventions) Right to form and join trade unions and the right to strike (ICESCR and ILO Conventions) Right to social security, including social insurance (ICESCR) Right of aliens to due process when facing expulsion (ICCPR)	Labour and working conditions
Right to participate in public life (ICCPR)	The Project has prepared a Stakeholder Engagement Plan, see Chapter 6 Public Participation
Right to equality before the law, equal protection of the law, and rights of non-discrimination (ICCPR, ICESCR and ILO Conventions)	Labour and working conditions Community health and safety Impacts on local communities' livelihoods
Right to an adequate standard of living (ICESCR)	Labour and working conditions Community health and safety Impacts on local communities' livelihoods
Right to health (ICESCR)	Labour and working conditions Community health and safety
Right to education (ICESCR)	Impacts on local communities' livelihoods Positive impacts and benefits
Rights to take part in cultural life, to benefit from scientific progress, and to protection of the material and moral rights of authors and inventors (ICESCR) Rights to freedom of thought, conscience and religion (ICCPR)	Cultural heritage

ICCPR = International Covenant on Civil and Political Rights; ICESCR = International Covenant on Economic, Social, and Cultural Rights; ILO = International Labour Organisation

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11.16 Gender-related Risks and Impacts

The Social Baseline data collection activities carried out in January 2022 revealed widespread manifestations of gender-based inequality and discrimination across the Study Area. Gender-specific issues observed on field can be summarised in the following key points:

- **Land** – in both Rwanda and DRC, women face serious constraints to land tenure security. In Rwanda, the only way for women to access land ownership titles is through marriage. In fact, land is so scarce that inheritance tends to be passed on to male children only and the land market is generally dominated by men. In DRC, customary rights do not allow women to own land through at all. Women generally access land only through getting informal usage rights from their father, brother or husband. Due to these difficulties, unmarried women and widows are likely to remain landless or homeless unless their family can support them.
- **Domestic Life** – All across the Study Area in Rwanda and DRC, women usually are socially expected to take care of their house and children. The interviewed women have reported being more likely than men to perform unpaid work for their family rather than receive a salary. Even the women that do earn a salary are financially dependent on male family members and have little control over their own salary and spending power. All women and while they reported having access to services and resources as well as men, they felt that men had the ultimate control of these resources and the benefits coming out of it. Women reported participating actively to the life of the village and feeling represented by all collective institutions. Women are using microcredit institutions at village level to gain control over their own financial resources. In DRC, women reported often experiencing restrictions in their control of agricultural activities and revenues.
- **Livelihoods** – Alongside their domestic duties, women in both Rwanda and DRC worked within the family's field and are responsible for selling produce at markets. Fewer women reported also supporting their husband's business or shop, especially in the larger centres of Bugarama (Rwanda) and Kamanyola (DRC).
- **Health** - Women face constraints accessing maternity and gynaecological services for themselves and child health services for their children. Constraints in accessing healthcare is mostly due to lack of transport, high cost of health centres, bad quality of roads and failing to receive support or agreement from their husband to seek treatment. Some cases of at-home abortions and births have been reported in Rwanda and in DRC alike.
- **Divorce and Marriage** – In Rwanda as well as DRC, polygamy has been reported as a common practice threatening women's reputation and land tenure stability. Since legal polygamy is not allowed, illegal wives often remain stuck in landless conditions working on plots which belong to their husband but might be taken away at the termination of the relationship. In both countries, divorced women and widows face
- **Gender-based Violence** - Cases of physical and sexual gender-based violence have been mentioned in Rwanda as well as DRC. There are no specific networks or platforms available to support victims of GBV, apart from referrals to hospitals from the local health centres. Sexually transmitted diseases and cases of sexual assault were reported in all of the health centres visited. Episodes of unwanted pregnancies caused by immigrant workers due to projects around the Study Area were also reported in Rwanda (Bugarama to Gisheke Road Project and Gishoma Geothermal Power Plant).

Due to the manifestations of gender inequality described above, there is a risk that the Project may negatively affect women.

Two categories of risks could materialise, having a significant impact on women's livelihood and land tenure security and potentially leading to an increase in GBVH. These two categories of impacts are described in detail and mitigated in Section 11.12, which deals with livelihood-related impacts and Section 11.16.2, which covers GBVH impacts.

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11.16.1 Land Tenure and Livelihood Security Impacts

As outlined in Section 11.12.4, the preliminary census of 2022 identified that 25% of all physically and economically displaced households was headed by a woman. The potential negative impacts that the Project may have on women's land tenure and livelihood security are:

- Within the land acquisition process, female land users may struggle to prove their eligibility to compensation measures, resulting into some women being unable to receive compensation for their loss of revenue. This is likely to be the case for the following categories of women:
  - Widows that have been using the land of their deceased husband without ever acquiring a title in their name.
  - Unmarried women with land use rights gifted or inherited from their family without a title or customary right attached to it.
  - Married women working exclusively on their husband's land without their name figuring on the land title.
  - Women engaging in an extra-legal polygamous relationship and working exclusively on their partner's land, on which they do not have rights.
- If physically and economically displaced, women-headed households may struggle more than men to find alternative sources of revenue, re-establish their livelihoods or find new land for their homes.
- If married men receive compensation for their family's land, there is a possibility that they might claim control over the compensation money and use it for expenses that their wives do not prioritise.

The sensitivity of the receptive environment for gender-based violence is considered high because, as described in the Section 11.12.3, in the Project area women have little access to land use and ownership rights in practice, although they may be allowed to these rights in paper. Since all land acquisition for the Project will be permanent, with PAPs still being able to cultivate under the transmission line during operation, and the percentage of women-headed households is not negligible (25%), the magnitude of land acquisition impacts on women's land tenure security is moderate. The significance of the potential impact before mitigation is Major (Significant).

Specific mitigation measures will be implemented to (i) reduce the likelihood that the risk may materialise and (ii) reduce the impact's magnitude, should its avoidance be inevitable. In addition to the mitigation measures established in Table 11-60 for all physically and economically displaced households, specific mitigation measures will be put in place in the RAP to reduce the risk and mitigate the potential impact on women's land tenure and livelihood security:

- REL will carry out specific consultations with women all throughout the RAP process, to inform them of their rights and present to them the compensation process.
- Gender-separate consultations will be carried out with both men and women to educate them about how to manage the compensation money fairly for the benefit of the household.
- For married couples, compensations will be paid on shared bank accounts.
- Specific measures to support women by restoring their livelihoods and assisting them in their displacement will be proposed in the RAP.

11.16.2 Gender-based Violence Impacts

The Project may contribute to the rise of gender-based violence and harassment (GBVH) cases. GBVH cases included sexual exploitation and abuse (SEA) and sexual harassment (SH), including physical, sexual, emotional and financial control and violence. As outlined in the GBV World Bank

Good Practice Note on GBV (2019), GBVH can be exacerbated by (i) resettlement and land redistribution processes and (ii) a large influx of male workers. Consequently, the project may contribute to rise in SEA and SH cases due to the following causes:

- Women may experience GBVH during the compensation and resettlement process, due to the following factors:
  - When trying to prove their right to affected land that they were gifted or inherited, women may face violence or threats from male relatives trying to claim the land for themselves.
  - If physically of economically displaced, financial stresses and the loss of livelihoods may lead to additional instability within homes where women are already affected by domestic violence.
- Women may be negatively affected by the predominantly male labour influx into the Project area, due to the following factors:
  - Men are more likely to benefit from local employment opportunities, which may lead to a higher workload for women on family farms with a potentially exploitative surcharge of domestic and agricultural work, to make up for the loss of male workers.
  - If the labour force is predominantly male, the few women hired by the Project may face discrimination, violence or harassment by male workers.
  - As more workers move or commute to the Study Area to seek employment in the Project, spending time living with and / or engaging with local communities, women may face additional risks of physical and sexual harassment and abuse within their communities.

The sensitivity of the receptive environment for gender-based violence is considered high for two main reasons:

- As outlined in the Social Baseline, discrimination and harassment against women are not uncommon across the study area.
- According to methodologies used to assess the risks of gender-based violence and harassment[8], being a green-field project, recruiting a large workforce, engaging local communities, employing private security staff and operating in an isolated area are all risk factors for gender-based violence.

Although the sensitivity of the receptive environment is high, the potential impact on GBVH is considered moderate in magnitude, since it may only be experienced during the 56-month construction period.

As the receptor's sensitivity is high and the magnitude of the risk is moderate, the significance of the potential impact before mitigation is Major (Significant).

To reduce the risk of women facing GBVH as part of the resettlement and compensation process, the RAP's grievance mechanism will include a tool to report and treat grievances related to GBVH risks within the framework of land acquisition and compensation. Specific indicators to assess the nature of GBVH incidents and the demographics of victims will be added to the monitoring arrangements of the grievance mechanism, to ensure that GBVH cases are adequately monitored and that corrective measures can be put in place in a timely manner. The RAP explains in detail how this system will function.

To reduce the risk of women facing GBVH in the context of labour influx and construction works, several mitigation measures will be implemented to (i) reduce the likelihood that the risk may materialise and (ii) reduce the impact's magnitude, should its avoidance be inevitable. The mitigation measures to reduce the risk and mitigate the potential impact on GBVH during construction are outlined as follows::

[8] See Social Development Direct (2020) *Addressing Gender-Based Violence and Harassment. Good Practice Note for the Private Sector.* Good Practice Note produced with the assistance of the European Bank for Reconstruction and Development (EBRD), the International Finance Corporation (IFC) and CDC Group plc (CDC). The content of this publication has been developed by Social Development Direct.

[M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female.

[M 117] Provisions regarding non-discrimination and equal opportunities will be included in the Project's HR Policy.

[M 120] REL will review the EPC contractor's subcontractors' management procedures prior to the start of construction and organise and finance 6-monthly Integrated Environmental, Social, Health and Safey audits by an independent auditor of the EPC Contractor and its subcontractors' working practices to check compliance with the Project's HR Policy, Labour laws of Burundi, DRC and Rwanda, and Lenders' labour management requirements.

[M 121] The EPC will develop a gender-sensitive recruitment strategy and communicate it to the local communities.

[M 122] REL will recruit two trained female Gender Officers (1 in Rwanda and 1 in DRC) to define and implement GBVH protocols. These protocols will apply to all Project workers, including contractors and sub-contractors.

[M 123] The EPC will develop and implement a workers' code of conduct, including GBVH policies, and mandatory training of all workers on sexual harassment and GBVH protocols.

[M 124] The EPC contractor will develop an Occupational Health and Safety Management Plan which will gender and GBVH aspects, such as: gender-separate accommodation on camp, gender-separate lockable latrines and WASH facilities that are well-lit, conveniently located and easily accessible..

[M 125] The EPC will establish workers' safety committee which will include at least one trained female worker representative.

[M 126] The Workers' grievance mechanism and Community grievance mechanism will channel all GBVH complaints and store them on a separate database. REL's Gender Officers will be responsible for handling and solving these complaints.

[M 158] REL Gender officers will prepare and implement a Community Outreach Programme on Gender-based violence and harassment, to disclose the Project's GBVH protocols and reporting processes.

After implementation of these mitigation measures, the risks are considered Minor (Not Significant).

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11.17 Cultural Heritage

11.17.1 Impact Producing Factors

The factors which could potentially affected elements of cultural heritage are threefold:

- During pre-construction and construction: Land acquisition, earthworks and construction of the physical component of the Project, which can destroy material elements of cultural heritage, including potential archaeological artefacts.
- During construction and operation: disturbances from construction activities (such as noise, dust or vibrations), which may affect either the tangible elements of cultural heritable or disturb the social, religious or cultural practices occurring at the sites of the cultural heritage elements.
  - During construction, this will be from the following activities: clearing of vegetation, site preparation, earthworks, excavations, temporary construction camps and accommodation camps from vehicles and stationary machinery equipment such as power generators and compressors, tunnelling activities – which will include some drill and blast operations, construction traffic movement along access roads.
  - During operation, this will be around the operators' village (generators, compressors, occasional sirens and alarms), the powerhouse, the 220 kV substation and 220 kV transmission line and the Project road traffic (vehicles to access the facilities for operational reasons, inspections and maintenance, and occasional deliveries.)
- During construction and operation: potential restriction of access or impairment of access to sites where cultural heritage practices occur (such as baptism sites along the riverbanks, or grotto where local communities are praying), for safety reasons or because of the physical presence of the Project elements.

11.17.2 Assessment of Receptors Sensitivity

The sensitivity of Cultural Heritage elements to impacts from the Project's activities is primarily dependent upon the nature of the cultural heritage elements. The sensitivity criteria are set out in the Table 11-72 below.

Among those identified in the baseline section, the cultural Heritage elements which may experience impacts are those:

- Located inside the Project footprints,
- Located in the immediate vicinity of the Project's sites (less than 50m from the Project's sites boundaries), and potentially affected by the disturbances from construction activities, and
- Which access to could be impaired.

These cultural heritage elements are listed in Table 11-73 and Figure 11-8 illustrates their location. The assessment of the potential impacts is given in the next sections.

Table 11-72 Cultural Heritage Receptor Sensitivity

Sensitivity	Description
High	Internationally recognized heritage of communities who use, or have used within living memory the cultural heritage for long-standing cultural purposes; or protected by local, national and international laws or treaties, including those proposed by host governments for such designation. It has substantial value to local, national, and international stakeholders; and / or it has exceptional scientific value and similar types of resources are rare or non-existent. The Cultural heritage element cannot be moved or replaced. The religious or cultural practices attached to it cannot be done somewhere else. It meets the IFC PS8 criteria for non-replicable cultural heritage[9] *Examples: Regional pilgrimage sites; multi-community or regional cemeteries or sacred sites; Large, complex archaeological sites spanning various periods*
Medium	The Cultural heritage element is specifically or generically protected by local or national laws but laws allow for mitigated impacts. It has considerable cultural value for local and/or national stakeholders. It can be moved or replaced, or the religious or cultural practices attached to it can be done somewhere else, or data and artefacts recovered in consultation with stakeholders. It has substantial scientific value, but similar information can be obtained at a limited number of other resources. It meets the IFC PS8 criteria for non-replicable cultural heritage *Examples: Small to medium sized, complex archaeological sites with intact, surface or subsurface features (mounds, pits, burials, etc.); location where ancestral spirits are housed or important sacrifices are made; small rock art sites; multi-family or village cemeteries; sacred groves or sites used by a community*
Low	The Cultural Heritage element has cultural value to local stakeholders but limited value to national or international stakeholders (it is not recognised by the local or national authorities) The Cultural heritage element can be moved or replaced, or the cultural practices attached to it can be done somewhere else without any difficulty. It is of a type that is common in the surrounding region. It has limited scientific value or similar information can be obtained at numerous other resources. It meets the IFC PS8 criteria for replicable cultural heritage[10]. *Examples: Small, surface scatters of archaeological artefacts; stone axes or cutting tools; location used by the community for medicinal treatment, sites used for community gathering or cultural, ritual or religious events; family shrines; impacted or heavily modified historic buildings; isolated graves*
Negligible	The Cultural Heritage element has limited or no cultural or scientific value to local, national, or international stakeholders, and/or it has been substantially impacted and has lost all or most of its scientific or cultural value. The Cultural heritage element can be moved or replaced, or the cultural practices attached to it can be done somewhere else without any difficulty. It is of a type that is common in the surrounding region. It meets the IFC PS8 criteria for replicable cultural heritage *Examples: previously disturbed small archaeological sites; abandoned single-use ritual or medicinal sites; small sites used by families or community members for social, non-ritual events.*

[9] Nonreplicable cultural heritage may relate to the social, economic, cultural, environmental, and climatic conditions of past peoples, their evolving ecologies, adaptive strategies, and early forms of environmental management, where the (i) cultural heritage is unique or relatively unique for the period it represents, or (ii) cultural heritage is unique or relatively unique in linking several periods in the same site. (IFC PS8 §12 note 5)

[10] Replicable cultural heritage is defined as *tangible* forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures. (IFC PS8 §11 note 3)

Table 11-73 List of Potential Cultural Heritage Receptors

Country	Cultural heritage element	Category	Potential impact producing factor
Rwanda	[R1] Nyagahanga Baptism spot	Intangible	Potential restriction of access and effects from changes in river flow.
Congo	9 private graves	Tangible	The graves are located inside the Project land acquisition areas
	[C4] Bugano's CEV Catholic Church	Tangible	Located inside the Project land acquisition area.
	[C14] Kafunda 's Praying Spot	Tangible	Praying spot located about 10m from the Project land acquisition area for the access road. May be affected by disturbances from Project's vehicles traffic.
	[C1] Bugano's Baptism Site	Intangible	Located along the riverbank, about 10m from the Project land acquisition area for the access road. Potential restriction of access and/or may be affected by disturbances from Project's vehicles traffic.
	[C3] Bugano Protestant Church	Tangible	Located less about 50m from the access road which will be used by the Project. May be affected by disturbances from Project's vehicles traffic.
	[C2] Paying spot in a grotto	Intangible	*Located in the Transmission Line Right-of-Way*
	[C4] Prayer place on an island	Intangible	Potential restriction of access and effects from changes in river flow.

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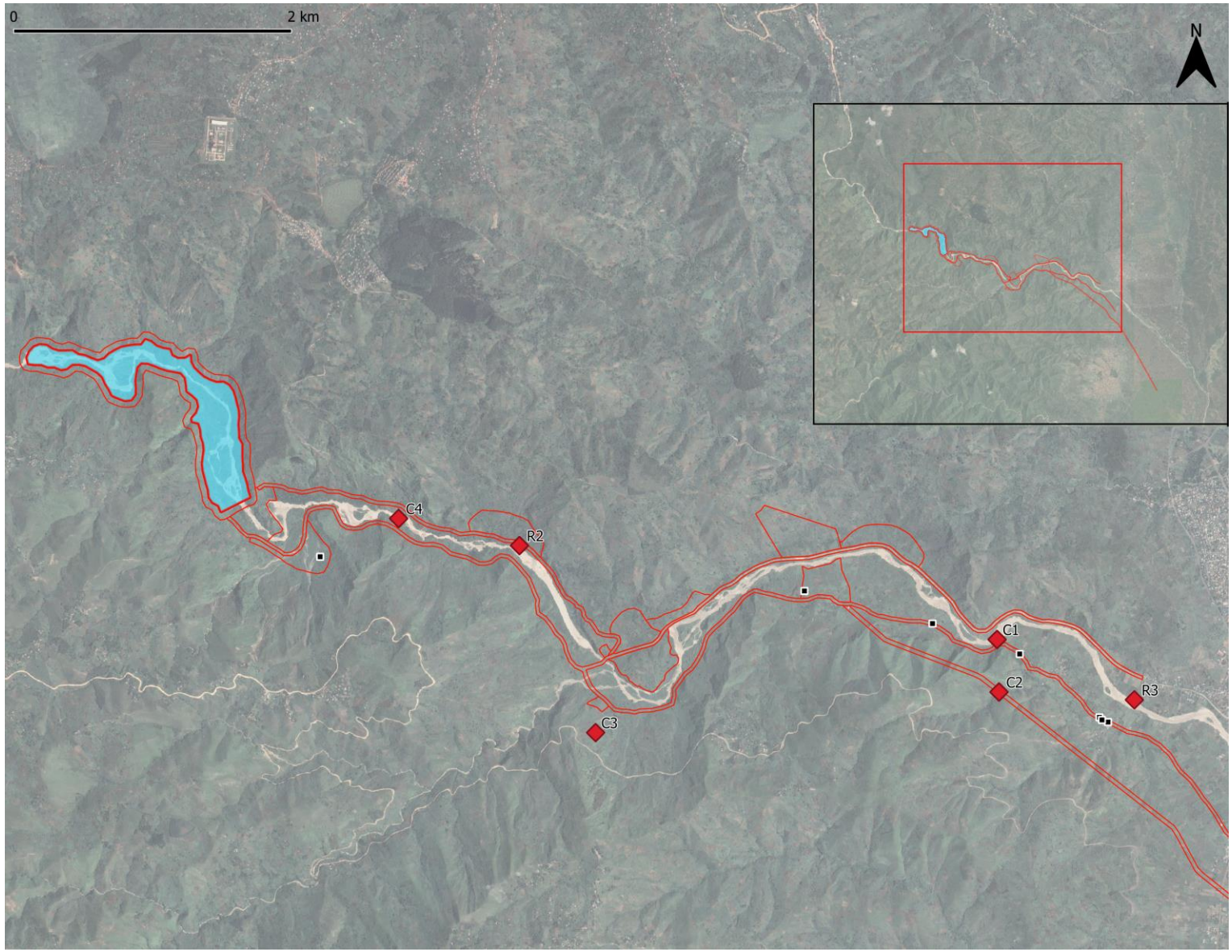

Figure 11-8 – Location of Cultural Heritage Elements Receptors of Potential Impacts

11.17.3 Predicted Impacts during Pre-Construction and Construction

The magnitude of potential impacts on Cultural Heritage elements are assessed using the criteria provided in Table 11-74 below. The significance of potential impacts during pre-construction and construction is assessed in Table 11-75. Proposed mitigation measures for significant impacts are presented in Table 11-76.

Table 11-74 Cultural Heritage Impacts Magnitude Criteria

Magnitude	Description		
	Earthworks and physical construction of Project's Components	Disturbances from Project's activities (dust, noise or vibration from construction activities)	Restriction of access or impaired access to the Cultural Heritage element for local communities
Major	The cultural heritage elements are located in the Project footprint, and if the CH element cannot be moved, the construction of the Project will cause the complete destruction of the cultural heritage element	The disturbances are preventing the local communities from having any cultural, religious, or social practice with or in the cultural heritage element at all time. Or the disturbances (vibration) are causing heavy damages to the cultural heritage element, rendering it unsafe or destroying it	Access to the cultural heritage element is blocked or impaired permanently. The local communities cannot access the cultural heritage elements anymore.
Moderate	The cultural heritage elements are located in the Project footprint, and if the CH element cannot be moved, the construction of the Project will cause some partial damages to the cultural heritage element	The disturbances are preventing the local communities from having any cultural, religious, or social practice with or in the cultural heritage element during certain periods of time. Or the disturbances (vibration) are causing some damages to the cultural heritage element, without threatening it	Access to the cultural heritage element is blocked or impaired during certain periods of time, but not permanently.
Minor	The cultural heritage elements is located in the Project footprint, but the physical state of the Cultural heritage elements will not be affected by the Project.	The disturbances require the local communities to adapt their use of the cultural heritage element, but they can continue their social, cultural or religious practices. The disturbances do not affect the physical state of the cultural heritage element	The access to the cultural heritage element has to be modified or adapted but can be maintained.
Negligible	The cultural heritage elements are not located in the Project footprint	The disturbances do not require any change from the local communities in their social, cultural or religious practices attached to the cultural heritage element. The disturbances do not affect the physical state of the cultural heritage element	No change in the access to the cultural heritage element

Table 11-75 Potential Impacts on Cultural Heritage during Pre-Construction/ Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Earth works and physical construction of project components	7 private graves and 1 church (see Figure 11-10) are located in the Project affected land plots.	Low	Major	Moderate (S)
	1 praying site in a grotto is located in the Transmission line right of way	Low	Minor	Major (S)
	Archaeological artefacts could potentially be discovered during earthworks	Negligible to Low	Major	Minor (NS) to Moderate (S)
Construction activities creating disturbances (noise, dust and vibration)	1 church and 1 prying site are located less than 50 m from the Project access roads. 2 baptism sites are located less than 50 m from the Project access roads 1 praying site in a grotto is located in the Transmission line right of way Prayer Island is located about 50 m from the access roads in Congo and Rwanda. They may be affected by dust, noise and vibration during construction. While it is not expected that the disturbances will prevent any permanent use of the cultural heritage elements or sites, it is possible that the vibrations from the Project's vehicles traffic could cause some damage to the churches. Noise and dust from construction activities may disturb the social or religious practices of the local communities for the sites closest to the Project's sites.	Low	Moderate to Major	Minor (NS) To Moderate (S)
Restriction of access	For safety reasons, the access to the cultural heritage elements closest to the Project's site may be restricted either during periods of time or permanently throughout the construction period. This could be the case for (i) the 2 baptism sites on the riverbanks which are less than 10 m from the access roads and (ii) the island used as a prayer site (see Figure 11-10)	Low	Minor to Major	Minor (NS) To Moderate (S)

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Figure 11-9 – Church affected by the Access Road in DRC

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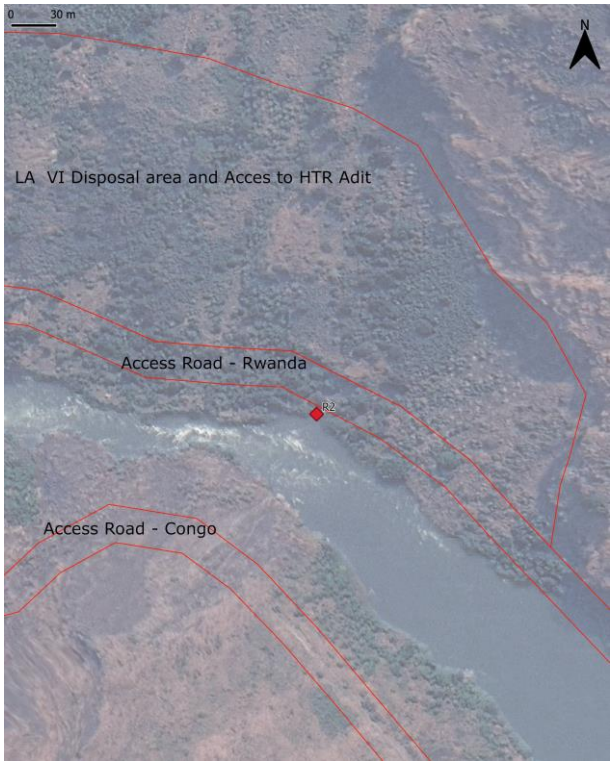
Site C4 in Figure 11-8



Site R2 in Figure 11-8

Site C1 in Figure 11-8

Figure 11-10 – Baptism sites and island used as a praying site, close to the Access Roads

Table 11-76 Mitigations & Residual Impacts – Impacts on Cultural Heritage during Pre-Construction/ Construction

Project Activity	Mitigation	Residual Impact		
		Sensitivity	Magnitude	Significance
Earth works and physical construction of project components	[M 161] Compensation or moving of the graves and church located in the Project acquired land plots, as defined in the Resettlement Action Plan.	Low	Minor	Minor (NS)
	[M 162] Define and implement a Chance Find Procedure	Negligible to Low	Minor	Negligible to Minor (NS)
Construction activities creating disturbances (noise, dust and vibration)	All measures to control noise, dust and vibration. Measures to repair or correct the effects and compensate if needed will also be implemented [M 163] All cultural heritage elements located adjacent to a construction site or the external boundaries of the future reservoir (within 30 m), will be protected from potential damages due to construction methods.	Low	Low	Negligible (NS)
Restriction of access	[M 164] Consultation with communities using the 2 baptism sites and prayer site on the island close to the Project's sites and the prayer site under the Transmission Line Right of way to assess if access to these sites could be impaired by the Project activities [M 165] Commitment to not block accesses to places of worship throughout the construction phase as much as possible, taking into consideration safety issues. [M 166] Where existing access cannot be maintained, provision of an alternative access route, subject to overriding health, safety, and security considerations	Low	Minor	Minor (NS)

11.17.4 Predicted Impacts during Operation

The significance of potential impacts during operation is assessed in Table 11-77. Proposed mitigation measures for significant impacts are presented in Table 11-78.

It must be noted that the payer site under the Transmission Line right of way in DRC (site [C2]) should not be affected, as it is located in the valley between to hills. The towers are likely to be located at the top of these hills, and access to the prayer site should not be impaired during operation. The Electro Magnetic Frequencies (EMF) levels under the transmission line have been estimated and they are below the recommended threshold for community exposure considered by international standards[11]. No restriction of access to this site for safety reason should be established during operation.

[11] The International Committee on Non-ionizing Radiation Protection (ICNIRP), in cooperation with the World Health Organization (WHO), has developed guidelines for the public and workers exposed to electromagnetic fields (ICNIRP, 1998). For the public, ICNIRP recommends exposure limits of 5.0kV/m for electric fields and 100µT (50Hz) for magnetic fields.
See International Commission on Non-Ionizing Radiation Protection. « Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 ghz) ». Health Physics 74, nº 4 (1998): 494-522.

Table 11-77 Potential Impacts on Cultural Heritage during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Operation activities creating disturbances (noise, dust and vibration)	During operation, the elements of cultural heritage potentially affected by noise, dust or vibrations are located close to the access roads. It is not expected that the traffic during operation will cause important disturbance.	Low	Negligible	Negligible (NS)
Restriction of access for safety reasons	During operation, it is not expected that any restriction of access will be established on the cultural heritage sites located in the river (praying site on an island), along the riverbank in DRC (baptism site in Bugano – [C1]) or access to the payer site under the Transmission Line will be impaired (site [C2]) However, the baptism site along the riverbank in Rwanda (in Nyagahanga – [R2]) will be located just next to a disposal area. It is unlikely that the disposal area will create any safety risk, but the potential consequences could be important (fatalities). The safety risks from this disposal area should be studied and integrated in the design.	Low	Minor to Major	Minor (NS) To Moderate (S)

Proposed mitigation measures for significant impacts are presented in the following table

Table 11-78 Mitigations & Residual Impacts on Cultural Heritage during Operation

Project Activity	Mitigation	Residual Impact		
		Sensitivity	Magnitude	Significance
Restriction of access for safety reasons	[M 167] Implement GIP for ensuring the disposal area do not represent any safety risk for the general public.	Low	Negligible to Minor	Negligible (Not Significant)

11.18 Ecosystem Services

The approach for the assessment of impacts on ecosystem services follows the method defined by the World Resource Institute (2013).

11.18.1 Ecosystems Services the Project Could Impact

Ecosystems and habitats that could be impacted by the Project are presented in Table 11-79. See also Chater 8 - Social Baseline, Section 8.13 Ecosystem services: Provisioning and Cultural Services, which provides a more detailed analysis of these services.

Table 11-79 Ecosystems and Habitats

Ecosystem	Habitat
Lotic ecosystem (river)	River
Riparian ecosystem	Riparian thicket
	Riparian wetland
Hillslope ecosystem	Bare rock
	Hillslope Grassland / Open savanna
	Hillslope Thicket
	Riparian Thicket (Bamboo)
Anthropized ecosystem	Cultivated land
	Tree plantations
	Settlements

11.18.2 Ecosystem Services Screening

The screening exercise uses a generic ecosystem services classification list and Project-specific information on the habitats, communities and Project activities. The outputs of the screening assessment are summarized in Table 11-80.

Table 11-80 Ecosystem Services Potentially Present in the Study Area

Service category	Ecosystem service	Resource/Examples
Provisioning	Food: game meat	Animals hunted primarily for food or sale (recreational hunting is covered under cultural services)
	Food: wild plants, nuts, mushrooms, fruits, honey	Fruit, wild plants, nuts, etc. collected in natural areas for consumption or sale
	Food: cultivated crops	Annual and permanent crops grown for subsistence use and commercial sale
	Food: livestock farming	Sedentary livestock farming
	Food: wild-caught fish	Fish caught for subsistence or commercial sale
	Food: Aquaculture	Fish that are bred and reared in ponds for purposes of harvesting
	Freshwater	Freshwater for bathing, drinking, irrigation, laundry, household sanitation, cattle, and husbandry
	Timber and wood products	Wood collected for local use or for sale as timber.
	Biomass fuel	Wood
	Biochemicals, natural medicines, pharmaceuticals	Natural medicines, biocides, food additives, pharmaceuticals and other biological material for commercial or domestic use
	Ornamental resources	For example, pelts, carved or decorative animal products, live animal trade
Cultural	Spiritual or religious value	Natural spaces or species with spiritual or religious importance

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Service category	Ecosystem service	Resource/Examples
	Traditional practices	Cultural value placed on traditional practices such as hunting, fishing, crafts and use of natural resources
	Recreation and tourism	Use of natural spaces and resources for tourism and recreation (e.g. fishing, kayaking, hiking, hunting)
	Aesthetic value	Cultural value placed on the aesthetic value provided by landscapes, natural landmarks
	Intrinsic value of biodiversity	Species or specimens valued for their mere existence, regardless of their utilitarian value to humans (e.g., 'each species has an intrinsic right to exist')
Regulating	Regulation of air quality	The influence ecosystems have on air quality by extracting chemicals and dust from the atmosphere (i.e., serving as a 'sink') or emitting chemicals to the atmosphere (i.e., serving as a 'source')
	Climate regulation: local regional and global	Vegetated areas sequester carbon dioxide, with implications for global climate change, regulation of temperature, shade, and quality of vegetated areas
	Regulation of water timing and flows	Influence ecosystems have on the timing and magnitude of water runoff, flooding, and aquifer recharge
	Erosion regulation	Role of vegetation in regulating erosion on slopes and riparian areas
	Pollination	Birds, insects and some small mammals pollinate certain flora species, including some agricultural crops
	Natural hazard regulation	Regulation of hydrological (e.g. flood) and meteorological (e.g. drought) frequency and intensity (e.g. dense forest can limit floods, droughts and provide firebreaks)
	Pest regulation	Regulation of the presence/abundance of pests (animal or plant) including invasive species
	Disease regulation	Influence ecosystems have on the incidence and abundance of human pathogens
Supporting	Nutrient cycling	Flow of nutrients (e.g., nitrogen, sulphur, phosphorus) through ecosystems
	Water cycling	Flow of water through ecosystems in its solid, liquid, or gaseous forms
	Soil formation	Contribution to natural soil-forming processes
	Habitat Provision	Natural spaces that maintain species populations and protect the capacity of ecological communities to recover from disturbances

11.18.3 Ecosystem Services Scoping

Ecosystem services potentially present in the study area have been first scoped in or out, based on the findings of site visits in December 2021 and January 2022, including interviews and focus groups. The scoping was performed by identifying potential impacts that may affect the provision of services by ecosystem and the impacts that may prevent the beneficiaries from obtaining the services provided by the ecosystems. When a potential impact is linked to a beneficiary the ecosystem service is scoped in, when there is a potential impact on an ecosystem service but no beneficiary that ecosystem service is scoped out and not assessed further. The results of the scoping process are found in Annex F.

11.18.4 Types and Value of Ecosystem Services

Table 11-81 describes the prioritized ecosystem services identified in the Project area and their values, based on the importance of ecosystem services for their beneficiaries and the replaceability of the ecosystem services.

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Table 11-81 Values of Ecosystem Services in the Study Area

Service	Ecosystem providing the service	Description/beneficiaries	Importance to beneficiaries / dependency of beneficiaries to this ecosystem service	Replaceability	Value
Provisioning services					
Cultivated crops	• Anthropized ecosystem	Subsistence farming is a major source of income and means of livelihood in the study area. All the villagers have cultivated plots of land located on the slopes and banks along the Ruzizi River.	Agriculture is vital for communities as it is the primarily subsistence activity, providing food for household consumption and surplus sold for additional income.	Not replaceable	High
Livestock farming	• Hillslope ecosystem • Anthropized ecosystem	Livestock farming is not an important activity within the project area. Livestock farming is mainly for subsistence purposes. The most common types of animal farming are small scale goat farming and domestic farming of chickens for both commercial and subsistence purposes. Cattle are mainly using hillslopes (including grassland) ecosystem as grazing land.	Livestock farming is not a significant activity in the Project study area. It punctually provides food for household consumption	Not replaceable	High
Fishing	• Lotic Ecosystem	Fishing is practiced all throughout the study area, although it is not a primary activity for local communities (see social baseline). Fishing is mostly for own consumption although some is traded by fishermen.	Fishing activities are an economic activity for some households but is not essential for the communities living near the river.	Not replaceable	Low
Aquaculture	• Lotic Ecosystem	Fish farming activities are occurring downstream the powerhouse, in Bugarama, and in DRC, close to the Burundi border.	Fishponds are filled with water by a gravity filling system. Fish farming is a significant economic activity in the area. FAO is sponsoring a fish farming program in RDC with the aim of distributing fish to farmers to increase fishing activities and fish commercialisation	Not replaceable	High
Freshwater for domestic purposes, and farming activities	• Lotic Ecosystem • Riparian ecosystem	Communities living along the Ruzizi River use water for domestic purposes. Main uses include recreational purposes, washing, drinking, bathing, and irrigation. Ruzizi River is also used to water the cattle.	People who are using Ruzizi River have sometimes no other access to water for domestic purposes. Ruzizi river is essential to several communities as it provide water points for cattle. Communities who grow vegetable along the river also depends on it for irrigation.	Not replaceable	High
Biomass fuel	• Riparian ecosystem • Hillslope ecosystem	Walking to collect firewood around settlements and crops is a routine activity for local communities in the project area. Charcoal fabrication is not a significant activity within the project area.	Firewood is essential for communities to cook, as charcoal is expensive. People use firewood on a daily basis.	Replaceable – firewood could be replaced by charcoal and/or gas but is not affordable for local communities as they use it on a daily basis.	High

Service	Ecosystem providing the service	Description/beneficiaries	Importance to beneficiaries / dependency of beneficiaries to this ecosystem service	Replaceability	Value
Medicinal plants, natural medicines	• Hillslope ecosystem • Riparian ecosystem • Anthropized ecosystem	Collecting medicinal plants is common in the project area but is not a regular activity and varies depending on necessity.	Medicinal plants collection is a punctual activity that is important for local communities. According to local communities, medicinal plants are very common and can be found in all types of ecosystems, even in cultivated crops.	Replaceable – medicinal plants could be replaced by conventional medicine. This type of medicine is however not easily accessible in the area.	High
Regulating services					
Air quality & carbon emissions regulation	• Hillslope ecosystem • Riparian ecosystem • Anthropized ecosystem	Natural vegetated habitats play an important role in air quality & carbon emissions regulation.	The mosaic of largely modified habitats along the Ruzizi River play a relatively minor role in air emission and climate change regulation.	Not replaceable	Low
Water and flood regulation	• Lotic Ecosystem • Riparian ecosystem	The riparian fringing and floodplain vegetation can play a role in flows regulation. Such regulation benefits to the communities that live and cultivate along the Ruzizi River.	The Ruzizi River has limited fringing riparian and floodplain habitat and therefore plays a limited role in attenuating or regulating flows between Lake Kivu and Lake Tanganyika. The extensive habitat clearance in the Ruzizi catchment for cultivation further exacerbates flood runoff into the Ruzizi River which may result in more extreme flood events over time.	Not replaceable	High
Water purification and waste treatment	• Lotic Ecosystem • Riparian ecosystem	Vegetation can play an important role in water purification, mainly in swamp habitats. This can directly benefit to local communities who are using the river water for domestic purposes.	Wetland, swamp and floodplain habitats are limited along the Ruzizi River and therefore play a minor role in water purification arising from pollution from upstream settlements. The most abundant aquatic plant observed during the field survey in January 2022 was the filamentous alga *Cladophora glomerata*, and this could serve to remove nutrients, but the roles of this species in water purification and waste treatment is likely to be small because of the fast current speeds and short contact time. Generally, river flow is high velocity with limited time for filtration through instream habitats.	Not replaceable	Low

Service	Ecosystem providing the service	Description/beneficiaries	Importance to beneficiaries / dependency of beneficiaries to this ecosystem service	Replaceability	Value
Erosion regulation	• Hillslope ecosystem • Lotic Ecosystem • Riparian ecosystem	Sediment transported by the Ruzizi River and the fringing riparian vegetation reduces the erosional effect of the river flow, thereby maintaining riverbanks and providing land for riverbank cultivation. The steep cultivated slopes on shallow soils adjacent to the Ruzizi III HPP are prone to landslides and resultant erosion and sedimentation. The riparian woodland/thicket occupies a narrow strip along the river and helps to stabilise riverbanks and protect against sedimentation to some extent.	The narrow strip that is cultivated (mainly vegetables as it is close to the river and crops can be easily watered) along the river is vital for communities as it is the primarily subsistence activity, providing food for household consumption and surplus sold for additional income.	Not replaceable – available agricultural land along the Ruzizi River is scarce in the gorge section between the reservoir area and the powerhouse site.	High
Natural Hazard regulation	• Riparian Ecosystem • Lotic Ecosystem	The attenuation of flow in the lower Ruzizi River due to the low gradient and extensive floodplain systems helps to protect local communities and infrastructure along the river from sudden or rapid fluctuations of flow during flooding. This reduces community safety risks, and floodplain cultivation or harvesting. River level changes occur at a rate that communities can adapt to and predict.	Floodplain and riverbank farming is important for food security and livelihoods of communities living along the Ruzizi River.	Not replaceable – available agricultural land along the lower Ruzizi River is scarce.	High
Disease regulation	• Riparian ecosystem • Lotic Ecosystem	Many communities in the study area are reliant on close contact with the river water for bathing/washing, watering crops, livestock watering and fishing. High river velocity and flooding serves to flush pathogens more rapidly downstream preventing the establishment of bilharzia snails and reducing habitat for mosquitoes and other water borne vectors of disease.	The Ruzizi River provides potential habitat for the pest Blackfly *Simulium damnosum* complex (*Diptera: Simuliidae*). This species complex could transmit the nematodes that cause river blindness (Onchocerciasis) among humans, but none were recorded during the field surveys in January and February 2022. Snails that are intermediate hosts of the parasites that cause liver fluke disease among livestock, and bilharzia among humans, are present in the Study Area, but these do not appear to be problematic. Fast river flow may be important for keeping numbers of snails down.	Not replaceable – role of natural hydrological cycle of the Ruzizi River in disease regulation cannot be adequately replaced by other disease prevention or curative measures.	High

Service	Ecosystem providing the service	Description/beneficiaries	Importance to beneficiaries / dependency of beneficiaries to this ecosystem service	Replaceability	Value
Supporting services					
Nutrient cycling	• Riparian ecosystem • Lotic Ecosystem • Anthropized ecosystem (crops)	Riparian vegetation, especially in swampy areas downstream Bugarama where water moves slowly through reeds (*Phragmites mauritianus*) and tall grasses (*Hyparrhenia* species) grass, plays a water quality purification role through filtering out high nitrogen and other contaminants entering the river from settlements/industry upstream. Because the riparian vegetation is very degraded and represent very low surfaces, the efficiency of this function is probably relatively low.	As for disease regulation above, many communities are reliant on close contact with water for livelihoods.	Not replaceable – filtering role of Ruzizi River floodplain vegetation plays an important role in filtering nutrients and water quality maintenance. There is limited treated water supply to communities along the river that can provide an alternative to river water use for multiple purposes.	High
Soil formation	• Riparian Ecosystem • Lotic Ecosystem • Anthropized ecosystem (crops)	The large sediment volume carried by the river serves to buffer potential erosional effects of the river and thereby maintain riverbanks and sediment delivery to floodplains to support the aquatic ecosystem, and particularly fisheries downstream, as well as supply of sediment to support riverbank cultivation.	Floodplain and riverbank farming is important for food security and livelihoods of communities living along the river, while fishing is a marginal subsistence activity. Fishing increases in importance downstream of the planned dam site.	Replaceable – sediment inputs from the catchment can balance that trapped by the reservoir	Low

Service	Ecosystem providing the service	Description/beneficiaries	Importance to beneficiaries / dependency of beneficiaries to this ecosystem service	Replaceability	Value
Habitat provision	• Riparian Ecosystem • Lotic Ecosystem • Hillslope ecosystem	Local communities especially fishers benefit from the lotic and riparian ecosystem that provide suitable habitat for fish species. Hillslope ecosystems provide habitat for terrestrial biodiversity species (e.g. birds, insects) that are involved in the pollination process that benefit to the local communities.	The fisheries productivity supported by the flowing Ruzizi River and its fringing floodplain habitats provide a subsistence food source for local residents, primarily downstream of Bugarama where the river velocity is slower and there is easier access to the riverbanks near settlements.	Not replaceable – habitat provision role and fisheries provided by the Ruzizi River is not replaceable although aquaculture (that already exists upstream in Lake Kivu and in downstream fish ponds) can potentially provide an alternative fishery resource (depending on support and training provided), although may have adverse effects on indigenous fish.	High
Cultural services					
Traditional practices	• Riparian habitat • Hillslope ecosystem	Special sites can be considered as cultural sites by the communities for various reasons. Several intangible cultural heritage sites have been identified in the project area and include several praying spots.	Cultural value of praying and/or use of sacred sites is considered to be of high importance for the local communities.	Not replaceable but alternative sites may be identified by communities.	High

11.18.5 Ecosystem Services Assessment

The ecosystem services assessment considers the following 3 key criteria:

- Does the Project change the quality or quantity of the service?
- If yes, whether the change would adversely affect users significantly, for example by tipping them over a threshold, or making demand outstrip supply, or changing perceptions about availability?
- If yes, whether the service is important for livelihoods?

When all 3 criteria are met, the impact on the service can be characterised as an affected 'priority' ecosystem service. The assessment is presented in the following table.

Table 82 – Mitigation Measures for impacted Ecosystem Services

Service	Ecosystem providing the service	Source and description of potential impact on biophysical receptor	Vol./Section of the ESIA where mitigation measures are identified
Provisioning services			
Cultivated crops	Anthropized ecosystem	Reduced area available for crop cultivation caused by Project land take (e.g. physical and economical displacements). Land plots that will be lost will be compensated as part of the RAP.	Vol. V RAP
Livestock farming	Hillslope ecosystem Anthropized ecosystem	Reduced area available for livestock farming caused by Project land take. The reduction of pasture area availability from land take for the Project is not anticipated to be significant and will be compensated through the RAP.	Vol. V RAP
Fishing	Lotic ecosystem Riparian ecosystem	Overall, fishing is not an important economic in the Project area of influence even though more fishers have been identified downstream of the dam. During construction, the main impacts caused by the dam will affect fish habitats in the 5.5 km dewatered stretch, through flow alteration and increased sedimentation but where few fishing activities occur. The Project operation will alter the aquatic ecology and river hydrology upstream and downstream, affecting water quality, quantity and fish breeding grounds, and likely leading to a reduction in fish abundance in some river reaches. However, most fish species are expected to continue to use the river course in the same way and to aggregate downstream of the new dam and powerhouse where they may be easier to harvest due to lower off-peak baseflows. Unsustainable fishing practices could however impact on the long term catch rates if insufficient fish numbers are unable to spawn and recruit and reach maturity. . the impact of the project on community fishing is not considered significant.	Vol. IV ESMP - Fisheries Management Programme
Aquaculture	Lotic ecosystem Riparian ecosystem	Fish farming is not expected to be affected by the Project, as changes in river flows are not expected to prevent the periodic filling of fishponds.	N/A
Freshwater for domestic purposes, industrial / farming activities	Lotic ecosystem Riparian ecosystem	Cattles and villagers will continue to have access to the river during construction and operation. People will continue to be able to fetch water. Water resources may be affected by the following: Increased sediment loading in the Ruzizi River from earthworks. Accidental spills and leaks from the storage and handling of hazardous materials may contaminate surface and groundwater. Discharge of sanitary and domestic wastewater.	Vol. II / Section11.6

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Service	Ecosystem providing the service	Source and description of potential impact on biophysical receptor	Vol./Section of the ESIA where mitigation measures are identified
Regulating services			
Erosion regulation	Lotic ecosystem	Retention of sediment in the reservoir will lead to increased riverbank and bed erosion downstream with implications for fisheries productivity and floodplain crop cultivation.	Vol. II / Section 11.8
Disease regulation	Lotic ecosystem Riparian ecosystem	The flow velocity of the Ruzizi River minimises the availability of still water areas where water borne disease vectors can proliferate thereby minimising prevalence of diseases such as bilharzia.	Vol. IV ESMP – section 4.8 – Alien Invasive species Management
Supporting services			
Soil formation	Lotic ecosystem Riparian ecosystem	Trapping of suspended sediment and nutrients in dam will cause riverbank erosion and loss of floodplain area for cultivation. Bank and bed erosion may lead to deposition of sediment and smothering of floodplains with negative effects on fisheries.	
Habitat provision	Lotic ecosystem Riparian ecosystem Hillslope ecosystem	Trapping of suspended sediment and nutrients in reservoir will cause negligible riverbank erosion. Impacts on fish species typically caught by fishers is predicted to be minimal.	N/A
Cultural services			
Cultural services	Ruzizi River	In DRC the river is perceived as carrying a particular cultural and spiritual value. Project will create a 5.5 km dewatered stretch modifying the river's hydrology.	Vol. II / Section 11.7 Hydrology

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11.19 Landscape and Visual Amenity

11.19.1 Impact Producing Factors

The landscape and visual impacts that may arise from the construction of the Project include works at the proposed infrastructures sites, and any associated works such as:

- Temporary accommodation camp for construction workers.
- Spoil disposal areas.
- Access roads.
- River diversion works (tunnels and coffer dam).

Landscape-visual permanent impacts will be connected to the existence of permanent HPP buildings during the operational phase.

Project facilities that might affect the landscape and visual amenity will be the permanent infrastructures:

- Rockfill embankment dam
- Reservoir
- Access roads
- Power waterway (including water intake, headrace tunnel, surge shaft, penstock and powerhouse)
- Switchyard
- Transmission line
- Permanent camps

11.19.2 Assessment of Landscape Value and Visual Sensitivity

11.19.2.1 Landscape Value

The existing landscape within the project area can be divided into two categories:

- Ruzizi deep gorge
- Ruzizi floodplain

The first category consists of a deep gorge (Ruzizi River gorge) with steep cultivated slopes running down to the Ruzizi River. This basic terrain varies in terms of slope steepness, extent of farming and vegetation types. When going further down (South), the gorge opens to the Ruzizi floodplain. Almost the entire project area, apart from some small portions of largely natural habitat, is under anthropic influence – mostly cultivation and degraded secondary shrubland - classified as modified habitat.

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Figure 11-11 View on the Ruzizi gorge from the Plateau (Rwanda) toward Southeast

The second category consists of a large, opened floodplain that starts at the end of the Ruzizi gorge, in Bugarama, and goes along the Ruzizi River toward Burundi. Houses, roads and small power lines are much more frequent than in the upstream areas especially. Most of the floodplain is flat and cultivated.

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Figure 11-12 View on the Ruzizi floodplain (from Rwanda) toward North West

11.19.2.2 Visual Receptors

Visual receptors are the components of the landscape that are likely to be affected by the scheme and can include individual elements (such as rivers or buildings), aesthetic characteristics (for example tranquillity or openness), or, at a larger scale, the character of a defined character area or landscape type.

The sensitivity of visual receptors affected by a project is generally defined by the views of the people who may be affected by a proposed project proposals. They generally include users of public rights of way or other recreational facilities; travellers who may pass through the study area because they are visiting, living or working there; residents living in the study area, either as individuals or, more often, as a community; and people at their place of work.

As part of the Ruzizi 3 project development, affected people will be:

- Local permanent residents of settlements and land users.
- Road users using the road from Bugarama toward the Ruzizi gorge (road going to the future powerhouse site).
- Road users using the road going from Kamanyola toward Bukavu (Road N5).

The people affected by visual impacts will be the residents living in the Project area of influence. Village's receptors are mainly located on the plateau and most of them do not have a direct view down the Ruzizi River Gorge where the dam will be located. Due to the winding of the valley, the dam will not be visible from the floodplain (e.g. Bugarama area).

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11.19.2.3 Assessment of Sensitivity

The assessment criteria of Landscape character and visual amenity are described in Table 11-83 below.

Table 11-83 Landscape and Visual Amenity Receptor Sensitivity Classification

Sensitivity	Description of Landscape Character	Description of Visual Amenity
High	Landscape of distinctive components and characteristics, or a relatively undisturbed, pristine landscape, where changes or disruptions to the existing landscape would be noticeable and difficult to mitigate or restore; a small change is likely to be prominent or even dominant; a change to the landscape could alter the classification and integrity of the landscape character or quality and its perceived value relative to the scale and openness.	High Receptors with a key interest and expectation of enjoying the view (e.g. residential receptors, tourists or people engaged in outdoor recreation whose attention is focused on the landscape) and/or a greatly valued existing view (e.g. a designated landscape, unspoilt countryside, recognised viewpoint or conservation area).
Moderate	Landscape of relatively widespread, featureless, common components and characteristics, able to tolerate some changes or modifications without altering the classification of landscape character or quality. Landscape lacking in structural landform would also be considered of medium sensitivity.	Moderate Receptors at locations where the view is valued but not fundamental to the location or activity (e.g. people engaged in outdoor recreation that does not focus on an appreciation of the landscape). Visual receptors are less sensitive to changes to their view if the quality, condition and extent of the existing view is unexceptional (e.g. some high density suburban townscapes).
Low	Landscape of relatively indiscernible components and characteristics, the nature of which is likely to be tolerant of substantial change, where modifications are unlikely to alter its character or quality classification. Landscape of poor condition, and low perceived value relative to their scale and form. Where a landscape holds a high potential for mitigation it would also be considered to be of low sensitivity.	Low Receptors engaged in activities that either distract from the view or require concentration on the foreground, resulting in a minimal interest or appreciation of the view (e.g. people at work or motorists travelling through the area with the sole purpose of getting from one place to another and not for the specific enjoyment of the scenery). Receptors might very well appreciate the view if they chose to, but visual amenity is not the principal reason for them to be present. Visual receptors are less sensitive to changes to their view if the quality of the existing view is poor (e.g. industrial areas or derelict land).
Negligible	N/A – it is not considered appropriate to include this category since no landscape is considered so unimportant that it may safely be disregarded.	Negligible N/A – it is not considered appropriate to include this category since no visual receptor is considered so unimportant that it may safely be disregarded

The landscape character sensitivity is assessed in Table 11-84.

Table 11-84 Assessment of Sensitivity of Landscape Character

Receptors	Description	Sensitivity
Ruzizi deep gorge	This high value is a function of the relative lack of development, unbuilt area (even if cultivated) and dramatic terrain.	High
Ruzizi floodplain	This is a function of the flat terrain and relative density of development.	Low

The social baseline study identified a number of settlements that could be potential visual receptors (people with a view of one or several Project component(s)). Due to (i) the winding nature of the valley, (ii) the rugged terrain and (iii) the distribution of the project components over a large area, the number of Project components visible to people from a single location will be limited. Potential receptors are listed with an assessment of sensitivity in Table 11-85.

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Table 11-85 Assessment of Sensitivity of Visual Receptors

Receptors	Description	Sensitivity
Residents of the plateau's edge (on both sides of the Ruzizi valley)	The largest components that might change the most the landscape is the dam and reservoir, which will be located in a remote area, not visible from the main settlements. However, permanent resident of settlements located within the zone of visual influence might be affected daily by the changes in the landscape and visual amenity.	Medium
Land users of the valley and floodplain (e.g. farmers, fishermen)	Land user of the area will be affected by the changes in the landscape and visual amenity. However, visual amenity is not the principal reason for them to be present <as they are working in the area.	Low
Road travellers through the area, especially on Road N5 in DRC	The users of the main roads and passengers of public transport that are not resident of the settlements within have transport as their primary interest. They will witness the landscape changes during the time needed to drive through the zone of visual impact.	Low

11.19.3 Predicted Impacts

The effects are likely to include:

- Removal of the existing vegetation
- Temporary construction camps and associated equipment.
- Localised light pollution
- Excavation and cuts in hillsides from development of tunnel and access roads
- New quarries which at the worst scenario could leave a permanent scar on the hillsides especially since, once opened, they are likely to continue in use
- Change in tranquillity of the surrounding landscape

Table 11-86 Landscape and Visual Amenity Receptor Sensitivity Classification

Magnitude	Description of Impact on Landscape	Description of Impact on Visual Amenity
High	High Extensive change to existing view, loss of key characteristic features; introduction of anomalous and highly prominent or dominant new elements. Impact is more likely to be high if change is long-term or permanent.	High Ranging from a limited change in landscape and seascape characteristics over an extensive geographical area, to an intensive or pronounced change over a more limited area. Impact is more likely to be high if change is long-term or permanent.
Moderate	Moderate Notable change to existing view (e.g. partial loss of key characteristic features); introduction of prominent, but essentially localised new features or elements; could include high impact change of a short-term or temporary nature.	Moderate change in a localised area (e.g. limited woodland clearance without compromising the overall integrity of the wider woodland area). Could include high impact change of a short-term or temporary nature.
Low	Low Minor change to existing view (e.g. limited loss of characteristic features), changes are evident, but not especially prominent and are generally localised impact is more likely to be low if change is short-term or temporary.	Low Minor change in scale and geographical extent (e.g. loss of small areas of vegetation or indirect impact resulting from intervisibility with development in adjoining character type). Impact is more likely to be low if change is short-term or temporary.
Negligible	Negligible Barely perceptible change to existing view and/or very brief exposure to view	Negligible Virtually imperceptible change to the baseline context.

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11.19.3.1 Dam

A Landscape

During the construction phase, there would be considerable disturbance to the landscape:

- The clearance of land and removal of vegetation would result in direct effects on the fabric of the landscape over a wide area.
- Construction traffic, compounds and working areas would result in a large increase in activity levels. Noise and lighting associated with both traffic and construction areas would influence landscape character, notably through effects on perceptual qualities, particularly tranquillity.
- The creation of the quarries and deposit areas would result in recurring disturbance. Assuming the working areas are restored following construction, elements of these deposit areas and quarry works will be temporary and reversible. However, the removal of vegetation and creation of new landforms will take time to restore to the extent that they blend with the adjacent landscape.

Some the elements that form part of the construction phase would be temporary and reversible e.g. construction areas would be removed, and the land restored following the completion of works. Many structures, such as the dams and the powerhouse would remain following the construction phase. During operation, the main element that will modify significantly the landscape is the reservoir.

B Visual Effects

The most transformative elements in the area of visual influence will be the dam and the reservoir. These would become the largest scale elements within the area. However, the dam site is located in a deep gorge, not in a populated area and, therefore, will not be seen by many receptors.

The multiple areas of disturbance associated with quarries and deposit areas would also result in effects that extend into the operational phase. It will take time for new planting to replace vegetation that is removed. The changes in landform would also be permanent. However, providing effective restoration of these areas take place, the land should gradually blend with the local context.

All permanent and temporary facilities at the dam site (i.e. the dam, the powerhouse, the construction camp, the switchyard, the quarry and disposal areas) will not be visible from one single location.

11.19.3.2 Transmission Line

A Landscape

The construction of the TL will also necessitate clearance of land and removal of vegetation beneath the line and at the pylon's construction location. New temporary access tracks would be likely to be required to provide suitable access for the delivery of materials, plant and the workforce to the working areas.

Vegetation clearance and the traffic will influence landscape character and change the undisturbed nature of the area.

B Visual Effects

The transmission line will be visible from several settlements, including Bugarama and Kamanyola. However, as it will be located on the hill slope and not on the skyline, the contrast will allow not to be too visible. As the line will cross the N5 asphalted road, the TL will also be seen by any road user.

11.19.3.3 Access Roads

A Landscape

The construction of new access road (16.4 km) might affect the landscape, whether improvement of existing dirt roads (12.7 km) is not likely to have significant changes on it. The clearance of land and removal of vegetation will mainly occur fir the new access roads construction. However, the area is already degraded and mainly covered with crops and thickets. Construction traffic will also result in a large increase in activity levels that will influence landscape character.

B Visual effects

The access roads will be visible from several settlements as roads will be spread out in several location over a total of 29.1 km (both for new and improved roads).

11.19.3.4 Assessment of Visual Impacts

Potential impacts are presented in the following tables.

Table 11-87 Potential Impacts – Landscape & Visual Amenity during Pre-Construction/Construction

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Dam	Local residents People living in settlements nearby construction sites will experience a range of changes and effects.	Medium	Negligible	Negligible (NS)
	Land users People working on the valley slopes will experience a range of changes and effects.	Low	Negligible	Negligible (NS)
	Road users The dam infrastructures construction sites will not be visible from most parts of the road. However, it could be briefly visible from specific point of view.	Low	Negligible	Negligible (NS)
Transmission Line	Local residents The transmission line construction sites will be visible from Bugarama and Kamanyola, the main two cities in the area.	Medium	Negligible	Negligible (NS)
	Land users People working on the valley slopes (downstream from the dam site) and in the floodplain will experience a range of changes and effects.	Low	Negligible	Negligible (NS)
	Road users Locals using the asphalted road N5 from Bugarama to Kamanyola and then toward Bukavu will notice landscape change due to the construction of the power line and the pylons which are crossing the road.	Low	Negligible	Negligible (NS)
New access road	Local residents People living in the area will experience a range of changes and effects. It is however anticipated that, due to the relief, only few hundred meters sections of access road(s) will be visible from one single location.	Medium	Minor	Minor (NS)
	Land users As per the local residents, people working in the area (farmers within the valley and the floodplain) will experience a range of changes and effects.	Low	Negligible	Negligible (NS)
	Road users Locals using the asphalted road N5 will experience a permanent change in the landscape due to the presence of access roads, from a few specific points of view.	Low	Negligible	Negligible (NS)

Table 11-88 Potential Impacts – Landscape & Visual Amenity during Operation

Project Activity	Summary Description of Impact	Potential Impact		
		Sensitivity	Magnitude	Significance
Dam	Local residents Number of settlements from which dam infrastructures will be visible will be very limited. People living in those settlements will experience a range of changes and effects.	Medium	Minor	Minor (NS)
	Land users People working on the valley slopes will experience a range of changes and effects.	Low	Minor	Minor (NS)
	Road users The dam infrastructures will not be visible from most parts of the road. However, it could be briefly visible from specific point of view.	Low	Negligible	Negligible (NS)
Transmission Line	Local residents The transmission line will be permanently visible from Bugarama and Kamanyola, the main two cities in the area.	Medium	Minor	Minor (NS)
	Land users People working on the valley slopes (downstream from the dam site) and in the floodplain will experience a range of changes and effects.	Low	Negligible	Negligible (NS)
	Road users Locals using the asphalted road N5 from Bugarama to Kamanyola and then toward Bukavu will notice landscape change due to the construction of the power line and the pylons which are crossing the road.	Low	Negligible	Negligible (NS)
New access road	Local residents See construction phase.	Medium	Minor	Minor (NS)
	Land users See Construction phase.	Low	Minor	Minor (NS)
	Road users See Construction phase.	Low	Negligible	Negligible (NS)

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11.20 Positive Impacts and Benefits

11.20.1 Impact Producing Factors

During pre-construction and construction, the creation of job opportunities and business opportunities for the Project's supply chain will produce positive impacts.

During operation, the generation of electricity will be the main positive impact of the Project.

11.20.2 Predicted Impacts during Pre-Construction and Construction

The construction activities will generate temporary employment opportunities. Construction duration is estimated at 56 months, requiring an estimated workforce of 500-1,000 workers during the period of peak activities (Tractebel, 2021). A key positive impact will be the provision of an income source for workers and their families contributing to their well-being.

Based on comparison with similar projects in the region, it is estimated that about 180 unskilled jobs[12] could be available during the construction period.

The supply of goods and services along the Project's supply chain will also create economic opportunities.

To enhance these positive impacts and ensure they benefit as much as possible to the local communities in the vicinity of the Project, the following measures already defined in the previous sections will be implemented:

[M 112] The Project will set local employment objectives and targets.

[M 114] The local Recruitment Policy will be communicated widely.

[M 115] Construction phase training programme will be implemented by the EPC Contractor.

11.20.3 Predicted Impacts during Operation

The main positive impact during operation is the objective justifying the Project: electricity production

The Project will generate clean and renewable power, reducing the region's reliance on expensive thermal generation. The estimated energy production for the Ruzizi-III powerplant[13] is between 1,153 and 1,197 GWh (mean annual energy) or between 945 and 989 GWh (firm energy).

Availability of the renewable power will support efforts to extend electrification to the region. It is currently projected that the Project will benefit a population of 30 million people, 54% of whom are living under the poverty line and averaging a 24% electricity access rate. Once commissioned, Ruzizi III will almost double Burundi's current capacity, increase Rwanda's installed capacity by nearly 30% and provide much needed baseload power in Eastern DRC, a region that is otherwise isolated from DRC's interconnected grid.

Permanent employment opportunities during operation will be more limited than during construction. The operation of the scheme will require only a small number of staff, probably in the order of 50 people.

[12] 6 Unskilled occupations correspond to International Standard Classification of Occupation (ISCO-08) Skill Level 1 See International Labour Office – ISCO-08 "Volume I - International Standard Classification of Occupation – Structure, group definitions and correspondence tables"

[13] Source: Project's feasibility Study (Tractebel, 2021)

The measures to enhance the positive impacts during operation are described in the next section.

11.20.4 Local Area Development Plan

The Project recognizes that the economic benefit at the national level will be produced using the natural resources of the Ruzizi River and that communities have a right to share in that benefit – and that this is not compensation for negative impacts. For that purpose, a Local Area Development Plan has been prepared and will be implemented by the Contracting States to ensure that the local population in the area of the Project can also benefit from the Project. The Local Area Development Plan sometimes has different names and abbreviations in other projects, such as Corporate Social Responsibility (CSR) Plan or Community Investment Plan (CIP), but for Ruzizi-III Project, LADP will be the name of the support program towards the wider community. It is a tool proposed by the Project to support the local communities to improve their living conditions, address development challenges and to take advantage of emerging opportunities.

The Project intends to fund local development activities during the construction period and the operation phase to achieve sustained sharing of benefits with the project-affected communities. The Local Area Development Plan initiatives will be implemented in 2 phases: a first phase of 5 years, (year 1 to year 5) followed by a second phase of 5 years (year 6 to year 10). The first phase has been budgeted as part of the RAP. It will start as soon as the construction activities start. The second phase will be funded after evaluation of the activities implemented during the first phase.

This Plan will not be limited to the households affected by the Project's land acquisition process: *it will target all villages in the immediate vicinity of the Project footprints*.

The Project will screen investment options and prioritize shared areas of interest, mainly between communities, the local authorities and the Contracting States. This screening will be undertaken based on criteria that will be discussed and agreed with the communities and the local authorities. Criteria that would be applied are:

- Sustainability factors, i.e. viable handover strategy and clear set-up for the ownership, operation and maintenance arrangements to avoid creating dependency and to ensure that the initiative can become self-sustaining once REL withdraws its support. This includes consideration of the local government's interest, and the availability of local implementing partners to deliver the initiatives and services.
- Alignment with existing government or municipal plans for local developments.
- When possible, rehabilitate or complete existing infrastructure before investing in new construction.
- Cost-benefit considerations, i.e. the number of people benefiting from the initiative compared to the cost for the Project.

The Local Area Development Plan initiatives could include the following components:

- Electrification of villages or improvement of access to electricity,
- Support to the development of fish farming and fisheries activities in the future reservoir,
- Support to the development of sustainable water supply systems in the villages,
- Support to roads improvement,
- Support to health centres, by provision of medicines and medical equipment,
- Flour mills and small processing installation in the villages,
- Support to improve schools (construction of new rooms and provision of schooling equipment and access to electricity).

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11.21 Impacts on Historically Marginalised People

The presence of Historically Marginalised People (HMP) in the Project area was identified during the qualitative survey carried out in 2022. In 2022, a stand-alone anthropological study was conducted to further explore the socioeconomic characteristics of the community. Based on the outcome of this study, the Project has concluded that the 'Twa' social group, known as 'Batwa' in DRC and 'Historically Marginalised People (HMP)' in Rwanda, qualifies as Indigenous according to SP 7, WB ESS 7, AfDB OS 1 and EIB ESS 7.

The socioeconomic characteristics of this community are outlined in detail in the Social Baseline. In summary, this community is known as Batwa in DRC and as *Abasigajwinyuma Namatekas*, or Historically HMP, in Rwanda, where identification with ethnic labels has been outlawed in 2003. In both Rwanda and DRC, this community self-identifies and is perceived as descending from a hunter-gatherer community which historically lived in the region's forests. HMP faced marginalization, land grabbing, violence and forced displacement from their ancestral lands throughout the 20th century. In the Project area, they currently live in extreme poverty as tenants or squatters, occasionally engaging in daily agricultural labor. They still experience discrimination and struggle to access healthcare and education. Many of their cultural traditions and practices have been lost after their displacement from ancestral lands.

While the anthropological study produced in 2022 concludes that the Project is not expected to have a significant impact on the livelihoods, culture and lifestyle of HMP, a robust stand-alone impact assessment is required to adequately assess impacts. To adequately assess impacts on the HM community in the Project area, the Project will develop an Historically Marginalized People Development Plan (HMPDP), which will assess and mitigate adverse impacts on the community, as well as develop a timebound plan to ensure informed participation and consultation of indigenous people and create positive opportunities for the sustainable development of the communities.

11.22 Recap of Impacts and Mitigation Measures

A recap of all impacts and mitigations that are assessed in this Section 11 is provided in Table 11-89.

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Table 11-89 Summary of Potential Impact and Risks and Mitigation Measures

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Climate Change Vulnerability	C / Op		R	N/A	[M 1] Slope stability shall be monitored and if necessary, dam and reservoir bank protection features shall be constructed to protect structures from landslides. [M 2] Hydro-meteorological data (temperature, precipitation, river flow) and sedimentation shall be monitored. [M 10] Good Practice measure to monitor Scope 1 and Scope 2 GHG emissions during construction and report the emissions in REL's annual environmental and social performance report and post on the Project's website. [M 3] Consider the use of alternative energy sources such as solar energy. [M 4] Project infrastructure shall be monitored for damage (gates and turbines) and electrical equipment failures and regular maintenance of facilities undertaken. [M 5] A sediment management system shall be developed and implemented that includes provision for watershed management to reduce erosion, and dredging of the reservoir, if needed. [M 6] Revegetation of the river basin should be considered to improve infiltration, reduce sedimentation and minimise flooding of infrastructure. [M 7] Changes in the energy generation schedule, hourly or seasonally, resulting in a change in grid requirements shall be monitored. [M 8] A data management system that makes provision for proper storage of data, proper monitoring and formatting of metadata, documenting the full history of the data (e.g., who took the data, when and how) and preservation of raw data shall be implemented and maintained. [M 9] The Climate Risk Assessment should be updated every 10 years as new data and projections become available, following the IHA Guidelines relevant at the time.
Greenhouse Gas Emissions	C	GHG emissions from construction <IFI threshold of 100,000 tonnes CO2e per annum which triggers need to monitor and publicly disclose GHG emissions	I	NS	[M 10] Good Practice measure to monitor Scope 1 and Scope 2 GHG emissions during construction and report the emissions in REL's annual environmental and social performance report and post on the Project's website. [M 11] The Project undertake a separate study to explore the opportunities to benefit from carbon credits.
	Op	GHG emissions from reservoir operation	I	NS	No measures proposed as the impact is not significant
Air quality, Dust and Odour	C	Emissions of air quality pollutants from fuel combustion at worksites	I	NS	[M 12] The Contractor shall prepare and implement an Air Quality and Emissions Management Plan as part of the CESMP, which details measures to manage air emissions and dust. [M 13] The Contractor shall use equipment and adopt construction and transport methods with air emissions that do not exceed threshold emission values specified in Rwanda and DRC regulations or IFC EHS Guidelines, whichever is the most stringent. [M 14] The fleet of vehicles or equipment emitting combustion gases shall be maintained at the intervals and according to the methods specified by the manufacturer. The Contractor shall keep maintenance records.
	C	Dust emissions from land clearing and site preparation		S	
	C	Emissions of air quality pollutants and dust from construction related traffic		S	
	Op	Emissions of air quality pollutants from fixed point sources at the dam, powerhouse and operators' village	I	NS	[M 15] Power generators at the operator's village will be designed to comply with IFC General EHS emission limit values and DRC/Rwanda emission limit values (whichever are the most stringent). Annual monitoring of the emissions will be performed to check conformity.

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Noise and Vibration	C	Noise from vegetation clearing and site preparation at worksites	I	S	[M 16] The Contractor shall prepare and implement a Noise & Vibration Control and Monitoring Plan as part of the CESMP. [M 17] Regular noise level monitoring will be performed during construction to demonstrate compliance with WHO noise guidelines and DRC and Rwanda noise level regulations. [M 18] The Contractor shall use equipment and adopt construction and transport methods so as minimise noise levels and prevent exceeding threshold values recommended by the DRC/Rwanda regulations and WHO recommendations. [M 19] Where communities are located close to worksites, access roads and public roads affected by construction traffic, the Contractor shall study, propose, implement and monitor the efficiency of all reasonable and practicable measures to minimize noise resulting from the activity and to minimize the acoustic nuisances to adjacent households during day and night. [M 20] Noise barriers or acoustic shields shall be considered if works are close to sensitive receptors and installed if monitoring detects noise levels at residential areas that exceed WHO noise guidelines and DRC and Rwanda noise level regulations. [M 21] Noise-intensive works such as piling, demolition, metalworking, and blasting (in quarries) will not be undertaken at night. [M 22] The Contractor shall monitor the vibration level at buildings nearest to the Works during activities which could generate offset vibration effects. The Contractor shall prepare a pre-construction condition survey for all buildings located within 1 km of any blasting activities (including photographs of existing situation). The condition survey will be used to assess the effect of blasting on structures and the scope of any remediation works necessary to repair the effects of blasting.
		Noise from machinery at construction sites,	I	S	
		Noise from rock crushers at quarries	I	S	
		Noise from cement batching plant	I	S	
		Noise and vibration from tunnelling (includes blasting)	I	S	
		~~Noise and vibration from blasting at quarries~~	~~I~~	~~S~~	
		Noise and vibration from construction traffic movements along dam and quarry access roads	I	S	
	Op	Noise from operators' village (generators, compressors, sirens, alarms)	I	S	[M 23] Noise modelling study for the operators' village, powerhouse and substation will be carried out during the design phase and noise prevention measures included in the design as necessary to ensure that noise levels at the site boundary complies with WHO noise guidelines and DRC and Rwanda noise level regulations. [M 24] Noise level monitoring will be performed at the operator's village, powerhouse and substation during commissioning to check compliance with the owner's noise requirements. [M 25] Periodic noise level monitoring will be performed during operation at the powerhouse, operators' camp and substation to check compliance with WHO noise guidelines and DRC and Rwanda noise level regulations. [M 26] The transmission line and switchyard will be designed with features to minimise the corona affect.
		Noise from powerhouse operation	I	S	
		Noise from the 220 kV switchyard and 220 kV transmission line	I	S	
		Noise from Project road traffic	I	NS	
Soils, Groundwater and Surface Water	C	Topsoil removal and excavation during site preparation of worksites and roads	I	NS	[M 27] A soil, slope stability and erosion control plan will be developed and implemented by the EPC Contract [M 28] Construction site pollution prevention and protection plans, and measures will be developed and implemented for all worksites by the EPC Contractor. [M 29] Groundwater at construction worksite will be monitored monthly during construction. [M 30] Construction accommodation camps will be equipped with wastewater treatment facilities to ensure sanitary and domestic wastewater discharges are compliant with Burundi, DRC and Rwanda regulatory discharge limits and IFC EHS guideline emission limit values.
	C	Pollution of soils, groundwater and surface water from accidental spill and leaks of hazardous substances	I	S	

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Soils, Groundwater and Surface Water (cont.)	C	Alteration of Ruzizi River water quality from discharge of effluents and wastewaters from the construction workers' accommodation camp	I	S	[M 31] The quality of wastewater discharges from construction worksites will be monitored to check conformity with discharge limit values. [M 32] During construction, erosion mitigation measures will be employed to prevent soil erosion and fluvial erosion when undertaking works on bare soil and banks and when working in the river (EPC Contractor). [M 33] Cofferdams and diversion tunnels used for construction works in the river will be designed to enable suspended sediment to be carried downstream while construction is taking place. [M 34] During construction, worksite surface erosion and effectiveness of control measures will be monitored by taking weekly fixed-point photos of cleared areas. [M 35] During the reservoir filling phase, bottom sluicing will be undertaken to maintain sediment throughflow as best possible and flows will be sufficient to transport the released sediment downstream to avoid siltation of instream habitats immediately downstream of the dam. [M 36] Environmental performance of the EPC Contractor will be monitored to check conformity with Project standards and non-conformities will be managed through a non-conformity management process.
	C	Increased sediment loads in the Ruzizi River from runoff from worksites and spoil disposal areas	I	S	
	C	Alteration of the Ruzizi River from filling of the Ruzizi-III reservoir	I	S	
	Op	Alteration of the Ruzizi River water quality from discharge of wastewaters from the operators' village	I	S	[M 37] The operators' accommodation camp will be equipped with a sanitary and domestic wastewater collection and treatment facilities to ensure discharges comply with regulatory discharge limit values and IFC EHS guideline emission limit values. [M 38] Quality of wastewater discharges from the operators' accommodation camp will be monitored quarterly to check conformity with discharge limit values. [M 39] A Pollution prevention and control plan for the operation phase will developed and implemented. [M 40] Facilities for the storage and handling of hazardous substances at the dam site, powerhouse and switchyard will be designed with spill prevention and protection measures.
	Op	Alteration of reservoir water quality and consequently	I	S	[M 41] Water quality impacts will be monitored and adaptively managed.
Hydrology	C	Temporary river diversion	I	NS	Measures included in the Project design
	C	Reservoir clearing	I	NS	Measures included in the Project design
	C	Reservoir filling	I	NS	Measures included in the Project design
	Op	Diversion of the river through the headrace tunnel, leaving a bypassed reach of river.	I	S	[M 42] Implement monitoring of release from the bottom outlet using flow measurement / video evidence. Provide real-time open web portal to allow for stakeholder assessment of performance. [M 43] Publish annual report of bottom outlet flow release data. [M 44] Implement operational maintenance schedule to ensure full and correct functioning of bottom outlet monitoring & data publishing, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.
		Normal powerhouse operation with peak and off-peak discharges	I	S	[M 45] Assess requirements for improved hydrological modelling of upstream and tributary catchments to reduce uncertainty inherent in current broad-scale assessment. [M 46] Assess requirements for improved hydrological and hydraulic characterisation of micro-/meso-scale habitat in hydropeaking reach to reduce uncertainty inherent in current broad-scale assessment. [M 47] Implement monitoring of powerhouse tailrace flow and flow / water levels at selected locations in the hydropeaking reach (between the powerhouse tailrace and the Burundi border) using flow measurement / radar / video evidence.. [M 48] Publish annual report of powerhouse / hydropeaking reach flow data. [M 49] Implement operational maintenance schedule to ensure full and correct functioning of powerhouse tailrace / hydropeaking reach monitoring & data publishing, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Hydrology (cont.)		Sediment flushing operations	I	S	[M 50] Develop, agree with key stakeholders (e;g., ABAKIR), and implement a Dewatered Reach Sediment Management Plan that explicitly evaluates associated ecological and social functioning in the dewatered and further downstream reaches (including, *inter alia*, sediment transport and floodplain inundation). [M 51] Maintain regular, periodic releases from Ruzizi III reservoir (bottom outlet / spillway) to flush sediment in the dewatered reach. [M 52] Implement monitoring of sedimentation in the dewatered reach (between the powerhouse tailrace and the Burundi border) using periodic sediment sampling / aerial (drone) survey. [M 53] Publish annual report of sediment monitoring in the dewatered reach. [M 54] Implement operational maintenance schedule to ensure full and correct functioning of Dewatered Reach Sediment Management Plan, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.
		Exceptional operating conditions	I	S	[M 55] Develop, agree with key stakeholders (e.g., ABAKIR), and implement a Reservoir Operation Plan (exception operating conditions and flood risk management) that explicitly evaluates associated ecological and social functioning in the dewatered and further downstream reaches (including, *inter alia*, sediment transport and floodplain inundation). [M 56] Publish annual report of Reservoir Operation Plan. [M 57] Implement operational maintenance schedule to ensure full and correct functioning of the Reservoir Operation Plan, to include level of service agreements made with key stakeholders (e.g., ABAKIR) and recommendations for adaptive management variations.
Geomorphology and Sediment Transport	C	Cofferdam and temporary river diversion causing reduced sediment loads in the downstream reach	I	S	[M 33] Cofferdams and diversion tunnels used for construction works in the river will be designed to enable suspended sediment to be carried downstream while construction is taking place.
	C	Runoff from worksites increasing sediment loads in the river	I	S	[M 32] During construction, erosion mitigation measures will be employed to prevent soil erosion and fluvial erosion when undertaking works on bare soil and banks and when working in the river (EPC Contractor). [M 34] During construction, worksite surface erosion and effectiveness of control measures will be monitored by taking weekly fixed-point photos of cleared areas.
	C	Reservoir clearing causing increased sediment loads in the river	I	S	[M 32] During construction, erosion mitigation measures will be employed to prevent soil erosion and fluvial erosion when undertaking works on bare soil and banks and when working in the river (EPC Contractor).
	Op	Normal and exceptional operating conditions with diversion of the river through the headrace tunnel, leaving a reach of the river left dry and peak and off-peak discharges. Causing trapping sediment in the reservoir and reduced sediment loads in the reach downstream from the dam	I	S	[M 58] Develop, agree with key stakeholders (e.g., other HEPP operators, ABAKIR), and implement Sediment Management Plan. [M 59] Publish annual report of Sediment Management Plan operations. [M 60] Implement operational maintenance schedule to ensure full and correct functioning of Sediment Management Plan, to include level of service agreements made with key stakeholders (e.g., other HEPP operators, ABAKIR) and recommendations for adaptive management variations.
Wastes	C	Excavation spoil (Inert waste)	R	N/A	[M 61] The EPC Contractor will prepare a Site Waste Management Plan as part of the CESMP in alignment with GIIP and the Employers E&S Requirements. [M 62] The EPC Contractor will ensure that waste is segregated and stored on site according to GIIP, and a register of waste maintained.

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Wastes (cont.)	C	Waste concrete (inert waste)	R	N/A	[M 63] The EPC Contractor will identify accredited third-party waste management facilities for the management of waste, including facilities for reuse and recycling. The facilities will be audited by the EPC Contactor to ensure compliance with GIIP and E&S requirements of the environmental permit. [M 64] Wastes that cannot be managed by offsite contractors will be managed by the EPC Contractor, and this may include construction of a landfill or installation of an incinerator. The design of these facilities will follow GIIP and environmental permits will be obtained. [M 65] The EPC Contractor make all the necessary arrangements for transport of waste that is not managed on-site to accredited offsite waste management facilities. A waste tracking system shall be implemented (waste manifests) and compliance with the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal. [M 66] If quality permits, the EPC Contactors will reuse excavation spoil material, such as for concrete formation, backfilling, foundations and road construction. Excess spoil will be disposed of at designated and specially designed spoil disposal sites and the necessary permits from local authorities obtained by the EPC Contractor. [M 67] The practice of disposing of inert spoil from road construction by side-casting is to be prohibited.
	C	Iron and steel scrap and non-ferrous scrap (Non-hazardous waste)	R	N/A	
	C	General domestic waste, paper and cardboard, packaging, pallets, glass, plastic, tires (Non-hazardous waste)	R	N/A	
	C	Oils and lubricants, oil contaminated rags, batteries, fluorescent tubes, paints and chemicals (Hazardous waste)	R	N/A	
	Op	Iron and steel scrap and non-ferrous scrap (Non-hazardous waste)	R	N/A	[M 68] REL will conduct a waste management study to asses how to manage the domestic trash that accumulates in the Ruzizi III reservoir. REL will prepare a Waste Management Plan for the operation phase as part of the ESMP in alignment with GIIP and in coordination with local authorities and the operators of Ruzizi-I and -II. [M 69] REL will ensure that waste is segregated and stored on site according to GIIP, and a register of waste maintained. [M 70] REL will establish contracts with accredited third-party waste management facilities for the management of waste, including facilities for reuse and recycling and conduct regular audits to ensure compliance with GIIP and E&S requirements of the environmental permit. [M 71] REL will make all the necessary arrangements for transport of waste that is not managed on-site to accredited offsite waste management facilities. A waste tracking system shall be implemented (waste manifests) and compliance with the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal.
	Op	General domestic waste, paper and cardboard, packaging, pallets, glass, plastic, tires (Non-hazardous waste)	R	N/A	
	Op	Oils and lubricants, oil contaminated rags, batteries, fluorescent tubes, paints and chemicals (Hazardous waste)	R	N/A	
Aquatic Habitats and Biodiversity	C	Increased sedimentation/ turbidity affecting fish and fish habitat	I	S	[M 72] A riparian buffer zone of 50 m around riparian habitats will be maintained in all construction works areas to restrict erosion and sedimentation and rehabilitation, and alien plant control will be applied after construction to re-establish natural vegetation (EPC Contractor). [M 73] Community land use activities will be regulated within the 50 m buffer zone such that no new agricultural clearance will be permitted whatsoever within 10 m of the riverbank in the project's area of influence (reservoir and dewatered reach). [M 74]. Protect the riparian corridor through implementing measures to reduce erosion and sediment inputs into river courses through construction of gabions, embankments, and/or berms.
	Op	Development of bilharzia snails and blackflies and increased risk of development of waterborne diseases	R	N/A	[M 75] Conduct monitoring of bilharzia host snails and blackflies, and prevalence of water borne diseases and identify control and management measures if required.

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Aquatic Habitats and Biodiversity (cont.)	Op	Project impacts on fish from altered flows and barrier to migration	I	S	[M 76] Maintain a minimum flow of at least 10 m3/s at all times (including during reservoir filling) with video evidence shared with ABAKIR and other stakeholders; and release freshets of at least 50 m3/s over a few days on a biannual basis timed with rising river levels (volume to be confirmed through further modelling). [M 77] Conduct fish monitoring and implement adaptive management based on results and disclose results to relevant institutions and lenders on a biannual basis. [M 78] Implement and enforce a no fishing zone in dewatered reach and 1 km downstream of powerhouse and work with communities to improve sustainable fishing practices downstream of Bugarama. [M 79] Implement fish monitoring to determine whether fish stranding occurs and determine additional mitigation if required (e.g. extended ramp down rates after each sub-daily peaking event to achieve a rate of water level drop of max. 3 cm/minute downstream of the powerhouse; or river engineering solutions to moderate flow fluctuations.
	Op	Impact of altered flows on Rusizi National Park and Ramsar site	R	NS	Mitigation and monitoring of flows, water quality and wastes are applicable to the lower Ruzizi River. Fish monitoring is required for the Rusizi River reaches within Rwanda but should be extended into Burundi should results indicate the potential for fish impacts downstream of the confluence of the Ruhwa River. No additional mitigation measures are specifically required for the Rusizi National Park.
Terrestrial Habitats and Biodiversity	C	Loss of natural habitat (dam, reservoir, powerplant, roads)	I	S	[M 81] Construction work site planning shall seek to minimise impacts on vegetation and an Environmental Compliance Officer with ecological experience will oversee site clearance and ensure control measures are implemented (EPC Contractor). [M 82] Construction site clearance activities will be implemented in a manner to minimise loss of vegetation by restricting footprints of vegetation removal, stockpiling and vehicle access (EPC Contractor). [M 83] During construction, topsoil management will be implemented in accordance with a Topsoil Management Plan that defines the location, storage, size/shape and protection measures for topsoil stockpiles (EPC Contractor). [M 84] Prepare and implement a Restoration and Rehabilitation Plan aimed at achieving no net loss of natural habitat in the reservoir sub-catchment area. Collect seed from native plants & propagate key species identified in the restoration plan in an off-site project nursery and implement progressive re-establishment of Natural Habitat wherever possible (EPC Contractor).
	C	Loss of species of conservation concern (dam, reservoir, powerplant, roads)	I	S	[M 85] Conduct walk-through of construction area footprints prior to clearance to ensure no SCC present (low likelihood) (EPC Contractor) and micro-site infrastructure where possible if any SCC are found
	C	Disturbance of fauna from blasting (especially during breeding periods) (dam, reservoir, powerplant, roads)	I	S	[M 86] Although few breeding raptors are likely to be present, conduct a walk-through bird survey in breeding season to confirm presence of breeding birds, especially raptors and restrict blasting to periods outside of breeding season (Dec-May) where possible (EPC Contractor).
	C	Introduction of invasive alien species (dam, reservoir, powerplant, roads)	I	NS	[M 87] Develop and implement a Terrestrial Alien Invasive Plant Management, Monitoring and Control Plan for the HEPP and TL construction activities (EPC Contractor).
	C	Loss of natural habitat (transmission line)	I	S	[M 88] Plan the location of pylons in degraded habitat wherever possible. [M 89] Collect seed of typical natural grassland species for revegetating any cleared or damaged areas of Hillslope Grassland post-construction & propagate key species in off-site project nursery. [M 90] Implement progressive re-establishment of Natural Habitat wherever possible in construction footprints.
	C	Loss of species of conservation concern (transmission line)	I	S	[M 91] Conduct walk-through of the final confirmed pylon sites in Hillslope Grassland habitats to confirm presence of SCC to enable micro-siting of pylons or plant rescue if required.

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Terrestrial Habitats and Biodiversity (cont.)	C	Introduction of invasive alien plan species (transmission line)	I	S	[M 92] Implement terrestrial alien invasive plant management, monitoring and control measures along the TL wayleave and access routes during construction (EPC Contractor).
	C	Disturbance to birds (transmission line)	I	S	[M 93] If possible, erect pylons and fit transmission lines between December and May, when few raptors are likely to be breeding.
	C	Loss of natural habitat during reservoir impoundment	I	S	[M 94] Compile a Revegetation and Rehabilitation Plan aimed at achieving No Net Loss for the 41.8 ha of Largely Natural Habitat impacted by the Project. This should include restoration of degraded habitats in the reservoir sub-catchment above the full supply level and along the river course.. [M 95] Implement restoration of priority habitats (Hillslope Grassland / Savannah) adjacent to the full supply level.
	C	Loss of species of conservation concern during reservoir impoundment	I	S	[M 96] Conduct walk-through of areas of Hillslope Grassland / Savannah, Riparian Thicket and Hillslope Thicket that will be inundated by reservoir to confirm presence, and rescue any threatened or restricted-range species that are found and can be translocated to similar habitat adjacent to the full supply level (i.e. buffer zone).
	C	Loss of fauna through drowning during reservoir impoundment	I	S	[M 97] Implement reservoir filling during lower flow, dry season periods or by regulating peaking flows from upstream hydropower plants in such a way to enable fauna (including smaller animals (e.g. snakes and other reptiles, rodents) to escape to higher ground.
	Op	Mortality of large birds during operation of the 220 kV transmission line	I	S	[M 98] Plan the TL route along the hillslopes rather than along the hill crests, which are often followed by raptors on migration and where collision risk is higher. [M 99] Install bird diverters and anti-perching devices (e.g. metal spikes) along the section of the TL route crossing Natural Habitat and where bird collisions with the conductors can occur.
	Op	Degradation of habitat through clearance of vegetation along wayleave	I	S	[M 100] Avoid ongoing clearance of Natural Habitat along the wayleave, especially Hillslope Grassland / Savannah habitat on steep slopes unless necessary for safety reasons.
	Op	Introduction or spread of invasive alien species	I	S	[M 101] Implement a Terrestrial Alien Invasive Plant Management, Monitoring and Control Plan for the Operation Phase. [M 102] Implement monitoring of erosion and rehabilitation / restoration success and implement additional measures if required to facilitate recovery of construction areas.
	Op	Impacts of Reservoir on Wildlife	R	NS	[M 103]Inform local communities of potential for increased risk of hippopotams and crocodiles in the reservoir and related safety concerns and need to protect wildlife, and monitor and record wildlife presence in the reservoir. This should be done by community liaision officers and environmental staff of REL or outsourced to external ecological consultants or reserarchers.
	Op	Impacts of Altered Flows on Downstream Wildlife (including Rusizi National Park)	R	NS	No specific mitigation required.
Impacts on local communities' livelihoods	C	Land acquisition	I	S	[M 104] Implementation of the Resettlement Action Plan [M 105] Compensation of all affected lands and assets at full replacement costs [M 106] Assistance to physical resettlement [M 107] Livelihood Restoration Programme, including a transitional [M 108] Specific assistance for affected vulnerable [M 109] Local Area Development Plan
	Op	Impact of alteration to flow conditions on fishing	I	NS	[M 110] Monitoring of fisheries activities downstream of the dam to confirm the absence of any discernible change in fish catch because of the Project

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Labour and Working Conditions	Op	Compliance with lender policies with regard to human resources policies and procedures	R	N/A	[M 111] The Project's HR policy and labour management principles will align with Lenders' Policies and the labour laws of Burundi, DRC and Rwanda and be available in Kinyarwanda, English and French.
	Op	Compliance with lender policies with regard to employment	R	N/A	[M 112] The Project will set local employment objectives and targets. [M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female. [M 114] The local Recruitment Policy will be communicated widely. [M 115] Construction phase training programme will be implemented by the EPC Contractor.
	Op	Compliance with lender policies with regard to workers' organisations	R	N/A	[M 116] Provisions regarding allowance of workers' organizations and collective bargaining will be included in the Project's HR policy.
	Op	Compliance with lender policies with regard to non-discrimination and equal opportunities	R	N/A	[M 117] Provisions regarding non-discrimination and equal opportunities will be included in the Project's HR Policy.
	Op	Compliance with lender policies with regard to retrenchment	R	N/A	[M 128] The EPC Contractor will prepare a detailed Demobilisation Plan and implement the plan at the end of the construction.
	Op	Compliance with lender policies with regard to workers grievance mechanism	R	N/A	[M 118] Workers' grievance mechanism will be implemented and monitored during labour audits.
	Op	Compliance with lender policies with regard to protecting the workforce	R	N/A	[M 119] Project's HR Policy and labour management principles will clearly state that there will be no forced labour and child labour.
	Op	Compliance with lender policies with regard to occupational health and safety	R	N/A	[M 136] Operation phase occupational noise exposure management measures. [M 137] Operation phase fire and explosion management measures in compliance with NFPA. [M 134] General operation occupational health and safety measures: ESMS aligned with OSHAS 18001, Health and Safety Plan, Employee training. [M 135] Operation phase hazardous substances management measures. [M 136] Operation phase occupational noise exposure management measures. [M 137] Operation phase fire and explosion management measures in compliance with NFPA.
	C	Compliance with lender policies with regard to workers engaged by third-parties	R	N/A	[M 120] REL will review the EPC contractor's subcontractors' management procedures prior to the start of construction and organise and finance 6-monthly Integrated Environmental, Social, Health and Safey audits by an independent auditor of the EPC Contractor and its subcontractors' working practices to check compliance with the Project's HR Policy, Labour laws of Burundi, DRC and Rwanda, and Lenders' labour management requirements. [M 129] General construction phase occupational health and safety management measures. [M 130] Construction phase hazardous substances management plan. [M 131] Construction phase noise, dust and vibration management measures. [M 132] Construction phase fire and explosion management measures. [M 133] Conduct a risk assessment for natural hazards for workers during construction.
	C/Op	Risk of gender-based violence for the project as a whole	R	N/A	[M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female.

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
					[M 117] Provisions regarding non-discrimination and equal opportunities will be included in the Project's HR Policy. [M 121] The EPC will develop a gender-sensitive recruitment strategy and communicate it to the local communities [M 122] REL will recruit two trained female Gender Officers (1 in Rwanda and 1 in DRC) to define and implement GBVH protocols. These protocols will apply to all Project workers, including contractors and sub-contractors. [M 123] The EPC will develop and implement a workers' code of conduct, including GBVH policies, and mandatory training of all workers on sexual harassment and GBVH protocols [M 124] The EPC contractor will develop an Occupational Health and Safety Management Plan which will gender and GBVH aspects, such as: gender-separate accommodation on camp, gender-separate lockable latrines and WASH facilities that are well-lit, conveniently located and easily accessible. [M 125] The EPC will establish workers' safety committee which will include at least one trained female worker representative [M 126] The Workers' grievance mechanism and Community grievance mechanism will channel all GBVH complaints and store them on a separate database. REL's Gender Officers will be responsible for handling and solving these complaints.
Community Health and Safety	C/Op	Community health and safety risks as a whole	R	N/A	[M 130] Construction phase hazardous substances management plan. [M 131] Construction phase noise, dust and vibration management measures. [M 132] Construction phase fire and explosion management measures. [M 133] Conduct a risk assessment for natural hazards for workers during construction. [M 134] General operation occupational health and safety measures: ESMS aligned with OSHAS 18001, Health and Safety Plan, Employee training. [M 135] Operation phase hazardous substances management measures. [M 136] Operation phase occupational noise exposure management measures. [M 137] Operation phase fire and explosion management measures in compliance with NFPA. [M 138] Coffer dam design criteria for seismic and hydraulic loading will follow ICOLD guidelines and take into account findings of detailed natural hazard risk assessments. [M 139] Safety distances between onsite areas for storage and handling of hazardous substances and offsite residential areas. [M 140] Control of access to worksites. [M 141] Construction phase traffic management plan. [M 142] Public disclosure of the construction phase traffic management plan. [M 143] Local authorities given prior warning of the programmed arrival of heavy convoys. [M 144] Traffic hazard awareness campaigns organised for communities including school children. [M 146] Adherence to the Voluntary Principles on Security and Human Rights - and the International Code of Conduct for Private Security Service Providers including contractors and their subcontractors [M 147] Security services providers personnel to be trained to comply with the Voluntary Principles on Human Rights and the International Code of Conduct for Private Security Service Providers [M 148] Cooperation with local police forces [M 149] Community health management measures included in the construction phase health and safety plan. [M 150] Monitoring by REL of the implementation of the community health management measures by the EPC Contractor.

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
					[M 151] Technical measures to avoid impacts on water quality including from wastewater discharges, runoff and tunnelling spoils. [M 152] Disclosure of water monitoring results. [M 153] Detailed design to include detailed seismic studies to complement the preliminary studies already performed and to confirm dam and coffer dam design criteria. [M 154] Coffer dam and diversion tunnel flood management criteria and procedure in detailed design. [M 155] Assessment of reservoir rim stability and analysis of hydraulic consequences. [M 156] Carry out detailed landslide risk assessment and include dam, coffer dam and temporary construction facilities in the assessment and include the findings into the Project design.
Community Health and Safety (cont.)		Community health and safety risks associated with Project induced in-migration	R	N/A	[M 111] The Project's HR policy and labour management principles will align with Lenders' Policies and the labour laws of Burundi, DRC and Rwanda and be available in Kinyarwanda, English and French. [M 112] The Project will set local employment objectives and targets. [M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female. [M 114] The local Recruitment Policy will be communicated widely. [M 119] Project's HR Policy and labour management principles will clearly state that there will be no forced labour and child labour. [M 122] REL will recruit two trained female Gender Officers (1 in Rwanda and 1 in DRC) to define and implement GBVH protocols. These protocols will apply to all Project workers, including contractors and sub-contractors. [M 123] The EPC will develop and implement a workers' code of conduct, including GBVH policies, and mandatory training of all workers on sexual harassment and GBVH protocols [M 141] Construction phase traffic management plan. [M 142] Public disclosure of the construction phase traffic management plan.[M 149] Community health management measures included in the construction phase health and safety plan. [M 150] Monitoring by REL of the implementation of the community health management measures by the EPC Contractor. [M 146] Adherence to the Voluntary Principles on Security and Human Rights - and the International Code of Conduct for Private Security Service Providers including contractors and their subcontractors [M 147] Security services providers personnel to be trained to comply with the Voluntary Principles on Human Rights and the International Code of Conduct for Private Security Service Providers [M 148] Cooperation with local police forces [M 157] Preparation and implementation of an Influx Management Strategy. [M 158] REL Gender officers will prepare and implement a Community Outreach Programme on Gender-based violence and harassment, to disclose the Project's GBVH protocols and reporting processes. [M 159] Monitoring on Project-induced in-migration around the reservoir during operation during the first years of operation [M 160] Addressing potential negative social impacts of continued presence of project-induced influx during the first years of operation
Human rights	C/Op		R	N/A	Addressed through measures under separate headings as explained in the main text

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Gender-specific risks and impacts	C/Op	Gender-specific risks and impacts	R	N/A	[M 113] The Project's local employment objectives will include specific targets for the employment of women. According to these targets, at least 15% of the total workforce (skilled and unskilled) will be female. [M 117] Provisions regarding non-discrimination and equal opportunities will be included in the Project's HR Policy. [M 120] REL will review the EPC contractor's subcontractors' management procedures prior to the start of construction and organise and finance 6-monthly Integrated Environmental, Social, Health and Safey audits by an independent auditor of the EPC Contractor and its subcontractors' working practices to check compliance with the Project's HR Policy, Labour laws of Burundi, DRC and Rwanda, and Lenders' labour management requirements. [M 121] The EPC will develop a gender-sensitive recruitment strategy and communicate it to the local communities [M 122] REL will recruit two trained female Gender Officers (1 in Rwanda and 1 in DRC) to define and implement GBVH protocols. These protocols will apply to all Project workers, including contractors and sub-contractors. [M 123] The EPC will develop and implement a workers' code of conduct, including GBVH policies, and mandatory training of all workers on sexual harassment and GBVH protocols [M 124] The EPC contractor will develop an Occupational Health and Safety Management Plan which will gender and GBVH aspects, such as: gender-separate accommodation on camp, gender-separate lockable latrines and WASH facilities that are well-lit, conveniently located and easily accessible. [M 125] The EPC will establish workers' safety committee which will include at least one trained female worker representative [M 126] The Workers' grievance mechanism and Community grievance mechanism will channel all GBVH complaints and store them on a separate database. REL's Gender Officers will be responsible for handling and solving these complaints. [M 158] REL Gender officers will prepare and implement a Community Outreach Programme on Gender-based violence and harassment, to disclose the Project's GBVH protocols and reporting processes.
Cultural Heritage	C	Impacts from earthworks and physical construction	I	S	[M 161] Compensation or moving of the graves and church located in the Project acquired land plots, as defined in the Resettlement Action Plan. [M 162] Define and implement a Chance Find Procedure
	C	Construction activities generating noise, dust vibration	I	S	See measures above for noise, dust and vibration [M 163] All cultural heritage elements located adjacent to a construction site or the external boundaries of the future reservoir (within 30 m), will be protected from potential damages due to construction methods.
	C	Restriction of access	I	S	[M 164] Consultation with communities using the 2 baptism sites and prayer site on the island close to the Project's sites and the prayer site under the Transmission Line Right of way to assess if access to these sites could be impaired by the Project activities [M 165] Commitment to not block accesses to places of worship throughout the construction phase as much as possible, taking into consideration safety issues. [M 166] Where existing access cannot be maintained, provision of an alternative access route, subject to overriding health, safety, and security considerations
	Op	Restriction of access for safety reasons	I	S	[M 167] Implement GIP for ensuring the disposal area do not represent any safety risk for the general public.
Ecosystem Services	C/Op	Ecosystem Services	I	S	Addressed through measures under separate headings as explained in the main text

	Phase [a]	Impact / Risk [b]		Significance [c]	Mitigation
Landscape and Visual Amenity	C/Op	Physical presence of structures represent a degradation of the land scape and visual amenity	I	NS	No measures proposed because the impact is not significant
Positive Impacts and benefits	C	Employment opportunities	I	S	[M 112] The Project will set local employment objectives and targets. [M 114] The local Recruitment Policy will be communicated widely. [M 115] Construction phase training programme will be implemented by the EPC Contractor.
	Op	Enhancement of benefits	I	S	Local Area Development Plan

Notes

[a] C = Construction, Op = Operation

[b] I = Impact, R = Risk

[C] S = Significant, NS = Not Significant, N/A = Not Applicable (the case for risks)