Environmental, Social and Health Impact Assessment Study for Marampa Mines Limited (MML) Project Expansion (M3.75 mdtpa)

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Marampa Mines Limited
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Environmental Management Services (SL) Limited.
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This report is based on an Environmental, Social and Health Impact Assessment (ESHIA) study conducted by Environmental Management Services (SL) Limited, the consulting firm contracted by the Marampa Mines Limited (MML) for its southern and northern expansion project phases. A collaborative effort was required to conduct and prepare an ESHIA report of this nature. EMS appreciates the involvement and assistance provided by MML's technical unit leads Technical Unit Leads, especially the HSE department, Geology, Survey, Geotech, Project Unit and Mining department in providing the moral and organisational support for the successful implementation of the study. EMS expresses gratitude to the MML Management, with special gratitude to Prof Sheik Umar Kamara, Hawanatu Sam, Alexander Wood and the entire HSE team for their unwavering support throughout the entire ESHIA process.

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We are thrilled to have had the amazing opportunity to provide our services to MML, and we are truly grateful for the trust they placed in us. As we worked tirelessly on this report, we made every effort to ensure that the facts and information presented were accurate, reliable, and of the highest quality.

While we remain optimistic that the insights contained within this report will prove invaluable to MML and their partners both in the short and long term, it is important to note that the application of these findings to any contractual agreements is the sole responsibility of the user (MML), and not of EMS or its expert consultants.

We are confident that MML will make the best use of this information and look forward to continuing our partnership with them.

Alhaji Ibrahim Koroma

Managing Director

Environmental Management Services (SL) Limited

VISION HISTORY OF THE ESHIA REPORT

NO.	CAPTION	CONTENT DESCRIPTION		COMMENT(S)/ ROLE
1	Document Title	**Environmental, Social and Health Impact Assessment (ESHIA) for Marampa Mines Limited's Expansion Project**		
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3	Reporting	**Mr. Alhaji Ibrahim Koroma**: Report Planning, Preparation, Reviewing, compilation and Submission to the client (MML)		
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EXECUTIVE SUMMARY

Environmental Management Services (SL) Limited conducted an Environmental, Social and Health Impact Assessment (ESHIA) for Marampa Mines Limited's M3.75 expansion project (also referred to as 'M3.75'). This assessment (also referred to as 'study'), including the collection of primary data, evaluates the potential and realized impacts of the expansion of MML's mining activities from approximately 3 million tonnes per annum of dry concentrate production (mdtpa) to 3.75 mdtpa on the environment, social fabric, human health, and biodiversity of the project's area of influence. The ESHIA was conducted following all applicable regulations and guidelines and used a multidisciplinary approach, to assess impacts on including geology and soil, hydrogeological, socio-economic conditions, and biodiversity assessments to establish baseline data for the expanded production capacity's impact within the concession area.

Project Synopsis and Context

The Project is located adjacent to the township of Lunsar, some 125 km northeast of the capital city of Freetown, in the Port Loko District of Sierra Leone, West Africa. MML's concession area spans 116.22 km^2 and includes what is known as Marampa (the area held by SL Mining Limited) and Marampa North (previously held by Marampa Iron Ore).

The mining concession area comprises inland valley swamps, the Masaboin and Gafal Hills and interfluves of variable heights. The Bathbana and the Baki and their tributaries are the main streams within the concession boundary and comprise the catchments draining the area. MML's concession area is a brownfield site, with an extensive history of mining activity dating back to 1933.

The mining method currently being use for the weathered ore material is free dig mining method in an open pit shell. An open pit mine is a cut made at the surface of the ground for the purpose of extracting ore and which is open to the surface for the duration of the mine's life. To expose and mine the ore, it is generally necessary to excavate and relocate large quantities of waste rock.

MML is expanding its dry iron ore concentrate production capacity from approximately 3 mdtpa to 3.75 mdtpa with an iron grading target of 65%. MML's project has phases and sub-phases to enhance feasible life of mine operation. At a production rate of 3.75 mdtpa, MML's Life of mine is greater than 100 years from the time of publication of this report. Each of these phases involves mining, beneficiation, hauling and export of high-grade iron ore concentrate. The current mining operation will be expanded to mine and process ore from the Mathukia complex, a cluster of contiguous mineral resource deposits to be mined over the course of the coming 5 years.

The study identifies positive and negative impacts, both potential and realized, and recommends mitigation measures to reduce the potential adverse effects of the Marampa

M3.75 project. In cases where adverse effects are identified, the ESHIA considers project alternatives, the implementation of mitigation measures, and estimating the likely remaining or residual impact following their deployment.

This document captures:

- The project's compliance with Sierra Leone's legislative framework
- The project's adherence to international standards
- A description of the project and its alternatives
- A determination of the regional and site-specific physical and social baseline conditions
- All standard ESHIA impact assessment categories (extent, duration and magnitude) and mitigation measures in place and recommendations for additional interventions

Additionally, the ESHIA applied the assessment system to three distinct areas of the project: the mine site, haulage route, and the jetty at the Thofayim River Terminal (TRT). The study also incorporates a detailed assessment of the site's Valley B Tailings Storage Facility (TSF), which will play a central role in facilitating the mine's production capacity increase.

Air Quality

Primary emission sources that have been identified to have air quality impacts include dust and exhaust emissions arising from land clearance, mining, stockpiles, vehicles, and machinery. MML already employs standard mitigation measures such as adequate containment of loads during haulage including tarpaulin covers, dust suppression through water spraying, appropriate machinery selection and monitoring. To compensate for the potential increased levels of particulate matter pollution, MML will step up its existing interventions, namely spraying SDS, a biodegradable water-soluble suppressant on haul routes, particularly during the dry season. The company also strictly enforces the haulage road's speed limit, which limits the amount of dust kicked up into the air.

Noise

The haulage route's proximity to villages and Lunsar residential areas is a major negative impact that affects people who live and/or otherwise utilize or spend time around the road. Maintaining a buffer zone of at least 500m should be adequate for most residential areas, but in exceptional cases when a suitable buffer cannot be maintained, additional measures such as noise barriers should be implemented to minimize impacts. Blasting, crushing, and trucking noise are considered to have the greatest potential impact. Adhering to occupational noise limits is the primary mitigation action for these impacts. For communities that fall within the 500m buffer zone, enhanced mitigation measures will be considered, such as tree barriers, which support noise and dust suppression.

Biodiversity and Ecological Systems

The assessment of the ecological risks of the project's expansion found that its impacts are significant and need to be carefully managed. Without mitigations and interventions, the project will negatively affect biodiversity richness and the conservation status of the species present in the various discreet habitats within the concession. The primary direct impacts will arise from the clearance of land within the project's footprint and its associated infrastructure. It is important to note that vegetation that is not cleared or buried may also be indirectly impacted by alteration, the spread of invasive species, and pressure from the influx of anthropogenic activity that will amplify deleterious outcomes for the site's ecosystems.

To minimize these impacts, the project has implemented a range of mitigation measures, such as the use of buffer zones and the adoption of best management practices. By the end of 2023, MML will start sample collecting for eDNA (Environmental DNA) – trace amounts of genetic material from species present in a given area – to monitor the number of species present, and the density of those species within our monitoring areas. This new type of environmental monitoring will allow MML to track and report on its biodiversity conservation performance. This program will result in the company drafting a Biodiversity Offset Plan which will guide it to net positive biodiversity outcomes for the concession area.

MML's Biodiversity Program and activities overlap extensively with the company's Mine Closure and Rehabilitation Plan (MRCP) activities, which guides MML's land remediation and progressive rehabilitation of mined out land and disused areas within the concession. Biodiversity restoration is both the desired outcome and the central component of the process of land rehabilitation. MML's goal is to return mined out and disused areas to a state of long-term stability and ecosystem resilience. The MRCP is included in the submission package as an attachment.

Furthermore, the project has identified areas of high ecological sensitivity that require special attention and protection. For instance, the forested areas located at the mine site have been identified as well as the mangrove ecosystem at the barging route as key habitats for several endangered species, and as such, strict measures should be put in place to ensure their protection.

The project's ecological impacts will be closely monitored throughout the life of mine, and measures will be taken to ensure that any adverse effects are addressed in a timely and effective manner. The location of the ore bodies and constraints in mine and waste rock design makes it impossible to avoid or fully mitigate the impact of land clearance and burial in the primary mining and rock dump areas. Therefore, MML is committed to establishing a seed nursery, replanting, habitat renewal, and protection at one or more conservation sites to be established within the concession. As MML develops our MRCP, Biodiversity and land remediation and rehabilitation capabilities over the coming years, the risks to the ecosystems that hosts the project will be increasingly well-managed and well-mitigated.

Hydrogeology and Hydrology

MML's operations to date and the M3.75 expansion project have caused significant alterations to the rivers' natural ecosystem, including increased levels of suspended sediments and changes in catchment behaviour. Without mitigation measures, these risks can result in flooding and negative impact on water quality and availability. MML's interventions in this area prioritize avoiding changes to the chemistry of the water, which has a low chemical buffering capacity. MML has a robust environmental monitoring system in place to track its operation's effects on water quality of groundwater and surface water. Starting in 2023, MML has been collecting water extraction data for surface water and will report on this important metric going forward in its annual sustainability report. The hydrogeological assessment determined that the mining operations have and will continue to affect the water quality and quantity in the area. The study recommends monitoring and management of water resources to avoid adverse effects on the local hydrological system.

The increased demand for potable and construction water in the mine and haulage corridor may lead to the over-extraction of surface and groundwater sources, resulting in impacts on downstream flows and dependent ecosystems, as well as the local communities. Groundwater is considered a sensitive and vulnerable resource in the Port Loko District and requires special attention to minimize any adverse impacts that may arise. Although MML doesn't extract material quantities of groundwater, the project's expansion and operations could result in groundwater disturbance, namely the added risk of contamination from brownfield run-off and siltation from operations at TRT. The project's worst-case residual effects include permanent loss of flow from springs and streams, and changes in stream and river channels and water levels, but all measures will be taken to avoid such outcomes.

Geology, Soil and Land Use

As a mining operation, MML's activities, including land clearance, the resulting erosion and/or inundation, and compaction, have had and will continue to have significant impact on the land the company mines. MML is highly aware that these factors have modified and will continue to modify natural run-off systems and soil composition and that its expanded operations will continue to do so. Moreover, chemical contamination may occur from the release of hydrocarbons, diesel, lubricant oils, and explosives residues, which can have severe implications for the areas affected.

Despite MML's nascent progressive land remediation work as part of the MRCP, the residual impacts of land clearance and sterilisation/burial on soil resources and land use are likely to remain significant and long-term in the mine area. However, with enough resources allocated to mine closure planning, these effects can be reduced or nearly eliminated. MML intends to proactively mitigate land degradation via the mechanisms outlined in the MRCP. MML is committed to addressing future land use constraints arising from mining activities to the highest degree possible by devoting sufficient financial resources to materially address the scope of the affected area, and by pursuing partnerships with other companies, NGOs and/or government.

Socio-Economic

The socio-economic assessment evaluated the potential impacts of mining on the local community, including displacement, loss of livelihoods, and social disruption. The most substantial socio-economic impact of the M3.75 project will be the two resettlement projects it calls for: the ROM Pad house/Magberie village and Maforki village. For project-specific resettlement information, please see Section 2: Project Expansion – M3.75 Infrastructure and Support Services.

Resettlement has major impacts on affected individuals and communities. In cases where resettlement is required to facilitate our operations, MML will conduct these processes in a manner that respects affected individuals and communities. MML endeavours for all resettlement projects to materially benefit project affected persons' quality of life and will invest resources into long-term social and economic monitoring to ensure positive outcomes. This includes developing a monetary and physical asset compensation framework for all affected individuals with the Resettlement Action Plan (RAP), in conformity with international best practices, for each resettlement project.

While the project is in operation, there will be a mixture of both economic benefits and social disturbances. The economic benefits, lasting for as long as the company operates, will come in the form of employment opportunities, wages, procurement of supplies, social investments, and government revenue. However, there may also be negative impacts due to the disturbance to landowners and the influx of workers and job seekers, which could lead to increased pressure on social infrastructure and natural resources, as well as potential increase in social issues, such as community displacement, worker in-migration.

To mitigate potential negative socio-economic outcomes, MML is investing in expanding the capacity and size of our Community Relations & Development (CR&D) department, which proactively conducts community engagement and sensitization. They also facilitate resettlement projects with the oversight of the Sustainability/ESG team. MML is also actively rolling out social intervention projects as part of our Community Development Action Plan (CDAP), as stipulated by our EPA licensing (please see the CDAP annex for an update on those activities.

In addition to CDAP, as per the Mines and Minerals Development Act (2023) of Sierra Leone, MML is required under our licensing to implement a framework for community engagement and development. MML's Community Development Agreement is that framework and was ratified on 17 June 2021 after a months-long stakeholder engagement and assessment process. MML allocates 1% of free-onboard export revenues to community-driven development projects as required by Sierra Leonean law and the company's large-scale mining license agreement. These monies are collected into the Community Development Fund (CDF), which is payable at the beginning of the financial year, based on the previous year's production output. The CDF's first tranche of funds is for FY23 and is USD 1.7m. Funded project categories will be: education, infrastructure (water and electric), and agricultural/ food security.

Human Health

As one of the largest employers in Sierra Leone with 3,362 direct and indirect employees at the end of 3Q23, MML's presence and the employment opportunities the company provides is linked to improved human health outcomes compared to the absence of these employment opportunities. However, there are some negative outcomes MML is careful to manage, acknowledging that the mining industry does present occasionally dangerous conditions. The company meticulously tracks injury rates and medical statistics as part of our Occupational Health and Safety Plan, included as an annex to this document.

There are several proven strategies, such as harm reduction interventions, and long-term community development initiatives, that have been shown to minimise negative health outcomes. These actions should lower the residual impacts' severity from major to moderate or minor. A broad range of factors, including socioeconomic status, and quality of the air, soil, water and food, all affect human health. As such, the evaluation of potential effects on human health has been combined with the findings of other ESHIA disciplines, such as socio-economic assessment, air, noise, hydrology, and hydrogeology.

In conclusion, this ESHIA contains a series of recommendations for MML to implement to minimize potential negative impacts of the expansion of its current mining and expansion operations on the environment, social fabric, and human health. All recommendations are made with the understanding that MML will execute them in good faith and through proactive stakeholder engagement and compliance with relevant environmental regulations, ensuring sustainable development for the mine site's primary host communities, the Port Loko District, and Sierra Leone at large.

Degree of Certainty of Impact

Certainty of Impact	Description
Certain	The incidence of this impact is unavoidable and to be expected.
Very Likely	There is a high percentage of possibility for this impact to occur, and measures need to be put in place to mitigate it.
Likely	There is an even chance that the impact will may occur
Unlikely	The possibility of this impact occurring is remote, however it must be considered

Environmental and Social Significance Scale

Significance scale	Description
Very High	Major or permanent alteration of environmental or social dynamics, with severe or very severe consequences, or (in the case of benefits), beneficial or very beneficial effects.
High	Long term effect on the social or natural environment. This category should be treated with a significant degree of importance at the project decision making stage.
Moderate	Medium to long term effects on the social or natural environment. This category should also be taken into cognizance in decision making as constituting a fairly important degree of threat. The threat is real but not substantial.
Low	These would have medium to short term ramifications on the social or natural environment; these are relatively unimportant and pose very little real threat.

Degree of Difficulty to Mitigate

Degree of Difficulty	Description
Very Difficult	The impact can be mitigated in theory, but the extent of financial or technical involvement militates against its application or effectiveness
Difficult	The impact can be mitigated, but there is a significant degree of difficulty in implementing the proposed measured.
Degree of Difficulty	**Description**
Achievable	The impact can be mitigated without much technicality or cost.
Easily Achievable	The impact can be easily and effectively mitigated

Impact Assessment Matrix

Mitigation Potential	Impact Significance				Certainty of Impact
	Low	Moderate	High	Very High	
Very Difficult	Medium	Major	Extreme	Extreme	Certain
Difficult	Minor	Medium	Major	Extreme	Very likely
Achievable	Minor	Minor	Medium	Major	Likely
Easily Achievable	Minor	Minor	Minor	Medium	Unlikely

Impact	Description
Extreme	Very significant action would be required to avoid or reduce these impacts. In certain instances, such impacts would prevent the action or option concerned from being taken or approved; and alternatives would have to be considered.
Major	These impacts are significant, meaning that if effective mitigation measures are not taken, a project may be hindered from commencing or continuing. Such option would require effective management and monitoring or abandoned altogether for other options.
Medium	These impacts, though important, are of less serious nature; in such a case, the Best Available Technology (or Practice) Not Entailing Excessive Cost (BATNEEC) should be employed. Such impacts alone are usually not significant enough to prevent a project from commencing or proceeding.
Minor	These impacts fall within the acceptable limits of the impact of a project on the environment, and mitigation is desirable but not necessary. This does not preclude 'Best Practice' as a means of avoiding cumulative impacts.
Positive	A beneficial impact to the bio-physical and/or socio-economic environment.

Project Development and Operations-stage Environmental and Social Impacts and Mitigation Measures

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Air Quality and Pollutants	**Blasting:** Blasting activities produce air pollutants like particulate matter, carbon monoxide, and ammonia. **Particulate Matter/Dust:** Dust generated from everyday operations and handling of materials contributes to poor air quality. Activities such as crushing, and transportation of raw materials generate particulate matter. **Non-CO^2 Pollutants:** Combustion of waste in incinerators (also produces particulate matter) Ozone-depleting gases used in cooling devices. Exhaust emissions from mine vehicles and powerhouse. **Greenhouse Gases:** Exhaust emissions from mine vehicles, powerhouse, and other combustion of fossil fuels.	**Certain**	**Moderate**	**Major**	**Blasting:** A 500m radius around blasting zones will be maintained for safety without exception. **Particulate Matter/Dust:** Workers will be provided with respiratory protection when working in high-risk areas. Iron ore concentrate is transported in covered trucks to prevent dust entering the air during transportation. Dust scrubbers and other dust suppression features installed at unloading and loading points. All haul roads will be regularly treated with dust suppressant to reduce dust generation, especially during the dry season. MML's Environmental Monitoring System tracks air quality and composition across key monitoring points around the concession. **Non-CO^2 Pollutants:**	**Achievable**	**Medium**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Air Quality and Pollutants	**Air pollutants pose respiratory health hazards to workers and project-affected persons.**	**Certain**	**Moderate**	**Major**	Use of 1000ppm sulfur fuel in mine vehicles. Use of USEPA Tier II compliant engines in heavy equipment. Incinerator manufacturer's specifications for loading and temperature controls are strictly adhered to. Prohibit incineration of PVC or similar plastics. Use of approved non-ozone-depleting refrigerants in cooling appliances. **Greenhouses Gases:** MML has physical intensity and absolute GHG emissions reductions targets established and publicized in the company's Sustainability Reporting. MML intends to deploy on-site renewable energy generation from carbon-free sources, namely photovoltaics, in the medium-term.	**Achievable**	**Medium**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Noise and Vibration	**Noise:** Residents will be regularly exposed to noise from the mining activities including heavy machinery in operation and vehicular movement along roads. Workers who are exposed to noisy operations at close range are at risk of developing hearing problems. Noise and vibration levels from operation of the plant and related machinery. Increased noise and vibration from vehicular movement along haul roads. The negative impacts of elevated noise levels and vibrations on communities and workers can disrupt the serenity of communities and cause anxiety. **Blasting:** Severe vibrations, such as those caused by blasting, can lead to structural damage in nearby structures.	**Certain**	**Moderate**	**Major**	**Noise**: Regular servicing/preventive maintenance of vehicles and machinery. Limit working in or near sensitive noise receptors at night. PPE for hearing protection is mandatory in applicable contexts. Shift system is used to limit the duration of worker exposure to elevated noise levels. Speed limits will be installed along haul roads. Haul truck's maximum speed is 40km/h in the day and 35km/h in the night. Light vehicle max speed is 60km/hr at any time. MML's Environmental Monitoring System tracks noise levels at key points throughout the concession, including in residential communities in close proximity to mine infrastructure. **Blasting:** Blasting will be designed and managed in accordance with good industry practices to minimize noise and vibration.	**Achievable**	**Medium**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Noise and Vibration		**Certain**	**Moderate**		Blast noise and vibrations are monitored using seismographs. Survey of houses and infrastructure will be conducted prior to blasting as needed to obtain a baseline condition of cracks and stability.	**Achievable**	**Medium**
Water Stewardship	**Surface water contamination:** Erosion and run-off from mining activities alter the hydrology of surface water in the project area. Sedimentation of creeks can occur due to run-off from concentrate stockpiles and/or the TSF. **Ground water contamination:** Fuel and other toxic substances can inadvertently permeate into the aquafer and contaminate ground water. Potential for negative effects on the	**Likely**	**High**	**Major**	**Surface water contamination:** Protective measures such as silt traps (cleaned on a regular maintenance schedule) are deployed to contain run-off to prevent siltation of the surface water. The Valley B TSF dry stacking and cyclone deposition program design incorporates perimeter catchment paddocks (sediment ponds) and sediment traps to capture sediment before it causes siltation of nearby surface water.	**Easily Achievable**	**Minor**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Water Stewardship	quality/composition of groundwater in the aquafer that serves the concession area. **Water Availability:** All process plant water extraction is from surface water from the Bathbana creek or Rokel river. These bodies of water are at no risk of depletion from MML activities during the rainy season. Surface water levels are monitored carefully in the dry season to avoid extraction placing a burden on the ecosystem. **Aquatic Ecology:** Pollutants generated during activities like excavation, erosion, and resulting sedimentation, can lead to a decrease in surface water oxygen levels, affecting the respiration of fish and other aquatic life, as well as the photosynthetic rate of aquatic flora.	**Likely**	**High**	**Major**	**Ground water contamination:** Ground water quality/composition is monitored as part of MML's Environmental Management System to track potential and realized impacts from project activities. Effluent is treated before being discharged. MML's activities have a minimum impact on community ground water resource quality and availability. The mining operation has a much more significant impact on surface water composition. All petroleum products and chemicals are safely stored to avoid any leakage and/or spillage on the ground. Grease and oil traps are provided in fueling and maintenance areas and workers involved in fueling are trained to avoid spills. **Water Availability:** All process plant water is obtained from surface water sources: Bathbana creek and the Rokel river. Extraction from ground water/boreholes occurs at TRT,	**Easily Achievable**	**Minor**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Water Stewardship		**Likely**	**High**	**Major**	but volumes are extremely limited (eg: 434 cubic meters in July 2023). Alternate water sources will be provided (eg: new boreholes) if it is determined that community water availability is affected by the project. Reuse/recycling of water is being evaluated for increased water efficiency. **Aquatic Ecology:** The locations for the removal, stockpiling and dumping of earth are to be carefully selected to control erosion and sedimentation.	**Easily Achievable**	**Minor**
Soils and Topography	**Soil Degradation:** Excavation and blasting permanently alter the natural topography and geomorphology of an area. This process displaces topsoil, reducing its quality and quantity. Loose soil materials, such as overburden and tailings, are susceptible to wind erosion and can be washed away by rainfall, leading to siltation in water bodies. The overall disruption of soil from	**Certain**	**High**	**Major**	**Soil Degradation:** Mitigating the impact of a project during its operational phase is challenging. To meet the challenge, MML has a Mine Closure and Rehabilitation Plan (MRCP) in place, including soil testing, land reclamation, remediation, and monitoring. During the initial stage of operations, topsoil will be stockpiled for later use in rehabilitation. Erosion protection measures are	**Difficult during operations**	**Major**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Soils and Topography	mining operations decreases its nutrient values, which lowers the overall health of the ecosystem. **Topography:** The mining operations in the area has and will continue to cause changes to the topography, including hills, interfluves, and inland valley swamps. The landscape will be altered as a result.	**Certain**	**High**	**Major**	installed to prevent topsoil loss. Stockpiled topsoil will be fertilized for vegetation rehabilitation. Tailings should be deposited in a way that minimizes destruction and preserved for filling the pit during reclamation. **Topography:** The impact on the landscape caused by excavation can be permanent, but the MRCP will see as much progressive land remediation as possible before and after mine closure. These measures include filling excavated pits with overburden, shaping the landscape through terracing and contouring, and distributing stockpiled and fertilized topsoil over the modified landscape.	**Difficult during operations**	**Major**
Viability of Fauna	**Habitat degradation:** Land clearing for excavation in new areas has negative effects on animals, including mammals, birds, and herpetofauna. The removal of vegetation disrupts habitats, leading to migration, injury, and potentially death.	**Likely**	**Moderate**	**Medium**	**Habitat degradation:** MML's MCRP calls for progressive land remediation and habitat restoration starting in 2024. MML intends to establish one or more conservation areas within the mining concession where animals that need to be relocated away from mining areas	**Difficult**	**Medium**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Viability of Fauna		**Likely**	**Moderate**	**Medium**	will be transferred to. These zones will be proving grounds for the company's biodiversity program and nature-based solutions investments. **Environmental Management Plan**: Animals encountered during mining activities will be relocated to safe areas whenever possible. Drivers receive training and sensitization to avoid unnecessary road kills. **Biodiversity interventions:** MML's Biodiversity Offset Plan will follow the IUCN impact mitigation hierarchy as well as Sierra Leone guidance to achieve net positive biodiversity outcomes.	**Difficult**	**Medium**
Viability of Flora	**Habitat degradation:** Loss of vegetation from mining activities will result in fragmentation of vegetation corridors and habitats for species, and disruption of animal foraging. Fortunately, overburden and tailings from iron ore mining are hospitable to	**Certain**	**Moderate**	**Medium**	**Mine sequencing:** Vegetation clearing will be concentrated only within the areas where active mining is ongoing. Mined out areas will be targeted for land remediation activities as guided by the MRCP.	**Achievable**	**Minor**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Viability of Flora	vegetation regrowth after left undisturbed. This natural regrowth can be observed on the concession's disused tailings storage facility and legacy overburden dumps. The loss of agricultural lands, wind breaks, and destruction of medicinal herbs and food supplements will also occur.	**Certain**	**Moderate**	**Medium**	**Progressive land remediation:** Areas found to host threatened and endangered species may become conservation areas, depending on the viability for mining. If an area of significant biodiversity needs to be mined, MML intends to relocate as much of the vulnerable flora as possible within the project area.	**Achievable**	**Minor**
Waste Management	**Mining waste:** Waste from mining activities such as overburden and unwanted materials, tailings are strategically managed in by MML's mining department to minimize cumulative damages. **Anthropogenic waste:** MML rigorously adheres to best practices for waste management and disposal and/or recycling. All practice and protocols are established by the Waste Management Plan and the Chemical Management Plan.	**Certain**	**High**	**Major**	**Mining waste:** Depending on feasibility, mining waste will be crushed and used as much as possible as aggregates in road maintenance and other construction works. Waste that cannot be used will be crushed and spread out at designated disposal sites within the concession. Mine waste areas will be targeted for land remediation activities. **Anthropogenic waste:** MML's Waste Management Plan and the Chemical Management Plan protocols are strictly enforced and followed. All waste is to be stored and transported in a safe manner, in	**Achievable**	**Medium**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Waste Management		**Certain**	**High**	**Major**	accordance with Material Safety Data Sheet (MSDS) standards. Appropriate containers, segregation and bunding is required. MML contracts EPA-SL approved waste removal and recycling service providers. In the absence of suitable contractors, MML stockpiles recyclables. For waste that is incinerated on site, best practices are observed to mitigate the release of harmful air pollutants and their effects on human health.	**Achievable**	**Medium**
Occupational Health and Safety (OHS)	**Occupational safety:** Workers face the risk of accidents, injuries, exposure to harmful elements and sometimes risky situations related to mine development and mining operations. Long term damage or problems may develop if workers are not given the required protection for operating in a project of this nature. **Emergency preparedness:** Lack of awareness of how to respond in the event of emergencies could result in	**Certain**	**High**	**Major**	**Occupational safety:** Workers will be provided with appropriate personal protective equipment (PPE) for working in all areas of the project. Machinery will be kept in good working conditions to minimize accidents and reduce air pollution. OHS induction, trainings and sensitization are mandatory for all employees. Appropriate OHS safety practices are strictly enforced.	**Achievable**	**Medium**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Occupational Health and Safety (OHS)	injury, loss of life and/or loss of assets. **Use and storage of explosives:** The use and storage of explosives could pose environmental, community and occupational health and safety risks. **Endemic diseases:** Sierra Leone suffers from highly prevalent endemic diseases. Malaria, Typhoid and Yellow Fever are major public health challenges and deleterious for social and economic outcomes. Because MML is responsible for the health and safety of our employees, the company is charged with addressing vector-borne diseases. It is difficult to say conclusively how the project's operations affect frequency rates of endemic disease in the project area compared to if the project wasn't operating. That said, there are some disease vectors such as static bodies of water (eg: water-filled mined-out pits) that are known disease vectors for mosquitos that may infect MML employees with malaria.	**Certain**	**High**	**Major**	Toolbox safety talks are conducted daily. First aid and medical facilities are readily available from the on-site clinic. Detailed incident reporting and statistics analysis is conducted to identify patterns, weak points, and areas for improvement. **Emergency preparedness:** Preparation, implementation, and regular updating of the company's Emergency Response Plan (ERP). **Use and storage of explosives:** Initiate and implement a health and safety system on site to include mainly the workers on site but also to a lesser extent the closest communities. Use of qualified blasters in blasting exercises. Use of explosives according to manufacturer's instructions Construction of a special explosives magazine whose design incorporates all the necessary safety features.	**Achievable**	**Medium**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Occupational Health and Safety (OHS)		**Certain**	**High**	**Major**	Training for workers in responding to emergencies. **Endemic diseases:** Obligatory use of malaria-preventive measures, including the use of insecticide-treated bed nets, indoor residual spraying and larviciding mosquito breeding grounds. Strict adherence to World Health Organization guidelines for management of prevalent diseases. Improved access to health care services, including free testing on malaria a (subsidized) prophylaxes. Introduction and implementation of effective measures to reduce breeding places for water-borne diseases.	**Achievable**	**Medium**
Community Health and Safety	**Safety:** Communities along haul roads may be exposed to more traffic than they have been used to, creating road safety hazards. Accidents/ incidents caused to, by or because of interaction between project	**Likely**	**Moderate**	**Medium**	**Safety:** Several proactive measures to ensure road safety, security, and stakeholder engagement at the mining site shall be undertaken. MML and contracted drivers receive training in road safety.	**Easily Achievable**	**Positive**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Community Health and Safety	and trespassers. Possibly resulting in injury, loss to process, death etc. **General public health:** Public health in a general sense has and will continue to improve because of the economic/employment opportunities that MML's presence creates in Port Loko District and beyond. In specific facets of public health, outcomes may not always be positive. MML is committed to addressing all instances of observed adverse public health outcomes.	**Likely**	**Moderate**	**Medium**	Sensitization programs will be conducted for communities about road safety. Security personnel will patrol the site to prevent unauthorized access, and security fences and access controls will be used to minimize entry by unauthorized personnel. Stakeholder engagement activities will inform nearby communities about the risks and consequences of trespassing onto the mining site. **General public health:** MML seeks to amplify the positive outcomes our presence has on public health and to minimize the negative outcomes. The company's Community Development Action Plan (CDAP) project areas include HIV screening and referral for treatment, support for local educational institutions in Lunsar, and building new latrines and water wells in Lunsar.	**Easily Achievable**	**Positive**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Economic Impact	**Increased employment opportunities:** Community benefits from employment would be realized if the company endeavors to offer employment to project area residents. The benefits of those who are employed would be obvious such as the ability to provide more for family members, etc. Due to the project operations, people may migrate to nearby communities in the hope of securing employment or to establish a small business in the area. **Labor issues:** The issue of labor in the mining industry can create competition and conflict among residents, as well as between locals and newcomers. This competition for jobs and perceived unequal treatment in employment allocation by the company may result in rivalry and jealousy among the settlement inhabitants.	**Likely**	**High**	**Positive**	**Increased employment opportunities:** Priority for employment will be given to the local population who bring the required skills to the roles they apply for. **Labor issues:** MML gives preference to local (to Port Loko District) candidates for employment, provided they have the requisite skills and qualifications. MML employed 3,362 people at the end of 3Q23, 92% Sierra Leone nationals. **Local content:** MML is obliged by Sierra Leonean law to build in-country financial value by giving preference to hiring Sierra Leonean nationals over expats, contracting SL-based suppliers to meet procurement needs, and proactively training national employees for succession in management roles. **Socio-economic development:** The mining development will lead to	**Achievable**	**Positive**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Economic Impact		**Likely**	**High**	**Positive**	economic growth, resulting in the development of skills among the local population. This will empower individuals, households, and communities, while also benefiting businesses due to the increase in population.	**Achievable**	**Positive**
Community Relations & Development (CR&D)	**Community Development Agreement:** The Community Development Agreement (CDA) is the governance framework by which the company allocates 1% of free-on-board revenue to the Community Development Fund (CDF). The governing bodies of the CDA and CDF work to nominate and select development projects to benefit the Marampa and Maforki Chiefdoms, and then manage them to completion. **Community Development Action Plan (CDAP):** As required by MML's EPA-SL licensing, the company allocates USD $60K/year to be spent across 6 project categories. See the CDAP annex of this ESHIA for project details.	**Certain**	**High**	**Major**	**Community Development Agreement:** 2023 was the first year the CDF received funding. MML reports transparently on CDA and CDF activities and project statuses on an annual basis in the company's Sustainability Report. **Resettlement / loss of land:** The statutory surface rent for the whole of the mining lease area within the project chiefdoms will be paid. For communities or households that are relocated, a survey of affected property/crops will be conducted, and compensation provided accordingly. Resettlement Action Plans include livelihood restoration and long-term	**Achievable**	**Positive**

Impact Category	Impact Description	Certainty of Impact	Significance	Pre-mitigation Impact Category	Mitigation/Enhancement measure	Mitigation Potential	Post-mitigation Impact Category
Community Relations and Development (CR&D)	**Resettlement / loss of land:** Communities adjacent to the Valley B TSF expansion areas will need to be relocated from their current places. This will result in short- and medium-term disruption of lives and livelihoods followed by substantially improved living conditions/quality of life. MML is committed to meaningfully improving the lives of project affected persons.	**Certain**	**High**	**Major**	outcomes monitoring to ensure that project affected persons do not fall behind socially or economically as a result of resettlement. **Resettlement / loss of land:** A Resettlement Management Plan has been developed as part of this ESHIA, which outlines the legislation and standard operating procedures MML will adhere to for all resettlement projects.	**Achievable**	**Positive**

DISCLAIMER

This report has been exclusively prepared for Marampa Mines Limited's (MML) project northern and southern expansions by Environmental Management Services (SL) Limited (EMS) in accordance with the agreement between MML and EMS. It is important to note that EMS assumes no liability or responsibility for any third party's use or reliance on this report. Moreover, this ESHIA study was conducted using data from previous ESHIA and EIA studies, as well as assessments, surveys, and sampling from the current assignment. EMS has made efforts to identify any data gaps that may exist in this ESHIA study. This report may not be copied or reproduced without prior permission from Marampa Mines Limited (MML). It is worth stating that EMS's opinions, findings, and recommendations in this report are based on the circumstances and facts that existed at the time of their work. Any changes to these circumstances and facts may have an adverse effect on the recommendations, opinions, or findings. Furthermore, the field investigations conducted were limited to the level of detail required to meet the stated objectives of the work as specified in the contract's scope of work (SOW). This work was carried out in accordance with international best practices as well as the Sierra Leone EPA's requirements, and it followed the Quality Assurance and Quality Control (QAQC) paradigm of EMS.

Signed by:

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GLOSSARY

To improve comprehension and facilitate communication, clarity and consistency in terminology usage, a glossary has been provided in this ESHIA report. Environmental Management Services (EMS) has tried to define key terms and concepts to ensure that all readers, regardless of their level of familiarity with the subject matter, have a common understanding of the language used in this report. This is especially important as certain aspects of the report contain technical or specialised fields with complex and specialised terminologies. In summary, this glossary is meant to help improve the readability of the report by reducing the need for lengthy explanations or definitions within the body of the report.

No	Technical word	Simplest and Best Possible Explanation
1	**Avifauna**	Is the term used to refer to the birds present in a particular region or period, or the study of birds and their behaviour, ecology, and distribution.
2	**Amphibians**	Amphibians are a class of cold-blooded, vertebrate animals that spend part of their life cycle in water and part on land. They are characterized by their smooth, moist skin, which is permeable to water and gases, and their ability to breathe through their skin.
3	**Barge**	A barge is a type of flat-bottomed boat that is designed for carrying cargo on inland waterways or in coastal areas. Barges are typically large and rectangular, and they are propelled by tugboats or pushed by other vessels.
4	**Board of EPA-SL**	The EPA-SL's governing body is the Board of Directors, led by the Executive Chairperson and composed of representatives from various line Ministries and three members of society
5	**Community of Influence**	refers to the group of individuals or entities that are potentially affected, either positively or negatively, by the implementation or outcome of a specific project or development
6	**Communities**	A group of interacting people, living in some proximity (i.e. in space, time or relationship) that shares common values and has social cohesion. Here the communities would mean those 19 villages within the project with direct and indirect influence.
7	**Community Development Action Plan (CDAP)**	A Community Development Action Plan (CDAP) is a document that outlines a community's goals and objectives for development. It typically includes strategies and actions to be taken to achieve those goals, along with timelines and responsibilities assigned to specific individuals or organizations.
8	**Conservation**	The process of organizing, administering, and carrying out an operation aimed at safeguarding the vital physical, chemical, and biological attributes of the environment from deterioration. This includes managing biological resources like fish and timber in a manner that guarantees replenishment by regrowth or reproduction of the portion that has been harvested before another harvest cycle takes place. The objective is to maintain a harmonious balance between economic development and the preservation of the environment and its natural resources.

9	**Client**	A client is a person or organization that receives a service or product from another person or organization in exchange for payment or other forms of compensation. In this context, MML is the client
10	**Ecosystem**	An ecosystem is a complex network of living organisms, their physical environment, and the interactions that occur between them. It includes all the living and non-living components of a specific area, functioning as a natural system and maintaining a balance between various biological and ecological processes.
11	**Environmental, Social and Health Impact Assessment (ESHIA)**	The act of estimating and assessing the potential social, health, and environmental effects and hazards of a proposed project, along with determining strategies to minimize these effects, to meet stakeholder needs, legal standards, and any other social or environmental performance criteria established by the project, while reducing impacts to the greatest extent feasible from both technical and financial perspectives
12	**Environmental, Social and Health Management Plan (ESHMP)**	A plan outlining all of the proposed mitigation measures that the project's proponent will take to prevent, reduce, remedy, and compensate for adverse effects while maximising the project's benefits. Also included is a plan for monitoring and auditing to ensure compliance with the ESMP.
13	**EPA-SL "checklist"**	This is the list of minimum requirements and/or instructions developed and provided by the EPA-SL that a client must follow to conduct the ESHIA process necessary for the issuance of an EIA licence.
14	**Framework**	a planned system of laws, regulations, tasks, and programmes developed to accomplish a particular goal. At different scales (e.g., provincial, regional, sector, media), there can be frameworks for broad policies, strategic initiatives, programmes and programme delivery, as well as short-term tasks and projects.
15	**Hazardous Waste**	Hazardous waste refers to any material or substance that poses a threat to human health or the environment due to its toxic, flammable, corrosive, or reactive properties. It includes a wide range of waste streams such as chemicals, pesticides, medical waste, electronic waste, and radioactive materials, which require careful handling, transportation, and disposal to prevent harm to people and the planet.
16	**Haulage Road**	A haul road is a type of roadway that is designed and constructed for the specific purpose of transporting heavy equipment and materials, such as earth, rocks, or minerals, in a mining or construction operation.
17	**Human Development Index**	The Human Development Index (HDI) is a composite statistical measure of various dimensions of human development, such as education, health, and standard of living, used to rank countries into four tiers of human development. It was created by the United Nations Development Programme (UNDP) and has become an influential tool for policy-making and monitoring progress towards achieving human development goals. The HDI is calculated based on indicators such as life expectancy, education, and gross national income per capita

18	**Hydrogeology**	Hydrogeology is a branch of geology that focuses on the study of the Earth's water system, including the movement and distribution of groundwater within the soil and rocks of the Earth's crust, typically in underground reservoirs called aquifers. It involves the use of geological principles and techniques to understand and manage groundwater resources for various purposes such as drinking water supply, irrigation, and industrial use.
19	**Hydrology**	Hydrology is the study of water in the earth's system, including its distribution, movement, and quality. It encompasses the study of precipitation, groundwater, surface water, evapotranspiration, and the interactions between water and other components of the natural and human-made environment.
20	**International Finance Corporation**	A global financial organisation that supports the growth of the private sector in developing nations by providing asset management, advisory, and investment services. A member of the World Bank Group is the IFC.
21	**Invertebrates**	All animal species except for those belonging to the subphylum Vertebrata lack a vertebral column. This means that they do not have the bony structure that encases and protects the spinal cord, which is a defining characteristic of vertebrates.
22	**Life of Mine (Life of mine)**	Life of Mine (Life of mine) refers to the estimated lifespan of a mining operation, which is the period during which a mine is expected to be economically viable and operational
23	**Mammals**	Mammals are a class of warm-blooded animals that have fur or hair and are distinguished by their ability to produce milk to nourish their young. They are found on all continents and in a wide range of habitats and include well-known animals such as dogs, cats, horses, whales, and humans.
24	**Mining Concession**	A mining concession is a legal agreement between a government and a mining company that grants the company the right to explore, develop, and extract minerals from a specific area of land for a certain period
25	**Mining**	Mining generally refers to the extraction of valuable minerals or other geological materials from the earth. This can include various types of ores, precious metals, coal, and other materials that have economic value
26	**Mitigation measures**	Mitigation measures refer to actions or strategies implemented to reduce, minimize or eliminate the negative impacts of a project or activity on the environment, communities or other stakeholders. These measures are typically put in place to prevent or reduce potential harm or damage and may involve changes to project design, the use of alternative technologies, or the implementation of environmental management plans. Mitigation measures aim to promote sustainable development by balancing economic, social, and environmental considerations

27	**pH**	A pH is a measurement unit that indicates a solution's acidity or alkalinity. It uses a logarithmic scale with 7 as neutral, lower values indicating greater acidity and higher values indicating greater alkalinity. pH is determined by the concentration of hydrogen ions in a solution, expressed in moles per litre (-log10 c), and is influenced by geochemical and biological factors in an environment. pH levels can have a major impact on aquatic organisms' distribution and pollutants' toxicity.
28	**Pollution**	It is intended to include other forms such as foul-smelling odours, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts, including light, as well as hazardous and non-hazardous pollutants in solid, liquid, or gaseous forms.
29	**Potable Water**	Portable water refers to water that is safe and suitable for human consumption and is free from harmful contaminants. It can be obtained from various sources, such as wells, rivers, lakes, or municipal water supplies, and is typically treated to meet strict quality standards
30	**Project Interested and Affected Parties (IAPs)**	Any individual, group of individuals, or organisation who is interested in; affected by; concerned about; or has statutory authority over an activity, development, project, policy, or action and who needs to be consulted during the decision-making process.
31	**Project Proponent**	A project proponent is an individual or organization responsible for proposing a project and advancing it through various stages of development, such as planning, design, and implementation. They are typically the ones who initiate the project and are responsible for securing funding and resources to ensure its success
32	**Reptile**	A reptile is a cold-blooded, air-breathing animal that belongs to the class Reptilia. Reptiles are characterized by their scaly skin, which helps them conserve water and their internal fertilization
33	**Socio-economic data/ study**	Social science focuses on the relationship between economic activity and social processes. Specifically, it examines how societies are influenced by their local, regional, or global economies, and how economic changes can lead to progress, stagnation, or regression.
34	**Social Indicators**	Social indicators are statistical measures that provide direct and accurate information on key social concerns, such as economic growth, values, or goals. These numerical measures describe the well-being of individuals or communities and may consist of one variable or multiple components that are combined into an index. Social indicators help to evaluate community well-being in terms of social, economic, and psychological welfare.
35	**Stakeholders**	Stakeholders are individuals or groups who have a vested interest in a particular project, business, or activity. They may be affected by the outcomes of the project and have interests related to financial, social, environmental, or other factors. Examples of stakeholders include customers, employees, shareholders, suppliers, and local communities.

36	**Water Quality**	The diverse qualities of water, encompass its chemical, physical, biological, and radiological properties. The quality of water refers to how well these qualities satisfy the requirements of either living organisms or human purposes. Put simply, water quality is an evaluation of how appropriate water is for its intended use
37	**World Bank**	The World Bank is an international institution that plays a crucial role in maintaining the global economic and financial system. It is primarily concerned with managing foreign exchange reserves and promoting balanced international trade

LIST OF ACRONYMS/ABBREVIATIONS

BAU	Business As Usual
CBD	Convention on Biodiversity
CCD	Convention to Combating Desertification
CDAP	Community Development Action Plan
CDC	Centre for Disease Control
CITES	Convention on International Trade in Endangered Species
CoCP	Code of Construction Practices
CRA	Climate Risk Assessment
CSR	Corporate Social Responsibility
DFS	Definitive Feasibility Study
DHMT	District Health Medical Team
EIA	Environmental Impact Assessment
EMS	Environmental Management Services
EPA	Environmental Protection Agency
ESHIA	Environmental and Social Health Impact Assessment
ESMS	Environmental and Social Management Systems
ESNO	El Niño Southern Oscillation
FRA	Flood Risk Assessment
GHG	Green House Gases
HDPE	High-Density Polyethylene
ICMM	International Council on Mining and Metals
IFC	International Financial Corporation
ILO	International Labour Organization
IMC	International Medical Corp
INDC	Intended Nationally Determined Contribution
IRC	International Rescue Committee
ITCZ	International Tropical Convergence Zone
IUCN	International Union for the Conservation of Nature
Life of mine	Life of Mine
MIOL	Marampa Iron Ore Limited

MML	Marampa Mines Limited
MoHS	Ministry of Health and Sanitation
PPCP	Public Participation and Consultation Plan
ROM	Run of Mine
RWD	Raw Water Dam
SAG	Semi Autogenous Grinding
SEP	Stakeholders Engagement Plan
SIA	Social Impact Assessment
SoI	Sphere of Influence
TLO	Train Load Out
ToR	Terms of Reference
TRT	Thofayim River Terminal
TSF	Tailings Storage Facility
TSV	Trans-Shipment Vessels
UNCLOS	United Nations Convention on the Laws of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
WFP	World Food Programme

1 SECTION ONE

1.1 INTRODUCTION

Marampa Mines Limited (MML) currently operates the iron ore mine in Sierra Leone pursuant to a mining lease signed with the Government of Sierra Leone in 2021. This is a joint venture between Gerald Group (90 per cent) and the Government of Sierra Leone (GoSL) at 10 per cent. Marampa Mines Limited holds the "Large Scale Mining Licence" duly registered as No ML 4/2021 which was issued on 6th August 2021 and was ratified by the Parliament of Sierra Leone on the 16th December 2021 which is valid for an initial 25 years, renewable for consecutive periods of 15 years.

An ESHIA report was submitted in 2021 permitting the production of 3.25 Mt/year of concentrate. This license has an area of 116.22 km2 that includes what is known as Marampa South (the area held by SL Mining Limited) and Marampa North (previously held by Cape Lambert, Marampa Iron Ore). The total area of the mining license is indicated in Figure 1-2 below. The mine is located near Lunsar within the Port Loko District. The Marampa Mine is a "Brownfield" operation with historical iron ore extraction and processing.

This MML Environmental Social and Health Impact Assessment (ESHIA) study is based on the expansion of the existing open pit iron ore mining operation at the Marampa and Masaboin deposit from its current 3.25 mdtpa capacity ore concentrator to 3.75 mdtpa iron ore concentrate grading 65% Fe. To achieve this new yearly capacity, it is required that the requisite infrastructural support systems are in place for processing the ore with the concentrates exported from the Port of Freetown by Cape-size vessels.

These expansion plans are supported by a Definitive Feasibility Study (DFS) by MICON (Mining), Zenito (Processing) and EPOCH (tailings disposal) completed in 2022 for the expansion to 3.75 mdtpa of concentrate. A Pre-Feasibility Study by MICON and Zenito supports the expansion to 3.75 mdtpa for export to overseas customers.

1.2 Overview of the ESHIA Process

To obtain development consent and the associated permits for construction and operational activities, MML's Project expansion must be subject to the Environmental Social and Health Impact Assessment (EIA) process, as specified in the Environment Protection Agency Act (2022). These regulations apply to corporate organisations and individuals applying for or issued mineral rights under the Mines and Minerals Development Act (2023). Mineral rights are also required to enable mining operations to proceed, as MML has already secured the required mining permits from the Government of Sierra Leone.

A single and combined impact assessment process shall be undertaken for the proposed Project expansion, combining the dual requirements of both EIA and SIA requirements in Sierra Leone and the ESHIA requirements as specified in the requirements (termed 'Performance

Standards') from the International Finance Corporation (IFC).

The term ESHIA will be used to denote this dual-impact assessment process. The ESHIA and license process as provided in the Environmental Protection Act (2022), is divided into five distinct stages (Figure 1.1), as follows.

1. **Pre-assessment Application:** The project is screened against applicable environmental laws to determine the nature and scope of the ESHIA Process.
2. **Environmental and Social Scoping:** Scoping is undertaken to identify potential impacts, engagement with local communities and define the Terms of Reference (ToR) for the ESHIA.
3. **Environmental and Social Impact Assessment:** This stage provides a detailed analysis of the potential environmental and social impacts, supported by objective and defendable scientific studies. To mitigate any identified negative impacts, and to enhance positive impacts, a set of Management Plans will also be produced as an outcome of the ESHIA.
4. **Disclosure:** At this stage, the ESHIA Report is then disclosed to any interested party and specific actions are taken to ensure that the local communities and affected people are directly engaged as part of the disclosure process.
5. **Approval:** This is the final stage of the ESHIA where the Regulators grant approval for the Project to go ahead and issue all the relevant permits.

The ESHIA Pre-Assessment Application was submitted to the EPASL on 26th July 2022. The EPASL responded to this application on 2nd August 2022 and confirmed this project qualifies as a Category **"A"** project, and given this, requires an ESHIA to be completed. The Environmental and Social Scoping report was submitted to the EPASL in August 2022. This Report presents the findings and outcomes of the ESHIA.

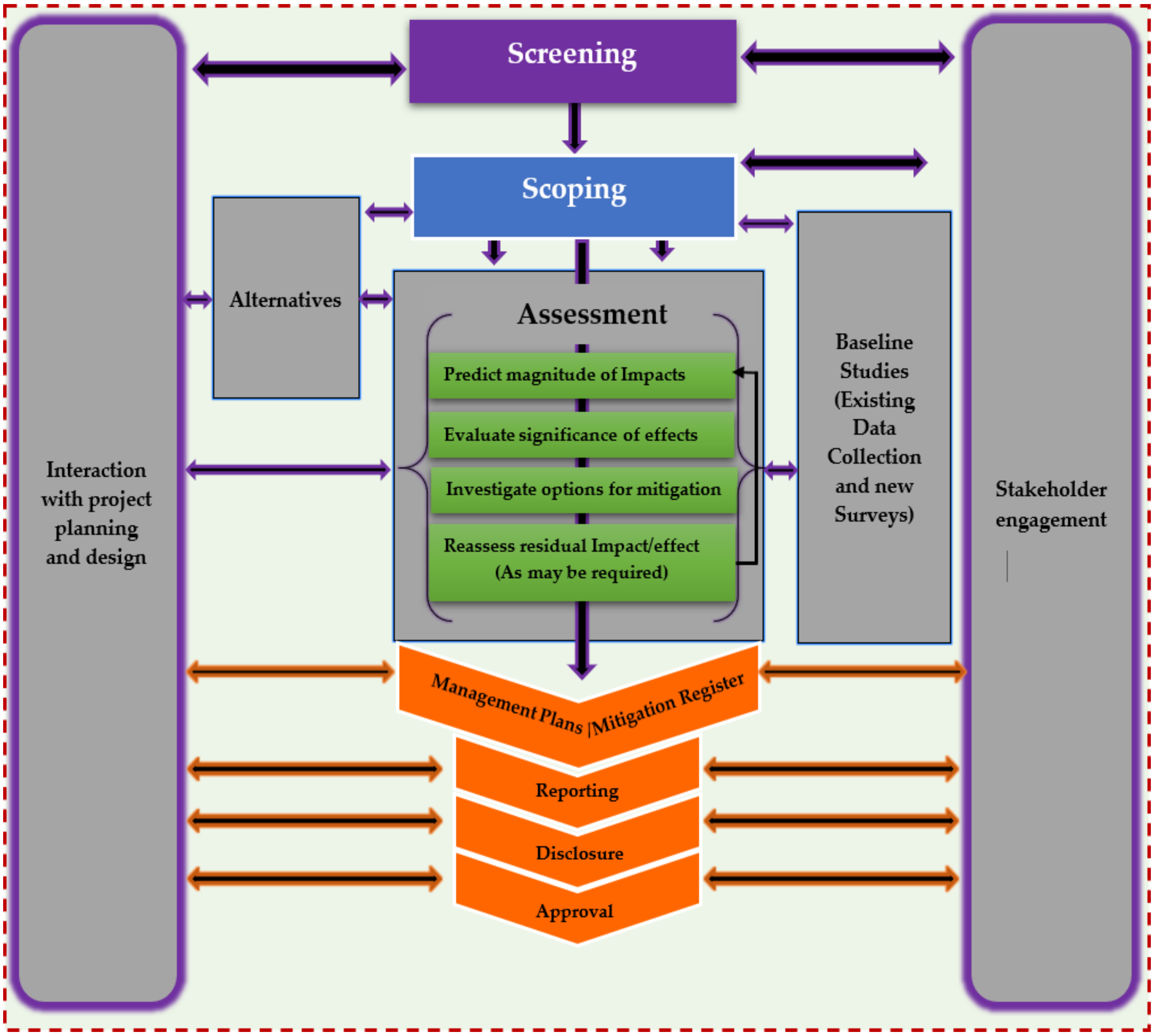


Figure 1- 1: A summary of the ESHIA Process

1.3 Purpose of this ESHIA Report

The purpose of the ESHIA report is to present the following:

1. A detailed description of the proposed project expansion.
2. The Environmental Social and Health Impact Assessment process and a review of the legislation, guidelines, and strategies pertinent to the proposed project expansion.
3. The outcomes associated with stakeholder engagement activities are carried out within the scope of the project expansion and its sphere of influence.
4. A detailed baseline review of the physical, biological, socio-economic and health characteristics of aspects within the new concession in relation to the project expansion.

5. An assessment of potential impacts on the physical, biological, socio-economical and health environments related to the different phases (construction, operational, decommissioning and closure phases) of the proposed project expansion.
6. Mitigation measures and associated management plans that aim to avoid/ minimise/ manage the severity of identified negative impacts and to maximise potential positive impacts; and
7. An assessment of cumulative impacts associated with other planned, existing or project-related developments within the proposed project expansion.

1.4 Marampa Project Phasing

The Marampa Iron Ore Project (MIOP) location is in the Republic of Sierra Leone, adjacent to the township of Lunsar, some 125 km northeast of the capital city of Freetown, in the Port Loko District of Sierra Leone, West Africa. It is a brownfield site formerly operated by DELCO and William Baird between 1933 and 1975. In this period, Marampa peaked at 2.5 Mt/y productions before low iron ore prices forced its closure. However, continuing weak market economics and civil war prevented redevelopment of the mine until London Mining Corporation (LMC) acquired the mining license in 2006 and ratified it in February 2010. LMC immediately commenced construction of Phase 1 to collect and process iron-rich tailings from the previous operation and fresh highly weathered ore. Phase 1A started production in 4Q11, with the first exports in January 2012. In addition, an identical plant, 1B, further increased the total Phase 1 production to 3 Mt in 2013.

The phase 1C crushing and grinding circuit to process weathered ore commissioning was Q1/2014. The anticipated total production of 5 Mtd/y with all circuits running to the nameplate using weathered ore and tailings. Two feasibility studies undertaken by LMC identified the growth path and costs to 6 and 10 Mt/y of concentrate. The expansion projects were approved but then cancelled due to falling iron ore prices. LMC then went into receivership.

The Project changed hands to TIMIS Corp in October 2014. The Project then went into care and maintenance in April 2015 due to low iron ore price up until Gerald Group took over the property. SL Mining, a wholly owned subsidiary of Gerald Group, refurbished and modified the 1C and 1B plants in 2018. The plant was commissioned in January 2019 and ran at nameplate 2 Mt/y of concentrate when put into care and maintenance again in September 2019 which ran until June 2021. Marampa Mines Limited, a joint venture between Gerald Group (90 per cent) and the Government of Sierra Leone (GoSL) at 10 per cent, restarted operations in September 2021 and immediately start expanding the operations.

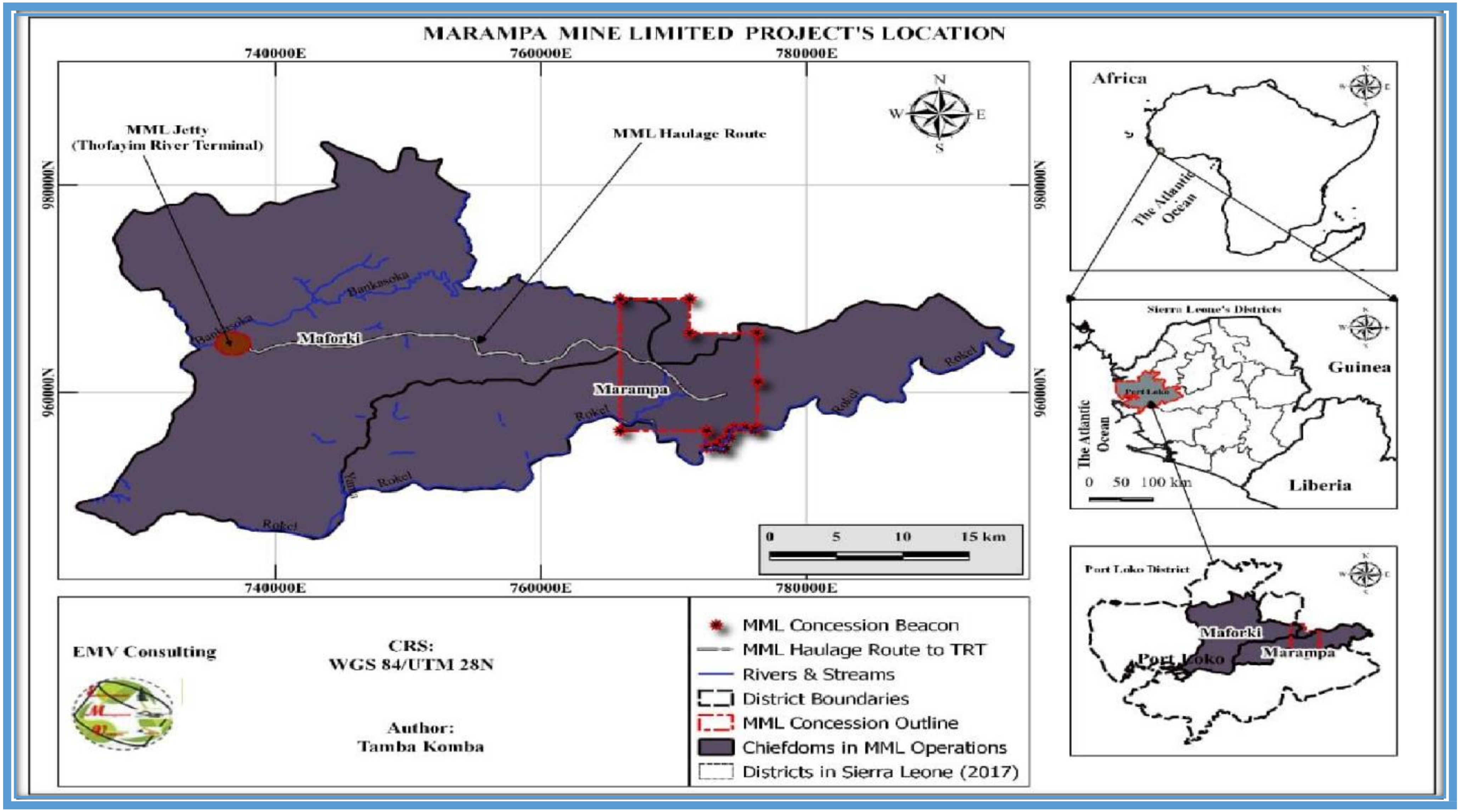


Figure 1- 2: MML's Total Concession Boundary and Physical Locations

1.5 Structure of the ESHIA Report

The structure of the ESHIA follows the detailed procedural requirements defined by the Environmental and Social Regulations for the Minerals Sector (2013). The structure and contents of the ESIA are presented in eleven sections as illustrated undermentioned.

Sections:

1. Introduction: This section briefly introduces the ESHIA for MML's Expansion Operation. It further presents the ESHIA process as per standard best practices.
2. Project Description: A concise overview of the project's description, location, expansions objectives, scope and potential environmental, social, and health impacts are deliberated.
3. Applicable Legislation and Standards: Deals with the regulations, standards and guidelines that have been followed by the conduct of the ESHIA study for the Marampa Mine Limited.
4. Impact Assessment Methodology: Regarding procedures and techniques used to evaluate the potential impacts of MML's project expansion on the environment, social and public health of the perceived communities involved.
5. Environmental Baseline: The current environmental, social and health conditions in the project's areas are compared against the project's impacts (i.e., assessing the existing ecosystem, socio-economic conditions, and health status of the local community, and understanding the natural and anthropogenic factors that influence these conditions).
6. Social Baseline: Engagement with stakeholders, such as local communities and government agencies, to solicit their feedback and input on the expansion project and its potential impacts.
7. Statement of Public Participation: Looks at the potential effects of the expansion project on the natural environment, social aspects, and economic conditions of the local communities (assessing the positive and negative impacts on biodiversity, air and water quality, cultural heritage, social structures, employment, income, and other relevant factors).
8. Environmental Impact and Mitigation: In this section, the potential impacts of MML's expansion project in conjunction with other past, present, and future projects in the same or nearby areas, and the measures to minimize or avoid negative effects are carefully considered.
9. Social Impact Assessment and Mitigation: Regarding the potential and realized impacts

of MML's expansion project.

10. Cumulative Impact Assessment: A holistic synthesis of all assessed impact areas.
11. Environmental Monitoring Programs and Sustainability Initiatives
12. Conclusions
13. References
14. Appendices
15. Annexures

2 SECTION TWO

2.1 Project Description

This Environmental and Social Health Impact Assessment (ESHIA) is based on the expansion of the existing open pit iron ore mining operation at the Marampa deposit, and the expansion of the current 3.25 mdtpa production capacity and required infrastructure to support capacity for of 3.75 mdtpa iron ore concentrate grading target of 65% Fe. The concentrates are to be exported from the Port of Freetown by Cape-size vessels.

The expansion plans are supported by a Definitive Feasibility Study (DFS) by MICON (Mining), Zenito (Processing) and EPOCH (tailings disposal) completed in 2022 for expansion to 3.75 mdtpa of concentrate. A Pre-Feasibility Study by MICON and Zenito supports the expansion to 3.75 mdtpa for export to overseas customers.

The expansion of the project requires extension of the existing mining, plant and export infrastructures accordingly. Electricity supply will be increased through the expansion of the existing diesel powerhouse with new diesel gensets, with the potential for some demand to be met with renewable electricity generation from photovoltaics in the future.

The main features at the Marampa site include the following.

1. Mining of ROM Ore and haul roads to the ROM Pad.
2. Process Plant.
3. Waste rock dumps.
4. Run-of-mine (ROM) pad to stockpile ore for blending.
5. Tailings Storage Facilities (TSF).
6. Water pipeline and pump stations at Katik.
7. Mine site camps.
8. Water treatment plant for potable water.
9. Landfill site and Incinerator.
10. Support facilities.
11. Administration and general offices.
12. Vehicle maintenance area.
13. Powerhouse.
14. Warehouse facilities.
15. Maintenance areas for process plant equipment, and electronics.
16. Concentrate Haulage/Mining Contractor allotments, and
17. Haul roads.

At Thofayim River Terminal, the following project components are present at the Thofayim River Terminal area (TRT),

1. Power station.
2. Camp facilities.
3. Concentrate dumping and stockpiling.
4. Concentrate loading to barges.
5. Fuel Storage Facility.
6. Quay and small craft jetty, and
7. Waste rock dump and dredge spoil storage areas.

2.2 Project Location and Beacon Coordinates

The Project sphere of influence is located near the township of Lunsar, some 125 km northeast of the capital city of Freetown, in the Port Loko District of Sierra Leone, West Africa (Figure 2-1). The Project area comprises the original mining lease held by SL Mining, and the original mining lease held by Marampa Iron Ore Limited (MIOL) north and southwest of the original SLM lease of 2018.

The Marampa Mine is located adjacent to Lunsar Town, Marampa Chiefdom, Port Loko District, Northern Province. The barge loading facility at Thofayim that will be used by the Project is located approximately 48km to the west of the mine site, connected by an existing haul road. Barges will follow the Port Loko Creek to the Freetown Port area, where the concentrate will be transhipped to export bulk carriers for onward carriage to smelters around the world.

The area of influence of mining and processing is shown in Figure 2-1

Figure 2- 1: Map Showing Project Area of Influence

Table 2- 1: Coordinates of Project Sphere of Influence

Name	Easting	Northing
Area 2	773406	964988
Area 2	776314	964959
Area 2	774809	965036
Area 2	773400	962231
Area 2	774221	962595
Area 2	776352	961024
Area 2	775261	961834
Concession Area 1	773400	962231
Concession Area 1	774221	962595
Concession Area 1	776352	961024
Concession Area 1	775261	961834
Concession Area 1	772032	961532
Concession Area 1	772005	960078
Concession Area 1	771029	959987
Concession Area 1	771017	960764
Concession Area 1	770020	960398
Concession Area 1	770656	958202
Concession Area 1	772508	958431
Concession Area 1	772957	958539
Concession Area 1	772852	958863
Concession Area 1	774228	959035
Concession Area 2	776352	961024
Concession Area 2	772508	958431
Concession Area 2	772957	958539
Concession Area 2	772852	958863
Concession Area 2	774228	959035
Concession Area 2	775496	956473
Concession Area 2	775070	956466
Concession Area 2	774620	956434
Concession Area 2	774397	956230
Concession Area 2	774329	955753
Concession Area 2	774158	955474
Concession Area 2	773911	955295
Concession Area 2	773762	955167
Concession Area 2	773766	954917
Concession Area 2	773846	954642
Concession Area 2	773749	954415
Concession Area 2	773423	954410

Concession Area 2	773121	954480
Concession Area 2	772570	954497
Thofayim	736814	965444
Thofayim	736985	965053
Thofayim	736966	965034
Thofayim	737025	964890
Thofayim	737113	964480
Thofayim	737075	964209
Thofayim	736901	964176
Thofayim	736767	964208
Thofayim	736596	964371
Thofayim	736828	964509
Thofayim	736814	964650
Thofayim	736642	964778
Thofayim	736610	964817
Thofayim	736614	964854
Thofayim	736634	964870
Thofayim	736678	964821
Thofayim	736744	964808
Thofayim	736698	964880
Thofayim	736618	964977
Thofayim	736360	965052

Table 2- 2: ***Concession Outer Boundary, Lease Exclusion Area & Total Area of Influence***

Eastings (X)	Northings (Y)
765972	969000
771200	969000
771200	965700
776300	965700
776300	961000
772485.4	956300
765972	956300
UTM, WGS 84, ZONE 28N	

(A) MML Total Concession Outer Boundary

Eastings (X)	Northings (Y)
770000	963800
772900	963800
772900	961762
772000	961150
772000	960000
771000	960000
771000	960800
770000	960450
UTM, WGS 84, ZONE 28N	

(B)Area Excluded from Leases (Lunsar Town)

Concession Area	Area (Km^2)
Marampa 1	14.5994
Marampa 2	14.7575
Area 2	8.98652
Thofayim Port	0.438803

(C)The total area of the project Sphere of influence for 32 years

The projected final areas disturbed for mining, waste disposal and tailings are shown in Figure 2-2 below.

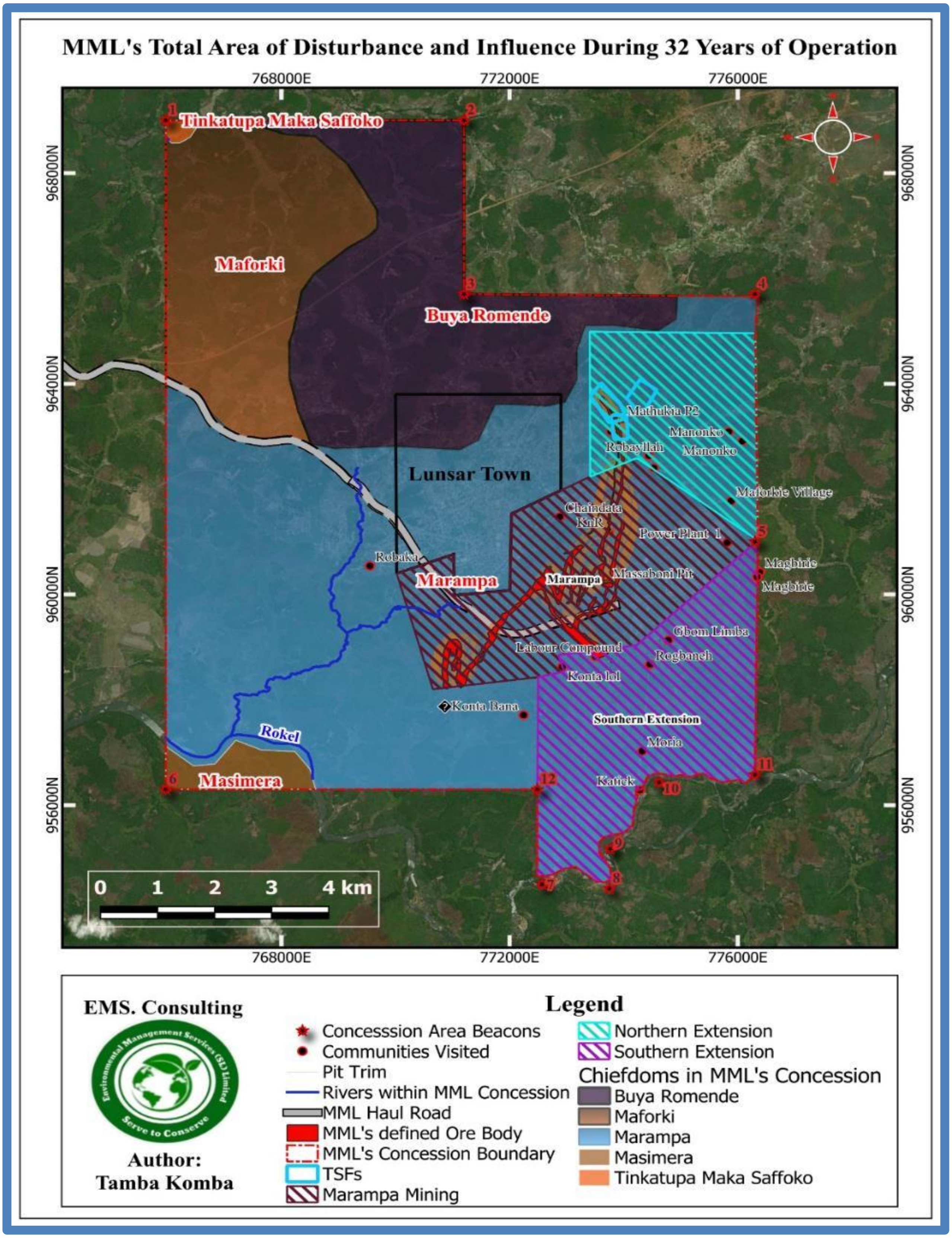


Figure 2- 2: Total Area of Disturbance and Influence During 32 Years of Operation

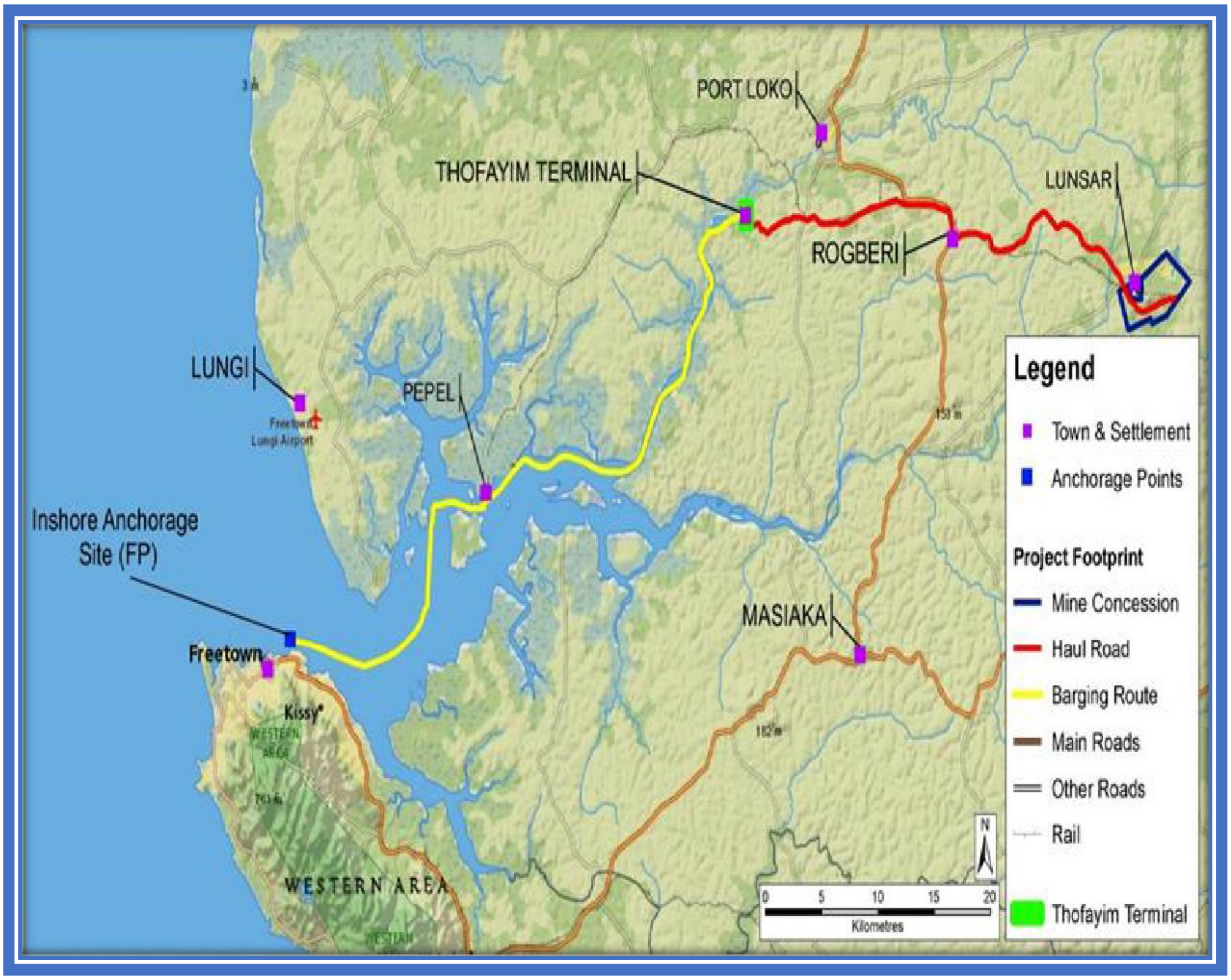


Figure 2- 3: Project Locations in Sierra Leone

2.3 Physiograpgy

2.3.1 Climate

The climate of Sierra Leone is characterised by a tropical and Savanah climate and distinct wet (May – October) and dry (November -April) seasons each year. During the dries, the regions received hot dry wind from the Sahara Desert intermittently between November and March. Average rainfall from historical data is about 1,580mm and temperature ranges from 25 – 32 degrees centigrade with generally low wind.

2.3.2 Topography

The Project area is located within the interior lowland of Sierra Leone. As such it is characterised by relatively flat and low-lying lands and undulating between 40 to 90 in relation to the coastal plains. The topographical variation creates two main drainage regimes within the Area; the majority of much of the concession area drains southwards into the Rokel River and the north of the Project Area drains westward into the Port Loko Creek. The lowland river valleys are characterised by relatively flat profiles with broad floodplains, which are generally waterlogged during the wet season and often used for rice cultivation.

2.3.3 Local Resources

2.3.3.1 Water

Surface drainage within the Project area falls within two river catchments; the Rokel and Port Loko Creek (also called Bankasoka Rivers). The Bankasoka is to the North of the Project area and drains predominantly east to west, before turning southwest where it drains into the Freetown Harbor (also known as the Sierra Leone River) at Tumbu Island. The Rokel is Sierra Leone's largest river originating in the Guinea Highlands, from where it flows southwest, passing in proximity to the south of the site. The flow of the Rokel is regulated by a hydroelectric dam (Bumbuna Dam) which is located approximately 100 km upstream of the concession area.

Local drainage in the Project area is dendritic in form with shallow catchments and poorly defined stream channels within flat-lying wide, marshy flood plains. The three rivers located within the Project area which all drain into the Rokel are the Kagbu, Baki and Bathbana.

2.3.3.2 Groundwater

According to previous studies done by MIOL, the hydrogeological setting of the Project area is characterized by a shallow, weathered zone overlying fresh rock which supports an unconfined aquifer. Groundwater is likely to be present in three distinct aquifer settings: perched aquifers within the surface laterites, the base of the saprolite zone and the major fracture systems within the fresh rock. The dominant aquifer is likely to be the base of the saprolite to the top of the fresh rock zone, supplemented by deeper fracture systems, many of which may prove high yielding.

2.3.3.3 Ecosystem

Previous studies have suggested the Marampa project area especially the current mine concession is a brownfield area with a long history of mining activity which has resulted in low ecological diversity. The southern concession however is largely untouched by industrial activities, human activity (village level) has caused a degradation of ecological diversity. Several ecologically vulnerable species were discovered in the project area. They were clustered along the riparian and gallery forests bordering the southern end of the concession and the Rokel River. These areas are far outside the operational footprint of the mine and are unlikely to be impacted by mining activities.

Studies originally carried out by MIOL about a decade ago established six types of terrestrial habitats in the entire concession; secondary forest/ farm bush mosaic, rice wetlands, lowland forests (which includes gallery forest and swamp forest), flooded natural grassland, and secondary savannah. The predominant habitat types are secondary forest/farm bush and rice wetlands, reflecting the transformed and disturbed nature of the habitats within the concession.

2.4 Current Status

MML intends to expand the existing beneficiation plants to 3.7mtpa capacity. This Project is expected to be complete by 24Q1. The plants were re-started in 21Q4 after approximately 24 months under care and maintenance. Exports of the existing concentrate stockpiles were undertaken. Several ESIA studies have been conducted for previous mining operations (e.g London Mining) historically which contain baseline data which is of relevance to the planned ESHIA.

The current operation involves the use of the following infrastructure.

- Process Plant.
- Waste rock dumps.
- Run-of-mine (ROM) pad to stockpile ore for blending.
- Tailings Storage Facilities (TSF).
- Water pipe and pump station.
- Fuel Farm.
- Mine site camps.
- Water treatment plant and wastewater treatment plant.
- Landfill site and Incinerator.
- Support facilities.
- Administration and general offices.
- Vehicle maintenance area.
- Powerhouse.
- Warehouse facilities.
- Maintenance areas for process plant equipment, electronics etc.
- Concentrate Haulage/Mining Contractor allotments.
- Haul roads.
- Export River terminal.

2.4.1 Current Infrastructure

The Project's infrastructure for Marampa Mines Ltd is summarized below.

2.4.1.1 Marampa

- Phase 1C/1B - Installed 2 crushing and grinding circuits to feed a new spiral plant that facilitates processing and improves recovery rates using gravity separation. This included a process of debottlenecking the existing plant to optimize total production at ~2.2 Mt/y. Note debottlenecking is not completed.
- Waste rock dumps (Chendatha) to cater for ~56.4 Mt of overburden.
- Run-of-mine (ROM) pad to stockpile ore for blending and to cater for wet season periods when mining is inhibited.
- Tailings Storage Facilities (TSF).
- Hospital Swamp – Southern TSF (Full).
- Valley B TSF
- Final capacity is expected to be 15.68 Mt(dry) at 98 m RL maximum height and ~45 Ha.
- Water pipe and pump station on the Rokel River for extracting process and potable

water. This required upgrading the existing road to Katik village.

- A 339-man mine site camp to cater for both construction and operations personnel.
- Water treatment plant and wastewater treatment plant.
- Landfill site and Incinerator.
- Support facilities.
- Administration and general offices.
- Utilization of the old service area for vehicle maintenance.
- A 15MW powerhouse using 10 Hyundai Himsen 9H21/32 packed power station units each rated at 1,710 kW (electrical) but de-rated to 80% of nameplate capacity.
- Some concrete bunded fuel farm of 234,000 L capacity (main plus reserves) is located next to the powerhouse.
- Warehouse facilities.
- Maintenance areas for process plant equipment, electronics etc.
- Concentrate Haulage/Mining Contractor allotments.
- The old railway right-of-way was converted into a haulage road. This extends from the mine site to just north of Lunsar town.
- A 48km long haul road from the mine concession area to Thofayim. The eastern section was built following an existing Sierra Leone Road Authority

- dirt road.
- The current 1A process plant is on care and maintenance.

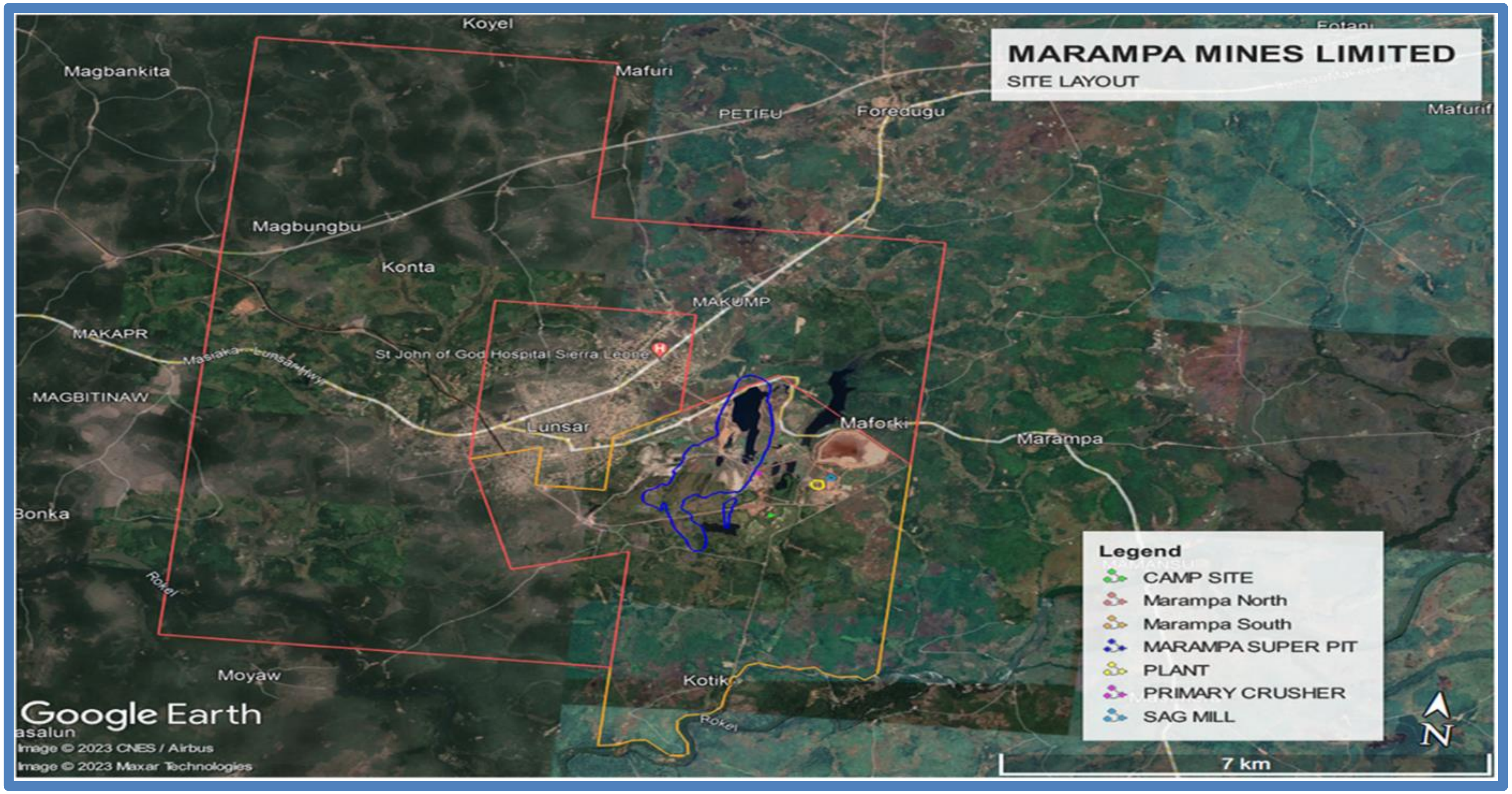


Figure 2- 4: Marampa Mines Facilities

2.4.1.2 Key Marampa Infrastructure

1. Process Plants, Power Plants, weighbridge, plant offices and engineering workshops.
2. Work camp (accommodation facilities for 360 people), water treatment plant and sewage treatment plant.
3. Mining contractor laydown area.
4. Haulage contractor laydown area.
5. Administration (general offices), clinic and infrastructure workshop.
6. Geology lab, junior staff canteen, fuel farm and warehouse.

2.4.1.3 Thofayim

At Thofayim River Terminal area (TRT), the following project components are present:

1. MW of power generation with 52,000L bunded fuel tank, small (5,000 L) fuel dispensing area for mobile plant, basic offices, accommodation for 33 people, messing facilities and shedding for maintenance, water treatment and wastewater treatment plants.
2. Waste rock dump and dredge spoil storage areas.

2.4.1.4 Port

The existing Thofayim River port facility will be utilized to barge concentrate for Marampa M3.75 mdtpa, before it is loaded onto ships for export. The materials handling systems can support the Marampa 2 and then 3.75 mdtpa. As MML expands from 3.25 mdtpa to 3.75 mdtpa, and the TRT facility is still used in transit, MML may have to refer to its 2019 Dredging Management and Monitoring Plan prepared by Environmental Management Ventures.

2.4.1.5 Roads

The Marampa Project roads are mostly un-sealed, laterite-surface dirt roads apart from an approximately 1km concrete section of the haul road in the process plant area.

2.4.1.5.1 Site Roads

The site roads are currently all un-sealed, laterite-surfaced dirt roads. They are requiring continuous maintenance throughout the project. Laterite material is available in abundance from earthworks excavation for use in road maintenance. Plant roads will comprise 6.0 m wide gravel roads with a 0.5 m shoulder and a minimum cross fall of 3%. For safety purposes approved guard rails/barriers have been allowed for on fills greater than 1.5 m in vertical height.

2.4.1.5.2 Concentrate Road Haulage

The 46km laterite haul road is considered adequate for 3.25 and 3.75 mdtpa production rate of Marampa and no changes to the haul road route are expected. Several borrow pits were used during Phase 1 (a total area of approximately 15 ha) to source laterite and will continue to be used for Marampa 3.25-3.75 mdtpa. Maintenance on the haul road is conducted at regular intervals.

2.4.1.5.3 Mine Access Roads

Access roads will comprise 6.0-metre-wide gravel roads with a 1.0-meter shoulder with a minimum camber of 3%. Three access roads have been identified as follows:

- **Road A** will run southwest from the existing main access towards the Chendata Waste Dump and partly along the base of this waste dump. It will continue southward within the greenfield area where it connects to an existing road. This existing road extends to an existing intersection where all three roads meet. Road A is set at an approximate length of 3.4 km.
- **Road B** will run from the southern boundary of the site along green fields areas, over an existing bridge which crosses the existing haul road and connect to the above intersection. Road B is set at an approximate length of 1.1 km: and
- **Road C** will run from the existing plant parallel to the existing haul road where light and heavy vehicles will be separated by an earth berm. It then branches off and connects to the above-mentioned intersection. Road C is set at an approximate length of 2.7 km. The total approximate length of mine access roads is 7.2 km.

2.4.1.6 Buildings

Administration and general buildings on site are mainly refurbished remnants from historical operations, and of solid construction. There are sufficient buildings to cater for Marampa M3.75 mdtpa construction and initial operational needs, and most are serviced by full utilities including air- conditioning. The administration complex is well laid out and there is sufficient space for all the major departments, housing all levels of management and support staff. The core administration buildings are centralized and provide easy inter-departmental access and collaboration.

Construction contractors will provide for themselves all the buildings they require within the scope of their respective contracts, including offices, workshops, stores, etc. Accommodation is expected to be allocated from within the current camp arrangements.

The Mining contractor will provide for themselves:

- Suitable administration offices.
- Mobile plant workshops.
- Wash bays.
- Oil traps.
- Lubrication and tyre management systems; and
- Suitable truck-mounted mobile workshop units.

2.4.1.7 Accommodation

The existing camp, a combination of refurbished masonry structures, remnants from historical operations and modular prefabricated units caters for 4338 beds. A new 50-bed facility is coming online in 2023 and will have a life of 15 years. Further camp replacement projections have been made for 2040 and 2055.

As required in the future, new camp facilities will be constructed as replacement capacity. Expected camp occupants are tabulated below. The future replacement buildings will be of the prefabricated type and building materials resistant to mould will be used. The following facilities shall be included:

- Camp administration office.
- Camp reception; security; fencing; access control; gatehouse, internet communications
- Camp maintenance workshop, store, and fenced compound.
- Catering: Kitchen, food store with goods receiving, bakery, waste oil traps.
- Restaurant.
- 2 off Kiosk – no seating or cooking arrangements – one located at the camp, one located at the production plant.
- Bar.
- Recreation facilities, e.g., clubhouse, gymnasium, snooker; Laundry.
- Camp first aid / medical clinic and/or emergency response/fire services.
- Light vehicle car park.
- Bus shelter and boarding / disembarking area.
- Incinerator and composter.
- Waste disposal area; and
- Camp services: Power, potable water (storage and reticulation), sewage (reticulation, treatment plant and disposal), stormwater control – complete.

The existing 20-man camp will continue to be used at Thofayim and will be expanded incrementally as needed.

2.4.1.8 Workshops

The Processing Plant workshop is being upgraded for Marampa M3.75 requirements. The Construction workshop for M3.75 is being constructed after which, maintenance will take over. The mining contractors will need to expand their workshop facilities. If the mining fleet is owner-operated the mining department will improve the workshop facilities as they see fit.

2.4.1.9 Power Generation

A power generation study was undertaken in 2012 to determine the optimal power generation solution in terms of the preferred type of fuel, generation plant configuration, location of the generating plants and lowest cost of generation. Based on these criteria, medium-speed reciprocating engine-generator sets were selected.

The Phase 1 power generation capacity consists of 10 x 1.7 MW units. The existing Phase 1 power plant will be used to supply power to existing equipment for the current Marampa 2 and then integrated into the Marampa M3.75 mdtpa infrastructure. New loads will be added to the Phase 1 power plant for Marampa M3.75 to ensure that the Marampa 1 power plant runs at optimum capacity.

2.4.1.9.1 Power Supply

Total new installed power will have a capacity of approximately 27 MW. On–site generation is to be done using medium-speed reciprocating engine generators. The running load requirements for the Marampa Plant, offices, and accommodation camp total approximately 23 MW.

The Phase 1 residual load and the Thofayim river port will each have their localized power plant with no transmission infrastructure connecting them. A provision has been made for this interconnection in the future.

2.4.1.10 Fuel Supply

Fuel will be delivered by road tanker to the Marampa storage tanks. The consumers of fuel on the Marampa site are the power generation plant, the mining fleet, the tailings disposal fleet, and the general-purpose vehicles. Diesel fuel from the Marampa bulk storage tank is pumped directly to the Marampa power generation plant day tanks. Each generator is equipped with its day tank. Site storage capacity for diesel might be increased. Diesel from the Marampa bulk storage tank is distributed to a refuelling station with bays for general-purpose light vehicles, earthmoving equipment, and trucks, and to a separate fuel station provided for filling tanker trailers, Rubber tyre vehicles such as mine haul trucks, the fuel/lube truck, etc.

2.4.1.11 Water Supply

The existing potable water treatment plant at Marampa will require refurbishment to expand capacity to cater for Marampa M3.75 water needs. Distribution from this plant to new Marampa M3.75 facilities is included. The existing water treatment plant also has adequate capacity to cater for the peak manning complement during construction and mining. The two existing treatment units at the plant have a combined capacity of 400 m^3/per day, which is sufficient to cater for the total requirements. A reservoir capacity of 330 m^3 will provide storage for approximately 1.5 days, which is following common practices.

The main consumers of potable water are the administration offices, workshops, camps, gland seal water, safety shower and eyewash stations. A site-wide raw water balance was prepared by SRK in 2013. The main conclusions from the water balance can be summarized as follows:

- The average monthly water pumped to the Plant from the Ghafal pit during the wet season ranges from 1,000 m^3/month to 290,000 m^3/month between year 1 and year 20 of the pit life.
- The average monthly water pumped to the plant from the Masaboin pit during the wet

season ranges from 200,000 m^3/month to 950,000 m^3/month between year 1 and year 42 of the pit life.

- All runoff within the open pits will flow into the in-pit sump located at the lowest point within the respective pit. The runoff within the sumps will be pumped to plant storage.
- Make-up water during the wet season is not required for the plant.
- Make up is required from December to April 1 to year 3, and thereafter between December and March for the rest of the mine life.
- Monthly makeup water requirements for the dry season range from 150,000 m3/month to 260,000 m3/month between year 1 and year 50 of mine-life.
- All the decant water collected by the tailings storage facility (TSF) will be pumped to the plant storage.
- Storage facilities constructed at the waste rock dumps will collect the runoff. The collected runoff will be pumped to the plant; and
- Excess water from the plant storage facility will be discharged to the river when the capacity of the storage facility is exceeded. Silt traps and monitoring ensure water quality for discharge. The existing water supply from the Rokel River or Bathbana Creek will be utilized with low, intermittent utilization.

2.5 Project Expansion – Marampa M3.75 mdtpa Infrastructure and Support Services

The general approach to the addition of supporting infrastructure is that the current infrastructure will be utilized, and where necessary additional infrastructure will be built or existing infrastructure upgraded to support the additional mining and processing facilities specific to the project, at the time when such facilities will be required.

2.5.1 Mining Core Shed

Building necessary for core storage, impact on the environment PAD creation of 50 m x 25 m in ensuring the smooth running of the Marampa Mine project expansion. This scope of works refers to the construction of a new core storage facility in the proposed suitable construction site close to the current Mining Office for the intended purpose referred to as Core shed Building. This new superstructure is to be furnished with Core storage stack bay, core logging table with core angled bar bay, core cutting room and toilets facility with an office space to be provided and one septic tank will be created.

2.5.2 MCU Office

To ensure that warehouse staff be centralized in one office building outside of the main Warehouse store. This will allow for less crowding within the warehouse and reduce the risk of loss. Existing offices in the Warehouse are too small and will therefore be broken down. This will create more space in the receiving and issuing bay. Allowing for the area to be divided into bays ensuring an orderly and structured storage in the receiving bay as well as the issuing bay. This should lead to a more efficient warehouse process. The intention is to change the Warehouse from a reactive to a pro-active structure whereby Work Order are picked-and-packed and staged prior to the end-user collecting the material. There will be minimal impact on the environment because the company will used existing slabs for this building and superstructure.

2.5.3 Toyota Garage phase 2

After the Phase 1 completed concerning the refurbishment of the building Slab and Roof, the SOW is to define the method and different tasks and works that must be done for the building to be used like a standard Toyota workshop for light vehicle maintenance on site as per the Toyota standards.

This building will realize an upgraded for maintenance as define below:

1. Light Vehicles – passenger vehicles, plus light ancillary vehicles, such as bobcat, telehandler, forklift

2. Heavy Vehicles – Mine/Heavy Movement Machinery, such as ADTs, Excavators, Dozers, FEL, Graders

3. Medium Vehicles – Haulage Trucks, load trucks (Water, fuel bowsers, fire, sewage), heavy lifting equipment (cranes, hiab), Light Movement Machinery, such as Backhoe, Tractor.

2.5.4 TSF Tails Pumps M3.75

To upgrade Valley B TSF for M3.75, the company must install new pumps for feeding into the TSF expansion. Impact on the environment 28,000 m^2 of the bush has been grubbed and cleared.

2.5.5 Engineering Workshop

The aim of the project is to provide a safe and secure working and storage facility for plant maintenance department to support plant process. Each contractor shall be tasked to provide the listed concrete structures, erection of buildings, provision of all personnel access doors within the steel containers, safety staircases, handrails, ablution, and the refurbishment of the containers to a variety of designs.

The excavation and construction of a permanent septic tank system shall be included, along with all the necessary piping, plumbing, waste disposal and comfort rooms (toilets).

Installation of power cables will be done by MML. The tasks and facilities listed within this document shall be priced as one package. The site will be visually inspected by the contractor accompanied by an MML representative. Alternative solutions to the suggested package will be considered, without compromising the aim of the project.

2.5.6 Camp Sewage Plant Upgrade

MML Sanitation facilities facing the following challenges: -

1. The present water treatment plant can treat water equivalent to One Day consumption only (The ideal should be minimum 3 days reserve for contingency situations). Average 192,000 Litre treated per day – Average 182,000 Litre Consumed Per day.

2. The filters, aeration, and biological components of the current sewage plant need refurbishment but the shutdown of the plant for any possible maintenance is not possible in the absence of a standby sewage plant.

3. No Retention Weir in the current plant for final sedimentation & UV treatments before discharging the water into the environment.

4. The current sewage capacity of 500 PE needs to be raised to 700 PE with even a 30% increase in workforce.

5. The current grey water collection pits are too small and overflowing and the water is just pumped out of the camp into the environment without any system of treating / purifying physically / biologically.

6. Reduce the influent and effluent with the target below with installation of RBC system.

2.5.7 TRT Fuel Farm Fire Barrier

The objective of this project to raise the height of the existing provide adequate fire protection for the Fuel Farm. The construction all relevant construction designs, codes, and legislation.

2.5.8 Valley B TSF Penstock Remedial Work

The purpose of this project is to outline a Scope of Work for the filling of the centre penstock ring at Valley B TSF with grouting. The remedial work is required to ensure that decant water from TSF is not polluted with tailings and reducing water clarity.

Penstocks are concrete rings that fit on top of each other to form a tight seal allowing for water to seep through but retain courser tailings material. These penstock rings are stacked in horizontal position. Any movement of these concrete rings will break the seal and allow courser tailings material to drain with the decant water.

The Final take off point for the Valley B TSF consist of three penstocks discharging into one drainpipe. This drainpipe ensures that water being decanted from on top of the TSF, is discharged safely towards the Copper dam that is situated towards the West of the TSF. The centre of the three penstocks, have displaced and is leaning over towards the side. This movement of the concrete penstock breaks the seal resulting in tailings material reporting with decanted water. Remedial work is required to seal the gap created in between the dislodged penstock rings.

2.5.9 Magberie

The objective of this Scope of Work is to develop a Resettlement Action Plan (RAP) associated with the relocation of the ROM PAD houses of the Magberie community. The RAP to be developed will detail the relocation program to move three (3) households. The new homes to be built will each contain two bedrooms, an outside kitchen, and a pit latrine with one drop hole for each house. The community structures that are to be reconstructed in the new location include a water well and a Mosque. The CR&D team will engage the project affected persons (PAPs) of Magberie to establish their buy-in to be relocated and to capture their input and preferences for the process. This community engagement process will inform MML's proposal that will become the formal agreement between the community/PAPs and the company to execute the relocation program activities. The CR&D team must ensure that all community engagements are documented. Very often simple restoration of livelihood may be insufficient to protect affected persons from adverse impacts, especially induced effects, such as competition for resources and employment, inflation, and the breakdown of social support networks. Therefore, MML intends for its resettlement project to result in measurable improvements in the economic conditions and social well-being of affected persons and communities.

In addition to the RAP preparation itself, the most critical objectives of the project will be to complete the due diligence, assessments, and pre-planning for the relocation project, all aligned with IFC standards (see methodology section below), such that the subsequent implementation of the RAP is as seamless and integrated with the primary host community's interest as possible.

2.5.10 Maforki

Much larger than the Magberie/ROM Pad resettlement project, the northern extension of the Valley B TSF will require MML to relocate 618 people/60 houses. Using the same care and IFC PS 5 standard operating principals and procedures, CR&D informed the village at a community meeting that MML has intentions to relocate them on August 9, 2023. Development of the RAP will begin imminently.

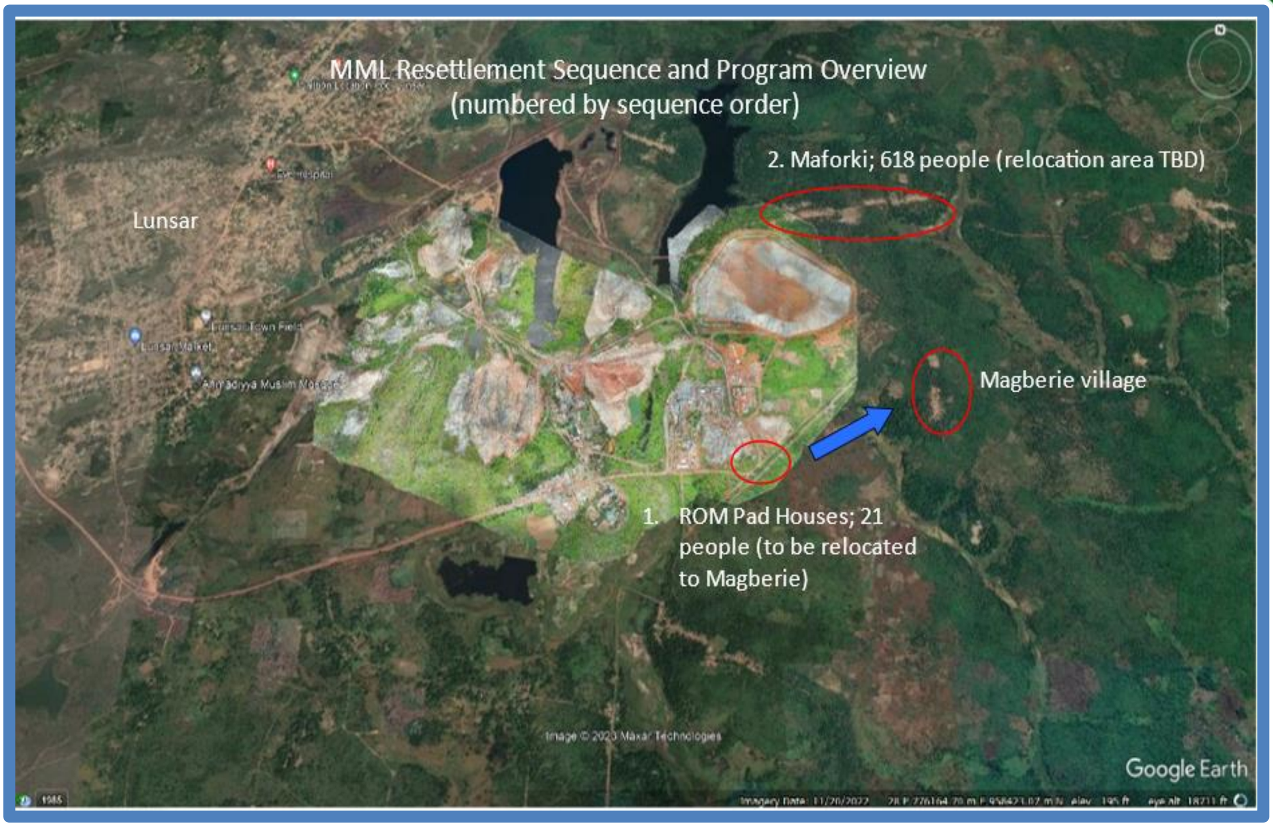


Figure 2- 5: MML Resettlement Sequence and Program Overview

Figure 2- 6: MML M3.75 Infrastructure Register

2.6 Mining

2.6.1 Mining Concessions Features

The mining concession area comprises inland valley swamps, the Masaboin and Gafal Hills and interfluves of variable heights. The Bathbana and the Baki and their tributaries, being the main streams within the concession boundary, comprise the catchments draining the area. The hills and valley swamps within the area have been largely altered by previous iron ore mining activities so that the hills portray terraces with sparse grass cover, while the swamps reveal streams with hampered flows.

The mining concession area can mainly be accessed through mostly rough and rugged laterite roads and motorable tracks branching off from the well-constructed tarmac highway leading from the town of Lunsar. The unpaved secondary roads and tracks generally form links to the sites of the various settlements.

Further, accessibility into the interior of the surveyed project area is possible mainly by footpaths and traverses. Where streams cut across the road network, bridges and/or culverts have been constructed to connect the settlements but sometimes, going through the valley on foot is the only access to get from one landform or habitat to the other.

The jetty site is in the Maforkie Chiefdom, Port Loko District in the Northwest Province of Sierra Leone. The site is located about 12km southwest of Port Loko town, at the settlement and environs of Thofayim located on the banks of Port Loko Creek. The jetty site at Thofayim and its environs comprise inland valley swamps, interfluves with low to moderate heights, and the Port Loko Creek which is bordered by mudflats characterized by a gallery of mangrove vegetation. The jetty site is accessible by a very rough and rugged motorable track about 7.5 miles (12km) from Port Loko in a south-westerly direction to the settlement of Thofeyim. The mining and processing operations as well as shipping operations are key for MML. The facilities are in the lease areas in Marampa and Thofeyim.

Apart from the facilities needed for the main operation, the mine is supported by several other departments and their facilities. These include but are not limited to power generation, engineering, work camp, purchasing, administration etc.

A mine like MML in a developing country like Sierra Leone is like a township and must be self-sufficient with most of its facilities.

2.6.2 Currently Identified Iron Ore Deposits

The currently identified ore bodies in the Marampa concessions comprise the following:

- The Marampa main ore body comprises Massaboin Hill and Massaboin Northern extension
- Matukia
- Ghafal
- Rotret
- Mafuri

The location of these ore bodies relative to each other is shown in Figure 2-7. The Marampa main ore body comprises several defined areas as shown in Figure 2-8.

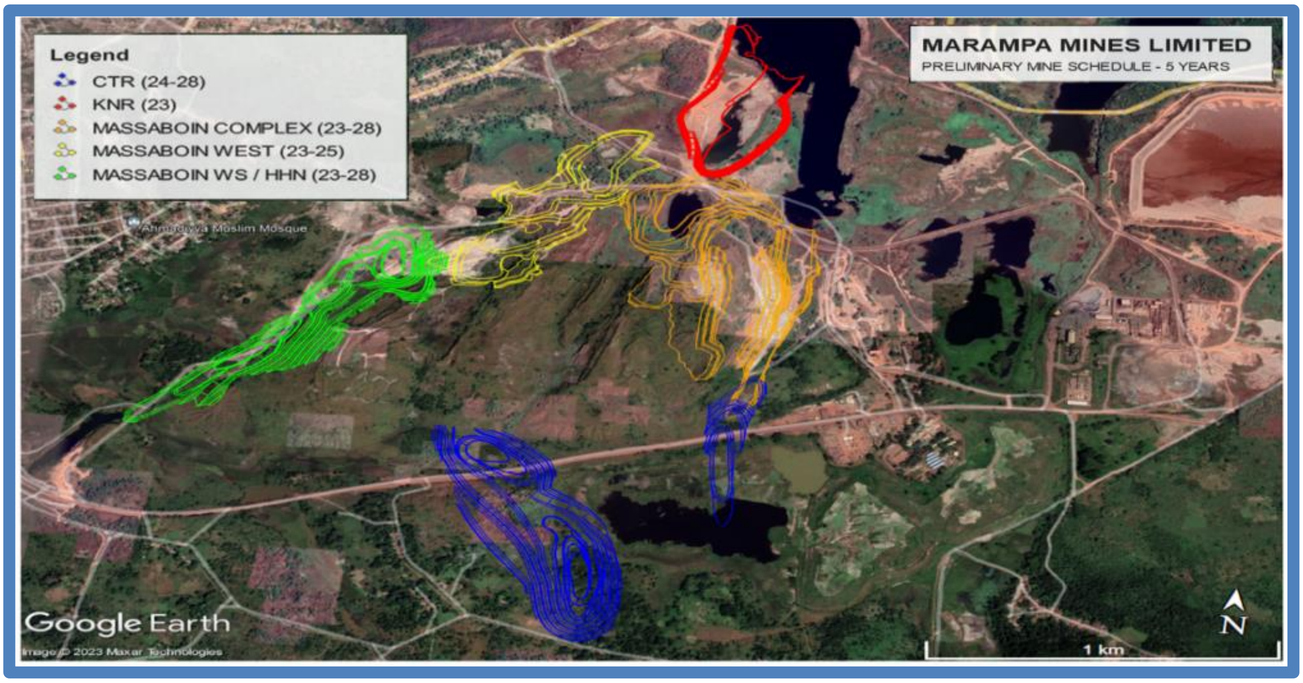


Figure 2- 7: Marampa Iron Ore Deposit by Pit Locations

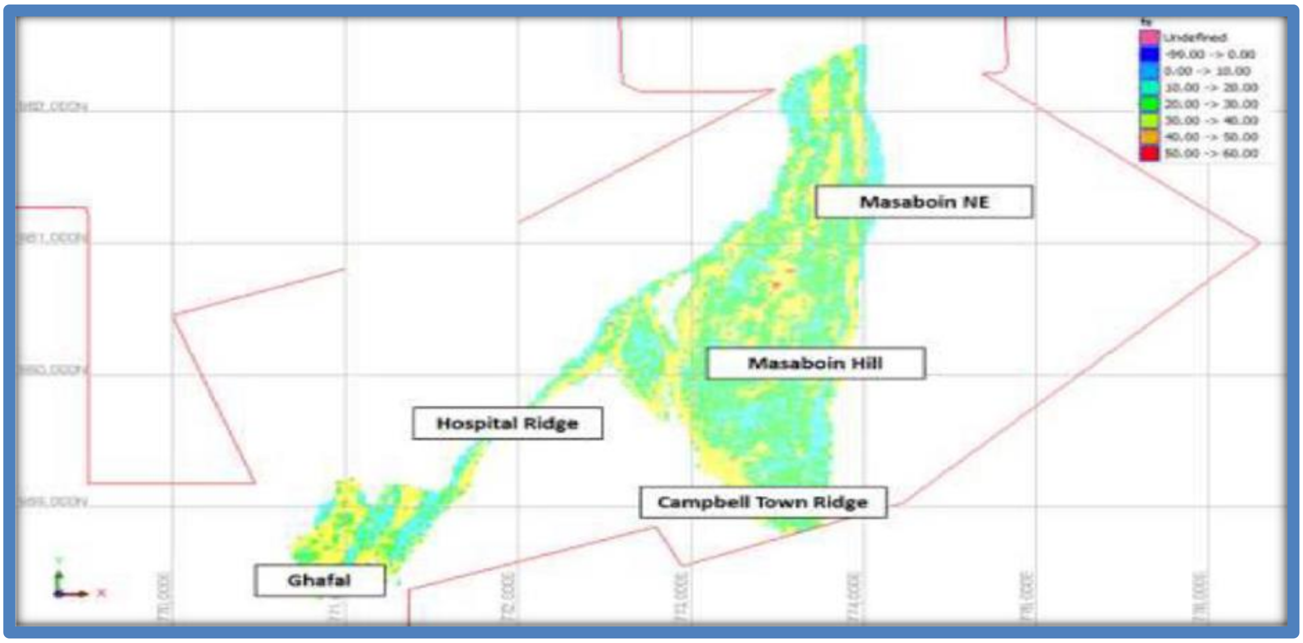


Figure 2- 8: Marampa Ore Body as per defined areas with estimated Fe Grades category.

The mine planning for this ESHIA is based on mining the main Massabion central complex, KNR, Massaboin west, Marampa super, Massaboin west – south hospital and CTR ore bodies as shown in Figure 2-9. The plan that the studies and this ESHIA carry is based on mining and processing the ore at a rate of approximately 10.5 million tonnes per year for 30 years, producing an average of 3.75 million dry tonnes per year of concentrate.

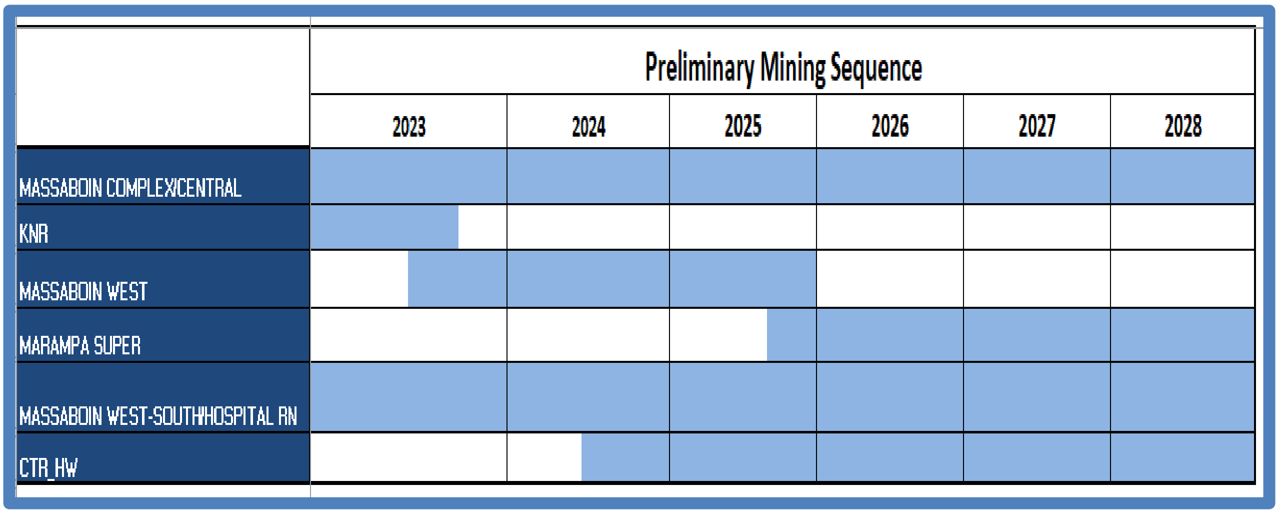


Figure 2- 9: 5-year Mine Sequencing

2.7 Project Status

A Definitive Feasibility Study (DFS) led by MICON with input from Zenito and EPOCH has been completed in Q2 2022. The Mineral Resources for the Marampa Project are detailed below in Table 2-3 and Figures 2.-10.

Table 2- 3: Marampa Project Mineral Resource

Resource Category	Weathering	Tonnage (Mt)	Iron Grade (Fe%)
Indicated	Canga/Laterite	15	23.78
	Highly Weathered	43,424	32.61
	Moderately Weathered	73,306	31.45
	Unweathered	940,349	29.93
Sub-Total		1,057,095	30.15
Inferred	Canga/Laterite	21,513	28.12
	Highly Weathered	61,678	30.55
	Moderately Weathered	40,650	29.83
	Unweathered	462,970	26.78
Sub-Total		586,812	27.44
Total		1,643,907	29.18

Mining for the Marampa M3.75 project at the Marampa Mine will involve around 17.5 mdtpa, earth movements a year with 10.5mt moved to the ROM (Run of Mine) stockpile for feeding into the process plant and 7mt moved to waste stockpiles over a life of mine of 100+ years.

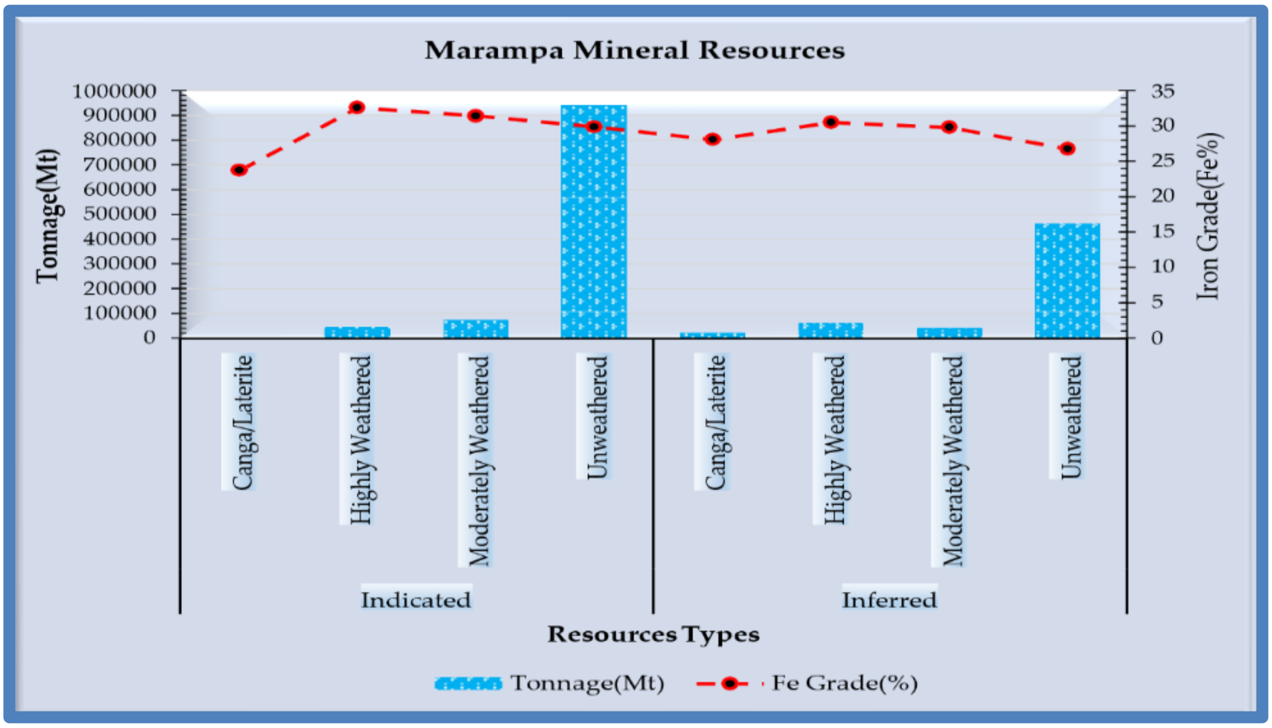


Figure 2- 10: Visual Display of Marampa Project Mineral Resource

2.7.1 Production Concept

The base case for the project involves contract mining with a suitably qualified and experienced world-class mining contractor. The mining contractor drills, blasts, loads and hauls rock out of the open pits to designated ore and waste destinations, according to Marampa Mines's defined short-term mine plans. Ore and waste are mined in bulk using large shovels (15-20 m3 bucket) and haul trucks (120, 150 t capacity). Contractors are and will be responsible for all aspects of the drilling, and blasting operations, including the mobilization and management of the explosive's magazine and explosives, import to such magazines. This will be achieved by partnering with a specialist subcontracting explosives supplier. This concept may change to owner operated with specialist contractors employed for certain fields e.g., drill and blast at the discretion of management. Grade control procedures ensure that the ore and waste tons are separated from each other to minimize ore losses and dilution, under the supervision of MML. The ore is hauled primarily to the ROM tip, or to the wet season stockpiles. The operation is planned to increase production during the dry months and build an ore stockpile adjacent to the concentrator feed bin. This stockpile is then loaded into the feed bin during the wet season to maintain constant production through the concentrator. The waste is hauled to the nearest waste dump or backfill area.

2.7.2 Drill and Blast Parameters

The mining contractors or specialist drill and blast contractor will be responsible for all blasting activities, including the import, transport, storage, and use of explosives as well as blast design.

The contractor will also be responsible for all training of personnel.

Blasting will be required to loosen the primary ore prior to excavation. Table 2.3 lists the typical blast designs; a blast pattern that meets a fragmentation of 80% passing 400 mm will be used. For a 12 m high bench, production blast holes will have a diameter of 203 mm and be 13.4m deep.

The loaded explosives will be charged using primers and firer using millisecond delays and non-electric detonators. Stemming will be used to contain the blast (Figure 2-11).

Table 2- 4: Drill and Blasting Parameter

Type	Diameter (mm)	Maximum Depth (m)	Burden (m)	Spacing (m)	Drilling/day (h)
Buffer holes	165	13.4	1.7	1.7	16.5
Primary Ore	203	13.4	4.7	5.6	16.5
Primary Waste	203	13.4	5.0	6.0	16.5

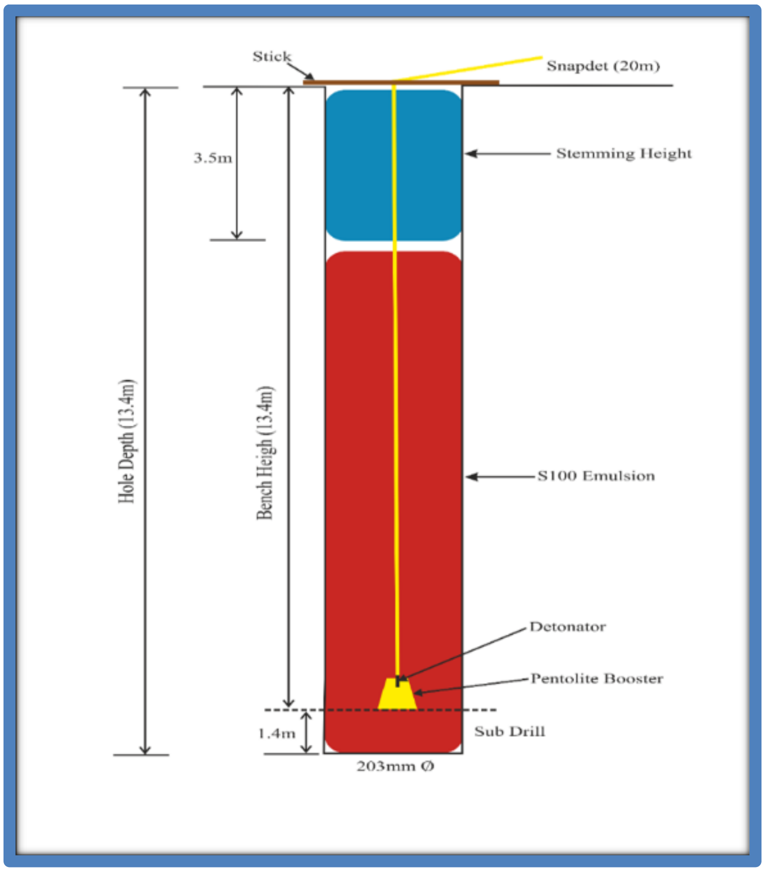


Figure 2- 11: Typical Blast Hole Charge Showing Stemming

The basic procedure for blasting operations is:

- Each blast design is prepared by the Drill & Blast Engineer. The design includes drill hole patterns, spacing, hole depths and stemming height. A blast design software package will be used to determine the ***appropriate*** explosive per hole and the optimum detonating sequence to achieve acceptable fragmentation while minimizing adverse environmental impacts such as ground vibrations and air blasts.

- Drilling of the blast holes will be supervised by the Drill & Blast foreman to a pre- surveyed pattern. Once drilled, the holes will be checked for accuracy, and then charged as per the blast design and stemmed.
- Once the blast has been fully charged and connected, a final check will be carried out to ensure compliance with the design.
- All potential accesses to the blasting site will be identified and, prior to blasting, these routes will be closed off to prevent unauthorized access. Guards will be equipped with a radio; through which the Drill & Blast foreman confirms all is secure before detonating the blast.
- To keep the public and employees informed of the blasting Programme, permanent blasting notice boards will be located at strategic locations around the pits and blasting areas, and in the community, on which are given details of the time and location of all blasts in the next 24 hours. A siren will also be sounded once charging is complete and 10 to 15 minutes immediately before the detonation of the blast.
- A 500m safety exclusion zone will be maintained around the blast area to minimize risks.
- Blasting will only occur between 10h00 and 16h00, with 2-4 blasts required per week.

Two types of explosives will be used: emulsion S100 and Magsplit Cartridges. The emulsion has waterproof properties which will be required especially from May to November during the wet season. The Magsplit will only be required for buffer holes (see Figure 2.9 below).

Approximately 7,200 t of emulsion are expected to be used per annum. Using emission factors from the Australian Government Dept. of Climate Change (National Greenhouse Accounts (NGA) Factors 2008), explosives use will generate in the order of 1,224t of CO_2. (Note: emission factor of 0.17 for emulsion). All explosives will be stored in an industry- standard magazine that complies with Sierra Leone Regulations and security requirements. Table 2-5 below summarizes the blast pattern characteristics and Figure 2-12 illustrates the difference between production holes and buffer holes.

Table 2- 5: Blast Pattern by Bench Height and Explosive

Description	Ore	Waste
Explosive Type	Emulsion S100	Emulsion S100
Explosive RBS	154	154
Bench Height (m)	12	12
Sub Drill (m)	1.4	1.4
Stemming Height (m)	3.3	3.5
Burden (m)	4.7	5.0
Spacing (m)	5.6	6.0

Volume/hole (m^3)	316	360
Tons/hole	1,010	972
Explosives/hole (kg)	392	385
Explosives Density (kg/m^3)	1,200	1,200
Powder Factor (kg/t rock)	0.33	0.34

Figure 2-12 is a typical Blast Hole Drilling Pattern showing the difference between buffer and production holes.

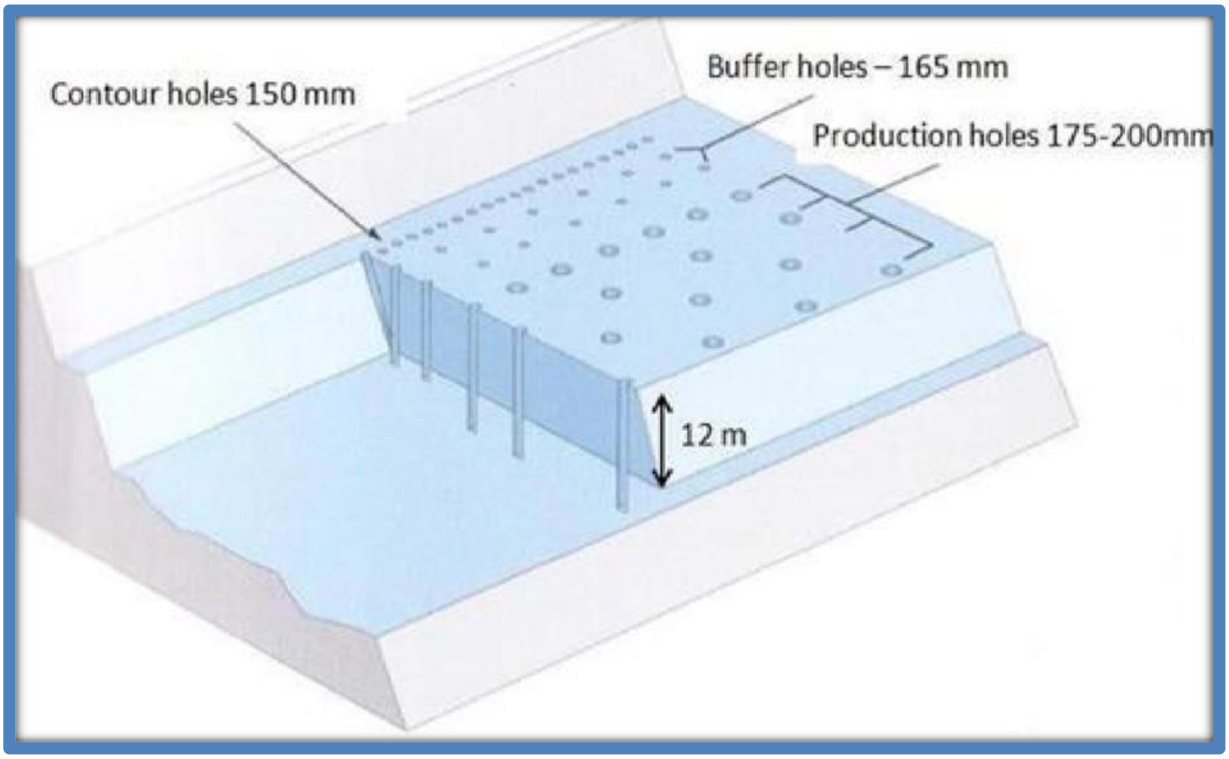


Figure 2- 12: Blast Hole Drilling Pattern

2.7.2.1 Buffer holes

Figure 2-12 above, a prototype Blast Hole Drilling Pattern showing the difference between buffer and production holes. MML's contractor will drill buffer holes (also referred to as pre-splitting) along the toe of the pit wall to minimize the transmission of vibration related to blasting. Buffer holes are drilled slightly farther apart and are loaded very lightly (i.e., 8% to 12% of full load) and fired before the main blast. The light explosive charges propagate a crack between the holes creating an artificial discontinuity along the final excavation line. In badly fractured rock, unloaded guide holes may be drilled between the loaded holes. Magsplit cartridges will be used for this at a powder factor of $1kg/m^2$.

Due to the reflection of the shock waves from the main blast by the shear plane created by the buffer holes, the stability of high-wall slopes is improved. This enables pit walls to be steeper, thereby reducing the waste rock being mined and the overall impact footprint (Figure 2-13).

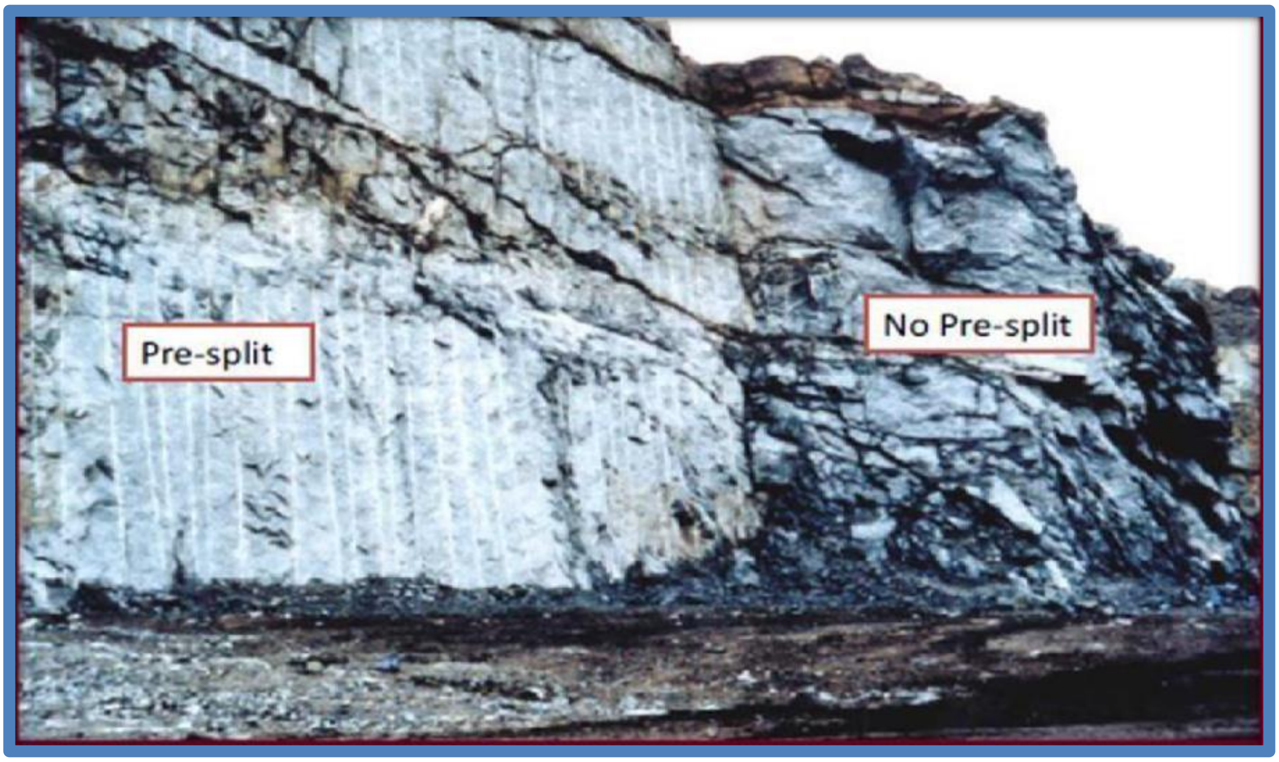


Figure 2- 13: Comparison of a Mine Face with and Without Buffer Holes (Pre-Split)

Ground vibrations are also reduced by up to 30% of that produced by normal blasting. In large open cast blasting, the use of buffer holes is the most suitable method for controlling the intensity of ground waves resulting from the blast from propagating outside the blast zone, thereby protecting surface structures.

2.7.2.2 Waste Dumps

All waste material will be dumped at the nearest waste dump to minimize haul distances. Backfilling of pushback will occur as soon as possible during mining operations, commencing in the northern part of Massaboin Northern Extension (MNE).

There will be two waste dumps located on the surface within the boundaries of the original concession area named Chendatta (already created) and Konta. The waste capacity for Chendatta waste dump is 43 million m^3, while the capacity of Konta waste dump is 81 million m^3. Pushbacks 1,2 and 3 will dump waste on the Chendatta dump while pushbacks 10 and 11 will deposit waste on Konta dump. After Chendatta and Konta are filled, backfilling will commence in Pushbacks 1, 2 and 3 (MNE mine area).

2.7.2.3 Processing

This report provides the process flowsheet and plant description of the Marampa 2 followed by the Marampa M3.75 processing plant. The Marampa 2 project will utilise the phase 1C and 1B processing plants with some rearrangement of the process flows. Phase 1A plant will remain on care and maintenance indefinitely.

The Marampa M3.75 plant will then integrate the spirals and magnetic separation circuits of the Phase 1B and 1C plants with the further addition of new crushing, milling, classification, spirals and regrind circuits. The Phase 1 plants will be upgraded to include two additional rougher and cleaner spirals per bank, a new re-cleaner slon circuit, additional rougher spirals banks in 1B plants and a new horizontal vacuum belt filter. The integrated plant will process a combination of primary ore and weathered ore to achieve an annual production of 3.75 Mt(dry) of 65% concentrate product.

2.7.2.4 Marampa M3.75 Flow Sheet

The flowsheet developed for Marampa M3.75 does not incorporate any new, unique, or special technologies. The selected processing flowsheet for the Marampa M3.75 project is a comminution circuit consisting of one stage of feed crushing and an 8 MW twin-pinion gear-driven SAG mill to liberate the iron values before the gravity and magnetic concentration circuits. The mill product will be processed in spiral and WHIMS circuits of the plant; all of which will be upgraded to achieve the target production of 3.75 Mt/y.

The scale of operation is well proven with the best example being the Phase 1 plant which was capable of 3.25 mdtpa of product. The proposed processing flowsheet for Marampa M3.75 consists of the following:

- A ROM feed stockpile of blended weathered and primary ore ahead of the primary crusher to be used as buffer capacity during the rainy season.
- Gyratory crusher to reduce ROM ore to a P95 of 150 mm.
- Intermediate crushed ore stockpile with a live capacity of 6 hours.
- SAG milling (SAG) for the crushed ROM ore feed. The SAG circuit will incorporate the removal of scats larger than 9.5 mm from the SAG discharge with a screen located above the sump. Oversize scats will be dumped onto a stockpile and will be discarded at a designated disposal facility. Contents of the mill discharge sump will be pumped to classification screens to produce a mill product with a nominal top size of 500 μm and overall sizing specification of P80 at 250 μm while classification screens are conveyed back to the SAG mill feed.
- Dewatering of the spiral's feeds using the classification and desliming cyclone concept. The underflow from the classification and desliming cyclones will be adjusted to achieve 35% to 40% w/w solids for feeding to the spirals plant. The cyclone design will aim to limit iron losses in the desliming cyclones overflow to particles less than 15 μm nominal diameter.
- Open circuit cobbing of the classification cyclone and desliming cyclones underflow in the Phase 1C spirals plant which will be upgraded to include a re- cleaner circuit. The specification to use spiral gravity concentration is aimed at using simple technology to maximize the rejection of alkali deleterious elements (K and Na) and to minimize iron losses. The spiral circuit product grade is to be at the concentrated target of 65% iron.
- Magnetic separation of the milling product and spiral middling using high gradient and

pulsating magnetic separators (VPHGMS), which is more commonly known as “SLons”; in a cleaner and cleaner scavenger/rougher configuration. The Phase 1B magnetic separation plant will be integrated and utilized in Marampa M3.75 with upgrades to each plant to include rougher spiral banks with concentrate regrinding using a ball mill.

- Dewatering of the final concentrates from the spirals and magnetic separation circuits to ≤8% moisture, on average, by filtration on the belt filter units.
- Dewatering of plant tailings using Phase 1 tailings thickeners.
- Disposal of the dewatered tailings at the tailing’s storage facility; and
- Provision of the identified services and utilities to support the treatment process.

Large crusher and SAG mill technology will be provided by industry-leading suppliers, as will the additional rougher SLon units for magnetic separation. To minimize process technology risk, only equipment sizes with proven track records have been selected for the Marampa M3.75 flowsheet. Vertical tower mills have been operating successfully at several sites in Africa for a few years.

2.7.2.5 Process Plant Description

The key parameters for the process plant are:

- Treating feed of approximately 17.5 mdtpa or ROM feed to produce 3.75 mdtpa of sinter concentrate at 65% Fe.
- Plant operations of 24 hours per day, seven days per week with planned maintenance and operating delays giving a plant availability of 7,450 hours per year.
- Standby equipment is confined to only critical areas with key parts held in stores.
- Automation in key areas to minimize the need for operator intervention; Major maintenance such as mill relining is by specialist contractors; and
- The plant uses the same standards as the 1B/1C projects and fully incorporates all the equipment. Latent capacity is realized by fitting out spare equipment bays in the plant. An overview of the plant showing the integration with Phases 1B/1C (shaded brown and grey) is shown below.

Figure 2- 14: Process Plant for M3.75

2.8 Tailings Management

2.8.1 Existing TSFs Overview

There are currently two TSFs at the Marampa Site:

2.8.1.1 Hospital Swamp – Southern TSF

The Hospital Swamp TSF built in 2011 was the first tailing storage facility built by LMC; it was followed by the Southern TSF in 2013 both of which were located to the south of the process plant. In 2013 due to a projected lack of tailings storage before the completion of the Valley B TSF, the two TSFs were merged to form a single facility. This TSF is currently at capacity and is disused. It also has legacy issues largely stemming from loss of containment which are explained in depth in the Environmental Legacy Report in the Mine Closure and Rehabilitation Plan.

2.8.1.2 Valley B TSF

During the process of beneficiation, the process plant generates tailings, a slurry containing iron, silica, alumina, minor oxides, and trace elements. Tailings are discharged into a Tailing Storage Facility (TSF) situated 2 km from the plant, known as the Valley B TSF. Tailing generation during the process constitutes 58% of the feedstock to plant by mass. Valley B TSF was originally designed by Epoch consultant and constructed by London Mining in 2011. Valley B TSF has been in operation since 2012 using a conventional open spigot deposition and wall raise methodology. Solid settles in the TSF impoundment while clarified water is discharged into a penstock.

Figure 2- 15: Overview of Valley B TSF Before Cyclone Deposition

2.8.1.3 TSF – Valley B Cyclone Deposition Strategy

In 2022, MML engaged two consultants to perform TSF inspections for wall stability analysis and to advise on short-, medium- and long-term tailings deposition strategy. These independent and expert inputs guided MML towards a hydrocyclone deposition strategy. Unlike an open spigot deposition, in a cyclone deposition the tailing slurry is pushed through a cyclone to produce two streams: a high-density stream call "dry stack" with low water content that can be deposited directly over or outside the wall of the TSF, and a "wet stream" with high water and low solid content to be deposited within the impoundment of the TSF.

The benefits of cyclone deposition methodology are numerous and materially lower the risk of operating a TSF. The "dry stack" stream helps build and strengthen the wall of the TSF, increasing the (factor of safety) FOS of the TSF with each new layer of dry tailing deposited. The "wet stream" deposited within the TSF has a much lower solid content, resulting in a quicker settlement and clearer water being discharged in the penstock, and in a much lower overall rising rate of the TSF. The lower rising rate of the TSF gives much more time for the solid to consolidate, also improving overall FOS of the facility.

Other advantages include a much more compact TSF facility, and minimization of environmental contamination as the cyclone deposition/dry stacking eliminates the need for traditional wet tailings dams, which can pose a threat to nearby water sources if they were to fail. Cyclone deposition/dry stacking is a more sustainable and environmentally friendly solution for tailings management, and also considerably reduces operating cost of the facility as the wall of the TSF is being built by dry stacking during deposition, as opposed to being built mechanically and expensively with mining equipment. Furthermore, cyclone deposition/dry stacking method allows for easier reclamation and rehabilitation of the land once mining operations have ceased, as there is less water to manage and to remove from the site.

The main risk to be managed stemming from cyclone deposition is run-off of the material deposited due to wind and rain. Once the final extent of the expanded footprint from the implementation of cyclone deposition is determined, a series of perimeter catchment paddocks have to be constructed to contain the erosion product from the outer embankment. The catchment paddocks will be routinely cleaned during the dry season to allow adequate capacity for catchment of erosion products when rain erodes the downstream slopes of the dry stack. This proactive approach will help prevent any potential contamination of nearby water sources and maintain the integrity of the surrounding ecosystem. Additionally, regular monitoring and maintenance of the catchment paddocks will be carried out to ensure their effectiveness in containing erosion run off and mitigating any potential environmental damage. Furthermore, sediment traps are being installed within the catchment paddocks to capture and retain any eroded sediment, preventing it from entering nearby water sources. These traps are regularly inspected and cleaned to ensure their optimal functionality. Additionally, erosion control measures such as vegetation restoration and slope stabilization techniques will be implemented to further enhance the resilience of the downstream slopes and minimize the risk of erosion.

Based on the requirements of the Valley B TSF and the clear benefits of this operation, cyclone deposition is also adopted for the M3.75 expansion. This deposition strategy allows for additional tailings storage capacity within the current Valley B TSF footprint while improving the dam's overall structural integrity.

2.8.1.4 Cyclone configuration:

- Out of 26 cyclones, 19 cyclones are currently operational – 10 outer wall; 9 inner wall; remaining units are waiting for spigots.
- 30 additional cyclones on order and expected to arrive by end of November 2023.
- Toe wall, Toe trench, catchment paddock construction is in progress.
- A TSF Superintendent has been hired on a permanent basis.

The adopted TSF cyclone deposition strategy is designed to meet all regulatory requirements, guidelines, and engineering design criteria in Sierra Leone and the new Global International Standard for Tailings Disposal guidance. Seepage and penstock discharge are collected in a special pond and all water returned to the plant as process water. Finally, monitoring boreholes positioned around the TSF are being continuously monitored.

Figure 2- 16: Overview of Valley B TSF – Current View of Cyclone Deposition

To increase impounding capacity of the Valley B TSF, MML is constructing an inner wall using conventional cyclone method to RL86 from current level of RL83 (3m height inner wall). This short-term deposition strategy aims to address the immediate need for increased impounding capacity in Valley B TSF. By constructing an inner wall using the conventional cyclone method, the impounding capacity can be raised by 3 meters, reaching RL86 from its current level of RL83. This will provide a temporary solution to accommodate the ongoing tailings deposition and prevent any potential overflow or breach of the storage facility within the next 12 months.

MML will deploy additional conventional and dewatering cyclones to fast-track an optimized deposition strategy without compromising on structural integrity. During the first three months the inner wall construction will be completed to create vertical freeboard of at least 3 m height (RL86). Simultaneously dry stacking on outer wall will continue in a sequence of North, West, South and Southeast. This phased deployment of cyclones will ensure efficient and timely management of the tailings, allowing for the construction of a secure storage facility. Furthermore, the phased deployment of cyclones will also facilitate proper drainage and water management within the storage facility, reducing the risk of any water-related issues such as flooding or leakage.

2.8.1.5 Valley B TSF Expansion Plan

2.8.1.5.1 Phase 1 – Extension to the Southeast

To augment storage capacity of Valley B TSF, MML is actively developing a lateral extension towards the southeast direction to support short- to medium-term deposition. The gross area of the Phase 1 extension will be 311,525 m2 or approximately 26 months of additional tailings storage at a production rate of 3.75M mdtpa.

This extension will provide the necessary space to accommodate the increasing volume of tailings in the Valley B TSF and will also allow for better organization and separation of tailings, optimizing the overall management and storage efficiency of the facility. The Southeast extension will improve the overall safety of the tailings facility by creating a larger buffer zone between the deposition area and surrounding infrastructure or sensitive environmental areas. This will help minimize the risk of any potential accidents or environmental impacts that could occur from tailings overflow or leakage. This will include reinforced toe safety berms to prevent run off, construction of sediment traps, and storm drains to ensure safe and optimal TSF operations. The extension will also establish a surface water management system to mitigate erosion.

The reinforcement of the monitoring system includes but is not limited to pore pressure and phreatic surface from piezometer readings and slope movement from slope inclinometers. Regular inspections and maintenance of the monitoring system will be conducted to ensure accurate data collection and promptly identify any potential issues.

This deposition strategy aims to optimize the capacity of the Valley B TSF in the medium to long term. By extending the lateral footprint towards the Southeast, dry stacking within the existing borrow pit can be utilized, minimizing the need for additional land.

2.8.1.5.2 Phase 2 – Extension to the North

Relocating the Maforki community will create space for further expansion towards the North, ensuring sufficient capacity for future needs. Phase 2 horizontal expansion of the Valley B TSF footprint will yield an additional area of 711,747 m2, providing approximately 62 months for additional tailings storage capacity at a production rate of 3.75M mdtpa.

Geotechnical analysis, a Resettlement Action Plan (RAP), community sensitization, and engineering designs will all need to be completed for the proposed extension of Valley B TSF towards the north. MML will conduct extensive community sensitization efforts to ensure that the residents of Maforki village are well-informed and involved in the decision-making process, fostering buy-in with the resettlement program. This will also help address any concerns or issues raised by the community and allow for potential modifications to the project design to accommodate their needs.

At more than double the new capacity and area of the southeast extension, Valley B TSF's northern extension will require significant resources and care. MML is committed to adhering to industry best practices across the full lifecycle of the project. This will help mitigate potential risks and ensure that the construction and operation of the extended Valley B TSF align with industry best practices. Furthermore, regular monitoring and reporting on the TSF's performance will be crucial to identify any potential issues and implement necessary corrective measures in a timely manner.

The original design by Epoch suggests the possibility of raising the Valley B TSF to RL90 which makes provision to raise current crest by another 7 meters which would enable to increase the life of impounding capacity. This potential increase in impounding capacity would not only extend the lifespan of the TSF but also provide additional storage for any future waste disposal needs. Additionally, conducting a thorough feasibility study and environmental impact assessment will ensure that any proposed modifications to the TSF are safe, sustainable, and compliant with regulatory requirements.

Raise of existing embankment crest to RL 90 from current RL 83 will be carried out following due processes to meet industry standard in designing vertical raise keeping in view of wall stability and structural integrity of the existing facility. This shall create sufficient storage capacity for impounding overflow for extended dry stacking. Additionally, the increase in impounding capacity will allow for better management of water resources during periods of heavy rainfall, reducing the risk of flooding in the surrounding areas. Furthermore, the vertical raise design will ensure that the embankment remains stable and structurally sound, minimizing any potential risks or hazards associated with the expansion of the facility.

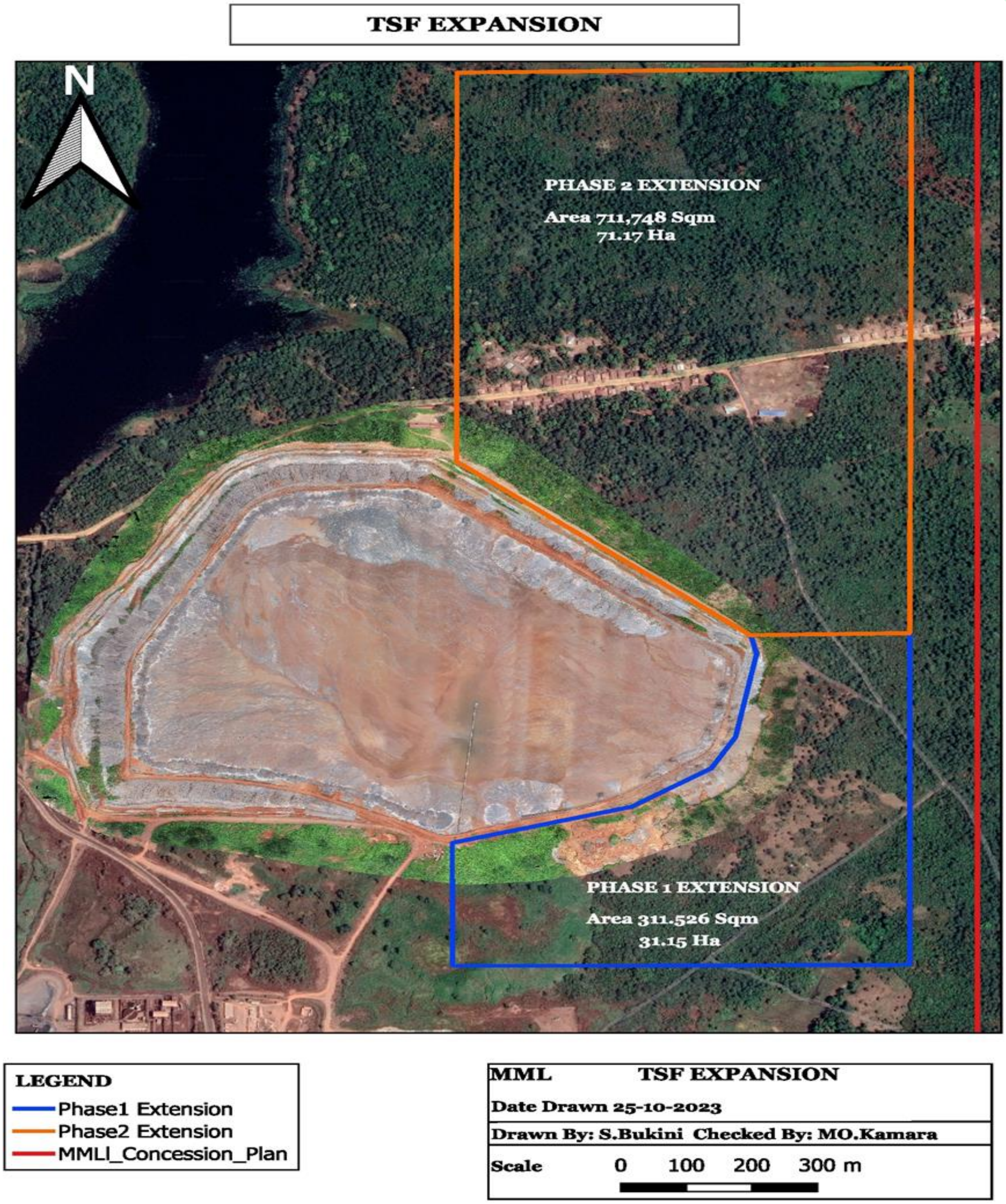


Figure 2- 17: TSF Expansion Plan

2.9 Export Route

2.9.1 Road Haulage - Barging -Transhipment

This is the option MML is using in its current operation. Transport by road from the mine site to TRT, where loading of the barges will take place to a transhipment point off Freetown, and loading of the bulk carriers for export are the main stages of this option.

2.9.2 Road Haulage

The existing 46km laterite haul road to Thofayim will be used for Marampa M3.75; no changes to the haul road route are expected. Several existing borrow pits (a total area of approximately 15 ha) to source suitable grade laterite will continue to be used for M3.75. Initial rehabilitation will return the Haul Road to an operational standard and then a follow-on maintenance plan will be needed along with dust suppression watering.

Haul trucks are expected to be tipper trucks with a capacity of between 40-60 tonnes in a deviation. Haulage operations will be contracted out or owned and operated by Marampa Mines.

The 96km return journey has a 3-hour cycle time with an average approximate of 17 trucks departing for TRT every hour. Speed limits of 50kmph (day) and 40kmph (night) are expected to be enforced.

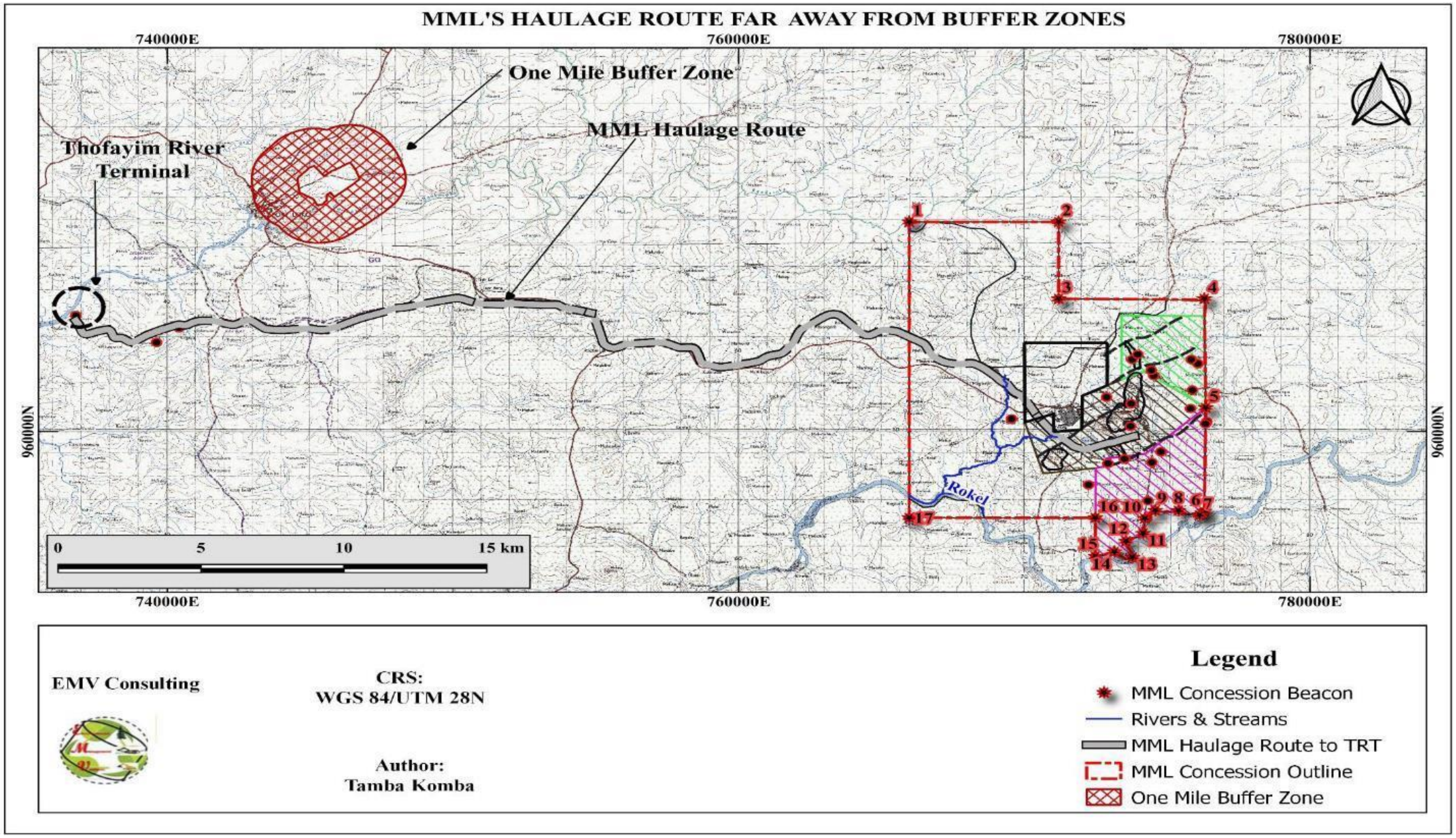


Figure 2- 18: MML's Mining Concession, Haulage Route, and Jetty not within Protected/Buffer Zones.

2.9.2.1 Barge Loading System

The existing concentrate loading system at Thofayim includes:

- A concentrate receiving hopper for truck unloading. Incoming trucks drive over an elevated section of the road allowing discharge into a receiving bin.
- An apron feeder underneath the receiving bin discharges the concentrate onto a transfer conveyor at ground level, which in turn feeds a 1,100 t per hour (tph) telescoping radial stacker to form a kidney-shaped concentrate stockpile of up to 200,000 t capacity.
- A hopper and feeder for reclaiming from the stockpile by FEL (Front End Loader Approximately Cat 992 or 988 sizes);
- Transfer conveyors to the barge loader.
- A telescoping radial barge loading conveyor to load concentrate into the barges at a maximum rate of 1,500 tph.
- A floating Jetty-Empty concentrate barges berth on the upstream end of the jetty, which is the loading berth and then shifted after loading and awaiting the tidally optimized departure window. The jetty can accommodate two barges at a time alongside and further vessels can be stacked outside of these. The loaded barge is shifted to the downstream end of the jetty once loading is complete, thus allowing an empty barge to accommodate the upstream end of the jetty; and
- Earthworks, roads, stormwater control and fencing.
- Existing support infrastructure, such as offices, maintenance areas, concentrate haulage contractor facilities, accommodation, and waste management facilities, are also located at Thofayim. Potable water for the site will be supplied from the existing water bore, with a treatment plant suited to the demand.

2.9.2.2 Barging

Concentrate will be transported from Thofayim to Freetown Port by self-propelled barges otherwise known as coasters, capable of transporting 2,500t intake of concentrate on an optimized 4m draft.

To meet production capacity of 3.75 dmt/yr. of iron ore concentrate 9 coasters will be required (subject to the exact tonnage intake for each vessel).

Figure 2- 19: An Aerial View of Thofayim River Terminal Showring Self-propelled Barges

2.9.2.3 Transshipment

Depending on market availability at the time of the tender process, a converted supramax, handymax or purpose-built vessel will be used as a hybrid type transhipment vessel (TSV). Prior to loading of ocean-going vessels (OGV) by the TSV, the TSV may be preloaded by the barges at an anchorage point inside the Freetown port area to reduce barge cycle times from TRT and operate within safer waters.

On arrival of an OGV, the TSV will be moved to an offshore ship-to-ship anchorage point. The TSV will then direct load the OGV from the coasters or self-discharge its onboard cargo into the OGV in between coasters.

2.9.2.4 Maintenance Dredging

It is expected that over time there might be general sedimentation and movements in the sand bank/dunes along the seabed or dredged sections of the Port Loko Creek channel that will necessitate the need for maintenance dredging to be conducted.

The TSV would be loaded to the available port draft limits within Freetown and the same as fuel delivery vessels, general bulkers or Shandong/ARPS TSVs plying the same voyage in/out of Freetown Port. Any port dredging conducted would be under the control and compliance of the Sierra Leone Ports Authority (SLPA).

3 SECTION THREE

3.1 APPLICATION LEGISLATION AND STANDARDS

This section describes the regulatory policies, framework and standards that apply to the upgrade to achieve the target production of 3.75 mdtpa. The focus is on environmental and social standards and regulations across the country. In addition to relevant Sierra Leone regulations and national standards, the Project is committed to complying with the IFC Performance Standards.

3.1.1 National Legislation

A range of sectorial policies and regulatory and institutional frameworks have been formed by the government of Sierra Leone (GOSL) to address scenarios involving natural resource management, protected area system management, and biodiversity conservation and to address social impacts. There are several key manifestations of this name, the Constitution of the Republic of Sierra Leone, the Environmental Protection Agency Act, 2022 and the Mines and Minerals Development Act, 2023.

3.1.1.1 Constitution of the Republic of Sierra Leone

The Constitution of Sierra Leone have direct applicability to the MML project expansion and operations as it is the law that gives government the authority to make laws governing all aspects of the state, including the management of its resources, its economy and the health and safety of its citizens. The constitution also spells out the rights of the citizens of Sierra Leone, which are set out in Part III of the Constitution, including the right to protection from deprivation of property without compensation as set out in sections 15 and 21 of the Constitution. Section 21 set out the circumstances within which persons may be deprived of their property, such as where the necessity to do so affords reasonable justification, but it mandates that adequate compensation must be provided for such deprivation.

3.1.1.2 Environmental Protection Agency Act, 2022

The Environment Protection Agency Act, 2022 replaced the Environment Protection Agency Act of 2008 and establishes the authority, responsibility, structure, and funding of the Environmental Protection Agency of Sierra Leone (EPASL). Part III of the Act describes the functions of the EPASL, which include the implementation and enforcement of the Act and regulations made under it, the issuing of environmental licenses, the development of policy for the protection and improvement of the environment, ensuring compliance with the prescribed environmental impact assessment procedures in the planning and execution of development projects, and the promotion of national environmental standards and guidelines relating to ambient air, water and soil quality, and pollution.

Part VI of the Act outlines the environmental permitting process, including the need for an ESHIA and an environmental impact assessment licence for certain category of projects, including mining. A full project description is required for the ESHIA as activities that are not included in the ESHIA, and thus not formally assessed for their potential impacts, will not be permitted. The environmental licence will also stipulate requirements for the protection of the environment as a condition of project approval, often referring to the mitigation measures identified in the ESHIA or associated management plans.

Part VII of the Act deals with the prohibition on the discharge, introduction, or importation of toxic and hazardous substances into the environment, including ozone-depleting substances (e.g., chlorofluorocarbons, halogenated chlorofluorocarbons, halon,). It prohibits the importation of controlled substances or products prescribed in Fourth Schedule of the Act unless with a permit from the EPASL. This applies to the importation of refrigerators and air conditioners, including those already installed in vehicles, which contain these products or substances.

Part X of the EPA Act deals with powers of the EPASL to compel compliance in cases of non-compliance, and they include institution of both criminal and civil proceedings before the Courts, the service of enforcement notices and the powers of the Court to impose penalties and/or order the cancellation of an environmental licence.

The Third Schedule of the Act specifies that the ESHIA must contain a true statement and description of the following:

- the location of the project and its surroundings.
- the principle, concept, and purpose of the project.
- the direct and/or indirect effects that the project is likely to have on the environment.
- the social, economic, and cultural effect that the project is likely to have on people and society.
- the communities, interested parties and Government ministries consulted.
- any actions or measures which may avoid, prevent, change, mitigate or remedy the likely effect on people and society.
- any alternatives to the proposed project
- natural resources in the locality to be used in the project.
- the plans for decommissioning of the project; and
- Such other information as may be necessary for a proper review of the potential environmental impact of the project.

In compliance with the EPA Act 2008 (now repealed), MML registered the Marampa M3.75 project expansion with the EPASL in July 2022. The EPASL subsequently advised MML to proceed with the impact assessment process for Marampa M3.75 upgrade, classifying it as a Category A Project and as such, must be subject to a full ESHIA. The Marampa M3.75 ESHIA will also include the necessary management plans, i.e., Environmental Management Plan

(EMP), Emergency Response Action Plan (ERAP), Grievances Redress Mechanism (GRM), Occupational Health and Safety Plan (OHSP), Community Development Action Plan (CDAP) and Resettlement Action Plan (RAP), Waste Management Plan (WMP) and Chemical Management Plan (CMP).

3.1.1.3 Environment Protection (Mines and Minerals) Regulations, 2013

The Environment Protection (Mines and Minerals Regulations 2013 (hereinafter referred to as the "Environmental Regulations") was made pursuant to the EPA Act and it made supplementary provisions to give effect to the Act. It made further provisions on the process of applying for and obtaining environmental permits and licences, provided guidance on the contents of the ESHIA and related environmental management instruments/plans (e.g., EMP, RMP, MCRP), and specified the environmental standards, and mine closure requirements. The ESHIA and Environmental License process, as prescribed by the EPA Act and Environmental Regulations are detailed in Section 1.2 of the ESHIA.

Furthermore, the Environmental Regulations set out the roles and responsibilities of mineral rights holders in terms of environmental and social impacts resulting from their activities and obligates them to prevent, minimize, manage, and mitigate these impacts. In the case of serious harm coming to public health and/or the environment, the lack of scientific certainty must not limit cautious and cost-effective measures to prevent damage to the environment.

Details of the potential impacts of the proposed Project on the surrounding biophysical environment, possible mitigation measures, avoidance recommendations and/or compensation proposals must be outlined in the ESHIA. The ESHIA report must also describe the social, economic and health issues affecting the host communities. The adverse social impacts associated with the proposed project must also be detailed and recommendations for avoiding, mitigating, or compensating these must be provided.

The Environmental Regulations stipulate specific management plans that should also be submitted with the ESHIA including A Contingency Plan, Mine Closure Plan (MCP), Environmental Management Plan (EMP), Social Management Plan (SMP) and Community Development Agreement (CDA).

- The EMP and SMP must detail the applicant's implementation plan about the measures recommended to avoid, mitigate, or compensate for the potential adverse impacts caused by the project as identified in the ESIA. Furthermore, the SMP will include a stakeholder engagement plan (SEP) and a grievance procedure.
- The MCP will include measures that must be undertaken to rehabilitate the mine site. The MCP outlines the requirement for progressive rehabilitation to be undertaken and the ultimate strategy for the closure of the mine site. To demonstrate successful rehabilitation of the site, a three-year monitoring program is also required.
- The CDA contains details of the planned agreement between the mine and

landowners/local community.

3.1.1.4 The Mines and Minerals Development Act, 2023 ("MMD Act")

This Act replaced the Mines and Minerals Act of 2009. Like the 2009 Act, it established the authority and responsibility of the Ministry of Mines and Mineral Resources regarding the management, oversight, and regulation of the mining sector in Sierra Leone. The MMD Act further sets out the responsibility of the National Mineral Agency (NMA) to provide technical support to the Ministry, exercise regulatory administration and supervision over licence operations, and implement compliance and inspection functions, including advising mineral right holders on proper and safe mining methods.

Part VII of the MMD Act contains provisions on the protection of the environment which complement the EPA Act. It imposes a general obligation on mineral right holders to conduct their activities in accordance with the laws of Sierra Leone and in a manner that is practicable to minimise, mitigate, and manage environmental and social impacts of such activities and further requires mineral right holders to:

- Obtain the legally required authorisations, licences, permits, and approvals from EPASL and other Agencies.
- Carry out environmental impact assessment which shall include an environmental impact study that considers social aspects, environmental and social management plans, as well as waste management and other prescribed plans under the laws of Sierra Leone, such plans to have sufficient information and data to determine the effectiveness of the environmental and social management actions.
- Undertake public consultations when preparing environmental screening reports and environmental impact assessments.
- Provide financial assurance to guarantee compliance with the environmental and social obligations, including site rehabilitation, resettlement, closure and/or compensation of affected communities.
- Obtain from EPASL certified approval for mine closure prior to expiry or termination of the licence.
- Have a community development agreement.

Under the 2009 Act, Mining Licence ML 4/2021 was granted to MML and it requires that the project complies with relevant legislation as well as to conduct operations to prevent or mitigate adverse impacts to the environment or health of people.

3.1.1.5 The National Minerals Agency Act, 2012

This **Act** established the National Minerals Agency **(NMA)**, which is tasked with the regulatory administration of mineral rights and the implementation and enforcement of the MMD Act and other related Acts and regulations.

3.1.1.6 Mines and Minerals Operational Regulations, 2013

This regulation made extensive provisions regulating the operations of mineral right holders, including provisions on:

- The general obligations and liabilities of mineral right holders (Part III);
- Mine designs for open pit mines (Part V)
- Occupational health and safety (Part VI)
- Workplace Standards (comprising provisions regulating noise, vibration, noxious or inflammable liquids, pollution, illumination, machinery safety measures etc) (Part VI)
- Waste Disposal and Containment Control (dealing with the management and control of tailings and tailing storage facilities) (Part VII)
- Storage and Transportation of Minerals (Part VIII)
- Explosives and Blasting (Part IX)
    - MML's first blasting license BL05/2022 was issued on 01 June 2022 and valid until 31 May 2023.
    - MML's second blasting license BL04/2023 was issued on 25 May 2023 and valid until 24 May 2024.
- Surface and open Pit Mining (Part X)
- Reclamation and Mine Closure Considerations (Part XIII)

3.2 Other Applicable Legislation

3.2.1 The Explosives Act, 1955

This Act is the principal legal instrument regulating explosives in the country and makes provisions for the issuing of permits for the manufacture, import and export of explosives. It authorises the Chief Inspector of Explosives to issue licences and permits for the importation, manufacture and use of explosives and prohibits the possession, manufacture, import and use of explosives without permits or licences.

Notwithstanding the above, the import, transportation, storage manufacture, supply and use of explosives for mining activities is regulated by the Mines and Minerals Operational Regulations, 2013. Part IX of the said regulation authorises the Director of Mines to issue licences for the above activities relating to explosives after consulting the appropriate authorities, such as the Inspector General of Police and the Chief Inspector of Explosives.

As described in Section 2.13.5, the Marampa Project expansion will require the use of explosives and MML will comply with the requirements of Explosives Act and the Mines and Minerals Operational Regulations to ensure the lawful and safe import, transport, manufacture, usage, and storage of explosives used in its mining operations.

3.2.2 *The Ports Act of 1964*

The Ports Act of 1964 provides for the establishment of the Sierra Leone Ports Authority (SLPA) as the body responsible for the management and maintenance of existing ports within Sierra Leone (primarily the Port of Freetown and the Port of Sherbro) as well as declaring new ports. Section 39(1) of the Act specifically gives the Authority the mandate to make regulations for the maintenance, control, and management of any port. These include regulation of ships whilst taking in or discharging ballast or cargo, the placing and maintaining of moorings or buoys and prescribing the duties of masters of ships carrying explosive or dangerous cargo.

Under the management of SL Mining, the Marampa Mines Project dredged a channel to allow safe passage of the barges, and installed navigation aids (i.e., marker buoys). These were handed over to the control of the SLPA. The SLPA also has control of the Freetown Port area, which MML will continue to use for its transhipment activities (see Section 2.9.3.3) as well as the importation of various equipment and consumables. The Ports Act is therefore applicable.

3.2.3 *The Wildlife Conservation Act, 1972*

The Wildlife Conservation Act of 1972 and the Forestry Act of 1988 are the main legislation that deals with issues of Biodiversity Conservation in Sierra Leone. The Act covers the taking of animals (e.g., birds, fish, turtles, and aquatic mammals), trade in trophies, and the declaration of certain protected areas.

The Marampa mines site, haul road and Thofayim terminal do not fall within any protected area and/or buffer zones. The barging route does pass through Port Loko Creek and the Sierra Leone River Estuary, which is a RAMSAR site. Species protected by this Act likely exist around this area of the operation.

3.2.4 *The Factories Act, 1974*

The 1974 Act considers certain mining operations as factory-based and is therefore governed by this Act with specific reference to the health and safety of employees. It includes a duty of care to provide a safe work environment for employees.

MML recognizes its role in promoting Health and Safety amongst its workforce and in the wider community. Under its Occupational Health and Safety Policy, MML stipulates its commitment to preventing injury and ill health by proactively identifying and managing occupational health and safety risks.

3.2.5 *The National Environmental Policy, 1994*

The National Environmental Policy of 1994 outlines the government’s position on the exploitation of natural resources. The goal of this Policy is to achieve sustainable development in Sierra Leone via sound environmental management. Specific objectives of the Policy are:

- To secure for all Sierra Leoneans a quality environment adequate for their health and well-being.

- To conserve and use the environmental and natural resources for the benefit of present and future generations.
- To restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere.
- To preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems.
- To use available land resources in such a way that their quality is conserved to enhance their potential for continuous productivity and to prevent degradation.
- To ensure adequate quantity and acceptable water quality to meet domestic, industrial, transportation, agricultural and fisheries.
- To control air pollution and reduce emissions and noise to levels adequate to protect human health and the environment.
- To ensure that prospecting, exploration, mining, and processing of mineral resources on land and water proceed in an environmentally sound manner; and
- To ensure that the working environment promotes health and safety.

This document outlines the Sierra Leonean Government's position on the alteration of the environment as well as the exploitation of natural resources. Some of these provisions applicable to this project include Land Tenure, Land Use and Soil Conservation, Water Resources Management, Forestry and Wildlife, and Preservation of Biological Diversity. The Marampa Project shall continue to support these goals with the development of its Marampa M3.75 Project.

3.2.6 Fisheries Legislation

National Fisheries Regulations such as the Fisheries Act of 1988 and the Fisheries Amendment Act of 1990 have evolved to address specific matters relating to the conservation and management of natural resources within the marine environment. The 1994 Decree further established sufficient provisions for the conservation of marine resources. These range from monitoring, control, and surveillance provisions, as well as those relating to enforcement.

MML will consider its potential impacts on the fishing resources and will aim to comply with all Acts and regulations guiding the Marampa M3.75 Project towards sustainable development.

3.2.7 The Maritime Administration Act, 2000

The Maritime Administration Act of 2000 establishes the Maritime Administration for the purpose of:

- Regulating and developing improved standards of performance, practice, and safety in the shipping industry in Sierra Leone, including the coastal and inland water transport system, and in the maritime environment.

- To fulfil flag and port state responsibilities in an effective manner having regard to the relevant international maritime conventions.
- Prevention of maritime source pollution, protection of the marine environment and response to marine environmental incidents.

Due to the barging operations to be conducted during the Project, the Maritime Administration Act (2000) will be considered and integrated, where required, into the Marampa M3.75 Project's management plans.

3.2.8 Nuclear Safety and Radiation Protection Act, 2012

The Protection from Radiation Act of 2001 requires all users to obtain a license from the Radiation Board to own, purchase, acquire, import, export, use or dispose of irradiating devices, radioactive materials, or other sources of ionizing radiation.

MML will utilise a few low-level radioactive sources in the process plant that will require permitting under this Act.

3.2.9 The Sierra Leone Water Company Act, 2017

This Act aims to promote and improve efforts towards the efficient and equitable utilization of water resources in Sierra Leone. This Act applies to the Project in terms of Section 51 (1), which states that no person shall:

- wilfully or negligently injure any or cause damage to the environment in the catchment area; and
- unlawfully divert or take water from any waterworks or catchment area.
- Pollution causes a risk to any water in waterworks or catchment areas.

Section 52 (1) is also applicable and stipulates that no person shall willfully or negligently misuse or waste any water passing into, through or near any premises, from any waterworks. A SALWACO-operated site is located on the edge of the mine concession area and MML will continue to work with the Ministry of Water Resources and SALWACO in protecting this infrastructure.

3.2.10 The Merchant Shipping Act, 2003

The Merchant Shipping Act of 2003 consolidates the laws relating to the registration of ships, their regulation, the maintenance of safety at sea, the marine environment, and other related matters. The Act provides the authority to develop regulations governing vessels operating in inland waterways of Sierra Leone, safety, training and qualifications of personnel, carriage of hazardous goods, ship collision, incident reporting and navigation aids.

MML will continue to consider the requirements of this Act with regard to barging activities in terms of maintenance of vessels, safety checks and procedures, training and credentials of personnel, cargo, and incident reporting.

3.2.11 National Lands Policy, 2005

The National Lands Policy (2005) of Sierra Leone provides for the sustainable use of the nation's land and its natural resources, including protecting sites of historical, cultural, or ecological interest. Section 3.1 includes the requirements for mines to restore lands to a pre-impact state once operations are completed. The "polluter pays" principle applies to land, water, and the environment.

Section 4.4(b) states that all land declared as forest reserves, strict nature reserves, national parks, cemeteries, wildlife sanctuaries and similar land categories are "fully protected". for ecosystem maintenance, biodiversity conservation and sustainable timber production. Section 4.4(g) prohibits draining, diverting, mining or disposal of wastes (solids or effluents) in inland and coastal wetlands or streams feeding wetlands. Section 4.4(i) states mining must conform to prescribed environmental conservation principles and guidelines. Section 4.5 (b) relates to the restoration of ecology, landscape and productivity on lands following mining or road construction. The National Lands Policy is important in terms of MML's "duty of care" and in terms of its responsibility to rehabilitate the site on mine closure.

Furthermore, the protection of specified ecosystems and environments is regulated to promote sustainable development.

3.2.12 Road Traffic Act, 2007

The Road Traffic Act of 2007 deals with registering and licensing of vehicles, carrying hazardous goods, non-roadworthy or overloaded vehicles, licenses for commercial drivers, maximum work hours, the alcohol limit (i.e., 80 mg of alcohol in 100 ml of blood) and drugs. The Sierra Leone Roads Authority Act of 1992 creates the authority of the Sierra Leone Roads Authority to create regulations pertaining to the safe usage of roads. MML will comply with the rules and regulations on vehicles and goods transportation as they apply to its operations.

3.2.13 The National Disaster Management Agency Act, 2020

Being an Act to provide for the establishment of the National Disaster Management Agency to manage disasters and similar emergencies throughout Sierra Leone, to establish offices of the Agency throughout Sierra Leone, to establish national, regional, district and chiefdom disaster management committees, to establish a National Disaster Management Fund to provide finances for the prevention and management of disasters and similar emergencies throughout Sierra Leone and to provide for other related matters. MML will comply with this act and align it with its emergency response action plan as it applies to its operations.

3.2.14 The Fisheries and Aquaculture Act, 2017.

Being an act to make provision for the long-term conservation, management, development and sustainable use of fisheries resources and ecosystems in Sierra Leone; to provide for the development of aquaculture for the benefit of the people of Sierra Leone and other related matters. MML will consider its potential impacts on the fishing resources and will aim to comply with all Acts and regulations guiding the Marampa M3.75 Project towards sustainable development.

3.2.15 The National Water Resources Management Agency Act, 2017.

Being an Act to provide for the equitable, beneficial, efficient, and sustainable use and management of the country's water resources; to establish a National Water Resources Management Agency; to provide a Water Basin Management Board and Water Catchment Area Management Committees for the management of the water resources and other related matters. MML will consider its potential impacts on the water resources and will aim to comply with all Acts and regulations guiding the Marampa M3.75 Project towards sustainable development.

3.2.16 The Sierra Leone Local Content Agency Act, 2016.

Being an Act to establish the Sierra Leone Local Content Agency to provide for the development of Sierra Leone Local content in a range of sectors of the economy such as industrial, manufacturing, mining, petroleum, marine resources, agriculture, transportation, maritime, aviation, hotel and tourism, procurement of goods and services; public works, construction and energy sectors; to promote the ownership and control of productive sectors in the economy by citizens of Sierra Leone; and to provide for other related matters. MML will consider its potential impacts on the local content policy and will aim to comply with all Acts and regulations guiding the Marampa M3.75 Project towards sustainable development.

3.2.17 The National Development-Induced Resettlement Act, 2023

The Act seeks to introduce uniform principles, to guide the planning, implementation, and monitoring of development-induced resettlement activities, and to provide for other related matters.

3.3 National Strategies and Plans

3.3.1 National Development Priorities

The Government of Sierra Leone has developed several key national development priorities, aligned with the Millennium Development Goals (MDGs).

3.3.2 Development Plans

The Sierra Leonean government has been working with the districts to produce district council development plans. The Port Loko District Council Development Plan (2019-2021) has been prepared in line with the national development priorities. A sample of key development projects is summarized in *Table 3-1* below.

Table 3- 1: District Development Plans for Port Loko District 2019 - 2021

Issue	Description
Education	• Construction of a school in Mamosa

Agriculture/farming	• Rehabilitation and construction of dry floor to improve hygiene practices related to drying rice and seeds • Provision of micro-credit and agricultural projects to empower women (rice and cassava)
Health	• Construction of a health Centre in Lunsar with an electricity generator, refrigerators for vaccinations, solar panels, improved water supply and toilet facilities in every labour room.
Infrastructure & Sanitation	• WASH Programme and provision of improved toilet facilities • Construction of wells

3.4 International Best Practices Framework

In addition to local environmental and social legislation, the Project is committed to meeting international best practice standards established by the International Finance Corporation (IFC).

3.4.1.1 International Finance Corporation Performance Standards

The IFC functions as the private investment arm of the World Bank and has established several performance standards on social and environmental sustainability. These standards generally form the basis for any internationally funded project and these standards are considered the leaders in terms of good environmental and social practice. The Performance Standards (Table 3-2) on Social and Environmental Sustainability (IFC, 2012) have been formally adopted by the Project.

Table 3- 2: IFC Performance Standards, 2012

The IFC Performance Standards (PS)
PS 1: Assessment and Management of Environmental and Social Risks and Impacts
PS 2. Labour and Working Conditions
PS 3. Resource Efficiency and Pollution Prevention
PS 4. Community Health, Safety and Security
PS 5. Land Acquisition and Involuntary Resettlement
PS 6. Biodiversity Conservation and Sustainable Management of Living Natural Resources
PS 8. Cultural Heritage

The Performance Standards are directed towards guiding how to identify risks and impacts and are designed to help avoid, mitigate and, manage risks and impacts as a way of doing business sustainably, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. MML adheres to the IFC Performance Standards in all applicable project contexts.

3.4.1.2 IFC Environmental Health and Safety (EHS) Guidelines

The IFC EHS Guidelines are technical reference documents that address the management and performance of projects. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to Performance Standard 3: Pollution Prevention & Abatement, as well as certain aspects of occupational and community health and safety.

The EHS Guidelines state that when host country (e.g., Sierra Leone) regulations differ from the levels and measures presented in the EHS Guidelines, projects will be expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate given specific project circumstances, a full and detailed justification for any proposed alternatives is required. General EHS Guidelines also exist which contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors are listed in Box 3-1.

3.4.1.3 IFC General EHS Guidelines

1. **Environmental**
   - 1.1. Air Emissions and Ambient Air Quality
   - 1.2. Energy Conservation
   - 1.3. Wastewater and Ambient Water Quality
   - 1.4. Water Conservation
   - 1.5. Hazardous Materials Management
   - 1.6. Waste Management
   - 1.7. Noise
   - 1.8. Contaminated Land
2. **Occupational Health and safety**
   - 2.1. General Facility Design and Operation
   - 2.2. Communication and Training
   - 2.3. Physical Hazards
   - 2.4. Chemical Hazards
   - 2.5. Biological Hazards
   - 2.6. Radiological Hazards
   - 2.7. Personal Protective Equipment (PPE)
   - 2.8. Special Hazard Environments
   - 2.9. Monitoring
3. **Community Health and Safety**
   - 3.1. Water Quality and Availability
   - 3.2. Structural Safety of Project Infrastructure
   - 3.3. Life and Fire Safety (L&FS)
   - 3.4. Transport of Hazardous Materials
   - 3.5. Disease Prevention
   - 3.6. Emergency Preparedness and Response
4. **Construction and Decommissioning**
   - 4.1. Environment
   - 4.2. Occupational Health and Safety
   - 4.3. Community Health and Safety

Box 3- 1: IFC Industry-Specific EHS Guidelines

3.4.1.4 EHS Guidelines for Mining

The EHS Guidelines for Mining apply to underground and open-pit mining, alluvial mining, solution mining, and marine dredging. The extraction of raw materials for construction products is addressed in the EHS Guidelines for Construction Materials Extraction.

3.5 Hierarchy of Compliance

The compliance (legal and internal) requirements associated with the activities and operations of the Marampa Mines operational/production activities are defined in a descending hierarchy of order as follows:

- Compliance requirements imposed by the Sierra Leone Regulatory Framework.
- International conventions to which Sierra Leone is a signatory or with which MML must comply (e.g., MARPOL).
- IFC requirements as outlined in the Performance Standards; and
- MML corporate requirements include those recommended by organizations of which MML is a member.

In general, Sierra Leone legislation related to environment, health and safety compliance issues within the mining industry is still under development. Where there is no specific Sierra Leone legislation coverage, or the standard required does not meet international standards, MML will default to the IFC standards for guidance.

3.5.1 Marampa Mines Limited Policies

Policies have been developed by MML to guide its operations. Refer to: https://marampamines.com/policies/

4 SECTION FOUR

4.1 ENVIRONMENTAL BASELINE

4.1.1 Regional Climatic Condition

The climate of Sierra Leone is characterised by a tropical and Savanah climate and distinct wet (May – November) and dry (December – April) seasons each year. During the dries, the regions received hot dry wind from the Sahara Desert intermittently between November and March. Average rainfall from historical data is about 1,580mm and temperature ranges from 25 – 32 degrees centigrade with generally low wind.

The region's climate is shaped by the convergence of two air masses, one originating from the Sahara Desert and the other from the Atlantic Ocean, which meets at a zone best described as the Inter-Tropical Convergence Zone (ITCZ). According to the ITCZ, the dry season, which lasts from December to April, is characterized by the tropical continental air from the northern anticyclone over the Sahara. These north-easterly trade winds are dry and often carry a high dust load, occasionally penetrating over the Atlantic as far south as 2°N in January, resulting in a prolonged period of dry weather over the region.

During the rainy season, which occurs between May and November, the northward migration of the ITCZ brings warm and humid maritime air further inland, resulting in increased rainfall. The ITCZ's most northerly limit occurs between July and August, ranging from approximately 18-24°N. The location and movement of the ITCZ at different times of the year influence the weather patterns and seasonal changes in Sierra Leone. The country experiences two distinct seasons characterized by specific weather conditions.

The dry season, from December to April, has relatively low humidity and high evaporation, further intensified during the Harmattan period (between December to February). The Harmattan winds, which generally blow from the northwest, carry significant amounts of dust. During the rainy season, the monsoon winds coincide with the northward migration of the ITCZ, resulting in predominant winds from the southeast.

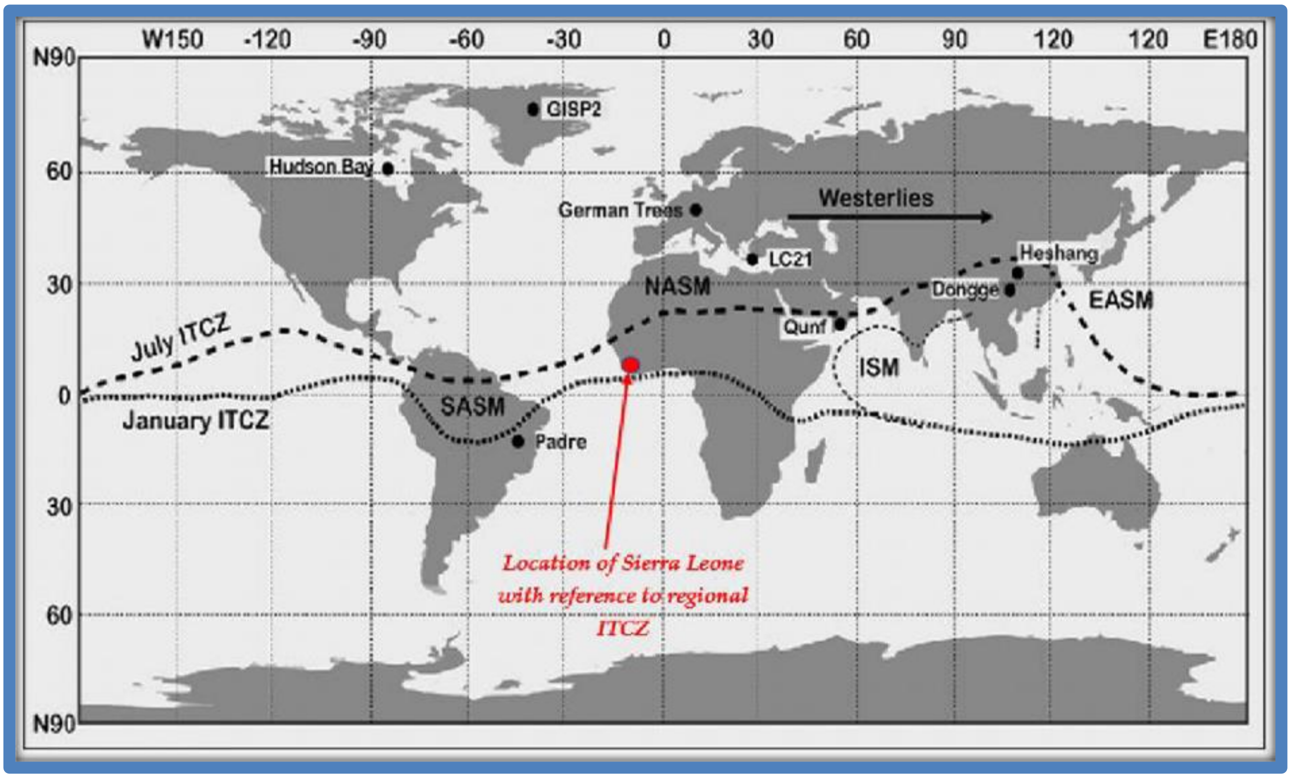


Figure 4- 1: Modern Position of ITCZ in July and January. Source: Cheng et al, 2012. Slightly modified my Tamba Komba in 2023.

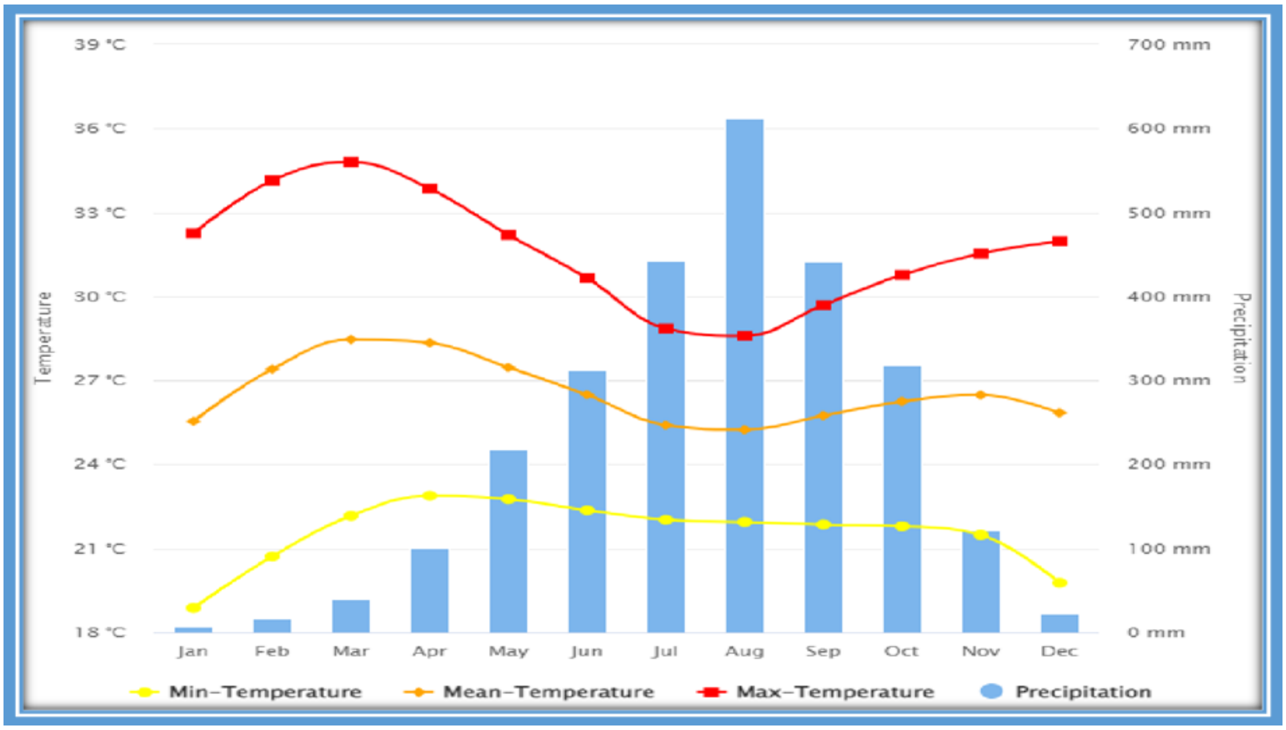


Figure 4- 2: Monthly Climatology of Sierra Leone (1991-2021) Source: Climate Change Knowledge Portal

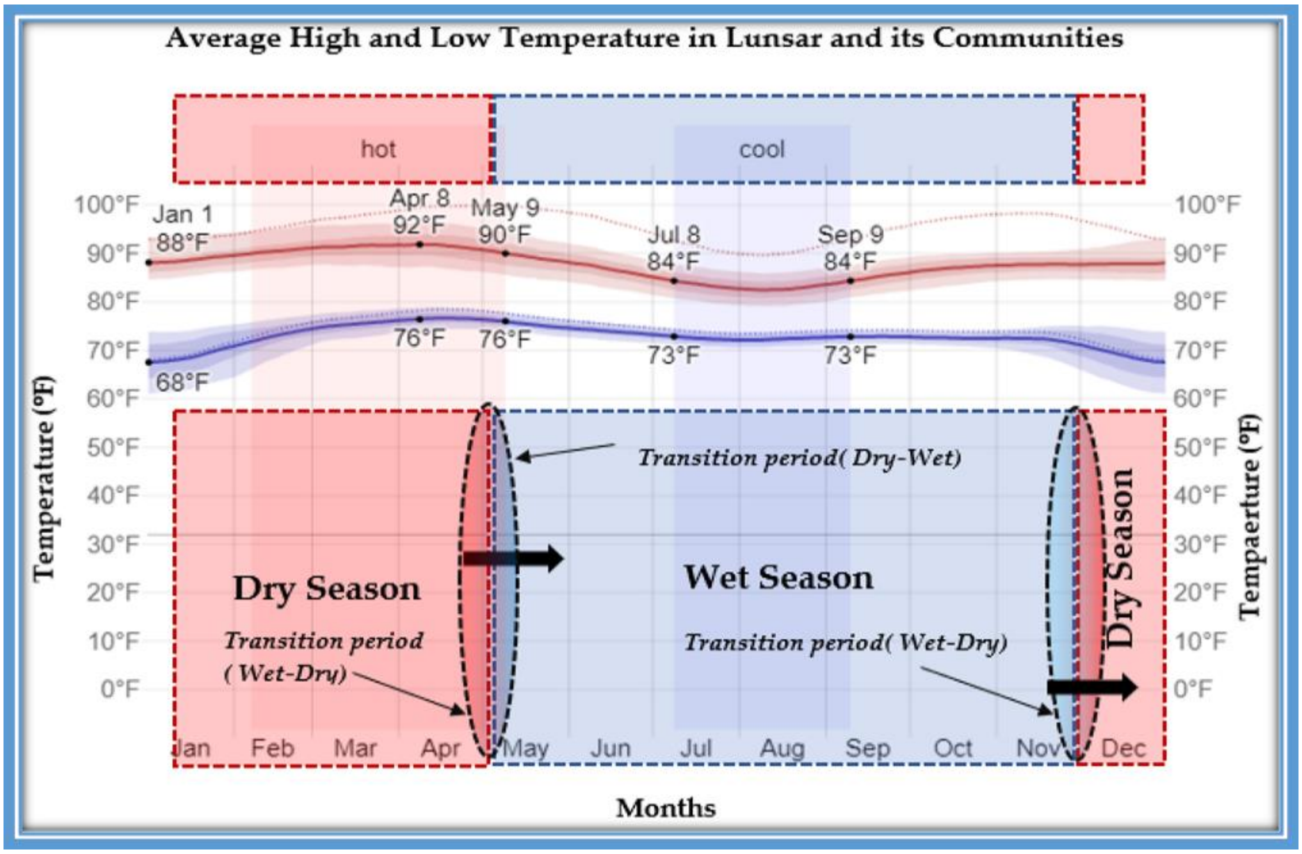
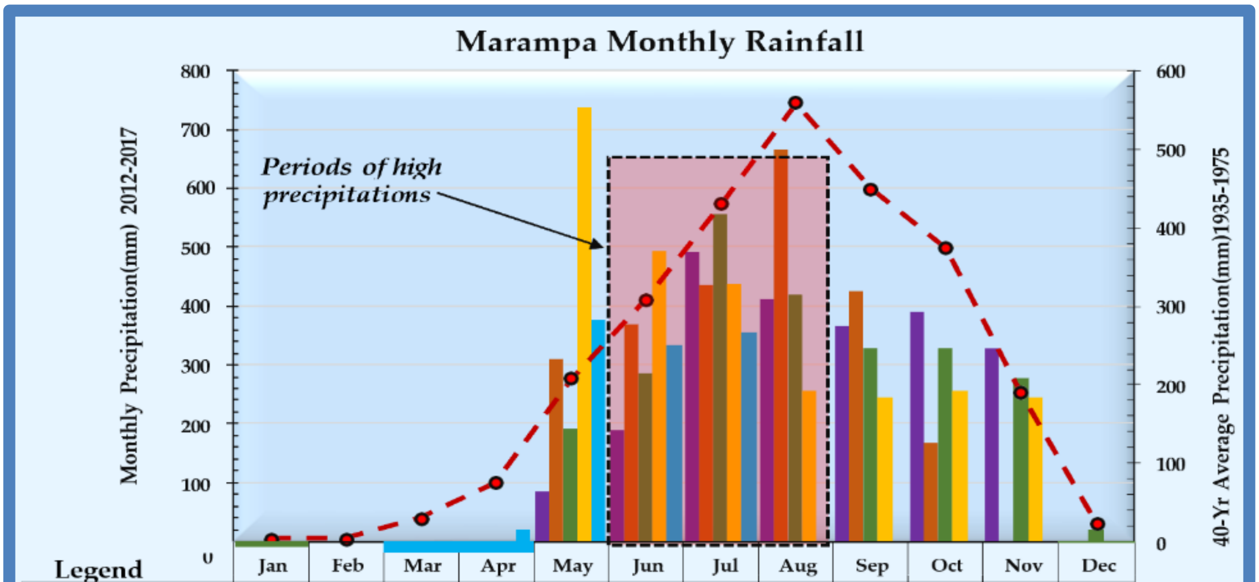


Figure 4- 3: Seasons and Average Temperatures in Lunsar and its environs. Source: Weather Spark (2022). Slightly modified by Tamba Komba in 2023.

4.1.1.1 Regional Rainfall

Using the mean monthly rainfall data from the Marampa station during the period 1935- 1975, a 40-year average for rainfall in the project area was computed. The mine area experiences an annual average rainfall of 2,664mm, with the wet season occurring from June to October and the dry season lasting for five months, from December to April. The highest amount of rainfall (more than 500mm) is observed in August, while January receives the lowest average rainfall (less than 4mm). The Marampa operational team installed a weather station and measured data from 2012 to 2017, with a break in 2015.



Legend	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012					86	190	492	410	366	389	327	17
2013					310	367	435	666	424	167	0	0
2014	7	0	0	13	191	285	555	419	329	328	278	21
2016	0	0	0	0	737	493	439	257	244	257	244	0
2017	0	0	12.2	21	376	334	356					
40-yr Average	4	4	30	75	208	309	430	559	449	374	189	24

Figure 4- 4: Monthly rainfall data from 2012 to 2017. Source of raw data: ESIA 2021 stud. Slightly modified by Tamba Komba in 2023.

4.1.1.2 Topography and Relief

The Mine and Southern Concession areas are situated in gently rolling plains that are intersected by inland valley swamps and drainage depressions. The interfluves, which account for about 80% of the leased area, have well-defined, almost level, broad crests and side slopes. The valley swamps are typically narrow and closely associated with broad, flat drainage depressions. In the mine concession area, the Masaboin and Ghafal hills are the most prominent features, with inter-joining low ridges. These hills rise to around 100m above the surrounding plains, with a maximum elevation of about 160m above sea level. The landscape within the Mine Concession area has undergone significant changes over the past 50 years due to mining activities.

During the Delco era, large areas of tailings (totalling 241ha) were deposited to the north, south, and east of Masaboin Hill, obstructing or redirecting historical watercourses and partially filling the valley. This has also occurred on a smaller scale in upland valleys around the Ghafal Hill deposit. As a result of these past activities, several lakes have been formed, including Bathbana Lake. Old plant areas, mine workings, and waste dumps are apparent on the ridge line running from Masaboin Hill to Ghafal Hill. Over the past decade, most of these tailings have been mined, reprocessed, and redeposited in Tailings Storage Facilities (TSFs) to the east and south of Masaboin Hill. The mining of ore has left mine pits and benches in Masaboin Northern Extension and Masaboin Hill, respectively. There are new waste dumps on the southern and northern faces of Masaboin Hill, as well as one to the northwest of the site adjacent to Chendatta Village.

Thofayim's topography is characterized mainly by interfluves with slopes that range from moderate to gentle, as well as inland valley swamps. The interfluves are divided by valley swamps, which are brief, uncurving, and have slopes that range from gentle to moderate. The area's altitude ranges from 50 to 100 meters, with the valley swamps being almost flat and straight, with different widths and minor drainages. The Thofayim location is positioned on a small elevation that slopes downwards towards Port Loko Creek.

4.2 GEOLOGY AND SOIL

4.2.1 The Objective of the Geology and Soil Components of the ESHIA

This Environmental, Social and Health Impact Assessment (ESHIA) study focuses on the geology and soil components of the northern and Southern extensions project of Marampa Mines Limited. The study aims to assess the potential environmental impacts of the mining extension on the geology and soil, and then identify measures that will be taken to prevent and/or ameliorate these impacts.

The study areas are located within the existing mining operation and cover an area of approximately 116.2 km2 (scoping report, 2022). It is situated in the Marampa geological formation, which is characterized by its north-Northwest and South-Southeast trending volcano-sedimentary rocks that extend for about 125km from Kuala in Moyamba to obscure in Guinea by the Paleozoic cover of the Bauve's Basin. The mineral resource that will be extracted from the mining extension is Iron Ore. The mining methods that will be used to extract this mineral include open pit mining and processing of the ore on-site into concentrate and then hauled to Thofayim River Terminal (TRT) for subsequent transhipment.

The geology of the study area is complex, and there may be several geohazards that may be present, including slope instability, rockfall, etc. The soil components of the study area are also complex, and there are several soils types present, including man-made ground, sandy loam, silty clay, and gravelly soil. The soils are generally well-drained, with moderate to high nutrient content. However, some areas may be prone to erosion and soil instability.

Generally, the objectives of the geology and soil components of the ESHIA are to provide a detailed description of the geological and soil conditions of the study area, assess the potential impacts of mining on these components, and recommend measures that will be taken to prevent or mitigate these impacts.

4.2.1.1 Overview of the Mine and Extension Footprint

The mine is situated approximately 2.5 km closer to Lunsar in the Marampa Chiefdom, Port Loko District, Northern Province, and approximately 125 km NE of Sierra Leone's Capital City, Freetown, West Africa. Moreover, the project mining, processing and haulage corridor footprint covers up to 19 villages in three chiefdoms; Marampa, Mawulay, and Mathunkara respectively (stated in the previous chapters above). The geology and soil components of the

ESHIA are contingent on the expansion of the current open cast iron ore mining operation at the Marampa and Mathukia ore deposits to scale up production from 3.25 million tonnes of dry iron ore concentrate of the processed ore to 3.75 mdtpa with Fe grade 65%. Thofayim, the badge loading facility is situated roughly 40 Km direct west of the mine site. This facility is linked to the mines via a well-graded feeder haul road whose soil components are predominantly lateritic with a few pods of clayey materials in selected places. The iron ore concentrate will be transported by barges via Port Loko Creek to the Freetown Port area, where it will be transhipped onto export bulk carriers for further transportation to the smelters.

4.2.1.2 Procedures and Methodological Approach

A general overview of the Project site's biophysical settings has been done as a desktop study, including a review of existing studies about the project's phases. A field visit was conducted by the Geology and Soil Team of Environmental Management Venture, the consulting firm.

The Geology and Soil impacts of the MML's current and extension project are predicted in respect of the environmental receptors, especially in terms of land use, residents of villages and natural resources. This is accomplished by comparing the baseline conditions with situations ensuing when the Project is implemented. Additional information was gained by consultations with representatives of the company's technical leads (HSE, mining, geology, survey, geotech and project).

4.2.1.2.1 Desktop Review

A general overview of the Project site's biophysical settings has been done as a desktop study, including a review of existing studies about the project's phases. A field visit was conducted by the Geology and Soil Team of Environmental Management Venture, the consulting firm.

The Geology and Soil impacts of the MML's current and extension project are predicted in respect of the environmental receptors, especially in terms of land use, residents of villages and natural resources. This is accomplished by comparing the baseline conditions with situations ensuing when the Project is implemented. Additional information was gained by consultations with representatives of the company's technical leads (HSE, mining, geology, survey, geotech and project).

This document's desktop review was carried out using the following sources of data and tools:

1. Reports.
    a. Geological maps from MML reports and previous ESHIA/EIA (Environmental and Social Impact Assessment –Volume 1 & 2, June 2021, by CEMMAT adopted from previous studies;
    b. MSE Mini Pit Design Stability Report (PowerPoint, no date);
    c. M3.75 Iron Ore Project Proposed Crusher, Conveyors and Stockpile Construction-Geotechnical Investigation Report, by Zenito, 2022;
    d. Geotechnical Investigation 3.75 DSF Tailings Storage Facility Report by EDA (Edward Davies and Associates, 2022;

e. Waterlab (PTY) LTD Certificate of Analyses, 2022;
f. Feasibility Study for LMC Marampa 10 Project – Water Management Study Draft Final Report, 2013 by SRK consulting;
g. Hydrological Study of the surrounding Areas of the Marampa Project. By MDGEO, 2010;

2. Other data sources
    a. https://www.usgs.gov/ : to obtain Landsat 8 raster imagery and other related Geo tiff files;
    b. Sierra Leone 50k topo map- to get the topographic map of the MML's concessions;
    c. Digital soil map of the world. Source: FAO Map catalog: https://data.apps.fao.org/map/catalog/srv/eng/catalog.search#/home
    d. Online literature: Geology and Mineral Resources of West Africa. Authored by J.B. Wright
    e. https://climateknowledgeportal.worldbank.org/country/sierra-leone/climate-data
    f. Journals/papers:
        i. Keyser and Mansaray, Geologic Map of Sierra Leone: (1:250,000), Sierra Leone National Mineral Agency (Sierra Leone Geological Survey), 2004.
        ii. H. R. Williams, "The Archaean geology of Sierra Leone," Precambrian Res., vol. 6, no. 3–4, pp. 251–268, 1978.
3. Tools used:
    a. Quantum geographic information system (QGIS), ArcMap Desktop and Google Earth pro.

4.2.1.2.2 Field Investigations

To effectively characterize the geology and soil of the project's influence, a site visit was conducted, and the specific objectives were, but not limited to the following:

- ascertain the veracity of the pieces of literature reviewed,
- understand the sort of mining being practised,
- visits all the communities that may be impacted by the mining operation, especially those within the influence of the project's extensions (north and south),
- understand MML'S local geology and validate it against the regional geology,
- perform physical soil analysis,
- establish the soil profile,
- request raw and/or processed data from MML's technical leads, and
- developing prototype ground models for the geology and soil

4.2.1.2.3 Reporting

Following the field/ site visit, a comprehensive report on the finding, gap analysis, impacts of the project on the Geology and Soil, and recommendations have been made especially for the ESHIA on behalf of the proponent.

4.3 Mineral Resources Component

In this section of the geology and soil components, a general overview of the mineral resource that will be extracted as part of MML's expansion of the ongoing project will be deliberated. The geology and mineralization of the study area, the current and any proposed techniques to be used for extracting the ore, and the potential environmental effects of such mining practice.

4.3.1 Geology and Mineralization

4.3.1.1 Regional Geology

Sierra Leone forms a part of the West African Craton; a portion of the continent that has been stable for over 1700 million years. The majority of the rocks are Precambrian in age (older than 500 million years), with a younger coastal strip that is about 50 km wide. Tertiary, Quaternary and Recent marine and estuarine sediments make up this strip. The younger Quaternary and recent deposits are found in the low-lying areas, where the Tertiary deposits from the Bullife of mine Group, mostly consist of interlayered silts, sands, clays, and occasionally lignites. The Bullife of mine Group is known to be thicker than 60 metres onshore and may even be up to 120 metres thick. Alluvium deposits make up the younger Quaternary deposits, which are often highly organic soft sandy clay.

According to Keyser and Mansaray (2004), Sierra Leone occupies the central portion of the Achaean craton that was disrupted by the opening of the Atlantic Ocean. The eastern cratonic fragment extends from Western Sahara to Mauritania, Senegal, Guinea, Sierra Leone, Liberia, Ivory Coast, and Ghana. The western portion of the craton forms the Guyana Shield, which extends from northeastern South America.

The country's regional geology is divided into two major tectonostratigraphic units having up to eight major formations (Figure 4-5); the eastern and western units. In the west, the country is bordered by an intensive ductile shear zone that dips towards the west, resulting in simple deformation of high-grade, fine-grained rocks forming the Kasila Group. These rocks exhibit a structural mark known as the Suture and are located to the west of the granite-greenstone terrain. On the other hand, the eastern side of the greenstone terrain consists of low-grade metamorphic rocks referred to as the Marampa Group. This group is in tectonic contact with the Rokel River Group Sediments, and the Volcanic demonstrate evidence of thrusting, folding, and slight metamorphism during the Pan Africa (Rokellide) thermotectonic episode.

Also, it is worth noting that the country is largely covered by Archaean basement rocks. Like the regional pattern of the geology of West Africa, the geology of Sierra Leone is divided into three major rock types:

- The Basement Complex (Infracrustal suite-the oldest)
- Supracrustal suite and
- The intrusives (the youngest)

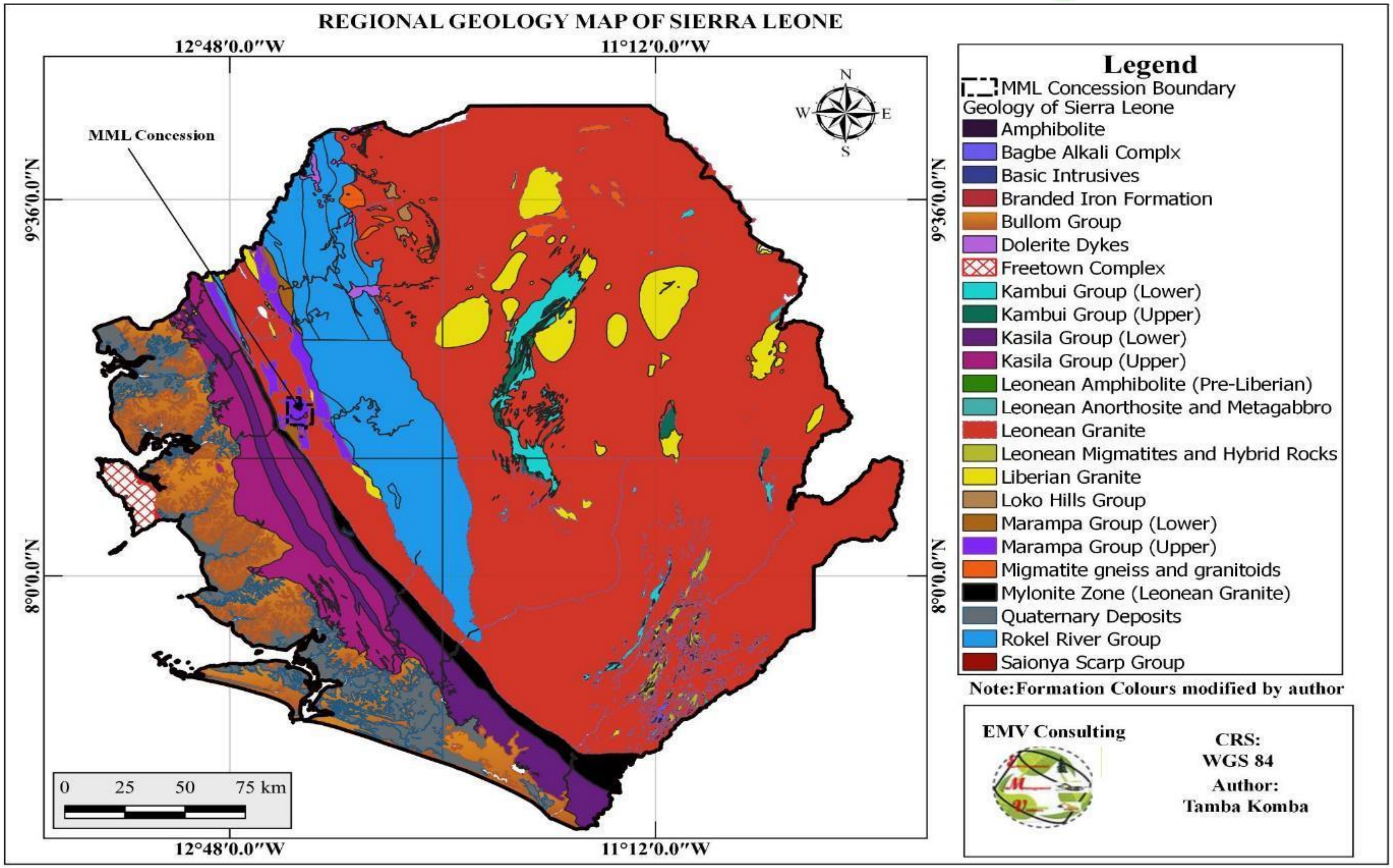


Figure 4- 5: The Geology Map of Sierra Leone

It is believed that four episodes of tectonic events have affected Sierra Leone Archaean rocks. The rocks affected by these events have been broadly categorized into 2 major groups:

- The supracrustal rocks- constituting rocks from the Kambui Super Group, Kasila, Marampa Groups, Rokel River Group, Bullife of mine Group etc. that are metabasites, meta-ultramafic, and metasedimentary, arranged from oldest to youngest, and
- Infracrustal rocks- Paleoarchean-era rocks, including granitic and gneissic ones, serve as representation.

East of the Kasila Group, on top of granitic terrains, is the Marampa Group. Ironstone, low-grade supracrustal rocks that were recumbently folded, and derived volcanic sediments are all present.

4.3.1.2 Basement Complex

These basement rocks have been dated to be over 2,700 million years old. MacFarlane et al., (1974) recognized three types of granitic rocks in the basement: The Synkinematic granitic migmatites which range in composition from quartz diorite to granites with a predominance of granodiorite, the homogeneous Synkinematic granites which are pale colour and poor in mafic constituents. These are sporadically distributed throughout the basement with gradational intrusive and frequently distinct contact with a foliated host (Williams, 1978). Finally, the late Kinematic granites (younger granites) are distinctly discordant bodies formed during the Liberian (Thermo-tectonic) event, Ca2700 Ma. Furthermore, Macfarlane et al, (1974), Rollinson (1974), and Keyser and Mansaray (2004) have subdivided the granitic Basement into two time-structural stratigraphic units:

- The older unit is referred to as the Leonean, and
- The younger one is called the Liberian.

4.3.1.3 The Supracrustal Suite

The supracrustal rocks are situated on a platform composed of granitoid and migmatite gneisses that make up the basement. They are rocks with varied lithologies and ages that are exposed in a stratigraphic sequence. They are believed to be younger than the Basement complex rocks. Greenstone and schist from the Basement complex make up its composition. Because it was believed that they were deposited on the basement rocks, they were given the name upper crustal.

Supercrustal and Basement rocks can be distinguished among the rocks in the project area. Meta-basites, meta-ultramafics, and meta-sedimentary rocks are part of the supracrustal suite. Dike intrusions made of dolerite are also present. The quartz- muscovite-haematite schist and quartz-muscovite-sericite schist, which make up a small portion of the area, are typical examples of rocks found in the metasedimentary assemblages within the MML mining footprint influence.

4.3.1.4 The Intrusive-Late-Kinematic Granites

They are the product of the various thermotectonic events that took place within the region. These events resulted in the metamorphism and restructuring of the Basement complex rocks and the various fold structure seen on the supracrustal rocks. According to Escolar's concept of classification, granite that forms during the peak of orogeny he called syn-kinematic, those form at a reducing orogenic event, he called late-kinematic and post-kinematic granite to those that form after orogeny. Most of the granites fall into two main categories: the small discordant and typically unfoliated late-tectonic to syn- tectonic granite; and the large-syn-tectonic batholitic granites. They are usually concordant with regional structures and often foliated.

4.3.1 MML Local Geology

The mining area footprint forms a part of the Marampa group. This group is one of the eight major geological units in the geology of Sierra Leone. According to MacFarlane et al., (1981), the Marampa Group is situated about 20 km to the east of the Kasila Group and is in low angle thrust faulted contact with the underlying granitic basement. The iron ore deposits in this volcano-sedimentary group, which trends NNE-SSW, are noteworthy. Two formations make up the Marampa Group, which is surrounded on its eastern margin by a tectonic contact:

1) The Upper Meta-Sedimentary Formation, also known as the Roktolon Formation and
2) The Lower Meta-volcanic, better described as the Matoto formation.

The MML's current mining and extension operations fall within the Upper Meta- sedimentary formation. Three sub-members can be distinguished in the Upper Meta- sedimentary formation: the Mabole, Masiemra, and Masaboign members. Both the existing mining areas and the sites for extension are in the Masaboign member, which is predominantly haematite, quartz-haematite-sericite schist. The Marampa Group has a typical greenstone lithology, but the structural and Metamorphic characteristics are in sharp contrast.

The Marampa Deposit's primary iron minerals are specularite and hematite, with trace amounts of martite and magnetite. The weathering of the primary iron ore caused the deposit to produce a thin layer of secondary-enriched iron ore known as "Red Ore Cap," which was almost entirely mined out by earlier mining operations. During this process, millions of tonnes of tailings accumulated as alternate bands of millimetric-sized low- grade hematite and clay materials. As stated by Geoestavel (2011), within the tailings, there are significant lateral and vertical variations in the iron grade and grain size distribution.

At depths of about 150–200 m and 400 m below the surface at Masaboin Hill and Ghafal Hill, respectively; basement gneiss lies beneath the schist. A hornblende gneiss and a muscovite gneiss make up the mine's basements to the east and west, correspondingly.

Additionally, there exists quartz-muscovite-sericite schist that is believed to contain patches of tremolite actinolite-talc schist. The actinolite-talc-hornblende schist makes up the meta-ultramafic, and it is on the opposite side formation. Small-scale folds can be found in the quartz muscovite-sericite schist. The Basement granite in some places displays an asymmetrical synclinal fold, and the majority of the rocks within the project area of influence have undergone greenschist to lower amphibolite facies metamorphism.

The geology of MML's mining area of influence is characterized by a sequence of low- grade meta-sedimentary rocks consisting of interbedded Quartz-haematite-mica and

quartz-haematite-sericites schists which is part of the Paleoproterozoic-aged Kasila

Group (Figures 4-6 and 4-7).

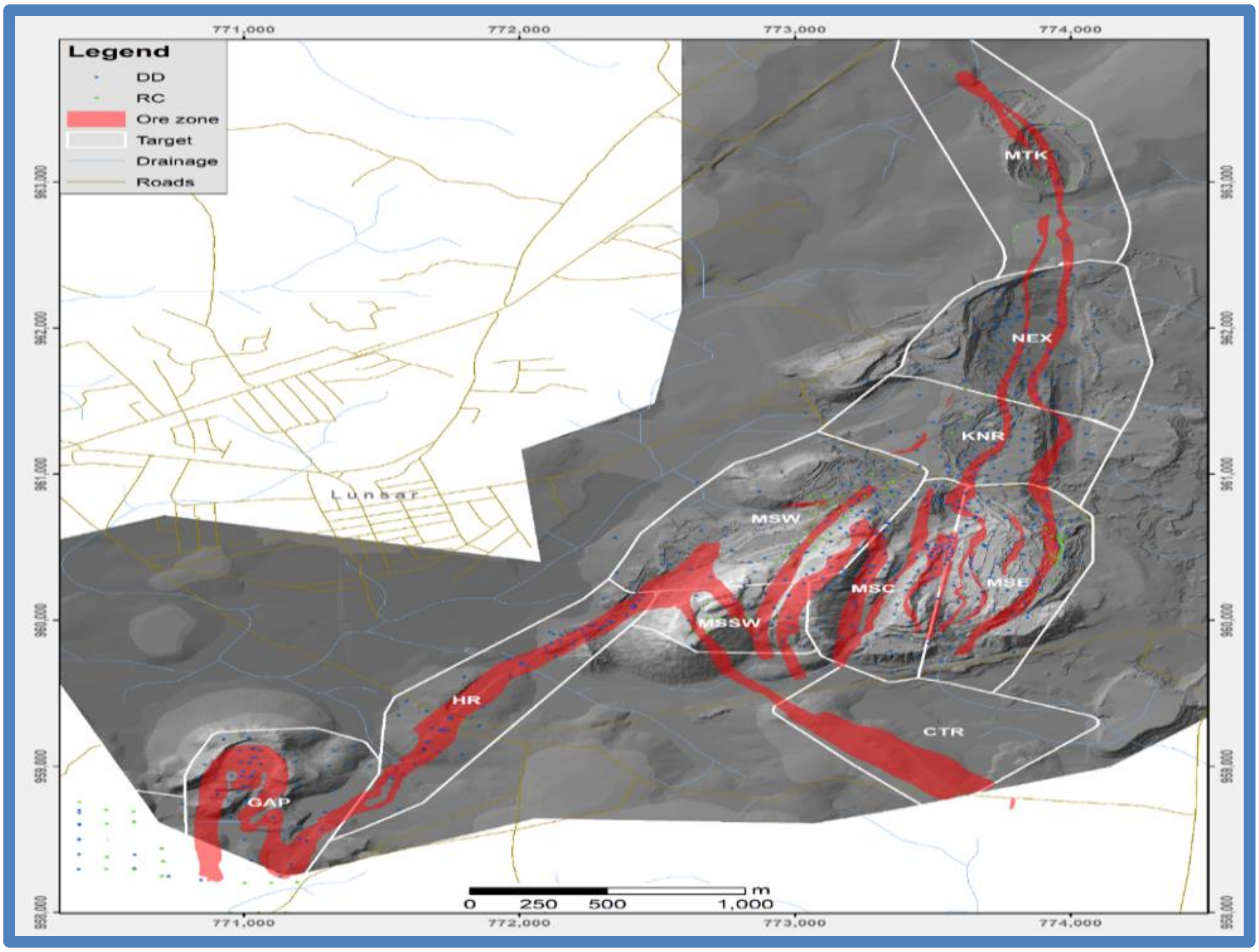


Figure 4- 6: Marampa Local Geology Map

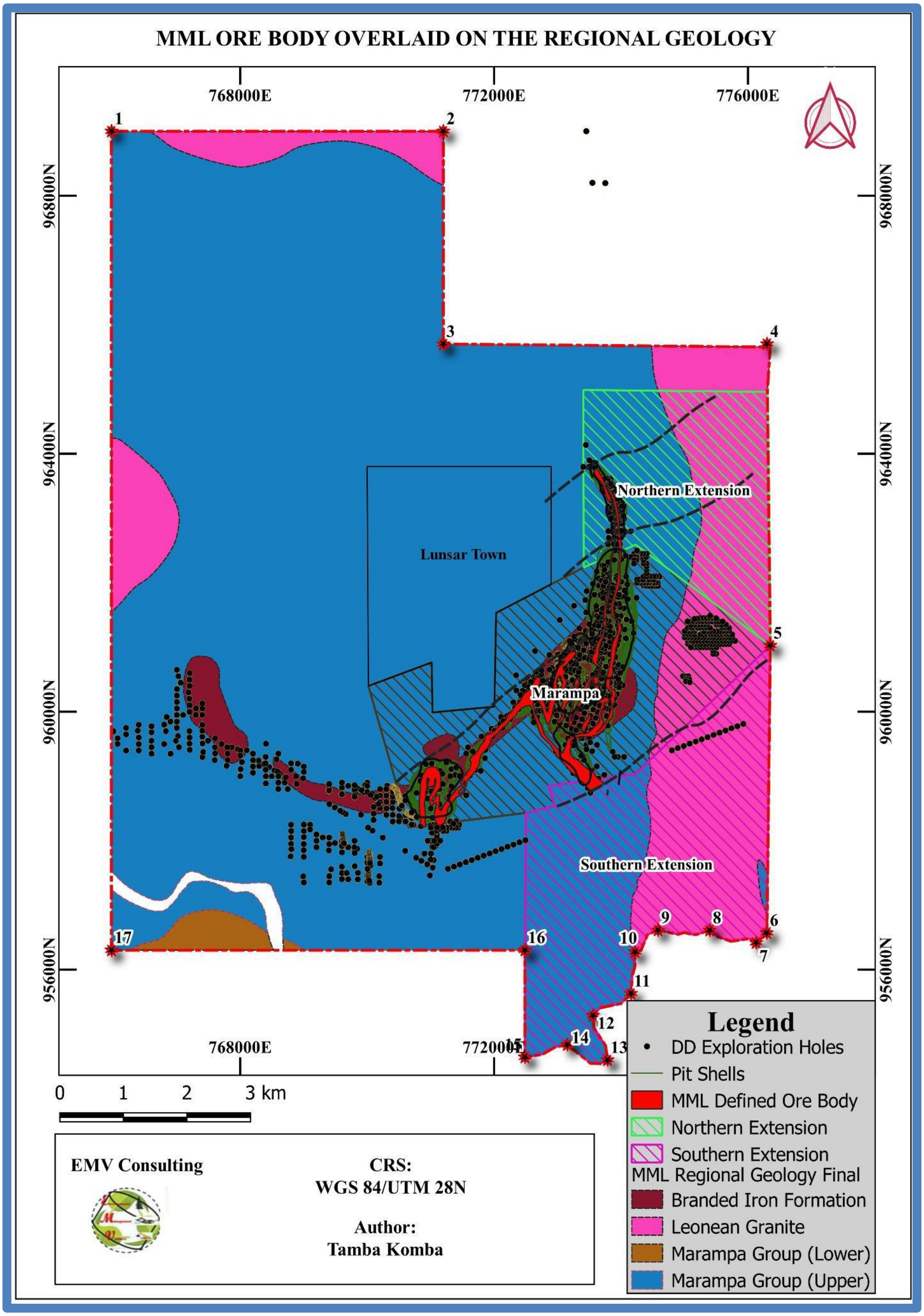


Figure 4- 7: Marampa Local Geology Map capturing the extension sites with reference to Sierra Leone's regional geology.

4.3.2 Mineralization of the Mine's Operational Area

The mineralization at Marampa is typically an iron ore deposit. It is this commodity that MML is mining in its current operation. The same ore deposit is found in the northern and southern extensions, indicating what the company will be extracting as part of its drives to scale up production to achieve the proposed 3.75 million tonnes of dry iron concentrates per annum. The iron ore is hosted within the Masaboin members in the Marampa Group meta-sedimentary rocks. The iron ore deposit occurs in the form of quartz-mica-schist, which is the waste and quartz-specularite-sericite schist, the ore with grades ranging from 35% to 65%. Other minerals such as quartz, feldspar, and mica are also present in minor amounts.

Overall, the Marampa Mines' geology and mineralization show a rich deposit of iron ore with the potential for further exploration, the discovery of additional resources, and ultimately, the definition of reserves.

4.3.2.1 Ore deposits

It is worth noting that not all "mineral deposits" are "ore deposits". The term, "ore deposit" has more economic implications than just geological viability. In this report, an ore refers to minerals deposits that have the potential to be mined at a profit, after considering all contemporary factors that may influence the mining operations. According to ESHIA reports from the company, six primary ore deposits have been defined within the company's operational influence:

- Masaboin complex (east, west, central, and south)
- Campbell Town Ridge ore body
- Mathukia
- KNR

Additionally, ESHIA reports indicate that six priority areas have been identified for prospecting specularite-hematite-schist within the company's concession. These areas are listed below:

- **Gafal Prospect-South and West**: Situated immediately to the west of the old Gafal Hill mining area and bordering ML02/05. This area shows gravity high and strong scattered high anomalies.
- **Mathukia Prospect**: an area that is approximately 1.5 km stretch, covering a gravity high located proximately along strike to the north of the old Masaboin Hill mining area bordering ML02/05.
- **Makambo Prospect**: positioned roughly 8km north of the Lunsar community,
- **Mafuri Prospect**: a gravity high placed almost 3 km west of Gafal,
- **Rotret Prospect**: like the Matukia prospect distance, a gravity high located around 1.5 km south of Gafal,

- **Toma Prospect** - nearly 7 km south of Lunsar Town and south of the River Rokel.

Before it was recently transferred to Marampa Mine Ltd., the then Marampa Iron Ore Limited was primarily focused on the development of four of the six prospects: Gafal, Rotret, Mafuri, and Matukia Prospects.

4.3.2.2 Mineral Resources and Reserves

The Joint Ore Reserves Committee (JORC) Code 2004 governs how resources are reported. The primary iron ore deposits in the original SL Mining area were estimated to have mineral resources totalling 832 Mt of indicated resources with a grade of 31.8% Fe and 208 Mt of inferred resources with a grade of 30.7% Fe at a 15% Fe cut-off grade, according to the 2013 ESIA report.

In the same 2013 ESIA report, it is established that the hard fresh rock which makes up approximately 86% of the indicated resources that are accessible is followed by highly and moderately weathered ore, totalling 116 Mt. The mine plan during this time will also include the ore deposit in Area 2 of the Cape Lambert Area.

Sound Mining Solutions undertook the resource-to-reserve conversion in August 2013. The JORC code is followed in the preparation of the reserve statement. Table 4-1 below, "Primary Ore Reserve Statement," provides that information.

Table 4- 1: Primary Ore Reserve Statement. Source: Sound Mining Solution JORC Statement (2013)

Type of Ore	Classification type	Mt	Fe (%)	Al_2O_3	Mno2	SiO_2	P
Weathered	Probable	42.7	34.1	6.5	37.8	0.3	0.1
Unweathered	Probable	473.1	31.3	4.8	29.7	0.6	0.1

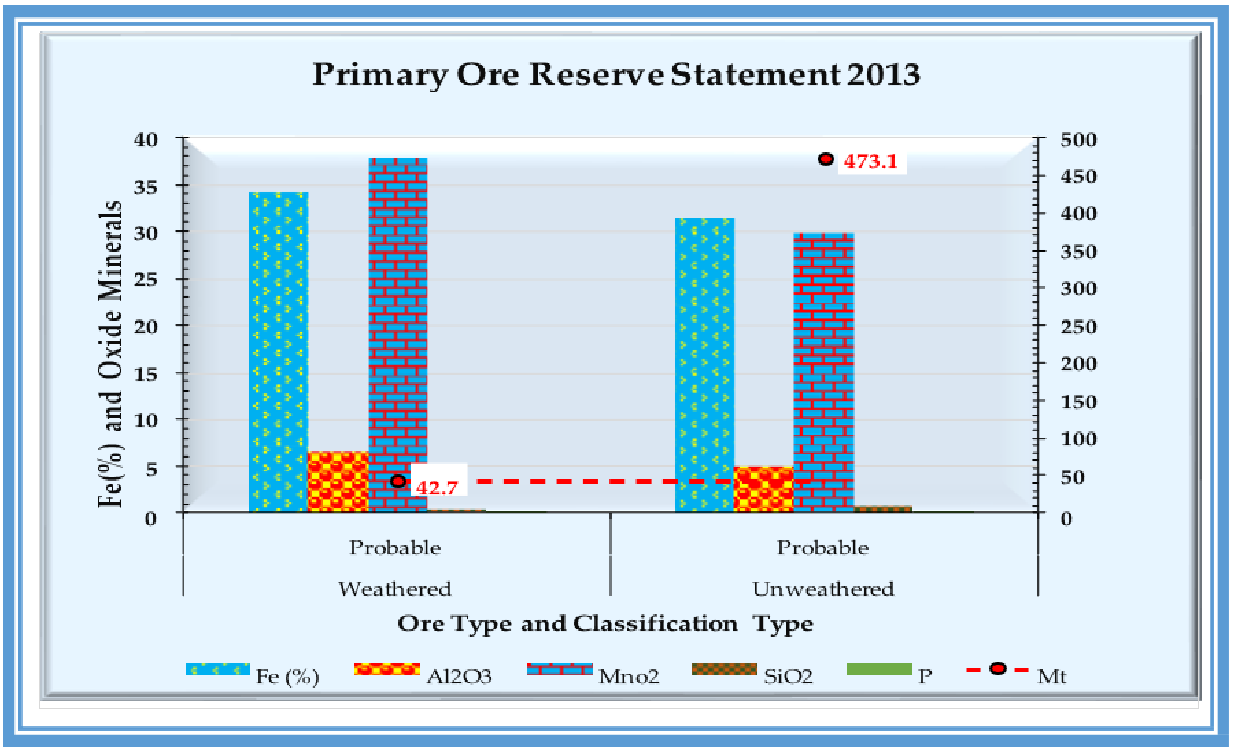


Figure 4- 8: Primary Ore Reserve Statement. Source of raw data: Sound Mining Solution JORC Statement (2013). Chart by Tamba Komba

Also, the recent estimation of the resources by the defined pits, type and weathering class was carried out with respect to "Resource Categories in the Life of mine (Weathering)" of MML. The Inferred category tonnage cannot be converted to Ore Reserves, while the Mineral Resources considered for conversion are listed in Table 4-2 and totalling 287,199(kt) with a weighted average Fe grade of 32.52%.

Table 4- 2: Summary of the Life of mine (Weathered)

MARAMPA MINES LIMITED - Summary of Life of Mine schedule					
Report	Year	Cut-off grade (%Fe)	Average grade (%Fe)	Resources (bt)	Obs.:
Snowden (BFS)	2012	15%	31.5%	1.04	Limited by the boundary of the tenement.
PMDE (Medium-term schedule)	2017	15%	31.5%	1.04	LM resources - limited by boundary of the tenement.
MICON (DFS)	2022	15%	30.18%	1.2	LM+CP resources and new pit optimization

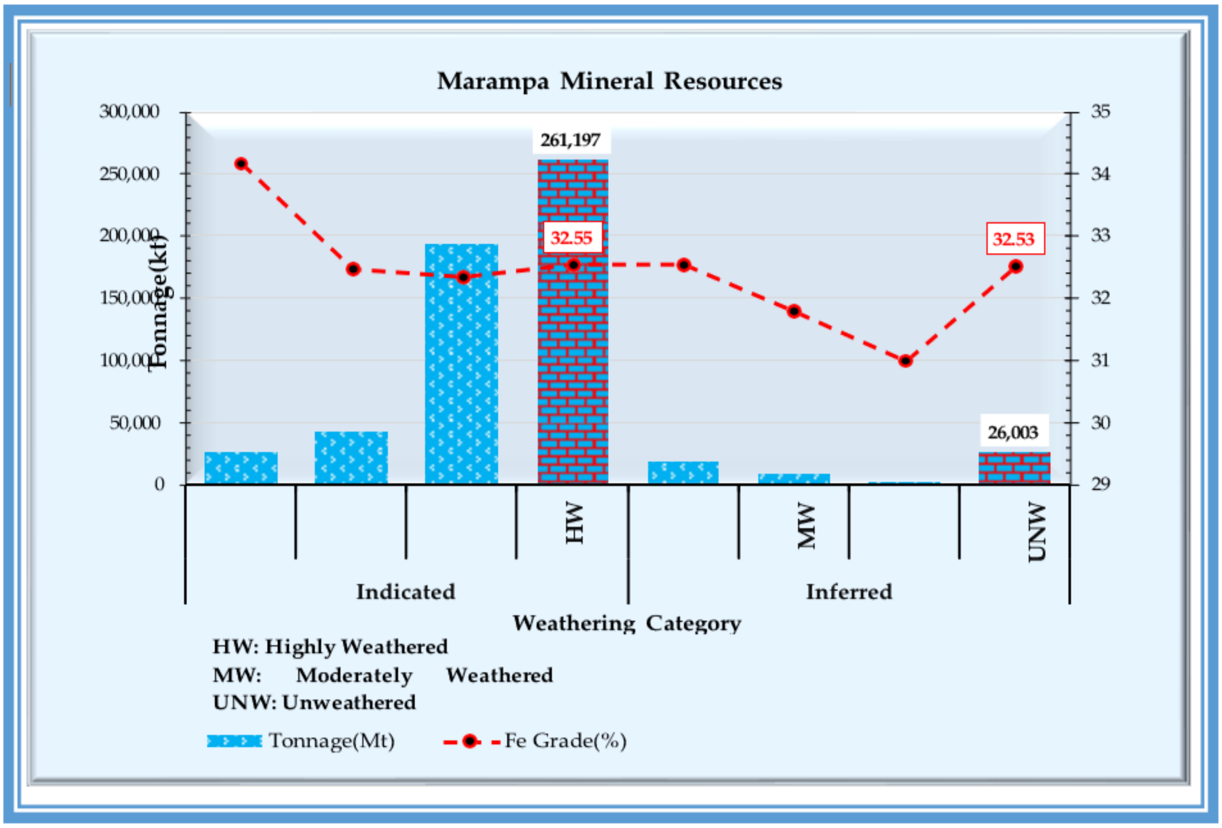


Figure 4- 9: Mineral Resources in Life of mine Plan. Source of raw data: MML Technical Leads (2023). Chart by Tamba Komba

4.4 Grade control Practice

Grade control procedures are cyclical, and it is aimed at ensuring that the ore and waste materials are separated from each other to minimise ore losses, dilution, and contamination. This is done under the supervision of MML. The ore is hauled primarily to the Run-of-Mine (ROM), or direct feed to the crusher or the wet-season stockpiles. The operation is planned to increase production during the dry months and build an ore stockpile adjacent to the concentrator feed bin. This stockpile will be loaded into the feed bin during the wet season to maintain constant production through the concentrator. The waste is hauled to the nearest waste dump or used as backfill materials.

4.4.1 Ore Processing at MML's Plants

The processing of ore on-site will involve several stages, including crushing, grinding, flotation, and the use of flocculants and coagulants to improve the efficiency of the separation process and enhance the quality of the final product. The ore is crushed and ground to a fine size and then undergoes flotation to separate the ore minerals from the gangue minerals. The concentrate will be further processed through Flocculation and Coagulation. Flocculants and coagulants are chemicals commonly used in processing plants. At MML's processing plants, Polyquaternary amine (PQA) and Polyacrylamides (PAMs) are the main coagulants and

Flocculants used respectively to improve the efficacy of the separation process.

Coagulants are chemicals that help to bind small particles together, forming larger clumps or flocs. During the iron ore processing, the above coagulant is used to help separate the iron ore from impurities such as silica and alumina. Coagulants are typically added to the ore slurry prior to the addition of flocculants.

Flocculants, on the other hand, are used to help settle the coagulated particles by increasing the size and weight of the flocs. This makes it easier for the heavier iron ore particles to settle to the bottom of the separation tank, while the lighter impurities are carried off with the water. Flocculants are typically added after the coagulant has done its job. The use of this coagulant and flocculant in the iron ore processing at MML's processing plants can lead to significant improvements in the efficiency and effectiveness of the separation process, resulting in higher quality iron ore concentrate and more efficient use of resources. When used in tandem, flocculants and coagulants offered a reliable and affordable way to get rid of suspended particles in water solutions or slurries. If given enough time, some particles would eventually separate from the water on their own. Due to their small size and electrical charges, other particles, however, would not settle for days or even months. The main purpose of coagulants is to remove very small, suspended particles from solutions that do not settle quickly. The primary function of the flocculant is to bind and aggregate suspended particles in water into large particles to aid in their settling and make it easier to remove them using particle and water separation processes.

Mica and ankerite, which are weakly paramagnetic and harmful to the saleability of a product, are found in Marampa ore. The flowsheet includes stages of separation using WHIMS and spirals, both of which have been effective in obtaining the desired concentrate iron grades. For the combined spirals and WHIMS concentrate, the gravity concentration circuit helps with rejecting the alkali and ankerite minerals below market penalty limits.

Prior to being transported to Thofayim River Terminal (TRT), concentrate is filtered by a horizontal belt filter to achieve a safe moisture content level and stockpiled. FEL recovers concentrate for loading onto trucks, which are then used for road haulage.

4.4.2 Soil Analysis

Soil analysis for MML'S extension project is based on both primary and secondary data available during the conduct of the ESIA studies. The secondary data include but are not limited to the FAO Digital classification of soils at different levels, soil geotechnical test reports from MML, borehole logging, grade control drilling cuttings and lithological logging of drilled cones etc. Whereas the primary data include a physical assessment of soils in the project extension footprints by the geology and soil team of the ESIA studies. In this section of the report, the physical and chemical properties of the soils in the extension areas, the potential impacts of mining on its quality and stability, and then the feasible mitigation measures that can be taken to minimize these impacts are considered.

4.4.2.1 National Soil Categorization from a Global Perspective

At the seventh congress in Madison, Wisconsin, USA, in 1960, the International Union of Soil Sciences (IUSS) emphasized the importance of creating soil maps that are accessible to the public on a continental and regional level. As a result, in 1961, the Food and Agriculture Organization (FAO) and UNESCO initiated the Soil Map of the World project, which was based on a 1:5,000,000 scale. The project took twenty years to complete and resulted in the production of 19 map sheets. This remarkable achievement was made possible through the collaborative efforts of numerous soil scientists worldwide. For many years, it remained the sole comprehensive overview of global soil resources, until recent times.

In Sierra Leone, three major soil types have been placed under 23 sub-soil classifications (Figure 4-10) according to different textural features and other related- distinguishing factors. The Marampa Mines Limited operations have two of these soil classes, according to the FAO soil classification system. In this system, a code is used to identify soil types based on their properties and characteristics. The code consists of a series of letters and numbers that provide information about the soil type. Across the existing and expansion sites, the "***Fo39-2b-1168***" and "***Fo39-2b-1169***" are the dominant soil types. Both soils are Sandy_Clay_Loam, but the difference between these two soil classes lies in the "**degree of base saturation (DBS)"** (a ***measure of the proportion of soil cation exchange sites that are occupied by basic cations such as calcium (Ca2+), magnesium (Mg2+), and potassium (K+). It is expressed as a percentage of the total cation exchange capacity (CEC) of the soil).*** Comparatively, Fo39-2b-1168 has a much lower **degree of base saturation** than Fo39-2b-1169 (Figure 4-11)

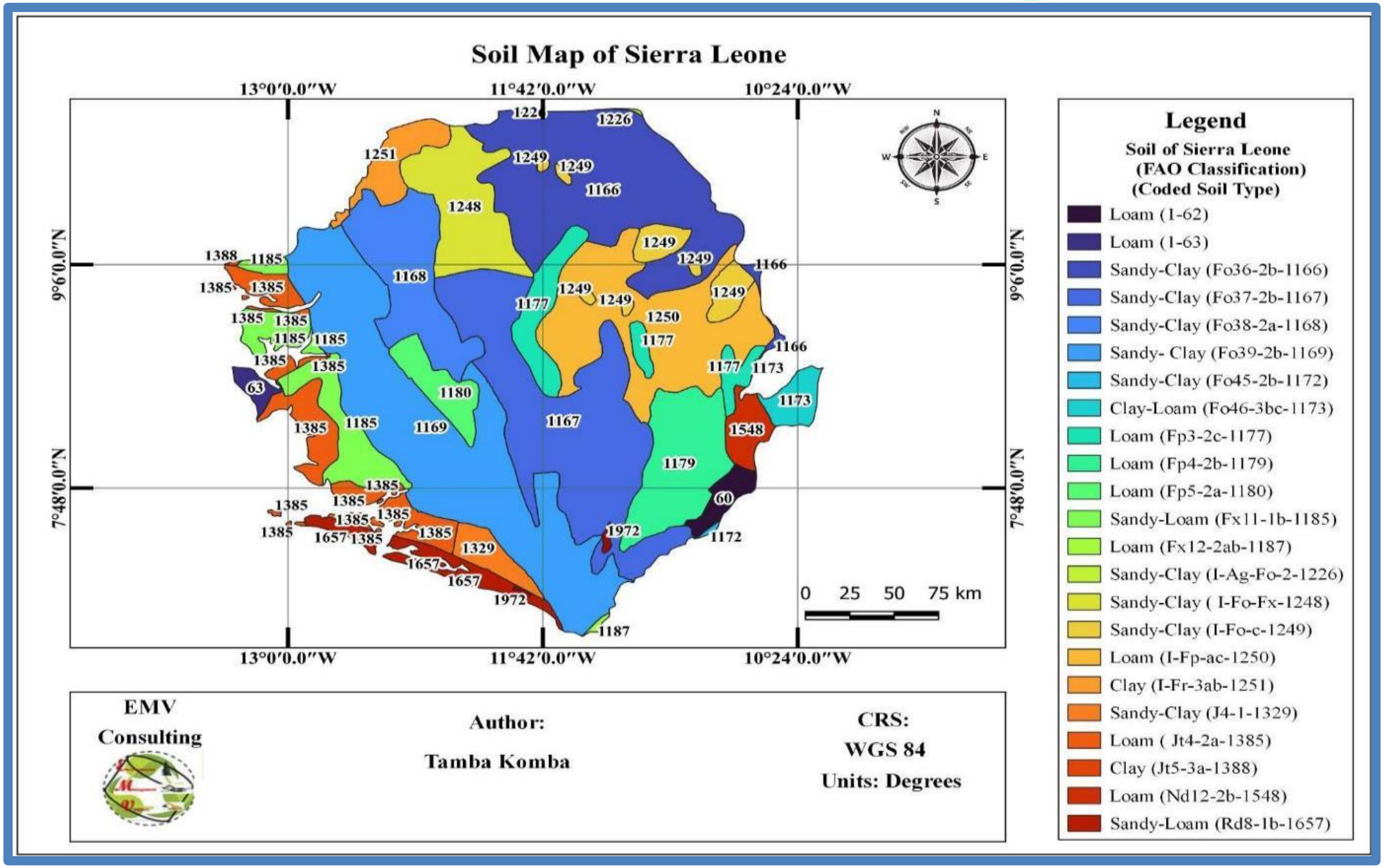


Figure 4- 10: The FAO's Classification of Soil Types in Sierra Leone

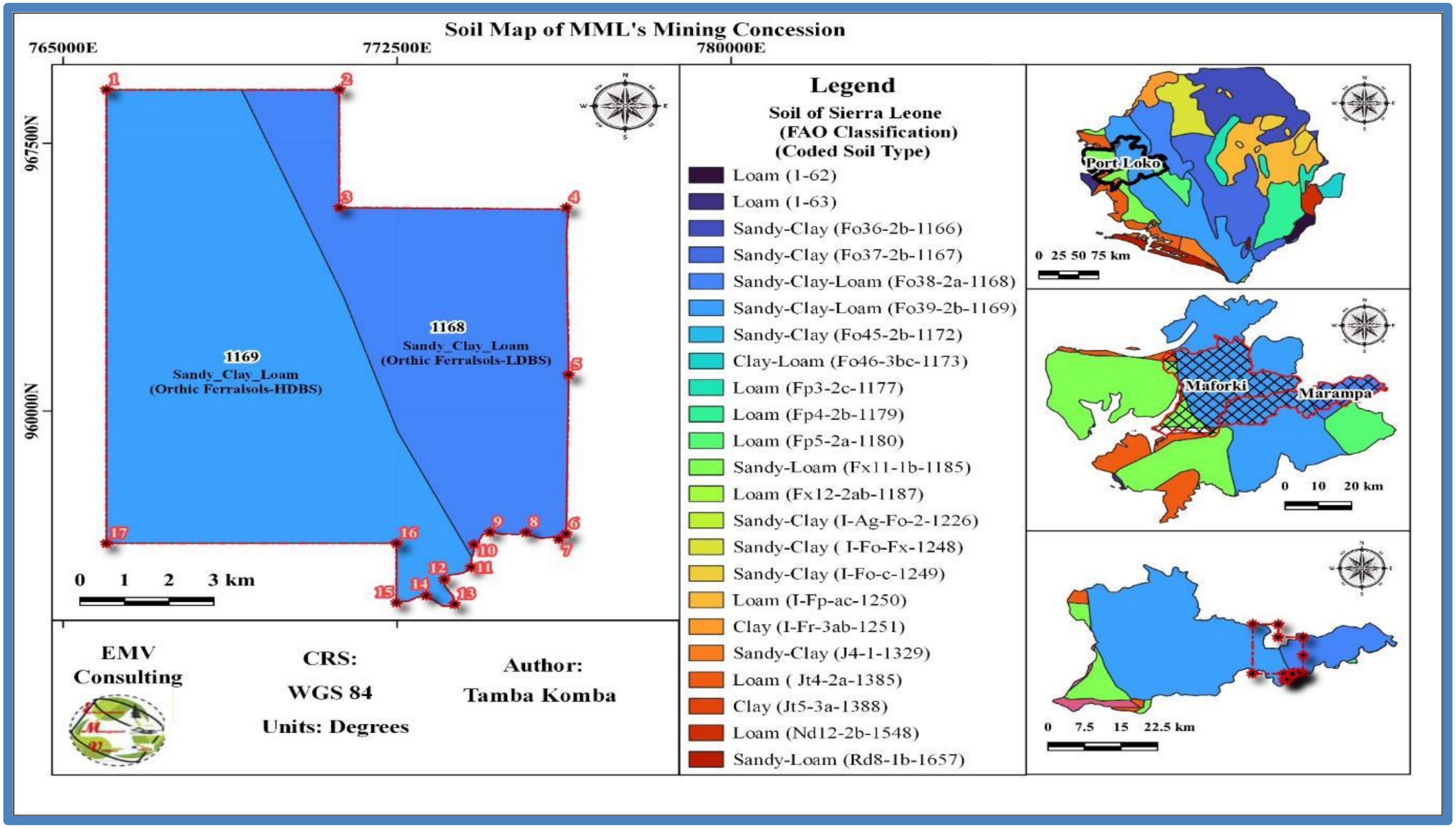


Figure 4- 11: MML's Soil Types According to the FAO's Classification System

4.4.3 Soil Composition and Characterization

The soils in the current mining areas and extensional zones are typical of tropical soils and those connected to the parent material's weathering process. Although the soils typically have a sufficient water-holding capacity to meet plant needs during the dry season, they are heavily leached, and as a result, tend to be low in nutrients that are adsorbed. Two dominant reference groups of soils, each reflecting similar physical and chemical characteristics, can be used to broadly classify the soils in the project's footprint influence as presented below.

4.4.3.1 Ferralsols

represent the traditional, heavily weathered, red or yellow soils of the humid tropics and have diffuse horizon boundaries, an assemblage predominately composed of low-activity clays, primarily kaolinite, and a high concentration of sesquioxides (non-silicate clay minerals or colloids; and

4.4.3.2 Gleysols

tend to involve submerged soils that have been sufficiently saturated with groundwater to experience reducing conditions and develop gleyic properties. Reddish, brownish, or yellowish colours at aggregate surfaces and/or in the topsoil layers, combined with greyish/bluish colours inside the aggregates and/or deeper in the soil, make up the majority of this pattern. Nearly all of the swamplands in the South and Southwest of the ESIA study area were the only places where these soils were found predominantly.

4.4.3.3 Physical Properties:

Examination of the physical properties of the soils in the project's extension areas indicates that the soils are primarily composed of sand, silt, and clay particles. The texture of the soils varies from sandy loam to clay loam, with moderate iron stains in some places.

From a localized perspective, the soils in the project's extension footprints can be categorized into three groups based on the redox evolution that the soils are believed to have undergone:

1) Oxidized soil,
2) Reduced soil, and
3) Weakly oxidized soil

4.4.3.4 Oxidized soil

This type of soil in both the current and extension areas is believed to have undergone processes that have resulted in the organic matter being broken down by exposure to oxidizing agents. The resultant effect is a change in the colour, texture, composition, nutrient content, water-holding capacity etc. This soil is characterized by reddish to a reddish-brown appearance and yellowish-brown. The texture is coarse and less compacted, having a more granular structure due to the breakdown and subsequent loss of organic matter in the original formation. Physical examination of this group of soil shows that it is less compacted, indicating a decrease in the soil's ability to hold water. And this is an integral component in soil structure and water retention. The oxidation process of this group of soil must have produced some form of organic acid, making the soil more acidic. Because the soil has an unhealthy balance of organic matter and other nutrients, it is now less fertile and poorly suited to support plant growth. This soil is normally found in areas with high elevations with sparse vegetation across MML's operations- mine to TRT.

Figure 4- 12: An Exposed Face of a Newly Excavated Area Where the New Power Plant is to be Built.

Figure 4- 13: An Exposed Active Mining Dig Face at KnR Pit Shows Different Soil Layers.

4.4.3.5 Reduced soil

In the project's footprint, this type of soil has undergone a reduction process, in which the absence of oxygen in the soil results in the reduction of some compounds. In this case, the texture, colour, and composition of the soil have been altered. A conspicuous feature of this soil category is the greyish to bluish-grey appearance due to the presence of reduced iron and magnesium contents. This soil is better compacted and sticky with finer texture owning to the accumulation of healthy organic matter. The soil is more alkaline and will invariably have better nutrient contents to support healthy plant growth. Moreover, the build-up of organic matter and the decrease in iron may help to improve soil structure and water retention. This will lead to an increase in the soil's capacity to hold water. This soil is mostly encountered in low-elevation areas like swamps, old, mined pits and marshland.

4.4.3.6 Weakly oxidized

This type of soil within the project footprints has undergone partial oxidation, leading to the formation of some iron oxide and/or manganese oxide. This soil typically occurs in humid areas within the project's concession, and where the water table is high with intermittent saturation and drying. The partial oxidation of this soil causes it to become mottled, with alternating zones of oxidized and reduced soil material.

The degree of oxidation in this soil is less than that found in fully oxidized soil, which has a higher degree of iron oxide formation. This soil may still contain significant amounts of organic matter, which can be preserved by the oxidized zones of the soil. These soils can have important implications for plant growth and nutrient cycling, as well as for soil drainage and water quality.

In general, this soil can indicate a particular type of soil-forming environment, which may be important for land management and conservation efforts. However, it is important to note that specific characteristics and properties of this weakly oxidized soil can vary greatly depending on factors such as climate, topography, and parent material in the area.

In some places, especially where the soil is exposed to anthropogenic activities, the soil structure is generally weak with low porosity and permeability. This is due to compaction and erosion caused by natural processes such as wind and water, as well as human-driven activities such as grazing and farming.

4.4.4 Generic Soil Profile

The soil profile across the existing mining area and extension sites were established using both primary and secondary data. The primary data consists of on-site visit assessment of excavated pits, newly exposed face walls, physical examination of soil materials etc. whereas, the secondary data were obtained from previous geotechnical studies reports done by several consulting firms: spanning from 2011 to 2022. Two sets of soil profiles have been established:

1) the current mining area and northern extension soil profile, and
2) the southern extension sites' soil profile.

4.4.4.1 Current Mining Area and Northern Extension Soil Profile

In almost every area of the current mining setting, there is a significant correlation between the soil profile data from drilled cores and exposed excavated pits. The soil profile in MML's current operational area is made up of made-ground, which is composed of old tailings on top of weathered lateritic soils that grade to saprolite before changing to unweathered fresh rock.

The base of the fresh rock is made up of bands of high iron hematite and specularite interspersed between layers of quartz-mica-schist. Occasionally, quartz dykes cross over the bedrock. Moreover, geotechnical logging data revealed faults dipping at about 45 degrees and running parallel to the ore body's folding. To better understand and describe the soil profile within the current mining area, a careful examination of geotechnical boreholes interpreted data was utilized. From the "M3,75 iron Ore Project Proposed Crusher, Conveyor and Stockpile Construction Geotechnical Report", nine boreholes were sunk at suitably selected locations to depths between 25m and 29.5m. The hardness and structural information of the ground were the key criteria for drilling the holes. It shows from the drilled cuttings that the composition of the materials to the predefined depths is consistent with the drilled cores, exposed dig face and other newly excavated pits. Therefore, the below soil profile (Figure 4-

14) has been established to be generic for both the current mining areas and the northern extension:

- Made ground- old tailing and topsoil organic matter.
- Weathered lateritic soils.
- Saproplite
- Unweathered fresh rock

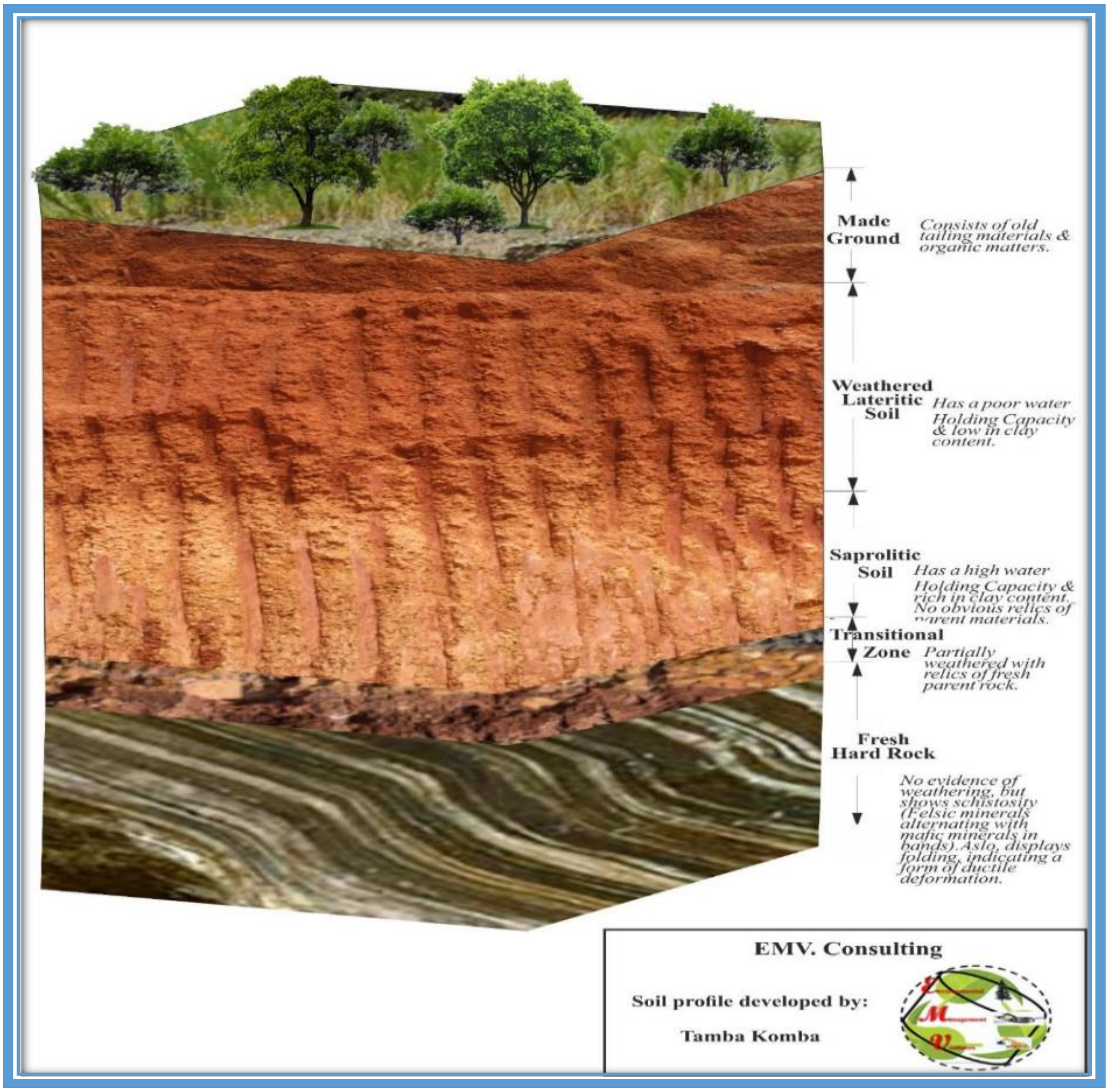


Figure 4- 14: Generic Soil Profile for the Current Mining and Northern Extension Site

4.4.4.2 The Southern Extension Sites' Soil Profile

In both extension areas, the topsoils are devoid of old tailing materials, which is the marked difference between the soil in the current mining area. The topsoil layer consists of dark brown to reddish brown, loamy soil with a depth of about 4m. This layer contains roots of grasses and other small plants. The subsequent layers of the soil in the northern extension are consistent with the soil in existing mining areas.

For the southern extension, an examination of the logging data and photos of the trial pits in the geotechnical investigation carried out at the proposed new TSF show an incredible difference in the soil's composition. The soil shows a very dense dark brown clayey gravel with abundant organic materials at the top. This is followed by a highly weathered yellowish-brown clayey gravel that is moist.

	
A highly reduced upper soil layer at the proposed new TSF. Trial Pit 14. Source*: Final Report, Geotechnical Investigation 3.75 DSF Tailing Storage Facility*	**Oxidized/weathered component at the proposed new TSF**. *Trial Pit 14. Source: Final Report, Geotechnical Investigation 3.75 DSF Tailing Storage Facility*

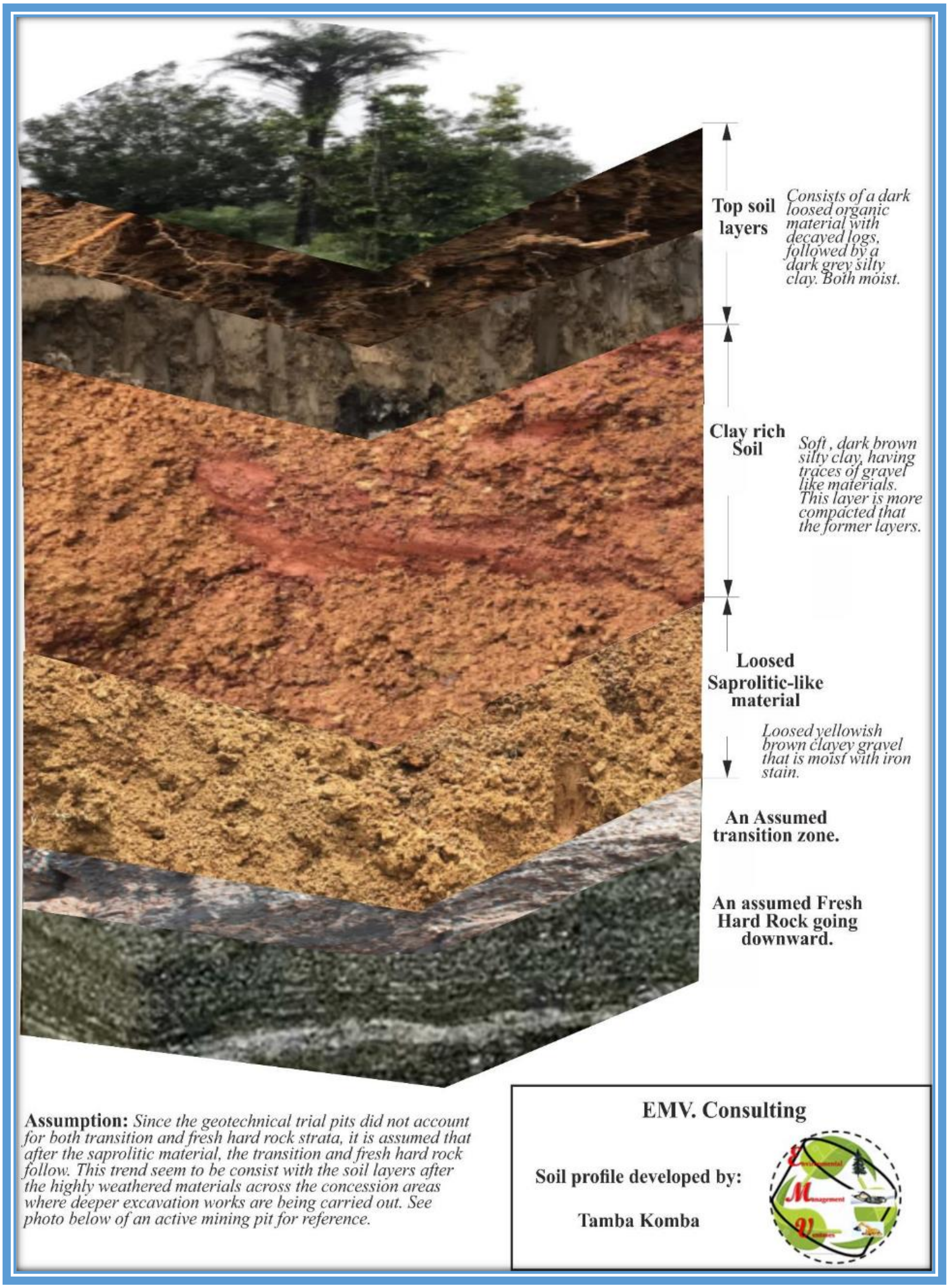


Figure 4- 15: Generic Soil Profile for the southern extension site

4.5 Chemical Properties:

There is a slight difference in the overall composition between soils in the northern and southern extensions. However, soil composition in each of the extensions is consistent across all the surrounding communities that may be directly or indirectly influenced by the project's operation. The chemical properties of the soils, especially in the northern extension were analysed through assay results of grade control drillings. Whereas the soil in the southern extension at Moria, where the new TSF will be developed was analysed from the soil laboratory result from Waterlab (PTY) Limited. For the northern extension, the assay result shows no evidence of sulphide and heavy metal occurrence.

And for the southern extension, where the waste effluent will be discharged, tailing samples were analysed to establish the waste classification type using the following:

- Toxic elements in the tailing/ waste material,
- Sulphide floatation,
- ABA (Acid-Base Accounting),
- NAG (Net Acid Generation)
- Sulphur Speciation

Interpretation of the result from Waterlab (PTY) Limited (Appendix B) indicates the undermentioned:

- All the toxic elements and/or heavy metals tested for are far below Sierra Leone and the international threshold limits
- The samples' Leachable Concentrations (LCs) in mg/l are way below Leachable Concentration Thresholds (LCT0, LCT1, LCT2, LCT3 and LCT4) in mg/l.
- Similarly, the Concentration Thresholds (CTs) are below the Total Concentration Threshold (TCT0, TCT1, and TCT2) in mg/kg
- The trailing/ waste can be classified as type 4, indicating it is suitable for disposal in the Valley B TSF
- The samples have an average Ph of 6.7, which is slightly acidic
- The difference between the Neutralization Potential (NP) and the Acid Potential (AP) of the sample analysed is greater than zero: (NP-AP)>0. This implies the waste/tailing has the potential to neutralize any acid produced
- The Nett Neutralization Potential (NNP) of the representative sample(160472D) is recorded as 0.375. Since it is less than 20(NNP< 20), it is potential acid-generation, but it is self-neutralizing (see point 6 above)
- Finally, the sulphur content is far below 0.3 %. Meaning there is no sustainable long-term acid generation

Generally, the current and extension areas have both negligible Acid Rock Drainage (ARD) and Acid Mine Drainage (AMD) in terms of the mining operation and waste management. The soils in the extension areas have moderate to high levels of organic matter; especially the southern extension, which is indicative of a healthy soil ecosystem. The representative sample from the proposed new TSF does not indicate any elevated levels of heavy metals such as Arsenic, Cadmium, lead, copper, zinc etc., which are associated with the underlying mineral deposits and rock in the mine (Appendix B). As of the time of this study, no geochemical data was available for the Getty at Thofayim where the dry concentrated is being loaded for subsequent transhipment.

4.5.1 Potential Impacts of Mining on Soil Quality

4.5.1.1 Mining Operation

Mining activities associated with the ESHIA in the existing and extension areas can impact the quality of soil in several ways. One significant impact is the disturbance of the natural soil structure and the removal of topsoil and vegetation during the mining process. This can lead to soil erosion and compaction, which can reduce soil fertility and nutrient availability.

Additionally, mining activities can also expose underlying soil layers to air and water, which can result in the oxidation of sulphide minerals and the release of acid and metals into the soil. This process is known as Acid Rock Drainage (ARD) and can have significant impacts on soil quality. ARD can lower soil pH levels, making it difficult for plants to grow, and can also result in the release of toxic metals that can accumulate in the soil and impact the health of soil organisms and the wider ecosystem.

4.5.1.2 Mining Infrastructural Development

The construction and operation of mining infrastructure, such as roads, tailings dams, and waste storage facilities, can also impact soil quality. These structures can disrupt natural soil drainage patterns and result in the compaction of soils, reducing soil aeration and the ability of plants to take up water and nutrients.

Summary

In summary, mining activities in both current and extension areas can impact soil quality through soil erosion and compaction, ARD, and the construction of mining infrastructure. Effective mitigation measures, such as soil amendments and the use of cover crops, can help restore soil quality and minimize the impacts of mining on the soil ecosystem.

4.6 General Mitigation Measures:

Several mitigation measures can be taken to minimize the impacts of MML's mining on soil quality. These include:

- Implementing erosion control measures such as revegetation and terracing to reduce soil erosion and compaction,
- Implementing a soil management plan that includes regular monitoring of soil quality and the implementation of soil conservation measures,
- Implementing a waste management plan that includes the proper disposal of waste rock and tailings to minimize soil contamination,
- Implementing a groundwater management plan that includes regular monitoring of groundwater quality to prevent contamination of soil and groundwater resources.

4.7 Potential Impacts of the Processing Plant Chemicals at MML

The use of chemicals for flocculation and coagulation such as Polyacrylamides during the processing of iron ore can result in the contamination of soils and groundwater resources.

4.7.1 Polyacrylamides (PAMs)

Polyacrylamides (PAMs) are also used as flocculants in MML's processing plants to improve solid-liquid separation and reduce water consumption. However, the use of PAMs can have impacts on soil and water quality in a mining environment.

- **Soil Impacts:** When PAMs are used, they can accumulate in the soil, reducing soil permeability and potentially affecting soil fertility. PAMs can also bind to soil particles and create a soil crust, reducing water infiltration and increasing soil erosion.
- **Water Impacts**: PAMs can also have impacts on water quality by binding to suspended solids and reducing turbidity. However, PAMs can also contribute to water pollution by leaching into surface and groundwater, potentially causing harm to aquatic life.

4.7.1.1 Mitigation Measures

To mitigate the impacts of PAMs in the processing plants and mining environments of MML at large, the following measures can be taken:

- **Using alternative flocculants:** Various alternative flocculants can be used instead of PAMs, such as chitosan, polyethene oxide, and starch-based flocculants. These alternative flocculants can be effective in reducing soil and water impacts**.**
- **Proper application:** Proper application of PAMs can help minimize impacts. For example, applying PAMs at the right dosage and at the right time can reduce the number of PAMs that accumulate in soil and water.
- **Monitoring and remediation:** Regular monitoring of soil and water quality can help identify any potential impacts from PAMs. If impacts are identified, remediation measures such as soil amendments or water treatment can be implemented to reduce

PAM concentrations.

- **Regulations:** Regulations can be put in place to limit the use of PAMs and ensure proper application and monitoring of their impacts on soil and water quality.
- PAMs can be useful in mining operations, but their effects on the quality of the soil and water should be carefully considered, and steps should be taken to mitigate any potential negative impacts.

Polyacrylamides and quaternary amine solutions both can affect the quality of soil and water. To reduce the environmental impact of these chemicals, responsible use and proper disposal practices are imperative.

4.8 Contaminated Soil

Soil contamination is potentially associated with hydrocarbons, most likely in areas where the product is stored or in areas where refuelling and maintenance activities are undertaken. While there is no confirmation of contamination, contaminants may also be associated with historical exploration activities and laboratory activities if assay reagents have not been appropriately managed. Should these contaminants have leached through the Summary of Significant Impacts

4.8.1 Dust and Particulate Matter Releases

Dust emissions from the mining operation will occur, primarily because of digging and loading during the dry season. The major impacts on the soil include blasting of hard rock, earth-moving activities, clearing of vegetation, exposing bare ground, stockpiling of materials, and driving on unpaved roads.

Unpaved road networks in MML's current mining areas and extension sites are likely being developed from a mixture of rocks, stone, gravel, sand, and silt, and it can become especially dusty when disturbed by moving vehicles. Even though it may be less of a problem during the rainy season, any moisture in the material or moisture applied by water sprays quickly evaporates during hot weather and times when there is little humidity in the air. Little to no moisture is therefore available when the surface is disturbed to fix fine particulates and lessen the production of dust.

Because there are fewer natural barriers at the mining sites and the project footprint appears to have higher wind speeds, this will further increase the high potential for dust generation and its capacity to travel great distances. The duration of this impact will last throughout my life of mine.

Additionally, it is thought that the weather condition and topographic setting (relatively flat in most places of the concession) in MML's operational areas favour the generation of dust for a substantial portion of the year. As a result, intermittent exposure to dust- generating activities and related dust emissions is likely to occur throughout the mining operation.

4.8.2 Altered Erosion and Deposition of Soils.

Given the presence of standing water and changes to the physical characteristics of soils, along temporary and permanent unpaved roads, and haulage routes in particular, soils may be eroded in some places and deposited in others. The duration and area of these effects are likely temporary and small, but they are likely to be repeated over the long term and so cumulatively may affect large areas, and overall are medium magnitude as soils would be able to re-establish over time.

These effects are probably short-lived and localised, but because they are likely to occur repeatedly over time and may consequently affect large areas, they are generally regarded as being of medium magnitude since soils can regenerate over time. Therefore, before mitigation; the impact significance is rated as Moderate. soil, to the underlying aquifer, groundwater contamination may have resulted.

4.8.2.1 Residual Impacts

The soil management plan is imperative, and with the implementation of mitigation measures in the soil management plan, many of the impacts to soil expected during mining operations can be reduced to negligible residual impact. The residual impact significance for the most important effects, however, may inevitably persist until mine.

Due to the project's footprint and the nearby low-lying land, particularly the downstream where the new TSF will be built are, however, the temporary moderate and major residual impacts to the soil.

Table 4- 3: Summary of Project Impacts with Respect to Geology and Soil

No.	Environmental Issue	Source of Impact (Activities)	Impact	Areas/Communities that will be Affected / Receptors	Significance			
					Timescale	Area	Magnitude	Likelihood
1	Topography	Removal of vegetation, Excavation of Overburden, Opening of Mining Pits, Back Filling, Grading, Levelling etc.	Disturbance of land, Compaction of Soil, Slope Displacement	Extension Areas, Current Mining Area, Haul Road, Villages within Concession	Permanent	Localized	Low Severity (Moderate)	**Very likely**
2	Geology	Over Burden Removal, Excavation from mine pits	Soil erosion, Sedimentation in streams and valleys	Extension Areas, Current Mining Area, Haul Road, Villages within Concession	Permanent	Localized	Low Severity (Moderate)	**Very likely**

3	Accidental Release of Sludge from Tailing Storage Facilities	Ore beneficiation	Sludge discharge and release into local drainage systems and dams, An increase in the drainage	Communities in the lease area's downstream sections.	Short-term	Local	Low	**Likely**
			system's turbidity, conductivity, and inorganic particulates					
4	Borrow Pits and Quarry Sites	Quarrying and rehabilitation of roads etc.	eroding soil, Open pits serve as a breeding ground for disease-carrying insects. the sediment intrusion into agricultural areas.	Villages along access and main roads	Short medium term	Local	High	**Likely**

Table 4- 4: Impact Mitigation on the Geology and Soil

No.	Environmental Issue	Possible Mitigation Measure
1.	Topography	Use designated routes during the wet season, reclaim mined-out areas, and reclaim stockpile areas.
2	Geology	Super soil and subsoil separation during removal. Grading and reshaping the disturbed area properly. Procedures for determining the suitability of crops in reclaimed areas. Re-vegetation of reclaimed land should be done as soon as possible to prevent topsoil removal during early rain events. Construction of diversion ditches when necessary and establishment of sediment raps and bunds. Whenever necessary, routinely inspect reclamation and repair work; Apply rock mulch to uncovered surfaces.
3	Accidental Release of Sludge from Tailing Storage Facilities	Restoration, creation, and implementation of the Tailings Management Plan in conjunction with a routine inspection programme
4	Borrow Pits and Quarry Sites	Immediately following use, the pits must be closed. The mine closure and reclamation plan must include quarry sites.

4.9 Blasting and Vibration

Blasting and vibration in MML's operation are highly likely to occur, especially in the northern extension areas during the mining. Blasting and vibration in this context are a measure of the acoustic energy released into the mining areas of influence. Therefore, their significance, impacts and mitigation measures are critically integral to the geology and soil component of this ESIHA study. During mining operations, potentially significant vibration sources include excavation (which may involve drilling and blasting), earthworks, infrastructure works, construction waste material disposal and aggregate crushing.

Table 4- 5: Vibration Impact Significance

No.	Classification Impact Magnitude	Potential Influencing Factors	Impact Significance Rating
1	Negligible	Consider other factors that can influence the magnitude of the impact, such as the duration of the mining operation, constructed-related works, type of explosives and the receiver's perception of vibration.	Negligible
2	Small		Minor
3	Medium		Moderate
4	Large		Major

4.9.1 Processing plant construction work

This has a direct impact on the soil. No obnoxious chemicals are anticipated to be used during the new plant construction. Also, all major works will be done during the daytime and are not anticipated to yield significant impacts on the immediate and direct receptors. Except where critically important work, such mass concreting will continue at night. Since this work is not normally done at night, it is negligible. But minor to moderate during the daytime.

However, for the continued operational side of the current processing plant, vibration and noise may be regarded as moderate to major in respect of Near Noise and Vibration Sensitive Receptors (NNVSR).

4.9.2 Road's upgrade and new access road development

All Roadworks will only be done during the daytime, except intermittent road grading at night for rainy reasons. Noise and vibration impacts of minor magnitude are predicted as a result of these works at Noise and Vibration Sensitive Receptor closer to roads (>= 250m). Those within 150-200m of the works are likely to experience medium-magnitude impacts. Impacts at this level could last up to the LIFE OF MINE of the company.

4.9.3 General vibration from blasting within the project influence

Vibration impacts resulting from blasting will be contingent on the type of explosive used. It is anticipated that mild detonators/explosives will be used, as the Marampa formation is part of the supracrustal suite which is not as hard as the basement rocks. Vibration Impacts classification will depend on the Near Vibration Sensitive Receptor (NVSR) proximity to the vibration source at any given time. The significance of the impacts for a Vibration Sensitive Receptor within 200m will be moderate to major. Whereas those VSRs above 250m would experience minor to negligible impacts. All impacts from the use of vibratory rollers will be negligible, and their use will be mostly daytime. At any NVSR, blasting will be designed so that air overpressure and vibration levels do not exceed the criteria for a Moderate impact. This will be accomplished by controlling the maximum instantaneous charge. The vibration level will be reduced as the maximum instantaneous charge is reduced. To achieve a similar effect in terms of hard rock, more charges are fired in rapid succession.

Prior to the start of blasting in any new location, test blasts will be conducted. The results of this will be used to generate a scaled distance graph suitable for estimating the magnitude of the allowable maximum instantaneous charge. Thus, impacts from blasting will be minor or below at all Near Vibration Sensitive Receptors.

4.10 Ground Conceptual Model

When creating the conceptual models, both known and poorly defined geology, soil, old DD exploration drill holes, surface water and water table were incorporated to produce them. The well-defined features include the topographic profile, geology, soil, DD exploration drill holes, water table, Masaboin pit outline and an excerpt of the available regional geological map etc. This allows the creation of the vertical profile of the different materials that were identified during the field visit at the mines. The conceptual geological and soil models that were developed are shown as a cross- section in Figures 5.16 and 5.17 below. The position and orientation of section X-Y with the pit area are indicated, and the contact between lateritic soils and saprolite in some instances is overlain with old tailing materials.

This unit can be up to a few meters thick. The contact between the weathered material, transition zone and fresh hard rock, quartz-mica-schist and quartz-haematite-muscovite- schist show gradational contacts.

The poorly defined features are the stratum sections. These constitute what the author of this report considers the limitations of the models. Unfortunately, the actual thickness of the different soil layers, especially the lateritic and saprolitic soils could not be properly defined during the site visit, and no secondary data is available before and after the site visit.

This means certain assumptions had to be made in modelling the thickness of the weathered zone. Therefore, any revised models that would have an accurate thickness of the different layers should be able to account for the poorly defined features within the anticipated and accepted scientific precision and/or error.

4.10.1 Improvement in the Conceptual model

Accurate data need to be obtained for the geological and soil layers in their current and/or in-situ sequence on the mine site. Therefore, boreholes need to be drilled and pits excavated at suitable locations in the site to appreciable depths. This will provide more detailed information on the existing thickness of the geological and soil stratum.

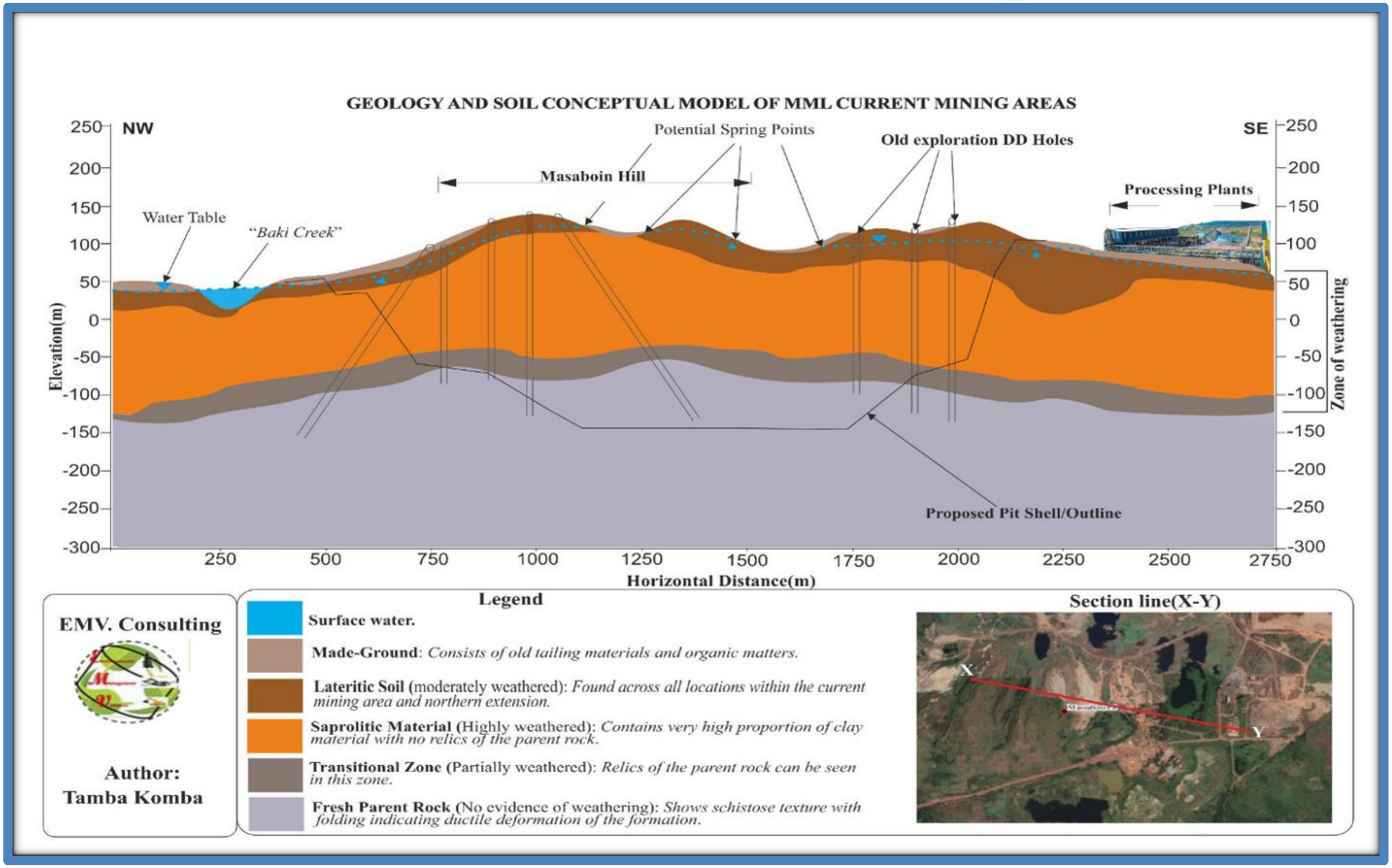


Figure 4- 16: Geology and Soil Conceptual Ground Model (Pre and Current mining operation)

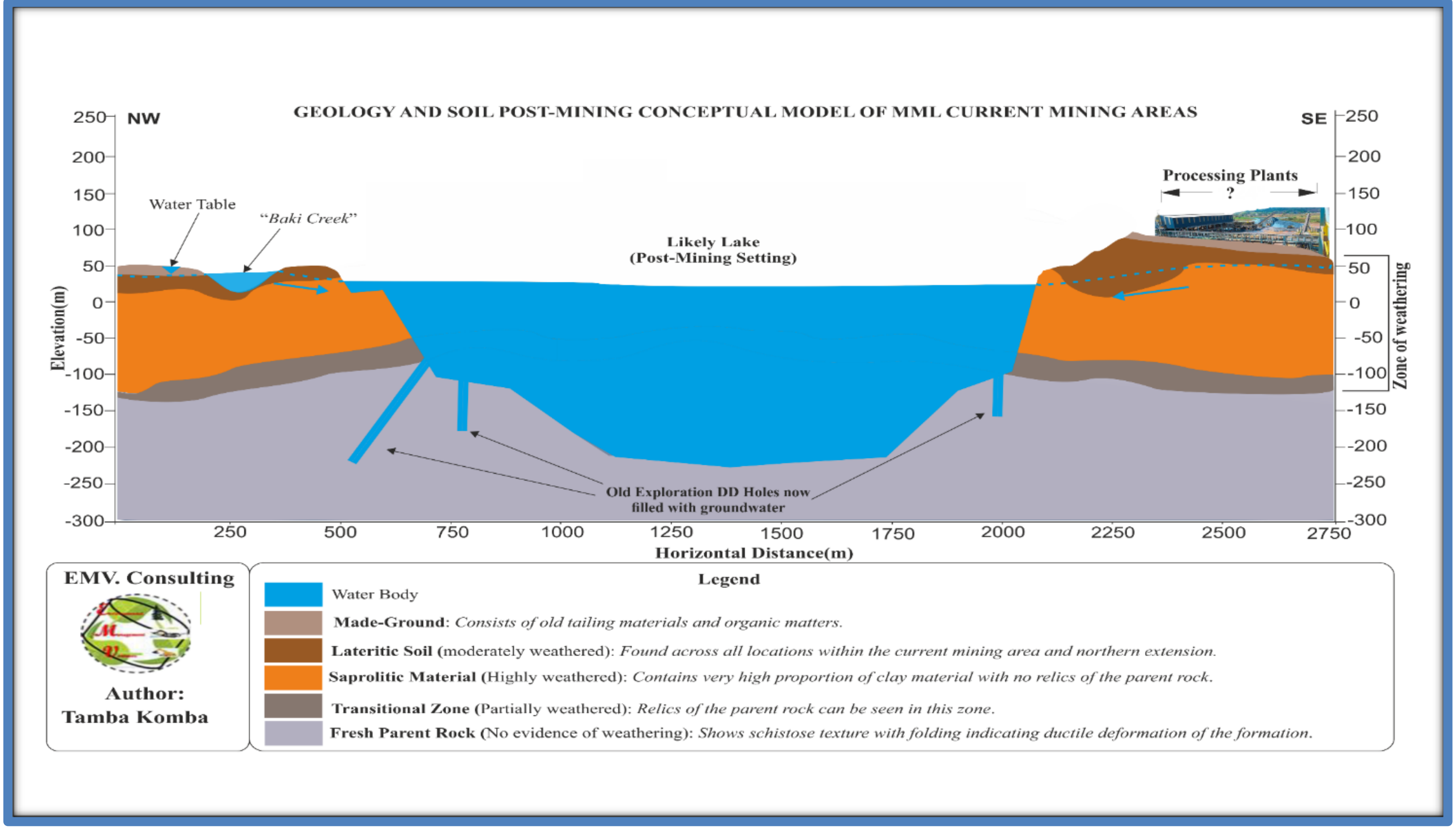


Figure 4- 17: Geology and Soil Conceptual Ground Model (post-mining setting)

4.11 LAND USE CHANGE

Land use is an important consideration in an Environmental, Social and Health Impact Assessment (ESHIA), as it can have significant impacts on the natural environment, including soil, water, air quality, and biodiversity. It is essential to understand the current land use patterns and practices in the Marampa M3.75 project areas, as well as any potential changes that may occur because of the project expansion activities.

Land use can also include activities such as mining, forestry, agriculture, and urban development. These activities can have both positive and negative impacts on the environment, and it is essential to carefully assess these impacts during this ESHIA study being conducted for MML by EMS.

Land use is also closely linked to social and economic factors, such as population growth, income levels, and cultural practices. Understanding these factors is critical to developing effective mitigation and management strategies that balance the needs of the environment and local communities. Overall, a thorough understanding of the land cover and land use patterns and practices is essential for conducting a comprehensive ESHIA and developing effective environmental management plans.

4.11.1 Brief Overview of the Project and its Objectives

It is understood that earlier sections of this study have elucidated considerably on the general overview of the Marampa M3.75 operations and its objectives. Therefore, you are kindly referred to section one of this report for details on the project's overview.

4.11.2 Purpose of the Land Use Change Assessment

The purpose of land use change assessment for the ESHIA study conducted for the Marampa M3.75 Project was to evaluate the potential impacts of changes in land use that may occur because of the expansion project within and around the project's sphere of influence. The assessment aimed at identifying all perceived and/or potential impacts on natural resources, biodiversity, ecosystem services, and local communities that will be due to the direct and indirect activities of the project.

During the operations, the mining activities will involve the clearing of vegetation, the excavation of soil, and the construction of infrastructure, which can lead to changes in land use patterns. These changes can affect the availability of resources such as water and soil, and may also impact the habitat of local wildlife and the functioning of ecosystems.

The land use change assessment, therefore, evaluates the potential impacts of the mining, processing, transportation and other related-subsidiary activities on the environment and society. This assessment can inform the decision-making process for the mining company, regulatory agencies, and other stakeholders by identifying potential risks and opportunities associated with the land use changes within the MML's operational influence.

The results of the land use change assessment can be used to develop mitigation measures to minimize the impacts of the Marampa M3.75 activities on the environment and local communities. These measures will include strategies to minimize the area of land used, reduce the impacts on wildlife habitats, and restore degraded areas after the mining activities have ceased 32 years down the line.

4.11.3 Methodological Approach

Several approaches have been considered during the conduct of the land use change assessment for the Marampa M3.75 Project. These include, but are not limited to the following four main approaches:

- Desktop Review
- Secondary Data
- Primary Data
- Data Collection, Analysis, and Interpretation
- Conclusion and Findings

4.11.3.1 Desktop Review

To provide a broad overview of the land use change and local environmental settings of the project site, the Environmental Management Venture consulting firm's land use change expert and team conducted a desktop study that included a review of previous relevant documents and/or studies on the project phases. A part of the desktop review involved the use of secondary data from the company (previous EIA and ESHIA reports).

4.11.3.2 Primary Data

The Land Use Change Team also went on a field trip to evaluate how the MML's current and future projects might affect environmental receptors like current land use, stakeholders, village residents, and natural resources. Geospatial technologies (remote sensing, GIS, GPS etc.) have been used to provide a spatial context of the land cover. For land use, both physical visits to the communities of influence and focus (FGDs) group discussions were carried out.

4.11.3.3 Data Collection, Analysis, and Interpretation

The primary data consist of both qualitative and quantitative. For the socio-economic aspect of the land use, data was collected from the field using a semi-structured Questionnaire, FGDs and Personal Observations. With the quantitative data, the Statistical Package for Social Scientists (SPSS v 21) and MS Excel LTSC were used to process and interpret the raw field data. Also, the geospatial data was captured from the 2022 aerial satellite imagery using the USGS platform, and then the raster images were processed using the Semi-Automatic Classification Plugin in Quantum GIS (QGIS). Thematic maps with six Land Cover Classes were generated using both ArcMap and Quantum GIS(QGIS).

4.11.3.4 Conclusion and Findings

Finds from the land use change assessment have been presented in the conclusion section of the report.

To predict the impacts of the project, a comparison was made between the baseline conditions and the situations that may arise during and after the implementation of the project. To gather additional information, representatives from the company's technical leads, supplied EMS with all requested data about land use change.

The methodological approaches above have been succinctly expounded below:

- **Remote sensing:** For analysing changes in land use over a large area, remote sensing techniques, such as satellite imagery and aerial photography, are helpful. These resources can offer details on vegetation, land use, and other landscape characteristics. The raster images used to generate all thematic maps for the Marampa M3.75 project (mining site, haulage corridor and the jetty) were remotely accessed using the most updated satellite imagery from the USGS platform.
- **Geographic Information Systems (GIS):** GIS is a computer-based tool that allows users to visualize, analyse, and interpret spatial data. It is useful for mapping land cover and land use changes over time and identifying patterns and trends. An extensive application of GIS was deployed in this study.
- **Field observations:** Field observations entail gathering information on the ground to evaluate changes in land cover and land use. Documenting changes in vegetation, soil, and other environmental factors was part of this.
- **Historical Records:** Historical records, such as aerial photographs, maps, and land- use surveys, can provide valuable information on past land-use patterns and changes over time. Limited historic satellite imageries were used in this assignment, as the study is aimed at establishing baseline data (current biophysical setting/data, and not historic data)
- **Stakeholder Engagement:** This is an integral component of the land use change assessment of the ESHIA study. Working with local communities, landowners, and other stakeholders to comprehend their perspectives and recognise the potential effects of land use changes is known as stakeholder engagement. For this aspect of the ESHIA study, not many stakeholder engagements were done, because the socio-economic section gives a plethora of baseline data on stakeholders' engagements. Readers of this report are referred to the socio-economic section for detailed information.

4.11.4 Description of the Existing Land Use

4.11.4.1 Landform

The landform of an area can be described in terms of its relief, topography, geomorphology, landforms, and drainage patterns. These characteristics provide valuable information about the physical structure and processes of the land surface and can help inform land management and planning decisions. Sierra Leone is divided into three distinct physiographic regions, each characterized by unique terrain and topography. The coastal lowlands form a narrow band along the country's western coastline, while the interior is comprised of wooded plains, and the upland plateau is in the northeast and features scattered mountains and hills.

The Marampa M3.75 Project is situated in the interior plains of Sierra Leone. This region is characterized by relatively flat terrain, with occasional undulating hills and valleys. The climate is tropical with two distinct seasons-the rainy seasons, which runs from May to November, and the dry season, which lasts from December to April. Due to the erratic global and regional climatic and weather conditions propelled by climate change, these seasonal sequences are not happening as per geographic prediction as they used to be in former times.

The interior plains region is also home to a diverse array of flora and fauna, including several species of large mammals (please refer to the biodiversity section for details). The region also supports a variety of agriculture, including rice cultivation, palm oil production, fishing etc.

As part of the Marampa M3.75 Project's commitment to environmental stewardship, the company will take steps to ensure that the current mining activities and expansion project do not negatively impact the region's natural resources, including its wildlife and vegetation. This will involve implementing appropriate measures to minimize soil erosion and sedimentation, as well as monitoring air and water quality to ensure that any impacts are kept to a minimum. In sections 2.3, 2.4, 5.1.1-5.1.3 respectively, an extensive description of the project’s landform has been presented (please refer to these sections for details).

4.11.4.2 Description of the Current Cover and Land Use in the Project Area

The project's current footprint and extension sites have various land uses, such as wetlands, forests, and agricultural areas, as well as the current cover of the land. This assessment considers the modifications that are being made to the land, such as waste dumps and pits resulting from mining activities. Also, some ecological importance habitats, such as wetlands, which support a diverse range of fauna and flora, including important plant species are found in selected areas within the project areas of influence.

4.11.4.3 Critical Habitats, or Other Ecologically Important Features

4.11.4.3.1 Loss of Wetland Habitats

The mine concession area and its surroundings contain a significant number of wetlands. These wetlands serve as habitats for a diverse range of fauna, with birds being particularly abundant. Additionally, these wetlands are home to crucial plant species. Although rice cultivation is practised within these wetlands, which has modified them to some extent, they still play an essential ecological role.

It should be noted that the loss of wetland habitats will only occur within the mining concession area and will be permanent. This is due to the changes in landforms caused by mining activities, such as waste dumps, pits, and tailing facilities, which prevent the rehabilitation or retention of wetland areas in most cases. After the mine closure, the land will likely be used for either forest or agriculture. The impact of losing wetland habitats in the project sites is considered to have a medium magnitude.

During Phase 1 of the project at Thofayim, a portion of the modified wetland was utilized for dredge waste management. However, it is worth noting that there will be no further impact on this type of habitat resulting from the Marampa M3.75 Project at Thofayim. It is important to recognize that modified wetlands have undergone significant alterations and do not possess the same ecological value as undisturbed wetlands. The impact of the dredge waste management activities that took place during Phase 1 on the modified wetland at Thofayim needs to be carefully monitored to prevent any adverse consequences on the environment. Nonetheless, the project planners have ensured that no additional harm will come to this type of habitat during the execution of the Marampa M3.75 Project at Thofayim.

4.11.4.3.2 Tall Mangroves at Thofayim.

The upper Port Loko Creek supports many tall mangrove trees that provide important nesting habitat for Palmnut Vultures and a variety of large bid species. Some of these trees are being damaged by the turning of barges at Thofayim. Current levels of impact are not significant, but efforts should be made to minimise further damage.

4.11.4.4 Land Cover within the Project's Footprint/Influence

The current Iron ore mining operation by MML and its Marampa M3.75 expansion project is essential for the provision of raw materials for steel production, construction, and other critical sectors globally. However, the mining activities, processing and transportation of the dry concentrate can have significant impacts on the environment, particularly the land cover. The current land cover of the project's sphere of influence can be described as a mixture of natural and modified habitats. The mining activities have resulted in the creation of waste dumps, pits, and tailing facilities, which have altered the original topography of the land.

Additionally, forests and wetlands have been cleared or modified to create space for mining operations, infrastructure, and waste management. Understanding the current land cover is essential for assessing the environmental impacts of the ongoing activities and designing appropriate management and rehabilitation strategies.

4.11.4.5 Current Status of Land cover

The description of the physiographic setting of the Marampa M3.75 project has been thoroughly elucidated in sections two and five. What has not been accounted for is the baseline land cover and land use. This sub-section of the ESHIA study provides a comprehensive account of the land use change with a specific focus on the existing land cover and land use.

4.11.4.6 Land Cover within the Mines and Jetty

Description of the physiographic setting of the mine site in terms of its topography, drainage system, climatic condition etc. has been covered in earlier sections. The land use of the company's operational areas (the mines and jetty) has a mixture of dense and sparse vegetation (*Table 5.6*) which is regarded as a delicate balance between preserving natural habitats and supporting human activities. Careful planning and management strategies that account for the ecological value of these areas can help mitigate the impacts of mining activities on the environment and support sustainable development.

Table 4.1 Table 5.6 Different Landforms and Land Use

	
A Relatively flat and undulating landform leading to Katick village, showing sparse vegetation cover	***A sandwiched Wetland/swampy valley with palm trees. Swamp land rice farming.***
	
An artificial pond developed after DELCO Mining	***Exposed dig-face at Mathukia Pit-Northern extension***


Mining site showing the tailing storage facility and the partially vegetated land cover	*Thofayim River Terminal, showing mangrove forests and palm trees along the barging route*

The land cover is characterized by both dense and sparse vegetation, settlement, water bodies, barren land, agricultural areas, fallow land, and grasses. Six major classes characterize the land cover of the mine site, haulage corridor and jetty (*Figure 4-18*). In areas of dense vegetation, the land cover consists of forests, shrubs, and grasslands. These areas are crucial habitats for wildlife and provide essential ecosystem services such as carbon sequestration, soil conservation, and water regulation. However, mining activities may have a significant impact on these dense vegetation areas, leading to deforestation, soil erosion, and loss of biodiversity. In contrast, the land cover in areas of sparse vegetation is dominated by grasslands, with occasional shrubs and scattered palm trees (*Table 4.6*) above. These areas are typically used for agriculture or livestock grazing, and their importance lies in supporting local livelihoods. Mining activities in these areas may have less severe impacts. Mine Site and Haulage Route and Jetty Land Cover Classification

The land cover classification of the haulage corridor runs from the mine site (*Figure 4-18)* to the barging area at Thofayim River Terminal (*Figures 4-19 and 4-20)*. It forms a crucial part of the logistics system for MML operations. Transport of the dry concentrate ore from the mining site to the barge loading facilities takes place along this route. The haulage route typically consists of a network of parallel tracks and roads that are built to accommodate large, powerful vehicles, like haul trucks and other heavy mining equipment. The route traverses a variety of landscapes, such as forests, wetlands, and a part of Sierra Leone's interior lowlands.

4.11.4.7 TRT

The Marampa M3.75 project will not involve expanding the existing Jetty facilities located at Thofayim (*Figures 4-22)* where barges are being loaded for subsequent transhipment, as these facilities will continue to be used for the transportation of the mined ore concentrate. However, the project may require an assessment of dredging requirements, which refers to the removal of sediment or debris from the bottom of a body of water to maintain or improve its navigability.

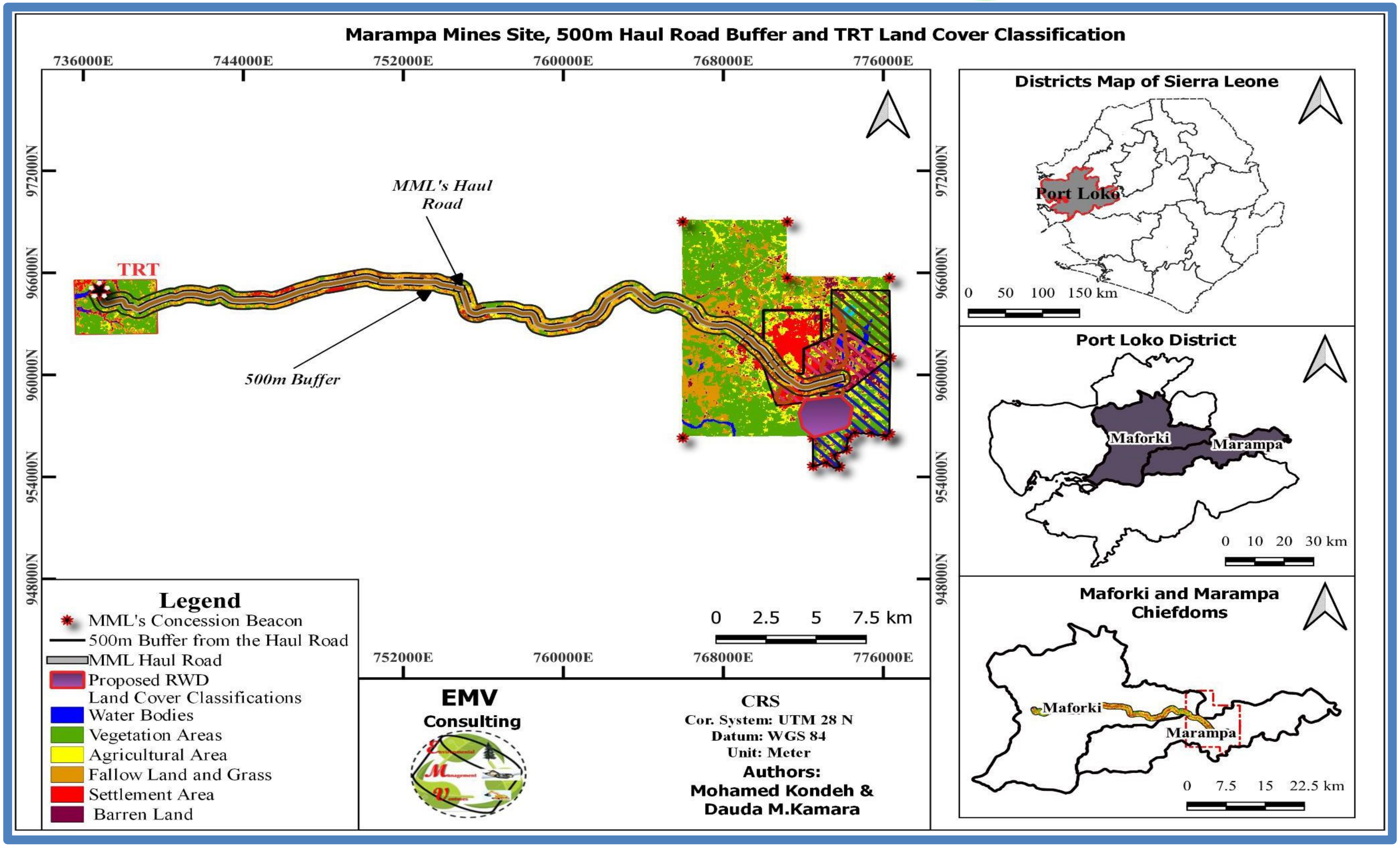


Figure 4- 18: Land Cover Classification of the Mine Site, Haul Road, and Jetty

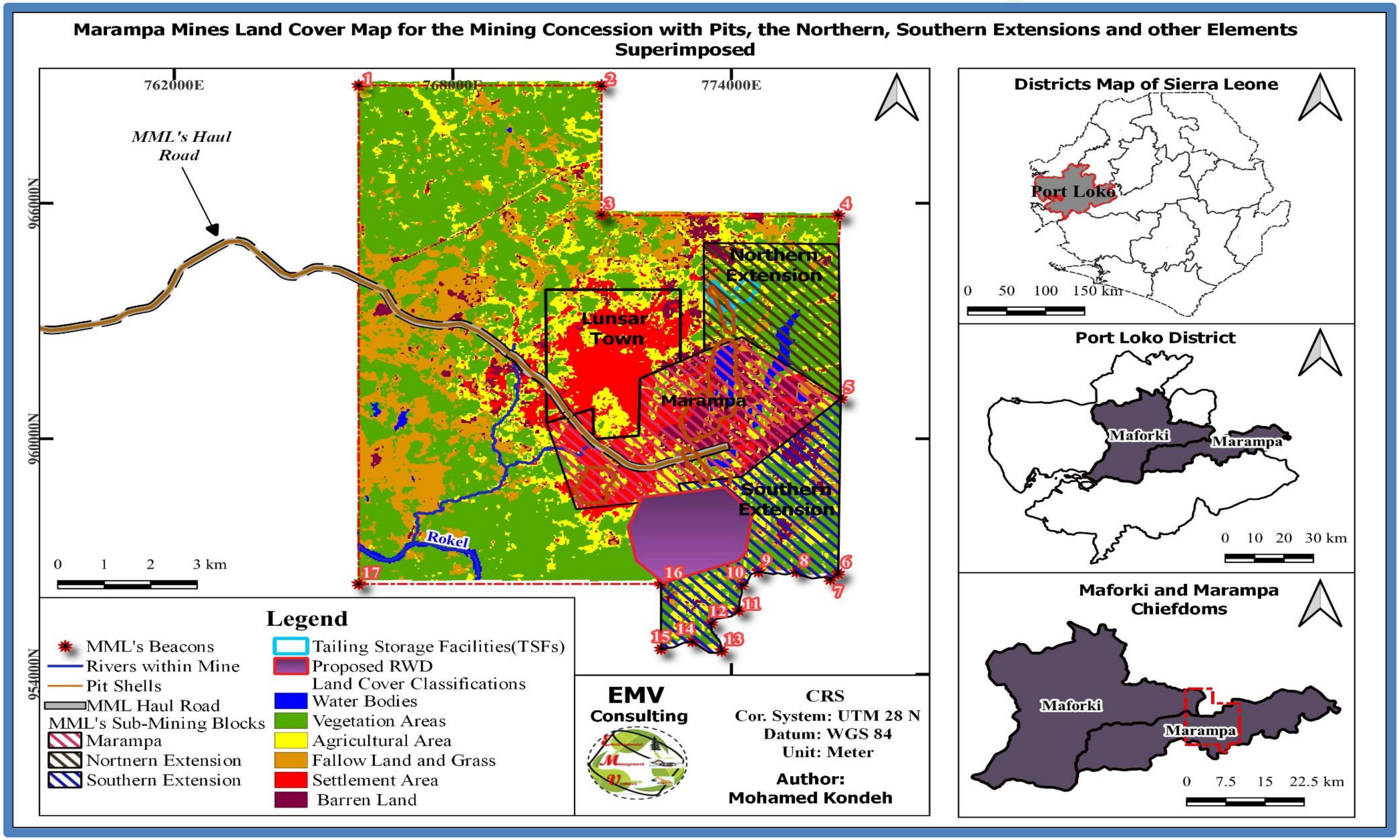


Figure 4- 19: Land Cover Classification of the Mine Site.

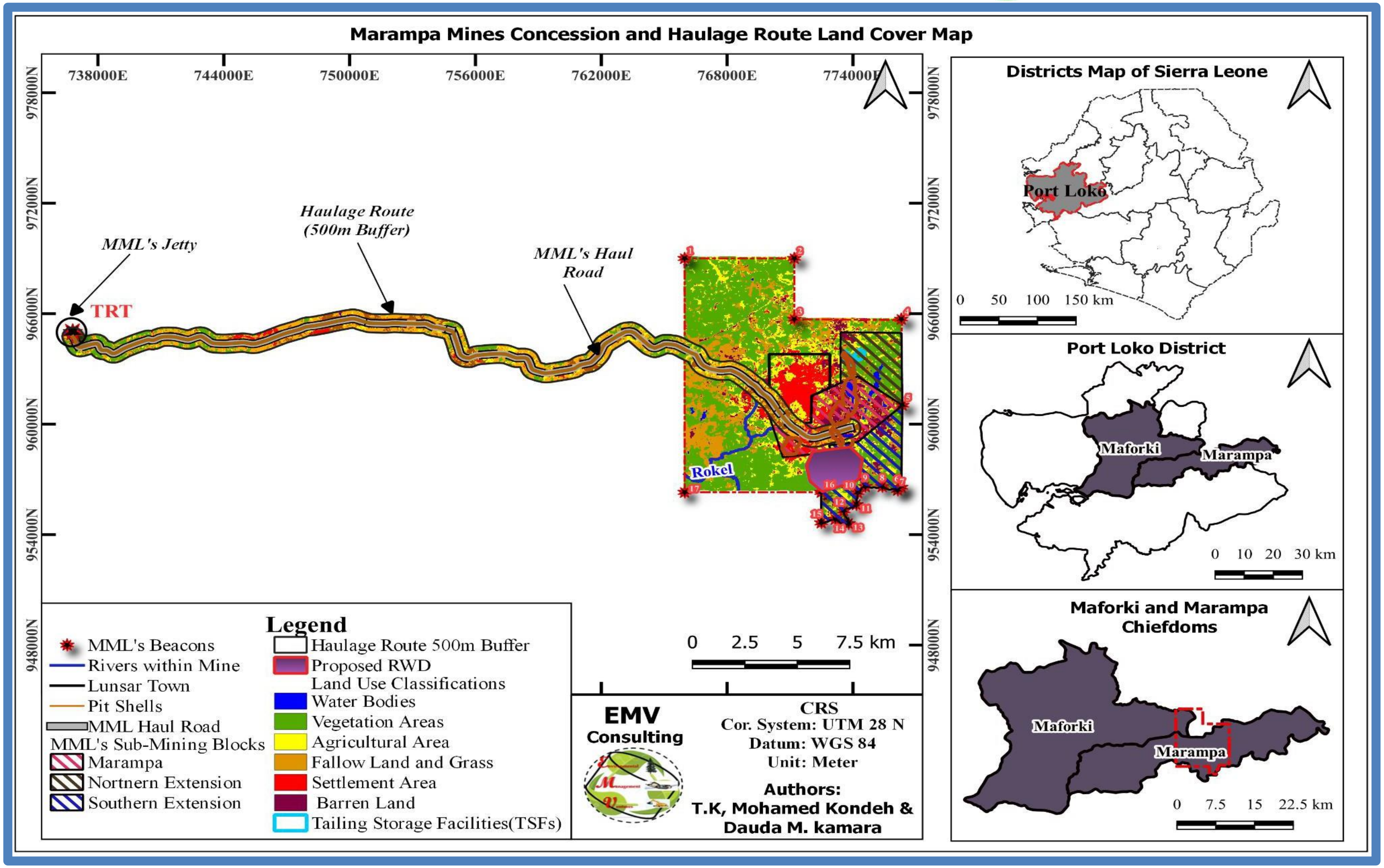


Figure 4- 20: Land Cover Classification of the Mine Site and Haulage Corridor

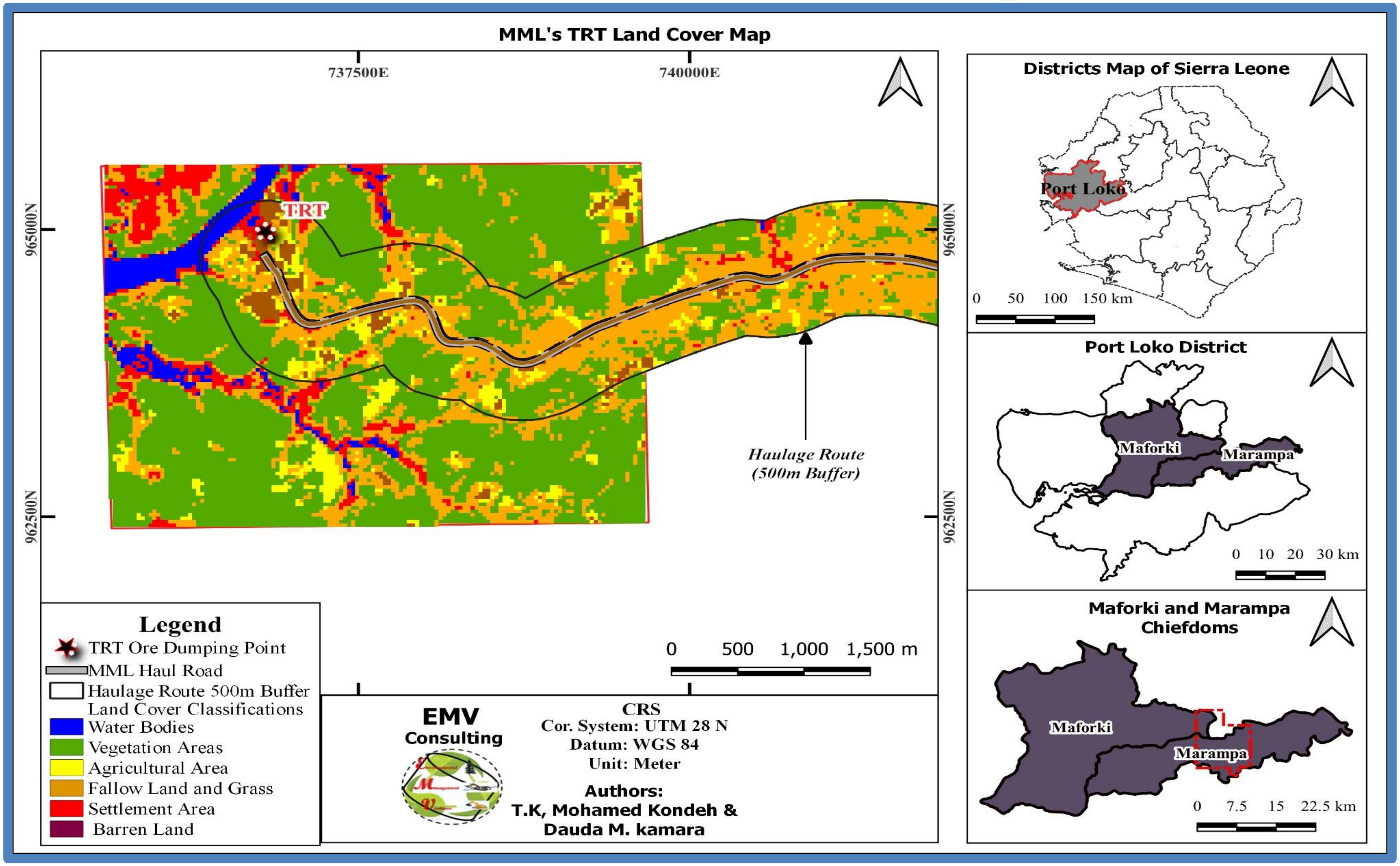


Figure 4- 21: TRT Land Cover Classification

Figure 4- 22: Birds Eye View of TRT Barging Location

Given that the transportation of the concentrate from the mining site to the transhipment facility involves the use of barges, it is essential to ensure that the waterways are adequately maintained and navigable. This may involve dredging to deepen or widen the water channels, particularly in areas where sedimentation or natural erosion has reduced the depth or width of the waterway.

An assessment of the dredging requirements has helped to identify any potential environmental impacts that may result from the dredging activities and develop appropriate mitigation measures to minimize these impacts. These measures may include implementing best management practices, such as sediment control or erosion prevention, and monitoring water quality to ensure that the dredging does not harm the aquatic ecosystem. The statistics of the land cover classification for each area discussed above are shown below in the tables and figures.

4.11.5 Land Cover Classification Statistics

The statistical analyses for the Haulage Corridor, Jetty and Barging Route are presented below in the tables and Charts.

4.11.5.1 Haulage Route

Forest Types

4.11.5.2 Secondary Forest (Farm bush)

The project expansion area is dominated by a habitat type known as secondary forest, or farm bush, which accounts for roughly 70% of the area. However, the ecological state of this habitat has been considerably modified due to human activity in the region.

Although some areas within the project expansion zone have shown signs of regeneration, most of the secondary vegetation is dominated by oil palm trees, large mango trees, coconut trees, and Gold Coast Bombax trees, among others. The species composition is mostly composed of widespread species that typically colonize secondary regrowth.

Despite the modifications to the habitat, the secondary forest still supports a variety of bird species assemblages. The project expansion area is believed to be home to a diverse range of bird species, which are reliant on this habitat type for nesting, foraging, and other vital activities.

The Marampa M3.75 Project recognizes the importance of protecting the secondary forest habitat and will take appropriate measures to mitigate any negative impact on this ecosystem during the mining process. These measures will include minimizing soil erosion and sedimentation, as well as monitoring the air and water quality to ensure that any negative impact is kept to a minimum.

4.11.5.3 Lowland Forest

This consists entirely of swamp forests and riparian forests. The Gallery Forest is most developed in slender strips along the Rokel River's banks (up to 25-35 m) at the site of the

Marampa M3.75 project. But it frequently breaks up and discontinues. The ecological condition of the gallery forest today is categorised as slightly modified. High species diversity is a defining characteristic of Gallery Forest. When it comes to riverbank stabilisation and flood attenuation, gallery forests are highly functional.

In both the northern and southern extensions there are swamp forests, but more common along a branch of the Rokel River. Like the riparian forest along the Rokel River, swamp forests share the same species composition. The removal of vegetation for use as fuel and small-scale logging are the main causes of this habitat's current ecological state, which is categorised as moderately modified. The swamp forest still has a moderately high functional value, however, because it helps to stabilise riverbanks and attenuate floods. The gallery forests higher up the main tributary are connected to the larger forest along the Rokel River by this habitat.

4.11.5.4 Hydromorphic Vegetation

Hydromorphic vegetation is an important component of many wetland ecosystems, as it helps to stabilize soils, prevent erosion, and provide habitat for a wide range of wildlife species. However, it is also vulnerable to disturbances such as land-use changes, drainage, and pollution, which can have significant impacts on these ecosystems and the organisms that depend on them. Some of the wetland areas in the communities of influence within the Marampa M3.75 project display strong hydro morphic vegetation features, as evidenced by some plant communities showing waterlogged and flooded soils. This is particularly in areas of low altitude in the swampy ecosystem.

4.11.6 Land Use within the Project's Influence/Footprint

4.11.6.1 Land Use Types

In this section, the land use change team delve into the crucial aspect of land use types that significantly impact the livelihoods of the local population in the project expansion areas. To provide a comprehensive understanding, this report synthesises the information from various sources, including existing reports and primary qualitative data gathered by EMS land use change experts during their fieldwork in the different communities visited. Our focus is on analysing the various land use types prevalent in the Marampa M3.75 project areas and their associated tenure systems, as well as exploring the roles of gender in the local production system.

Apart from presenting an overview of land use patterns, the team also probe into the intricate details of the land tenure arrangements that govern access to and control over land resources.

Furthermore, EMS examined the role of gender in shaping the local production system, particularly regarding land use and management. Close attention is paid to the gender-based division of labour and access to resources, and how they impact the productivity and sustainability of local agricultural practices. The following are evaluated during the ESHIA study.

4.11.6.2 Settlements

Settlement refers to the process of human occupation and use of a specific geographic area. Land use is an essential aspect of the settlement, as it defines how humans utilize the land and its resources. Settlements can take different forms, ranging from rural villages to urban cities, each with its distinct land use patterns and practices.

Land use within Marampa M3.75 project settlement varies widely, depending on factors such as population density, cultural practices, and economic activities. The settlements across all the communities that may be directly or indirectly influenced by the project is a rural- type settlement. Therefore, land use is focused primarily on agriculture, livestock rearing, and forestry, unlike in urban settlements, land use may involve residential, commercial, and industrial activities.

4.11.6.3 Agriculture/Farming

Sierra Leone's agricultural sector encompasses food and tree crops, livestock, forestry, and fisheries. According to Statistics Sierra Leone (2010 and 2015), food crop production is the most prevalent agricultural activity in the country, particularly in rural communities. About two-thirds of the country's population relies on agricultural crop production for their livelihoods. A similar trend was observed in the study area, where farming or food production is the primary source of income for the local population.

In the subsequent subsections, a summary of the different types of agricultural land use present in the Marampa M3.75 project explained.

4.11.6.4 Farming

The agricultural potential of the project communities, chiefdom, and districts varies from place to place due to factors such as topography, soil type, and other environmental conditions. The Lunsar area features a gentle topographic relief, with broad, level river valleys winding throughout (*Table 5.6*) above. Despite the small differences in elevation, soil fertility, moisture levels, and crop suitability vary significantly. Through focus group discussions (*Figure 2.5*), it was evident that the utilization of various landscape units, crops, and crop varieties interact in complex ways. Nevertheless, farming remains a vital part of the economy and livelihoods of the local population in all the communities visited.

The population of Port Loko District and Marampa Chiefdom relies heavily on agricultural land use, particularly in the form of food crop production. Like many other rural areas in the country, the chiefdom engages extensively in farming, using traditional shifting cultivation techniques and simple hand tools. Mixed farming, mixed cropping, and crop rotation are commonly practised, along with the bush fallow system.

Initially, the land is cleared for rice cultivation, and a variety of other crops are grown in combination, such as pepper of different varieties, corn, okra, cassava, beans etc.

Following a harvest period, cassava is typically grown throughout the farms, with groundnuts and corn sometimes planted between the cassava plants. The land is left to fallow for several years after two or three seasons of farming, depending on the availability of land in the community. However, some key communities in Marampa Chiefdom are finding it difficult to secure well-fallowed bushland for farming due to population growth and previous mining activities that have claimed much of their farming land.

In the chiefdom, the planting season typically begins with field preparation from January to March, followed by planting mainly between April and July. Due to the erratic climatic conditions of recent times, there seems to be a slight change to the conventional farming practices across the communities. Cutting of trees and charcoal making is usually done in April before the start of the wet season. Harvesting begins in September, and the main harvest goes on until November or December. However, the period from May to August is often referred to as the "hungry period," as it is the time when food is scarce.

4.11.6.5 Tree/Cash Cropping in the Communities

The visual assessment indicates that Marampa Chiefdom cultivates tree or permanent crops, with Cashew Nut being a common crop in the proposed Marampa Mining Project area. Within the concession area, three communities, including Rogbane, Robellah, and Magberie, reported small portions of Oil Palm cultivation. Other perennial crops such as citrus, coconut, and mango are also grown. While tree crops like banana, avocado, mango, orange, coconut, and guava can be found in communities, they are not as prevalent as other crops. However, unlike in other areas, such as the southeast of Sierra Leone, where cocoa and coffee plants are present, they are completely absent in Marampa Chiefdom, especially within the concession area.

According to SRK Consulting (2013), cultivating and selling products from tree crops is probably the most accessible source of income for those engaged in their cultivation. Both cash and food crop products can be sold within the villages or taken to the daily market in Lunsar or the weekly Tuesday market in Foredugu. However, obstacles associated with marketing agricultural produce exist, primarily due to a lack of transportation. Traders who visit villages to purchase larger quantities of produce typically offer lower prices, and there are also wholesalers based in Lunsar.

Despite the obstacles to marketing agricultural produce, tree crop cultivation remains a viable source of income for the local population. Additionally, it is worth noting that the cultivation of various perennial crops provides the local population with a diverse range of food sources and contributes to the overall agricultural productivity of the region.

4.11.6.6 Livestock

Livestock ownership was assessed within the Marampa M3.75 project area, and it was found that sheep, goats, and ducks were the primary types of livestock reared or owned by households. According to data presented in *Table 4-9* (SRK, 2013) and chart (EMS land use consultant), chickens were the most owned livestock, with 79% of households surveyed reporting ownership. Goats and sheep were also popular, with 41% and 36% of households owning them, respectively.

In contrast, only 21% of households reported owning ducks. While cattle were not commonly owned by households, SRK Consulting (2013) did report a few sightings of cattle in the study villages. The consulting firm also recorded the presence of 15 herders in Matukia, a community directly located to the northern extension of the Marampa M3.75 project.

Table 4- 6: Livestock Assessment. Source of the data: SRK 2013

No	Livestock Type	Households Possessing Livestock	Average Number Livestock per Household	Households Selling Livestock
1	Goats	41%	3	**34%**
2	Ducks	21%	5	**17%**
3	Sheep	36%	3	**31%**
4	**Chickens**	**79%**	**19**	**68%**

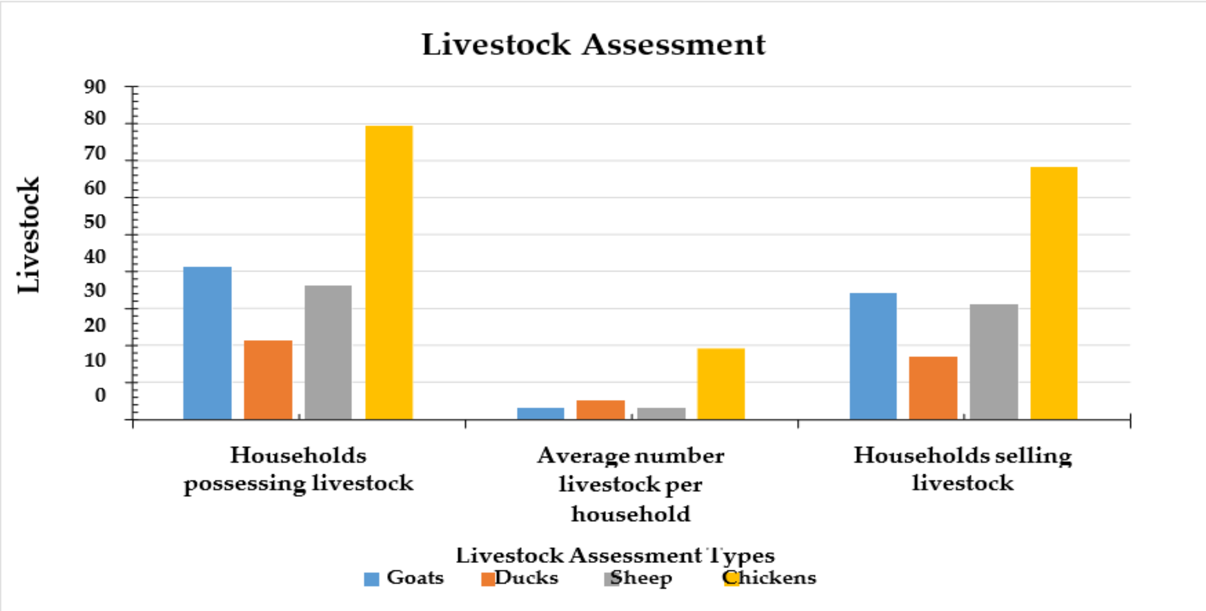


Figure 4- 23: ***Livestock Assessment in the Communities within the Expansion Influence***.

Livestock breeding in the Marampa M3.75 project influence area mainly involved customary free-range methods at the household level. Livestock breeding was sometimes restricted to households or family compounds in areas close to the community due to concerns about security and crop damage prevention. In some rare cases, specialized herdsmen were employed to tend to the livestock. Poultry, particularly chicken, was typically owned in large numbers, with an average of 19 per household. Although some livestock were used for households' ritual purposes, all livestock were primarily sold for income generation. According to *Table 4-9*, chicken was one of the most commercialized livestock, with 68% of surveyed households reporting its use for commercial purposes.

4.11.6.7 Hunting

In Marampa M3.75 project communities of influence, hunting is a significant livelihood activity that involves the use of short guns, traps, and trained dogs. The animals hunted include grasscutters, deer, monkeys, etc. Hunting is exclusively a male activity carried out by men and boys, primarily for home consumption and income generation. However, hunting is also a specialist activity, and everyone who farms also uses traps to provide food and control crop-raiding pests such as grasscutters, locally called "*Cutting-Grass*". Due to the blasting from mining activities and related noise, the level of hunting in the study area is generally low because of the possible migration of animals. Trained dogs are also used for hunting in the villages, and they are primarily kept as pets or hired by farmers to drive away animal pests from their farms.

The locals claim that hunters are busiest during the rainy season because they protect their own and other farmers' crops. Even though they practise their skills all year long, the rainy season requires more focus. The species that can withstand heavy hunting pressure include Maxwell's duiker, Brush-tailed Porcupine, Giant Rat, and Antilope. Moreover, hunting in the communities within the project's expansion areas frequently involves the use of homemade traps. Giant Rats are captured using "dead-fall wooden box traps," while smaller rats and mice are captured using spring-loaded break-back traps.

Additionally, community members can go out on a group hunt using dogs to herd the prey towards the traps and nets acting as traps.

4.11.6.8 Fishing

Fishing is an important way for people in Marampa Chiefdom to make money. Both men and women can earn a lot of money from fishing, especially when it's not rainy. But there are not many big streams to use dugout canoes in Marampa Chiefdom. So, most fishermen go to Port Loko Greek to fish in the sea and bring back what they catch to Lunsar to sell. In Marampa Chiefdom, people only fish in small streams, like the Baki Stream, which often dry up in the dry season. Women also fish using traditional nets called "*baimbay*" on the smaller rivers when it is not rainy.

According to a study by SRK Consulting (2013), nets, impoundments, traps, hand lines, and individually held sieves wrapped around light-weight elliptical sticks are other common fishing techniques used in the communities, particularly during the height of the dry season. Depending on the length of the net, the stick may be single or joined. Small fish are typically caught for domestic use, whereas larger fish may be taken to Lunsar or sold fresh in the nearby village. In the communities, fish they catch which are neither for sale nor ready for immediate consumption are often preserved in various ways, including by smoking, sum drying, frying in vegetable or palm oil, and salting.

4.11.6.9 Mining Activities

Marampa is home to one of the largest deposits of Iron Ore in Sierra Leone. The restart of mining is creating job opportunities for many Sierra Leoneans, boosting business, and increasing government revenue. Compensation is being provided to landowners, and community development payments are contributing to the provision of basic services in the chiefdom and district. Sand mining is also a significant extractive activity, primarily conducted on the Rokel

River in places like Katick, located downstream of the southern concession. According to a 2013 report from SRK Consulting, sand mining is an important economic activity with high commercial value due to its demand from the construction sector. Men, women, and children from various backgrounds participate in different roles, such as collecting, loading, and transporting sand. This activity is exclusively reserved for the peak period of the dry season.

4.11.6.10 Firewood (a source of heating) and logging

Firewood is an essential source of fuel for many rural communities worldwide, including in developing countries. In these communities, households rely heavily on firewood for cooking, heating, and boiling water, as electricity especially in the villages is unavailable and gas is often unavailable or too expensive for residents of the communities. However, the communities using firewood for fuel have negative impacts on both the environment and the people's health.

Cutting down trees for firewood and logs leads to deforestation and loss of habitat for wildlife. These activities in the forested areas of the communities are a primary land change driver and can contribute to soil erosion and reduces the ability of forests to absorb carbon dioxide, a greenhouse gas that contributes to climate change. In addition, the smoke from burning firewood contains harmful pollutants that can cause respiratory illnesses, especially in women and children who spend more time around fires.

Despite these negative impacts, firewood remains a crucial source of fuel for many of those communities. Sustainable approaches to firewood collection and use can help mitigate its negative impacts. These include sensitization on planting trees for fuel, using more efficient stoves, and promoting alternative energy sources like solar and biogas.

Efforts to address the challenges associated with firewood use require collaboration between governments, NGOs, MML and local communities. By promoting sustainable approaches to firewood use, it is believed that the negative impacts on both the environment and people's health will be put to a minimum while ensuring that the communities continue to have access to the energy they need. In mangrove areas, the mangroves are often cut and transported in dug-out canoes for sale in a bigger town.

4.11.6.11 Land Tenure and the Right to Access Land

Like other assets, the ownership of agricultural land is a significant indicator of a household's economic and social status in farming communities. Nearly every home in the Marampa M3.75 project of influence claims to be the owner of some land that is used for farming. Land tenure in rural Sierra Leone is typically organised through a customary system run by the chiefs, according to earlier reports by SRK Consulting from 2013. The tribal leaders are each chiefdom's general stewards of the land and oversee settling land disputes.

Land belonging to a community is typically communally "owned," but it is distributed to people living in the village by the chief's council. In these situations, ownership is informal and customary, so title deeds are not necessary. Only village residents are typically permitted to "own" (hold title to) land that they can leave to their offspring. 'Strangers' from outside must rent land from either private parties or the chief's council to farm.

The Provinces Land Act of 1927, Cap. 122, regulates non-natives' use of land in the provinces. "Any person who is not entitled by customary law to right in land in the provinces" is defined as a non-native. The Act prohibits non-natives from purchasing land. Leasing of land is permitted with the paramount chief's approval. Only tenancy leases with a maximum term of 50 years and a 21-year renewal option may be approved.

A Landowners Association was founded in the Marampa region to serve as a forum for negotiations and to foster better ties between the local communities that own land in the Mine Concession Area. The land immediately surrounding the project areas is a rural setting, except for Lunsar Town. In Sierra Leone's rural areas, small, individual, or family- run farms are surrounded by residential areas (villages or hamlets).

4.11.7 Drivers of Land Use

This explains the motivation behind a land use practice within the Marampa M3.75 Project. Three drivers are recognized at the time of this assessment:

- Direct/proximate drivers
- Indirect/underlying drivers
- Intervening/mediating drivers

4.11.7.1 Direct/proximate drivers

Two types of direct drivers were noticed:

- Agriculture-Like all rural communities, food production for household use is the main reason for using land in all communities studied.
- Commerce- The communities are involved in commerce, in both food and non-food items. Some crops are grown mainly for trade whilst others are for both trade and food of the household.

4.11.7.2 Indirect/underlying drivers

Population Growth- This is the only element that defines these drivers. The growth in household size intensifies land use practices. All things being equal, households with more members tend to increase the size of their plots than those with smaller sizes.

4.11.7.3 Intervening/Mediating drivers

Labour is a key element in determining how much land is to be used. With it also is the number of males or females in the households, their ages etc. Others include the number of wives, education, religion etc. All of these played a role in the land uses identified in the communities.

4.11.8 Household Income and Expenditure

This component is extensively covered under the socio-economic sections of This ESHIA study. What is presented here are the summary facts in the undermentioned highlights:

4.11.8.1 Household Income

Households depend on two main sources of income: food and non-food items.

4.11.8.2 Income from Food Items

Food sources of income, according to respondents are derived from cassava and rice. These are grown by all households. The average income realized from the sale of cassava is NLe 772.9 (the new Sierra Leone Denomination), whilst imported rice is sold between NLe 550- 650. Though rice is the staple food in Sierra Leone, households nonetheless cultivate and sell it to generate income.

4.11.8.3 Income from non-food items

For non-food items, income is realized from various sources:

- Petty trading is the most significant. This is not surprising as petty trading is common in these parts of the country.
- Hired labour is also popular as people trade their energy working on people's plots.
- Motorcycle has in recent years become one key livelihood activity amongst youths. For some households, it is the main livelihood sustainability.
- Employment returns.

4.11.8.4 Household Expenditure

Food, medical, education and clothing are the four most important areas of expenditure of households. Households spend more on rice than any other food type. This is expected as rice is the staple food consumed by the majority of the population. This also indicates they are not producing enough food for consumption. What is even surprising is the fact that in rural areas, they are also buying leafy vegetables, pepper, and garden eggs. These are expected to be grown in the communities.

4.11.9 Potential Land Use Changes

Two main areas have been identified that will significantly lead to both temporary and permanent land change across all sites within the Marampa M3.75 project operations:

- Construction
- Project Operations

4.11.9.1 Construction

Land clearing or sterilization/burial will have the biggest direct impact, resulting in a long-term or permanent loss of soil resources and existing land-use capabilities at all construction sites. Additional effects on soils that are not cleared or sterilised include contamination from wind-blown dust from bare ground, blasting operations, heavy equipment movements, and haul truck movements, increased erosion, or inundation due to altered drainage patterns, compaction from vibration and loading under temporary stockpiles, contamination with hydrocarbons and other chemicals, including diesel and lubricant oils, and explosive residues. Following natural colonisation or intentional introduction in disturbed areas where such species tend to thrive, invasive species may also spread to undisturbed land.

4.11.9.2 Project Operations

During the operational stage of mining activities, there will be ongoing impacts on the soil and land use in the mine area and the haulage corridor. These impacts will be like those experienced during the construction stage. As mining operations expand, more land clearance or sterilization will be necessary to create space for resource strips, infrastructure, waste dumps, tailing storage facilities, and access routes. This will result in further impacts on the land and soil, including increased erosion, reduced soil fertility, and changes in the natural landscape. Additionally, the expansion of mining activities may lead to the displacement of local communities and a loss of biodiversity in the area. MML needs to work closely with local communities and environmental organizations to mitigate these impacts and ensure sustainable mining practices.

4.11.9.3 Potential Mitigation Measures

Measures such as land rehabilitation, reforestation, and the implementation of environmental monitoring programs can help to minimize the long-term impacts of mining activities on the land and soil at large. Since land use is soil are interwoven when it comes to impacts on the environment, the following mitigation measures have been identified for soil and land use issues that are considered to have a significant impact:

- Undertake studies to determine appropriate recolonisation programmes for impacted areas
- Minimise land/soil to be cleared or buried and concentrate such activities in areas with limited soil quality and land-use capability.
- Consider biodiversity offsets for unavoidable long-term and permanent soil/land clearance and soil/land burial. Integrate livelihood components as necessary with offsets to replace lost land-use capability.
- Before the commencement of mining, prepare a waste rock management plan and rehabilitation programme to include designs for progressive rehabilitation/re- vegetation of suitable areas throughout the mining lifecycle to minimise cleared/buried areas. Inspect and monitor rehabilitated surfaces to establish the success of revegetation and soil recovery.
- Implement appropriate conservation and preservation of stripped top soils and subsoils from all areas to retain physical and chemical characteristics and seed bank for subsequent use for rehabilitation activities.
- Implement required stormwater drainage and control before preventing erosion of exposed areas and inundation of down-slope areas.
- Minimise access by vehicles to essential areas to reduce the compaction of the soil.

- Isolate and manage potential soil contaminants (including wind-blown specks of dust and water-borne contaminants).
- Avoid disturbance/exposure of acid sulphate soils if present.
- Avoid deliberate introduction of alien invasive species during rehabilitation activities.
- Manage pathways by which alien invasive species can enter a disturbed area (including avoidance of non-indigenous plant species in rehabilitation activities).

4.11.9.4 Conclusions

Generally, the land use change assessment of the ESHIA for the Marampa M3.75 Project was able to classify the land cover of the project's spheres of influence-the mine site, haulage corridor and Jetty. Also, the current land use and land tenure system were considered. In addition, two major areas of land use change were identified (construction and operations), and their potential impacts on the environment, and local communities, have been outlined. Finally, potential mitigation measures to minimize those impacts have also been promulgated.

4.12 HYDROLOGICAL ASSESSMENT

Introduction

Water is extremely an important resource for the mining industry. Development in the mining sector has the potential to impact many aspects of the environment, and the responsible management of these natural resources is key to conserving them for future generations. Mining does not only influence the quality and quantity of water in the mine area and its surroundings but also sometimes changes the hydrological and topographical conditions of the environment. Water is a critical resource for which competing demands may often be the root source of conflict and tension within and between communities, societies, and nations. Governments play a crucial role in balancing the conflicting needs for water from many sectors, including mining, agriculture, industry, recreation, and household use. In the extraction and mining industry, governments are responsible for overseeing water extraction, water use, discharge, and quality at the site, watershed, and regional levels.

Water is typically a protected resource, and the problems associated with both surface and groundwater contaminations caused by mining operations are widely known. A failure of inefficient water resource management throughout a whole mine life cycle leads to situations where community and government support for the current and forthcoming mining projects can be increasingly difficult to achieve. Although mining companies have long been conscious of water-related risks, they still face environmental problems.

These risks and problems have proven how important it is for a mine to know its dynamic water use and to be able to manage its water efficiently. Inadequately assessed water management practices are one of the major concerns in the mining industry. These problems mainly emerge because the water balances of mine sites have not been adequately assessed during the planning phase of most mining projects.

Mining operations involve two main hydrologic components: natural and mine water systems. Natural waters are associated with the natural hydrological cycle, such as groundwater and meteoric water from precipitation, evaporation, and runoff. During the mine-life cycle, sufficient and accurate knowledge and characterization of baseline hydrogeological parameters in the mine site are crucial for establishing baseline hydrological conditions for the prediction of drainage release and transport, and monitoring of the environmental conditions and potential impacts. The hydrological parameters are needed also for impact evaluations and the proper design of detention structures, diversions, culverts, pregnant ponds and barren ponds, tailings dams, and other facilities controlling waters at the mine site.

Since the infiltration, surface runoff and groundwater recharge are all controlled by the characteristics of the soil and bedrock, comprehensive information about the surface and near-surface geology and morphology of the site is also crucial for quantifying and evaluating the hydrological and hydrogeological characters of the site. This assessment will provide an in-depth analysis of the hydrological and water resources of the mining project area, including the availability and quality of surface and groundwater sources, the potential impacts of mining operations on water resources, the vegetation health around rivers and streams and the strategies and technologies that can be used to manage and mitigate these impacts. The assessment provides a detailed analysis of existing data and information, government legislation as well as the collection of new data through field investigations and monitoring. It also took into account regulatory requirements and community concerns and provided recommendations for best practices and management strategies that align with the mining.

4.12.1 Methodological Approach

4.12.1.1 Study Area

The Project Mining area is in the Port Loko District, Marampa Chiefdom and adjacent to Lunsar Town, while the jetty is located in Maforki Chiefdom in the same district. For a detailed description of the Marampa M3.75 expansion project, please refer to section one. *Figures 4-26* and 4-27 below show the geographic location of the project (Mining area and Jetty).

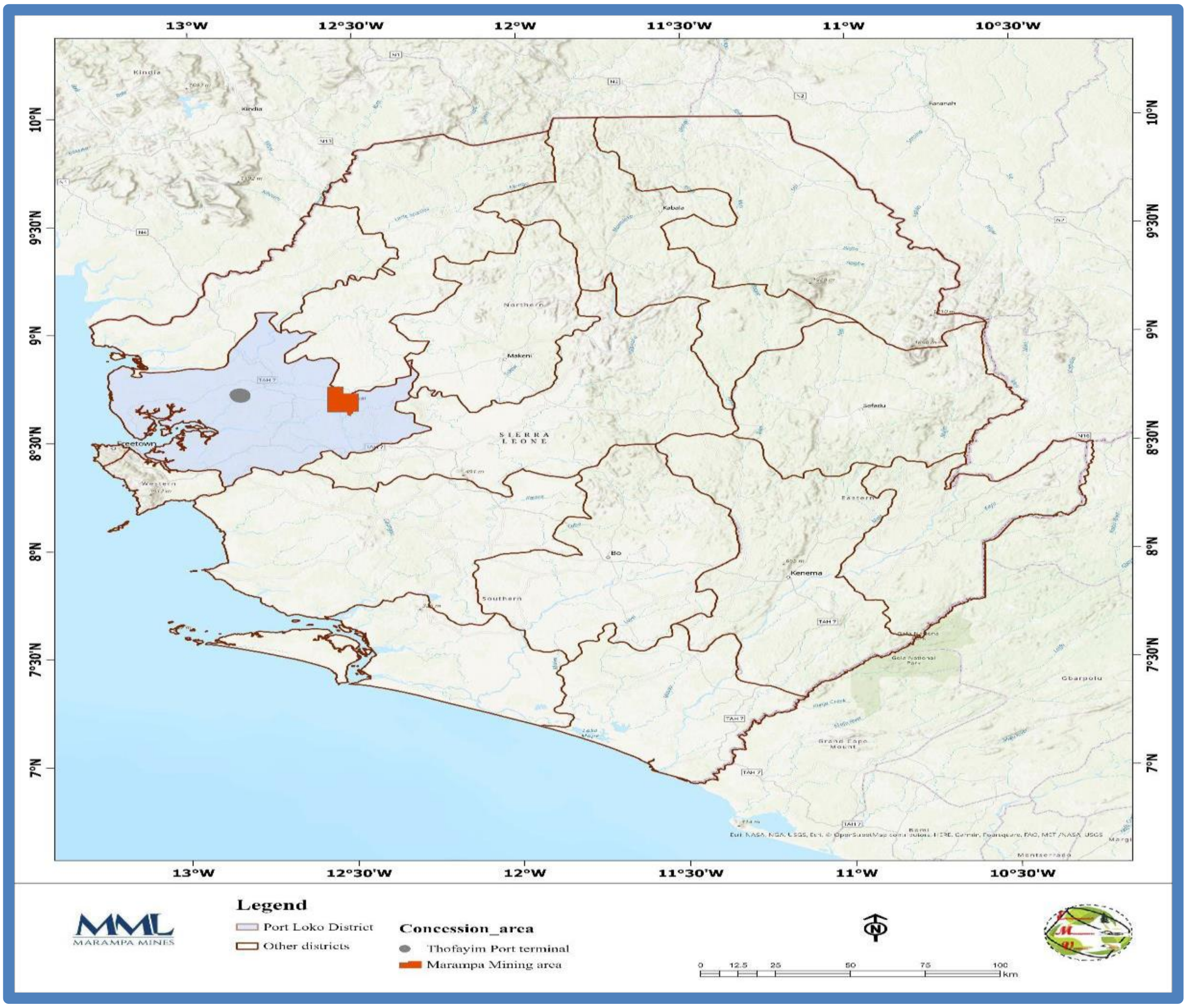


Figure 4- 24: Project area and district in Sierra Leone

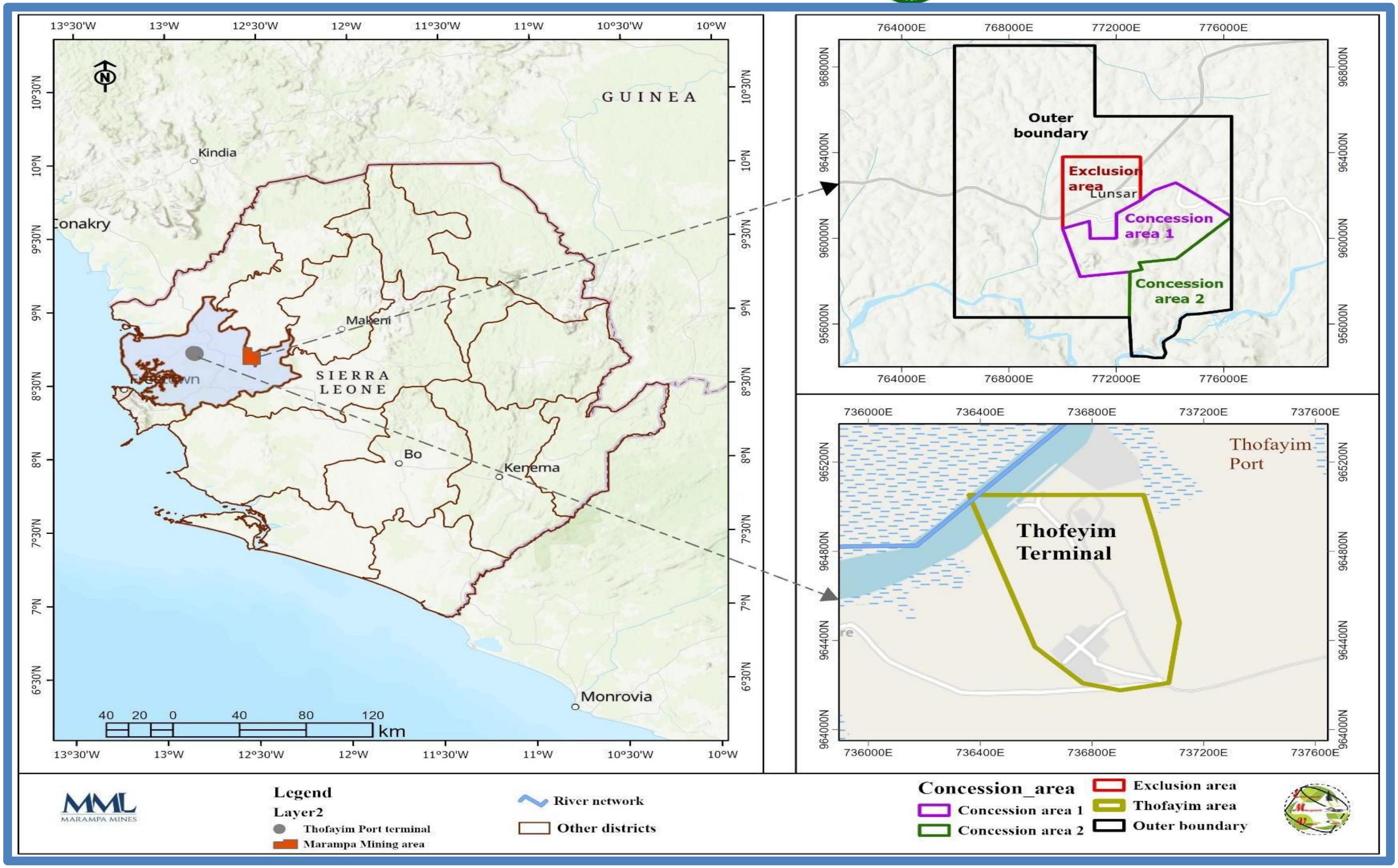


Figure 4- 25: Thofayim Port and Mining Concession Areas

High resolution (12.5m) digital elevation model (DEM) was downloaded from Earth Data in the Alos Polsar directory available at https://search.asf.alaska.edu/#/ from which a topographic map for the mining site has been derived after processing the DEM in ArcGIS Pro and is shown in *Figure 4-28.*

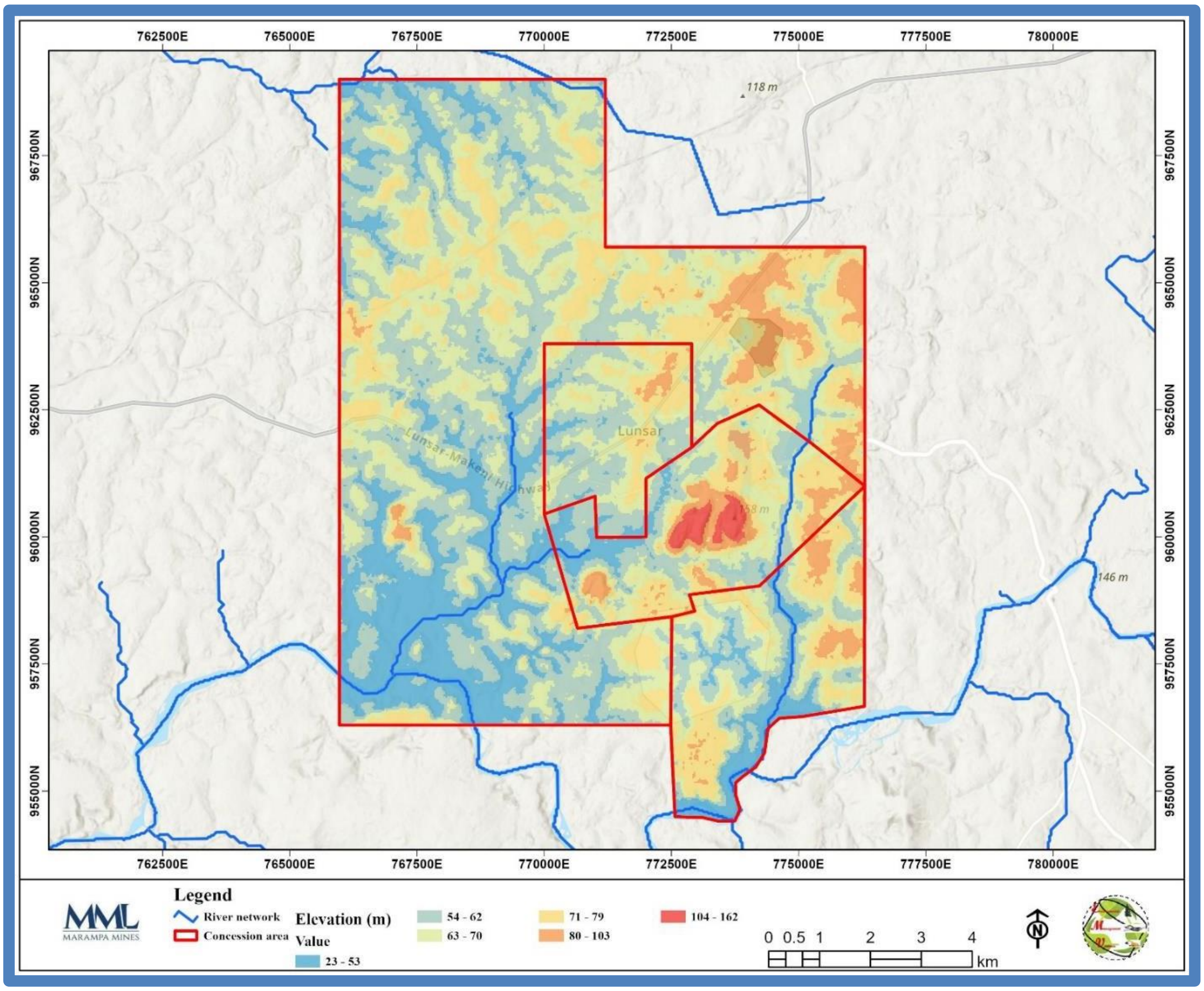


Figure 4- 26: Topographic Map of the Mining Concession Areas Showing the River Network.

The highest elevation of the whole concession area (162m) can be seen from a hill located at the centre of the Concession Area 1 boundary. High elevations occur mostly at the east of the concession boundary, while the minimum elevation is 23m above sea level and is found mostly in floodplain areas of rivers/streams.

The data collection process employed both qualitative and quantitative methods which included both desk studies and field assessments. In the desk study, government legislation, scanned maps, shapefiles, meteorological data and other relevant documents related to the project were obtained, reviewed, and analysed.

4.12.1.2 Community Engagement and Social Impacts:

The expansion and operations of mining activities can have significant social impacts on nearby communities, including displacement, loss of livelihoods, and changes in traditional practices. This study assessed the potential social impacts of the expansion activities on local communities and identified measures to mitigate or manage these impacts. Thus, key informant interviews (KII) and focus group discussions (FGD) were conducted at each settlement. During this process, community stakeholders were first targeted to ensure that their concerns and perspectives are taken into account and to acquire information on the potential social and economic impact resulting from the proposed expansion phases.

Questions for the FGDs and KII were designed using ArcGIS Survey 123 for the collection of qualitative data on social and economic impacts that may result from the proposed expansion of mining areas on water resources within the project's settlements.

4.12.1.3 Mapping of Water Sources

Assessment and mapping of water sources were conducted to identify and evaluate the quantity, quality, and accessibility of various water sources within the project area. The initial process involved an extensive desk study which was followed by a field survey and data collection on existing water sources within the project area that include wells, springs, streams, rivers, ponds and wetlands. During the field assessment, a water resources expert, lead consultant, and three field staff were involved in a five (5) day survey and data collection process within the project areas (mining site and the Thofayim port terminal).

Current flow meter, dip meter and handheld GPS devices were also used for the collection of quantitative and numerical information related to preliminary river/stream flow and groundwater levels for most water sources. For surface water sources, preliminary stream flow and ecological conditions were determined. For groundwater sources, the depth to the water table was determined using a dip metre. In addition to ground data collection, an aerial survey using drone was done at strategic locations within the mining and Thofayim port areas. The drone was specifically used to conduct field surveys in remote or inaccessible areas to identify water sources and agricultural water uses and the information was used to improve understanding of water-related features and hydrological processes in these areas.

A water quality assessment was done within the project area to identify areas of groundwater contamination and to physically determine the contamination of all surface water sources as baseline information for the project's expansion. Groundwater quality was evaluated through the collection of water samples and tested for specific physical, chemical, and biological parameters. The set of data collected was analysed to determine the quantity, quality, spatial distribution and proximity of these sources to the proposed expansion infrastructure using GIS.

The figure below shows an assessment of surface and groundwater sources.

Groundwater assessment	Surface water assessment

Figure 4- 27: Ground and Surface Water Assessment

4.12.2 Assessment of Proposed Mining Infrastructure

To complement the environmental and social impact assessment (ESIA) for the expansion of mining operations, an evaluation of the impact was done on ecosystem and biodiversity, water sources, air quality, communities and social impacts. A drone survey was also done to spatially determine impacts resulting from the movement of minerals from the mines to the port by identifying farmlands polluted by dust particles resulting from hauling. The figure below shows a drone survey for capturing aerial views at Thofayim Port.

Figure 4- 28: Drone survey at Thofeyim Port

4.12.2.1 Meteorological and Climate Conditions

The climate conditions in the expansion area were considered including rainfall patterns, temperature, and humidity. Meteorological characteristics were computed for both the mining site and the port at Thofayim. Due to a lack of available gauge station data for the project site, the daily Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) data was used for Thofayim and the Mining site. The GIS Climate raster dataset for a thirty (30) year period (1991 to 2020) was downloaded from Climate Hazards Group's (CHG) FTP server for the two project areas (Thofayim and Mining site). The average daily rainfall data from the CHIRPS raster datasets were extracted to the centroid of each project site using Python programming and processed into ArcGIS Pro. The result is presented in the result and analysis section of this report.

4.12.2.2 Catchment Delineation and Characteristics

Delineation of sub-catchments within the project site was done using the 12.5m resolution DEM in ArcGIS Pro. The DEM was used to create a flow direction raster, which shows the direction of water flow from each cell in the raster to its neighbouring cells. Using the flow direction raster generated, a flow accumulation raster which calculates the total upstream area draining to each cell in the raster was generated. The flow accumulation raster was used to identify areas of high flow accumulation which correspond to stream channels. Two pour points were defined; one downstream of the Thofayim Port and another downstream of the mining area, which represented the outlet of the stream network for analysis. Using the flow accumulation raster and the pour point, watersheds were created which defined the area of land that drains to the pour point.

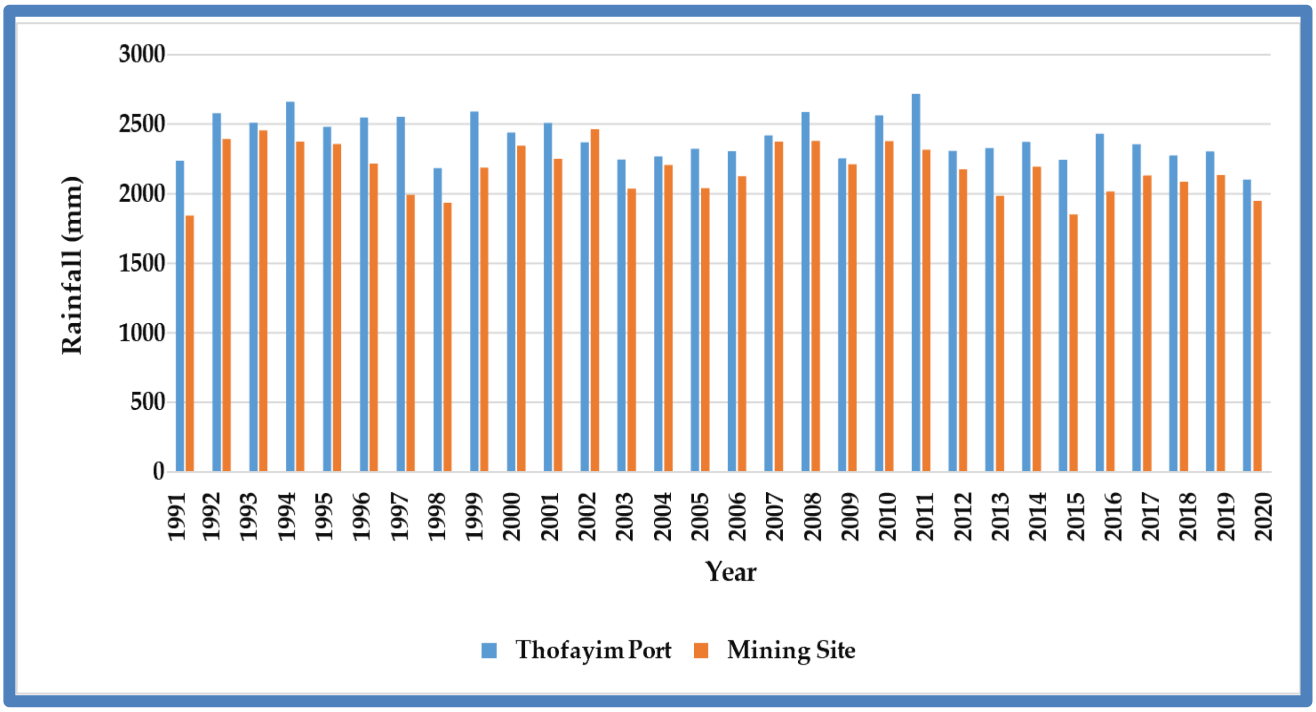
The two catchments generated from the delineation process correspond to the Rokel River basin at the mining site and the Bankasoka River basin at the Thofayim Port. The result from the delineation process is presented in the result and analysis section of this document.

4.12.3 ANALYSIS AND RESULT

This section presents the results obtained from the Desk Study and Field Assessment conducted at the two project sites for the expansion of the mines. The result from hydrological, economic, social and environmental impacts likely caused by the expansion phases of the mines are described in the following sections.

4.12.3.1 Meteorological Assessment

The figure below shows an overview of the average monthly rainfall recorded at Thofayim and the mining site for 30 years.



Graph 4- 1: Annual Rainfall Comparison (1990 - 2020)

From the diagram above, Thofayim Port experiences higher rainfall than the Mining Site. The highest rainfall at Thofayim Port was recorded in 2011 with a value of 2723mm whilst the highest rainfall recorded at the Mining Site occur in 2002 (2469mm). As rainfall patterns are complex and can be influenced by a variety of factors, two major factors influencing higher rainfall at the Port than at the mines are the presence of higher vegetation cover and proximity to nearby waterbody as shown in the figures below.

Figure 4- 29: High vegetation cover at Thofayim Port

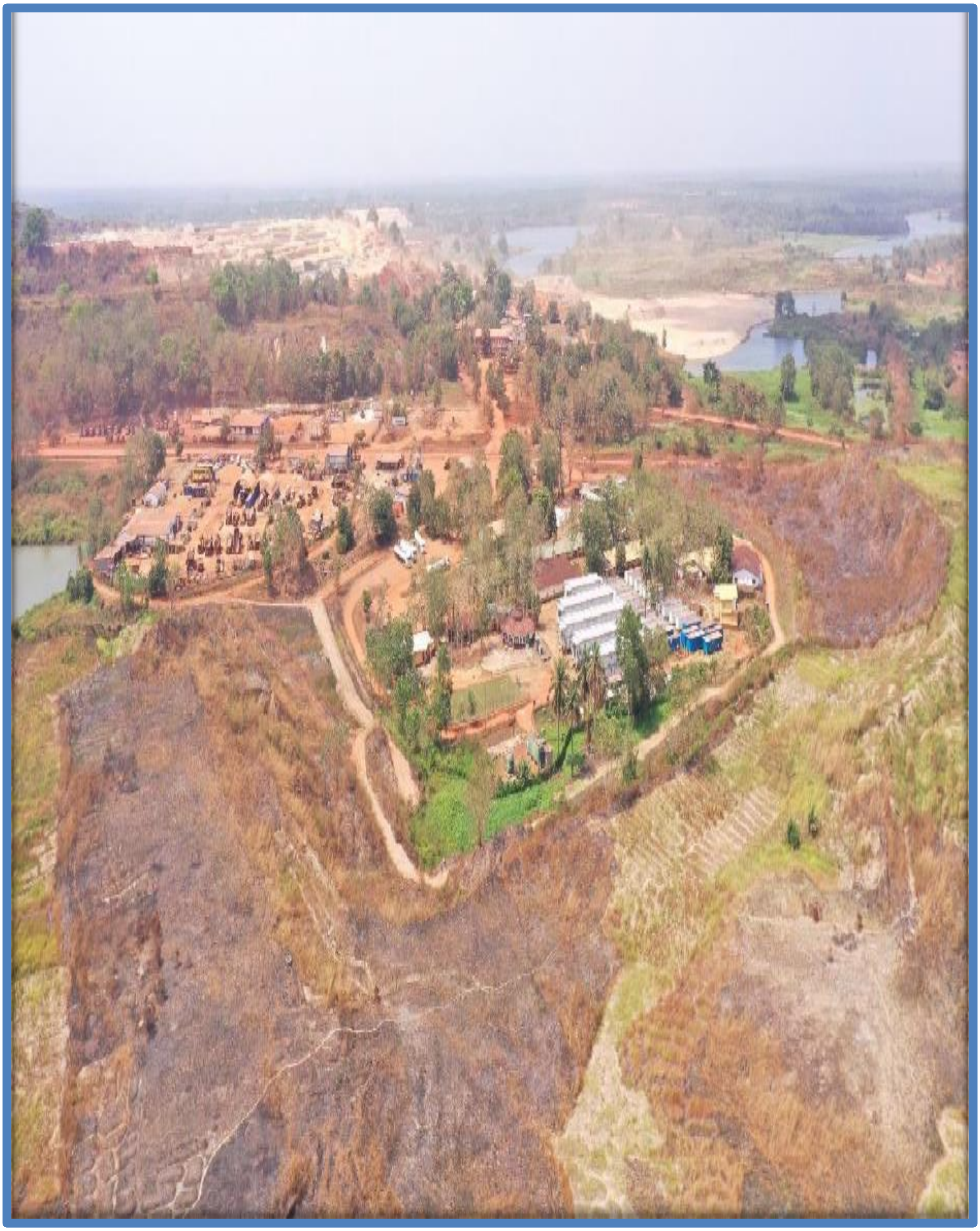
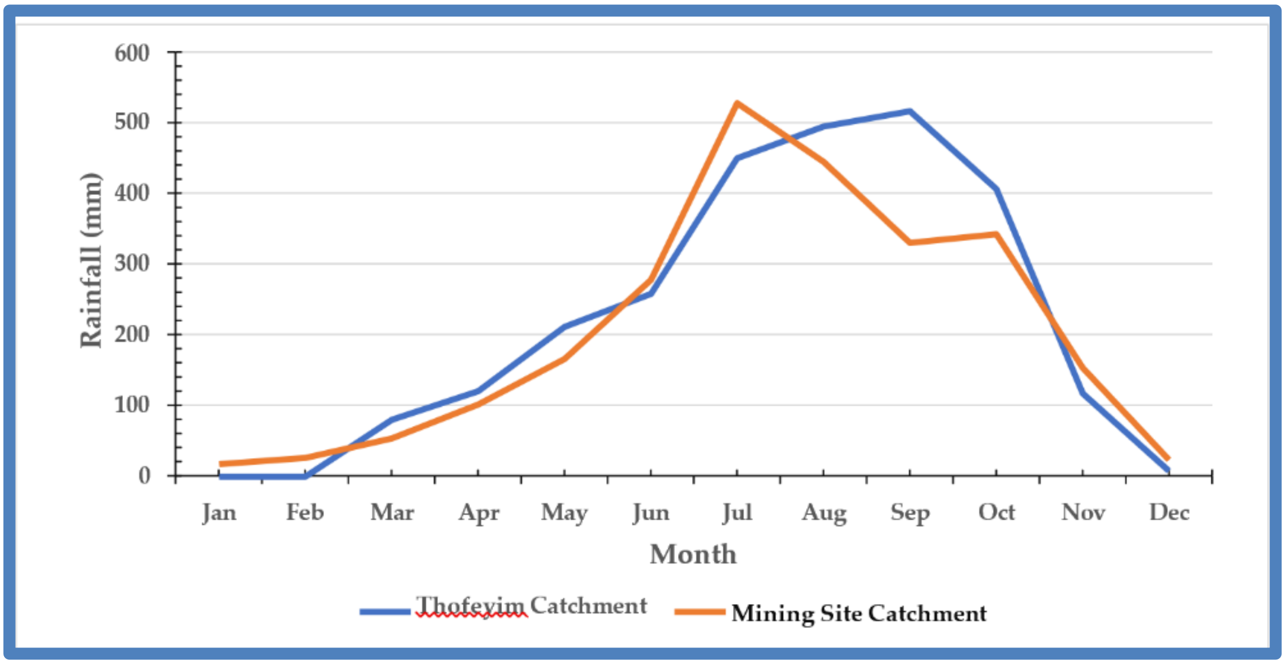


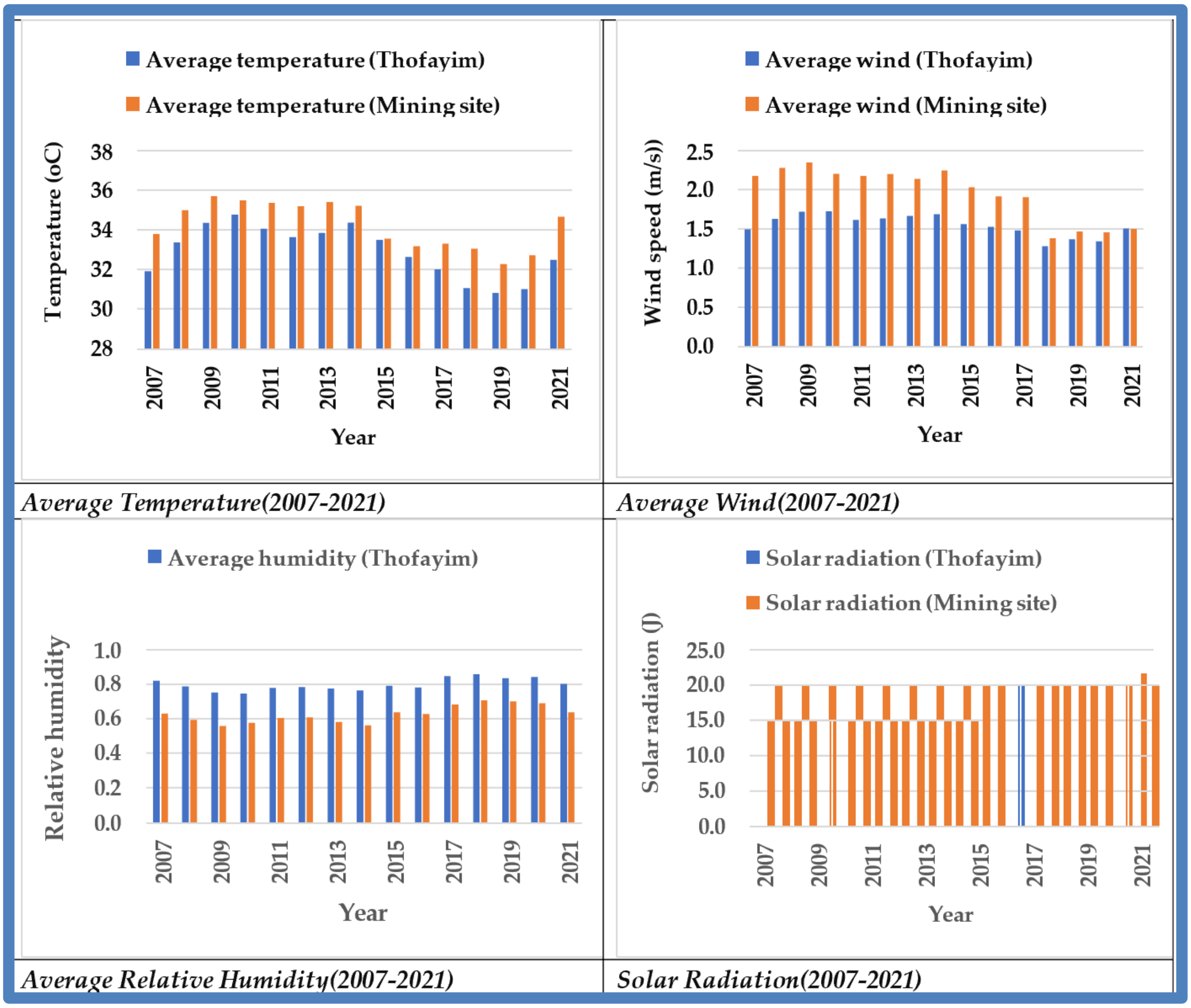
Figure 4- 30: Less Vegetation Cover at the Mining Site

The average monthly rainfall pattern was also computed for the two project sites (*Figure 4-31 and 4-32*). Although both sites experience dry periods from December to February with an average rainfall of less than 100 mm, the peak rainfall occurs in July and September at the

Mining Site and Thofayim Port respectively. The National Centres for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) was used to acquire other weather/climate variables. The CFSR was designed and executed as a global, high-resolution, coupled atmosphere-ocean-land surface-sea ice system to provide the best estimate of the state of these coupled domains over a long period. Daily CFSR data for a fifteen-year (15) period (2007 – 2021) for wind, relative humidity, solar radiation, and minimum and maximum temperature were downloaded for the two project sites in CSV format.



Graph 4- 2: Average Monthly Rainfall Pattern (1990 – 2020) for the Two Project Sites



Average Temperature(2007-2021)

Average Wind(2007-2021)

Average Relative Humidity(2007-2021)

Solar Radiation(2007-2021)

Graph 4- 3: Four Atmospheric Elements for the Mines Site and Jetty

4.13 WATER RESOURCES ASSESSMENT

4.13.1 Surface Water Assessment

Assessment of surface water was done at the mining site, settlements within the mining sites, and sources across the haul road to Thofayim Port. One of the main tributaries of the Rokel River started at the existing mining site as a creek (Bathbana Creek), flows through a wetland and finally empties into the main stem of the Rokel River. Preliminary flow measurement using the velocity area method was computed once at the upstream (mining site) and downstream section at Moria (close to the confluence with Rokel River) Since flow was measured during the dry period of March, any flow recorded was assumed as the minimum flow during that period. Thus, the minimum flow recorded at the upstream and downstream of the Bathbana Creek is 0.17 m^3/s and 0.26m^3/s respectively.

Bathbana Creek at the mines (Upstream)	***Bathbana Creek at Moria (downstream)***

Figure 4- 31: Bathbana Creek at the Mine Site

As shown in the figures above, the creek is more turbid at its source (the mining site) than downstream close to the confluence with the Rokel River. The resulting difference is due to a natural filtration process as it flows through a series of wetlands before emptying into the Rokel. Surface water assessment was also done at another main tributary to the Bankasoka River that flows through the Thofayim Port. This water source is predominantly used by the

MML bowsers for limiting dust along the haul road linking the mines to the port.

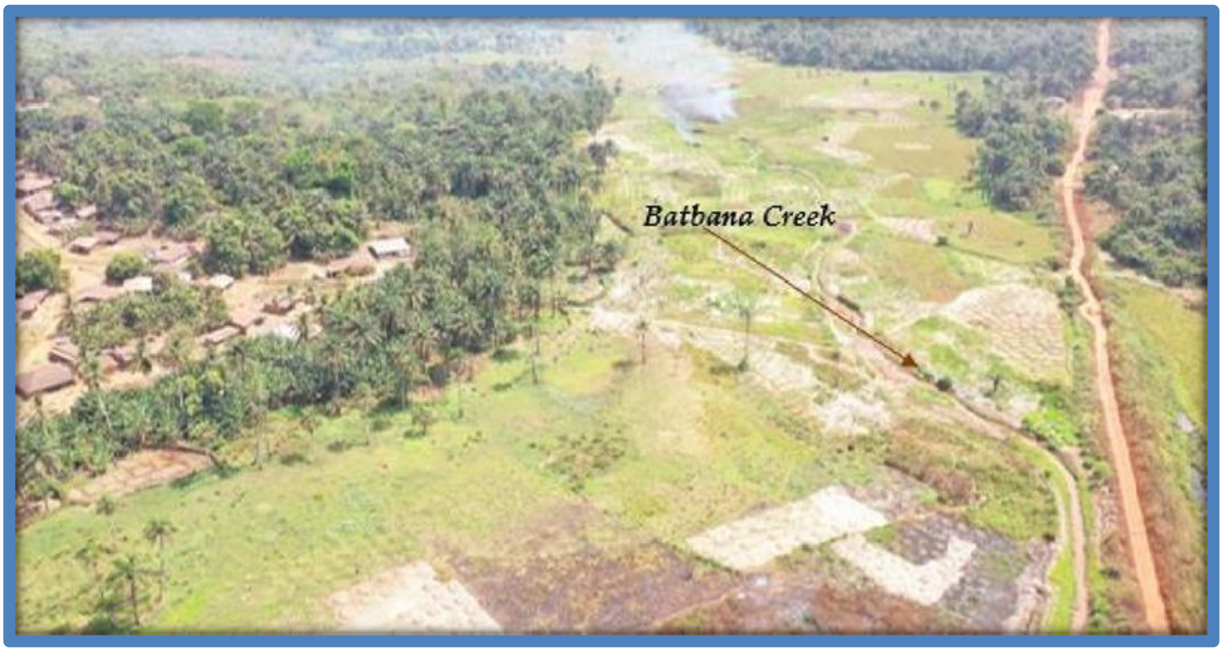


Figure 4- 32: Bathbana Creek Flowing Through Wetlands Undergoing Natural Filtration

As water is being pumped into the bowser through the hose, evidence of oil sheen can be seen on the water surface originating from the pumping machine installed at the riverbank. Little or no flow was observed at the section of water abstraction. The figure below shows water abstraction by browser and an oily sheen on the water surface of a Bankasoka tributary.

Figure 4- 33: Water Abstraction Point at Bankasoka Tributary

4.13.2 Groundwater Assessment

Groundwater sources including wells, boreholes and springs were identified at communities within and around the mining sites and the Thofayim Port. A total of 76 water sources are found within the mining sites and 3 at the Thofayim Port. Lunsar Town, which is located in the exclusion area was not considered in the groundwater mapping. For each water source, the diameter and depth of the water table were determined. Water quality was also determined for a few water sources located within the mining concession area.

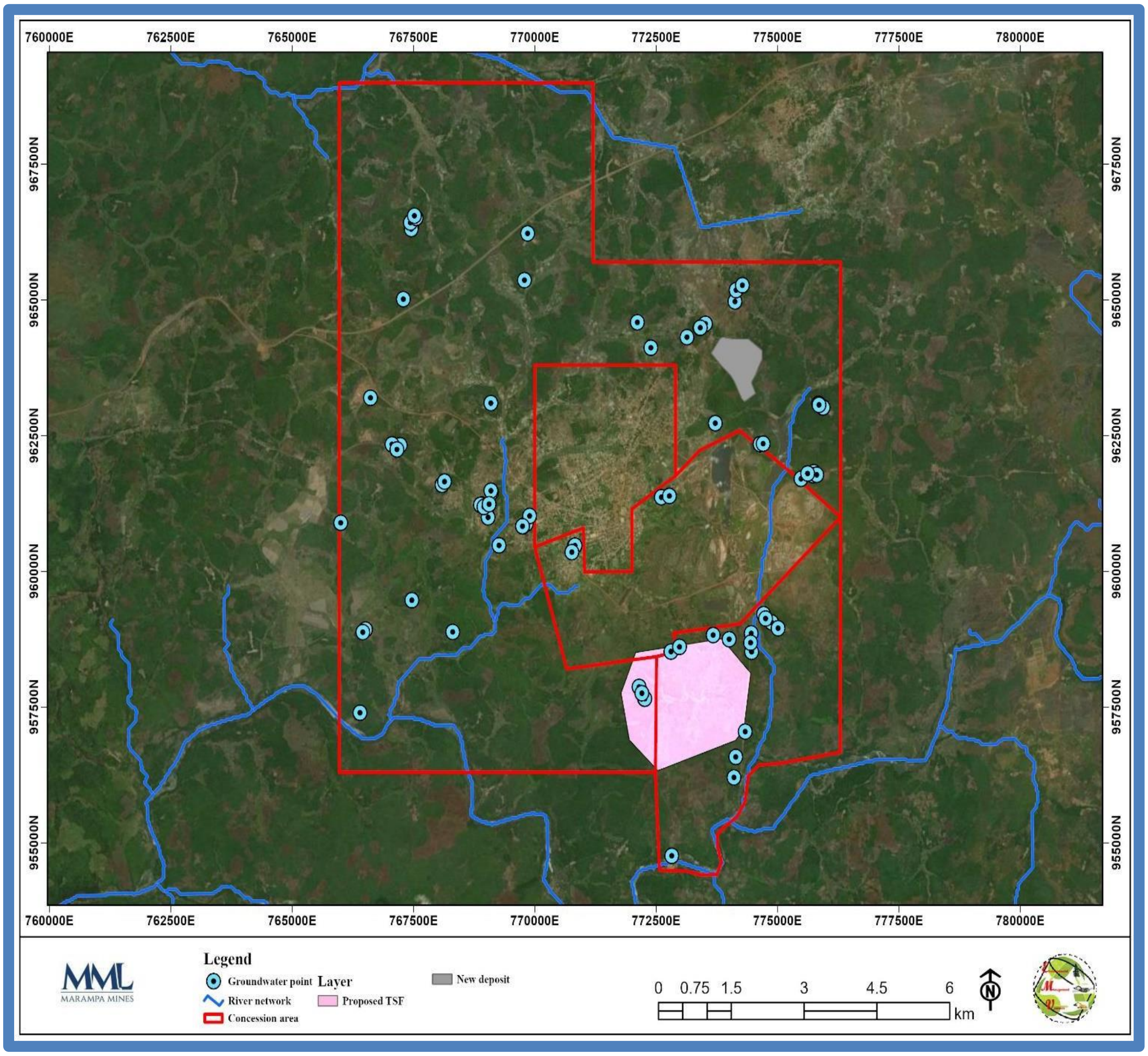


Figure 4- 34: Groundwater sources around the mining concession area

4.13.2.1 River Basin and Catchment Characteristics

The Marampa Mining concession area and the Thofayim Port are located within two separate river basins: the Rokel Basin in the south and the Bankasoka Basin in the north. About 80% of the mining concession area falls within the Rokel River basin while 20% is only contained in the Bankasoka basin. The concession area within the Rokel Basin also falls within two sub-catchments: the second catchment of the Sierra Leone Rokel River Basin (SLRRB_30_02) and the fifth catchment of the Sierra Leone Rokel River Basin (SLRRB30_05).

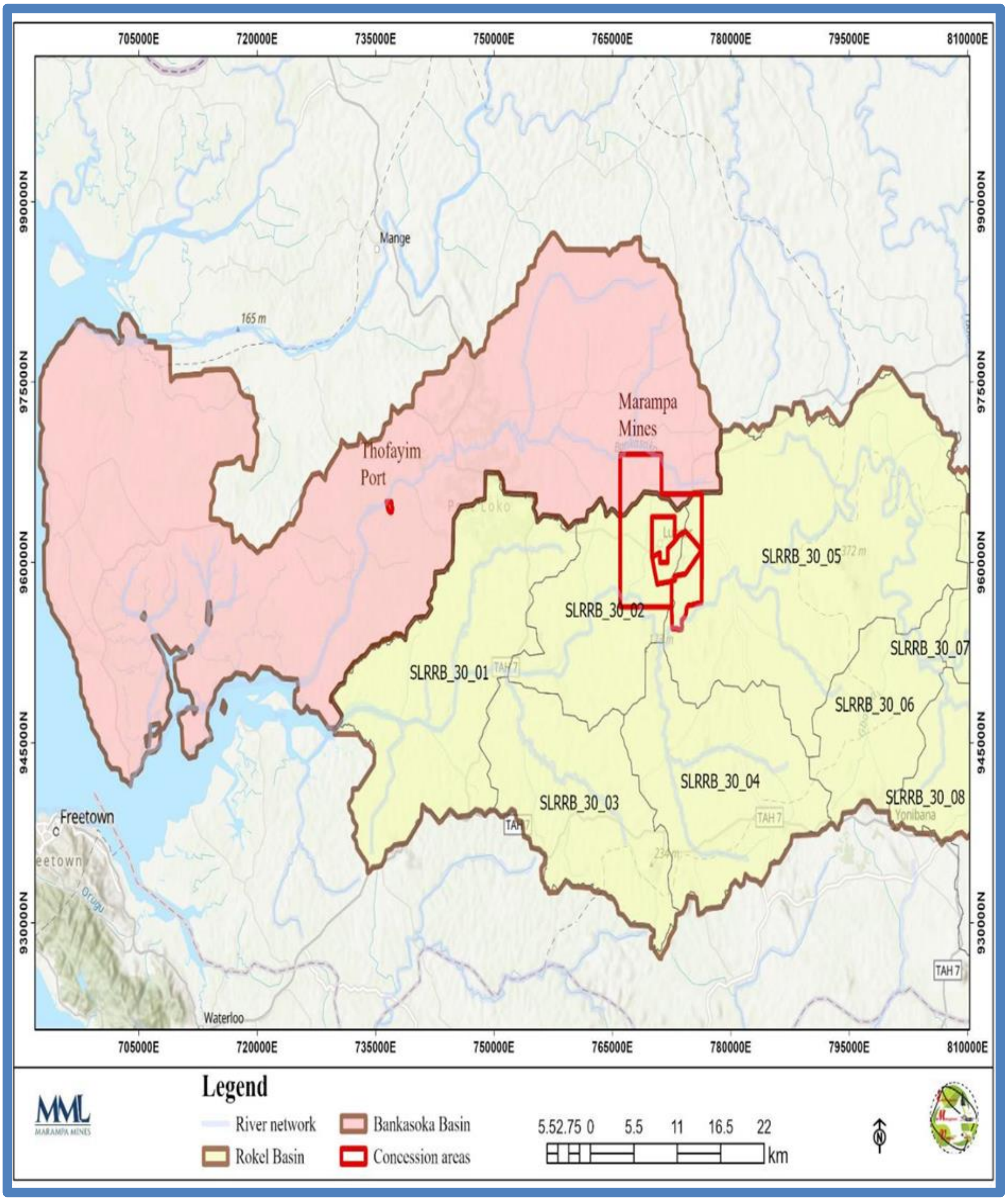


Figure 4- 35: Location of Mining and Port Areas within Sierra Leone's River Basins

4.13.2.2 Delineated Catchment at the Proposed Mining Area

The result from the delineation of the Bathbana stream shows that the proposed mining site is located downstream of the Bathbana Catchment. The approximate area of Bathbana Catchment is 29.1 km² with elevation varying from 71 to 192 masl.

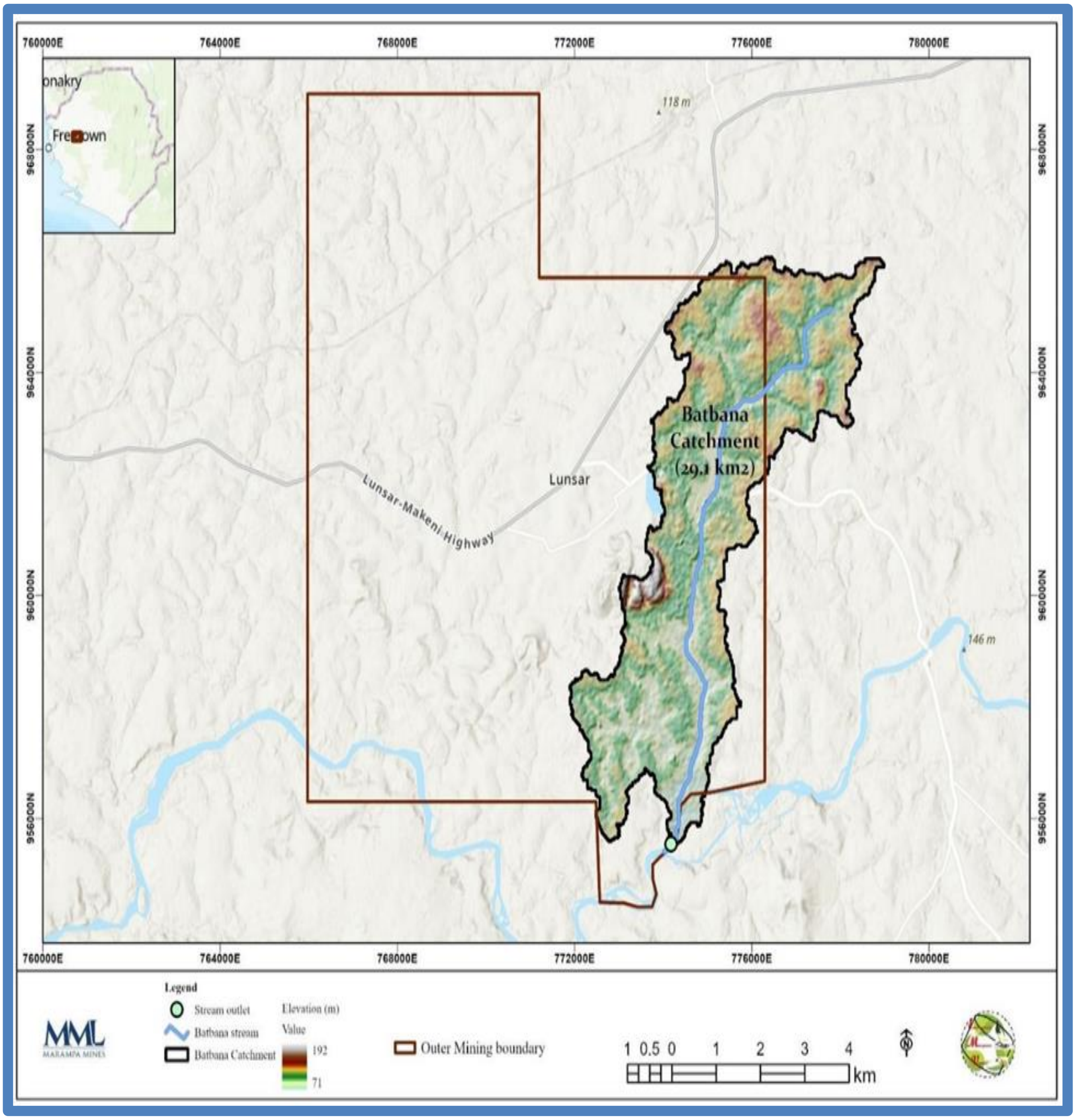


Figure 4- 36: Delineated Sub-catchment at the Proposed Mining Site

Table 4- 7: Lists of Coordinates for all Water Bodies and Water Points Found within the Project Sphere of Influence.

No	Location/Village	Feature category	Feature	Name	Eastings (m)	Nothing (m)	Elevation (m)
1	Mining site	Surface water	Stream	Bathbana Creek	774701	960072	**54**
2	Gbonlimba	Surface water	Stream	Bathbana Creek	774525	959330	**55**
3	Moria	Surface water	Stream	Bathbana Creek	774555	956838	**53**
4	Katick	Surface water	Stream	Bathbana Creek	774546	956603	**58**
5	Katick	Surface water	River	Rokel	774285	956286	**44**
6	Rogbaneh	Groundwater	Dug well	Hand pump	774445	958687	**63**
7	Moria	Groundwater	Dug well	Hand pump	774335	957050	**65**
8	Mathaimu	Surface water	River	Mathaimu River	740781	964617	**10**
9	Mathaimu	Groundwater	Dug well	Hand pump	740407	964450	**39**
10	Mapown	Groundwater	Dug well	Hand pump	739621	963826	**38**
11	Mapown	Groundwater	Dug well	Hand pump	739497	963748	**36**
12	Mapown	Groundwater	Dug well	Hand pump	739380	963568	**36**
13	Thofeyim	Groundwater	Dug well	Hand pump	736719	964337	**30**
14	Thofeyim	Groundwater	Dug well	Hand pump	736766	964370	**28**
15	Thofeyim Port	Groundwater	Borehole	Water supply/ treatment plant	736803	964878	**23**
16	Chaindatta	Groundwater	Dug well	Hand pump	772771	961392	**59**
17	Chaindatta	Surface water	Swamp	Swamp	772856	961349	**51**
18	Chaindatta	Surface water	Swamp	Swamp	772436	961164	**45**
19	Chaindatta	Groundwater	Borehole	Hand pump	772712	961349	**57**

20	Chaindatta	Groundwater	Dug well	Hand pump	772604	961363	**55**
21	Chaindatta	Groundwater	Dug well	Hand pump	772889	961492	**53**
22	Mathukia	Groundwater	Dug well	Hand pump	773717	962734	**74**
23	Mathukia	Groundwater	Dug well	Hand pump	773679	962631	**64**
24	Mathukia	Surface water	Swamp	Swamp	773597	962568	
25	Robella	Groundwater	Dug well	Hand pump	774441	962645	
26	Robella	Surface water	Stream	Robella stream	774424	962963	
27	Magbanthie	Groundwater	Dug well	Hand pump	774717	962337	**70**
28	Magbanthie	Surface water	Swamp	Swamp	774963	962078	**60**
29	Magbanthie	Groundwater	Dug well	Hand pump	774634	962358	**74**
30	Magbirie	Groundwater	Borehole	Hand pump	776394	960430	**79**
31	Magbirie	Groundwater	Dug well	Hand pump	776364	960388	**77**
32	Magbirie	Surface water	Swamp	Swamp	776014	960156	
33	Maforkie	Groundwater	Dug well	Hand pump	775621	961739	**82**
34	Maforkie	Groundwater	Dug well	Hand pump	775476	961709	**84**
35	Maforkie	Groundwater	Dug well	Hand pump	775806	961789	**85**
36	Manonko	Groundwater	Dug well	Hand pump	775937	963026	
37	Manonko	Groundwater	Dug well	Hand pump	775841	963090	
38	Konta Lol	Groundwater	Dug well	Hand pump	772981	958611	**86**
39	Konta Lol	Groundwater	Dug well	Hand pump	772805	958524	**81**
40	Labor Compound	Surface water	Spring	Spring	772791	959021	**57**
41	Robaka stream	Surface water			769431	960914	
42	Rosint stream	Surface water			768391	958462	
43	Mapoli	Surface water		Rokel River	772754	954581	

44	Unknown	Surface water	Swamp		770470	959605	
45	Unknown	Surface water	stream		769506	959314	
46	Royeama	Groundwater	Dug well	Hand pump	774123	964971	**113**
47	Magbongbon	Groundwater	Dug well	Hand pump	767291	965014	**114**
48	Magbafth Village	Groundwater	Dug well	Hand pump	768088	961596	**91.5**
49	Makomp	Groundwater	Dug well	Hand pump	773515	964561	**124.1**
50	Rofunk Village	Groundwater	Dug well	Hand pump	766398	957397	**90**
51	Mabetor	Groundwater	Dug well	Hand pump	774147	965181	**95.1**
52	Magatah	Groundwater	Dug well	Hand pump	774639	962345	**58**
53	Maforkie	Groundwater	Dug well	Hand pump	775483	961706	**116**
54	Rothana	Groundwater	Dug well	Hand pump	769851	966226	**81**
55	Katick	Groundwater	Dug well	Hand pump	774140	956583	**79**
56	Magbafth Village	Groundwater	Dug well	Hand pump	768140	961654	**98.9**
57	Maforay	Groundwater	Dug well	Hand pump	767467	959470	**77.7**
58	Maforkie	Groundwater	Dug well	Hand pump	775749	961827	**141.9**
59	Chandatha Village	Groundwater	Dug well	Hand pump	772606	961367	**88.2**
60	Gbom Limba	Groundwater	Dug well	Hand pump	775011	958953	**101**
61	Gbom Limba	Groundwater	Dug well	Hand pump	774713	959212	**89**
62	maronko	Groundwater	Dug well	Hand pump	767462	966364	**105.8**
63	Rogbaneh	Groundwater	Dug well	Hand pump	774466	958520	**81.9**
64	Maronko	Groundwater	Dug well	Hand pump	767454	966307	**122**
65	Madora	Groundwater	Dug well	Hand pump	772264	957654	**97.8**
66	Robaka Village	Groundwater	Dug well	Hand pump	769263	960480	**98.9**
67	maronko	Groundwater	Dug well	Hand pump	767437	966426	**-7**
68	ROMKOMP	Groundwater	Dug well	Hand pump	773402	964485	**104.4**
69	Thoffayim	Groundwater	Dug well	Hand pump	736766	964374	**64.1**
70	Makel	Groundwater	Dug well	Hand pump	769786	965365	**65.7**
71	Mafokie	Groundwater	Dug well	Hand manual (e.g. rope pump, rope & bucket)	775732	961771	**124.9**
72	Mafira	Groundwater	Dug well	Hand pump	766614	963198	**85**
73	Manokoh	Groundwater	Dug well	Hand pump	775938	963020	**135**

74	Foroad Baka	Groundwater	Dug well	Hand manual (e.g. rope pump, rope & bucket)	770763	960355	**95**
75	Rolal	Groundwater	Dug well	Hand pump	766512	958930	**83**
76	Rosint	Groundwater	Dug well	Hand pump	768309	958885	**100**
77	Konta Bana	Groundwater	Dug well	Hand pump	772148	957872	**122.5**
78	Maforkie	Groundwater	Dug well	Hand pump	775808	961781	**101**
79	Mayoka	Groundwater	Dug well	Hand pump	766001	960896	**85.7**
80	Konta Bana	Groundwater	Dug well	Hand pump	772265	957656	**94**
81	kalangba	Groundwater	Dug well	Hand pump	772112	964588	**123**
82	Magbainkthay	Groundwater	Dug well	Hand pump	775620	961804	**96.7**
83	Labour Camp	Groundwater	Dug well	Hand pump	773674	958828	**101.6**
84	Thoffayim	Groundwater	Dug well	Hand pump	736710	964335	**101**
85	Rolal	Groundwater	Dug well	Hand pump	766456	958881	**79**
86	Rogballan	Groundwater	Dug well	Hand pump	767227	962324	**96**
87	Mapoli	Groundwater	Dug well	Hand pump	772821	954761	**121**
88	Robaka Junction	Groundwater	Dug well	Hand pump	769749	960829	**92.8**
89	Labour Camp	Groundwater	Dug well	Hand pump	774004	958751	**135.8**
90	Mathuyai	Groundwater	Dug well	Hand pump	773718	962731	**50**
91	Rogballan Village	Groundwater	Dug well	Hand pump	767057	962340	**203.1**
92	Makomp	Groundwater	Dug well	Hand pump	773134	964315	**91**
93	Konta Bana	Groundwater	Dug well	Hand pump	772205	957757	**108**
94	Robaka Junction	Groundwater	Dug well	Hand pump	769746	960833	**89.3**
95	Rogballan	Groundwater	Dug well	Hand pump	767159	962246	**99.3**
96	Chandatha Village	Groundwater	Dug well	Hand pump	772773	961390	**91.6**
97	Manokoh	Groundwater	Dug well	Hand pump	775847	963087	**142.9**
98	Gbom Limba	Groundwater	Dug well	Hand pump	774754	959132	**80.2**
99	Magbankthay	Groundwater	Dug well	Hand pump	774705	962353	**252.2**
100	Maronko Village	Groundwater	Borehole	Submersible pump	767555	966513	**98**
101	Rogbesseh	Groundwater	Dug well	Hand pump	769095	963101	**100**

102	Mabettor	Groundwater	Dug well	Hand pump	774276	965271	**110**
103	Maronko Village	Groundwater	Dug well	Hand pump	767519	966552	**86.5**
104	Manokoh	Groundwater	Dug well	Hand pump	775855	963067	**159**
105	Katick	Groundwater	Dug well	Hand pump	774102	956206	**130**
106	Makomp	Groundwater	Dug well	Hand pump	773409	964489	**108**
107	Rogbaneh	Groundwater	Dug well	Hand pump	774457	958859	**92.2**
108	**Royal**	**Groundwater**	**Dug well**	**Hand pump**	**772391**	**964120**	118

4.14 WATER QUALITY ANALYSIS

Water quality analysis comprises on-site tests of the parameter that are affected by environmental conditions. Measurement of chemicals and ions and bacteriological tests are usually determined in the laboratory. The study of chemical composition enables us to determine its suitability for drinking and other domestic use. It is not feasible to measure the concentration of all constituents in groundwater, instead, the company measures the concentration of a standard set of constituents in what is known as the routine analysis.

Major constituents in groundwater (mg/l) include HCO_3, Ca, Cl, Mg, Si, Na, SO_4, and minor constituents (0.01 – 10mg/l) include B, CO_3, F, Fe, NO_3, K, Sr. The trace constituents include the following: Al, Sb, As, Ba, Ni, PO_4, Sn.

From the analysis of the regular parameters, most of them exceed the normal WHO standards which are discussed separately in the bar graphs presented. The high concentration of some of these constituents is a result of either mining activities, natural occurrences, or other human activities.

Table 4- 8: Water Quality Analysis Results from Various Communities and Water Sources

Parameters	WHO Recommended Permissible Limits	The Measured Value for Each Location						
		Gaffal Pond	Massaioin Pond	Bath Bana Pond	Rokel River	Bathbana Creek 1	Bathbana Creek 2	Rogbaneh
Water Temperature (°C)	No. Value	27.5	27.6	27.5	26.9	26.9	27.5	27.1
pH	6.5 – 8.5	6.9	6.9	6.9	6.9	6.9	6.8	6.8
Turbidity (NTU)	<5.0	15	4	6	10	15	33	0
Conductivity (μS/Cm)	<450 μS	18	30	44	28	38	30	66
TDS (ppm)	<248ppm	9	15	22	14	19	15	33
Salinity (ppt)	<0.4	-	-	-	-	-	-	-
Residual Chlorine (mg/l)	0.3-0.5 after 30min. disinfection	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Dissolve Oxygen (D O)		8	8	10	10	8	4	8
Total suspended Solids		45	5	35	50	45	65	2
Lead		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aluminum (mg/l)	<0.2	0.00	0.01	0.02	0.01	0.02	0.03	0.02
Ammonia (mg/l)	No. Value	0.01	0.02	0.00	0.02	0.01	0.00	0.14
Bromine (mg/l)	No. value	-	-	-	-	-	-	-
Calcium Hardness (mg/l)	<250	3.1	3.6	6.8	1.0	12	10.1	6.5
Copper (mg/l)	<1.0	0.47	0.31	0.43	0.16	0.49	0.22	0.00
Fluoride (mg/l)	<1.5	1.75	1.66	0.26	1.77	0.01	0.12	1.28
Iron (mg/l)	<0.3	0.29	0.04	0.01	0.19	0.33	0.30	0.12
Magnesium (mg/l)	<200	0.01	0.03	0.00	0.01	0.04	0.02	0.02
Manganese (mg/l)	<0.4	0.25	0.06	0.00	0.11	0.18	0.27	0.20
Molybdenum (mg/l)	0.25	0.11	0.10	0.00	0.01	0.00	0.16	0.05
Nitrite (mg/l)	3.0	0.00	0.00	0.01	0.29	0.00	0.01	0.00
Nitrate (mg/l)	<10	1.0	1.0	1.0	2.0	2.0	1.0	3.0
Nitrate – Nitrogen	<10	0.22	0.22	0.22	0.45	0.45	0.22	0.68
Potassium (mg/l)	<6.0	0.7	0.6	0.8	1.1	0.7	0.8	0.7
Phosphate (mg/l)	<20	0.3	0.8	0.2	3.3	5.1	0.1	0.4
Silica (mg/l)	<15	1.32	1.02	0.12	0.5	0.01	0.32	0.01
Sulphate (mg/l)	<400	0.0	4.0	10.0	8	7.1	5.8	0.00

Sulphide (mg/l)	<0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Sulphite (mg/l)	No. Value	0.00	0.1	0.2	0.3	0.3	0.2	0.2
Chloride (mg/l)	<250	1.2	3.2	2.2	0.1	0.11	1.2	0.01
Arsenic	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	<0.05	0.12	0.07	0.04	0.08	0.16	0.11	0.08
Bicarbonate (mg/l)	No. Value	0	0	0	0	0	0	0
Zinc (mg/l)	<5.0	1.32	1.88	0.00	0.00	0.01	0.00	0.00
E. Coli	Zero				100	20		Nil
Faecal Coliforms	Zero				40	100		40
Non – Faecal Coliforms	10				Nil	25		Nil
Vibro-parahaemolyticus	Zero	-	-	-	-	-	-	-
Salmonella sp.	Zero	-	-	-	-	-	-	-

Table 4- 9: Water Quality Monitoring Report Sheet for Old TSF

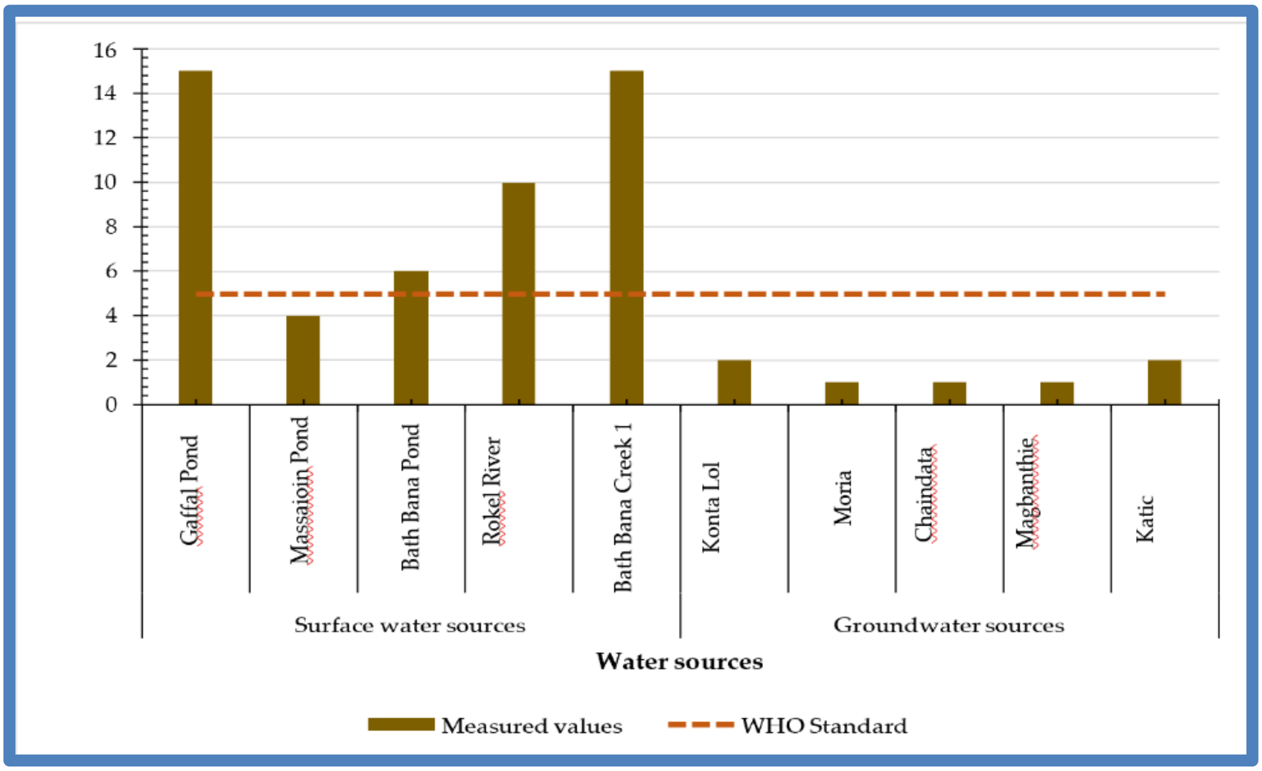
Water Authority:… Marampa Mines Ltd ……………………….. Sample: TSF-02. Location: ....Old TSF… ... Type: of Source: Effluent GPS X-774540 y-959376			
No.	Parameters	Values	Effluent Standard
	T D S	109	248 µS
	pH	6.6	6.0 – 9.0
	Turbidity	3	≤5.0 NTU
	Suspended Solids	15	
	Chlorine	0.00	0.3-0.5
	Copper mg/l	0.29	≤0.25mg/l
	Iron mg/l	0.22	3.5 mg/l
	Fluoride	2.5	≤2mg/l
	Nitrate mg/l	2.0	≤10 mg/l
	Arsenic mg/l	0.00	≤0.01 mg/l
	Calcium H mg/l	65	≤250 mg/l
	Total H mg/l	20	≤500 mg/l
	Sulphate mg/l	39.5	≤400 mg/l
	Ammonia	1.6	No. Value
	Molybdenum	0.21	<0.25
	Potassium	6.5	<6.0
	Chromium	0.18	<0.05
	Lead	0	No. value
	Zinc	0	<5.0
	E-coli	100	Zero
	Faecal coliforms	90	Zero
	None-faecal	Nil	10

Comment: Suspended solids, fluoride, ammonia, copper, potassium and chromium, which are above their standard. See result. Bacteriologically, the sample is polluted with faecal bacteria, see table above.

General analysis of certain parameters in selected surface and groundwater sources are as follows

4.14.1.1 Turbidity

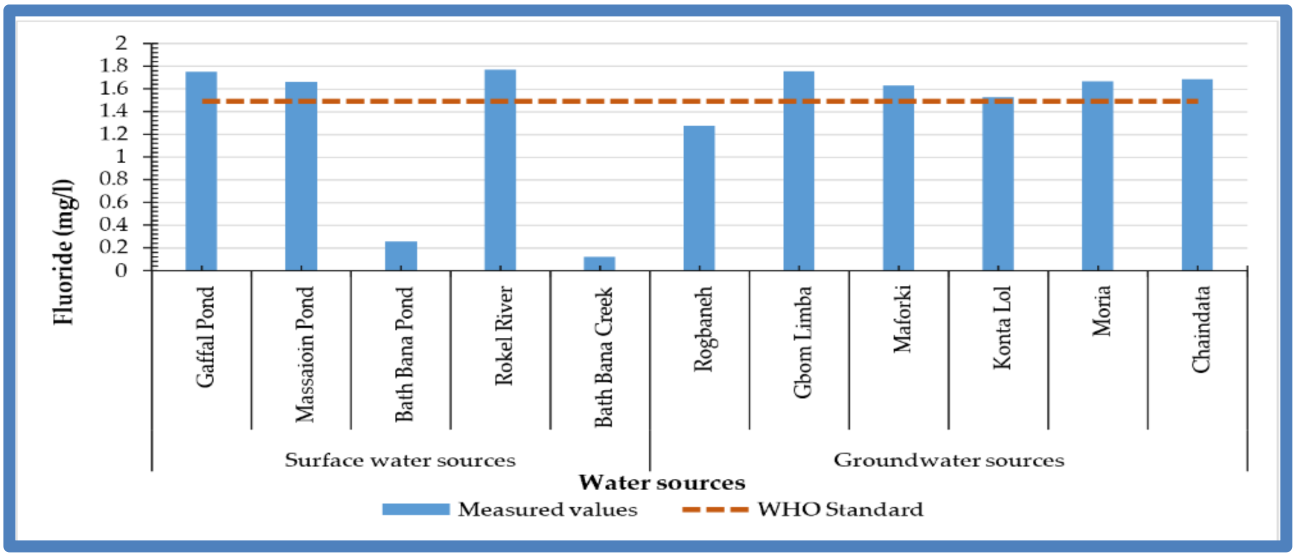
Turbidity is a measure of the number of suspended particles present in the water, which includes, chemical precipitates, colloids, silt, mud and micro-organisms as the case may be. If boreholes and hand-dug well are poorly constructed, silt and sometimes mud could be seen in the water, which will be unsafe for use, especially drinking and other domestic purposes. In surface water bodies such as rivers, streams, ponds etc., turbidity is caused by erosion, runoff or debris, and wastewater that is composed of residual particles which are deposited in the surface water. These are common processes in mine operation areas. As a result, the turbidity of almost all the water bodies within the mining concession area and the surroundings exceeds the WHO standard. Therefore, mitigation plans should be adopted. However, the turbidity for boreholes and wells is normal.



Graph 4- 4: Measured Turbidity versus WHO Standard

4.14.1.2 Fluorite

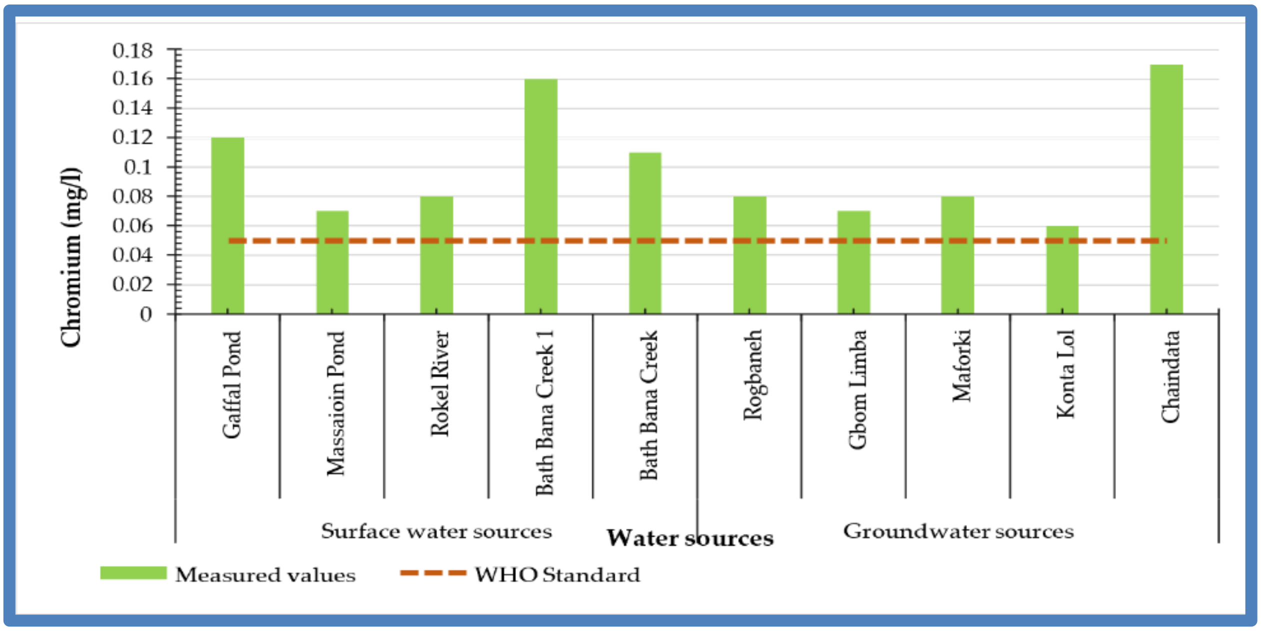
Fluoride contamination in drinking water is a general concern. Excess fluoride in water is primarily due to fluoride-rich soils and other anthropogenic activities. It occurs naturally and can be released from rocks into the soil, water, and air. Therefore, the high concentration of fluoride in both ground and surface water in the area is not unconnected with the mining operations.



Graph 4- 5: Measured Fluoride versus WHO standard

4.14.1.3 Chromium

Chromium is one of the constituents that exceeded the WHO standard in both surface sources and groundwater sources in the project area. It is caused by erosion of natural deposits, industrial wastes, water from cooling systems etc. All of these are related to mining operations.

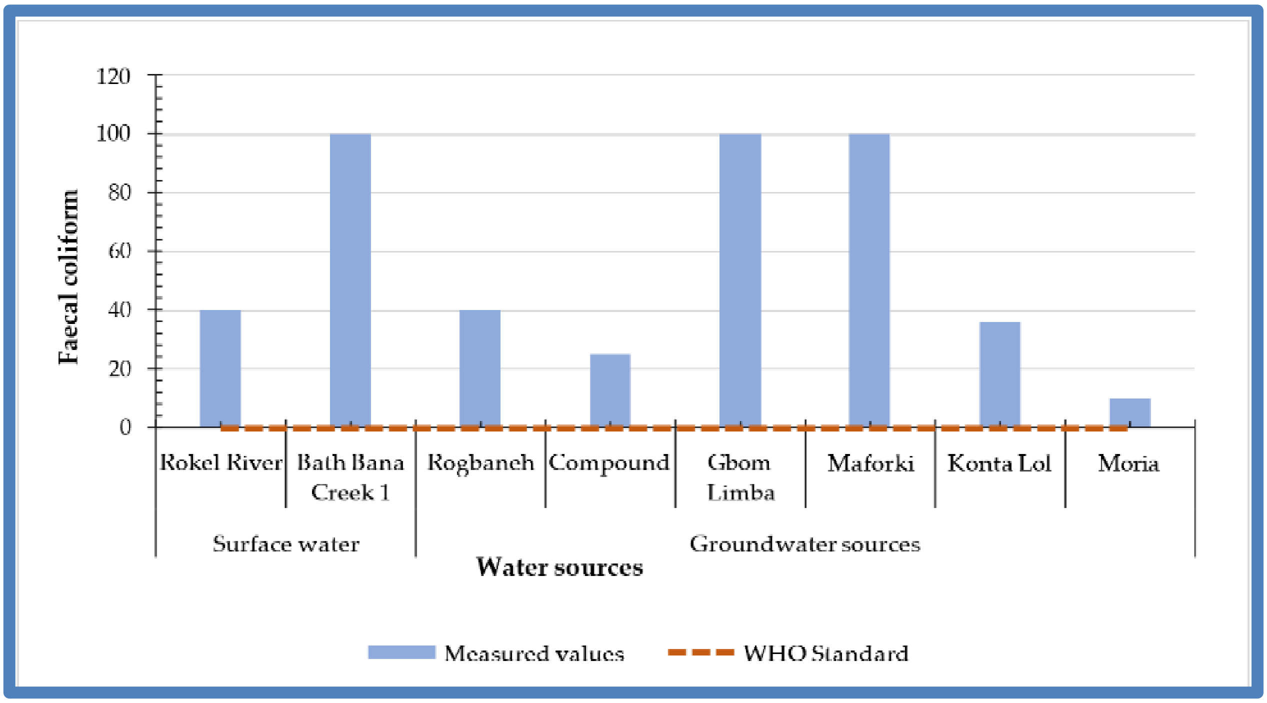


Graph 4- 6: Measured Chromium versus WHO Standard

4.14.1.4 Faecal Coliform

Coliform is a family of bacteria which includes Escherichia Coli (E. Coli). They occur in the intestines of mammals where they help to facilitate digestion. they are found in the faeces of humans and indicate faecal contamination. Their presence may indicate that the water is contaminated by human excreta which may also contain other pathogens.

As indicated in the bar graph below, almost all the surface and groundwater sources are contaminated with faecal coliform. They exceed the WHO standards in all of the selected locations.



Graph 4- 7: Measured Faecal Coliform versus WHO Standard

4.15 Focus Group Discussion – Hydrological Analysis

Socioeconomic assessment in this study included an assessment of the existing social and economic conditions of the settlements located within the mining area as well as an analysis of the potential impacts of the mining project on the livelihood of the communities. Although the proposed expansion of the mining project will likely create job opportunities as well as generate income for the local communities, the project may also have social impacts on the local community, such as changes in population dynamics, changes in cultural norms and practices, or social disruption.

In an FGD and KII held with the local communities, the existing mining operations have significantly impacted such as habitat destruction, and water and air pollution. Common among these impacts is the loss of agricultural land and the pollution of surface water sources. Examples:

For example:

- At Chaindatta Village, the local community previously do farm in the nearby swamps which have been destroyed by mining activities.
- At Mathukia, siltation from the run of mines is being deposited on their farmland.
- At Magbanthie village, the house gets cracked due to blasting from the mining site.
- At Maforkie village, the handpump at the community school is being polluted by the TSF. At the same Maforki village, community stakeholders reported that there was recent leakage from the existing TSF that nearly inundated the area, but a prompt response was made by the MML to stop the leakage.

- At Mananko village, the non-flow reservoir which was previously constructed by Decor mining also inundates farmlands during the rainy season and destroys crop production.
- At Mathaimu and Mapown communities located along the haul road to the Thofayim Port, dust from the haul road contaminates and impedes the growth of crops. This enables the communities to farm during the rainy season when the dust is minimised. Any crops that are lost as a result of MML activities are compensated for.
- Other responses from stakeholders may relate to either one or more of the impacts listed above. The figures below show areas of a settlement whose farmlands have been depleted due to the run of mines and dust from haul roads.

Figure 4- 37: Depleted swamp from run-off mines at Chaindatta

Figure 4- 38: Dust from haul road on farmlands

4.16 CONCLUSION AND RECOMMENDATION

The following is a set of recommendations proposed for the sustainable management of water resources and mitigation measures to the impact of mining activities to communities and the environment.

Water storage and decant capacity: tailings dams must provide sufficient storage capacity to retain the Environmental Design Flood (EDF) without releasing untreated water to the environment, and they must have sufficient decant capacity to draw down the pond after the storm event. Thus, MML should ensure that the proposed capacity of the tailings dam is sufficient to withstand the maximum EDF.

Safe operation: during normal operation, the water pond within the tailing's basin is maintained at a small size or eliminated and kept a safe distance away from the tailings dam. Constant monitoring of pond levels, early warning systems, and vigorous reporting are critical factors to operating safely and will always be considered.

To mitigate the impacts of TSF on groundwater sources, it is essential to design and construct them with appropriate engineering techniques, and to monitor them regularly. Monitoring programs can help to identify potential seepage issues and ensure that the facility is not causing harm to the local environment. Additionally, the company should implement measures such as wastewater treatment and recycling to reduce the amount of water used in their operations and decrease their impact on groundwater resources.

Extreme flood management: when constructing the tailings dam, an emergency spillway should be provided to safely pass an extreme flood event without overtopping the dams, and to safely release the water along a designated flow path that has less impact and damage to the surrounding environment.

Health and safety: The construction and operation of the proposed tailings storage facility can pose risks to the health and safety of workers and nearby communities. The ESIA should assess the potential risks and identify measures to mitigate or manage these risks. Overall, the ESIA for the construction of the tailings storage facility should be a comprehensive and transparent process that involves stakeholders, including local communities, and identifies measures to minimize the environmental and social impacts of the project.

Biodiversity: As the scope of this work is limited to hydrology and water resources, the ESIA should therefore extensively evaluate the potential impacts on flora and fauna, including endangered species, and identify measures to mitigate these impacts. The ESIA should assess the potential impacts on air quality and greenhouse gas emissions and identify measures to mitigate or manage these impacts.

4.16.1 Implement Reclamation Plans.

4.16.1.1 Engage with Local Communities and Stakeholders:

MML engages with local communities and stakeholders to understand their concerns and to involve them in the planning and implementation of mining activities. This can involve providing training and education, creating job opportunities, and implementing programs to support local communities.

4.16.1.2 Water Management Operations and Future Plans

As water experts warn of a serious global water shortage, the need for sustainable water management within the mining industry has become critical. So, what is the mining industry, a known water polluter and guzzler, doing to conserve this precious resource it can't function without? Thus, Marampa Mines Limited Mining should set out operational plans that will help to minimise the excessive use of freshwater resources in the mining site. Below is a description of the activities and plans that will improve water conservation within the mine.

4.16.1.3 Treatment of Effluent and Closed-Loop Recycling

One of the most common ways to maximize the usage of water is to install a water treatment unit. There are various efficient technologies available for effluent treatment. The overall objective of water treatment units is to treat effluent and recover water for reuse and drinking water purposes. It will also help to minimize the environmental compliance challenges and risks associated with effluent discharges. When installed, the next step would be to ensure an optimized automated chemical dosage in the water/wastewater treatment process. Thus, operations within the mines will lead to the development of a maintenance and reliability plan to cut down impact.

4.16.1.4 Employee Training & Engagement

Educating the staff on the importance of water conservation will help them understand why continuous improvement is essential. True environmental stewardship requires that everyone in the organization believes in the operation’s water goals. And each staff member must feel comfortable in challenging existing procedures and sharing ideas.

4.16.1.5 Leak Management

The operations of MML distribute water through a network of pumps, valves, and pipes. Leaks in these networks pose a production or economic risk to varying extents. Even if individual leaks appear small, they can often accumulate into a large volume quickly if not managed properly.

The following are some of the best practices related to water leak management in the mining site:

- Assess and plan for installations considering the capacity, probability, and frequency of failures. Consideration will also be made on the impact of an emergency on the water requirements, both inside and outside of the mine.
- Carry out proactive equipment maintenance for the installation and inspection of pipes.
- Install mechanisms for the timely detection of leaks in process water. This can be

something as simple as moisture elements, or more complex as the Internet of Things (IoT)-based pressure and flow-monitoring sensors.

- Repair leaks expeditiously when they occur.

4.16.1.6 Water Management Audit

Surface mining can have a significant impact on local water resources as shown in some of the parameters measured above, so it is important to monitor water quality and manage water usage. This can involve constructing sediment ponds, using water treatment facilities, provision of water treatment reagents, and using recycled water for mining operations. A fundamental part of any water conservation plan is a regular water management audit. This procedure allows operators to continuously evaluate opportunities for improvement. An audit involves accounting for every cubic metre of water that goes in and out of the site and analysing improvement opportunities in each of the processes.

4.16.1.7 Data-Driven Process Optimization

Leveraging modern technology such as artificial intelligence (AI) and analytics backed IoT sensors can work wonders for legacy plants. The pay-off period may not be immediate. Operators must collect the data first to understand the points of inefficiencies before they can take corrective actions through real-time AI-enabled systems.

AI can reduce energy in water/wastewater treatment processes to save on costs and maximize wastewater reuse. Installing an AI system at the mining site that allows plant staff to leverage historical data as well as continuously monitor and optimize the assets for water consumption. Like most AI-enabled technology, effectiveness only improves with time as it keeps learning from process parameters.

4.17 BIODIVERSITY AND THE BIOLOGICAL ENVIRONMENT

Introduction

MML may have negative effects on the flora and fauna inside the project area as well as any sensitive receptors in its vicinity due to the large areas it covers and the numerous activities it will carry out during the construction phase and operational phase of the expansion project.

4.17.1 Objectives and Scope of the Assessment

This biodiversity impact assessment seeks to identify potential effects on flora and fauna as well as to recommend appropriate compensatory and mitigation measures to protect/conserve biodiversity in the area that will likely be negatively impacted by the proposed project's activities inside and nearby. To accomplish this, a thorough investigation into the biological diversity aspects within and surrounding the proposed project area, focusing on the affected biodiversity area and evaluating the potential impacts and risks (direct as well as indirect/induced) associated with the project activities was carried out. As a result, recommendations for suitable measures of compensation and mitigating the perceived effects that have been identified are anticipated to result from the activities of the proposed project have been made. The biodiversity values are also described in this assessment.

4.17.2 Approach and Methodology of the Study

For this biodiversity impact assessment, a variety of techniques and strategies were used. The main methods used to gather data, analyse it, and produce biodiversity assessment reports for this proposed project were field surveys, which included consultation with local communities, and desktop review. The desktop analysis was conducted to generate trustworthy data and provide evidence to back up the field survey findings on the following crucial ecological and biodiversity issues.

- Identification and characterization of the ecological and biological characteristics of the project area and its environs.
- Finding protected biodiversity sites within a 10-kilife of mineetre range of the project's proposed location.
- Identify the protected biodiversity sites' status (i.e., whether they are protected internationally, nationally, regionally, or locally, and under what legislation), and give a brief explanation of why they are protected (e.g., habitat type, red-list species, etc.).
- Identification of all IUCN Red List fauna and flora species that may be present on site.
- Identification of non-protected areas nearby the site that may be sensitive to this proposed project (i.e., watercourses/wetland habitats).
- Identification of potential sensitive biodiversity resources on the site.
- Description of general habitat types located on the proposed project site that includes a table outlining typical flora

To confirm the extent of natural/sensitive environments on the site and around project areas, it appears that the field survey and consultation of pertinent stakeholders were also taken into consideration as supplemental and for ground proof evidence of the desktop review findings. This was especially true for determining the presence or absence of sensitive species on the site.

4.17.2.1 Specific Sampling Methods

As a general rule, the ecological assessment of the condition of vegetation, including mangroves, and their flora and fauna (fish, mammals, reptiles, birds, and mangrove macro-benthos), with a special emphasis on flagship species, employed a variety of ecological sampling techniques by experts on the project team within transects lines guided by standard procedures by many authors for similar research (de Juan and Demestre, 2012; Rakocinski, 2012; Rodil et al., 2013; IMBO, 2011; 2015; Konoyima, 2020).

4.17.2.2 Sampling the Marine Littoral Zone

A 50m by 50m transect was laid intermittently for the epifauna, infauna, and vegetation abundance sampling on the intertidal zones, including the mangrove substrates, and all plants and animals within each transect were counted and recorded. The sampling of the infauna benthos within transects required scooping of sediments, sieving, and recording of benthic organisms (infauna), in contrast to the sampling of the epifauna, which was complemented by counting their boreholes (COMARAF, 1980).

4.17.2.3 Fish

To observe and record local fishermen's catches and identify species present in their catches, marine fish sampling primarily relied on ecological transect walks. Identification guides were also made available to the local fishermen. These methods made sure that the sampling sites and species assemblages were fairly represented. In essence, both qualitative and quantitative methods were investigated for the survey because, as stated by Creswell (2013), they both offer unique perspectives and frequently work best together to produce the most insightful results. For the marine sea turtles, marine mammals, and birds, a thorough literature review was also conducted.

According to Payne et al. (2010), a collection of techniques was used for freshwater fish sampling to increase the likelihood of choosing different finfish and invertebrate species from the aquatic systems of the survey areas. These techniques included both active and passive fishing techniques. In contrast to in-situ (active) fish sampling, which involved using hand nets in smaller streams, tributaries, and swamps, passive fishing is an ex- situ technique that required the deployment of gill nets during the day and at night to capture more nocturnal fish species. The use of hand nets in smaller streams, tributaries, and swamps had the added benefit of allowing the collection of several fish species belonging to the family Distichodontidae, Eleotridae, Nothobranchiidae, and Amphiliidae, collectively known as Killi-fishes, which are adapted to live in such habitat and are hardly caught in set gill nets (Payne et al. According to Payne et al. (2010), local fishermen's catches were also evaluated as an additional fish sampling strategy. The collected specimens were put in a photo tank for photographic documentation, and habitats were depicted along with the water's depth, width, sediment type, colour, transparency, and nature (whether artificial or natural). Paugy et al.'s(2003,2004) and Payne et al.'s(2007)guides were used to identify fish specimens.

4.17.2.4 Plankton

Using the proper zoo and phytoplankton nets and a motorized boat moving at a speed of 1.5 knots, plankton samples were primarily collected from the Port Loko Creek area. The samples were brought to the Institute of Marine Biology and Oceanography's lab at Fourah Bay College, University of Sierra Leone, for additional examination under a light microscope (specifications), which included counting and recording.

4.17.2.5 Mammals, Reptiles, Amphibians

The sampling of mammals, reptiles, and amphibians used the ecological transect walk, which required travelling through the various sampling areas while observing ecological characteristics, in both existing and proposed concession extension areas (new areas). However, because of the limitations and amount of time and resources required for more thorough records, this study also utilized local expertise as a regular ecological sampling technique. Photographic records of the evaluated fauna group from earlier studies were shown to these, and the occurrence of the identified species during the ecological transect walk was verified. The results of the current study were contrasted with previous research.

4.17.2.6 Avifauna Sampling

The main method used to evaluate bird diversity was point counts using a hand-held microscope. However, following the advice of Fontrbel et al. (2020), EMS also used additional complementary methods like mist nets and sound recordings, considering that this method has some drawbacks and can be impacted by observer bias.

4.17.2.7 Vegetation Sampling

Through a 100 m intermittent line transect walk, samples of both terrestrial and aquatic vegetation were collected while being observed and noted. This non-random technique is used in a large sampling area, and it involves sampling the vegetation along a straight line (without any width) and evaluating it from beginning to end. For a particular sampling community, the collection was carried out again each time the line was laid 100 meters apart. The benefits of this approach in terms of information include:

a) The tendency for a species' distances to increase or decrease;

b) The proportion of different species that occur relative to all species;

c) The gradual emergence or disappearance of various species along the line; etc.

The littoral zone sampling was conducted in the same plots as the mangrove vegetation assessment, though. Local expertise and an identification guide (Cole, 1988) helped identify the plants and their socioeconomic significance at the survey sites, and a literature review added to the study's knowledge base. Unidentified samples were prepared and brought to Fourah Bay College's Laboratory of the Biological Sciences at the University of Sierra Leone for additional examination.

4.17.2.8 Lepidopterology

Relative abundance indices were produced by the transect counts used in this assessment, which are likely to correlate well with daily butterfly counts but may not always do so with seasonal butterfly population sizes (Khyade et al., 2018). The surveys were conducted using the point-and-line transect method at various locations within the chosen area and in its vicinity (Barhaum et al., 1980–1981), considering the time of day using a 24-hour clock and the weather conditions. To minimize the number of variables, present, the same observational path was taken on each subsequent visit to each location (Pyle, 1984). Specific sampling methods included butterfly (aerial) nets, walk-and- capture, and photography.

4.17.3 Site Characterization

4.17.3.1 Proposed Extension Sites

A summary description of the proposed site locations to various project areas (primarily, haul roads and mining sites) is given in Table 4-13

Table 4- 10: GPS Coordinate and Community Location around the Marampa Mines Proposed Expansion Area, March 2023.

Chiefdom (Section)	Fishing Site	GPS Reading			Brief comment
Marampa (marampa section)	Manonkoh village	28	775546	963277	Currently, the main haul road area and mining operations are far apart (more than 3000m).
	Robella village	28	774430	962635	Not too close to the main mining operation and haul road but fall within the concession area.
	Magbinthay	28	774967	962072	Very close to the operation (blasting) area. Considered to be a red zone community.
	Maforkie village	28	774859	961465	Very close to the operation (blasting) area. Considered to be a red zone community.
	Chaindata village	28	772975	961398	Very close to the operation (blasting) and tailings discharge area. Considered to be a red-zone community
	Robaka village	28	769091	960501	Fell along the haul road but not too close to the main mining operation area
(Mawulay section)	Labour Compound village	28	772791	959017	Close (about 1500m) to the main mining operation and about 300m to haul road
	Katic Village	28	773975	956210	Far from the haul road and main mining area but host the mining electricity plant.
	Moria Village	28	774304	957288	Far from the haul road and main mining area but do receive the heavy sediment from runoff from haul road and other mining areas
	Magbrere village	28	776065	960215	Close (2000m) to the main mining area/site but far from the haul road

	Gbom Limba	28	774585	959381	Close to the main mining area especially the tailing discharge area but far from the haul road
	Rogbaneh village	28	774448	958696	Close to the main dining area and haul road
	Konta Lol village	28	772835	958574	Not too close to the main mining and haul road area but fell with the proposed expansion area
	Konta Bana village	28	772391	957597	Far from both main mining and haul road areas
Maforkie Chiefdom (Mathunkra-section)	Mayonkro village	28	762613	964108	Far from the main mining area but fell (400m) along the haul road previously been relocated
	Mapown village	28	739801	964083	Far from the main mining area but fell (1000m) along the haul road.
	Mathimu Village	28	739801	964083	Far from the main mining area but fell (800m) along the haul road.
	Thofeyima Village	28	736640	964531	Far from the main mining area but fell (400m) along the haul road and barge/ terminal area previously been relocated.
Marampa (marampa section)	Manonkoh village	28	775546	963277	Currently, the main haul road area and mining operations are far apart (more than 3000m).
	Robella village	28	774430	962635	Not too close to the main mining operation and haul road but fall within the concession area.
	Magbinthay	28	774967	962072	Very close to the operation (blasting) area. Considered to be a red zone community.
	Maforkie village	28	774859	961465	Very close to the operation (blasting) area. Considered to be a red zone community.
	Chaindata village	28	772975	961398	Very close to the operation (blasting) and tailings discharge area. Considered to be a red-zone community
	Robaka village	28	769091	960501	Fell along the haul road but not too close to the main mining operation area

(Mawulay section)	Labour Compound village	28	772791	959017	Close (about 1500m) to the main mining operation and about 300m to haul road
	Katic Village	28	773975	956210	Far from the haul road and main mining area but host the mining electricity plant.
	Moria Village	28	774304	957288	Far from the haul road and main mining area but do receive the heavy sediment from runoff from haul road and other mining areas
	Magbrere village	28	776065	960215	Close (2000m) to the main mining area/site but far from the haul road
	Gbom Limba	28	774585	959381	Close to the main mining area especially the tailing discharge area but far from the haul road
	Rogbaneh village	28	774448	958696	Close to the main dining area and haul road
	Konta Lol village	28	772835	958574	Not too close to the main mining and haul road area but fell with the proposed expansion area
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Maforkie Chiefdom (Mathunkra-section)	Mayonkro village	28	762613	964108	Far from the main mining area but fell (400m) along the haul road previously been relocated
	Mapown village	28	739801	964083	Far from the main mining area but fell (1000m) along the haul road.
	Mathimu Village	28	739801	964083	Far from the main mining area but fell (800m) along the haul road.
	Thofeyima Village	28	736640	964531	Far from the main mining area but fell (400m) along the haul road and barge/ terminal area previously been relocated.

4.17.3.2 Terrestrial Ecological Integrity Qualifying Features

The presence of intact vegetation in a region that offers suitable habitat to support a variety of faunal species is a sign of an environment's ecological integrity. High secondary forest with economic fruit trees dominates the Marampa Chiefdom. Wild oil palms, *Elaeis guineensis*, are strewn throughout the area. Patches of disturbed secondary forest invaded by *Chromolaena odorata* and *Pennisetum purpureum*, farm bush regrowth, dense secondary forest dominated by economic fruit trees, and a vast savanna grassland extending towards tailings are all examples of this. Some areas are open grasslands with stray trees nearby artificial lakes and swamps. Along with grassland and farm bush at the back of the forest, high secondary forest dominated by mango *Mangifera indica*, and cultivated swamp rice and vegetables with degraded areas. The secondary forest has been depleted by agriculture, oil palm and citrus farms, logging, and the burning of charcoal.

There are sacred forests, particularly 'Poro' and 'Bondo' Society, which are located there along paths with oil palm and citrus farms that disturb patches of gallery forest. The Rokel River is another area that is dominated by savanna grassland with sporadic *Pterocapus erinaceous* plant species. Around the community, there is open grassland and a swamp with deteriorated gallery forests.

Marforki is primarily distinguished by open grasslands with wild oil palms *Elaeis guineesis* scattered throughout them and a swamp with patches of dense gallery forest. Additionally, there are pockets of economically beneficial fruit trees like *Papaya carica* and Mangos, *Mangifera indica*, Oranges, and Citrus around communities. Open grassland close to a community and young, degraded farm bush that extends to a swampy area can be found in another location.

This survey was only conducted in the fifteen communities listed below that are close to the proposed Marampa mines concession area extensions in the Marampa chiefdom: Manonkoh, Magbare, Roballah, Magbanthie, Maforki, Labour compound, Gbom limba, Katick, Moria, Taindata, Mathukia, Rogbanneh, Konta Lol, Konta bana, and Robaka communities, as well as four communities in the Maforki chiefdom.

Table 4- 11: Terrestrial Assessment Sites Location and Description

Marampa Chiefdom			
Survey Point & Nearest Settlement	Eastings 28 P	Northings UTM	Summary Vegetation Description
Manonkoh	817300	1009608	Vegetation is described as a high secondary forest dominated by economic fruit trees. Scattered wild oil palms around the surroundings.
Magbare	776372	960366	An upland ecology dominated by wild oil palm *Elaeis guineesis* farm bush regrowth, patches of disturbed secondary forest invaded by *Chromolaena odorata* and Pennisetum *purpureum*.

Roballah	774443	962642	Dense secondary forest dominated by economic fruit trees and an extensive savanna grassland extending towards tailings.
Magbanthi	774721	0962326	More farm bush, farm bush degraded secondary forest along the path.
Maforki	775652	961748	Open grass area scattered with wild trees.
Maforki	774861	961463	Artificial lake swamp
Labour compound	772892	959157	The compound is surrounded by a high secondary forest dominated by mango, and grassland mixed with farm bush at the back of the forest.
Labour Compound	772784	959010	Cultivated swamp rice and Vegetable.
Gbom limba	775067	958982	Fruits trees around the settlement mixed modern oil palm and wild farm bush-dominated vegetation type.
Gbom Limba	774577	959312	Cultivated swamp close to Gbom Limba rice and vegetable degraded farm bush between Gbom Limba and Katick.
Katik	774216	956278	Disturbed secondary forest oil palm and citrus farms, Timber logging, Charcoal burning, and agriculture have depleted the forest.
Katik	774170	956014	Sacred Forest [Poro]
Katik	774056	955881	Sacred forest [Bondo]
Katik	774090	955587	Patches of oil palm and citrus farms disturb patches of gallery forest Rokel River.
Moria	774367	957099	Completely disturbed farm bush mixed with grass.
Chaindatha	772714	961412	Economic fruit trees around the community.
Chaindatha	772860	961709	Savannah grassland is dominated by pterosaurs and vitex.
Chaindatha	772978	961399	Swamp destroyed by mining tailing mud and marshes. Woodland savannah between the two communities.
Mathukia	773704	962755	Economic fruit trees surround the town.
Mathukia	773720	962995	The secondary forest is intact.
Mathukia	773510	962975	The stretch of swamp cultivated rice and vegetable.

Rogbanneh	774451	958699	Secondary forest surrounded by grassland and farm bush
Konta Lol	772804	958531	Woodland savanna grassland and fruit trees
Konta bana	772221	957764	Woodland savanna grassland with scattered Pterocarpus erinaceus plant species
Robaka	769553	960544	Open grassland around the community and degraded gallery forest along the swamp.
Maforki Chiefdom			The community is located on an open grassland with scattered wild oil palm and a swamp that hosts a dense gallery forest.
Ma Yonkro	762737 762621	964485 964107	The dense secondary forest around the community and patches of economic fruit trees
Mathaimu	740376	964447	Fruit trees and farm bush
Mapong	739487	963727	Fruit trees and farm bush
Thofayim	736760	964366	Open grassland around the community and young farm bush extending to the swamp (736643; 964329)
Maforki	775652	961748	Open grass area scattered with wild trees.
Maforki	774861	961463	Artificial lake swamp
Labour compound	772892	959157	The compound is surrounded by a high secondary forest dominated by mango, and grassland mixed with farm bush at the back of the forest.
Labour Compound	772784	959010	Cultivated swamp rice and Vegetable
Gbom limba	775067	958982	Fruits trees around the settlement mixed modern oil palm and wild farm bush-dominated vegetation type.
Gbom Limba	774577	959312	Cultivated swamp close to Gbom Limba rice and vegetable degraded farm bush between Gbom Limba and Katick.
Katik	774216	956278	Disturbed secondary forest oil palm and citrus farms, Timber logging, Charcoal burning, and agriculture have depleted the forest.
Katik	774170	956014	Sacred Forest [Poro]

Katik	774056	955881	Sacred forest [Bondo]
Katik	774090	955587	Patches of oil palm and citrus farms disturb patches of gallery forest Rokel River.
Moria	774367	957099	Completely disturbed farm bush mixed with grass.
Chaindatha	772714	961412	Economic fruit trees around the community.
Chaindatha	772860	961709	Savannah grassland is dominated by pterosaurs and vitex.
Chaindatha	772978	961399	Swamp destroyed by mining tailing mud and marshes. Woodland savannah between the two communities.
Mathukia	773704	962755	Economic fruit trees surround the town.
Mathukia	773720	962995	The secondary forest is intact.
Mathukia	773510	962975	The stretch of swamp cultivated rice and vegetable.
Rogbanneh	774451	958699	Secondary forest surrounded by grassland and farm bush
Konta Lol	772804	958531	Woodland savanna grassland and fruit trees
Konta bana	772221	957764	Woodland savanna grassland with scattered Pterocarpus erinaceus plant species
Robaka	769553	960544	Open grassland around the community and degraded gallery forest along the swamp.
Maforki Chiefdom			The community is located on an open grassland with scattered wild oil palm and a swamp that hosts a dense gallery forest.
Ma Yonkro	762737 762621	964485 964107	The dense secondary forest around the community and patches of economic fruit trees
Mathaimu	740376	964447	Fruit trees and farm bush
Mapong	739487	963727	Fruit trees and farm bush
Thofayim	736760	964366	Open grassland around the community and young farm bush extending to the swamp (736643; 964329)

4.17.4 Freshwater Ecological integrity qualifying features: Vegetation and Faunal

Diversity

Environmental quality, which is also reflected in the transparency or turbidity of freshwater, has a significant impact on aquatic life survival and, consequently, ecological integrity. Natural and artificial perennial and ephemeral wetlands, such as swamps, streams, rivers, and tributaries, are abundant in the survey sites for the proposed Marampa mines expansion areas. However, the current mining operations have had an impact on some streams' and swamps' natural flow patterns, particularly in the areas where expansion is being considered. The tailings from runoff, according to the villages of Labour Compound, Moria, and Chaindata, severely harmed their swamps and streams. Nineteen (19) villages from two (2) chiefdoms in total were visited as potential extensions to the current locations (Table 5.16).

Table 4- 12:Freshwater Assessment Site Description (Proposed Marampa mines concession extension areas)

Chiefdom (Section)	Fishing Site	GPS Reading			Description
Marampa (marampa section)	Manonkoh village Rogbonga river	28	- 775546	- 963277	Rogboga River is the name given by Manonkoh community to the artificial lake known to be excavated by Delco mining in the 50s. The lake is named differently in different villages. It is a perennial lake now referred to as a river by the local communities. Due to the various tributaries that empty into it, it is now connected to the Rokel/Seli River via a channel that passes close to the Marampa mines operations area. It is shared by most of the villages in the two sections of the marampa chiefdom. Its depth, bottom sediment and width vary. It has a maximum width of about 100m. At Manonkoh, its bottom sediment is mud/sand, the average depth is 2.5m and the average width is 50m. Transparency was better. Both the depth and width may exceed during the rainy season, said the respondents. This water system is key for fishing activities in this community and most surrounding communities.
	Mathukia Village/ Rogbonga swamp	28 28	773714 773408	962750 963099	A natural ephemeral swamp that has been completely dried up except few smaller pools which are still important for fishing to the community women. Transparency was low at the time of the visit. The bottom sediment was mud.
	Robela village/ Bath Bella swamp	28 28	774454 774430	962635 962635	A natural ephemeral swamp is known to be connected to the main lake. Maximum width was about 1.2m and depth of 0.1m at the time of the survey. Both depth and width may exceed 1.2m and 0.1m respectively during the peak of the rainy season. The main sediment was sand/mud and transparency was low.
	Magbinthay village/ Rokuthr river	28 28	774723 774967	962331 962072	Is part of the main lake/river described above. Maximum width was about 60m and depth of 3m at the time of the visit. The depth and width may exceed current measurements during the rains. The bottom sediment was clay/mud. This river is key for fishing activities in the community.
	Maforkie village/ Makelegba river	28 28	775635 774859	961744 961465	The river/lake is partially surrounding Maforkie village. The maximum 100m depth of this lake can be found in this village. Most of the youths depend on the lake for fishing. The average width and depth are 70m and 3m respectively. Transparency varies, with low transparency at the lower part close to the mining area and moderate transparency at the upper part away from the mining area. This lake is perennial and its bottom sediment is

					clay/mud. Most of the natural perennial streams in this community are now ephemeral due to mining activities, said the local people and are found completely dried up during the time of visit.
	Chaindata village Bakie Swamp	28 28	772849 772975	961460 961398	A natural and perennial swamp that has been seriously disturbed by the effect of mining activities. The depth was 0.3m and the width of 6m. Turbidity was high at the time of the visit. The bottom sediment was mud. This swamp used to be key for fishing activities.
	Robaka village Dokergbo stream	28 28	769551 769091	960555 960501	Natural ephemeral stream of the probable depth of 1m and width of 3.5m. Sediment is mainly mud/clay. The stream was very turbid at the time of the visit. Most of the stream was already dried up completely except few small pools. Fishing activities are key to the community of women. Families of fish species recorded: Mormyridae, Malapteruridae, Butidae, Cichlidae and Aplocheilidae.
(Mawulay section)	Labour Compound village Pump house/swamp	28 28	772897 772791	959152 959017	A natural but ephemeral swamp that has been seriously disturbed by the effect of mining activities. The swamp was almost dried up at the time of the visit except at the dam created by the London mining company. Most activities are being done at this created dam including fishing. Water was highly eurtophied at the time of the visit but still supports some of the visit. The bottom sediment was mud.
	Robella village Bath Bella swamp	28 28	774454 774430	962635 962635	A natural ephemeral swamp is known to be connected to the main lake. Maximum width was about 1.2m and depth of 0.1m at the time of the survey. Both depth and width may exceed 1.2m and 0.1m respectively during the peak of the rainy season. The main sediment was sand/mud and transparency was low.
	Magbinthay village Rokuthr river	28 28	774723 774967	962331 962072	Is part of the main lake/river described above. Maximum width was about 60m and depth of 3m at the time of the visit. The depth and width may exceed current measurements during the rains. The bottom sediment was clay/mud. This river is key for fishing activities in the community.
	Maforkie village Makelegba river	28 28	775635 774859	961744 961465	The river/lake is partially surrounding Maforkie village. The maximum 100m depth of this lake can be found in this village. Most of the youths depend on the lake for fishing. The average width and depth are 70m and 3m respectively. Transparency varies, with low transparency at the lower part close to the mining area and moderate transparency at the

					upper part away from the mining area. This lake is perennial and its bottom sediment is clay/mud. Most of the natural perennial streams in this community are now ephemeral due to mining activities, said the local people and are found completely dried up during the time of visit.
	Chaindata village Bakie Swamp	28 28	772849 772975	961460 961398	A natural and perennial swamp that has been seriously disturbed by the effect of mining activities. The depth was 0.3m and the width of 6m. Turbidity was high at the time of the visit. The bottom sediment was mud. This swamp used to be key for fishing activities.
	Robaka village Dokergbo stream	28 28	769551 769091	960555 960501	Natural ephemeral stream of the probable depth of 1m and width of 3.5m. Sediment is mainly mud/clay. The stream was very turbid at the time of the visit. Most of the stream was already dried up completely except few small pools. Fishing activities are key to the community of women. Families of fish species recorded: Mormyridae, Malapteruridae, Butidae, Cichlidae and Aplocheilidae.
(Mawulay section)	Labour Compound village Pump house/swamp	28 28	772897 772791	959152 959017	A natural but ephemeral swamp that has been seriously disturbed by the effect of mining activities. The swamp was almost dried up at the time of the visit except at the dam created by the London mining company. Most activities are being done at this created dam including fishing. Water was highly eurtophied at the time of the visit but still supports some kind of fish species. The maximum depth is 0.2m and the width is about 10m.
	Katic Village Bath lol	28 28	774230 773975	960285 956210	Katik village also shared a large portion of the lake and in addition, natural swamps are also in existence though ephemeral. The survey focussed on the natural swamp, which was almost dried up except for a few pools. Water transparency was good at the main pool with 0.5m depth and 2m width. Fishing activities do take place mostly by women.
	Moria Village Romagbonga swamp	28 28	774335 774304	957114 957288	Moria has a natural but ephemeral swamp of depth 0.1m and width 2 at the time of the survey. Transparency was good at the time of the survey. The bottom sediment was clay/mud. Moderate fishing activities do take place.
	Magbrere village	28	776375	960365	A natural ephemeral swamp is known to be a tributary of the lake described above. Its maximum depth is 0.1m and its width is 1.5m at the time of visit but could exceed that

	Robiya swamp	28	776065	960215	during the rains. The water was slightly turbid. The bottom sediment was mud/sand. This swamp is key for fishing and gardening to the community, especially the women.
	Gbom Limba village	28	775062	958991	The stream is part of the main lake and passes close to the mining area. Transparency was low. The maximum width was
	Bath bana stream	28	774585	959381	2m and the depth was 0.1m. These measurements are believed to exceed during the rainy season. Fishing activities do take place mostly the women. Families of species recorded: Cichlids, Clariidae, Natobranchiidae and Cyprinidae.
	Rogbaneh village	28	774448	958696	Rogbanah and Gbom Limba shared the same stream.
	Konta Lol village	28	772835	958574	Konta lol village and Labour compound village share the same swamp.
	Konta Bana village Roton stream	28 28	772198 772391	957777 957597	Roton Stream was completely dried up at the time of the visit except for a small pool which they used for their domestic purposes. However, fish species such as Cichlidae and Clariidae were still supported and were observed. Fish sampling was restricted due to the importance of the pool to the community.
Maforkie Chiefdom (Mathunkra-section)	Mayonkro village Karkoh stream	28 28	762735 762613	964477 964108	Natural ephemeral stream of probable depth 0.2m and width of 1m. Sediment is mainly mud/clay. The stream was very turbid at the time of the visit. Most parts of the stream were already dried up completely except a few small pools. Fishing activities are key to the community women during the early rainy season. Families of species recorded: Mormyridae, Cichlidae, Butidae and Aplocheilidae.
	Mapown village Bundu swamp	28 28	739492 739801	963719 964083	Bundu swamp was completely dried up-no fish sampling was done. The community people depend on local wells for their domestic purposes.
	Mathimu Village	28	740511	964498	Mathimu village shared the same ephemeral swamp with Mayonkro village.

	Bundu swamp	28	739801	964083	
	Thofeyima Village Do-waka swamp	28 28	736846 736640	964417 964531	Do-waka swamp was completely dried up-no fish sampling was done except for the interview made with the residents. The community people depend on local wells for their domestic purposes. However, due to their closeness to Portloko Creek, the community people do not completely depend on the swamp for fish. Cichlidae, Butidae and Aplocheilidae.
	Mapown village Bundu swamp	28 28	739492 739801	963719 964083	Bundu swamp was completely dried up-no fish sampling was done. The community people depend on local wells for their domestic purposes.
	Mathimu Village Bundu swamp	28 28	740511 739801	964498 964083	Mathimu village shared the same ephemeral swamp with Mayonkro village.
	Thofeyima Village Do-waka swamp	28 28	736846 736640	964417 964531	Do-waka swamp was completely dried up-no fish sampling was done except for the interview made with the residents. The community people depend on local wells for their domestic purposes. However, due to their closeness to Portloko Creek, the community people do not completely depend on the swamp for fish.

4.17.4.1 Existing Sites: Ecological qualifying features

Since the most recent Marampa ESHIA survey (Table 4), the condition of the environment within and around the project concession has not improved to support significant ecological diversity. The term "existing sites" refers to the Marampa Mines concession areas, which are currently divided into three sections: Thofayim Berge Terminal, Port Loko Creek, and Marampa Mines. Although mining and settlement have changed these areas, some nearly natural habitats still exist on the site. Within the established site boundaries, the Thofayim Terminal occupies a modest space with scant native vegetation. Local communities have altered many areas of this habitat, and several regenerating vegetations have been seen.

Table 4- 13: **Characteristics of Existing Sites (Adapted from previous Marampa Mines ESHIA Report).**

Habitat Unit	Ecological State (a)	Marampa Mine concession area (ha)	Thofayim Terminal (ha)		Port Loko Creek (200m of river's edge)
			Within Thofayim Boundary	Vicinity (± 300 m of boundary)	
Woodland Habitats					
Thicket	Modified	51.06 ha	4.19 ha	0.18 ha	-
Dense woodland	Near-natural	48.67 ha	5.56 ha	10.62 ha	7.50 km^2 (31.0%)
Open woodland	Semi-modified	455.08 ha	-	-	
Mangroves	Natural	-	0.03 ha	2.24 ha	7.94 km^2 (32.8%)
Wetland Habitats					
Wetland	Largely modified	219.81 ha	0.05 ha	0.04 ha	-
Tidal Mudflats	Modified	-	-	--	3.30 km^2 (13.6%)
Open Water	Not assessed	44.81 ha	0.01 ha	10.44 ha	4.54 km^2 (18.8%)
Transformed Habitats					
Mine cleared areas	Modified	201.89 ha	6.70	1.81 ha	-
Iron Ore Hills	Modified	212.86 ha	-	-	-
Mine offices & infrastructure	Not assessed	14.59 ha	0.15 ha	0.30 ha	-
Settlement & Agric.	Not assessed	133.21 ha	3.54	-	0.92 km^2 (3.8%)

4.17.5 Main Findings

4.17.5.1 Aquatic Surveys

The location of aquatic areas in relation to the "Existing" and "Proposed" Marampa Mine concession areas was a key factor in their selection. The following indicators were used to specifically choose the aquatic sites within and surrounding these areas:

- Accessibility and safety,
- habitat that represented the current aquatic resource,
- proximity to anthropogenic activities in the catchment, and
- proximity to aquatic confluences were all important factors.

4.17.5.2 Ichthyofaunal Assemblages

4.17.5.2.1 Freshwater Assemblages

Nineteen (19) fish species, representing thirteen (13) families, were found in the results, of which sixteen (17) were finfish and two (2) were macro-invertebrates (species of shellfish). There was very little difference in the species composition between the survey sites. The majority of the fish species in the wetlands under investigation belonged to the Cichlidae family, and all of these species fell into the IUCN Red List Category of List Concern (LC). Additionally, the geographic ranges of the specimens recorded showed that the species collected for this study are not unique to or endemic to the wetlands under investigation but are instead known to occur in other Sierra Leonean rivers and tributaries (Paugy et al., 1990; Paugy et al., 2003, 2004; Payne et al., 2010).

In addition to the Killi-Fishes, which are primarily immobile (such as species of the Aplocheilidae and Poecilidae families), species from this survey belonging to the Clariidae, Cichlidae, Claroteidae, and Mormyridae families are known to spend a portion of their lives in streams and tributaries of rivers, either for food or at early developmental or juvenile stages (Paugy et al. al. 2012). A combined list of the fish and shellfish recorded from this survey, along with their abundance, is provided in Table 5.18. Species identified by locals in the various study sites were well inclusive of those observed from sampling.

Table 4- 14: List of Freshwater species and their conservation status (IUCN)

Family	Species	IUCN Red list Status	Distributed across the African coasts
Alestidae	*Brycinus nurse*	LC	Distributed across the African coasts
Cichlidae	*Tilapia brevimanus*	LC	Côte d'Ivoire; Guinea; Guinea-Bissau; Liberia; Sierra Leone
Hepsetidae	*Hepsetus odoe*	LC	Distributed across the African coasts
Mormyridae	*Brienomerus brachiustius*	LC	Distributed across the African coasts
Cichilidae	*Hemichromis fasciatus*	LC	Distributed across the African coasts
	Oreochromis niloticus	LC	Distributed across the African coasts
	Sarotherodon occidentalis	LC	Distributed across the African coasts
	Coptodon guineensis	LC	Distributed across the African coasts
Procatopodidae	*Aplocheilichthys spilauchen*	LC	Distributed across the African coasts
Nothobranchiidae	*Epiplatys dageti dageti/dageti monrovae*	LC	Côte d'Ivoire; Ghana; Liberia, Sierra Leone
Cichlidae	*Tylochromis intermedius*	LC	Côte d'Ivoire; Gambia; Ghana; Guinea; Guinea-Bissau; Liberia; Senegal; Sierra **Leone**
	Tylochromis (jentinki)	LC	Cameroon; Chad; Guinea; Mali; Nigeria
Latidae	*Lates niloticus*	LC	Distributed across the African coasts

**** Key: LC-Least Concern***

Additionally, the species diversity was estimated per chiefdom using the Shannon- Weiner Diversity Method. When compared to Marampa Chiefdom, the Maforki areas' freshwater systems had a high species diversity estimate despite the low species number (abundance) and richness (Table 4-18).

*Table 4- 15: **Comparing Species Richness, Abundance and Diversity of Study Sites***

	SITE A: MARAMPA CHIEFDOM	SITE B: MAFORKI CHIEFDOM
Abundance	351	40
Richness	16	13

Diversity	0.96				1.94			
	Ab	*Pi*	*Ln (Pi)*	*Pi*Ln (Pi)*	*Ab*	*Pi*	*Ln (Pi)*	*Pi*Ln (Pi)*
Brycinus nurse-juvenile	*4*	*0.011*	*-4.5099*	*-0.05*	*1*	*0.005*	*-5.298*	-0.03
Tilapia brevimanus	*63*	*0.179*	-1.7204	-0.31	*7*	*0.175*	1.743	-0.31
Hepsetus odoe	3	*0.009*	*-4.7105*	*-0.04*	0	0	*0*	*0*
Hemichromis fasciatus	*9*	*0.023*	*-3.7586*	*-0.088*	2	*0.005*	*-5.328*	*-0.026*
Brienomerus brachiustius	*0*	*0*	0	0	*0*	*0*	0	0
Oreochromis niloticus	*41*	*0.106*	-2.2423	*-0.238*	5	*0.125*	*-2.079*	-0.26
Sarotherodon occidentalis	*129*	*0.368*	*-0.9997*	*-0.366*	6	0.15	*-1.897*	*-0.285*
Coptodon guineensis	4	*0.01*	-4.5695	-0.047	2	*0.05*	-2.996	-0.15
Aplocheilichthys spilauchen	30	*0.078*	*-2.5546*	*-0.199*	0	*0*	*0*	*0*
Epiplatys dageti	1	*0.003*	*-5.9558*	*-0.015*	2	*0.05*	*-2.996*	-0.15
Gobid sp.	6	*0.016*	*-4.1641*	*-0.065*	0	*0*	*0*	*0*
Tylochromis intermedius	*2*	*0.005*	*-5.2627*	*-0.027*	*1*	*0.025*	*-3.689*	*-0.09*

Tylochromis jentinki	6	0.016	-4.1641	-0.065	1	0.025	-3.689	-0.09
Lates niloticus	2	0.005	-5.2627	-0.027	0	0	0	0
Carlarius latiscutatus	4	0.01	-4.569	-0.047	5	0.125	-2.079	-0.26
Notopterus afer	37	0.096	-2.3449	-0.225	0	0	0	0
Mangrove Snapper (c.f.,) probably Lutjanus argentimaculatus)	1	0.003	-5.9558	-0.015	1	0.025	-3.689	-0.09
Lutjanus sp. (c.f., probably L. cyanopterus)	9	0.023	-3.7586	-0.088	3	0.075	-2.59	-0.194
Diversity				0.96				1.94

***Ab = Abundance**

Regardless of the results of fish species assemblages from the current survey, the habitat present in the survey areas is expected to host quite a few freshwater fish species, including those listed in Tables 5.10&5.11, particularly species of the Cyprinidae and Characidae families, which were completely absent from this study but are known for their widespread distribution across freshwater systems in Sierra Leone (Paugy et al., 2004, 1990; Payne et al., 2007). Three of the anticipated species, which are listed in Table 5c as Vulnerable (VU) and Endangered (EN) on the IUCN Red List, may be contributing to the sensitivity of the freshwater ecology.

Table 0.20 Expected fish species in the proposed extended project concessions.

Family	Species	Geographic Range ((Paugy et al., 1990; Paugy et al., 2003, 2004; Froese and Pauly, 2020; www.iucn.redlist.org))	IUCN Red List Status
FINFISH			
Aplocheilidae	*Epiplatys fasciolatus*	Guinea; Guinea-Bissau; Liberia; Sierra Leone	LC
Clarotidae	*Chrysichthys maurus*	Burkina Faso; Côte d'Ivoire; Gambia; Ghana; Guinea; Guinea-Bissau; Liberia; Mali; Senegal; Sierra Leone	LC
	Chrysichthys johnelsi	Côte d'Ivoire; Gambia; Guinea; Guinea-Bissau; Liberia; Senegal; Sierra Leone	LC
Characidae	*Brycinus macrolepidotus*	Distributed across the African coasts	LC
	Hydrocynus forskahlii	Distributed across the African coasts	LC
Cichlidae	*Heterotilapia buettikoferi*	Guinea; Guinea-Bissau; Liberia; Senegal; Sierra Leone	LC
	Tylochromis leonensis	Côte d'Ivoire; Guinea; Liberia; Sierra Leone	LC
Claridae	*Heterobranchus isopterus*	Benin; Burkina Faso; Cameroon; Côte d'Ivoire; Ghana; Guinea; Liberia; Nigeria; Sierra Leone; Togo	LC
	Clarias laeviceps	Côte d'Ivoire; Ghana; Guinea; Liberia; Sierra Leone	VU
Cyprinidae	*Labeobarbus sacratus*	Côte d'Ivoire; Guinea; Guinea-Bissau; Liberia; Sierra Leone	LC
	Labeobarbus wurtzi	Côte d'Ivoire; Ghana; Guinea; Liberia; Sierra Leone	LC
	Labeo parvus	Distributed across the African coasts	LC
	Enteromius ablabes	Distributed across the African coasts	LC
	Raiamas steindachneri	Côte d'Ivoire; Guinea; Liberia; Sierra Leone	LC
Distichodontidae	*Ichthyborus quadrilineatus*	Guinea; Nigeria; Senegal; Sierra Leone	VU
	Neolebias	Distributed across the African coasts	LC

	unifasciatus		
Mochokidae	*Synodontis waterloti*	Côte d'Ivoire; Gambia; Ghana; Guinea; Liberia; Senegal; Sierra Leone	LC
	Synodontis thysi	Guinea; Sierra Leone	LC
Mormyridae	*Marcusenius thomasi*	Guinea; Guinea-Bissau; Liberia; Sierra Leone	LC
	Marcusenius mento	Cameroon; Gabon	LC
	Marcusenius meronai	Sierra Leone	EN
	Brienomyrus brachyistius	Benin; Burkina Faso; Cameroon; Ghana; Guinea; Guinea-Bissau; Liberia; Nigeria; Senegal; Sierra Leone	LC
	Hippopotamyrus paugyi	Guinea; Liberia; Sierra Leone	LC
	Petrocephalus pellegrini	Côte d'Ivoire; Guinea; Liberia; Sierra Leone	LC
Schilbeidae	*Schilbe micropogon*	Benin; Burkina Faso; Cameroon; Ghana; Guinea; Guinea-Bissau; Liberia; Nigeria; Senegal; Sierra Leone	LC
	Schilbe mandibularis	Côte d'Ivoire; Ghana; Liberia Burkina Faso; Guinea	LC
MACRO-INVERTEBRATES			
Polaemonidae	*Macrobranchium vollenhoveni*	Côte d'Ivoire; Ghana; Liberia Burkina Faso; Guinea	LC
Claridae	*Heterobranchus isopterus*	Benin; Burkina Faso; Cameroon; Côte d'Ivoire; Ghana; Guinea; Liberia; Nigeria; Sierra Leone; Togo	LC
	Clarias laeviceps	Côte d'Ivoire; Ghana; Guinea; Liberia; Sierra Leone	VU
Cyprinidae	*Labeobarbus sacratus*	Côte d'Ivoire; Guinea; Guinea-Bissau; Liberia; Sierra Leone	LC
	Labeobarbus wurtzi	Côte d'Ivoire; Ghana; Guinea; Liberia; Sierra Leone	LC
	Labeo parvus	Distributed across the African coasts	LC

	Enteromius ablabes	Distributed across the African coasts	LC
	Raiamas steindachneri	Côte d'Ivoire; Guinea; Liberia; Sierra Leone	LC
Distichodontidae	*Ichthyborus quadrilineatus*	Guinea; Nigeria; Senegal; Sierra Leone	VU
	Neolebias unifasciatus	Distributed across the African coasts	LC
Mochokidae	*Synodontis waterloti*	Côte d'Ivoire; Gambia; Ghana; Guinea; Liberia; Senegal; Sierra Leone	LC
	Synodontis thysi	Guinea; Sierra Leone	LC
Mormyridae	*Marcusenius thomasi*	Guinea; Guinea-Bissau; Liberia; Sierra Leone	LC
	Marcusenius mento	Cameroon; Gabon	LC
	Marcusenius meronai	Sierra Leone	EN
	Brienomyrus brachyistius	Benin; Burkina Faso; Cameroon; Ghana; Guinea; Guinea-Bissau; Liberia; Nigeria; Senegal; Sierra Leone	LC
	Hippopotamyrus paugyi	Guinea; Liberia; Sierra Leone	LC
	Petrocephalus pellegrini	Côte d'Ivoire; Guinea; Liberia; Sierra Leone	LC
Schilbeidae	*Schilbe micropogon*	Benin; Burkina Faso; Cameroon; Ghana; Guinea; Guinea-Bissau; Liberia; Nigeria; Senegal; Sierra Leone	LC
	Schilbe mandibularis	Côte d'Ivoire; Ghana; Liberia; Burkina Faso; Guinea	LC
MACRO-INVERTEBRATES			
Polaemonidae	*Macrobranchium vollenhoveni*	Côte d'Ivoire; Ghana; Liberia Burkina Faso; Guinea	LC

**LC-Least Concern; VU-Vulnerable; CR-Critically Endangered; EN-Endangered; DD-Data Deficient*

4.17.6 Livelihood Dependence on Freshwater Fish

One of the important ecosystem services that aquatic ecosystems in rural settlements provide is fish food (Payne et al., 2010; Konoyima et al., 2020). It is estimated that 30% of bordering communities' dependence on fishing is subsistence, especially in the vicinity of the proposed mine extension boundaries. However, the concession areas in the Marampa Chiefdom with much larger rivers showed relatively vast commonality in communities' dependence on aquatic resources like fish for livelihood (estimated at 70%). Here, fishing bordering communities frequently engage in fishing, despite reports that it is sporadic and primarily for subsistence purposes. This is a common way for locals to obtain protein and reduce costs associated with purchasing pricey marine fish from the market, which is the case when there is no catch. The majority of fishing groups are made up of young people who use hook and lines, while occasionally fishing women use the wooden hand nets known locally as “baimbay” in small streams. Additionally, local fishermen's catch volumes vary depending on the fisher and the time of year they fish, and indigenous people attribute this largely to "luck." The best time to go fishing is during the dry season when there is very little water in the streams, especially the bigger ones. Indigenous people in all communities generally reported that fish species of the Cichlidae, Claridae, Malapteruridae, and Polypteridae families were dominant because they typically made up the largest proportion of their catches, which is consistent with the fish family dominance in freshwater ecosystems reported by Payne et al. (2010). Examples of freshwater species including the killi-fishes known for limited mobility are given in the following pictures:

Table 4- 16: Freshwater Fish Species

	
Tilapia brevimanus(LC): Inhabits rivers and streams/tributaries. Widely distributed in Sierra Leone (www.iucnredlist.org). Demersal and tropical: 24°C - 26°C (www.fishbase.org).	*Hepsetus odoe*. Inhabits rivers and streams/tributaries. Widely distributed in Sierra Leone (www.iucnredlist.org). Demersal and tropical: 24°C - 26°C (www.fishbase.org).

	
Hemichromis fasciatus. Inhabits rivers and streams/tributaries. Widely distributed in Sierra Leone (www.iucnredlist.org). Demersal and tropical: 24°C - 26°C (www.fishbase.org).	*Sarotherodon(Micralestes) occidentalis* ***(LC):*** *Inhabits rivers and streams. Distributed widely in southwestern and northeastern Sierra Leone* (www.iucnredlist.org). pelagic; pH range: 5.5 - 7.5 (www.fishbase.org).
	
Epiplatys dageti (LC): Inhabits swamps and swampy parts of tributaries and small streams and was caught with hand nets. The maximum recorded size is 6cm, and rarely exceeds such length as indicated in Paugy et al. (2004). Benthopelagic; non-migratory and Tropical-24°C - 27°C	***Clarias buettikoferi*** **(LC).** Usually inhabits all wetlands ranging from swamps, and streams to large rivers. Widely distributed in Sierra Leone (www.iucnredlist.org) Demersal and Tropical; 20°C - 27°C (www.fishbase.org)
	
Scriptaphyosemion spp. (Unidentified): Inhabits swamps and swampy parts of tributaries and small streams and was caught with hand nets. The maximum recorded size is 6cm, and rarely exceeds such length as indicated in Paugy et al. (2004). Benthopelagic; non-migratory and Tropical-24°C - 27°C	*Scriptaphyosemion spp. (Unidentified):* Inhabits swamps and swampy parts of tributaries and small streams and was caught with hand nets. The maximum recorded size is 6cm, and rarely exceeds such length as indicated in Paugy et al. (2004). Benthopelagic; non-migratory and Tropical-24°C - 27°C

4.17.7 Marine Fish Assemblages

Over 500 km of the country's coastline makes up about one-third of its total length (Heymans and Vakily, 2004). At the confluence of the Canary Current in the north and the Guinea Current in the south, Sierra Leone is located just north of the Gulf of Guinea. According to Heymans and Vakily (2004) and GCLME (2006), Sierra Leone is located within one of the most productive marine ecosystems in the world thanks to this sizable continental shelf and the regional currents, which together produce a significant upwelling.

The Sierra Leone River Estuary, which narrows at the Marampa Mines area in the Port- Loko District as the Port-Loko Creek, is one of the marine coverage areas of the Marampa Mines. Fish, marine birds, mammals, reptiles, and amphibians, as well as other vertebrates, invertebrates, and plants (including marine micro-plants, phytoplankton, and coastal vegetation), have all been extensively studied in the Port Loko Creek.

4.17.7.1 Fish and Invertebrates

4.17.7.1.1 Fish

The study's main objective was to assess the species' richness, diversity, and abundance in the mangrove brackish water fish assemblage. Cast nets, hook and line fishing, and encircling gill nets were the main methods of evaluation. Twenty-seven (27) brackish water species from twenty-five (25) families were found overall, according to the research. The IUCN Red List Category classifies *Cynoglossus canariensis* and *Galeoides decadactylus* as Near Threatened (NT). *Sardinella maderensis* and *Fontitrygon margarita* are both considered vulnerable by the IUCN. As they are known to occur in the larger Sierra Leone River Estuary, other River Estuaries in Sierra Leone, and coastal environments of other African countries (**Regional Endemic**), none of the recorded species were, however, exclusive or endemic to the wetlands under study. According to a study by Seto et al. (2015), *Sardinella spp*. (24%) and Bonga shad (54%) make up the majority of the catches in the artisanal sector, respectively. The family Sciaenidae, which mainly consists of bobo croaker and law croaker, was also significant (3.3%). 2-3% of annual catches were also made up of barracuda (Sphyraenidae), jacks (Carangidae), grunts (Haemulidae), and threadfins (Polynemidae). The list of known marine species is presented in Table 4-20.

Table 4- 17: Recorded fish species, IUCN category and geographic range

Family	Species	IUCN Status	Geographic Range (www.iucnredlist.org)
Mugilidae	*Mugil cephalus*	LC	Globally distributed
Soleidae	*Dicologlossa cuneata*	LC	Globally distributed
Cynoglossidae	*Cynoglossus canariensis*	NT	Widely distributed across coastal Africa
Dasyatidae	*Fontitrygon margarita*	VU	Widely distributed across coastal Africa
Carangidae	*Caranx hippos*	LC	Globally distributed

Elopidae	*Elops lacerta*	LC	Widely distributed across coastal Africa
Haemulidae	*Pomadasys rogerii*	LC	Widely distributed across coastal Africa
Haemulidae	*Pomadasys perotaei*	LC	Widely distributed across coastal Africa
Sciaenidae	*Pseudotolithus typus*	LC	Widely distributed across coastal Africa
Scombridae	*Katsuwonus pelamis*	LC	Globally distributed
Carangidae	*Trachinotus goreensis*	LC	Widely distributed across coastal Africa
Carangidae	*Trachinotus ovatus*	LC	Globally distributed
Drepaneidae	*Drepane africana*	LC	Widely distributed across coastal Africa
Acanthuridae	*Acanthurus monroviae*	LC	Widely distributed across coastal Africa
Belonidae	*Ablennes hians*	LC	Globally distributed
Sphyraenidae	*Sphyraena sphyraena*	LC	Globally distributed
	Sphyraena guachancho	LC	Globally distributed
Monodactylidae	*Monodactylus sebae*	LC	Widely distributed across coastal Africa
Gerreidae	*Eucinostomus melanopterus*	LC	Globally distributed
Polynemidae	*Galeoides decadactylus*	NT	Widely distributed across coastal Africa
	Polydactylus quadrifilis	LC	Widely distributed across coastal Africa
Clupeidae	*Sardinella maderensis*	VU	Globally distributed
	Ethmalosa fimbriata	LC	Widely distributed across coastal Africa
Pristigasteridae	*Ilisha africana*	LC	Widely distributed across coastal Africa
Lutjanidae	*Lutjanus goreensis*	DD	Widely distributed across coastal Africa
Lutjanidae	*Lutjanus goreensis*	DD	Widely distributed across coastal Africa
Ariidae	*Carlarius latiscutatus*	LC	Widely distributed across coastal Africa

Lethrinidae	*Lethrinus atlanticus*	LC	Widely distributed across coastal Africa
Ariidae	*Carlarius latiscutatus*	LC	Widely distributed across coastal Africa
Lethrinidae	*Lethrinus atlanticus*	LC	Widely distributed across coastal Africa

4.17.7.2 Length Frequency and Spawning Potential Ratio (SPR) Length frequency and Spawning Potential Ratio (SPR)

Adrian Hoyke (2015) created the SPR model, which estimates the number of eggs that a fish stock will produce throughout its lifetime under a particular fishing regime in comparison to the spawn that the stock would produce throughout its lifetime if fishing were prohibited. It measures how fishing affects a fish stock's capacity to contribute to spawning (Hoyke et al., 2015).

The purpose of using this model in this study was to explain why there were so many juveniles of the most common species found during the current survey along Port Loko Creek in the Sierra Leone River Estuary, which is a measure of the mangroves' capacity to serve as fish nurseries. In the current survey, Mugil cephalus (N = 60), *Sardinella maderensis* (N = 39), *Ethmalosa fimbriata* (N = 41), *Eucinostomus melanopterus* (N = 25), and Ilisha africana (N = 28) were the most frequently encountered species. They serve as a significant source of fish protein and income as the most frequently landed fish groups in the neighbourhood market. Due to the small sample size, these estimates might offer information on the most exploited marine species in the project areas, but not the extent of exploitation.

4.17.7.3 Mugil cephalus

Because the estimated SPR is less than 0.2 (the limit point) and 0.4 (the target point), the length frequency is skewed toward the shorter length groups (juveniles for *M. cephalus*), and the stock had low spawning potential (SPR = 0.05). Additionally, it suggests that only 5% of the stock had a chance to reproduce before being caught by local fishermen.

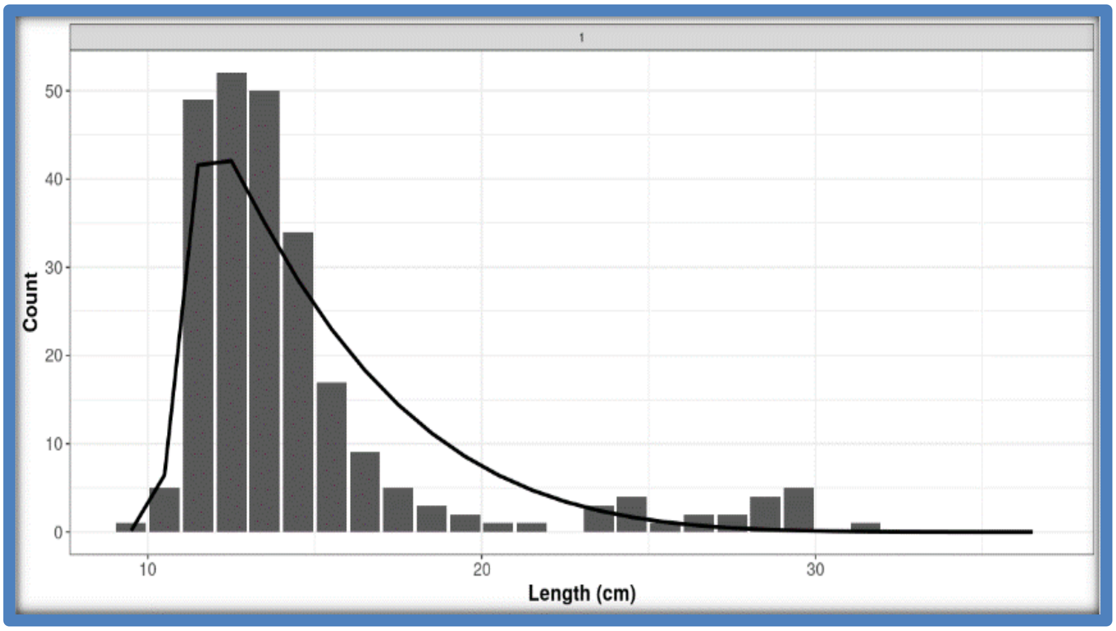


Figure 4- 39: Length-frequency distribution Mugil Cephalus (Marampa ESHIA 2023)

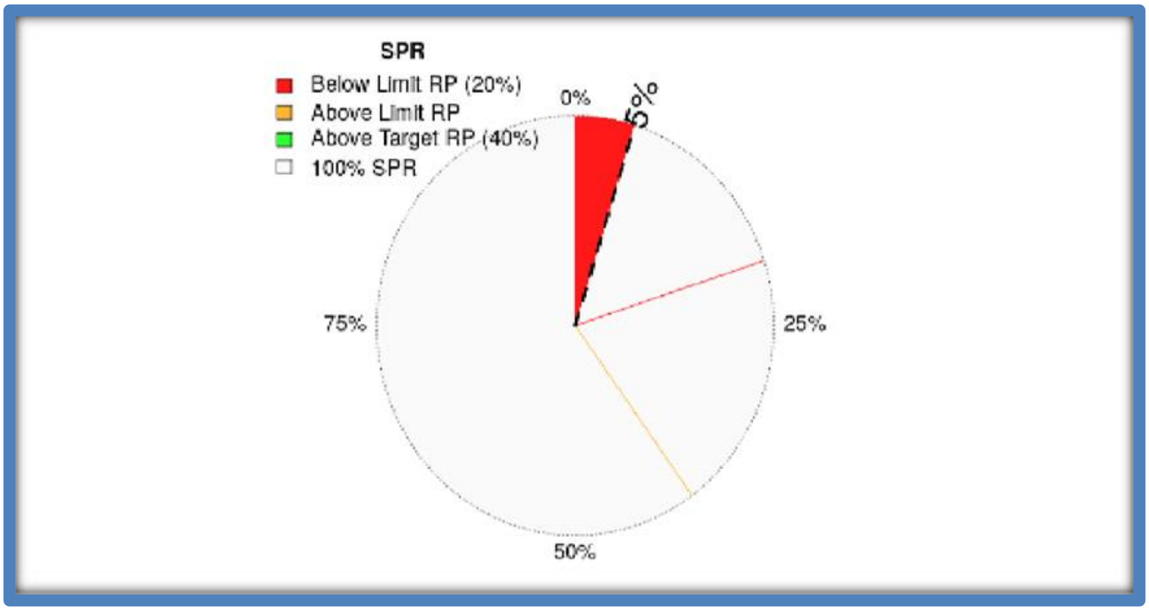


Figure 4- 40: ***Estimates of Spawning Potential and reference point Mugil cephalus-Marampa ESHIA 2023.***

4.17.7.4 *Sardinella maderensis (IUCN status: vulnerable)*

The largest number of Sardinella stock members were found in the length group with a total length of 15 cm. Despite this, the stock's SPR was high (SPR = 0.78, higher than the desired level of 0.4), and 78% of the fish had a chance to reproduce before being caught. This implied that the recorded stock's adults had stunted growth, likely because of fishing pressure.

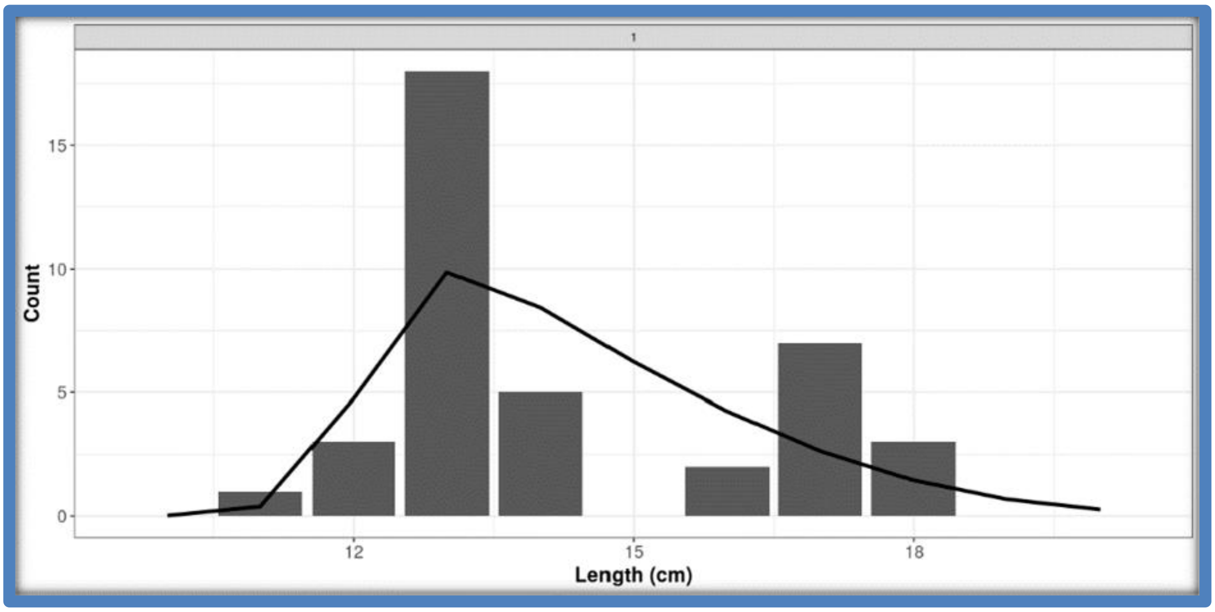


Figure 4- 41: Length-frequency distribution of Sardinella maderensis. (Marampa ESHIA 2023)

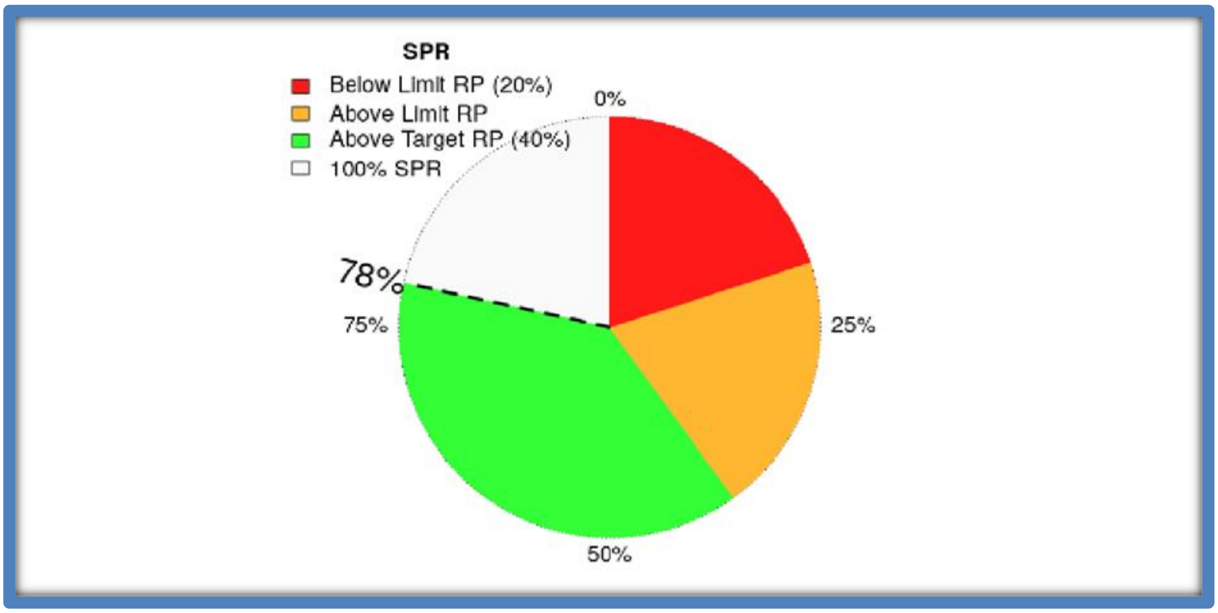


Figure 4- 42: Estimates of Spawning Potential and reference point (Right) of Sardinella Maderensis. (Marampa ESHIA 2023)

4.17.7.5 Ilisha Africana

The asymmetric length frequency distribution of I. Africana specimens suggest that lower and larger length groups were proportionally represented in the sampled population. The stock's spawning potential (SPR = 0.55) reflects these proportionate length groups, with 55% of the harvested biomass capable of spawning.

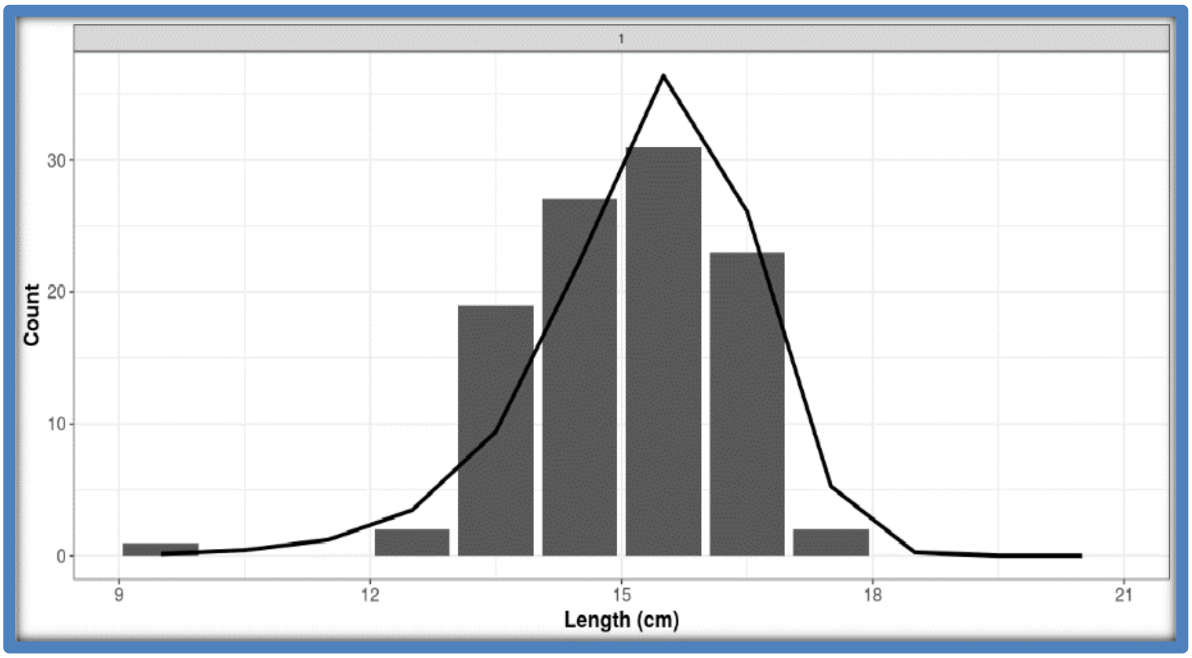


Figure 4- 43: Length-frequency distribution of Ilisha Africana (IUCN Status: Least Concern) (Marampa ESHIA 2023)

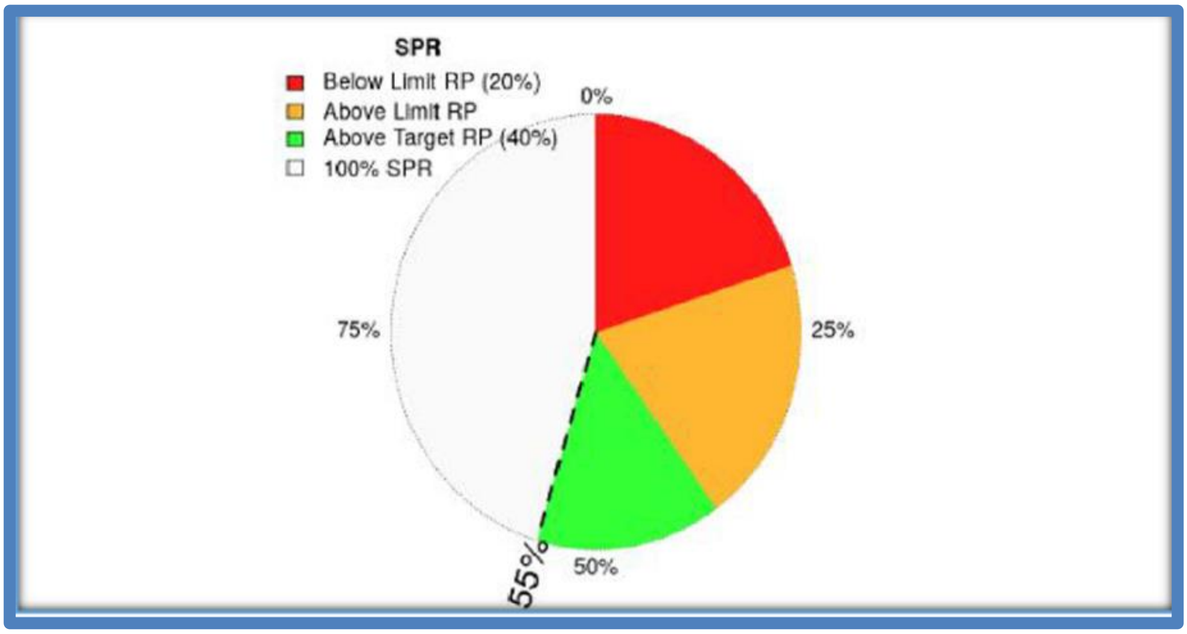


Figure 4- 44: Estimates of Spawning Potential and reference point of Ilisha Africana. (Marampa ESHIA 2023).

4.17.7.6 *Ethmalosa fimbriata*

The majority of E. fimbriata stock discovered during the Marampa ESHIA 2023 survey fell into the lower length groups (TL 20 cm; Figure 4-47), according to the length- frequency distribution. The stock had a high spawning potential (SPR = 0.46), both above and below the 0.2

and 0.4 limit and target reference points.

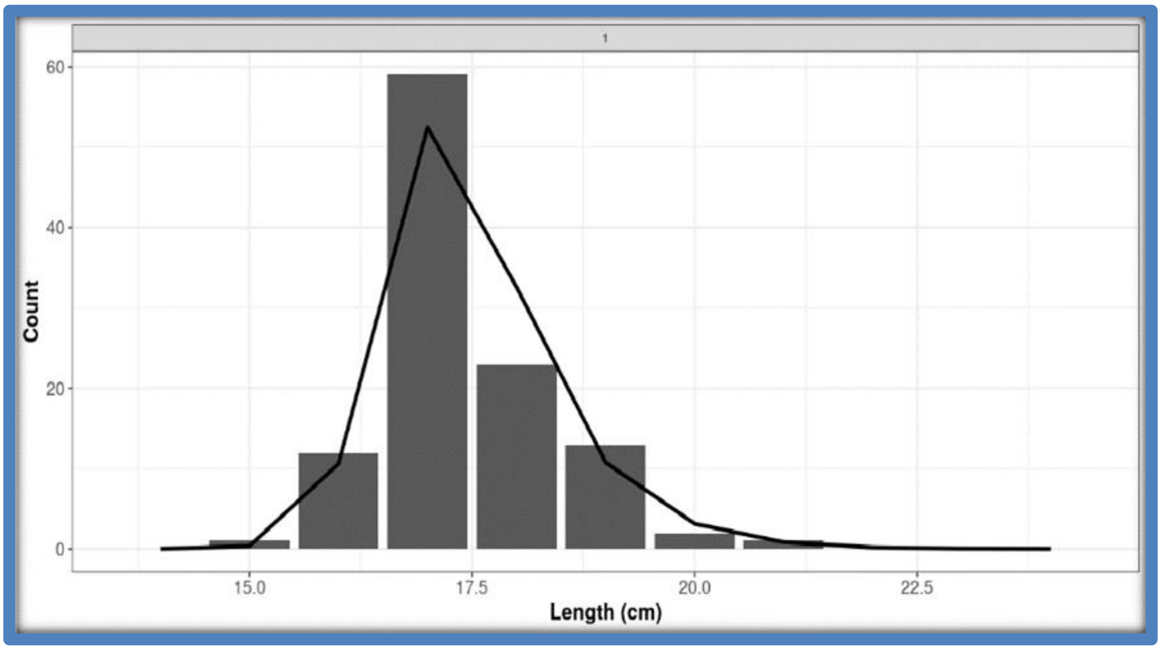


Figure 4- 45: Length-frequency distribution of Ethmalosa fimbriata. (Marampa ESHIA 2023).

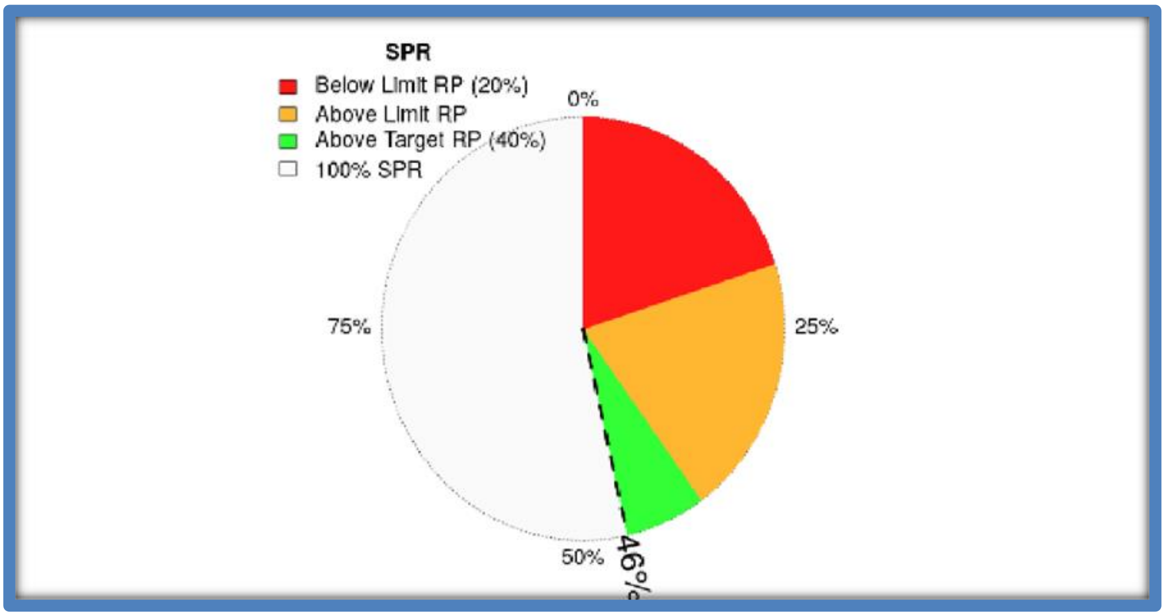
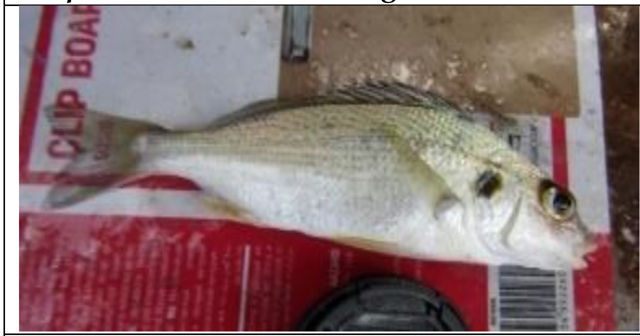
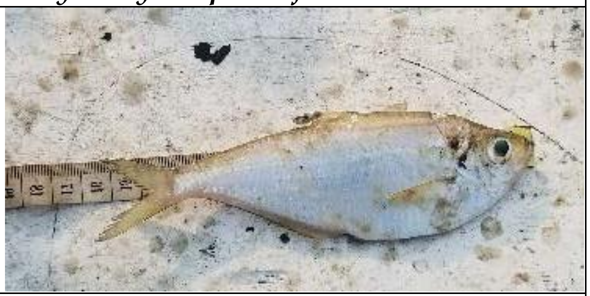


Figure 4- 46: Estimates of Spawning Potential and reference points of Ethmalosa fimbriata. (Marampa ESHIA 2023)

Table 4- 18: Photos of some of the recorded fish species

	
Elops lacerta (var. E. senegalensis)	***Pomadasys rogerii***
	
Pomadasys perotaei	***Pseudotolithus typus***
	
Galeoides decadactylus	***Polydactylus quadrifilis***
	
Sardinella maderensis	***Ilisha africana***
	
Ethmalosa fimbriata	***Mugil Cephalus***

4.17.8 Intertidal zones and associated fauna-Port Loko Creek

Overall, it appeared that the species diversity expected for such habitats was not being supported by the intertidal flats (sandy beach and mangrove mudflat) at the Port Loko Creek areas. Mangrove swamps at the port-Loko Creek area of Marampa Mines concession sites had sparse representations of species like Crassostrea tuliper (mangrove oyster), known to colossally cluster on mangrove stems and roots, Ghost and Fiddler crabs, commonly found in mangrove conglife of mineerates, and the mudskipper, *periophthalmus barbarous*, a crucial bio-indicator of coastal pollution (Konoyima, 2020). It's possible that the current substrates in mangrove areas do not provide the optimal environmental conditions needed to foster the physiological and dietary adaptations that should be present in true mangrove fauna. These, in turn, may have negative effects on the variety of mangrove species, which should indicate the ecological integrity or useful characteristics of such highly regarded natural capital. In essence, this means that beyond the usual rice farming and coastal defence, the Port Loko Creek mangroves can hardly provide the established biodiversity ecosystem services. Even so, there weren't as many rock oyster (*Crassostrea denticulata*) shells to be seen at the study locations. In addition, there were very few instances of infauna and epifauna as the benthos of the muddy/sand shore, in contrast to what happens at a rich sandy shore (Table 4-22).

Table 4- 19: List of recorded littoral organisms in this study.

Transect	Species recorded	Abundance	IUCN Red list Status
TRWOR01	Crab borrows	168	
	Typanotonous fuscatus	263	Not Evaluated
TRWOR02	Crab borrows	355	
	Typanotonous fuscatus	98	Not Evaluated
TRWOR03	Crab borrows	30	
	Typanotonus fuscatus	150	Not Evaluated
	Clibanarius africanus	20	Not Evaluated
TRWOR04	Crab borrows	39	
	Typanotonus fuscatus	232	Not Evaluated
TRWOR05	Crab borrows	347	
	Typanotonus fuscatus	53	Not Evaluated
	Crassostrea tulipa	232	Not Evaluated
TRWOR06	Crab borrows	50	
	Typanotonus fuscatus	4	Not Evaluated
	Clibanarius africanus	16	Not Evaluated
	Crassostrea tulipa	997	Not Evaluated
	Thais sp	9	Not Evaluated
	Perna perna	235	Not Evaluated
	Pugilina morio	6	Not Evaluated

This research identified a total of 19 species from 14 families. The photos below show the most prevalent species found during this study.

Table 4- 20: Most common littoral organism

	
Typanotonus fuscatus	*Ocypode cursor*
	
Macrobranchium vollenhoenii	*Cardiosoma armatum*
	
Callinectes amnicola (Male)	

Notwithstanding, for the invertebrates (shellfishes), historical records provide that there are sixteen (16) species of shrimps occurring in Sierra Leone, belonging to eight families. Of these, six (6) are of commercial importance, and include the pink shrimp (*Farfantepenaeus notialis*) which accounts for about 96% of the landings, tiger shrimp (*Melicertus keraturus*), Guinea shrimp (*Holthuispenaeopsis atlantica*), deep-water rose shrimp (*Parapenaeus longirostris*), red shrimp (*Aristeus antennatus*) and great red shrimp (*Aristaeopsis edwardsiana*). *Melicertus keraturus* and *Holthuispenaeopsis atlantica* inhabit mangrove swamps, estuaries, and inshore continental shelves to a depth of 55m, and *Parapenaeus longirostris* occurs in deeper waters of

40-70m (Okera and Chaytor, 1978). *Aristaeopsis edwardsiana* occurs above the continental slope (Coutin, 1989). In addition, among the crabs, the most important species are *Callinectes marginatus, Callinectes pallidus and Callinectes amnicola.*

Further, molluscs consist of three main classes: Cephalopods, Gastropods and Bivalves. There are three categories of Cephalopods-cuttlefish, squid and octopus. The two common species of cuttlefish include *Sepia officinalis,* and the African cuttlefish (*Sepia bertheloti*). These are found in the north and south of the territorial waters on the coarse ground at depths of 17-78m. The squid species include *Thysanoteuthis rhombus*, *Todaropsis eblanae* and Ilex coindentti which are largely demersal and are found below 100m (Coutin, 1989).

Also, the species of octopus that exist in the territorial waters of Sierra Leone are; *Octopus vulgaris* and *O. macrops*, both of which are purely demersal. Some common gastropod species that are mainly demersal and largely occur in the deep sea include, *Cymbium cymbium, Cymbium glans* and *Cymbium pepo*; those found in the littoral zones include *Thais haemastoma*, *Murex duplex*, *Pugilina morio* and *Thais cornutus*. Similarly, the bivalves include the intertidal: *Senilia senilis, cardium custatum, Cardiun ringens, Crassosstrea tulipa* (mangrove oyster), *Crassostrea denticulata* (rock oyster) (Aleem and Chaytor, 1980); and deep water species include: Mactra spp. and mussels.

4.17.8.1 Plankton

In-depth research has been done on the plankton of Sierra Leone's coastal waters, including creeks and bays (Watts 1962; Aleem 1979). High plankton production typically occurs from the middle of the dry season to the end of the rainy season (October to February). From March to June, there is a decline that lasts into the rainy season (Aleem, 1979).

The major genera of the phytoplankton species recorded in the study sites are *Thalassiosira, Nitzchia, Pleurosigma, Coscinodiscus, Thalassoinema, Skeletonema, Amphora, Ceratium, Peridinum,* and *Oscillatoria*. Some blue-green algae may occur in the rainy season. In addition, the dominant phytoplankton species were *Coscinodiscus* and *Thalassiothrix*. In the rainy season, the following dominant species are expected- *Coscinodiscus* and *Thalassiosira*. None of the species recorded are of significant conservation concern. Algae species are not known to be exploited; however major changes in composition are expected due to major habitat alteration. Currently, the Creek areas appear to be in a typical environmental condition.

Thalassiosira, Nitzchia, Pleurosigma, Coscinodiscus, Thalassoinema, Skeletonema, Amphora, Ceratium, Peridinum, and *Oscillatoria* are the main genera of phytoplankton species identified in the study sites, while the copepods which are probably a fish larvae, was noted. During the rainy season, some blue-green algae might be present. Additionally, *Thalassiothrix* and *Coscinodiscus* were the two most common phytoplankton species. *Coscinodiscus* and *Thalassiosira* are anticipated to be the two dominant species during the rainy season. None of the species listed poses a serious threat to conservation. Although it is unknown whether any algae species are exploited, significant habitat changes are anticipated to cause significant compositional changes. The

Creek area seems to be experiencing a typical environmental state right now.

4.17.8.2 Turtles and Marine Mammals

Five different species of sea turtles have been identified in Sierra Leone and have been observed on beaches. The species are the olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricate*), loggerhead (*Caretta caretta*), green (Chelonia mydas), and leatherback (*Dermochelys coriacea*). These species typically nest on the beaches near Turtle and Sherbro islands in the southern region (Fretey, 2001 in EPA-SL, 2015). The Reptiles and Amphibians Program-Sierra Leone (RAP-SL) places a high priority on protecting turtles in Sierra Leone. The species have also been classified as Critically Endangered (for the Hawksbill), Endangered (for the green turtle), or Vulnerable (for the Olive Ridley, Leatherback, and Loggerhead turtles) on the IUCN Red List. The Port- Loko Creek environment in the Marampa Mines regions, however, lacks the necessary substrate (vast sandy shore).

During this survey, photographic records were used to document the presence of two groups of marine mammals in the territorial waters of Sierra Leone, even though fishermen and community members were unable to identify specific species. While dolphins have been spotted by fishermen in offshore fishing grounds, the Sirenian (African manatee, *Trichechus senegalensis*) is a rare visitor to areas with mangrove rice farms and is frequently caught in fishing nets. Except for sporadic sightings, little is known about the status of the dolphin and porpoise populations in Sierra Leone.

The IUCN Redlist of threatened species (www.iucnredlist.org) lists the Atlantic Humpback dolphins (*Sousa teuszii*), a well-known species, as "Critically Endangered" and a species of global conservation concern. Because they are not harvested, dolphin and porpoise populations in Sierra Leone are in excellent condition, according to a previous analysis (EPA-SL, 2015). The African manatee (*Trichechus senegalensis*), the sole member of the Sirenean genus, is found in the river estuaries of Sierra Leone and is classified as "vulnerable" on the IUCN Red List of Threatened Species (www.iucnredlist.org). Therefore, the manatee is a concern for global conservation. The African manatee is also listed as endangered by the Convention on International Trade in Endangered Species (CITES) (Encyclopedia of Life, 2015).

Another list of the groups of sea turtles and marine mammals reported to have been accidentally or purposefully taken by local fishermen in the South, West, and Northern regions of the Sierra Leone coast is provided in Table 8 by Moore et al. (2010), though the list has not yet been confirmed by the authors.

Table 4-24. Sea Turtles and Marine Mammals were reportedly captured (incidentally or intentionally) by artisanal fishermen in the Northern, Southern and Western regions of the Sierra Leone coast (Moore et al., 2010).

Table 4- 21: Sea Turtles and Marine Mammals

	Scientific name	Common name	IUCN Relist Status (Global)	Habitat
Sea Turtles	*Caretta Caretta*	loggerhead	VU	Coastal and Offshore
	Chelonia mydas	green	EN	
	Dermochelys coriacea	leatherback	VU	
	Eretmochelys imbricata	hawksbill	CR	
	Lepidochelys olivacea	Olive ridley	VU	
Cetaceans	*Sousa teuszii*	Atlantic humpback dolphin	CR	Coastal and Offshore
	Steno bradenensis	Rough-toothed dolphin		
	Tursiops truncatus	Common bottlenose dolphins	LC	
	Stenalla sp.		NE	
	Delphinus sp.		NE	
	Globicephalla sp.		NE	
	Kogia sp.		NE	
Sirenians	*Trichechus senegalensis*	West African manatee	VU	Coastal

CR –Critically Endangered, VU-Vulnerable, EN-Endangered, NE-Not Evaluated, LC-Least Concern

4.17.8.3 Marine Avifauna

Important bird species that are threatened by global habitat loss can be found in Sierra Leone's marine environment. The Greater Snipe (*Gallinago media*), the Curlew Sandpiper (*Caladrius ferruginea*), the Lesser Flamingo (*Phoenicopterus minor*), and the Vulnerable Damara Tern (*Sternula balaenarum*) are among the migratory species that are frequently spotted in Sierra Leone's coastal waters. The IUCN Redlist status is of least concern for the other migratory birds, such as the Royal tern (Thalasseus maximus) and Ringed plover (*Charadrius hiaticula*). To find good feeding and nesting areas, these birds congregate near the river and estuarine mouths on mud and sand foreshores (Okoni- Williams et al., 2001 in PRCM, 2011). The Yawri Bay is the most crucial coastal estuary in Sierra Leone for migratory birds. A list of bird species found primarily in Sierra Leone's four main coastal estuaries (Sierra Leone River Estuary, Sherbro River Estuary, Scarcies River Estuaries, and Yawri Bay) was provided by Van der Winden et al. (2005).

The majority of these birds are found in eastern Sierra Leone's protected Guinean rainforest habitat. The Marampa study area lacks true forest habitat, but the variety of habitats present, including grasslands, wetlands, woodlands, and mangroves, supports a respectable number of bird species. The current Port Loko Creek coastal environment does not support a wide variety of bird species. But the following was documented. However, across the 19 sites surveyed for this study, a total of 45 species of birds from 29 avian families were identified.

A higher percentage (94%) of the birds were resident species, including three species known for Sierra Leone from the Guinea-Congo Forest biome. Additionally, none of the endemic species of the Upper Guinea forest was discovered during this survey.

One species of the Sudan-Guinea savannah biome was found: the magnificent sunbird *Cinnyris coccinigastrus*. One of the Afro-tropical assemblages was encountered by the migratory species, whereas only one Palaearctic species, one migrant resident, and one Endangered species were observed. Vulture with a Hood *Necrosyrtes monachus.*

Table 4- 22: Some examples of bird species recorded during fieldwork

	
Red eye dove *(Streptopelia semitorquata*	Pied Crow *(Corvus albus)*

In effect, there are limited chances of encountering savannah-dependent species. However, based on observation and the data generated, the present study sites have a fairly large number of bird species. Table 4-26 gives a summary of the abundance of birds recorded.

Table 4- 23: Abundance of birds recorded per chiefdom-2023.

Species category	Marampa	Maforki	Total
Number of species	30	15	45
Number of families	17	12	29

Resident species	20	13	33
Afrotropical Migrants	1	1	2
Migrants Resident	1	1	2
Residents Migrant	0	0	0
Palaearctic migrants	1	1	2
GC Biome spp	3	1	4
UGF endemic spp	0	0	0
SG Savanna biome spp	1	1	2
IUCN Threat status	0	0	0
Endangered (EN)	1	1	2
Vulnerable (VU)	0	0	0
Near Threatened (NT)	0	0	0

Table 4-27 provides detailed data on the distribution of species recorded into various thematic and Biogeography categories.

Table 4- 24: List of bird species recorded during this survey-2023

Scientific names	English names	Mara mpa	Mafor kie	Status	Threat status	Biome
ARDEIDAE						
Ardea cinerea	Grey Heron	x	x	PM		
Bubulus Ibis	Cattle Egret	x	x	R		
Dendrocygna viduata	White-Faced Whistling Duck	x	x	R		
Zapomia flavirostra	Black Crake	x		R		
Actophilife of mineis africanus	African Jacana	x		R		
Milvus migrans	Yellow-billed Kite	x	x	AM		
Necrosyrtes monachus	Hooded Vulture	x	x	R	EN	
PHASIANIDAE						
Francolinus bicalcaratus	Double-spurred Francolin	x	x	R		
COLUMBIDAE						
Streptopelia semitorquata	Red-eyed Dove	x	x	R		
Streptopelia senegalensis	Laughing Dove	x	x	R		
CUCULIDAE						
Centropus senegalensis	Senegal Coucal	x	x	R		
STRIGIDAE						
Strix woodfordii	African Wood Owl	x	x	R		
CAPRIMULGIDAE						
Caprimulgus inornatus	Plain Nightjar	x	x	R		
APODIDAE						
Cypsiurus parvus	African Palm Swift	x	x	R		
Apus affinis	Little Swift	x	x	R		
ALCEDINIDAE						
Halcyon malimbica	Blue-breasted Kingfisher	x	x	R		
Halcyon senegalensis	Woodland Kingfisher	x	x	R		
MEROPIDAE						

Merops persicus	Blue-cheeked bee-eater	x	x	R		
Merops pusillus	Little Bee-eater	x	x	R		
CORACIIDAE						
Eurystomus glaucurus	Broad-billed Roller	x	x	R		
CAPITONIDAE						
Pogoniulus bilineatus	Yellow-rumped Tinkerbird	x	x	R		
PICIDAE						
Picus canus	Grey Woodpecker	x	x			
HIRUNDINIDAE						
Psalidoprocne nitens	Square-tailed Saw-wing	x	x	R		GC
PYCNONOTIDAE						
Andropadus virens	Little Greenbul	x	x	R		
Pyrrhurus scandens	Leaflove	x		R		GC
Pycnonotus barbatus	Common Bulbul	x	x	R		
TURDIDAE						
Cossypha niveicapilla	Snowny - crowned Robin-chat	x		R		
Turdus pelios	African Thrush	x	x	R		
SYLVIIDAE						
Camaroptera brachyura	Grey-backed Camaroptera	x	x	R		
MUSCICAPIDAE						
Melaenornis edolioides	Northern Black Flycatcher	x	x	R		
Ficedula hypoleuca	Pied Flycatcher	x	x	R		
MONARCHIDAE						
Trochocercus nitens	Blue-headed Crested Flycatcher	x		R		GC
PLATYSTEIRIDAE						
Bias musicus	Black-and-white Flycatcher	x		R		
Platysteira cyanea	Common Wattle-eye	x	x	R		
NECTARINIIDAE						
Cinnyris venustus	Variable Sunbird	x	x	R		
Cinnyris coccinigastrus	Splended Sunbird			R		GC
LANIIDAE						
Lanius collaris	Common Fiscal	x	x	R		
MALACONOTIDAE						
Malaconotus sulfureopectus	Sulphur-breasted Bush-shrike	x	x	R		
Tchagra senegalus	Black-crowned Tchagra	x	x	R		
DICRURIDAE						
Dicrurus adsimilis	Fork Tailed Drongo	x	x	R		
CORVIDAE						
Corvus albus	Pied Crow	x	x	R		
PLOCEIDAE						
Ploceus cucullatus	Village Weaver	x	x	R		
Euplectes macroura	Yellow-mantled Widowbird	x		R		
ESTRILDIDAE						

Lagonsticta senegala	Red-billed Firefinsch	x	x	R		
Spermestes cucullatus	Bronze Mannikin	x	x	R		
Spermestes bicolor	Black-and-white Mannikin	x	x	R		
CAPRIMULGIDAE						
Caprimulgus inornatus	Plain Nightjar	x	x	R		
APODIDAE						
Cypsiurus parvus	African Palm Swift	x	x	R		
Apus affinis	Little Swift	x	x	R		
ALCEDINIDAE						
Halcyon malimbica	Blue-breasted Kingfisher	x	x	R		
Halcyon senegalensis	Woodland Kingfisher	x	x	R		
MEROPIDAE						
Merops persicus	Blue-cheeked bee-eater	x	x	R		
Merops pusillus	Little Bee-eater	x	x	R		
CORACIIDAE						
Eurystomus glaucurus	Broad-billed Roller	x	x	R		
CAPITONIDAE						
Pogoniulus bilineatus	Yellow-rumped Tinkerbird	x	x	R		
PICIDAE						
Picus canus	Grey Woodpecker	x	x			
HIRUNDINIDAE						
Psalidoprocne nitens	Square-tailed Saw-wing	x	x	R		GC
PYCNONOTIDAE						
Andropadus virens	Little Greenbul	x	x	R		
Pyrrhurus scandens	Leaflove	x		R		GC
Pycnonotus barbatus	Common Bulbul	x	x	R		
TURDIDAE						
Cossypha niveicapilla	Snowny - crowned Robin-chat	x		R		
Turdus pelios	African Thrush	x	x	R		
SYLVIIDAE						
Camaroptera brachyura	Grey-backed Camaroptera	x	x	R		
MUSCICAPIDAE						
Melaenornis edolioides	Northern Black Flycatcher	x	x	R		
Ficedula hypoleuca	Pied Flycatcher	x	x	R		
MONARCHIDAE						
Trochocercus nitens	Blue-headed Crested Flycatcher	x		R		GC
PLATYSTEIRIDAE						
Bias musicus	Black-and-white Flycatcher	x		R		
Platysteira cyanea	Common Wattle-eye	x	x	R		
NECTARINIIDAE						
Cinnyris venustus	Variable Sunbird	x	x	R		
Cinnyris coccinigastrus	Splended Sunbird			R		GC
LANIIDAE						

Lanius collaris	Common Fiscal	x	x	R		
MALACONOTIDAE						
Malaconotus sulfureopectus	Sulphur-breasted Bush-shrike	x	x	R		
Tchagra senegalus	Black-crowned Tchagra	x	x	R		
DICRURIDAE						
Dicrurus adsimilis	Fork Tailed Drongo	x	x	R		
CORVIDAE						
Corvus albus	Pied Crow	x	x	R		
PLOCEIDAE						
Ploceus cucullatus	Village Weaver	x	x	R		
Euplectes macroura	Yellow-mantled Widowbird	x		R		
ESTRILDIDAE						
Lagonsticta senegala	Red-billed Firefinsch	x	x	R		
Spermestes cucullatus	Bronze Mannikin	x	x	R		
Spermestes bicolor	Black-and-white Mannikin	x	x	R		

Key: R=resident; EN= Endangered; AM=Afrotropical Migrant; PM= Palaearctic Migrant; GC= Guinea Congo

4.17.9 Terrestrial Ecosystems

Vegetation

4.17.9.1 Marampa Chiefdom

A mixture of woodland savanna, disturbed farm bush, and patches of secondary forests were present on the surveyed sites in the proposed Marampa mines extension areas of the Marampa Chiefdom, along with a predominance of *Pennesetum purpureum* and scattered wild oil pam mixed *Pterocarpus erinaceus* and *Anisophyllea laurina*. In addition, the areas have an open landscape with derived vegetation, decayed forest remnants, swamps, and bush fallows. The concession site is on the western flank of the transition zone between a forest and savanna and is heavily impacted by widespread slash-and- burn farming. Because of this, a sizable portion of the vegetation is derived and is made up of a mixture of derived savanna, bush fallows, and small patches of regrowing forest. The most significant factor that changed the vegetation in the region and contributed to the predominance of mixed vegetation of farm bush and derived savanna is the area's long history of slash-and-burn agriculture. After a few years of cultivation, farmland is left in a state known as "farm bush." Additionally, this vegetation type in the proposed concession was primarily made up of stands of native forest timber species like *Terminalia superba* and *Afzelia africana*, as well as fruit trees like mangoes, tola, oil palm, tombi, and cashew. Also, the site's landscape includes dwellings and man-made lakes or swamps, particularly in the concession areas.

Figure 4- 47: Photos showing the landscape and vegetation types at Marampa Chiefdom

4.17.9.2 Maforki Chiefdom

In the Maforki areas, stands of wild oil palm *Elaeis guinensis* dominate the farm bush and farmland ecology. The majority of the farm bush is between four and six years old, and throughout the entire stretch of the proposed sites, there are farms growing cassava and peanuts. Other crops grown there include *Cajanus cajan* (konsho beanch). Compared to Marampa sites, these have more active farming going on, and locals were seen working in the fields. Palm wine tapping is also a visible and seemingly successful business.

The few remaining forest patches are mostly degraded, and the native trees that have been found are mixed with exotic species like Acacia spp. This may be the result of the few remaining forest patches. The tree stands in the patches of secondary forest containing two tree species: *Melicia regia* and *Terminalia ivorensis*, both of which are IUCN species of conservation concern.

The invasive weed Chromolaena odorata and the grass *Pennisitum purpureum* and *Panicum maximum* predominate in the vegetation along the edges of farmlands and farm bushes, as well as in some specific locations. The Raphia swamp, which borders the site to the northeast, is planted with different crops.

Figure 4- 48: Photos of the landscape and vegetation types at the Maforki Chiefdom

Table 4-28 below also lists the economic trees that were spotted in the proposed concession sites in descending order of significance. The most prevalent and economically successful ones are the mango (*Mangifera indica*), tola (*Beilshmiadia mannii*), and oil palm (*Elaeis guineensis*). The socioeconomic well-being of the locals depends heavily on these crops. Because it is a common ingredient in regional cuisines and has a large market in Sierra Leone, large oil palm plantations are now being established throughout the nation to supply foreign markets. Palm oil is an extract from the fruit of the oil palm's juicy mesocarp. The palm nut can be sold to local businesses for a variety of other uses in addition to being used to make nut oil.

Table 4- 25: List of economic trees in order of importance

Fruit species	Plant Family	Common name	Sites recorded	
			Mara mpa	Mafo rki
Elaeis guineensis	Palmae	Oil palm	X	X
Mangifera indica	Anacardiaceae	Mango	X	X
Citrus sinensis	Rutaceae	Sweet orange	X	X

Ananas comosus	Bromeliaceae	Pineapple	X	X
Cocos nucifera	Palmae	Coconut	X	X
Annona muricata	Annonaceae	Sour sap	X	X
Anacardium occidentale	Anacardiaceae	Cashew	X	X
Musa sapientum	Musaceae	Banana	X	X
Carica papaya	Caricaceae	Pawpaw	X	X
Psidium guajava	Myrtaceae	Guava	X	X
Artocarpus comminis	Moraceae	Bread fruit	X	X
Spondias cythera	Anacardiaceae	Chuk chuk plum	X	X
Termarindus indica	Fabaceae	Tombi	X	X
Persea americana	Lauraceae	Piya	X	X
Beilshmiedia mannii	Lauraceae	Tola	X	X
Saccharum offficinarum	Poaceae	Sugar cane	X	X
Ananas comosus	Bromeliaceae	Pineapple	X	X
Cocos nucifera	Palmae	Coconut	X	X
Annona muricata	Annonaceae	Sour sap	X	X
Anacardium occidentale	Anacardiaceae	Cashew	X	X
Musa sapientum	Musaceae	Banana	X	X
Carica papaya	Caricaceae	Pawpaw	X	X
Psidium guajava	Myrtaceae	Guava	X	X
Artocarpus comminis	Moraceae	Bread fruit	X	X
Spondias cythera	Anacardiaceae	Chuk chuk plum	X	X
Termarindus indica	Fabaceae	Tombi	X	X
Persea americana	Lauraceae	Piya	X	X
Beilshmiedia mannii	Lauraceae	Tola	X	X
Saccharum offficinarum	Poaceae	Sugar cane	X	X

The most frequent fruit tree found at the Marampa and Maforki sites, respectively, is the mango Mangifera indica, which is more prevalent in the former. The mango fruit, which comes in varieties and seasonally provides much-needed subsistence income during economically challenging times of the year, is a viable hunger fruit. Mangos come in up to five different varieties, all of which are edible, juicy, and sweet when ripe. Mango fruits, according to locals, begin to appear at the beginning of the rainy season (April to June), which also marks the beginning of the farming season, when there is not much food available for the household. Mongos supplement the limited food and income that are available, and they help support farming to some extent. The complete list of plant species by coordinates is provided in the annexe of this report.

4.17.10 Mammals, Reptiles and Amphibians

4.17.10.1 Mammals

The diversity and distribution of fauna were determined from the data and observations based on the state and distribution of the vegetation in the study areas.

However, compared to the typical viable habitat for wildlife in the nation, the density and diversity of these taxa were quite low due to the degraded state of the vegetation and likely pressure on the megafauna (birds and mammals). Small mammals (ungulates) are commonly trapped in areas with no legal protection. However, given the state of the vegetation, it is anticipated that the likelihood of encountering mammals or birds in these areas will be extremely low.

Both areas have been subjected to years of logging, clearing, and habitat degradation to the point where the habitats are unable to support species with specific habitat needs, especially those listed in Table 4-29 for which comments have been made regarding their presence in the area.

Table 4- 26: Mammalian species recorded for proposed mine extension sites during the survey

Common Name	Scientific Name	IUCN status	Marampa	Maforki
Spot-nosed monkey	*Cercopithecus petaurista*	LC	X	X
Maxwell's Duiker	*Cephalophus maxwelli*	LC	X	X
Royal Antelope	*Neotragus pygmaeus*	NT	X	X
Tree Pangolin	*Manis tricuspis*	VU	X	X
Marsh Cane-rat	*Thryonomys swinderianus*	LC	X	X
White-Toothed Shrews	*Crocidurinae*	LC	X	X
African Civet	*Civettictis civetta*	LC	X	X
Unstriped ground Squirrel	*Xerus rutilus*	LC	X	X
Fire-foot rope squirrel	*Funisciurus pyrropus*	LC	X	X
Striped Ground Squirrel	*Euxerus erythropus*	LC	X	X
African Giant Squirrel	*Protoxerus stangeri*	LC	X	X
Brush-tailed porcupine	*Atherurus africanus*	LC	X	X
Crested Porcupine	*Hystrix cristata*	LC	X	X
Common Cussimanse	*Crossarchus obscurus*	LC	X	X
Thomas Galago	*Galagoides thomasi*	LC	X	X
Bush Pig	*Potamochoerus larvatus*	LC	x	
Bush Buck	*Tragelaphus scriptus*	LC	X	X
Slender Mongoose	*Herpestes sanguinea*	LC	X	X
Common Gannet	*Genetta genetta*	LC	X	X

Only a small number of species were observed or reported to exist by locals because there was little mammalian diversity in all of these areas. Only five mammals were found at the Mathukie site under study; these included the Mazwell Duiker *Cephalopus maxwelli,* Stripped Ground Squirrel *Euxerus erythropus*, Fire-footed Rope Squirrel

Funisciurus pyrropus, Marsh Cane Rat *Thryonomys swinderianus*, and bush pig *Potamochoerus larvatus*. A patch of forest outside the area enclosing the core mining site was reported to be home to Green Monkeys (*Chlorocebus sabaeus*) and Spot-nosed Monkeys (*Cercopithecus petuarista*) by respondents from the local communities. Farmers have reported spotting green monkeys and spot-nosed monkeys on occasion within the Marampa chiefdom sites, which are home to more mammal species than those found in Maforki chiefdom. The Marsh Cane Rat, a widespread but elusive ungulate, is thought to be a pest to most crops but is prized by locals as a delicacy because it is trapped to lessen crop losses brought on by pests and also provides desirable bush meat. The Tree Pangolin *Manis tricuspis*, which is listed as vulnerable by the IUCN (2022), is rare in both chiefdoms, according to local respondents, but none of them could recall the last time the species was sighted. Mammalian diversity and distribution are generally very low in both locations, which may be explained by historical pressure from human activities like habitat destruction and hunting.

4.17.10.2 Reptiles

According to (Teleki and Baldwin, 1981; Zug,1987), the IUCN website (2012), and the Reptile Database website (2012), Sierra Leone is home to at least 115 different species of reptiles. Like mammals and birds, many of these reptile species are primarily found in eastern Sierra Leone's protected Guinean rainforest habitat. The status of the forest and general environment, in this part, does not support the high diversity of reptile species. Table 4-30 provides a list of reptiles reported by indigenes based on photographic records and previous Marampa ESHIA studies.

*Table 4- 27: **List of reptile species recorded in the Marampa Chiefdom***

Habitat	Marampa Chiefdom	Maforki Chiefdom
Snakes	West African Green Mamba (*Dendroaspis viridis*), Emerald, Green Snake (*Hapsidophrys smaragdina*), Hissing Sand Snake (*Psammophis sibilans*), and *Lycophidium albomaculatum*	West African Green Mamba (*Dendroaspis viridis*), Hissing Sand Snake (*Psammophis sibilans*), and *Lycophidium albomaculatum*
Lizards	Senegal Chameleon (*Chamaeleo senegalensis*), Red-headed Agama (Agama agama), Skinks (*Trachylepis sp.*), Tropical House Gecko (*Hemidactylus mabouia*)	Red-headed Agama (Agama agama), Skinks (*Trachylepis sp.*), Tropical House Gecko (*Hemidactylus mabouia*)
Turtle	Nile Soft–shelled Turtle (*Trionyx triunguis*)-reported	Not reported

4.17.10.3 Amphibians

Up to 60 frog species have been identified in Sierra Leone, according to a compilation of sources (Zug, 1987; Wake, 2012). Many of these frogs have been observed in eastern Sierra Leone's rainforest habitats, just like the other vertebrate groups. A relatively low diversity of frog species was noted in the Marampa Mine concession area, where habitat conditions are largely altered.

Table 4- 28: List of Amphibians recorded in the Marampa and Maforki Chiefdom

Habitat	Marampa Chiefdom	Maforki Chiefdom
Frogs	Brown-backed Tree Frog (*Leptopelis viridis),* Unidentified Squeaker (Arthroleptis sp.), Crowned Bullfrog (*Hoplobatrachus occipitalis*), Galam White-lipped Frog (Hylarana galamensis), Grass Frog (Ptychadena sp.)	Reed Frog (Hyperolius sp.), Brown-backed Tree Frog (*Leptopelis viridis),* Crowned Bullfrog (*Hoplobatrachus occipitalis*), Galam White-lipped Frog (Hylarana galamensis)
Toads	Guttural Toad (*Amietophrynus gutturalis*), Flat- backed Toads (*Amietophrynus maculatus),* Unidentified Toad (Amietophrynus sp.)	Guttural Toad (*Amietophrynus gutturalis*), Flat- backed Toads (*Amietophrynus maculatus)*

4.17.10.4 Lepidoptera: Butterflies

A total of 78 species of butterflies were found during the survey, which included members of the Nymphalidae, Pieridae, Papillionidae, Hesperidae, and Lycaenidae families. The three butterfly genera with the greatest diversity found during this study were *Acraea spp (n* = 10), *Euphaedra* (n = 8), and *Bicyclus* (n= 7). *Euphaedra* are forest butterflies, and they were only found in gallery forest patches and sacred groves close to visited settlements. 10% of all the butterflies surveyed, or 58 individuals, belonged to the species *Papilio demodocus* (Table 4-32), *Danaus chrysippus* and *Junonia oenone* came next. About 80% of the other butterfly species, aside from these two, are found in low densities.

Table 4- 29: Butterflies encountered and their relative abundance.

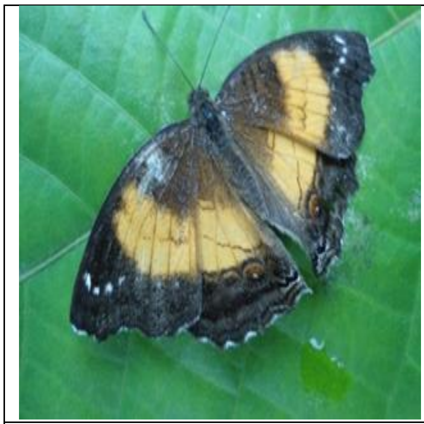
No.	Species Caught	Relative Abundance	Family	Marampa	Maforki	IUCN Status
1.	Acraea pharsalus	10	NYMPHALIDAE	X	X	LC
2.	Acraea caecilia	7	ʺ		X	LC
3.	Acraea serena	19	ʺ	X		LC
4.	Acraea perenna	4	ʺ	X	X	LC
5.	Acraea epaea	7	ʺ	X	X	LC
6.	Acraea abdera	6	ʺ		X	LC
7.	Acraea quirina	10	ʺ	X		LC
8.	Acraea lycoa	1	ʺ		X	LC

9.	Acraea rogersi	3	"		X	LC
10	Acraea vestalis	5	"	X	X	LC
11	Amauris hecate	10	"	X	X	LC
12	Amauris damocles	10	"	X	X	LC
13	Amauris niavius	5	"	X	X	LC
14	Aterica galene	16	"	X	X	LC
15	Pseudopontia paradoxa	9	PIERIDAE			LC
16	Eurema brigitta	19	"	X	X	LC
17	Eurema senegalensis	12	"	X	X	LC
18	Eurema hecabe	10	"	X	X	LC
19	Paracleros placidus	3	HESPERIDAE		X	LC
20	Epitolina dispar	2	LYCAENIDAE		X	LC
21	Liptena xanthostola	5	"	X	X	LC
22	Dendorix antalus	2	"		X	LC
23	Charaxes boueti	1	NYMPHALIDAE	X		LC
24	Charaxes cator	2	"	X		LC
25	Charaxes lycurgus	2	"		X	LC
26	Catopsilla florella	17	PIERIDAE	X	X	LC
27	Coeliades pisistratus	10	HESPERIDAE	X	X	LC
28	Neptis alta	16	NYMPHALIDAE		X	LC
29	Neptis nicoteles	5	"		X	LC
30	Neptis nemetes	10	"	X	X	LC
31	Neptis serena	3	"		X	LC
32	Colotis danae	6	PIERIDAE	X	X	LC
33	Colotis hetaera	2	"		X	LC
34	Citroniphila similis	12	LYCAENIDAE		X	LC
35	Pseudacraea eurytus	5	NYMPHALIDAE	X	X	LC
36	Precis pelarga	21	"	X	X	LC
37	Hamamunida daedalus	18	"	X	X	LC
38	Hypolycaena hatita	2	LYCAENIDAE	X	X	LC
39	Melanitis libya	11	NYMPHALIDAE	X	X	LC
40	Melanitis leda	9	"	X	X	LC
41	Nepheronia pharis pharis	12	PIERIDAE	X		LC

42	Belenois calypso	6	"	X	X	LC
43	Nepheronia argia	2	"	X	X	LC
44	Leptosia alcesta	4	"	X	X	LC
45	Hypolimnas missipus	36	NYMPHALIDAE	x	X	LC
46	Bebearia tentyris	2	"		X	LC
47	Bicyclus funestris	10	"	X		LC
48	Bicyclus mylyas	2	"	X	X	LC
49	Bicyclus sandace	10	"		X	LC
50	Bicyclus sofitza	4	"	X	X	LC
51	Bicyclus technatis	2	"		X	LC
52	Bicyclus evadne	2	"		X	LC
53	Bicyclus dorothea	7	"		X	LC
54	Papilio demodocus	58	PAPILIONIDAE	X	X	LC
55	Papilio dardanus	17	"	X	X	LC
56	Papilio phorcas	25	"	X		LC
57	Papilio nireus	12	"	X	X	LC
58	Gnophodes betsimena	10	NYMPHALIDAE		X	LC
59	Palia decius	2	"	X	X	LC
60	Graphium angolanus	10	PAPILIONIDAE	X		LC
61	Graphium leonidas	8	"	X	X	LC
62	Danaus chrysippus	45	NYMPHALIDAE	X	X	LC
63	Euphaedra janetta	2	"		X	LC
64	Hypolimnas salmacis	7	"	X		LC
65	Euphaedra medon	8	"		X	LC
66	Euphaedra harpalyce	2	"	X	x	LC
67	Protogoniomorpha parhassus	1	"	X	X	LC
68	Euphaedra hastiri	2	"		X	LC
69	Euphaedra themis	17	"	X	X	LC
70	Charaxes obudoensis	11	"		X	LC
71	Euriphene tadema	2	"	X		LC
72	Junonia oenone	26	"	X	X	LC
73	Jumonia terea terea	22	"	X	X	LC
74	Junonia sophia	7	"		X	LC
75	Ypthmic doleta	2	"		X	LC
76	Phalantha phalanta	21	"	X	X	LC
77	Phalanta eurytis	2	"	X		LC

78	Lachnoptera anticlia	2	″		x	LC

Table 4- 30:Table 0.35 Examples of butterflies recorded in this study.

		
Soldier Pansy Butterfly (Junonia terea)	***Forest Glade Nymph Butterfly (Aterica galena),***	***Common Evening Brown Butterfly- Bicyclus leda***

4.17.11 IMPACT ASSESSMENT

Iron ore mining operations are a crucial component of societal development. However, if the activities aren't properly mitigated, biodiversity is seriously and very specifically threatened.

Issues

The land surface is primarily disturbed, removed, or redistributed during mining operations, with both short- and long-term effects. Wildlife species, along with sedentary species like invertebrates, reptiles, burrowing rodents, and small mammals, are destroyed or dispersed during the excavation or mine spoil piling. Aquatic assemblages disappear and water quality deteriorates.

It alters the wildlife's migratory patterns by making it difficult or impossible for native species to spread from one patch to another. Habitat fragmentation causes most of the extinction of species that need large forest patches. The health of ecosystems, which include disturbed soil, vegetation, and fauna, is also impacted by biological factors.

Impact Significance

The severity of the effect (importance), reliance on the presence of receptors of high national or international conservation concerns (protected areas), disruption to the general environment, and harm to human wellbeing.

4.17.11.1 Scoring of Impact Significance

Table 4- 31: Importance

	Importance/Value

Size and Severity	Low or Local	Medium or Regional	High or National/International
High	2	3	4
Medium	1	2	3
Low	0	1	2

Table 4- 32: Sensitivity

Size and Severity	Sensitivity		
	Low	Medium	High
High	1	3	4
Medium	1	2	3
Low	0	1	2

Table 4- 33: Timeframe

Size and Severity	Timeframe		
	Short	Medium	Long
High	2	3	4
Medium	1	2	3
Low	0	1	2

Table 4- 34: Reversibility

Size and Severity	Reversibility	
	Reversible	Irreversible
High	**2**	**4**
Medium	1	2
Low	0	1

Table 4- 35: Levels of Significance

Impact Category	Score
Slight	0
Minor	1 - 4
Minor/Moderate	5 - 6
Moderate	7 - 8
Moderate/Major	9 - 10

Major	11 - 16

4.17.12 Impact Statements and Mitigation

Table 4- 36: Project Construction Impact and Mitigations

Environmental Aspect	Impacts	Importance	Sensitivity	Timeframe	Reversibility	Level of Significance
Land Clearance	- Loss of biodiversity and sensitive habitat - Loss of biodiversity and habitat - Change in species richness and Abundance habitat loss /disturbance/fragmentation	0 (Local)	0(none)	0 (Low)	0 (reversible)	0 (Slight)
Blasting and Earth Movement	- Loss of biodiversity and sensitive habitat - Loss of biodiversity and habitat - Change in species richness and Abundance habitat loss /disturbance/fragmentation	0 (Local)	0(none)	0 (Low)	0(reversible)	0 (Slight)
Changes in drainage Pattern	- Loss of biodiversity and sensitive habitat	0(Local)	0(none)	0 (Low)	0 (reversible)	0 (Slight)
Water Pollution	Increased sedimentation because of sediment mobilisation during construction and operation and/or	0(Local)	0(none)	0 (Low)	0 (reversible)	0 (slight)

	changes					

Mitigation Measures

Collectively, the design stages are the decision-making stages of every project. Properly planned and designed projects are sustainable and carry low impacts. No potential environmental and social impacts were identified at this stage. The need for a monitoring program, however, is essential.

Residual Impact Assessment				
Importance	Severity	Importance	Severity	Level of Significance
0 (Local)	0 (Low)			0(Sight)

4.17.12.1 Proposed Project Construction Phase

Table 4- 37: Project Construction Impact and Mitigations

Environmental Aspect	Impacts	Important	Sensitivity	Timeframe	Reversibility	Level of Significance
Land Clearance	- Loss of biodiversity and sensitive habitat - Loss of biodiversity and habitat - Change in species richness and Abundance habitat loss /disturbance/fragmentation	2 (Local)	2(medium)	3 (Long Term)	2 (Irreversible)	**5-6 (Minor/Moderate)**

Blasting and Earth Movement	- Loss of biodiversity and sensitive habitat - Loss of biodiversity and habitat - Change in species richness and Abundance habitat loss /disturbance/fragmentation	2 (Local)	2(medium)	3 (Long Term)	2 (Irreversible)	**5-6 (Minor/Moderate)**
Changes in drainage Pattern	- Loss of biodiversity and sensitive habitat	2 (Local)	2(medium)	3 (Long Term)	2 (Irreversible)	**5-6 (Minor/Moderate)**
Water Pollution	Increased sedimentation because of sediment mobilisation during construction and operation and/or changes	2 (Local)	2(medium)	3 (Long Term)	2 (Irreversible)	**9-10 (Moderate- Major)**

Mitigation Measures

a. Minimize the footprint of planned disturbances through advanced planning.
b. Plans must indicate the maximum acceptable footprint of each activity, which includes material laydown areas, vehicle turning areas, parking, temporary toilet facilities, overburden piles and drainage, etc.

c. These boundaries must be marked on the ground at the start of each activity and staff and contractors must be instructed to respect these boundaries and to restrict their activities within these boundaries. d. Develop and implement a land-clearing procedure that includes an assessment of alternatives before clearing land. e. Protection of trees or thickets that can act as buffers, wildlife refuges and seed sources for later rehabilitation. f. Stockpiling and management of topsoil and vegetative matter. Identify suitable soil types that can substitute for topsoil to make up for the shortfall from previous operations, i.e., laterite. g. No burning of vegetated areas or vegetative matter. h. Cultivate indigenous species for purposes of site rehabilitation. This is to be done by starting a small nursery managed by the environmental department which will be scaled up to meet demand. i. Implement measures to enforce the protection of wildlife by prohibiting harmful activities, including hunting, fishing, purchase sale or transport of bush meat or any wildlife products, collection of animal or animal products, keeping of wild or domestic pets or the intentional killing of creatures such as snakes, lizards, birds or other animals. j. Relocation of problem animals and animals at risk from active mine sites. k. Avoid dangerous situations for fauna such as open trenches and pits. l. Training and sensitization of drivers to avoid unnecessary road kill. m. Minimize non-haul road night driving wherever possible. n. Raise staff and contractor awareness of the local ecology, including biodiversity and sensitive habitats, and the need to protect them by inclusion into induction programs and sensitization activities. o. Support environmental programs to protect biodiversity/critical habitats in Sierra Leone as an offset for impacts to project areas p. Clearing of vegetation for new land takes focus on the dry season as far as practicable when the least amount of birds nesting occurs. q. Implementation of erosion, runoff and sediment control measures during operations to greatly limit the number of materials eroded into surface water bodies r. Provision for containment of fuel spills and wastewater in areas closer to wetlands s. Ensure proper and efficient water quality monitoring operations. t. Appropriate disposal of tailings, probably in bunds of a high thickness (preferably 3m thick) to prevent bund failure
Residual Impact Assessment
Important
1 (Local

4.17.13 Proposed Project Operation Phase

Table 4- 38: Project operation impact and Mitigations

Environmental Aspect	Impacts	Important	Sensitivity	Timeframe	Reversibility	Level of Significance

Land Clearance	- Loss of biodiversity and sensitive habitat - Loss of biodiversity and habitat - Change in species richness and Abundance habitat	2 (Local)	2(medium)	3 (Long Term)	2 (Irreversible)	5-6 (Minor/Moderate)
	loss /disturbance/fragmentation					
Blasting and Earth Movement	- Loss of biodiversity and sensitive habitat - Loss of biodiversity and habitat - Change in species richness and Abundance habitat loss /disturbance/fragmentation	2 (Local)	2 (medium)	3 (Long Term)	2 (Irreversible)	5-6 (Minor/Moderate)
Changes in drainage Pattern	- Loss of biodiversity and sensitive habitat	2 (Local)	2(medium)	3(Long Term)	2 (Irreversible)	5-6 (Minor/Moderate)
Water Pollution	Increased sedimentation because of sediment mobilisation during construction and operation and/or changes	2 (Local)	2(medium)	3(Long Term)	2 (Irreversible)	9-10 (Moderate-Major)

Mitigation Measures

a. Minimize the footprint of planned disturbances through advanced planning.
b. Plans must indicate the maximum acceptable footprint of each activity, which includes material laydown areas, vehicle turning areas, parking, temporary toilet facilities, overburden piles and drainage, etc.
c. These boundaries must be marked on the ground at the start of each activity and staff and contractors must be instructed to respect these boundaries and to restrict their activities within these boundaries.
d. Develop and implement a land-clearing procedure that includes an assessment of alternatives before clearing land.
e. Protection of trees or thickets that can act as buffers, wildlife refuges and seed sources for later rehabilitation.
f. Stockpiling and management of topsoil and vegetative matter. Identify suitable soil types that can substitute for topsoil to make up for the shortfall from previous operations, i.e., laterite.
g. No burning of vegetated areas or vegetative matter.
h. Cultivate indigenous species for purposes of site rehabilitation. This is to be done by starting a small nursery managed by the environmental department which will be scaled up to meet demand.
i. Implement measures to enforce the protection of wildlife by prohibiting harmful activities, including hunting, fishing, purchase sale or transport of bush meat or any wildlife products, collection of animal or animal products, keeping of wild or domestic pets or the intentional killing of creatures such as snakes, lizards, birds or other animals.
j. Relocation of problem animals and animals at risk from active mine sites.
k. Avoid dangerous situations for fauna such as open trenches and pits.
l. Training and sensitisation of drivers to avoid unnecessary road kill.
m. Minimize non-haul road night driving wherever possible.
n. Raise staff and contractor awareness of the local ecology, including biodiversity and sensitive habitats, and the need to protect them by inclusion into induction programs and sensitization activities.
o. Support environmental programs to protect biodiversity/critical habitats in Sierra Leone as an offset for impacts to project areas.
p. Clearing of vegetation for new land take to be focussed on the dry season as far as practicable when the least amount of birds nesting occurs.
q. Implementation of erosion, runoff and sediment control measures during operations to greatly limit the amount of materials eroded into surface water bodies
r. Provision for containment of fuel spills and wastewater in areas closer to wetlands
s. Ensure proper and efficient water quality monitoring operations.
t. Appropriate disposal of tailings, probably in bunds of a high thickness (preferably 3m thick) to prevent bund failure

Residual Impact Assessment

Importan t	Severity	Important	Severity	Level of Significance
1 (Local	medium			7 – 8 (Moderate)

4.18 AIR QUALITY

Introduction

The Air Quality baseline describes the background concentration of air quality in the project footprint. In general, meteorological conditions, particularly particulate matter, have a significant impact on air quality in Sierra Leone (dust). Unsealed roads, slash- and-burn agriculture, and forest degradation all contribute to poor air quality during the dry season in much of rural Sierra Leone, including the project areas. The environment is dry during the dry season, with low humidity and high evaporation, which helps mechanical dust formation. This is most noticeable during the Harmattan Period of the dry season (December to February) when dust-laden trade winds pass over the West African Area. During the rainy season, however, high humidity and rainfall levels restrict dust formation. Unlike most of Sierra Leone, there is enough air quality baseline information for the project footprint; Mine, Haul Road and Thorfayim River Terminal Environs, particularly; Particulate Matter P.M 2.5 & 10, Nitrogen dioxide (NO_2) & Sulphur dioxide (SO_2).

Air quality monitoring has been undertaken by Environmental Resource Management (ERM) Consultancy, United Kingdom in the vicinity of the previously licensed concession (ML01/2017-ML02/2009) to the London Mining Company in November 2011 using a Dust Track monitor. Similarly, baseline air quality information captured by SRK, UK in 2011, is available for six monitoring locations in the previously licenced concession (ML05 2014) to Cape Lambert. Furthermore, a 10-month baseline monitoring survey was also commissioned in April 2012 by ERM, UK to measure $PM_{2.5}$, PM_{10}, SO_2, NO_2 and dust deposition in the ML01/2017-ML02/2009 concession, Haul Road, Thorfayim River Terminal, Port Loko Creek and Freetown Queen Elizabeth II docks. The results of PM10 and PM2.5 concentrations in all monitoring locations carried out by SRK, UK 2011 and ERM, UK 2012) coincided with the dry season, during which Particular Matter (PM) concentrations in Sierra Leone could be relatively higher than the WHO guideline values, due to the prevailing environmental conditions (e.g., dust-laden Harmattan winds and unpaved road surfaces) and anthropogenic activities.

The high $PM_{2.5}$ concentrations indicate that sensitive human receptors within the study area may be at risk of respiratory diseases as the WHO guideline on air quality was exceeded. In the case of NO_2 and SO_2 concentrations, the reported value was lower than the International Finance Cooperation (IFC) average limit across all monitoring sites.

The air quality monitoring was intended to determine the average concentrations of pollutants in the selected area.

4.18.1 Methodology

Air quality monitoring was undertaken in the mine area, haul road and the Thorfayim River Terminal (TRT) using two monitoring equipment: Aeroqual Series 500 sensor to monitor PM 2.5, PM 10, SO_2 and NO_2; and Indoor/Outdoor Digital Tester and Annmeter AN 5800 D Air Quality Monitor Laser, which detects PM 2.5, PM 10, Formaldehyde (HCHO), and Total airborne Volatile Organic Compounds (TVOC)

Aeroqual Series 500 sensor air quality monitor has logging capability and is suitable for accurate fixed real-time surveying of common outdoor air pollutants. The sensors are held within an interchangeable cartridge ("head") that attaches to the monitor base which can be removed and replaced in seconds, allowing users to measure as many gases as desired. Aeroqual Series 500 sensor equipment was mounted at a height of 1.5 meters from the ground level and sufficiently away from the disturbance or direct obstacle from the source(s) under consideration to ensure that the air that was monitored is representative of the air in the monitoring location. In each monitoring location, the Aeroqual Series 500 sensor was used to capture air quality data for eight (8) hours.

Indoor/outdoor Digital Tester and Annmeter AN 5800 D Air Quality Monitor Laser, on the other hand, was employed in selected project-affected villages in the mine area, haul road and port area. In real-time mode, PM 2.5, PM 10, HCHO and TVOC measurements show at the same time, after the 30s defaulting measure time.

Table 4- 39: Air Quality Standards for PM10 and PM2.5

Guideline	Standard Values, µg/m³	
	PM10	PM2.5
WHO	45 (24-hourly Average) 15 (Annual Average Concentration)	15 (24-hourly Average) 5 (Annual Average Concentration)

Table 4- 40: Air Quality Standards for SO2

Guideline	Standard Values, µg/m³
WHO	40 (24-hourly Average)

Table 4- 41: Air Quality Standards for NO2

Guideline	Standard Values, µg/m³
WHO	25 (Annual Average)

4.19 Noise

Introduction

Noise surveys were carried out in March 2011 by SRK, UK in the vicinity of a previously licensed concession (ML05 2014) to Cape Lambert, to determine background noise levels and evaluate the potential impacts of the Project. The main existing noise sources then are, traffic through Lunsar and the surrounding areas, and community noise (in the villages). The results obtained were based on hourly measurements that revealed that the IFC nighttime noise guidance level was exceeded at all locations, and the daytime level was exceeded in Makomp and Rogbesseh. The difference in day and night noise levels appears to be negligible.

Also, long- and short-term noise monitoring survey was undertaken by ERM, UK in the adjacent concession (ML01/2017-ML02/2009) previously licensed to London Mining Company whilst its Phase 1 (i.e., plant construction, recovery and processing of tailings) of the Marampa mine project was in operation in February and October 2012. The monitoring was designed to identify any existing noise impacts, quantify mine, and determine the noise baseline prior to the re-commencement of mining at the site – that is, the baseline from which impacts will be determined. The results revealed background noise levels are higher at locations closer to the mine.

Furthermore, ERM, UK conducted short-term noise measurements in 2012 at selected villages near the product haul route, the Thofayim area, the barging route, and Freetown Queen Elizabeth II docks (Transhipment) which are considered noise-sensitive receptors. The results revealed that daytime and nighttime average noise level is within the WB/IFC noise limit.

To determine the baseline noise levels, noise measurements were undertaken in August 2022 in selected locations in both previously licenced concessions currently licenced to Marampa Mines Limited. Mining operations were ongoing in the project operational area during the baseline noise survey.

To determine the baseline noise levels, noise measurements were undertaken in August 2022 in selected locations in both previously licenced concessions currently licenced to Marampa Mines Limited. Mining operations were ongoing in the project operational area during the baseline noise survey.

4.19.1 Methodology

To establish the ambient noise level in the project footprint, a noise assessment was conducted in August 2022 using two noise monitoring equipment: Casella 633A (Class A noise meter) and ET-953 Noise Sound Level meter. The assessment was carried out using Casella 633A, in nine (9) locations; the core mine operating area, a settlement near the product haul route, and Thorfayim River Terminal deemed critical in establishing baseline data for the project. Furthermore, the ET-953 Noise Sound Level meter was utilised to measure noise at twenty-seven (27) places in selected communities identified as noise-sensitive receptors.

Table 5.53 and Table 5.54 present the noise monitoring locations using Casella 633A (which are the same locations used for air quality monitoring with the Aeroqual sensor), and the ET-953 Noise Sound Level meter respectively.

Table 4- 42: Noise monitoring locations using Casella 633A (Class A noise meter)

	ID	Monitoring Location
Core Mine Facilities	WT	Water treatment plant
	FF	Fuel farm by CRSG
	PP	Processing plant
	CP	Admin car park
	LA	Laboratory
	HRM	Haul Road to the Mine
	MP	Mine pit
Haul Road	HRG	Haul Road by Gberay Junction

Port	TRT	Thorfayim River Terminal (TRT) by the barge Loading area

*Table 4- 43: **Noise monitoring Locations using the ET-953 Noise Sound Level meter***

	ID	Monitoring Area
Mine Area	LBC-01	Labour Compound
	LBC-02	Labour Compound
	KOL-01	Kontha Lol
	LBC-03	Labour Compound
	ROG-01	Rogbaneh
	MOR-01	Moria
	KAT-01	Katick
	KAT-02	Katick
	GBL-01	Gbom Limba
	GBL-02	Gbom Limba
	MGB-01	Magbirie
	CCB-01	Concentration Boundary
	MAF-01	Maforki
	MAF-02	Maforki
	MAB-01	Magbanthie
	RAB-01	Robayllah
	MAT-01	Mathukia
	CHA-01	Chaindata
	KOB-01	Konta Bana
	ROM-01	Romangro
	MAN-01	Manonkoh
	ROB-01	Robaka
	ROB-02	Robaka
	MUM-01	Mathumu
Haul Road	MAW-01	Maworko
	MAP-01	Mawpon
Port	THO-01	Thofayeim

A Casella 633A (Class A noise meter), a Class 1 integrating averaging type capable of simultaneous measurement with recording capabilities, was employed at each of the nine(9) sites. The device was programmed to log 5-minute averages of the following A- weighted broadband statistical noise descriptors for a monitoring duration of 1 hour for each log and was installed on tripods at a height of 1.5 m. The noise survey took an average of 8 hours at each measurement point. Measurements were taken at a monitoring site continuously during the monitoring period.

The Casella 633A (Class A noise meter) Sound Level Meter equipment was set to log the following A-weighted broadband statistical noise descriptors at each measurement location every 5 minutes during the measurement:

- LAeq (Ambient Noise Level) - The Ambient Noise level is the background sound pressure at any given measurement location and it is used to study a new intrusive sound source. It's measured to map sound conditions over a spatial regime to understand their variation with locale.
- LAFmax (Maximum noise levels, fast time response) - This shows the highest sound pressure level within the measurement period. It's measured to ascertain the maximum sound level attained during any given measurement.
- LAFmin (Minimum noise levels, fast time response) - This shows the lowest sound pressure level within the measurement period. It's measured to ascertain the minimum sound level attained during any given measurement. The ET-953 Noise Sound Level meter was used in the twenty-seven (27) selected places to automatically measure noise levels without logging.

Table 4- 44: WB / IFC EHS Guideline - Noise Level Guidelines

Receptor		Noise Level - One Hour $LA_{eq,}$ dB(A)	
		Daytime (07:00– 22:00)	Nigh-time (22:00-07:00)
(a)	Residential; institutional; educational	55	45
(b)	Industrial; Commercial	70	70

4.19.1.1 Baseline Noise

Mining operations were ongoing during the baseline noise monitoring survey. The monitoring was designed to identify any existing noise impacts, quantify mine noise and determine the noise baseline prior to the re-commencement of mining at the site – that is, the baseline from which impacts will be determined. To determine the noise baseline whilst the mine was operating, noise measurements were conducted at locations where mine noise was not perceptible, and to determine noise levels that are representative of the baseline conditions before mining.

Most of the selected settlement areas considered as noise-sensitive receptors are rural with daytime and night- time background noise in some of the communities' areas predominantly from natural sounds (e.g., rain, wind, birds, insects and amphibians) and noises produced by community activities (e.g., local traffic, trade, work, living, leisure, and the sounds of radios and music being played), intrusion of mine operation noise. Local traffic mainly comprises motorcycles used for private and public transport. Traffic volumes of motorcycles in the villages are generally very low.

Lunsar Township is the biggest town close to the Mining area followed by Rogberry community area. Both communities have high traffic volumes due to the presence of major road linkage.

Table 5.46 and Figure 5.38 depict the daytime noise level is within the IFC limit for industrial/commercial areas. Rogberry Junction recorded a noise level above the IFC limit for a residential area. For Rogberry Junction the high noise is linked to the highway, settlement, and commercial activities.

According to Table 4-55 and Figure 5.39, fourteen (14) monitoring stations recorded daytime noise levels that exceeded the IFC limit for residential areas. The high noise levels in most of these areas are attributable to community noise, as there are no active roadways or industrial establishments.

Table 4- 45: Daytime Noise Monitoring Results using Casella 633A (Class A noise meter)

Monitoring Location	ID	LAe, dB(A)	LAFmax, dB(A)	LAFmin, dB(A)	WB/IFC EHS Noise Level Guidelines Industrial/ Commercial
Water treatment plant	WT	46.7	69.9	37.6	70
Fuel farm by CRSG	FF	54.8	78.9	43.7	70

Processing plant	PP	59.7	82.9	46.9	70
Admin car park	CP	46.5	74.9	39.7	70
Laboratory	LA	41.6	69.9	35.4	70
Haul Road to the Mine	HRM	57.3	87.5	40.7	70
Mine pit	MP	58.9	82.6	45.9	70
Haul Road by Rogberay Junction	HRG	58.1	81.2	41.2	70
Thorfayim River Terminal (TRT) by the barge Loading area	TRT	55.8	79.5	42.1	70

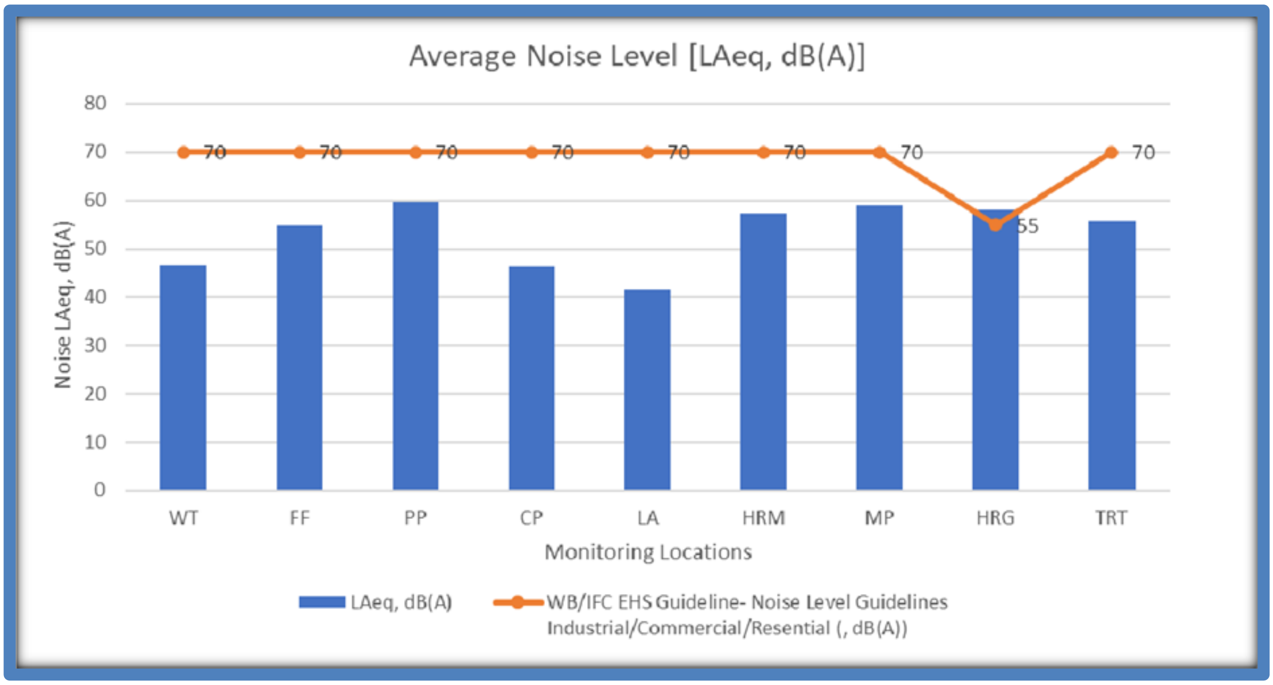


Figure 4- 49: Average Noise Level using Casella 633A (Class A noise meter)

Table 4- 46: Daytime Noise Monitoring Results using Casella 633A ET-953 Noise Sound Level meter

Location	ID	Average Noise Levels (dB)	WB/IFC EHS Guideline - Noise Level Guidelines Residential; institutional; educational
Labour Compound	LBC-01	54.1	55
Labour Compound	LBC-02	43	55
Kontha Lol	KOL-01	50.7	55
Labour Compound	LBC-03	46.6	55
Rogbaneh	ROG-01	59.6	55
Moria	MOR-01	40.8	55
Katick	KAT-01	66.3	55
Katick	KAT-02	64.2	55
Gbom Limba	GBL-01	56.6	55
Gbom Limba	GBL-02	60.1	55
Magbirie	MGB-01	60.9	55
Concentration Boundary	CCB-01	46.5	55
Maforki	MAF-01	53.5	55
Maforki	MAF-02	42.9	55
Magbanthie	MAB-01	47.3	55
Robayllah	RAB-01	67.1	55
Mathukia	MAT-01	47.3	55
Chaindata	CHA-01	70.1	55
Konta Bana	KOB-01	65.1	55
Romangro	ROM-01	44.3	55
Manonkoh	MAN-01	49.8	55
Robaka	ROB-01	58.6	55
Robaka	ROB-02	55.9	55
Thofayeim	THO-01	55.3	55
Maworko	MAW-01	68	55
Mawpon	MAP-01	63.4	55
Mathumu	MUM-01	51.8	55
Chaindata	CHA-01	70.1	55
Konta Bana	KOB-01	65.1	55
Romangro	ROM-01	44.3	55
Manonkoh	MAN-01	49.8	55
Robaka	ROB-01	58.6	55
Robaka	ROB-02	55.9	55
Thofayeim	THO-01	55.3	55
Maworko	MAW-01	68	55
Mawpon	MAP-01	63.4	55
Mathumu	MUM-01	51.8	55

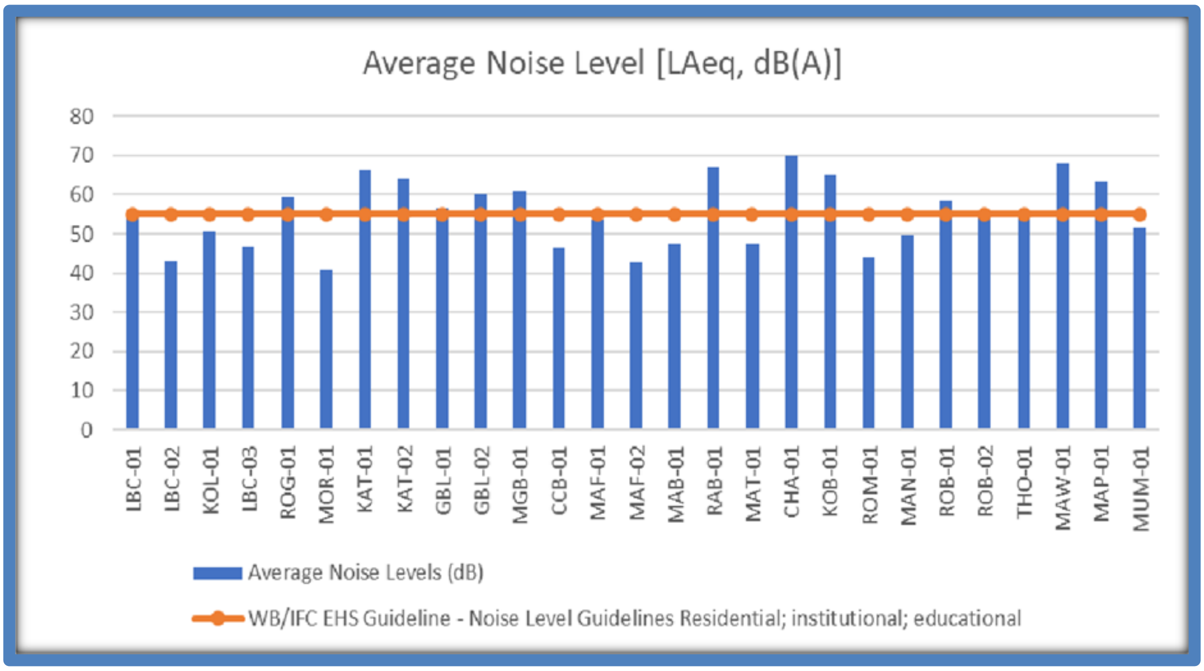


Figure 4- 50: Average Noise Level Casella 633A ET-953 Noise Sound Level meter

Figure 4- 51: Baseline Monitoring at Mathukia Mine Pit

5 SECTION FIVE

5.1 SOCIAL BASELINE: SOCIO-ECONOMICS CONDITIONS

This section focuses on the socio-economic characteristics of inhabitants and communities situated within and around MML's project site in Marampa and Mathukara Chiefdoms, in Port Loko District. This section gives background information on Sierra Leone and the Project area. The perceptions and the living conditions of the people living in the Project-affected communities were also investigated.

5.1.1 Socio-Economic Context of Sierra Leone

In the last decade, Sierra Leone has been ranked at or near the bottom of the Human Development Index (HDI) and in recent years it has moved ten places up. With an average per capita income of US$490 and an economic growth rate of about 6.5% per annum, the human development, and social indicators, including illiteracy, primary school enrolments, life expectancy, maternal deaths, malnutrition, and child mortality rates, are among the worst in the world. The Table below shows the information on the status of national social indicators.

Table 5- 1: Information on National Social Indicators

Key Social Indicators	
Average per capita income	US$490
Economic growth rate	6.5% per annum
Infant mortality rate (IMR)[1]	123/1000 (2009)
Life expectancy at birth	48 years
Adult literacy	30%
Illiteracy rate	70%
Primary school enrolment	1,322,000 (PSRP, 2008)
Gender parity in primary school enrolment for boys and girls	1.1:1

Basic water and sanitation facilities for the majority of Sierra Leoneans are extremely limited due to the limited functional infrastructure for water supply as well as the exponential increase in population in Freetown and provincial cities over the past decade because of the civil conflict (PSRP II, 2008).

About 70% of the population lives in absolute poverty, with expenditures below one US$ a day. The average person's total consumption falls short of the minimum consumption level necessary order not to be poor, by 27.5% of the poverty line. (PRSP II, 2008).

Agriculture is the largest economic sector in the country. Nearly two-thirds of the population depends on it for its livelihood, and it is responsible for almost half of the country's GDP. There has been a steady increase in domestic food production, and it is estimated that the share of households with adequate food consumption has increased from 56% in 2005 to 71% in 2007. With regard to the production of specific crops, the level of rice self-sufficiency in the country increased from 57.4% to 71% between 2002 and 2007 (PRSP II, 2008). However, the living conditions are extremely difficult; and rural villagers struggle to remain at subsistence levels (PRSP II, 2008). Poor health indicators reflect the lack of access among the population to basic services notably - health. Endemic diseases, especially malaria and HIV/AIDS, loom as a threat; in 1997, UNAIDS estimated the HIV prevalence among adults to be 3.2%. In 2002, a national prevalence survey estimated the rate at 5% while the survey in 2010 revealed an increase of 1.5%.

Sanitary conditions are very poor as sewage and refuse disposal systems do not function effectively in most places. Urban living conditions are extremely difficult; and rural villagers struggle to remain at subsistence levels (PRSP II, 2008).

Less than 10% of Sierra Leone's total population has access to electricity, compared to 49% in Ghana, 46% in Nigeria, 96% in North Africa, 73% in Asia, 99% in China and 76% on the global average. Only around 1% of the total rural population in Sierra Leone has access to electricity.

Of the 11,300km of classified roads in the country, 8,148km are classified in the national road system. The remaining roads consist of urban roads, community roads, local roads and farm tracks. Concerning the regional distribution of roads, the Northern Province accounts for 41% of the roads followed by the Southern Province with 33% and the Eastern Province with 23%. The Western Area accounts for only 3% (PRSP II, 2008).

Port Loko District Profile

5.1.1.1 Context

Port Loko District (***Figure 5-1)*** is in the Northern-Western Province and is the fourth most populous district in the country. Port Loko borders the Western Area to the west, Kambia District to the North, Bombali District to the East and Tonkolili District to the South. The 12 chiefdoms of the district are Bureh Kasseh Makonteh (BKM), Buya, Romende, Dibia, Kaffu Bullife of mine, Koya, Lokomasama, Maforki, Marampa, Masimera, Sanda Magbolontor, and Tinkatupa Makonteh Safroko (TMS). Lunsar is the district's largest Town, and other major towns are Masiaka, Rokupr, Lungi, Gbinti and Port Loko town. The population is predominantly Muslim (80%) and the largest ethnic group is Temne. According to the projected population for 2014, the average household size is 7 people per family. ***Table*** 5-2 is a summary fact sheet of the district.

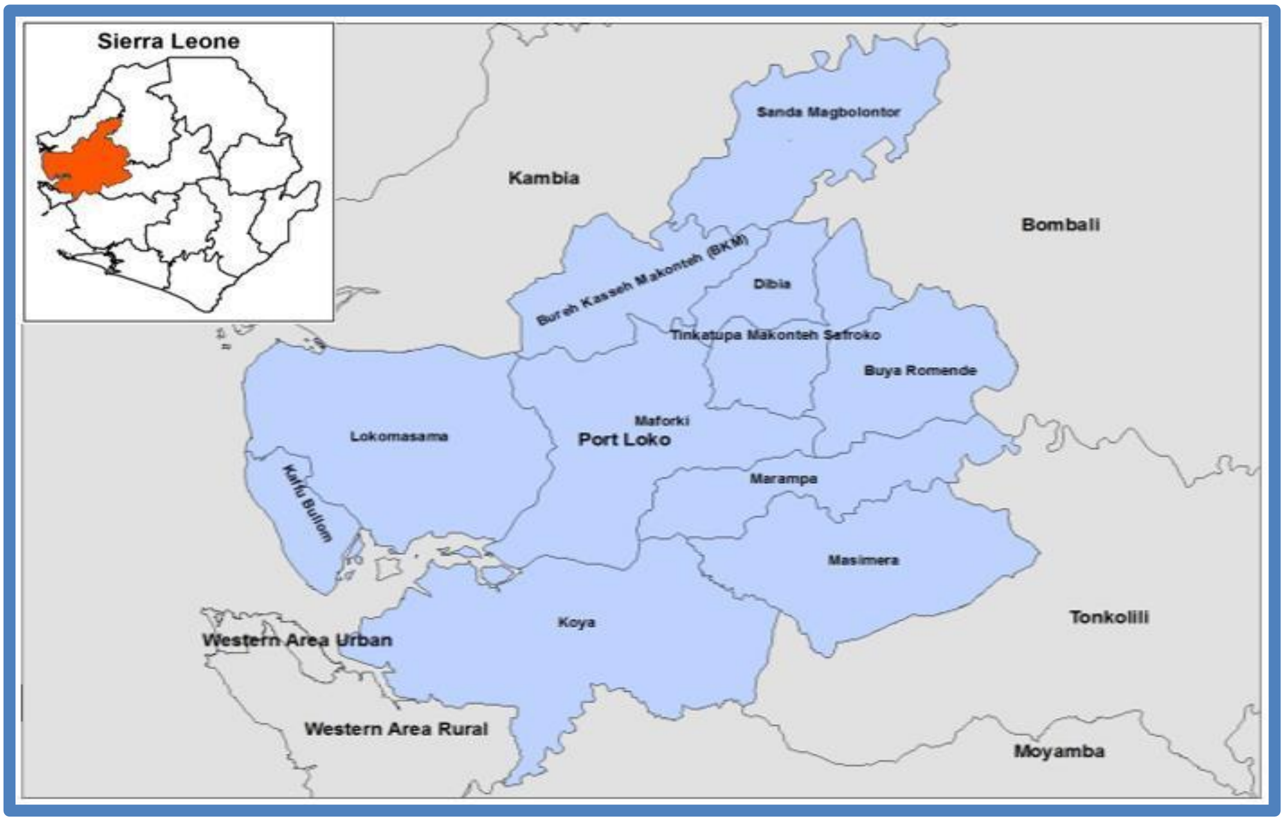


Figure 5- 1: Map showing the location of Port Loko District in Sierra Leone

Table 5- 2: A Summary Factsheet of Port Loko District

Population	557,978
Male	265,298
Female	292,680
Ethnic diversity	Temne
Geographical area	5719 sq. KM (2,208 Sq. miles)
Language	Krio is widely spoken, Susu and Temne are also a popular dialect[3]
District-level poverty rate	60%
Gini coefficient district	0.29%
Net Primary enrollment by district	58%
Total fertility rate (TFR)	5.3
Under 5 mortality rate	202 deaths per 1000 live births
Life expectancy at birth	49 years
Percentage of all basic vaccination	52%
Prevalence of food insecurity	70%
Prevalence of chronic malnutrition	35.2%
Agriculture is the main livelihood	81%
Livelihoods	Agriculture and mining

5.1.1.2 Population distribution

The population distribution by age group and gender (***Table 5-3 and Figures 5-2 and 5-3***) is presented below. Also, the record has it that 49% of the district population is of working age(15-64 years). 29% of the population is children in the 5-11 years age group, according to Population and Household Census 2004, and many of them, particularly in rural areas, are engaged in domestic or other forms of labour/economic activities. According to the projected population statistics[1], some 18% of the district population is below 5 years old. Almost 89%[4] live in the district's rural areas.

Table 5- 3: ***Projected Population by Age and Group for Port Loko District***

Population Group	Under 5	5 to 14	15-64	65+	Total
Male	52257	83397	118389	11255	265298
Female	49720	77272	152672	13016	292680
Total	101977	160669	271061	24271	557978
Percentage Distribution					
Population Group	**Under 5**	**5 to 14**	**15-64**	**65+**	**Total**
Male	9%	15%	21%	2%	**48%**
Female	9%	14%	27%	2%	**52%**
Total	**18%**	**29%**	**49%**	**4%**	**100%**

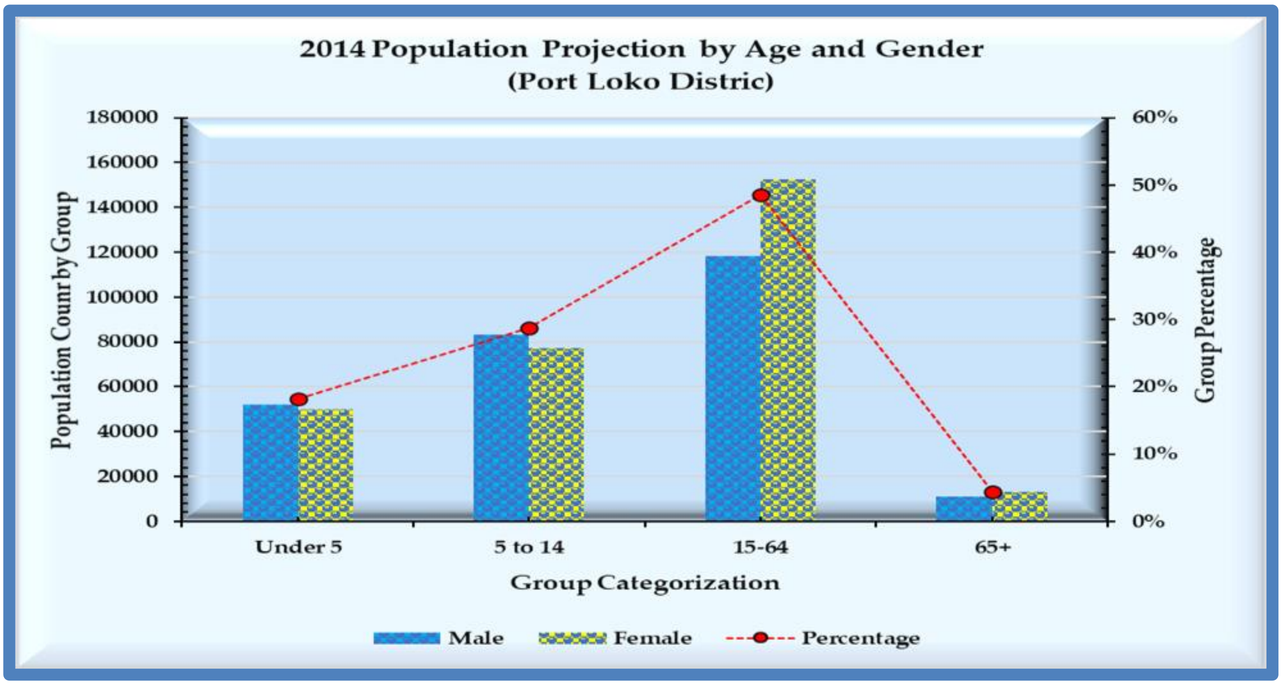


Figure 5- 2: Population Distribution and Characterization by Aged and Gender

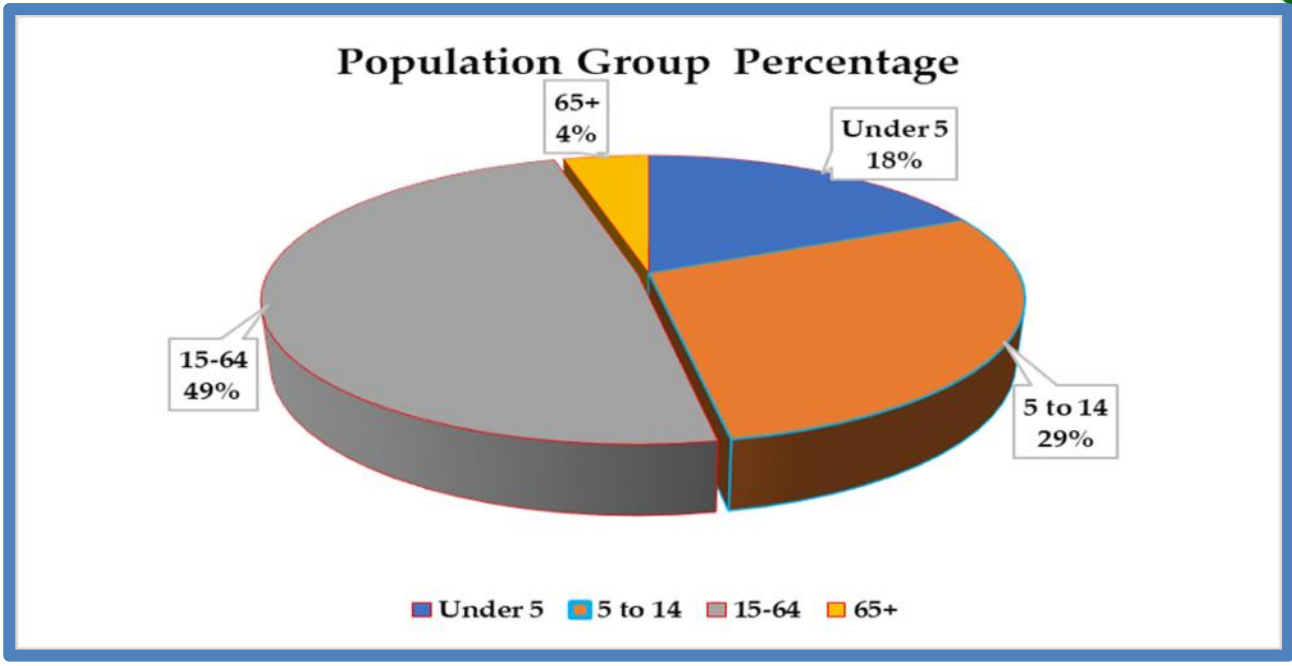


Figure 5- 3: Population Group by Percentage

5.1.1.3 Livelihood and Economy

Production of food crops, such as rice, cassava and sweet potato, are the main livelihood sources for over 80% of the population. Small-scale mining also takes place. The city of Port Loko is a major trade centre in the Northern Province. The areas around Port Loko are known for bauxite mining. The Marampa Mines Ltd, which operates iron-ore mining in Lunsar and Marampa, is a major employer in the area. The global demand for bauxite and iron ore slowed down recently, and this coupled with falling prices in the international market has negatively impacted the employment sector in the mining industry. To a lesser extent, some people are engaged in cash crop production, such as coffee and cocoa. During 2013-14, the London Mining Company, jointly with the Cotton Tree Foundation, Sierra Leone, implemented a USD 115,000 agricultural project supporting the youth groups of Marampa and Mafroki chiefdoms. Hiring labour and exchange workers are seasonal activities during the plantation and harvesting season from which the farming communities generate income. Due to the EVD outbreak, in 2014 that income was lost as the number of hired labour and exchange workers during the season was reduced by 29% compared to 2013. The Wealth Index (WI) indicates that 26% of the district population falls into the poorest quintile, while 33% fall under a medium- poor rating. Port Loko has the second highest portion of households (59%) in the two poorest quintiles.

5.1.1.4 Education

According to the Ministry of Education Science and Technology's (MEST) school census in 2013, there are 687 schools in the district, of which 39 are pre-primary, 512 are primary, 111 are junior secondary, and 25 are senior secondary schools. Port Loko has the second- highest number of schools in the country after Freetown City. The MEST recorded an increase of 30 schools (17 pre-primary, 6 junior and 7 senior high schools) in the 2012-13 session compared to that of 2011-12. The majority (63%) of the schools are a missionary, community or private schools, with the remaining 27% government schools. The net primary enrollment rate is 57.5%. Educational attainment is higher among boys compared to girls in all three school levels (see *graph aside*). The average teacher-student ratio for the district is 1:47. The overall literacy rate is 32%. The Port Loko Teacher's College (Now part of Ernest Bai Koroma University of Science and Technology) is one of the oldest and best- known colleges in Sierra Leone.

5.1.1.5 Health

The Port Loko Government Hospital and Lungi Government Hospital are the two main health facilities in the district. These hospitals have 5 doctors, 6 midwives, 37 nurses and 8 technicians. On average, one health facility serves 4776 people, and the population per hospital is 151,249. 65% of children aged between 12-23 months have completed a full course of vaccination against the most common diseases (BCG, DPT, Polio and Measles), while 5% of children of the same age group did not have any vaccinations in all. During the Ebola response, several organizations, such as CDC, IMC, IRC, GOAL, Marie Stopes, Plan International, Partners in Health, OXFAM, UNFPA, WHO, UNICEF, WFP, IFRC, Christian Aid, Restless Development and the District Health Management Team (DHMT) were actively involved in the response, surveillance, contract tracing, quarantine, managing the treatment centres (Ebola Treatment Centers) etc/

5.1.1.6 Impact of EVD Emergency

Port Loko, as a main business hub of the country, was severely affected by movement restrictions during the peak of the Ebola outbreak. The Port Loko farming community was heavily affected by the Ebola crisis. The district has suffered a high number of Ebola deaths and also has the second highest number of survivors (496 registered survivors as of Sept 2015), after the Western Area Urban district. Despite the end of human transmission of Ebola in the country, survivors continue to experience health complications and experience challenges in obtaining health care services and psychosocial support.

5.1.1.7 Water and Sanitation: (WASH)

The Sierra Leone Demographic and Household Survey 2013 indicated that 44% of households did not have hand washing (water, soap or cleansing agents) facilities within the household, while only 11% have the full range of hand washing facilities at the household level. During the Ebola outbreak, a nationwide campaign for hand washing (with soap, chlorinated water, hand sanitiser or a combination) was launched. The MEST school census 2013 indicated that 54% of schools do not have water sources in the compound, only 6% of the schools have pipe-borne water supplies, 30% of schools have boreholes, and the remaining 64% of schools relied on water from wells, streams, and other sources. Only 68% of the schools have toilet facilities in the compound with the conditions and cleanliness widely varying by school. Several organizations (UN and NGOs) are working in the WASH.

5.2 Methodological Approach

The primary objective of this Environmental and Social Impact Assessment is to report the assessment of the environmental and social impacts of MML's large-scale Iron Ore Mining in Marampa and Maforki Chiefdoms, Port Loko District in North-Western Sierra Leone. The secondary objective is the development of a 'Code of Practice' that would outline potential measures and that, if adopted, would prevent, or mitigate the major environmental and social impacts of the project within and around the project area and elsewhere; and maximize the positive impacts of the project to the social and environmental receptors of its benefits.

The impact assessment was undertaken in two stages:

- Comprehensive desktop review of the impacts, based on existing literature relating to Large – scale Iron Ore Mining. This literature is relatively extensive, but the degree to which Sierra Leone was referenced depended on the quantity of literature available in the Sierra Leonean context. This review guided the consultant on the development of the research instrument for the field study and the identification of the most appropriate methodological approach.
- Fieldwork to identify the significance of the potential impacts in the specific environmental and social context of Sierra Leone (particularly the communities in the vicinity of the project area) and to identify any additional impacts not highlighted during the desk review.

Within the study, environmental and social issues were considered holistically where possible; reflecting the fact that in many cases, social impacts derive from environmental issues and impacts.

The scope of the fieldwork visits to the Large – scale Iron Ore mining site at Marampa Chiefdom in Port Loko District included the identification of significant social and environmental impacts at all phases of development (positive as well as negative, direct, indirect, and cumulative, permanent, and temporary), as well as the identification of appropriate technical and strategic mitigation measures to address these impacts.

5.2.1 Social Impact Assessment Methodology

Social impacts are the social consequences to human populations of any public or private actions that alter how people live, work, play, relate to one another, organize to meet their needs, and generally cope as members of a society (ICGP, 1995).

Social impacts also include changes to the norms, values and beliefs of individuals and the society in which they live. A simple way of describing the nature of social impacts would be as changes to one or more of the following:

- People's ways of life – how they live, work, play and interact with one another.
- Their culture – shared beliefs, customs and values.
- Their community – its cohesion, stability, character, services and facilities.
- Their environment – the quality of air and water people use, the availability and quality of food they eat, the level of dust and noise they are exposed to, their safety, and their access to and control over resources.

5.2.1.1 Social Impact Assessment

is the process of assessing or estimating, in advance, the social consequences that are likely to follow from specific policy actions or project implementation (ICGP, 1995). The SIA process is designed to inform project planning, decision-making and ongoing management. At the most fundamental level, the SIA process can provide direction in

- Identifying social impacts
- Projecting and predicting social impacts
- Mitigation of negative social impacts, and enhancement of positive social impacts.

The scope and focus of the SIA of MML's Large – scale Iron Ore mining in Marampa Chiefdom, Port Loko District were undertaken in three stages:

Stage One: Identification, through desktop research and literature reviews, of the general construction and operation social impacts. This involved desk research to scope issues of infrastructure developments and their socio-economic impact at the most general level. This is the most important preparatory procedure in the SIA process and helped to clarify issues relevant to the field including the key social variables to be considered for the analyses. The main method that was used to conduct the general scoping exercise is the review of relevant general secondary sources of information.

Stage Two: Identification, through fieldwork in MML's concession site of its Large – scale Iron Ore mining, of specific social impacts of the operation in the local context. This involved fieldwork in the project-affected communities and their vicinity in Marampa and Maforki Chiefdoms in Port Loko District to assess relevant impacts, including the identification of positive as well as negative, direct, indirect, cumulative, permanent, or temporary. The assessment of social impacts involved investigating the impacts of MML's Large – scale Iron Ore mining in Marampa and Maforki Chiefdoms in Port Loko District and the response of the affected stakeholders. This was based on expert opinion, checklists, local secondary sources, participant observation and the result of semi- structured interviews with project stakeholders.

Stage Three: Recommendation for mitigating negative and enhancing positive social impacts at the strategic technical levels. This involved making recommendations for the mitigation of negative and enhancement of positive social impacts in the project area. This was based on the assessor's own experience as well as some expert opinions from key project stakeholders. It was important to recommend measures that involved: first, avoiding all adverse social impacts; second, minimizing any adverse social impact that cannot be avoided; and third, compensating for unavoidable adverse impacts. Mitigation and enhancement measures were made both at the strategic and technical levels.

5.2.2 Social Impact Assessment Instruments

The assessment instruments that were used during the stages of the SIA research and their specific relevance to the SIA process are described below:

- ***Checklists*** are comprehensive generic listings of potential impacts based on experience to aid data gathering and ensure that no important factors are overlooked. Their task was that of impact identification. Checklists do not usually include direct or indirect cause-effect links to project activities, although there may be some prediction of the character and nature of the impact itself.
- ***Expert Opinion*** contributed to the identification and prediction of impact possibly neglected by the public or by mandatory considerations. There are several techniques for effectively obtaining expert input, including the Delphi Technique. Delphi involves several iterative rounds of individually conducted interviews and questionnaires with the experts, returning to them with the results of earlier rounds for reassessment.
- ***General Secondary Sources*** provided a major guideline for future expectations that can be a general and past social experience. To know the probable impacts of a project in any location, one of the best places to start is to assess, through general secondary sources, the impacts of an established project in another location. The pieces of literature were summarized and focused on the dominant impact patterns relevant to the type of project under review.
- ***Local Secondary Sources*** were particularly useful in providing baseline information on the social, demographic, and cultural context within which project- related social changes occur. These include sources such as census data, geographical data, administrative reports, community accounts and newspaper reports. These local secondary sources, in conjunction with primary sources of data, provided a means of verifying the SIA.
- ***Semi-Structured Interviews*** were based on a checklist of general questions that can be

revised at any time. This leaves a degree of flexibility so that if other questions are raised during the interview they can be explored. Interviewees were typically key informants, focus or mixed groups. Interviews started with general questions before moving on to more sensitive areas.

- ***Participant Observation*** involved the SIA practitioner living among the people being researched, and sharing as many of their experiences, customs, and practices as possible. In SIA, the emphasis tends to be on obtaining data over a short period, rather than dialogue over a more protracted period. As well as providing a good method of crosschecking alternative methods, participant observation allowed for a rich contextual understanding of social groups and can inform the SIA from initial profiling through to long-term monitoring.

5.2.2.1 Social Study Methodology

The social baseline study involving a review of available data and appropriate literature materials on the project area of influence was followed by a reconnaissance visit in late August 2022, followed by field investigations in late September 2022, by various social experts to both ascertain ground-truth facts contained in the literature and to obtain primary data for this report.

The social study was carried out using participatory techniques and aimed at facilitating and enhancing awareness, mutual understanding, trust, and capacity building. Information was collected on the following issues:

Socio-economic conditions and land use patterns of affected communities.

- Formal and informal governing structures.
- Local infrastructure (transport, housing, health).
- Gardening, and other socio-economic activities and relevant statistics; and
- Income and expenditure trends.

Data analysis was carried out for both primary data collected at the focus group meetings and household surveys as well as the secondary data collected employing a desktop review of existing data sources to gather relevant socio-economic baseline information at a national and local level.

The fieldwork was conducted using three key data collection methods

5.2.2.2 Focus Discussion Group Meetings

One venue was selected for the MML's project most affected communities for this meeting and stakeholders from the various communities that are affected by the operations of the mines.

5.2.2.3 Administration of Household Questionnaires.

Household questionnaires were administered at random to household heads in each of the project-affected communities in Mawullay and Marampa Sections in Marampa Chiefdom, and Mathukara Section in Maforki Chiedom.

5.2.2.4 Meetings with Local and National Authorities.

To identify key socio-economic activities in the affected communities, meetings with the appropriate authorities also took place.

5.2.2.5 Survey Tool

Inventory checklists and a focus group discussion guide developed for this survey aided the gathering of relevant data used for analysis. As stated in the methodology above and as part of the action–research approach, household questionnaires were administered randomly to household heads in all project-affected communities across the three sections in two chiefdoms. The survey instruments included:

- ***Household Questionnaires***
- ***Focus Group Discussion Checklist***

5.2.3 Sampling Procedures

A total of three sections fall within the concession area and haulage road for the operations of MML. These sections include:

- Marampa Section, Marampa Chiefdom
- Maullay Section, Marampa Chiefdom
- Mathunkara Section, Maforkie Chiefodm

Marampa and Mawullay Sections fall within the concession site of MML while Maforkie Section falls along the haulage route of MML to convey Iron Ore to Pepel. Project-affected communities within each of the sections are as follows:

1. **Marampa Section:** Chaindata, Manonkoh, Maforkie, Magbanthey, Robala, Mathukia, Robaka
2. **Mawullay Section:** Konta Bana, Magbirie, Konta Lol, Gbaneh, Moria, Katik, Gbom Limba, Labour Compound
3. **Mathunkara Section:** Mathamu, Thofayim, Mapown, Maworroko

A total of 19 communities across the three sections were surveyed for this study. In each of the communities, 30% of the total number of respondents were selected and form the size of the study. A total of 209 households were interviewed for this baseline study in all 19 communities across the 3 sections.

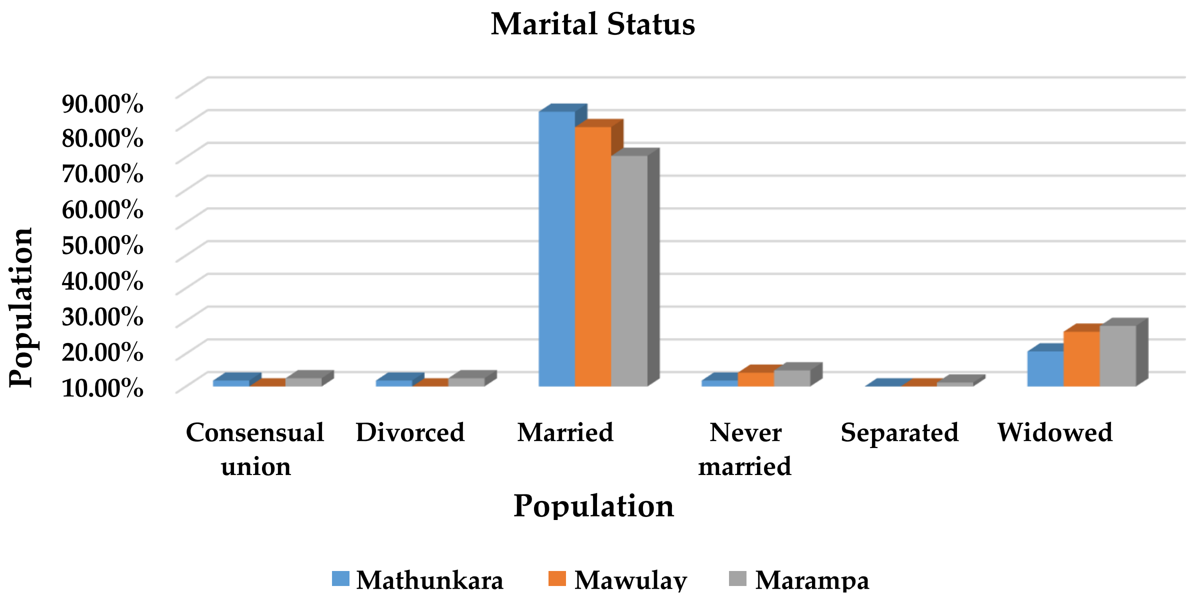
In each of the communities, 30% of households were systematically selected to ensure an even distribution of the sample within the community.

Physical counting and/or listing of all households in each of the communities was done by trained enumerators to have a count of the total number of households in each community. From the total number obtained, 30% was determined and the questionnaires were administered systematically to the sample size.

Table 5- 4: Baseline Socio-Economic and Living Conditions

		THE HIGHEST LEVEL OF EDUCATION ATTAINED								Total
		Complete primary education	Arabic education	Complete secondary education	Complete tertiary education	Incomplete primary education	Incomplete secondary education	Incomplete tertiary education	No formal education	
Name of section	Mathunkara	0	6	2	0	17	6	0	25	**56**
		0.0%	10.7%	3.6%	0.0%	30.4%	10.7%	0.0%	44.6%	**100.0%**
	Mawulay	8	7	1	0	6	11	1	38	**72**
		11.1%	9.7%	1.4%	0.0%	8.3%	15.3%	1.4%	52.8%	**100.0%**
	Marampa	3	4	7	2	13	17	1	34	**81**
		3.7%	4.9%	8.6%	2.5%	16.0%	21.0%	1.2%	42.0%	**100.0%**
Total		11	17	10	2	36	34	2	97	**209**
		5.3%	**8.1%**	**4.8%**	**1.0%**	**17.2%**	**16.3%**	**1.0%**	**46.4%**	100.0%

The magnitude of illiteracy in Sierra Leone could perhaps be best depicted by the country's rural population; this also provides a good reflection of the socioeconomic status of the population of the study area. The table above shows that 44.6%, 52.8%, and 42.0% of all respondents interviewed in Mathukara, Mawullay and Marampa Sections respectively never went to school. Among those who have acquired some form of education, 38.8% were unable to complete secondary education and 1% have tertiary education, some of which are certificates and diplife of mineas from various technical/vocational training centres.



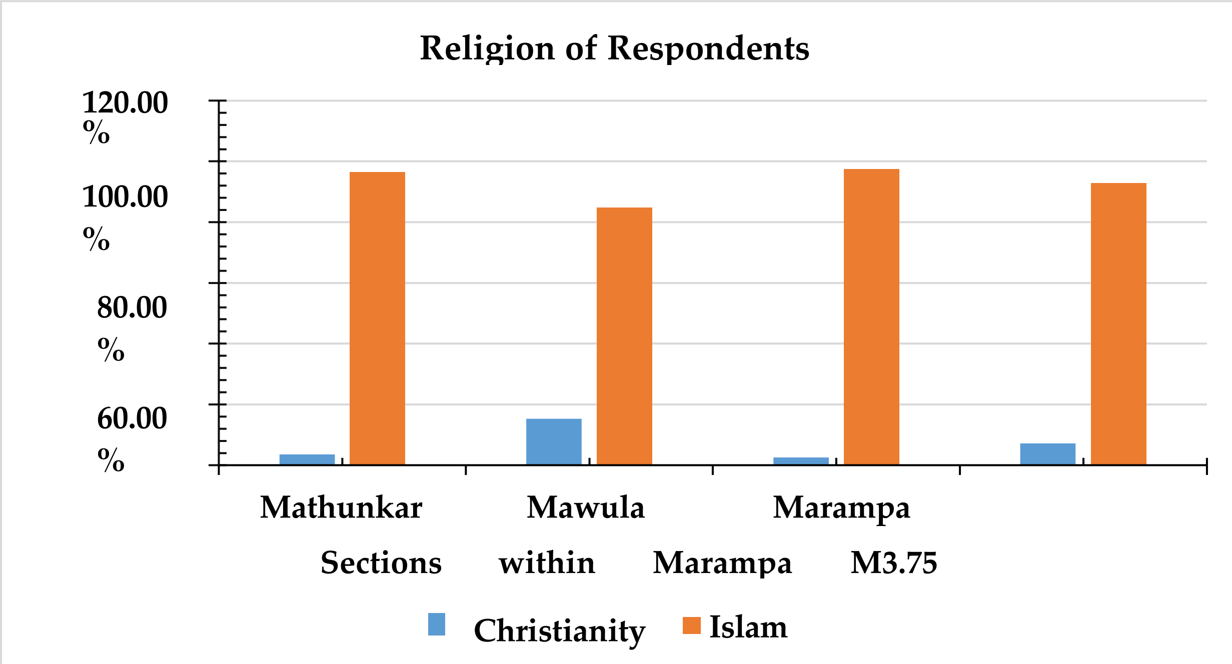
Graph 5- 1: Marital Status of Respondents

The table above shows that the large majority of the sampled population across the three sections are married; 83.9% of the population in the Mathuraka Section are married, 79.2% in Mawullay Section are married and 70.4% in Marampa Section are married. Only a small percentage of those interviewed are single/never married. These are mostly sons/daughters of the household head and were interviewed in cases where neither the household head nor the spouse was available for the interview.

Table 5- 5: Age Distribution of Respondents in the Three Sections of MML's Concession Area

		AGE					Total
		18-28 yrs	29-38 yrs	39-48 yrs	49-58 yrs	59 yrs and above	
Name of Section	Mathunkara	7	8	13	13	15	56
		12.5%	14.3%	23.2%	23.2%	26.8%	100.0%
	Mawulay	16	9	17	17	13	72
		22.2%	12.5%	23.6%	23.6%	18.1%	100.0%
	Marampa	1	5	23	43	9	81
		1.2%	6.2%	28.4%	53.1%	11.1%	100.0%
Total		24	22	53	73	37	209
		11.5%	10.5%	25.4%	34.9%	17.7%	100.0%

The Table above shows the age distribution of respondents across the communities of the three sections within MML's concession area. The findings show that the large majority of the population interviewed falls within the age cohort of 40 to 60 years. On average, 60.3% of all respondents across the three sections are between 40 to 60 years of age. This shows a drastic movement of people from rural to urban settlement and that the population of all sample communities is somehow ageing.



Graph 5- 2: Respondents' Religion

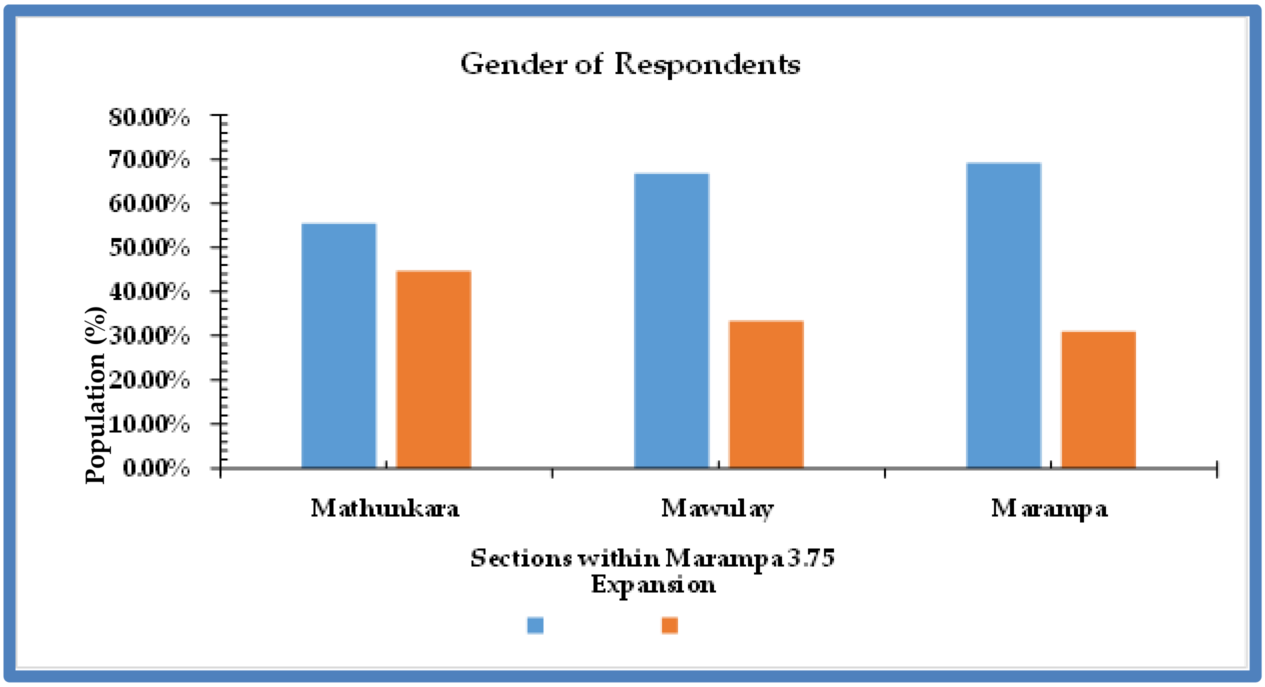
As shown in the Figure above, an overwhelming majority of household heads (96.4% in Mathunkara Section; 84.7% in Mawullay Section; and 97.5% in Marampa Section) and by extension, household members of the population in the Project area practice Islam as their main religious belief. This shows that Christianity is a widely practised religion in the study area and this was evidenced by the numerous Mosques in all the surveyed communities within the project area. Islam is generally the religion practised by the Temnes who are the dominant ethnic group of these communities; a religion inherited from their ancestors. colonial masters and early missionaries.

Table 5- 6: Ethnicity of Respondents

		ETHNICITY								Total
		Fullah	Ibo (Nigerian)	Krio	Limba	Loko	Mende	Susu	Temne	
Name of section	Mathunkara	1	0	0	2	0	0	0	53	56
		1.8%	0.0%	0.0%	3.6%	0.0%	0.0%	0.0%	94.6%	100.0%
	Mawulay	1	0	1	5	1	1	0	63	72
		1.4%	0.0%	1.4%	6.9%	1.4%	1.4%	0.0%	87.5%	100.0%
	Marampa	0	1	0	1	0	0	1	78	81
		0.0%	1.2%	0.0%	1.2%	0.0%	0.0%	1.2%	96.3%	100.0%

									%
Total	2	1	1	8	1	1	1	194	209
	1.0%	0.5%	0.5%	3.8%	0.5%	0.5%	0.5%	92.8%	100.0 %

Results on the ethnicity of respondents (Table above) show that the Temnes are in the majority, accounting for about 94.6% in Mathukara Section. 87.5% in Mawullay Section and 96.3% in Marampa Section. The Limbas and Fullahs also make up a small proportion of the population, each accounting for 3.8% and 1% respectively across the three Sections that comprised the study area.



Graph 5- 3: Gender of Respondents

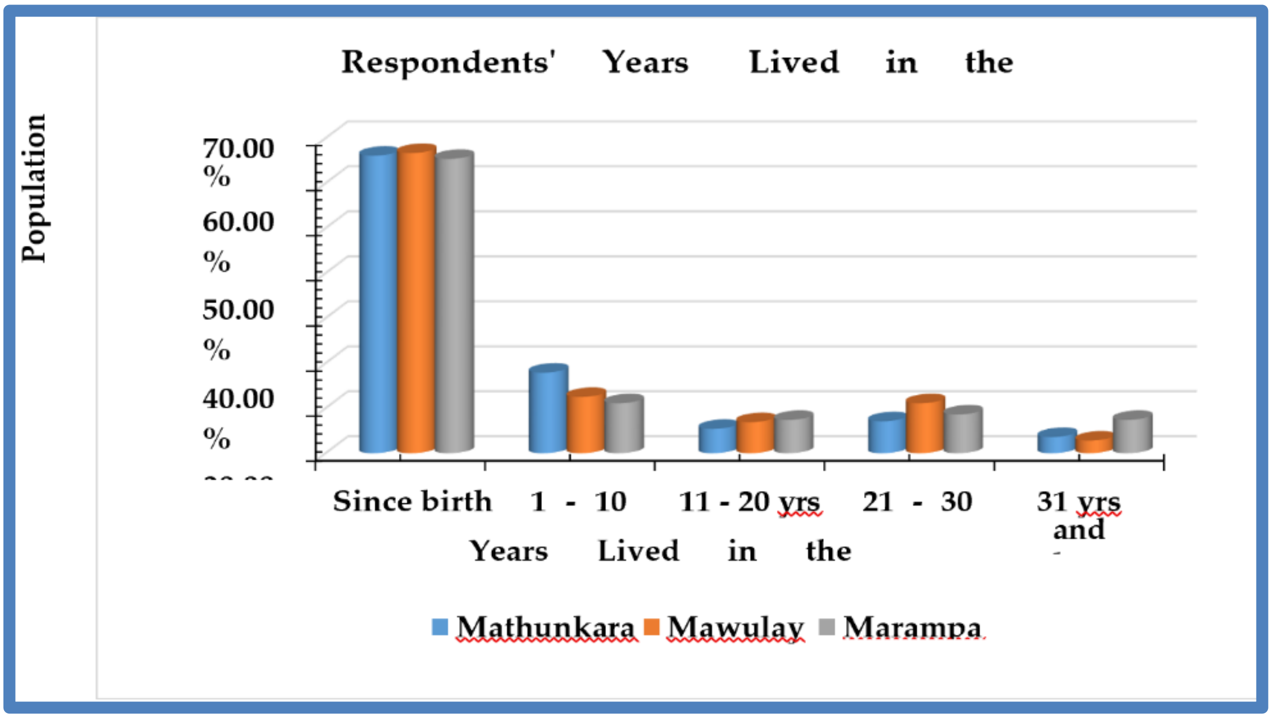
The result of the Graph 5-3 above shows the gender of the respondents interviewed across the three sections that form the study area. On average, nearly two-thirds of the total sample size is female respondents. In Mathukara Section, 55.4% of respondents are female; in Mawullay Section, 66.7% of respondents are female; and in Marampa Section, 69.1% are female respondents. Most of the female folk interviewed are spouses to the head of the household.

Table 5- 7: Residential Status of Respondents

		Residential Status		Total
		Immigrant	Indigene	
Name of	Mathunkara	19	37	**56**
		33.9%	66.1%	**100.0%**
	Mawulay	24	48	**72**
		33.3%	66.7%	**100.0%**

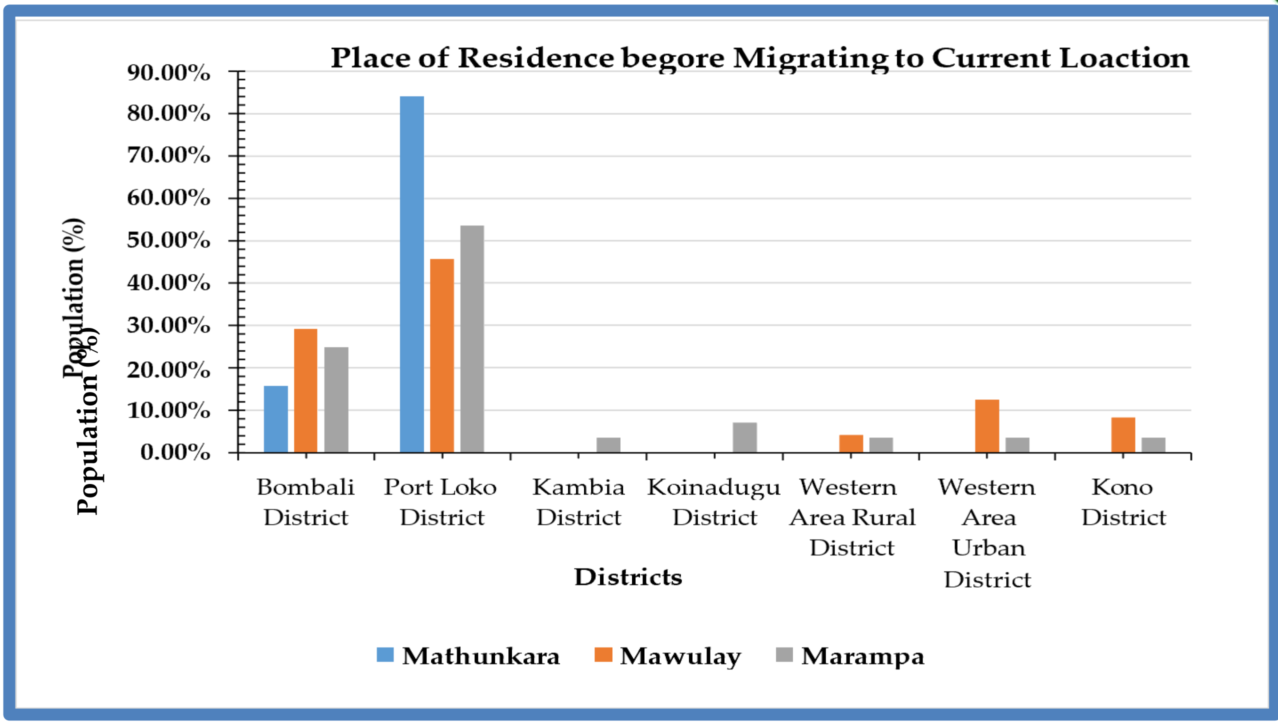
sectio n	Marampa	28	53	**81**
		34.6%	65.4%	**100.0%**
Total		71	138	**209**
		34.0%	**66.0%**	**100.0%**

Respondents were asked to state their residential status in their respective communities where they stay. Consistently across the three sections, about two-thirds of all respondents are indigenes in their respective communities of stay while a third of all respondents are immigrants in their respective communities. This has some implications for land tenure as immigrants normally don't have land right in their areas of residents and for farming purposes, marginal and unproductive lands are usually allocated to them.



Graph 5- 4: Number of Years Respondents Lived in the Community

The table above reveals that the overwhelming majority of the respondents have lived in the study area for more than 30 years and have a wealth of knowledge of the power structure and administration of their respective communities. Only 13.8% of the respondents across the three sections have lived for less than 10 years in the study area. These are mostly unmarried persons below the age of 30 years who are relatives of the household heads and have migrated into the study area to live with their relatives.



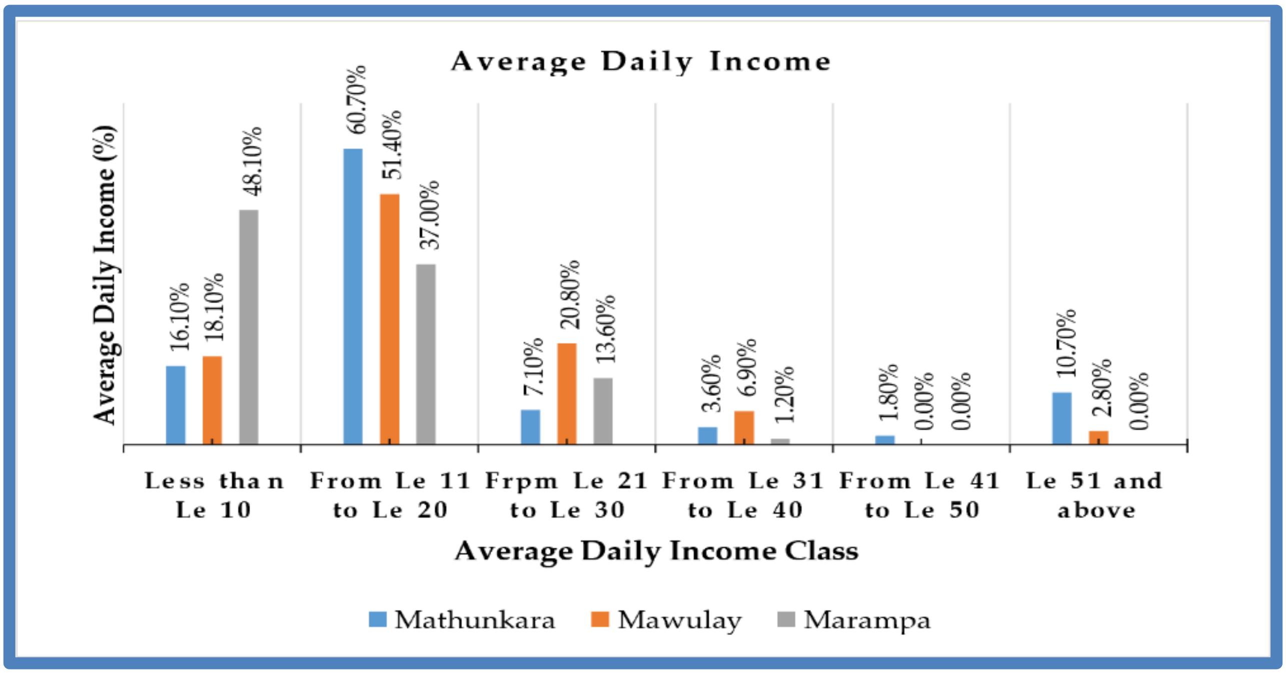
Graph 5- 5: Respondents Origin Place of Residence before Migration to Current Location

Respondents who are immigrants into the study area were further asked to state their previous area of residence before migrating into their current community of residence within the three sections in MML's area of operations. The results revealed that most (61.2% on average across the three Sections) of them have migrated from communities within Port Loko District and another significant proportion have migrated from the neighbouring district of Bombali.

Table 5- 8: Respondents' Reasons for Migrating to Study Area

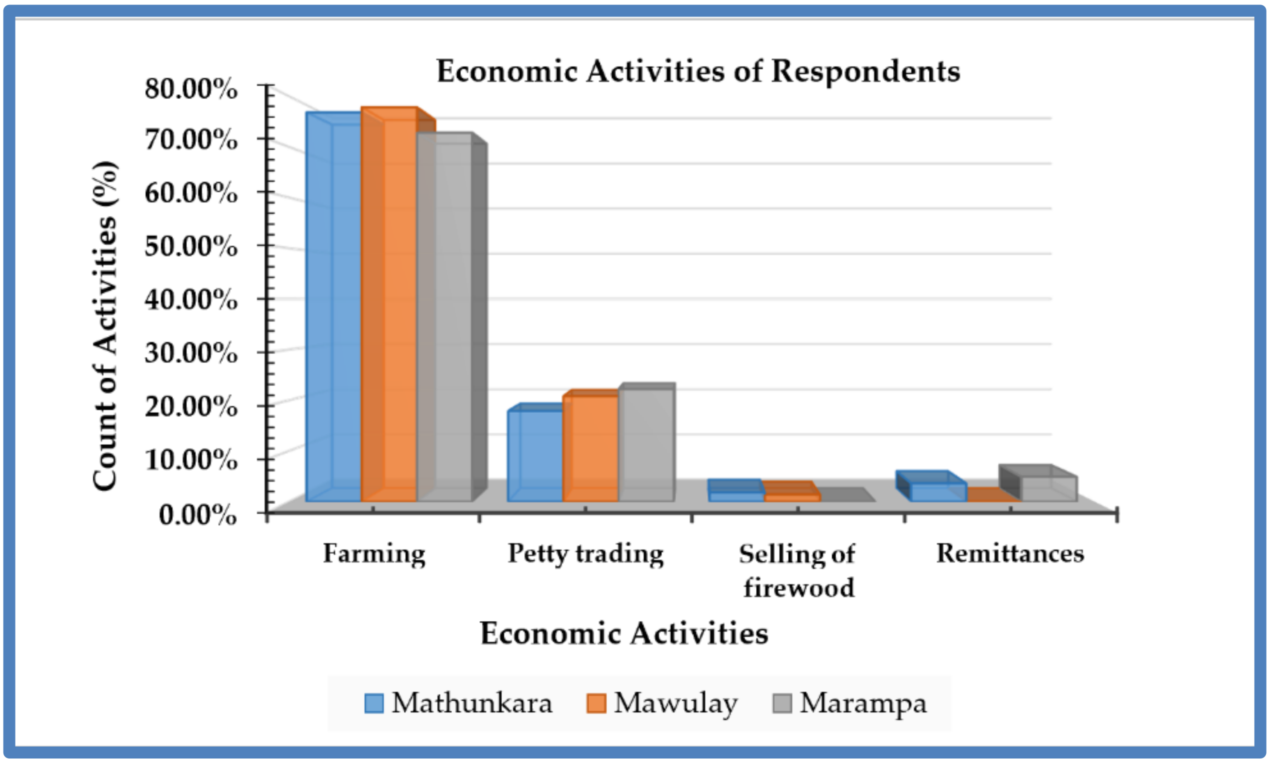
		Reasons for migrating to study area			Total
		Marital purposes	Seeking Employment	Escaping from family pressures back home	
Name of section	Mathunkara	13	5	1	19
		68.4%	26.3%	5.3%	100.0%
	Mawulay	20	4	0	24
		83.3%	16.7%	0.0%	100.0%
	Marampa	28	0	0	28
		100.0%	0.0%	0.0%	100.0%
Total		61	9	1	71
		85.9%	12.7%	1.4%	100.0%

Respondents that were born elsewhere and had moved to settle in the area were asked about the main reason for migrating. The results are shown in the table above. A very high proportion of immigrants (68.4% in Mathunkara Section, 83.3% in Mawullay Section and 100% in Marampa Section) mentioned marriage as the main reason for moving. These were mostly female respondents who are spouses to the household head. Another major reason highlighted by respondents was that they have moved into their respective communities to seek employment and on average, 12.7% of all migrants interviewed across the three sections gave this as a reason for migrating into their current community of residence.



Graph 5- 6: Average Daily Income of Respondents

Reflective of the poor economic status of most households in Sierra Leone, more so in the rural areas and consistent with the primary occupations of subsistence farming and petty trading, the reported average daily income by respondents across the surveyed communities within the three sections is generally small. In Mathunkara Section, 16.1% of all respondents earn less than LE 10 a day, and 60.7% earn between LE 11 to 20. In Mawullay Section, a similar trend was reported in which 18.1% of respondents earn less than LE 10 a day and 51.4% earn less between LE 11 to 20. In Marampa Section, 48.1% of respondents earn less than LE 10 a day while 37% earn between LE 11 to 20 per day. The results of the average earning power of respondents across the three sections surveyed indicate that over two-thirds of all respondents earn less than LE 20 a day. That expressed monthly income shows earnings far below the minimum wage in Sierra Leone.



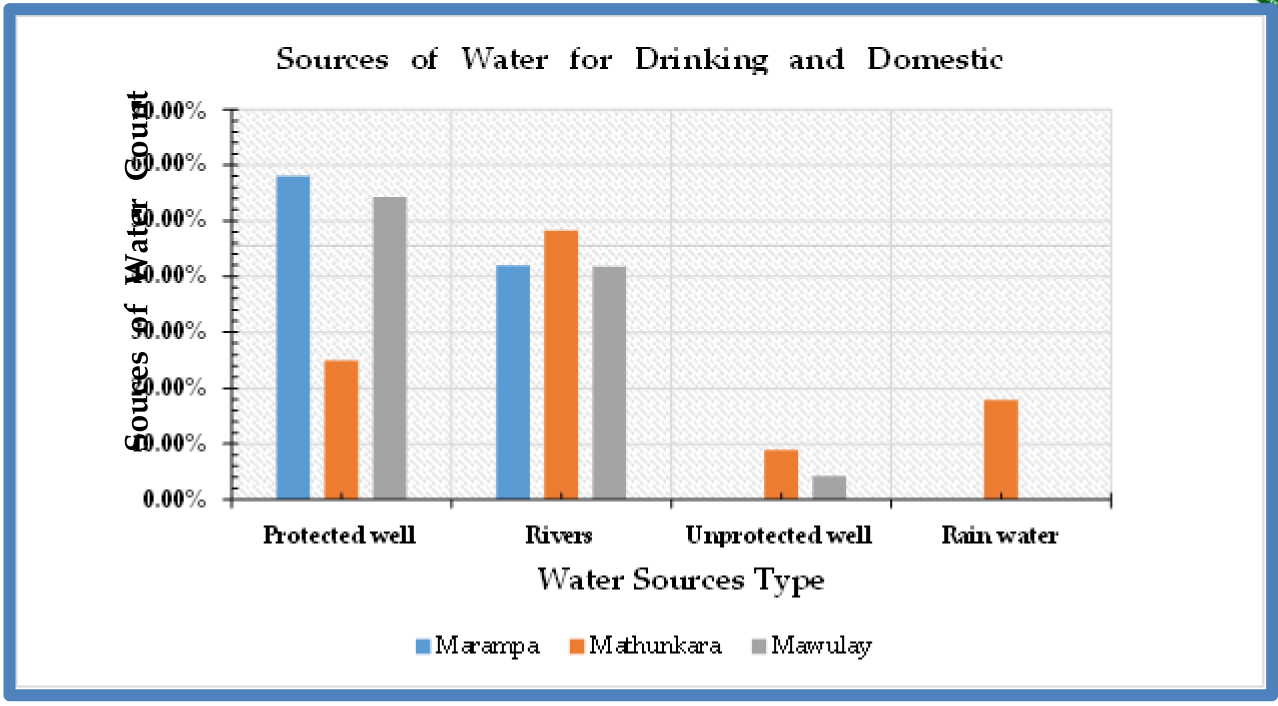
Graph 5- 7: Economic Activities of Respondents

Farming and petty trading are by far the most important economic activities in the surveyed communities that provide food and income for their residents. As shown in the figure above, 76.8% and 17.9% of respondents in the Mathunkara Section are respectively engaged in farming and petty trading; 77.8% and 20.8% of respondents in Mawullay Section are employed in farming and petty trading respectively; in the Marampa Section, 72.8% and 22.2% of respondents are respectively engaged in Farming and petty trading for their livelihoods. An insignificant number of respondents showed widely varied livelihood activities. This result conforms with the expectation that the overwhelming majority of rural residents are employed in the informal sectors of agriculture and petty trading.

5.2.4 Water Resources

5.2.4.1 Sources of Water for Drinking and Domestic Purposes (Cooking/Laundering/Washing)

The three sections within the Marampa M3.75 expansion project use four main sources of water for drinking and domestic purposes, as shown in the graph 5-8 below.



Graph 5- 8: Sources of Water for Drinking and Domestic Purposes.

Respondents across the three sections of MML's project-affected areas were asked to indicate the main sources of water for drinking and other domestic purposes of cooking, washing, and laundering.

The Graph 5-8 above shows that an overwhelming number of respondents stated that protected wee and rivers are the most common sources of water for drinking and other domestic purposes of cooking, laundering and washing. In Marampa Section, 58% and 42% of those interviewed indicated that well and rivers are respectively the most important sources of potable water for domestic use. In Mawullay Section, 54.2% and 41.7% of respondents interviewed stated that well and river sources are respectively the most important sources of potable water for domestic use. In Mathukara Section, 25% of respondents indicated protected well as the most important source of water for domestic use while 48.2% stated rivers as the most important source of potable water for domestic use. Rainwater also surfaced as one important source of water for domestic use during the rainy season. 17.9% of respondents in Mathunkara Section stated rainwater as the most important source of water during the rainy season.

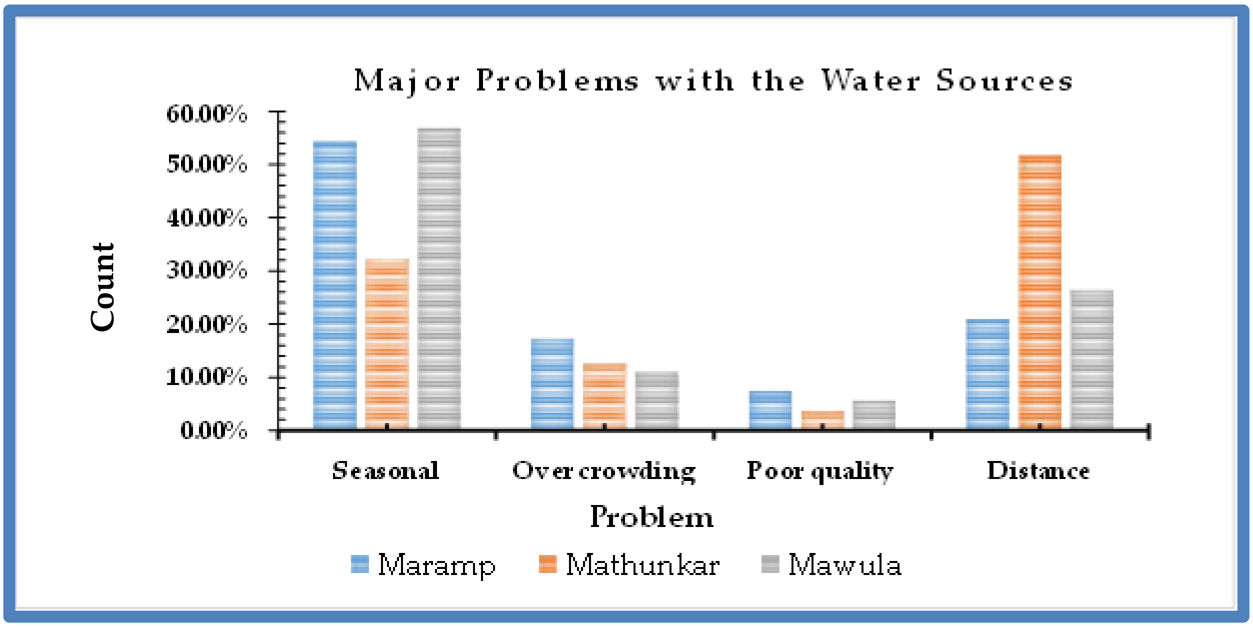
Table 5- 9: Quality of Drinking Water Available

		Quality of Drinking Water Available				Total
		Don't know	Good	Fair	Poor	
Section	Marampa	0	37	34	10	81
		0.0%	45.7%	42.0%	12.3%	100.0%
	Mathunkara	0	20	33	3	56
		0.0%	35.7%	58.9%	5.4%	100.0%
	Mawulay	3	46	15	8	72
		4.2%	63.9%	20.8%	11.1%	100.0%
		3	103	82	21	209

Total	1.4%	49.3%	39.2%	10.0%	100.0%

From the Table 5-9 above, nearly half of the respondents (49.3%) across the three sections rated the quality of drinking water for them and their household members are good and satisfactory. Most of these respondents are those that have access to protected wells. Another reasonable percentage (39.2%) of those interviewed across the three sections rated the water available to them for drinking and domestic use as fairly good. Some (10% of respondents) rated their drinking water as poor. They are mainly households that depend on stream and river water for drinking purposes and other domestic use.

5.2.4.2 *Major Problems Encountered with the Source of Potable Water*



Graph 5- 9: Major Problems with the Communities' Water Sources

Respondents were asked to indicate the major problems they encounter in accessing water for drinking and other domestic use. The figure above shows that fluctuations in the water table due to seasonality and distance from the source of water are the most striking inconveniences that are faced by households in the project-affected communities across the three sections in terms of access to water for drinking and other domestic use.

Overcrowding in protected wells during the dry season and poor quality of water are other constraints faced by some residents across the three sections. Distance is a common problem amongst residents who depend on streams and rivers as most are located several hundred meters away from their homes. The problem of seasonality was mostly highlighted by those who depended heavily on streams as a source of drinking water.

5.2.4.3 Responsible Persons for Fetching Water

Table 5- 10: Persons Responsible for Fetching Water

		Responsible persons for fetching water in the household	Total
		Children and Women	
Section	Marampa	81	81
		100.0%	100.0%
	Mathunkara	56	56
		100.0%	100.0%
	Mawulay	72	72
		100.0%	100.0%
Total		209	209
		100.0%	100.0%

The fetching of water is seemingly a gender role in rural communities of Sierra Leone. Respondents were asked to state the categories of persons in their households that are responsible for fetching water for drinking and other domestic uses in the home. The findings of the survey conducted in project-affected communities across the three sections indicated that all respondents interviewed stated that women and children are the members of households responsible for fetching water in their homes. This implies the regularity and punctuality of school-going pupils who spend a considerable time in the morning hours fetching water for their households before they depart for school.

5.3 WASTE MANAGEMENT

5.3.1 COMMON METHODS OF SEWAGE DISPOSAL

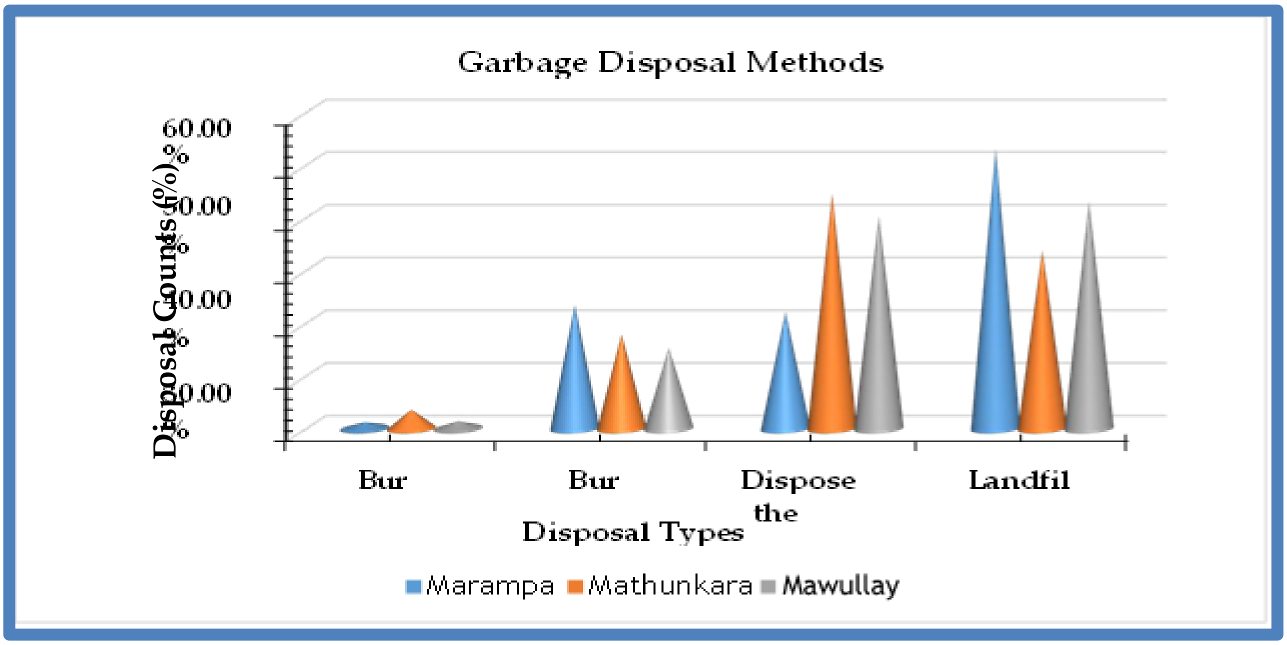
Table 5- 11: Common Methods of Sewage Disposal

		Most Common Method of Sewage Disposal			Total
		Local pit Latrine	Rivers and Bushes	VIP Latrines	
Section	Marampa	65	13	3	81
		80.2%	16.0%	3.7%	100.0%
	Mathunkara	37	13	6	56
		66.1%	23.2%	10.7%	100.0%
	Mawulay	44	24	4	72
		61.1%	33.3%	5.6%	100.0%
Total		146	50	13	209
		69.9%	23.9%	6.2%	100.0%

Results of the most common method of sewage disposal by households in the study area across the three sections are presented in the table above. As is expected of a rural setting, over two-thirds (69.9%) of all respondents in surveyed communities across the three communities pointed to the local pit latrine as their main toilet facility. This is a very common method of sewage disposal for dwelling units in rural areas that are constructed of mud walls and covered with corrugated sheets. Only 6.2% of respondents have VIP latrines in their homes. A reasonable number of respondents in all surveyed communities (23.9%) and their household members engage in open defecation in bushes and rivers/streams. This is one of the reasons for the low rating of the quality of water in streams/rivers for drinking purposes.

5.3.1.1 Common Methods of Garbage Disposal

The results of the most common methods of garbage disposal in all project-affected communities across the three sections that form the study area showed a similar and identical pattern of garbage disposal (***Graph 5-10***). The most common method of garbage disposal in all surveyed communities is throwing garbage in a designated area within the community which is regarded as a local landfill – 53.1% of respondents in Marampa Section; 43.1% of respondents in Mawullay Section; and 33.9% of the respondents in Mathunkara Section stated this as the most common method of garbage disposal in their respective communities. Disposing of garbage in the bush is another common method indicated by the respondents interviewed – 22.2% of respondents in Marampa Section; 40.3 % of respondents in Mawullay Section; and 44.6% of respondents in Mathunkara Section stated this as the most common method of garbage disposal in their respective communities. Among the other (less common) practices, the refuse is buried (practised by 18.9% of the respondents across the three sections) and burned (practised by only 2% of all respondents interviewed across the three sections).



Graph 5- 10: Garbage Disposal Methods Practised by the Affected Communities

5.3.1.2 Main Source of Energy for Cooking

Residents within the affected communities of the Marampa M3.75 expansion project have two main sources of energy to generate heat for cooking (***Table 5-12***)

Table 5- 12: Main Sources of Energy for Heating and Cooking

		The main source of energy for cooking		Total
		Charcoal	Wood	
Sections	Marampa	37	44	81
		45.7%	54.3 %	100.0 %
	Mathunkara	13	43	56
		23.2%	76.8 %	100.0 %
	Mawulay	16	56	72
		22.2%	77.8 %	100.0 %
Total		66	143	209
		31.6 %	68.4 %	100.0 %

Fuel wood and charcoal are the most important sources of energy for cooking in homes in all survey communities across the three sections that form the study area. As expected in a rural setting, most of the respondents interviewed use either wood or charcoal or both for cooking in their homes. Exclusively, 68.4% of respondents in all surveyed communities across the three sections use firewood and 31.6% use charcoal as a source of energy for cooking in homes.

The massive deforestation taking place around these communities can be associated (but not limited) with the high rates of charcoal burning and wood consumption by the local population.

5.4 Health

5.4.1 Availability of Health Facility

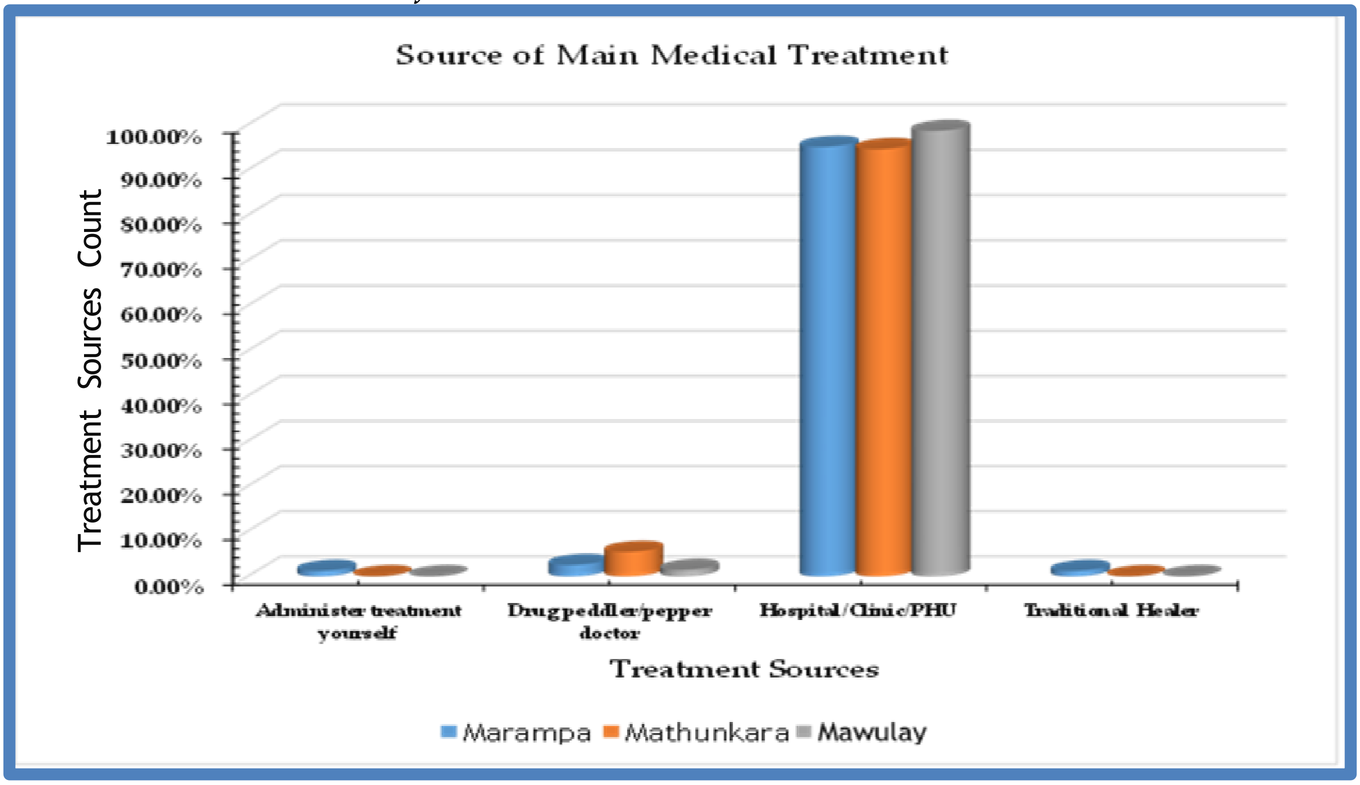
Table 5- 13: Availability Status of Health Facility

		Availability of Health facilities in your community		Total
		No	Yes	
Section	Marampa	81	0	81
		100.0 %	0.0 %	100.0 %
	Mathunkara	26	30	56
		46.4 %	53.6 %	100.0 %
	Mawulay	72	0	72
		100.0 %	0.0 %	100.0 %
Total		179	30	209
		85.6 %	14.4 %	100.0 %

Respondents in all surveyed communities across the three sections were asked to indicate the availability of healthcare facilities within their communities.

The results show that all respondents (100%) in all surveyed communities in Maramapa and Mawullay sections have no form of a healthcare facility in their communities. In Mathukara Section, 53.6% of respondents have a PHU in their community. The result points to the poor health care services in Sierra Leone and particularly in rural areas.

5.4.1.1 Main Source of Medical Treatment



Graph 5- 11: Main Sources of Medical Treatments

Most of the respondents and their household members in the study area seek treatment at a public hospital/clinic/PHU when they get sick. The Figure above shows that the large majority (95.1% of respondents in Marampa Section; 98.6% of respondents in Mawullay Section; and 94.6% of respondents in Mathunkara Section) of those interviewed in all communities across the three sections go to a public hospital/clinic/PHU when they get sick. Others (accounting for 3.1% across the three sections) of the total number of respondents in the study area consult and seek treatment from a drug peddler when they get sick.

The major constraints encountered by respondents and focus group discussants in terms of accessibility to medical facilities include distance to the nearest clinic/hospital, poor road network to convey patients who are seriously ill, unavailability of drugs in the various health facilities, and cost of medication.

5.4.1.2 Level of Satisfaction from the Medical Treatment

Table 5- 14: Level of Satisfaction from Medical Treatment

		Level of Satisfaction from the Medical Treatment						Total
		Excellent	Fair	Good	Poor	Very Good	Very Poor	
	Marampa	1	16	39	13	11	1	**81**
		1.2%	19.8 %	48.1 %	16.0%	13.6%	1.2%	**100.0%**
	Mathunkara	1	12	30	8	3	2	**56**
		1.8%	21.4 %	53.6 %	14.3%	5.4%	3.6%	**100.0%**
	Mawulay	0	11	44	6	11	0	**72**
		0.0%	15.3 %	61.1 %	8.3%	15.3%	0.0%	**100.0%**
Total		2	39	113	27	25	3	**209**
		1.0%	**18.7 %**	**54.1 %**	**12.9%**	**12.0%**	**1.4%**	**100.0%**

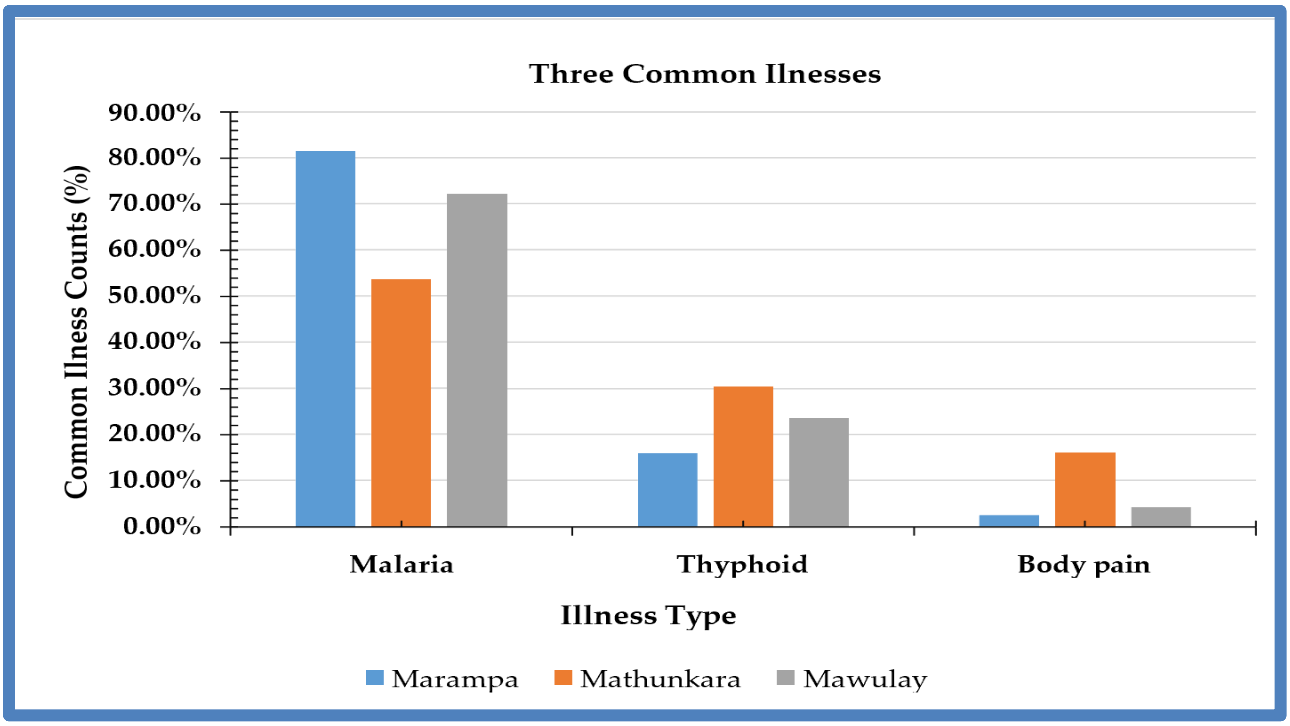
Respondents were asked to rate their level of satisfaction with the treatment they receive. On average across the three sections, over half of all respondents (54.1%) of those interviewed rate the satisfaction they derive from the treatment centre as good and another 12% of respondents rated the satisfaction as very good. They are mostly those who seek treatment from a public hospital/clinic/PHU. 18.7% rated their satisfaction as fair. Only 12.9% rated their satisfaction as poor. 1.4% rated their satisfaction as very poor. They normally seek treatment from a drug peddler when they are sick. One of the reasons for their poor rating is that the peddlers carry expired and counterfeit drugs and also give the wrong prescription.

5.4.1.3 Common Illness

The three most common illnesses in the study area are malaria, typhoid, and body pains. From the figure below, the overwhelming majority of respondents (81.5% of respondents in Marampa Section; 72.2% of respondents in Mawullay Section; and 56.6% of respondents in Mathunkara Section) indicated that the most common illness in the study area is malaria. This was confirmed by medical practitioners in the various health units; that, malaria is the most reported illness in medical centres. The prevalence of malaria in the study area is attributed to the existence of low bushes and stagnant water around the study area which provides breeding places for the mosquito which is the carrier of the disease.

Typhoid was the second most common illness reported by respondents in all surveyed communities in the three sections as reported by 16% of respondents in the Marampa Section; 23.6% of respondents in Mawullay Section; and 30.4% of respondents in Mathunkara Section. The prevalence of typhoid is attributed to the contamination of stream water which serves as a source of drinking water for a considerable number of inhabitants.

Another common illness reported was body pains. On average across the three sections, 7.6% of all respondents reported body pains as the most common illness they experience. This ailment is associated with farming using crude tools and own labour.



Graph 5- 12: Common Illnesses within the Project-Affected Communities

6 SECTION SIX

6.1 STATEMENT OF PUBLIC PARTICIPATION

INTRODUCTION

This section presents the outcomes of the consultations and engagements with stakeholders and interest groups that somehow have an interest and influence in MML's project development and operation, including the state agencies, individuals, etc. The consultations covered the various issues of concern about the impact of the project and the mitigation to alleviate the negative impacts.

Public participation is a two-way process of communication between the company (MML) and its stakeholders. It is a key aspect of the ESIA process, allowing stakeholders to express their views about the project. It involves sharing information and knowledge, seeking to understand the concerns of others and building relationships based on collaboration, thereby allowing stakeholders to understand the risks, impacts and opportunities of a project to achieve positive outcomes.

For this Project, a stakeholder is defined as: "persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interests, the academic community, or other businesses" (IFC, May 2007).

The Stakeholder Engagement Plan (SEP) provides the overarching framework for the MML project including details of the requirements governing public participation and stakeholder engagement.

For stakeholder engagement, the following principles were adopted and followed:

- Inclusive of all the relevant groups within the community, including the vulnerable and marginalized;
- Culturally appropriate (i.e. using the local language where possible,
- etc.);
- Held in venues that are accessible to all groups, e.g. women, people with disability and other vulnerable groups;
- Free of external manipulation, interference, coercion, or intimidation;
- Documented to avoid or minimize risks to, and adverse impacts on, the affected communities; and
- In-depth exchange of views and information constituting 'free, prior and informed consent'.

This chapter focuses on public participation activities that have been carried out to date in support of the MML's expansion ESIA process. This section of the ESHIA study has been divided into the following sub-headings:

- Approach to public participation;
- Stakeholder Identification and Mapping;
- Communication Strategy;
- Public Participation Activities;
- The Outcome of Public and Community Participation Meetings

6.1.1 Approach to Public Participation

The stakeholder Engagement Approach is important and was structured to consistently engage all the stakeholders both affected and interested parties; ensuring they are appropriately and adequately informed about the project development and progress during all the various phases of the project cycle.

Furthermore, the framework is expected to provide an appropriate channel for receiving information on the environmental and social performance of the project, obtaining feedback on the effectiveness of the environmental mitigation measures and management initiatives as well as dialoguing on grievances and issues of mutual interest between stakeholders and the project owners.

The stakeholder consultation and engagement process involved:

- Consultations with identified key stakeholders during the planning phase of the project, which also formed a part of the preparatory activities for the project ESHIA process.
- Consultations and dialogue with the stakeholders would continue throughout the project implementation phase to engage the stakeholders at all stages of the project development through decommissioning to ensure a minimal residual impact on the identified environmental receptors.

In addition, MML will follow a strategic and structural approach to establish and maintain constructive stakeholder relationships. This approach is defined in the "Stakeholder Engagement Procedure". Stakeholder engagement activities are a part of the comprehensive Environmental and Social Management Plan which is developed by Environmental Management Services (EMS) and MML to implement EHS procedures and to ensure full compliance with the requirements of local community grievance mechanisms and International Financial Institutions. Corporate social responsibility (CSR) is an important element of MML's strategy and plays a key role to discover new ways of extending and improving people's lives within the project-affected communities. As part of MML's corporate culture, it supports local initiatives, particularly those relating to communities' welfare and education. MML is committed to investing its time, expertise, and resources to help develop and maintain vibrant and sustainable local communities.

MML's CR&D department works to keep primary host communities informed of MML's activities on the mine site, and operates a Community Information Centre in Lunsar to interface directly with the public.

To identify local issues, MML refer to the feedback received from our stakeholders, local partners, community leaders and private companies. This engagement was held in September and October 2022 and was managed by Environmental Management Services (EMS) based in Sierra Leone. It involved presenting details of current and planned project activities for participants to ask questions and raise concerns. Stakeholders were invited to comment on potential impacts and appropriate mitigation measures. Contact details to provide additional comments or to report grievances were also presented.

6.1.1.1 Stakeholder Identification and Mapping

The overarching purpose of the stakeholder identification process is to establish which organisations and individuals may be directly or indirectly affected, positively or negatively, by the project.

The mapping process detailed in the SEP and information gathered during baseline data collection activities in September 2022 were used to identify stakeholders for this stage of public participation. Stakeholder engagement is a vital part of the ESHIA leading to the social baseline, identification of significant impacts and mitigation measures. This can be used to maximize the social benefits of the project and to effectively manage the stakeholders. The first part of this is the identification of the stakeholders, their interests and their influence so that the future consultation phase will be appropriate and effective.

Stakeholder identification is important to identify all people or groups that have an interest in the project or are knowingly or unknowingly affected in some capacity. They can include government agencies, chiefs, residents, community groups and more. A systematic approach was used to identify stakeholders was taken which built on existing knowledge from the desk review information.

The resulting output is a list of stakeholders with the category, name, characteristics, interest, and influence in a table. Influence is the ability to change and alter the project directly. Whereas interest is where the project falls within the stakeholders' area of concern.

Based on the influence and the interest some groups will only be kept informed, others consulted on areas of interest and the rest regularly be involved with communication and discussion. This is decided through the matrix which looks at Interest and influence, below(***Table 7.1***).

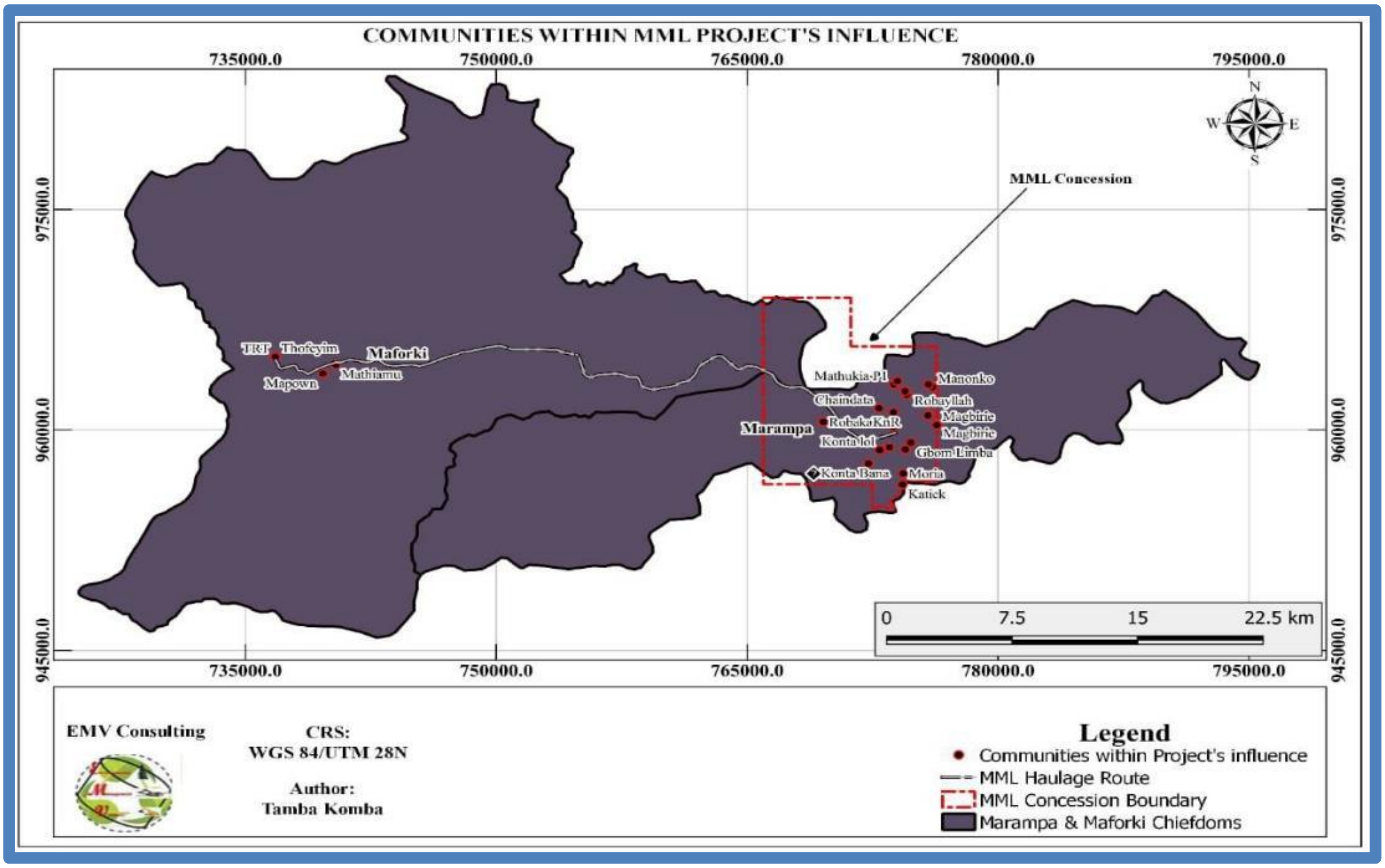


Figure 6-0: Communities Affected by Marampa M3.75 Project Expansion

Table 6- 1: Matrix Showing Influence and Interest in the Marampa M3.75 Project

Influence	High	Influential stakeholders but not directly interested in the issue; engage and consult on areas of interest	Key Stakeholders: focus engagement efforts and involve them regularly
	Low	Least interest and influential stakeholders to be kept informed	Very interested but low influence stakeholders: keep informed and consult on areas of interest
		Low Interest	High Interest

Green: Stakeholders with low interest and low influence will be kept informed through notices. However, some of these stakeholders will still be consulted if their experience, knowledge, or data is useful to the project. These are often stakeholders that are unlikely impacted.

Yellow: These are stakeholders that are influential but have limited interest. They should be notified of the work and as they will likely have valuable information they will be consulted through tailored interviews.

Orange: Stakeholders with high levels of interest but a low level of influence. These are often the ones that directly effects but have limited influence over the final decision. It is very important to engage with this group. Notice of the works, focus group discussions or semi-structured interviews will be undertaken.

Red: High-interest and high-influence stakeholders that should be regularly consulted through formal interviews, informal interviews, and focus group discussions. This group will likely be affected but can also change the outcome of the project. The communities of influence within the project expansion are displaced in ***section five above*** (please *refer to this section and figures for details*)**.** Moreover, other communities are located within 200m on either side of

MML's haul road that may be minimally affected by the Marampa M3.75 project (***Figure 6-1***).

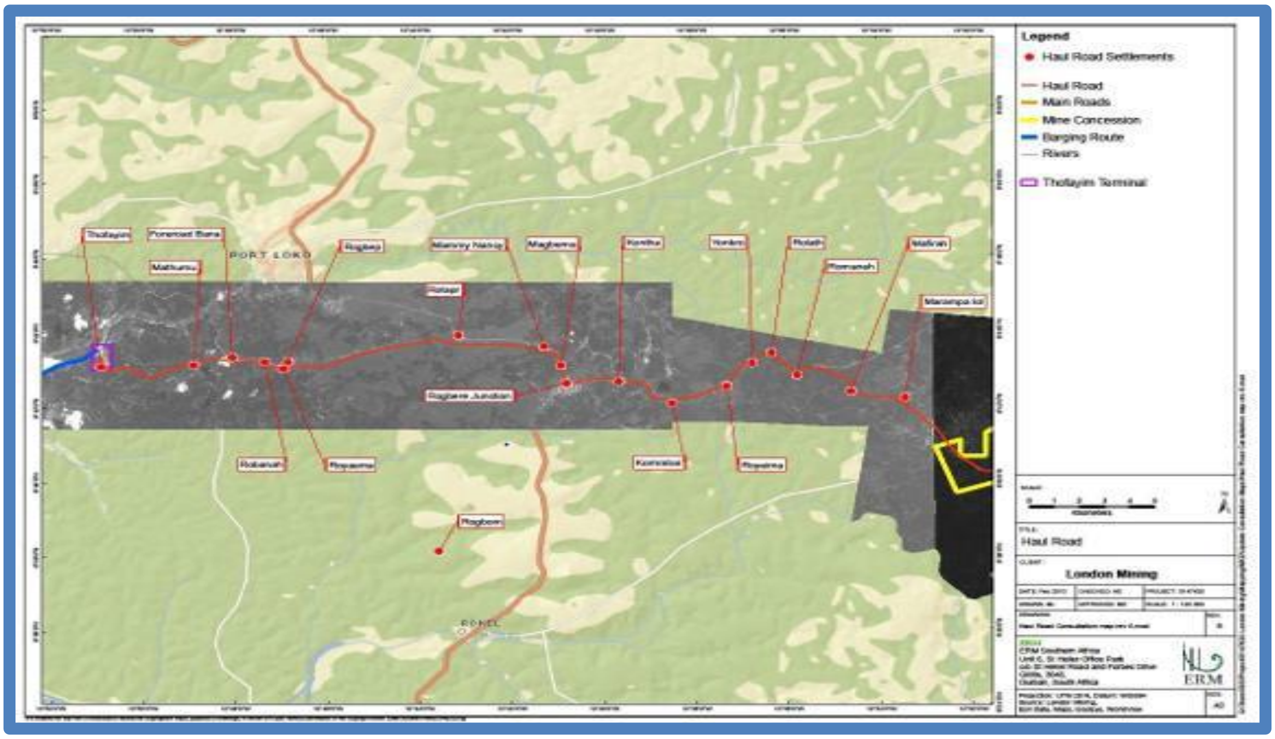


Figure 6- 1: Communities 200m on Either Side of the Haul Road

The barging route also has many communities 200m on either side of it. Figure 6.2 is a display of these communities.

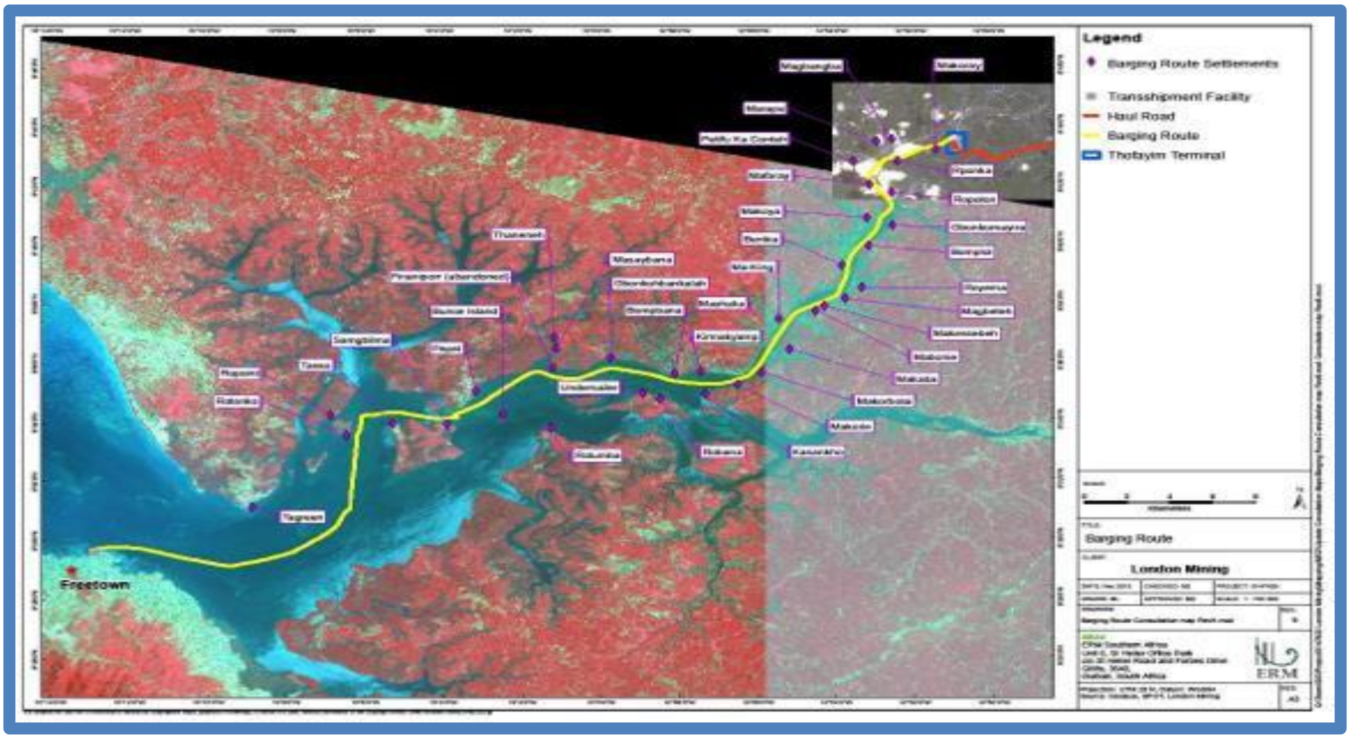


Figure 6- 2: Communities 200m on Either Side of the Barging Route

6.2 Stakeholders' Identification and Consultation

Stakeholders' identification and consultation constitute an integral component of the ESHIA study. The table below presents the groups of stakeholders that were identified and consulted. The identification and mapping process facilitated decisions on communication methods required for engagement activities.

Table 6- 2: The Group of Stakeholders Identified and Consulted

Stakeholder Categories	Stakeholder Groups
Directly Affected Communities (including traditional authorities)	• Communities that live in the mine concession area • Communities that own/lease or use land in the mine concession area • Communities that live within 200 metres on either side of the haul road • Communities that live within 200 metres of the waterway along the barging route
Lunsar representatives	• Health • Education • NGO's • Youth leaders • Agriculture associations • Women's associations • Blind /disabled organisations • Local businesses/livelihoods
District level representatives, Port Loko	• Chief Administrator, Port Loko District Council • Health • Education • Users of Port Loko Creek, • NGO's
National level representatives, Freetown	• Government authorities • NGOs / academics

6.3 Public Participation Activities

6.3.1 Stakeholder Engagement Plan

The Stakeholder Engagement Plan is intended to maintain consistent engagement with the stakeholders during the Project development, operation, and decommissioning phases. The primary objectives include:

- Ensuring all stakeholders are adequately informed about project progress and granted the opportunity to present concerns or grievances.
- Receiving feedback on effective environmental management measures and initiatives.
- Ensuring that the grievance mechanism is well communicated, and the grievances

management has been transparent and effective.

- Project updates and progress information are available to all affected and interested stakeholders at all phases of the project cycle.

6.3.2 Stakeholder Engagement Tools

The tools for communication and engagement with the stakeholders included letters and newspaper publications and advertisements, forums/meetings, dialogue, and seminars/workshops. The tools used in specific instances would vary with the different stakeholder groups based on ensuring effective communication and engagement with the stakeholder groups. Project information and communication considered cultural appropriateness and illustrative understanding.

6.3.3 Stakeholder Engagement Participation

High-level representatives of MML would always participate in the engagement sessions to assure the full commitment of MML to the stakeholders and the engagement process.

6.3.4 Stakeholder Engagement Activities (SEA)

There have been consistent consultations with the various identified stakeholders since the inception of project implementation through to the preparation of the ESHIA report. The stakeholder engagement activities have been consistent with the key stakeholders and provided appropriate channels for comprehensive interaction and management of the key issue.

6.3.5 Format of Meetings

The majority of community meetings were held in Temne. Meetings were also held in Krio in more populated areas, especially in Port Loko and Lunsar. Meetings involved the following activities:

- Project representative introductions;
- The registration process to record the number of participants;
- Presentation of the project in the most appropriate format including details of the project and ESIA process, potential impacts identified during scoping and the grievance mechanism.

6.4 Outcomes Of Public and Community Participation

DISCLAIMER: The views and opinions expressed below by attendees of the community engagement meetings do not necessarily reflect the reality of MML's actions. In many cases, the views expressed are premised on misinformation and misperceptions. MML values the input of project affected persons and is committed to ensuring that all grievances the company receives are resolved.

6.4.1 Mathunkara Section, Maforki Chiefdom, Portloko District

6.4.1.1 Noncompliance with Cultural Heritage

Stakeholders including the Section Chief, Headmen, youth leaders, women's leaders and community members of the four project-affected communities in Mathukara Section, Maforki Chiefdom reported that that has a long tradition of performing cultural rites and offering sacrifices annually. This comprised of the slaughtering of a sheep among other rites that are meant to appease the ancestors and evoke the spirits for protection and prosperity in their land. These rites have been sponsored by all of MML's predecessors (London Mining, Frank Timis, SL Mining). Stakeholders complained that MML has not complied with and paid attention to such practices since they took up the operations of the mines. They expect MML to toe the line of its predecessors and sponsor such cultural rites.

6.4.1.2 Dust Emission from the Haul Road

The impact of dust emission on communities along the haul road corridor was one of the most outstanding impacts of the operations of MML heightened by project-affected communities. All four communities in Mathukara Section are a few hundred meters away from MML's haul road.

Stakeholder and community concerns highlighted the impact of dust on public health and the associated diseases of air pollution from dust – that due to the proximity of the communities to the haul road, residents of project-affected communities are seriously impacted by dust particles from the haul road.

Another reported impact of dust particles from the haul road by communities along the corridor of MML's haul road is that it has affected the productivity of their crops, especially tree crops including mango, orange, coconut, banana and plantain. Stakeholders, as well as community members, reported that the productivity and yield of these crops have reduced tremendously due to dust particles from the haul road.

According to them, the dust particles from the haul road cover the crops, especially during the flowering period which is in the dry season and coincidentally the period with the highest intensity of dust from the haul road. They furthered this has reduced their income from these cash crops which they normally use for paying children's school fees, repairing houses, settling outstanding debts and the provision of food for themselves and their family members.

Community residents and community stakeholders pointed out that dust suppression by MML has not been effective. They opined that MML normally undertake dust suppression measures during the dry season but that more should be done especially for communities in Maforki Chiefdom. The dust suppression measures, they concluded, were more effected and more concentrated within the vicinity of Lunsar Township and Rogbere Junction.

Implementation of CDAP, Payment of Compensation and Surface Rent, and Cooperate Social Responsibility. Community stakeholders and community members highlighted lapses in the payment of surface rent and the compensation for plantations and other properties. The main concern is that there has not been a timely payment of surface rent to landowners and compensation for crops and other properties that are affected by the operations of the mines.

They also stated that MML has also not given much in terms of CRS and the implementation of CDAP. According to the Section Chief and Chiefs of the project- affected communities, MML promised scholarships for some children within the project- affected communities as part of the company's contributions to Community Development but MML has not implemented and fulfilled that commitment. However, they indicated that MML is a recent company and has just taken of its predecessor, SL Mining.

6.4.1.3 Neglect of Community Power Structure

The section Chief of Mathukara Section and Community leaders of the four projected affected communities in Maforki chiefdom stated their concern about the neglect of local and traditional authorities by MML. According to their testimonies, MML does not follow the channels of community power structure and hierarchy in most instances when it wants to engage the communities. Community leaders should be involved and engaged in matters of employment of local personnel within project-affected communities, they stated.

Table 6- 3: Photos of Meetings and Engagement with Communities Stakeholders

Community Meetings in Mathunkara Section, Maforki Chiefdom

Community Engagement of Women in Mathunkara Section

Engagement with Section Chief, Women's Leader, Youth Leaders and Village Headmen of Mathunkara Chiefdom.

6.4.2 Marampa And Mawullay Sections, Marampa Chiefdom, Port Loko District

In a joint meeting of the Paramount Chief of Marampa Chiefdom and the Section Chiefs of both Marampa and Mawullay Sections, these key stakeholders stated that this is the first time a meeting has been conveyed on consultation and community engagement to scope the concerns of the chiefdom head and the heads of the sections of projected affected communities.

They indicated that these community consultations and engagements are key to ensuring a peaceful co-existence of MML and project-affected communities. They furthered that these engagements are the best means of communication and information-sharing platform between the communities within the operational area of MML and the company.

Figure 6- 3: Stakeholder Engagement Session with Paramount Chief and Section Chiefs

6.4.3 Impact of MML's Operations on Projected Affected Communities within

6.4.3.1 Marampa Chiefdom

The single, most outstanding impact of the operations of MML on project-affected communities around the concession area of MML is the impact of mining on agricultural activities. Most community residents engaged in discussions on the impact of the operations for MML indicated that there is a huge impact of mining operations on inland valley swamps in most of the eight affected communities in the Mawullay Section and all the seven project-affected communities in the Marampa Section. They stated that the operations of MML and all the preceding companies (London Mining and SL Mining) have seriously affected inland valley swamps which are the main ecology for rice cultivation in the project-affected communities.

This concern was also expressed by the Section Chiefs of the two projected affected Sections and the Paramount Chief of Marampa Chiefdom. Stakeholders and community members interviewed affirm that water has progressively taken up swamps and has made them non-cultivatable for rice production during the dry season and vegetable production during the dry season. All key stakeholders engaged and community members interviewed expressed great concern over the impact of the operations of MML and its predecessors on livelihoods and especially on agriculture which is the main economic occupation of residents of project-affected communities in the two sections within Marampa Chiefdom.

6.4.3.2 Marampa Section, Marampa Chiefdom, Port Loko District Chaindata Community

Flooding during the rainy season due to the operations of MML has affected streams, rivers, and other sources of potable water on which communities depend for domestic, agricultural and other purposes. These water sources are either inaccessible or contaminated by the operations of the mines. Most of the community water sources like streams, rivers, springs and boreholes have been either covered by tailings or contaminated by the operations of MML. Hence there is limited access to potable water within the community due to the operations of MML.

IVS are the most viable ecological platform for the cultivation of rice in the community which is the staple food for inhabitants. Community members stated that they use to cultivate rice twice a year before the commencement of the operations of the mines. However, tailing from the operations of MML have covered the swamps and in some areas, the IVS are permanently flooded throughout the year and little cultivation can be done on IVS.

The operations of MML have led to a cut-off of community access roads and have affected the accessibility of the community. Commuting to and from the community is now more difficult and costly than it used to be. This has affected the cost of transportation and foodstuffs due to inaccessibility.

Extortion of money from checkpoints set up by MML and SLP; there are two checkpoints in total, one manned by MML security personnel and another manned by SLP. They confirmed that the extortion of money is mainly from the checkpoint manned by SLP. This has increased transportation costs and the cost of commodities that are mainly transported to and from the township of Lunsar.

Very little employment for community youths in the mines and in most cases, they have temporary employment in odd jobs. Community members reported that although MML committed to progressive rehabilitation and reclamation, there has been no reclamation and rehabilitation done since the commencement of its operations. This has left a vast acreage of land that is out of use because it has not been reclaimed and rehabilitated.

The implementation of CDAP has not been realized by project-affected communities, contrary to the terms and conditions of the EIA License. MML has also not shown any commitment towards its CSR in assisting project-affected communities.

6.4.3.3 Maforki Community

The operations of MML and previous mining companies like SL Mining, Frank Timis and London Mining Limited have acquired so much concession area that there are limited farmlands and IVS available to community inhabitants to practice farming. Farming is the main economic activity that employs almost every inhabitant in the community and is the main source of food and income for the large majority of households in the community. Where land is available, its either marginal and unproductive or it has been incapacitated for farming activities by the operations of MML and its predecessors.

6.4.3.4 Manonkoh Community

There is no employment for the community workforce. Most of the jobs are outsourced to other people that are not residents and indigenes of the project- affected communities even in situations where some of the jobs can be executed by community members. Participants highlighted that they were promised to have jobs that they can perform once the mines is operational.

Due to the operations of MML, water has flooded all access roads leading to the community. Another impact of the water from the operations of the mines is that IVS and most farmlands are flooded and are out of cultivation since the commencement of MML's operations.

MML has not met its obligation in terms of mitigation measures for the impact of its operations on projected affected communities. The implementation of CDAP has not been realized by project-affected communities, contrary to the terms and conditions of the EIA License. MML has also not shown any commitment towards its CSR in assisting project-affected communities.

6.4.3.5 Magbil Community

Participants reported that this is one of the closest communities to MML's concession site and hence bears some of the greatest impacts of the operations of the mines.

Representatives from this community reported that one of the greatest impacts on community health from the operations of MML is vibration and noise. They stated that MML operates round the clock on three shifts and that the impact of noise and vibrations from machinery and equipment is affecting the health and well-being of community members.

6.4.3.6 Magbenthay Community

Extortion of money from checkpoints set up by MML and SLP; there are two checkpoints in total, one manned by MML security personnel and another manned by SLP. Participants of FGD revealed that due to the extortion of money from commercial bike riders by the SLP manned checkpoint, transportation costs to commute to and from project-affected communities and the prices of both local and imported commodities have increased considerably and increased the burden on community members in addition to the hardship that they are already enduring due to economic instability in the country.

6.4.3.7 Robela Community

There is considerable impact on IVS by the operations of MML due to tailings from the mines covering IVS and in some cases, the IVS are flooded. Men use to cultivate rice during the rainy season in IVS and women cultivate vegetables and leguminous crops during the dry season. This has affected the food security status of households within the community and other project-affected communities, participants confirmed.

Community members reported that one of the impacts on community health from the operations of MML is vibration and noise. They stated that MML operates round the clock on three shifts and that the impact of noise and vibrations from machinery and equipment is affecting the health and well-being of community members.

Another impact reported from the operations of MML is the effect of blasting on dwelling units. Participants and community leaders reported that blasting by MML has affected most of the dwelling units within the community and has caused considerable damage to the ageing (mostly mud-constructed) houses.

6.4.3.8 Mathukia Community

Representatives of this community during FGD indicated that this is one of the communities that fall within the new concession area of MML's expansion. They have no documentation of the proposed expansion of MML's concession area to their community. They reported that there has been a crop assessment but they are not aware of the outcome of the assessment and hence they are not certain of the crop compensation. They reported blasting as one of the main impacts of the operations of MML on their community has affected infrastructure (mostly houses) and human health.

Another considerable impact of MML's operations is on IVS and farmlands due to tailings from the mines covering IVS and in some cases, the IVS are flooded. They furthered that Men use to cultivate rice during the rainy season in IVS and women cultivate vegetables during the dry season. This has affected the food security and income status of households within the community.

Attendance records of stakeholders that participated in the meetings are shown in the appropriate annexure.

Table 6- 4: Various Engagements and Meetings

	
Engagement Meeting with Section Chief and Community Heads of Project Affected Communities within Marampa Chiefdom.	***Stakeholder Meeting with Section Chief and Representatives of Land Owning Families within Marampa Section***
	
Engagement Meeting with Community Leaders and Community Members at Magbil	

6.4.4 Mawullay Section, Marampa Chiefdom, Port Loko District Mawullay Community

There has been no form of CDAP implementation by MML in the community even though there were numerous community development projects highlighted in the ESHIA documents of MML and its predecessors (Frank Timis, SL Mining and London Mining Company). Participants reported that project-affected communities by the operations of the mines will benefit from the implementation of CDAP and CSR of the company.

This community is situated close to the Rokel River which forms the boundary between Marampa and Masimera Chiefdoms. Community members reported that the quality of water in the river has changed considerably over the years and the water is very turbid and mostly not usable for domestic purposes during the dry season when the volume of water in the river dwindles considerably. However, participants stated that they can't ascertain whether this impact is associated with the operations of MML.

Noise and vibration from machinery and equipment due to the operations of the mines are affecting the community and have an impact on the community's health. Some members of the community are elderly and have an ailment that is aggravated by noise pollution.

The community members also reported that there has been no realization of employment of community members from MML. Most of the jobs that can be performed by employable members of the community have been outsourced to other people who are not residents of indigenes of the project-affected communities.

6.4.4.1 *Mamanso Community*

The chiefs and representatives of land-owning families reported that the payment of surface rent has not been done as per the agreement signed between the MML and project-affected communities. The payment has been made in tranches rather than holistically.

Participants reported that as per the agreement, all section chiefs within the concession of MML should have a specific quota of persons from their communities they can recommend for employment in the mines. This has not materialized and it has never been implemented.

The implementation of CDAP has not been realized by project-affected communities, contrary to the terms and conditions of the EIA License. MML has also not shown any commitment towards its CSR in assisting project-affected communities.

Community participants reported that the operations of MML and its predecessors have affected and impacted the quality of water in the Rokel River. This river is the main source of water for the Mamanso community and many other communities within the section. They use the water for domestic purposes and fishing and irrigation, especially during the dry season.

Another impact reported by participants during the focus group discussion is the impact of the operations of MML on infrastructure such as roads. They complained that some of the community access roads to and from the township of Lunsar have been completely cut off by MML. The optional roads to and from Lunsar are normally very dusty (during the dry season) and muddy (during the rainy season) and cost more to commute due to distance.

6.4.4.2 *Katik Community*

This community is reported to be located very close to MML's Mines site and bears very great impact from noise pollution, vibration and other associated effects of these impacts. Noise and vibration from machinery and equipment due to the operations of the mines are affecting the community and have an impact on the community's health. Some members of the community are elderly and have an ailment that is aggravated by noise pollution.

Sand mining by community members has been stopped due to the operations of MML as the area where sand is mined falls within the concession site of MML. Community members stated that sand mining use to one of the main non-farm activities performed by inhabitants of this community to generate income. The income generated supplements the proceeds from farming which is the main source of livelihood for the large majority of community members.

The community members also reported that there has been little employment of community members from MML. Most of the jobs that can be performed by employable members of the community have been outsourced to other people who are not residents of indigenes of the project-affected communities. In most cases, the few community members employed are on a contract that can be terminated at any time without notice and no benefits are paid, and in some cases, those employed do not retain their employment after a month or two.

Community members expressed their fear of the expansion of the operations of MML. They presented their concerns about the impact of the expansion of MML's Operations on livelihood activities, mainly farming. In their opinion, the expansion of the operations of MML will take more farmlands and impact more IVS. These ecological platforms are the foundation on which farming is anchored.

6.4.4.3 Konta Bana Community

Community members complained that MML has acquired so much concession area that there are limited farmlands and IVS available to community inhabitants to practice farming. Farming is the main economic activity that employs almost every inhabitant in the community and is the main source of food and income for the large majority of households in the community. Where land is available, its either marginal and unproductive or it has been incapacitated for farming activities by the operations of MML and its predecessors.

Community members also presented their fear of relocation and resettlement and stated that the surveyed concession for the expansion of the operations of MML is very close to their community. They also expressed that they have rumours that Konta Bana will be likely resettled.

There were reports by community members of Konta Bana that community roads have been impacted by the operations of MML. Trucks hauling sand for MML use community access roads and they are in deplorable condition. MML has not, as part of its CSR, done any rehabilitation of community access roads.

6.4.4.4 Masuu Community

The community members also reported that there has been little employment of community members from MML. Most of the jobs that can be performed by employable members of the community have been outsourced to other people who are not residents of indigenes of the project-affected communities. In most cases, the few community members employed are on a contract that can be terminated at any time without notice and no benefits are paid, and in some cases, those employed do not retain their employment after a month or two.

Another considerable impact of MML's operations is on IVS and farmlands due to tailings from the mines covering IVS and in some cases, the IVS are flooded. They furthered that Men use to cultivate rice during the rainy season in IVS and women cultivate vegetables during the dry season. This has affected the food security and income status of households within the community.

Community participants reported that the operations of MML have affected and impacted the quality of water of the rivers and streams within the vicinity of the community. This river is the main source of water for domestic purposes and fishing and irrigation, especially during the dry season. In their view, MML should assist and embark on the provision of potable water for the project-affected community.

6.4.4.5 Magbala Community

The community members also reported that there has been little employment of community members from MML. Most of the jobs that can be performed by employable members of the community have been outsourced to other people who are not residents of indigenes of the project-affected communities. In most cases, the few community members employed are on a contract that can be terminated at any time without notice and no benefit paid.

Community participants reported that the operations of MML have affected and impacted the quality of water of the rivers and streams within the vicinity of the community. This river is the main source of water for domestic purposes and fishing and irrigation, especially during the dry season. They acknowledged that MML has invested in hand-dug wells for some project-affected communities but that these wells have not been sustainable, especially during the dry season when the water table is very low.

It was reported by community participants that MML source most of the sand for its construction and rehabilitation works of the mines from their community and that has affected the condition of community accesses roads due to the plying of haulage trucks along these roads. The roads are very muddy during the rainy season and very dusty during the dry season.

6.4.4.6 Moria Community

The chief and community leaders of Mamoria reported that their community has been removed from the list of communities within MML's concession area. In a separate meeting with land-owning family members, participants stated that there use to be a total of ten communities that fall within the concession area of MML and its predecessors but that Mamoria has been removed from the list. This has affected the benefits that the community used to have from MML.

The community members also reported that there has been a big issue of employment of community members in the mines. There has been no permanent employment for community members and the promised employment quota for each project-affected community has not been fulfilled or honoured.

6.4.4.7 Mapoli Community

Community members also presented their fear of relocation and resettlement and stated that the surveyed concession for the expansion of the operations of MML is very close to their community. They also expressed that they have rumours that the Mapoli community will likely be relocated.

There is no employment for the community workforce. Most of the jobs are outsourced to other people that are not residents and indigenes of the project- affected communities even in situations where some of the jobs can be executed by community members. Participants highlighted that they were promised to have jobs that they can perform once the mines is operational.

Community participants reported that the operations of MML and its predecessors have affected and impacted the quality of water in the Rokel River. This river is the main source of water for communities within the section. They use the water for domestic purposes and fishing and irrigation, especially during the dry season.

Like the previous sections where community engagements and meetings were held with stakeholders, attendance was taken (see the relevant annexure section for the records).

Table 6- 5: Stakeholders Engagement and Focus Discussion Group

<table>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Stakeholder Engagement Session of Community Leaders and representatives of Land Owning
Families within Mawullay Section</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Focus Group Discussion with Women's Leaders of Communities within Mawullay Section</td><td>Meeting of Community Members to discuss project impacts on communities at Mawullay Community.</td></tr>
</table>

6.4.5 MML Actions to address Community Concerns

Despite the frustrations expressed in community engagement meetings, MML is working aggressively to mitigate harms, both real and perceived. The facts are:

Of MML's 3,368 employees, approximately 1,000 are local to the Port Loko District. The company's overall workforce is 92% nationals, a much higher rate than other mining companies in-country. MML is actively deploying Community Development Action Plan (CDAP) funds across 6 project areas (see CDAP update annex) and allocates 1% of free-on-board revenue to the Community Development Fund (CDF). Many of the grievances expressed above are grounded in misperception and misinformation around the company's activities. The reality is that MML is committed to working in harmony with our primary host communities and they will benefit from MML's presence over the long-run.

7 ENVIRONMENTAL IMPACT & MITIGATION

7.1.1 Climate Change

Climate change impacts of the mine, haul road and TRT have been identified based on data collected to date and are summarised in the tables below.

7.1.1.1 Greenhouse Gas Emissions (GHG)

Potential areas of environmental impact of the Project expansion and ongoing operation will add to the national GHG emission baseline, principally through the combustion of fossil fuels to provide electrical energy and motive power but also through removal of long-term carbon sequestration capacity through land use change and the loss of fluorinated gases.

7.1.1.1.1 Marampa Mine

Table 7- 1: Mine Greenhouse Gas Impacts and Mitigation

Impact	Mitigation Measures
Direct GHG emissions from the intermediate/ temporary power supply units. Indirect GHG emissions from the import of electricity from the power station required to meet the energy needs of the Project (for conveyors, electromagnetic ore concentrators etc).	Usage metering. Sub-metering of major consumers. Energy audit.
Direct combustion of liquid fossil fuels by plant, machinery, and vehicles. Diesel-fuelled generators for worker areas. Blasting combustion products.	Fuel supply metering. Operational procedures for running and idling. Preventative maintenance regime. Efficient, procedurals use of explosive.
Diesel engine exhaust emissions from the operation of plant such as excavators, crushers, and trucks; and the operation of diesel fuelled vehicles.	Procurement of fuel-efficient vehicles. Operational procedures for running and idling.
Fugitive losses from any gas insulated electricity substations or refrigeration plant.	Avoidance by design. Substitution by air insulated substations.

7.1.1.1.2 Haul Road

Table 7- 2: Haul Road Greenhouse Gas Impacts and Mitigation

Significant Impact	Mitigation Measures

Diesel engine exhaust emissions from haulage trucks	Fuel supply metering. Operational procedures for running and idling. Preventative maintenance regime.
Land use change effects if additional land is taken for road upgrade, i.e., lay yard, borrow pit.	Minimisation of land take for law down yard and borrow pits.

7.1.1.1.3 Thofayim River Terminal (TRT)

Table 7- 3: Port Greenhouse Gas Impacts and Mitigation

Significant Impact	Mitigation Measures
Whilst there is excess power capacity available at TRT, the increased energy requirements of the project expansion operations means that some or all of this capacity must be realised with additional indirect GHG emissions.	Usage metering. Sub-metering of major consumers. Energy audit. Fuel supply metering. Preventative maintenance regime.
Diesel fuelled power generation at the TRT is expected to increase due to the project expansion.	Fuel supply metering. Operational procedures for running and idling. Preventative maintenance regime.
Diesel exhaust emissions from transhipment to deep water loading. Diesel engine exhaust emissions from the operation of heavy plant such as excavators, and trucks; and the operation of diesel fuelled vehicles.	Procurement of fuel-efficient vehicles. Operational procedures for running and idling.

7.1.1.2 Climate Risk

7.1.1.2.1 Climate Risk Assessment

MML is currently conducting a climate risks and opportunities (CROs) assessment as per the recommendations of the Task-force on Climate-related Financial Disclosures (TCFD). Physical assets that comprise the infrastructure of the mine site will be examined for their physical, geographic, and temporal vulnerability to physical risks due to climate.

A baseline climate scenario will be developed, based on existing and historical climate data, to show the principal characteristics of the local climate. Using internationally recognized sources of information on climate projections, a future climate scenario will be built, to show how the local climate can change during the period of development.

MML conduct carbon accounting on an annual basis. The results are published in the company's Sustainability Report. The 2022 Sustainability Report is included as an annex to this report.

Table 7- 4 : Climate Risks and Mitigation

Illustrative Climate Risk	Mitigation Measures
Increased intensity and duration of extreme weather events, leading to risks to mine infrastructure.	Stormwater management measures. Emergency response procedures and flood forecasting.
Increased soil erosion due to increased rainfall intensity.	Implement appropriate soil erosion controls for mine, haul and terminal.
Health impacts on staff due to temperature changes (e.g., risks of greater disease, heat stress).	Devise appropriate Health and Safety management system.

7.2 Air Quality

Air quality impacts of the mine, haul road and terminal have been identified based on data collected to date and are summarised in the tables below.

Table 7- 5: Air Quality Impact and Mitigation Measures

Impact	Mitigation Measures
Mine	
Impacts arising from mining activities: Emissions of TSP, PM_{10} and $PM_{2.5}$ from fugitive emissions, haul roads, drilling, blasting ore-handling, crushing, transport, stockpiling and ore-processing. Emissions of NO_2, SO_2 and PM_{10} from vehicle traffic exhausts at the mine site, i.e., in-pit haul trucks, dozers, excavators, and drills.	Control of TSP, PM_{10} and $PM_{2.5}$. Use of engines compliant with required emission limits. Use of appropriate fuel sulphur content.
Impacts arising from power generation units: Emissions of NO_2, SO_2 and PM_{10} from generator units.	Use of appropriate fuel sulphur content.
Impacts from unpaved roads: Emissions of TSP, PM_{10} and $PM_{2.5}$.	Control of TSP, PM_{10} and $PM_{2.5}$.
Haul Road	
Impacts from haulage truck exhausts: Emissions of NO_2, SO_2 and PM_{10}.	Use of engines compliant with required emission limits. Use of appropriate fuel sulphur content.

Impacts from unpaved roads: Emissions of TSP, PM_{10} and $PM_{2.5}$.	Mitigation for control of TSP, PM_{10} and $PM_{2.5}$.
Terminal	
Impacts arising from material handling activities: Emissions of TSP, PM_{10} and $PM_{2.5}$ from fugitive emissions, ore-handling, transport, and stockpiling. Emissions of NO_2, SO_2 and PM_{10} from vehicle traffic exhausts at the port site, i.e., dozers and excavators.	Control of TSP, PM_{10} and $PM_{2.5}$. Use of engines compliant with required emission limits.

7.2.1.1 *Impacts Associated with Incineration*

General waste has been generated through all phases of the project. These materials are disposed of primarily by incineration and land filling. Incineration has been carried out in modern equipment meeting strict emissions standards. Consequently, negative impacts on air quality are not expected to occur because of the small scale of these activities.

7.2.1.2 *Emissions Associated with Transhipment*

There will be regular movements of coaster along the shipping route the terminal service jetties during operations. Emissions from these ships are not considered further as it is generally accepted that air quality issues only arise at the biggest ports, and that ports with shipping movements of less than 5000 vessels per annum, are unlikely to be associated with significant impacts on local air quality. Additionally, the TSV fleet will not increase the overall number of shipping movements as they are bigger and require less assistance from the local tug fleet.

7.2.1.3 *Non-plant traffic at the mine:*

Emissions from mobile mine facilities (such as excavators and dump trucks) were included in the detailed assessment. However, road vehicles, including heavy vehicles, cars and other trucks have not been included. The basis for this is that it is expected that there will only be a small number of these types of vehicles on site, and that emissions from the mobile plant will dominate impacts.

7.3 Noise and Vibration

Impacts from the Project being considered for both the construction and operational phases are:

- airborne noise.
- underwater noise.
- vibration; and
- blasting (air blast overpressure and ground vibration).

The likely occurrence of these impacts in the respective Project areas is presented in Table 7-6.

Table 7- 6: Likelihood of Noise, Vibration and Blasting Impacts

	Construction Impacts and Mitigation			
Project Area	**Noise**	**Vibration**	**Blasting**	**Underwater Noise**
Mine	Unlikely	Unlikely	n/a	N/A
Haul Road	Possible	Possible	Unlikely	N/A
TRT	Possible	Unlikely	N/A	Likely
	Operational Impacts and Mitigation			
Project Area	**Noise**	**Vibration**	**Blasting**	**Underwater Noise**
Mine	Likely	Unlikely	Possible	N/A
Haul Road	Likely	Possible	N/A	N/A
TRT	Unlikely	N/A	N/A	Possible
	Cumulative Impacts			
	▪ There is potential for cumulative impacts to occur from the interaction of the following operations: ▪ MML Mining haul road and the railway operations at mammy Nancy Junction; and ▪ MML shipping operations and Leone Rock ship loading operations at the Pepel port.			

Table 7- 7 : Noise, Vibration and Blasting Mitigation

Impact	Mitigation Measures
Construction noise - general	Offset buffers between receptors and construction sites Location of equipment Equipment selection and maintenance Barriers and screening Duration of construction and time of day Construction Management Plan Respite periods Temporary relocation
Construction noise and vibration from piling (including underwater noise)	Use of soft starts, shrouds Management procedures Respite periods Temporary relocation Seasonal variation in presence of sensitive marine species

Operational noise	Bunds or barriers Enclosure of fixed plant Equipment selection and maintenance Exhaust mufflers and equipment specific treatments (eg dozers, haul trucks, loaders etc) Planning of vehicle routes and locations Operational planning and scheme design Avoid working in exposed locations during the night-time through scheduling of operations Resettlement should noise-levels be unacceptable
Blasting	If blasting can be avoided, use free digging and ripping of material Reduced charge weight Stemming and blast design Monitoring and prediction Blast Management Plan

All the identified possible or likely impacts can be mitigated, and the need for mitigation is sometimes dependent on other factors such as separation distances, scheme design and other factors that are not known until further studies are completed.

However, for some aspects, there is a high level of confidence in the assessment of the likelihood for impacts to occur, as outlined below for each of the Project areas.

7.4 Water Resources

Water Resources impacts of the mine, haul road and the terminal have been identified based on data collected to date and are summarised in the tables below.

Table 7- 8: Water Resources Impacts & Mitigation

Impacts	Mitigation measures
Construction	
Impacts to watercourse quality and flow during dam construction works, temporary and permanent diversions, watercourse crossings and other facilitating works close to, within, over watercourses and drainage channels.	▪ Embedded mitigation: avoidance and abatement where possible through appropriate siting and design. ▪ Code of Construction Practice (CoCP) mitigation plans covering use, storage, and handling of materials. ▪ Method statements for specialist works *e.g.*, diversions. ▪ Monitoring programme.
Impacts to ground and surface water quality and flow associated with use of concretes, dewatering, excavations, piling, grouting	▪ Embedded mitigation: avoidance and abatement where possible. ▪ CoCP and method statements for specialist works, including dewatering informed by Mine Dewatering Plan, excavations below the water table, piling, grouting / ground treatments, concrete use.
Impacts to groundwater quality from the mobilisation of previous areas of contamination within the active mine site.	▪ Further assessment required to identify potential areas at risk ▪ Soil sampling surveys and monitoring where pre-existing contamination is suspected or known

Impacts	Mitigation measures
Impacts to surface and ground water quality associated with the handling and storage of fuels, oils, other pollutants, and waste streams.	▪ Application of good practice pollution prevention and control guidance and procedures for handling, storage, minor leaks, and spills. ▪ Monitoring programme.
Quality impacts associated with waste rock dumps and use of waste rock as ballast for access roads.	▪ Measures (*e.g.*, Monitoring programme and waste rock handling procedures) to be informed by geochemical sampling and laboratory testing programme, modelling.
Impacts to catchment drainage flows and groundwater recharge due to ground-clearance, top-soil stripping, profiling, cut and fill and site road construction. Secondary impacts upon water quality and flooding through the mobilisation of sediments and debris, together with the alteration of flow pathways.	▪ Embedded mitigation: avoidance and abatement where possible through design. ▪ CoCP to include procedures for topsoil and materials storage, drainage system maintenance, erosion control. ▪ Flood Risk Assessment (FRA) and Drainage Strategy to inform materials storage and temporary drainage. ▪ Monitoring programme.
Impacts to water environment and downstream users associated with increased water use and discharges	▪ Measures to be informed by site water balance and catchment modelling. ▪ Mitigation and monitoring programme to be developed in conjunction with Social and Ecological Impact Assessment teams.

Impacts	Mitigation measures
Impacts to water quality associated with increased pressure on wastewater treatment systems.	▪ Additional capacity to be provided.
Induced activity effects to catchment drainage, the riparian environment and watercourse quality and flow associated with access for the Project facilitating colonisation, land clearance and artisanal gold mining activities.	▪ Mitigation and monitoring programmes to be developed in conjunction with Social and Ecological Impact Assessment teams.
The phased extraction schedule introduces the potential for cumulative impacts to the water environment during the project expansion stages.	▪ Development of a combined (overarching) or integrated programme of mitigation controls across phases.
Operation	
Significant impacts to the Bath Bana and Baki catchments associated with the operation of RWDs, TSFs, diversions, crossings, and loss of natural channel: *i.e.*, catchment conversion and loss of natural character.	▪ Embedded mitigation: avoidance and abatement where possible through appropriate siting and design. ▪ Design, and mitigation requirements to be informed by further baseline monitoring, catchment modelling and assessment in conjunction with Ecology Impact Assessment team.
Impacts to catchment drainage, flooding, water quality and flows associated with the operation of RWDs and TSF's.	▪ Design, and mitigation requirements to be informed by further baseline monitoring, catchment modelling and assessment of ecological low flows, sediment tolerance in conjunction with the Ecology Impact Assessment team.

Impacts	Mitigation measures
Impacts to watercourse quality associated with process discharges and sediment mobilisation.	▪ As above. ▪ Erosion control and drainage system design.
Impacts to groundwater quality, flow and recharge associated with HMC extraction and dewatering. Permanent secondary impacts to spring-fed baseflow provision to watercourses affecting seasonal flows and water availability.	▪ Mitigation to be informed by catchment modelling, further hydrogeological, ecological, and social (water dependency) assessment. ▪ Mitigation and monitoring programme to be developed in conjunction with Social and Ecological Impact Assessment teams. ▪ Dewatering measures informed by Mine Dewatering Plan.
Contamination of groundwater by acid rock drainage beneath TSF, waste rock areas, ore stockpile and mine pit areas	▪ Measures (*e.g.*, monitoring programme and waste rock handling procedures) to be informed by geochemical sampling and laboratory testing programme and modelling.
Contamination effects from an increase in machinery, HMC processing plants and use of explosives	▪ Measures (*e.g.*, monitoring programme, storage, and handling procedures) to be informed by catchment and contaminant transport modelling.

Impacts	Mitigation measures
Impacts upon water availability due to increased water use (for extraction and saprolite processing). Potential for impacts to mine operation also associated with water limitations within the upper Bath Bana catchment.	▪ Mitigation to be informed by site water balance and further assessment
Impacts to surface and ground water environment and downstream users associated with increased water use and discharge	▪ Measures to be informed by site water balance and further assessment. ▪ Mitigation and monitoring programme to be developed in conjunction with Social and Ecological Impact Assessment teams
Exacerbation of potential water availability and flooding issues due to future climate change over the Project's lifetime. Impacts to downstream users, abstractors and to business continuity for the mine.	▪ Risk to be further quantified and resistance / resilience mitigation to be informed by engineering design, Climate Change Assessment and FRA
Impacts upon surface water flows and surface water flooding associated with changes to the Study Area's profile and the installation of infrastructure (site roads, plant, hardstanding).	▪ Mitigation to be informed by further assessment and FRA. ▪ Appropriate drainage design and erosion control measures
Impacts to surface and ground water quality associated with the handling and storage of fuels, oils, other pollutants, and waste streams	▪ Application of good practice pollution prevention and control guidance and procedures for handling, storage, minor leaks, and spills.
Impacts to water quality associated with increased pressure on wastewater treatment systems	▪ Additional capacity to be provided

Impacts	Mitigation measures
Induced activity effects to catchment drainage, the riparian environment and watercourse quality and flow associated with access for the Project facilitating colonisation, land clearance and artisanal gold mining activities.	▪ Mitigation and monitoring programme to be developed in conjunction with Social and Ecological Impact Assessment teams
Non-Routine / Emergency Events	
TSF and RWD breach	▪ Mitigation to be informed by engineering design. To include contingency planning and warning procedures.
Risks to construction, site assets and operations because of large storm and flood events	▪ Contingency planning.
Impacts to ground and surface water quality associated with large leaks and spills of materials with polluting potential (*e.g.*, fuels, oils)	▪ Implementation of good practice including appropriate primary and secondary containment of fuels, oils. ▪ The implementation of good practice handling, storage, and disposal procedures. ▪ Spill procedures and contingency planning informed by groundwater contaminant transport model.
Closure	

Impacts	Mitigation measures
The phased extraction schedule introduces the potential for cumulative impacts to the water environment during the closing stages MML operations. Potential for impacts to catchments as water use changes / ceases within certain areas causing water balance (e.g., potential flooding, groundwater rebound) and water quality issues. The extent of temporary and permanent changes to the water environment will be dependent upon the restoration of disturbed areas and the retention / restoration choices made with respect to ore extraction areas and water storage features such as the TSFs and RWD.	▪ Development of a combined (overarching) or integrated programme of mitigation controls across phases ▪ Mine closure and restoration planning ▪ Post-closure monitoring

7.5 Geology and Soils

7.5.1 Mine and Haul Road

Impacts of the mine, the haul road and TRT on geology and soils have been identified based on data collected to date and are summarised in the tables below.

Table 7- 9: Geology and Soils Impacts & Mitigation

Impacts	Mitigation Measures
Expansion Construction	
Burial, removal, or erosion of soils resulting in loss of potential agricultural resource.	▪ Further assessment required in conjunction with Ecosystem Services and Water resources teams to determine baseline quality and significance. ▪ Implementation of appropriate erosion control and soil management procedures
Impacts to ground and soil quality from the mobilisation of pre-existing contamination.	▪ Further assessment required to identify potential areas at risk. ▪ Soil sampling surveys and monitoring where pre-existing contamination is suspected or known.
Operation	
Burial, removal, or erosion of soils resulting in loss of potential agricultural resource	▪ Further assessment required in conjunction with Ecosystem Services and Water resources teams to determine baseline quality and significance. ▪ Implementation of appropriate erosion control and soil management procedures.
Localised contamination associated with the handling and storage of fuels, oils, other pollutants, and wastes.	▪ Application of good practice pollution prevention and control guidance and procedures for handling, storage, minor leaks, and spills.
Impacts to ground and soil quality from the mobilisation of pre-existing contamination.	▪ Further assessment required to identify potential areas at risk. ▪ Soil sampling surveys and monitoring where pre-existing contamination is suspected or

	known.
Non-Routine / Emergency Events	
Contamination effects from large leaks and spills of materials with polluting potential (*e.g.,* fuels and oils)	▪ Implementation of good practice including appropriate primary and secondary containment of fuels and oils ▪ Implementation of good practice handling, storage, and disposal procedures ▪ Spill procedures and contingency planning informed by groundwater contaminant transport model.
Closure	
Residual stress on soil resources from increased agricultural activity due to improved access.	▪ Development and updating of appropriate closure management plans to include after closure site-use and community consultation.
Cumulative	
Potential cumulative impacts to geology and soils primarily include those that may reduce the available area of agricultural grade land or cause a degradation in ground or soil quality.	▪ Mitigation will be focused upon the minimisation of impacts to geology and soils from the Project, which will reduce the potential for cumulative impacts to occur. Specific mitigation will be applied where deemed necessary following further assessment at ESHIA stages.

7.5.1.1 Thofayim River Terminal (TRT)

Table 7- 10: Geology and Soils Impacts & Mitigation

Impacts	Mitigation Measures
Construction	
Impacts to ground and soil quality from the mobilisation of pre-existing contamination.	▪ Further assessment required to identify potential areas at risk. ▪ Soil sampling surveys where pre-existing contamination is suspected or known. ▪ Monitoring programme.
Impacts to ground and soil quality associated with the handling and storage of fuels, oils, other potential pollutants, and waste streams.	▪ Application of good practice pollution prevention and control guidance and procedures for handling, storage, minor leaks, and spills.

Contamination by acid rock drainage and acid sulphate soils.	▪ Acid sulphate soils research study focusing on the site and including consideration of development platform fill material. ▪ The development and implementation of appropriate mitigation / monitoring / construction procedures based on findings.
Operation	
Impacts on soil quality arising from site run-off, erosion, site discharges, saline intrusion.	▪ Implementation of appropriate discharge and erosion control procedures and monitoring measures. ▪ Implementation of appropriate water supply measures.
Contamination of soils by ARD under stockpiles.	▪ Qualitative study on likely risk levels based on results of geochemistry study at the mine. ▪ Development of monitoring and management plans based on the findings of the study. ▪ Implementation of appropriate monitoring, ore handling and waste rock handling procedures.
Impacts to ground and soil quality from the mobilisation of pre-existing contamination.	▪ Further assessment required to identify potential areas at risk. ▪ Soil sampling surveys where pre-existing contamination is suspected or known. ▪ Monitoring programme.
Localised contamination associated with the handling and storage of fuels, oils, other pollutants, and wastes.	▪ Application of good practice pollution prevention and control guidance and procedures for handling, storage, minor leaks, and spills.
Non-Routine / Emergency Events	
Contamination effects from large leaks and spills of materials with	▪ Implementation of good practice including appropriate primary and

polluting potential (*e.g.*, fuels and oils).	secondary containment of fuels and oils ▪ The implementation of good practice handling, storage, and disposal procedures. ▪ Spill procedures and contingency planning informed by groundwater contaminant transport model.
Closure	
TRT infrastructure is likely to remain operational as a legacy component for national use.	▪ Extent and form of mitigation required to be further informed by decommissioning / handover planning.
Cumulative	
Potential cumulative impacts to geology and soils primarily include those that may reduce the available area of agricultural grade land or cause a degradation in ground or soil quality.	▪ Mitigation will be focused upon the minimisation of impacts to geology and soils from the Project, which will reduce the potential for cumulative impacts to occur. Specific mitigation will be applied where deemed necessary following further assessment at ESHIA stages.

7.6 Terrestrial Ecology

Potential ecological impacts of the mine, haul road and TRT that EMS has identified based on data collected to date are summarised in the table below.

Table 7- 11: Impacts on Terrestrial Ecology & Ecosystem Services

Impact	Mitigation measures
Mine	
Loss, degradation, and fragmentation of critical habitat for biodiversity, particularly hillslope and riverine forest habitat with high plant and faunal species diversity (direct impact) resulting in extirpation or extinction of populations of several rare and endangered species.	▪ Minimise mine and haul road footprint. ▪ Engage local communities to minimise unsustainable land use practices in biodiversity rich areas ▪ Compensate for loss of biodiversity by increasing protection of nearby areas of conservation value. ▪ Develop a constraints map of ecologically important areas to assist with project design and layout. ▪ Investigate the need and options for implementing a biodiversity offset and compensation measures. ▪ Engage conservation and forestry stakeholders, and community representatives on offset implementation.

Impact	Mitigation measures
Increased exposure of iron rich bare slopes causing microclimatic changes (increased heating and reduced moisture) leading to habitat degradation. Degradation of riverine forest in the Bath Bana, Baki and Rokel Rivers and extinction of rare and endangered plant species. Increased access from existing roads and presence of mine will lead to continued human in-migration (jobseekers) causing increased loss of forest habitat through cultivation and logging. In-migration and population expansion are threatening the survival of the remaining fauna and flora within the mine and haul Road.	▪ Monitor ambient moisture and temperature in mine areas and track changes. ▪ Construction appropriate diversion channels and sediment detention ponds. ▪ Search and rescue of plants and translocation to biodiversity offset area. ▪ Strengthen and expand the indigenous plant nursery programme with community members. ▪ Develop a detailed Rehabilitation Action Plan. ▪ Develop and implement a Plant Search and Rescue and Translocation Plan, especially for species threatened with extinction. ▪ Identify suitable biodiversity offset or compensation areas and develop a Biodiversity Offset Plan. ▪ Implement measures to minimise human in-migration (e.g., appropriate job recruitment). ▪ Implement environmental education and alternative livelihood strategies to reduce forest dependence. ▪ Develop a joint initiative with MML and MAFF ▪ Develop and implement an Integrated Alternative Livelihoods Plan. Focus on sustainable agriculture and training for job opportunities e.g., nursery assistants, forest guards, waste recycling/ composting etc. ▪ Develop / expand Community Engagement Strategy including environmental awareness on forest protection.
Haul Road	
Loss of forest habitat in haul road footprint, particularly at river crossings. Increased noise and light disturbance on fauna. Loss or reductions to ecosystem services to local communities such as natural resources used for food, medicine, and building; reduced water quality and flow regimes important for drinking supply and fishing; and	▪ Minimise construction footprint through identifying alternatives to minimise habitat loss and spoil deposition impacts. ▪ Strictly control deposition of spoil material outside of priority areas. ▪ Appropriate lighting design ▪ Noise control measures such as buffer zones and noise screening. ▪ Minimise loss of flora of primary importance for provisioning services (forest fruit, food, medicines, timber etc.) and for cultural/spiritual uses. ▪ Set aside forest areas of high value for community purposes to inform mine layout and development. ▪ Maintain quality and flow of rivers and streams used by communities for water supply and fishing by

Impact	Mitigation measures
loss of habitat used for spiritual and cultural purposes.	managing erosion and sedimentation and pollution risks. ▪ Develop a detailed constraints map demarcating areas of high value for ecosystem services to aid project planning and design. ▪ Develop an Erosion and Sediment Control Plan. ▪ Develop and Implement a Rehabilitation Plan
TRT	
Limited further direct loss of habitat is expected for TRT development. However, loss and degradation of mangrove habitat due to clearance and increased sedimentation may arise. Increased human influx attracted by TRT expansion causing degradation of terrestrial natural ecosystems.	▪ Minimise construction footprint. ▪ Effective rehabilitation of bare slopes. ▪ Monitoring and maintenance of sedimentation ponds. Environmental awareness of staff and community on environmental protection.
Cumulative	
Cumulative loss of forest habitat and biodiversity to the whole mine haul road and terminal within the projects predicted area of influence. Includes forest loss associated with population resettlement and in-migration (such as impacts from forest clearance for cultivation, hunting and logging).	▪ Undertake coordinated planning of resettlement with within the identified area of influence. ▪ Effectively manage in-migration through appropriate job recruitment mechanisms and emphasis on local recruitment and training.

7.7 Fresh Water Ecology

7.7.1 Mine and Haul Road

Table 7- 12: Fresh Water Ecology Impact and Mitigation Measures

Impact	Mitigation Measures
Direct loss of the habitat used by aquatic species (including species of conservation importance) occurring within the mine development footprint, including TSF areas.	A combination of mitigation measures is considered likely to be necessary including: Restriction of footprint area through delineation of set-aside areas upstream of impacts. Removal and exclusion of species of conservation importance in advance of destructive works, and translocation of individuals removed to suitable pre-identified refuge site(s). Diversion of the river section prior to destructive works to create new habitat to replace that to be lost. Identification of an offset area for protection/enhancement (will require commissioning of additional survey work to identify suitable areas).
Indirect loss of functional habitat used by aquatic species (including species of conservation importance) due to significant flow depletion caused by mining activities including dewatering and excavation and downstream of dam wall construction.	Compensation flow releases which should be seasonally adjusted to mimic natural conditions.
Change in aquatic species composition and relative abundances at the expense of species of conservation importance due to modification of habitat within the inundation area of the Raw Water intake from flowing to still conditions. Impacts may be direct (removal of habitat conditions required for the perpetuation of the species).	Offsetting through protection/restoration of other areas where the affected species occur. Mitigation will need to be informed by a desk study to determine the sensitivity of species present to inundation impacts.
Mortality and sublethal effects to species of conservation importance occurring downstream of mine works due to high levels of suspended sediment in the water column and siltation of habitat, caused by ground	Maintenance of an adequate riparian buffer zone in all areas where this is possible. This buffer zone should extend for 100 m from each bank top where the landform allows. Other measures include dust suppression and erosion control measures such as

disturbance, runoff and settling of dust. Impacts may be direct or indirect, as prolonged turbidity may cause a decrease in prey availability for carnivorous species and inhibit the growth of aquatic plants which form the diet of some herbivorous species.	appropriately sized sediment traps and re-vegetation of disturbed ground. Where possible, construction should occur in the dry season only and vegetation allowed to re-establish in disturbed areas before the rains commence.
Mortality and sublethal effects to species of conservation importance occurring downstream of mine works due to toxic substances entering the river from the mine site in runoff and due to accidental events.	An adequate water management system should be in place to prevent discharges of toxic substances to watercourses and regular water quality monitoring should occur. Emergency response plans should be in place for accidental events. A riparian buffer zone should be maintained in all areas where possible to trap pollutants before they reach the watercourse. Where possible, this buffer zone should extend for 100 m from the riverbanks.
Interference with fish movement and migratory cues due to dam walls creating physical barriers and flow deprivation in river reaches downstream of dam walls.	Installation of fish passes and adjusted compensation flow releases at the appropriate time of year.
Mortality and stress to species (including species of conservation importance) within mine works areas where the river is retained due to removal of vegetation from river sections causing a removal of leaf litter and terrestrial invertebrate nutrient input to the system with knock-on effects on food availability.	Minimisation of vegetation clearance ensuring maintenance of an overhanging riparian zone.
Permanent fragmentation of wetland areas due to barrier creation, cutting peripheral areas off from their water supply and leading to seasonal drying out and mortality of fish of conservation importance.	Wetland habitat connectivity should be always maintained through the installation of bridges/culverts plus any diversions necessary to allow the free passage of fish.
Mortality and sublethal effects to aquatic organisms of conservation importance caused by high levels of suspended sediment in the water	Road crossings should be designed to minimise scour and protect channel banks against erosion. Following construction and upgrade operations, riverbanks should

column and siltation of habitat, caused by erosion due to inadequate stabilisation of the embankments at water crossings and in areas where the road works occur close to the river.	be stabilised with rip rap and vegetation to minimise siltation as the result of erosion.
Creation of barriers to fish migration due to poorly designed and constructed road crossings.	Road crossings should be designed and installed to ensure that flows are not restricted, and that free passage of fish is always possible. Culverts should be positioned to avoid habitats of high conservation interest where possible.
Stress to and mortality of aquatic organisms of conservation importance caused by accidental spills such as fuel and oil into the river during construction of water crossings.	Vehicles should be always maintained in good condition and refuelling should occur at dedicated refuelling stations well away from watercourses. Harmful substances should be kept in bunded enclosures well away from watercourses and spill response procedures should be in place in the event of an accident.

7.7.2 Thofayim River Terminal

No freshwater ecosystems are present at the Thofayim River Terminal; therefore, no significant impacts on freshwater ecology because of the terminal operations are predicted.

7.7.2.1 Marine Environment

Marine environment impacts from the terminal have been identified based on data collected and reviewed to date and are summarised in the tables below.

Most significant impacts on the marine associated with the Project expansion are likely to be associated with activities and development outside the scope of this ESHIA update. These impacts are primarily related to dredging operations which will impact on the benthic environment in the dredge channel, the wider area affected by sedimentation and at the disposal site. Dredging management plan was developed by Environmental Management Ventures in 2019 prior to SL Mining commencing shipping operations. (SL Mining Limited, EMV, 2019).

Table 7- 13: Impacts and Mitigation on the Marine Environment

Impact	Mitigation Measures
TRT	
Potential for water / sediment quality issues resulting from discharges from construction and	Adoption / maintenance of management practices to control discharges and meet discharge quality criteria.

or operation both shoreside and from vessels/ marine structures.	Major spill response procedures.
Loss and degradation of mangrove habitat due to erosion from bow wash and prop scour associated with increased vessel movements.	Strict control on vessel speed – zero wave speed, Monitoring of mangrove stands in proximity to shipping channel and ship loader to track any scour occurring and manage / mitigate as appropriate.
Direct loss of benthic habitat under footprint of jetty and ship loader.	Minimise footprint, e.g., using piled trestle rather than gravity structure. Avoid high value receptors if identified.
Potential for underwater noise to harm marine fauna and trigger negative behavioural response.	Understand nature of likelihood and significance through assessment Adopt standard good practice such as ramp up and oversight by trained protected species observers for noisy activities such as piling during construction. Identify any high sensitivity seasons or periods for marine fauna and where necessary time most impacting activities.
Potential for collision of vessels with marine fauna e.g., mammals and turtle due to increased vessel movements	Training of vessel crews to identify marine fauna Development of safe navigational protocols if marine fauna collision if likely Observation of safe vessel speeds to minimise potential for collision.
Potential for introduction of alien/ invasive species associated with vessel traffic.	Adoption of strict protocols for ballast water exchange and discharge control for vessels as part of an invasive species management plan

8 SECTION EIGHT

8.1 SOCIAL IMPACT ASSESSMENT AND MITIGATION

Description of the Physical and Economic Baseline Environment

Much of the concession area was mined during historic mining operations that ended in the 1980s. Since that time, and especially since 2002, nearby residents have made increasing use of the area for livelihood activities. Five communities are living within the current mine concession area boundary, including parts of Chendatha, Campbell Town Ridge, Konta Lol and Romongoro and some areas of Lunsar. Lunsar is also potentially within the blasting safety exclusion zone (SEZ) and is the closest town to the mine and is densely populated.

An additional seven communities located outside of the mine concession area own land within the concession boundary. Some communities or individual structures may be affected by impacts associated with mining and concentrate haulage to Thofayim. MML believe that the mitigation measures outlined in the Marampa M3.75 EHSIA will be sufficient to effectively manage these potential impacts. Only when all mitigation options are exhausted shall resettlement be considered.

Livelihood activities within the mine concession area are mainly for subsistence and comprise farming, animal husbandry and some fishing in the Bathbana Lake. Along the Coaster route communities rely on fishing as their primary livelihood activity.

8.1.1 Proposed Project Activities

The following proposed activities are likely to result in physical and economic displacement at the mine site:

- Land clearance within the mine concession area to prepare for mining activities.
- Blasting and the associated safety exclusion zone (SEZ) may result in physical and economic displacement in some areas outside of the mine concession area; and
- Backfilling of approximately 40% of the Bathbana Lake located in the mine concession area to create a Tailings Storage Facility (TSF).

Some communities or individual structures may be affected by impacts associated with mining and concentrate haulage to Thofayim. MML believes that the mitigation measures outlined in the Marampa M3.75 ESIA will be sufficient to effectively manage these potential impacts. Mitigation is the preferred option as the IFC guidelines state that resettlement should be avoided wherever possible. To verify the efficacy of the mitigation measures, MML will implement an extensive monitoring program that looks at air quality, noise, and vibration. The results of this work will be used by MML to feedback on the management of potential issues and trigger additional mitigation measures if required. Only when all mitigation options are exhausted shall resettlement be considered.

Along the Coaster route, maintenance dredging may be required to maintain safe passage along the Port Loko Creek which could temporarily affect river users such as fishermen and those who use river transport. Following decommissioning, Coasting will stop and the land in the mine concession will be rehabilitated and returned to the original landholders.

8.1.1.1 Receptors

- Potentially affected communities are in one or more of the following categories:
- Communities living within the mine concession area;
- Communities living outside the mine concession area but within the SEZ (refer to *Figure 9.1* for map showing SEZ – 500meter exclusion zone);
- Communities living outside the mine concession area but who own land within it;
- Communities who use the Bathbana Lake for fishing;
- Communities whose access to Lunsar currently passes through the mine concession area; and
- Communities otherwise affected by MML activities, such as from noise and, dust (e.g. haul road) or impeded access to normal routes of travel (e.g. Port Loko Creek).

Communities in the mine area are presented in Table 8-1 below.

Table 8- 1: Communities Potentially Affected by the Marampa M3.75 Project

Community	Live within the mine concession area	Live outside the mine concession area but within SEZ	Village owns land within the mine concession area
Chendatha			
Mathukia			
Robela			
Magbenthay			
Maforki			
Magberie			
Rogbaneh			
Campbell Town			
Konta Lol			
Romangoro			
Konta Bana			
Robaka			
Lunsar West			
Lunsar Other within the concession			
Lunsar another outside concession			

While all households affected by economic and physical resettlement can be highly vulnerable, there are some specific vulnerable groups within the population to be resettled, such as female-headed households and those without full access to land.

8.1.1.2 Impact and Mitigation Measures

Table 8- 2: Impact and Mitigation Measures due to Land Clearing

Construction	
Significance of Impact	**Mitigation Measures/Recommendations**
The clearing of land within the mine concession area will result in the physical displacement of communities in Moria, Campbell Town, Konta Lol, Romangoro, Rogbanah, Mathukia, Gbom-limba, Magbenthay and other parts of Lunsar throughout various stages of the Project.	MML has designed the project to avoid and or minimise resettlement requirements as far as practicable, considering space restrictions within the mine concession area and standard safety requirements of modern mining operations (i.e., safety exclusion zones).
	MML will implement the Resettlement Management Plan (RMP) developed for the Project, which follows both national requirements and international standards, especially IFC PS5. Where resettlement is unavoidable, MML shall provide compensation at replacement value for loss of physical assets, revenue, and income resulting from both temporary and permanent economic and/or physical displacement. This includes: - Primary structures (residential houses and business premises). - Secondary structures (out-buildings, fencing, livestock pens, grain storage, etc.); and - Agricultural land/crops.
	- MML will commission the development and implementation of a Resettlement Action Plan (RAP) in accordance with Sierra Leonean laws and international standards.
Operation	
Significance of Impact	**Mitigation Measures/Recommendations**

During operations, no further physical or economic displacement will occur associated with the mine concession area. Communities originating from within the mine concession area, who have undergone physical and economic displacement should not experience further impacts from the project, provided the Project RAP has been implemented and livelihoods are fully restored or are being restored.	- Where damage has occurred because of MML activities, MML will pay compensation in cases of crop losses in line with the MML Compensation rates and consultation with affected parties.
Maintenance dredging along Port Loko Creek may result in some economic displacement over short periods (<1 month). Dredged material, if not disposed of in situ, will be disposed of at existing locations, so additional land take will not be required.	- MML will notify communities along the Coaster route about the timing of dredging activities and collaborate with them to minimize any negative effects on their livelihoods. This involves ensuring that transportation routes along the creek are kept in good condition. Additionally, any complaints or issues will be handled according to the MML grievance procedure. - MML have speed limits for its Coasters and tugs (4.5-6.0 knots) as well as small boats and they are required to stay within well-marked fixed channels for safe passage. Having fixed routes, clearly shows communities to be aware of areas not used by MML. The Project will continue with its awareness-raising campaign regarding the barge and vessel movements and risks. These sessions will be aimed at harbourmasters, fishermen and other river users.
Decommissioning	
Significance of Impact:	**Mitigation Measures/Recommendations**
By the end of the Project life, RAP implementation should ensure no further impacts related to either physical or economic displacement. As stated in MML's Mine Closure and Rehabilitation Plan (MRCP), a full consultation will be conducted with the	- Community consultation on end land uses, as per the Mine Closure Plan.

landowners about land uses post-closure. Past mining activities did leave the site in a poor state, with many areas not suitable for agriculture. MML has committed to returning the site to a productive state so that there will be a positive impact by MML rehabilitating the mine site.	

8.1.1.3 Residual Impact

Following the implementation of the mitigation measures the extent of the impact is expected to be largely **local**, primarily affecting communities in the mine concession area, and in the area where they are resettled. The scale of the impact is largely due to the geographical extent of displacement from the mine concession area. The impact frequency is a one-off at the start of construction. Even with proper mitigation and an international-standard RAP, the magnitude is still considered to be **medium** due to the potential household numbers involved, in accordance with the procedures for project categorization set out in the Environment and Social Regulations (Third Schedule). The significance following mitigation is considered **positive** if the RAP is successfully implemented and communities are afforded more secure livelihoods.

Table 8- 3:Impact Assessment Summary

Impact: Physical and Economic Displacement					
Impact Type:	Direct				
Impact Magnitude					
	Extent	**Duration**	**Scale**	**Frequency**	**Magnitude**
Construction:	Mine area	Permanent	Large	One-off	Large
Operation:	Mine area	Permanent	Large	One-off	Large
Decommissioning:	Mine area		N/A	N/A	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium	Subsistence-based livelihoods mean communities affected by physical or economic displacements are highly vulnerable.				
Impact Significance					
Construction:	Positive				
Operation:	Positive				
Decommissioning:	Not significant				

8.2 In-Migration

8.2.1 Proposed Project Activities

In-migration is a cumulative impact which has been triggered by the revival of mine operations and agriculture in the Northern Province since the end of the civil war. The level of influx will also depend on the plans of other mining companies operating in the immediate area. Opportunistic influx due to expectations regarding resettlement and compensation around the mine area and in Thofayim may also take place.

8.2.1.1 Receptors

Due to the cumulative effects on impacts including health/well-being and access to resources and public services, the sensitivity rating for these receptors is **high**. Although these effects will be felt more by vulnerable groups, the broader impacts will inevitably be felt in affected communities.

Table 8- 4: Impact and mitigation measures due to In Migration

Significance of Impact	Mitigation Measures/Recommendations
The following receptors are likely to be impacted: • Communities near the mine concession area and to a lesser extent along the haul road. • Public services and the associated workforce. • Infrastructure such as drinking water sources, waste and sanitation which are mainly unimproved; and • Natural resources, biodiversity, and farmland.	• It is important to point out that in-migration is difficult to manage in any circumstance, regardless of location or driver. This is especially the case since some of the measures that need to be taken rely on the capacity and collaboration of third parties including the government, chiefdom authorities and other mining companies in the area. • Resettlement activities will be designed to avoid or reduce incentives for opportunistic capture of resettlement benefits. • MML will also aim to support local administrative structures to cope with the influx, by measures such as the following: • Actively engaging with the Port Loko District Council, through the Chairperson and the District Development Planning Officer, to seek joint approaches to manage the negative effects of population influx; • Supporting the secondment of qualified planning staff to assist the Chiefdom authorities to address the issues of population influx;

8.3 Access to Public Services

Description of the Baseline Environment

8.3.1 Proposed Project Activities

Construction and operational activities will routinely require power, water, and waste processing facilities. However, the Project will be self-sufficient in these areas and will not impose any additional loading onto local facilities. Locally resident project employees and migrants will need health and sanitation facilities as well as educational services if they have families in the area. The presence of the Project is likely to result in indirect pressure on public services through the following activities:

- MML direct employees as well as contractors and subcontractors and their families who do not live in MML or contractor camps; and
- Migrants to the area and their families (indirect impact of the Project).

Receptors

The following groups are likely to be impacted:

- Communities close to the mine concession area, but also along the haul road; and
- Vulnerable groups with limited means to access public services.

The vulnerability of receptors is high due to the existing poor levels of access to services, such that any increase in pressure or decrease in access is likely to affect all parts of the community. However, female-headed houses and the poorest sections of the community are likely to be disproportionately affected as they lack the resources to seek alternative sources or pay higher costs to access services.

Table 8- 5: ***Impact and Mitigation Measures due to Access to Public Services***

Significance of Impact	Mitigation Measures/Recommendations
Health Facilities	
- The presence of a resident workforce and migrants to the Lunsar area is likely to increase the numbers of people accessing health facilities in the project area, in larger settlements, such as Lunsar and Rogbere Junction, where hospitals or health clinics are located. - As a result of this increased pressure, there is a risk of either higher costs being charged for service or an increase in waiting times, both of which are associated with poorer health outcomes. - In the event of an accident at the mine site (e.g., vehicle accidents), health facilities in Lunsar may be used to	- MML have a well-equipped clinic on site with a doctor and nurses to treat all MML workers. Only those cases beyond the capacity of the clinic to treat are referred to the Lunsar or Freetown hospitals for more specialist care. - MML have two ambulances and a fire truck with trained personnel, including paramedics, that respond to work-related accidents and can be used to transport evacuation cases to Lunsar or more likely Freetown for further treatment. MML have an agreement on place for medevac by helicopter to Freetown if required for seriously injured personnel. - MML has an agreement with the Lunsar and Freetown hospitals regarding the payment of fees for its workers. MML are responsible for all costs associated with work-related

augment on-site facilities to cope with any injuries	injuries, but MML has also provided health insurance to its workforce for non-work-related health issues. Increased fees provide scope for improved services to the public.
Education	
- Currently, in the Port Loko District, there are limited numbers of teachers, leaving a high teacher-pupil ratio. If mine site workers or job-seeking migrants move to the area with their families and want to use local schools, there is a risk of a further reduction in the quality of education in the area due to an even higher teacher-pupil ratio. - A further risk to services may come from the fact that the few qualified teachers in the area are poorly paid and may be attracted by better salaries on the mine site (as has happened on previous mine sites in the area), potentially leaving fewer teachers.	- Invest in educational supplies for schools impacted by migrant workers' families, as described in the CDA. - Support the training of teachers at the University of Lunsar and other tertiary institutions.
Utilities	
- The project will be self-sufficient in terms of its power requirements. The Project will therefore not affect community access to power. - Nevertheless, within communities, immigration as an indirect consequence of the Project may put pressure on community utilities, in particular, waste management and sanitation facilities which are already inadequate with potential consequences for health	- Invest in clean water for communities and better community sanitation as described in the CDA. - Continue to implement the Project waste management plan to ensure that Project waste is appropriately managed.

8.3.1.1 Residual Impact

Health

Depending on the implementation of the community needs identified in the CDA, the vulnerability of receptors is unlikely to remain unchanged as such the impact is considered to be **minor**.

Table 8- 6: Health Impact Assessment Summary

Impact: Access to Public Health Services					
Impact Type:	***Direct and indirect***				
Impact Magnitude					
	Extent	**Duration**	**Scale**	**Frequency**	**Magnitude**
Construction:	Local	18-24 months	All households using services	Occasional	Small
Operation:	Regional	15 years	All households using services	Occasional	Small
Decommissioning:	Local	1	All households using services	Occasional	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium/low:	Vulnerability of health services is high due to being under-resourced, ill-. equipped and understaffed				
Impact Significance					
Construction:	Minor				
Operation:	Minor				
Decommissioning:	Minor				

Education

The existing limitations of local education services in the Project area may be exacerbated by increased pressure on such services. However, as mentioned previously, MML has several commitments in place to support educational services including partnering with St. Joseph's Vocational Training Institute in Lunsar and investment in MML's workforce such as graduate programs, apprenticeships/ traineeships, and skills-based training. Depending on the successful implementation of the measures outlined in the CDA and those presented above, the vulnerability of receptors is likely to change. However, the extent of this change is unlikely to remove the limitations of the education services entirely and as such vulnerabilities will remain. The impact is therefore considered to be **minor.**

Table 8- 7: Education Impact Assessment Summary:

Impact: Access to Public Education Services					
Impact Type:	***Indirect***				
Impact Magnitude					
	Extent	Duration	Scale	Frequency	Magnitude

Construction:	Local	18-24 months	All households using services	Long term	Small
Operation:	Regional	15 years	All households using services	Long term	Small
Decommissioning:	Local	1	All households using services	Long term	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium/low:	The vulnerability of education services is high due to a lack of teachers and resources				
Impact Significance					
Construction:	Minor				
Operation:	Minor				
Decommissioning:	Minor				

Utilities

Since the Project is self-sufficient in terms of all utilities and following the impact of the above-described mitigation as well as implementing the measures outlined in the influx management policy the impact is **not significant**.

Table 8- 8: Impact Access on Utilities

Impact: Access to Utilities					
Impact Type:	***Direct and indirect***				
Impact Magnitude	Extent	Duration	Scale	Frequency	Magnitude
Construction:	Local	18-24 months	A limited number of households	Rare	Not significant
Operation:	Local	15	A limited number of households	Rare	Not significant
Decommissioning:	Local	1	A limited number of households	Rare	Not significant
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium/low:	Vulnerability is high due to the limited availability of these services in the communities				
Impact Significance					
Construction:	Not significant				
Operation:	Not significant				
Decommissioning:	Not significant				

8.4 IMPACTS ON CULTURAL HERITAGE

Description of the Baseline Environment

In the Project area of influence, there are no officially protected or nationally/internationally recognized sites of cultural significance. However, there are various sites of cultural heritage, including cemeteries, mosques, churches, sacred trees or shrines, and secret society activities. Cemeteries are the most common cultural heritage sites in the area. Traditional practices associated with secret societies such as Poro and Ojeh (men) and Bondo (women), as well as ceremonies like live animal sacrifice and FGM, are also part of the cultural heritage. These practices have survived previous changes, such as the development of a mine, civil war, and migration. Some cultural heritage sites have been relocated away from the mine concession area and haul road through collaboration with local communities.

8.4.1 Proposed Project Activities

The following project activities are likely to result in potential impacts associated with cultural heritage:

- Land acquisition and resettlement; and
- Reduced access to the mine concession area.

Receptor

- Cultural heritage sites and the communities who use them.

The types of cultural heritage sites found within the Project area of influence are not legally protected, but they have significant value to the local communities. The sensitivity of receptors is therefore considered **medium**.

Table 8- 9: Impact and Mitigation due to Cultural Heritage

Significance of Impact	Mitigation Measures/Recommendations
- Sites associated with cultural heritage are present in almost every settlement in the Project area of influence. However, the number of sites on Project land is limited since the site is brownfield and cultural heritage sites at Thofayim, along the haul road and in the mine concession area were relocated. - Physical structures, such as churches, mosques and gravesites located in communities that will be physically displaced, will be lost as part of the land taken and could result in some distress and concern to communities. MML must	The following mitigation will need to be implemented to minimise impacts on cultural heritage: o The company will continue to implement its Cultural Ceremonies policy to guide its future support for cultural ceremonies. This policy states that: o Community authorities must be consulted, and an MOU signed. o Financial assistance can be part of the package; and o The company cannot support any ceremony that contravenes the laws of Sierra Leone (for example, the Child

manage this sensitively following the Cultural Ceremonies Policy.	Rights Act of 2007 and the Gender Act of 2009 which prohibit acts of cruelty against children and domestic violence against women, such as Female Genital Mutilation). - Wherever it is possible, the project will avoid physical disturbance or restricted access to cultural heritage sites. When avoidance is not possible, cultural heritage sites will be relocated as set out in the Cultural Ceremonies Policy.

8.4.1.1 Residual Impact

The implementation of MML policies and mitigation measures related to resettlement and cultural ceremonies will reduce the impact of physical disturbance on remaining cultural heritage sites. The extent and duration of the impact are not expected to change. There will still be some impact despite mitigation, as some sites will need to be relocated due to site clearance activities and others will be lost if they cannot be relocated. The magnitude of the impact after mitigation is **small** and the significance of the impact after mitigation is expected to be **minor.**

*Table 8- 10: Cultural heritage **Impact** Assessment Summary*

Impact: Cultural Heritage					
Impact Type:	***Direct and indirect***				
Impact Magnitude					
	Extent	Duration	Scale	Frequency	Magnitude
Construction: Operation: Decommissioning:	Local	Short-term likely to occur during construction	Communities around mine sits	Rare	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium/low:	Vulnerability is medium as sites are not legally protected but are important to those who use them.				
Impact Significance					
Construction:	Minor				
Operation:	Minor				
Decommissioning:	Minor				

8.5 IMPACTS ON EMPLOYMENT AND THE ECONOMY

Description of the Baseline Environment

Approximately 80% of households in and around the mine concession area and haul road rely on subsistence agriculture as their main livelihood, along with other activities such as fishing and informal trading. Rice and sweet potato cultivation are prevalent in the area, particularly in swamp areas and riverine grasslands. Formal sector employment is limited due to job shortages, lack of skills, and discrimination towards vulnerable groups. Education, healthcare, and transport are the primary monthly expenses reported by households, followed by food, clothing, and agricultural inputs. In the wider mine area, the livelihoods profile is similar, but some communities have more formal sector employment, primarily in the mining sector. Along the haul road, all communities depend on farming and have minimal formal sector employment.

8.5.1 Proposed Project Activities

The following Project activities are likely to result in impacts:

- Direct employment with MML or through contractors on construction and operation of the Project.
- Indirect employment through procurement of goods and services to support construction, operations, and decommissioning activities; and
- Employment effects resulting from direct and indirect employment.

8.5.1.1 Receptors

Several employment groups are likely to gain benefits from the Project. The largest of these groups are households that benefit from employment or generate business opportunities by supplying goods and services to mine employees or to those who supply MML. These groups will see benefits throughout the life of the mine.

Other groups include:

- Households who benefit from direct employment with either MML or its main contractors (e.g., Rabotec, IML, CONSAR, ATS etc.,). This is the smallest of the three employment groups identified and for Marampa M3.75, there will be little new direct operations phase employment by MML above the current level.
- Households who benefit from employment or generate business opportunities by supplying MML with goods and services (i.e., indirect employment). This will peak during the construction phase but both direct and indirect opportunities will continue for the life of the project.
- Those most affected by Project induced inflation brought about by the economic stimulus will be vulnerable groups such as the old, disabled, and single-headed households who will have limited coping mechanisms if there are increases in the cost of living. Inflation is likely to disproportionately affect the most vulnerable sectors of society; however, inflation will affect the entire population as it relates to increased cost of

living.

- Some groups will benefit from inflation because of increased income. For example, if food price increases occur, these will benefit farmers who reside outside of the Lunsar area and who have poorer access to services; and
- The national government will receive royalties from the Project, in line with the Mine Lease Agreement with MML ratified by the House of Parliament in March 2012 and various taxes (e.g., income tax, import duties).

Table 8- 11: Impact and Mitigation due to Employment and the Economy

Significance of Impact	Mitigation Measures/Recommendations
Direct Employment during Construction	
- As Marampa M3.75 is a continuation of the existing mining operation, there will be a significant increase in the number of personnel employed. - Given the current understanding of local skills specific to the mining sector, most employment opportunities for local people are likely to be in unskilled or semi-skilled positions. It is expected that a significant proportion of the skilled and semi-skilled workforce will come from other parts of Sierra Leone or internationally.	*Positive*
Direct Employment during Operation	
- During the operations phase, opportunities along the haul road will focus mainly on routine maintenance and repair work on the road and will not result in a significant change in employment. The terminal at Thofayim will employ levels like the current numbers. A slight increase in personnel will be required by the Coaster and transhipment operators.	*Positive* - MML will maximize the employment of local people by offering on-the-job training schemes and mentoring programmes and ensuring that local communities are notified of job opportunities as they arise, and the qualifications required for these positions. - MML will continue to offer scholarships to children in communities to increase the skill bases and ability of these individuals to leverage benefits from indirect and direct employment and economic opportunities in the future to find employment or maximize indirect economic benefits.
Indirect and Induced Employment during Construction and Operation	
- Due to the scale of the Project workforce and its procurement needs, employee household spending is expected to occur within communities near the Project, in particular, Lunsar. As a result, the	MML will maximize local procurement opportunities by implementing its local procurement policy which includes the following measures: - Increase awareness among the local business networks of opportunities to

construction of Marampa M3.75 may impact the cost of goods and services resulting in local inflation	become a supplier to MML, using open tendering processes. - Measure and report the percentage of procurement that is sourced locally and aim to increase this on a year-by-year basis. - Where supplier terms are equal, give preference to the local company; and - MML requires contractors to meet the requirements of the Government of Sierra Leone which includes the recently published Local Content Policy.
Decommissioning	
- The process of decommissioning will require a workforce, though smaller than construction or operations, so the employment impacts will be similar, though of a lower magnitude and significance. - Once decommissioning is complete, there will be a loss of all direct employment on the Project. However, the company's Mine Closure policy states that: "the creation of jobs outside the mining areas, and the development of employability (transferable skills and working habits) are focus areas of the company's Programme of Community Investment. Marampa Mines Limited employees will be regularly updated on the projected life of the mine and encouraged to develop their skills for a competitive labour market post-closure. They will also be given priority consideration in the undertaking of decommissioning work wherever the technical skills permit".	MML will implement the following mitigation to minimise the impacts of decommissioning: As per the Mine Closure Plan, MML will: - Keep its workforce informed about the remaining life of the mine. - Ensure employees are prepared for working in a competitive workplace after closure: and - Comply with all legal and statutory requirements of Sierra Leonean Labour Law during the closure of the mine and fulfil all its obligations to the workforce in line with MML workplace contracts. - MML's presence in Sierra Leone will also provide opportunities and sustainable economic development in the Lunsar area and Port Loko District. This development will provide additional workforce opportunities in other industry sectors for staff affected by the mine site closure. - MML will minimize the impact of the closure on its workforce and nearby community by staggering any layoffs. - In the event of redundancies, MML will provide adequate and competitive severance pay adhering strictly to the requirements of Sierra Leonean Labour Laws together with the appropriate statutory obligations according to the Terms of the Agreement under the relevant Unions' Employees' Bargaining Agreements (EBA). Concerning Contract staff and in consultation with regulatory authorities, adequate notice will be given to all workers on site of the intention to close the mine.

8.5.1.2 Residual Impact

Employment and Economic Impacts

The implementation of MML's policy on local procurement and other mitigation measures related to employment will maximize the positive opportunities and reduce potential negative impacts (from local inflation). The duration of impact will be long-term and will increase as a greater percentage of the local population acquires better education and skills. There will still be some impact despite mitigation, particularly to vulnerable groups who may find it more difficult to access employment and procurement opportunities. Given the current context of low levels of education and skills in the area, the positive impact of the impact after mitigation is moderate and the significance of the impact after mitigation is expected to be **positive**.

Table 8- 12: Employment and Economic Impact Assessment Summary

Impact: Employment and economic impacts					
Impact Type:	***Direct (employment) and Indirect (procurement and induced incomes)***				
Impact Magnitude					
	Extent	Duration	Scale	Frequency	Magnitude
Construction:	Local, Regional and National	18-20 months	A small percentage of households are expected to secure work	Short term	Medium
Operation:	Local, Regional and National	15-30 years	A medium percentage of households are expected to secure work	Long term	Medium
Decommissioning:	Local, Regional and National	12 months	A small percentage of households are expected to secure work	Short term	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium/low:	Local community reliance on subsistence activities and a low skill base makes it sensitive to any changes in formal employment opportunities				
Impact Significance					
Construction:	Positive				

Operation:	Positive
Decommissioning:	Positive

8.6 IMPACTS ON COMMUNITY HEALTH

Description of the Baseline Environment

Communities located close to Project facilities lack access to adequate health care. In the event of accidents and injuries, appropriate health care can only be found in larger towns such as Lunsar and Port Loko. As such communities are vulnerable to factors that may affect their health and safety. Traditional medicine is used by a high percentage of people in communities throughout the Project's area of influence. Communicable diseases are reported to be common across the Project area of influence including diarrhoea, TB and respiratory tract infections. Malaria is endemic across all the settlements in the area of influence. STIs are likely under-reported due to stigma and taboos associated with such diseases as well as lack of access to health care. Lack of access to adequate nutrition is also reported as a problem, as is the lack of access to potable water in some communities: both of which are associated with poor health outcomes. Awareness and education regarding safety hazards and safety risk management tended to be relatively low in communities. High levels of illiteracy in many areas make the use of radio, drama, and visual signage necessary for the communication of safety messages to the public. The main community safety issues are road traffic accidents (see Section 9.9) and boating accidents. Boating accidents are common along the Coaster route, caused by overloading boats, the use of inadequate and poorly maintained equipment (eg motors) and the lack of safety equipment.

8.6.1 Proposed Project Activities

The following project activities may result in potential impacts on community health, safety, and security:

- presence of the mine site through construction, operation, and decommissioning.
- presence of an external workforce sourced nationally and internationally.
- interactions between the Project workforce and the local community.
- provision of health care for workers.
- changes to the environment due to increased noise decreased air quality and changes to the visual environment which may affect health and well-being.

- increased vessel movements along the Port Loko Creek; and
- presence of project security.

8.6.1.1 Receptors

The following groups are likely to be impacted:

- Communities close to the mine site, haul road and barge loading facilities.
- Primary health care facilities in communities close to the mine site and towns with hospitals served by these areas; and
- Fishermen and other users of the Port Loko Creek (Coaster route).

Table 8- 13:Significance of Impact and Mitigation Measures/Recommendations on Community Health

Significance of Impact	Mitigation Measures/Recommendations
Transmission of communicable diseases	
As a result of Project development during the construction phase when the workforce is likely to be greatest and when in-migration may peak, the rate of transmission of communicable diseases may increase throughout the life of the mine. This will be largely due to: - interactions between the Project workforce and local communities. - potential for overcrowding because of increased pressure on existing housing infrastructure, water, and sanitation services; and - in-migrants and the Project workforce bringing new diseases or varying disease profiles compared to the existing community.	The following mitigation measures will be implemented: - MML has a Community Health and Safety policy in place, under which the company commits to: - Conduct an assessment to identify health-related risks due to company operations in Sierra Leone, consulting national medical services as appropriate. - Establish monitoring programmes for potentially significant health risks caused by company operations. - Seek collaboration with national and district health authorities on public health challenges such as malaria, HIV/AIDS, cholera and other water-borne diseases. - Be prepared to commit community investment funds to public health initiatives, within the framework of the Community Development Agreement and the Port Loko District Development Plan. - Support the development or improvement of health information systems at the district and chiefdom level, including epidemiological monitoring. - Participate in relevant sectorial initiatives such as the Business.
- Diseases of particular concern, due to baseline conditions include TB, skin diseases and acute respiratory infections. Furthermore, poor quality housing is also likely to be associated with poor quality sanitation which can facilitate the transmission of diarrhoeal diseases, including cholera, especially in children.	
Transmission of Malaria	
- The current malaria burden is high in the communities surrounding the proposed Project and is endemic in Sierra Leone.	

- As malaria is endemic, the Project is unlikely to significantly change the existing disease burden of the community as there are currently extensive areas suited to breeding within the mine concession and surrounding areas. - If mining activities modify the environment such that the presence of suitable breeding grounds (usually slow-moving or stagnant water bodies) extends into the dry season, then impacts may occur. The risk of breeding grounds being created could occur throughout the life of the mine both due to direct Project activities and indirectly if there is inadequate waste management, storage of water by communities and the presence of make-shift structures. *Increased Transmission of STIs including HIV/AIDS* Evidence indicates that Projects within the mining sector can contribute to an increase in the transmission and prevalence of STIs and HIV/AIDS. The Project is likely to impact the transmission of STIs including HIV/AIDS due to: Transport drivers, who typically have higher rates of HIV or STIs than the general population, may engage in casual high-risk sexual activity along the transport route and at their end destination. in-migration resulting in the mixing of people with higher HIV or STI prevalence rates than the host community. - a mainly male workforce with disposable incomes may engage in high-risk sexual activities with commercial sex workers both in the local community and on transit routes to/from the site; and - existing stigma and taboos around STIs and HIV/AIDS will make it challenging to disseminate knowledge and use safer sex practices such as the use of condoms (including female condoms). - The frequency of the impact is constant as the possibility of transmission will	- Coalition on HIV/AIDS and joint efforts on disease vector control. - Seize opportunities to extend relevant medical training (e.g., first aid) to family members of company employees, and the wider community. - Continue to enforce pre-employment health screening protocols for all Project personnel. - Screening for STIs will be voluntary and encouraged through education and awareness-raising programmes. (As per current policy, workers will not be denied employment or discriminated against in any way based on their HIV status). - MML has provided insurance for its workers to cover non-work-related illnesses. - Continue to enforce the MML Workforce Code of Conduct for all Project personnel which includes guidelines on worker-worker interactions, worker-community interactions, development of personal relationships with members of the local communities, alcohol consumption, etc. - Continue to forbid illegal activities by all Project personnel, including the use of commercial sex workers, transactional sex, and the use and /or trafficking of illegal substances. - Continue to promote, as part of induction, awareness among Project personnel of sexually transmitted infections, communicable diseases (e.g., TB) and vector-borne diseases (e.g., Malaria), and other diseases as appropriate. - Continue to operate accommodation camps with good practices. - Monitor the emergence of major disease outbreaks such as cholera epidemics and implement appropriate response plans. - In line with the Community Development Agreement (CDA), the Project is committed to supporting health interventions.

exist over the life of the mine. Given the severe nature of the health outcomes of STIs and HIV/AIDS, the magnitude of the impact is high. - Given the low levels of understanding around transmission and prevention of STIs, the potential for affected people to be stigmatized and considering the fact that access to medical treatment is limited, receptor vulnerability is considered to be high. The significance before mitigation is therefore major negative.	- Continue to implement workplace malaria and vector control programmes including measures such as appropriate clothing (long sleeves) and the provision of bed nets at worker accommodations. - As per the CDA, the project will continue to implement a programme of sensitisation within communities on HIV/AIDS and STIs as well as malaria, cholera, and diarrhoeal diseases. - Ensure there is access to free condoms (including female condoms) at all worker campsites and accommodations. - The project will undertake a programme of stakeholder engagement with local communities regarding blasting before any activities to alleviate fears and concerns in communities around the mine concession. This will include demonstration blasts that will aid in educating communities about the safety practices that MML will put in place and the reasons why these practices are required; and - As stated in the CDA, the Project will implement an education programme around child nutrition. Furthermore, it will support initiatives to improve agricultural yields and an artisanal fisheries support program (for fishing equipment supply and training, fish processing, fish storage and marketing) through extension services and support programmes.
Nutrition Related Diseases	
Decreased food security may occur through the following pathways: - Loss of agricultural land associated with land taken by the Project. - Increase in the local population due to in-migration, resulting in the increased cost of food. - Land pressure and inflation in the cost of food may lead to the theft of crops, which in turn can lead to farmers harvesting their crops early when they provide less nutritional value; and - Fear and concerns around accidents may affect fishing activities and therefore catches. - Impacts on nutrition may occur around the mine concession area, along the haul road and Coaster route and therefore are district-level in extent. However, the expected increase in local food prices will also strengthen the incentives for farmers to produce more and sell part of their harvest on the local market. - It is possible that decreased nutrition will occur, in vulnerable groups, throughout the life of the mine and is therefore considered to be medium-term. - The scale of the impact is medium. Malnutrition could contribute to increased vulnerability to other diseases and affect individuals' ability to work and their livelihoods	
Hazardous Materials	

There are several activities planned at the mine that would involve the use of hazardous materials such as: - pesticides. - blasting products; and - hydrocarbons (e.g., diesel and oil). Hazardous materials have the potential to pose a risk to human health during on-site storage and transportation if not appropriately handled. However, as all hazardous materials will be procured, transported, stored, handled, and used appropriately in line with international best practices the potential for impacts on human health is minimal. The Project will enforce an exclusion zone at the mine site and implement tight controls around the storage and use of explosives (including maintenance of an exclusion zone around explosives stores).	

8.6.1.2 Residual Impact

Transmission of Communicable Diseases and Malaria

Following the implementation of the above-mentioned mitigation and factors outlined in the Community Health and Safety Plan and Community Development Agreement (CDA), there will be improved access to health care over time as such vulnerability will decrease, likewise, the magnitude of the impact is expected to decline. As such following the implementation of mitigation, the impact will be categorized as **minor.**

Table 8- 14: Impact Assessment Summary due to Diseases

Impact: Impact on Transmission of Communicable Diseases and Transmission of Malaria					
Impact Type:	***Induced***				
Impact Magnitude	Extent	Duration	Scale	Frequency	Magnitude
All phases	mine area and haul road	Long term	Medium	Often	Low
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium	Communities' access to health care will improve over time and understanding of transmission patterns within communities will remain low.				
Impact Significance					
Construction:	Minor				
Operation:	Minor				
Decommissioning:	Minor				

Increased transmission of STIs including HIV/AIDS

The mitigation should result in a **moderate negative** impact as while the measures will raise awareness around transmission and symptoms and controls related to workers, due to the predicted changes there is still a high likelihood of the number of cases of STIs and HIV/AIDS increasing as has been evidenced in other areas. Furthermore, infection with HIV/AIDS still results in life-long ill health and those infected are likely to be discriminated against due to existing taboos and perceptions around HIV/AIDS.

Table 8- 15: Impact Assessment Summary due to STI and HIV/AIDS Transmission

Impact: Impact on the transmission of STIs including HIV/AIDS					
Impact Type:	***Indirect***				
Impact Magnitude	Extent	Duration	Scale	Frequency	Magnitude
All phases	Mine area and haul road	Long term	High	High	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
High	Awareness around transmission, symptoms and controls will increase among the workers. Discrimination against infected people will persist.				
Impact Significance					
Construction:	Moderate				
Operation:	Moderate				
Decommissioning:	Moderate				

Nutrition Related Diseases

The above mitigation measures alongside the focus on agriculture/livelihoods in the CDA should be maintained throughout the life of the mine and therefore support access to sources of nutrition. As such, the impact is considered to be **not significant** following mitigation and has the potential to be positive by improving food security.

Table 8- 16: Impact Assessment Summary due to Labour and Working Conditions:

Impact: Impact on labour and working conditions					
Impact Type:	***Direct***				
Impact Magnitude	Extent	Duration	Scale	Frequency	**Magnitude**
All phases	Local	Medium-term	Small	Constant	Not significant
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium	Communities have a limited ability to adapt to the loss of food.				
Impact Significance					
Construction:	Not significant				
Operation:	Not significant				
Decommissioning:	Not significant				

Hazardous materials

As described in the pre-mitigation impact the magnitude of the impact is **low.** Following the programme of stakeholder engagement receptor vulnerability is likely to decline as concerns over blasting will be alleviated. Receptor vulnerability will therefore below and the impact following mitigation will be **not significant.**

*Table 8- 17: **Impact Assessment Summary due to Hazardous Materials***

Impact: Impact on hazardous materials					
Impact Type:	Direct				
Impact Magnitude					
	Extent	Duration	Scale	Likelihood	Magnitude
All phases	Mine area	Short term	Small	Low	Not significant
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Low	Communities are concerned by the presence of hazardous materials used in blasting activities.				
Impact Significance					
Construction:	Not significant				
Operation:	Not significant				
Decommissioning:	Not significant				

8.7 COMMUNITY SAFETY AND SECURITY

Table 8- 18: Impact Assessment Due to Community Safety and Security

Significance of Impact	Mitigation Measures/Recommendations
Site Trespass Resulting in Accidents and Injuries - During construction, operations, and decommissioning there is the potential for accidents to occur should members of the community trespass onto MML sites. During all phases, the key risks will be associated with mining activities and the plant. In the operations phase, there is the potential for the localised failure of pit walls (although this also currently exists), exposure to blasting, and interference with plant or mobile equipment. As such, there is the potential for accidents and injuries involving members of the public.	The following mitigation will be implemented to avoid impacts on receptors related to community safety and security: - MML security personnel will continue to patrol the mine concession area and Thofayim site to prevent unauthorized access along with ensuring that protocols for accessing the site through gates are observed. - Reasonable measures will be continued to discourage entry by the public into operational areas, e.g., signage and dialogue. - As part of the current stakeholder engagement activities, communities in the vicinity of the mine site and Thofayim are informed about the risks
Community Safety Associated with Increased Vessel Movements	
- Along Port Loko Creek, most boats are canoes and therefore limited in	

speed and manoeuvrability. Many also are significantly overloaded and have little freeboard as a result, leaving them vulnerable to swamping. Smaller canoes are also harder to spot, especially at night.	and consequences of trespassing on the sites. Such engagement will continue with Marampa M3.75. - Influx management measures will be implemented in line with the MML Influx Management Policy. - Community grievances concerning the conduct of security personnel and safety issues or activities are addressed under the Project 's established Grievance Procedure. - All MML vessels whether owned or hired by MML or by a contractor will display the MML logo, to enable easy identification by communities for use in incident reporting. - MML will continue to use escort vessels for barges in low visibility conditions and for night operations until river users are sufficiently aware of the MML activities. The need for escort vessels will be reviewed annually. - A speed limit of 6 knots will also apply to tugs travelling by themselves within the Port Loko Creek and upper Sierra Leone estuary above Tasso Island and staying within the marked channel. Similarly, small boats will be required to reduce speed in Port Loko Creek and the vicinity of canoes at any time. - Tugs will use appropriate equipment such as navigation lights, spotlights, electronic charts and navigation systems and horns to both maintain high visibility and stay within the marked channel. - Tugs and vehicles will have GPS tracking systems to verify the location
Community Safety Associated with Civil Unrest	
- The predicted increase in population, around Lunsar, inevitably brings with it the risk of civil disturbance, as happened occasionally during the period of previous mining activity until the 1980s when the town was also fully occupied. Such civil disturbances can impact community safety and security.	
Community Security due to the Need for Security Forces	
- Facilities at the mine, Thofayim and other locations as required will be patrolled by MML's unarmed security personnel, as provided for under the Mine Lease Agreement signed between MML and the Government of Sierra Leone. - There is the potential for negative interactions between communities and Project security, especially if community protests occur. - The use of inappropriate force by security personnel in the event of any incident could compromise the safety and security of individuals from local communities. This in turn could have impacts on the reputation of the Project eroding trust in the Project.	

	of equipment in the case of a reported incident. - The Project will continue with its awareness-raising campaign regarding the barge and vessel movements and risks. These sessions will be aimed at harbour masters, fishermen and other river users. - MML has adopted the Voluntary Principles on Security and Human Rights as such all MML security personnel and activities will be in line with these requirements; - Security personnel will continue to be screened before employment using detailed interviews to avoid hiring those who have previously been involved in abuse or violation of human rights. - Appropriate supervision is provided to ensure that established procedures are being applied by security personnel. - Security arrangements are communicated to relevant stakeholders including workers and communities, without compromising the security of the Project. - If unlawful or abusive acts are committed by security personnel immediate action is taken to prevent recurrence and report unlawful and abusive acts to public authorities.

8.7.1 Residual Impact

8.7.1.1 Site Trespass Resulting in Accidents and Injuries

Following the implementation of the above-mentioned mitigation, the extent of the impact is likely to remain unchanged i.e., local, although the potential for the impact to occur will be throughout the life of the mine, i.e., long term. The scale of the impact should decrease as the number of people trespassing should be reduced. Frequency should decline to 'occasional' and over time to rare. Following mitigation, the magnitude is **small**. The vulnerability of those who may be exposed is unlikely to change and is therefore considered to be **medium**. As such, the significance following mitigation is therefore **minor negative.**

Table 8- 19: Impact Assessment Summary due to Site Trespass

Impact: Impact on Site Trespass Resulting in Accidents and Injuries					
Impact Type:	***Direct***				
Impact Magnitude					
	Extent	Duration	Scale	Frequency	Magnitude
All Phases	Local	Long Term	Small	Occasional	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium	Communities will be aware of the risks of trespassing on the site and measures will be in place to prevent access.				
Impact Significance					
Construction:	Minor				
Operation:	Minor				
Decommissioning:	Minor				

8.7.1.2 Community Safety Associated with Increased Vessel Movements

Following mitigation, the extent of the impact remains local, i.e., affecting communities along the Coaster route and the duration remains long-term with the risk of accidents occurring throughout construction and operation. The scale of the impact is likely to be medium as such incidents should be avoided and the frequency will decrease to occasional or rare. Post mitigation the magnitude is therefore considered to be **low**. The vulnerability of all receptors is **medium** as they should be aware of the activities of MML and therefore better able to adapt to the changes that are taking place and to report issues through the grievance mechanism. However, in the event of an accident severe outcomes could result, and as such the significance of the time impact following mitigation will be **minor negative.**

Table 8- 20: Impact Assessment Summary due to Vessel Movement

Impact: Impact on community safety associated with increased vessel movements					
Impact Type:	**Direct**				
Impact Magnitude					
	Extent	Duration	Scale	Frequency	Magnitude
All Phases	Local	Long Term	Medium	rare	Medium
Sensitivity/Vulnerability/Importance of Resource/Receptor					

Medium:	Local fishermen will be sensitized to the MML Coaster activities and movements. However, their ability to adapt to changes will remain limited.
Impact Significance	
Construction:	Minor
Operation:	Minor
Decommissioning:	Minor

8.7.1.3 *Community Safety Associated with Civil Unrest*

Following mitigation, the extent of the impact is likely to remain local. The duration of the impact will be continuous, in line with the population increase. While the scale of the outcome is likely to remain high in the event of any conflict the frequency should further reduce. As such the magnitude of the impact is **small**. As community members will have the ability to seek redress for their grievances and MML security forces will be trained to deal with such incidents the vulnerability of receptors is **medium**. As such the significance of the impact following mitigation will be **minor negative.**

Table 8- 21: Impact Assessment Summary due to Community Safety

Impact: Impact on community safety associated with increased conflict and in-migration					
Impact Type:	***Indirect***				
Impact Magnitude					
	Extent	Duration	Scale	Frequency	Magnitude
All Phases	Local	Short Term	High	Occasional	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium:	Communities will still be at risk of conflict and lack access to services to address the consequences of such conflict but will be able to have grievances addressed by MML				
Impact Significance					
Construction:	Minor				
Operation:	Minor				
Decommissioning:	Minor				

8.7.1.4 *Community Security due to the Need for Security Forces*

The implementation of the above-mentioned mitigation will result in a **moderate negative** impact on security. The measures should ensure that Project personnel comply with standards that will avoid impacts on community security and reduce the likelihood of incidents occurring. However, while measures are in place to avoid a negative impact there remains the potential for security issues on the ground to go awry in the event of local unrest or intervention by third parties.

Table 8- 22: Impact Assessment Summary due to Need for Security Forces

Impact: Impact on Community Safety due to the Need for Security Forces					
Impact Type:	**Direct**				
Impact Magnitude					
	Extent	Duration	Scale	Frequency	Magnitude
All Phases	Local	Long Term	Medium	Occasional	Small
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium:	Communities will lack the capacity to deal with security incidents if they occur due to a lack of access to social services but will be able to seek the resolution of grievances through MML.				
Impact Significance					
Construction:	Moderate				
Operation:	Moderate				
Decommissioning:	Moderate				

8.8 TRAFFIC AND TRANSPORT IMPACTS

Description of the Baseline Environment

Existing traffic volumes are relatively low in and around the concession area—with a maximum of approximately 3-500 vehicles per hour. The heaviest traffic volumes were near the mine concession area entrance. It is unlikely that public roads in and around the concession area experience congestion or delay regularly due to traffic volume alone. Private vehicles and motorbikes (called okadas in the project area) comprise the largest share of vehicular traffic, and most residents of nearby settlements walk or ride motorbikes for trips to Lunsar or other destinations. An average of 5 to 10 vessels per hour were observed travelling past Thofayim on the Port Loko Creek, the majority of which were small canoes.

8.8.1 Proposed Project Activities

This summarizes the anticipated traffic and transport impacts of activities associated with the Marampa M3.75 project expansion.

Table 8- 23: Impact Characteristics: Traffic and Transportation

Summary	Construction	Operation	Decommissioning
Project Activity:	Increased traffic, including heavy vehicles.	• Increased size of haul trucks. • Increase in background traffic, independent of project activity.	Traffic, including heavy vehicles—decreases from operations traffic volumes.

		• Diversion of travel routes through the concession area. • Increased barge traffic.	
Receptors Affected:	Non-project drivers and pedestrians—especially children travelling to and from school—as well as livestock.		

8.8.1.1 Receptors

Receptors include non-Project-related users of public roads and paths, the haul road (outside of the concession area and Lunsar), and along Port Loko Creek. Pedestrians who use or cross the haul road or public roads that carry mine-related traffic to reach Lunsar or other destinations are at risk, particularly school children.

8.8.1.2 Significance of Impact and Mitigation Measures/Recommendations Construction and Operation

Significance of Impact	Mitigation Measures/Recommendations
With no mitigation, the construction and operation of Marampa M3.75 would have a moderate negative impact on traffic and transportation, due to the following: • Increased Project-related traffic, including heavy construction vehicles, some of which would use public roads to reach the concession area. This could reduce roadway capacity, increase delays, and degrade public road infrastructure. • Increase in accidents and injuries along the haul road, particularly those involving crashes between vehicles and pedestrians or cyclists outside of the concession area and Lunsar. The increased size of ore haul vehicles contributes to this impact. • Increase in accidents and injuries on Port Loko Creek, due to the potential for collision.	• Continue to conduct regular community information sessions around road safety and Project-related Road usage. • Continue to ensure MML drivers are qualified, trained to drive safely and have the required licenses. • Continue to enforce rules on speed limits and road usage for all company vehicles and contractor vehicles using the haul road. MML has already installed and will continue to use tracking technology (GPS, speed logging equipment, etc.) to review driver performance, and to identify drivers with a history of unsafe behaviour. • Cut footpaths and ensure that communities can safely cross the haul road where pedestrians frequently walk on or cross the haul road, especially outside of the concession area and Lunsar. This also includes the construction of separate pedestrian paths along the proposed plant site access road, as well as other roads that provide pedestrian access to Lunsar. • When appropriate, use horns on barges to notify of approach. MML tugs currently use short horn blasts in emergencies to

	notify other users of their presence as well as an escort boat to forewarn of any hazards. At night, horns will generally be replaced by a spotlight to notify presence unless for emergency reasons. Horns will not be sounded near and spotlights will not be directed toward bird nesting areas (i.e., mangroves and mudflats) except for emergency reasons. • MML uses and intends to continue using for the Marampa M3.75 project expansion, a well-marked channel to ensure community awareness of MML activities and routes. • Use barges to transport oversize materials to the mine site (via the haul road), as well as extracted materials to Pepel; this would reduce traffic on public roads. • Continue to properly maintain all barge and trucking equipment. • All captains and senior officers used by MML are internationally certified and trained. MML will continue to enforce compliance with all rules for river travel and safety-related issues, especially issues related to speed and wakes. MML will use tracking technology (GPS, speed-logging equipment, etc.) to review river captain performance and identify captains with a history of unsafe behaviour. • MML will continue to use its established incident investigation procedure and grievance procedure if any transport-related incident occurs Based on the findings of those investigations, MML will review and revise health and safety procedures as necessary.
Decommissioning	
• With no mitigation, the Decommissioning of the Marampa M3.75 project expansion would have a low negative impact on traffic and transportation. Impact activities would be similar to, but less intense than construction.	• Mitigation measures associated with Decommissioning are the same as for Construction and Operation.

8.8.1.3 Residual Impact

Following the implementation of the mitigation measures recommended in *Section 9.10.2*, Marampa M3.75 would have a low negative impact on traffic and transport (see *Table 9.22*). Implementation of these mitigation measures is likely to reduce, but not eliminate the risk of accidents and injuries. The proposed new road would maintain connectivity between Lunsar and settlements to the south. The new route to Lunsar would be longer, but realigned/reconstructed segments would be of a higher quality than the current road. As a result, drivers would likely not experience increased travel time, while pedestrians would.

The Lunsar-to-Rogbere segment of the haul road is a public road. After mine decommissioning, the Sierra Leone Roads Authority will resume responsibility for this section of the road. Similarly, the upgraded Katik Road would be available for public use, as well. The traffic and transport impact of the Decommissioning phase would therefore be positive, due to the provision of higher-quality public road access between the Lunsar region and other parts of the country.

Table 8- 24: Impact Assessment Summary due to Traffic and Transport

Impact: Traffic and Transport					
Impact Type:	***Direct***				
Impact Magnitude					
	Extent	**Duration**	**Scale**	**Frequency**	**Magnitude**
Construction:	Regional	2	Numerous settlements along Haul Road, and boat operators on Port Loko Creek	Short term	Low
Operation:	Regional	25		Long term	Low
Decommissioning:	Regional	1		Short term	Low
Sensitivity/Vulnerability/Importance of Resource/Receptor					
Medium/Low:	The vulnerability would be somewhat reduced due to better pedestrian facilities and enforcement of road and river rules.				
Impact Significance					
Construction:	Minor				
Operation:	Minor				
Decommissioning	Minor (positive if Haul Road is dedicated for public use)				

9 SECTION NINE

ENVIRONMENTAL MONITORING PROGRAMMES & SUSTAINABILITY INITIATIVES

9.1 The Environmental Monitoring Programme

Marampa Mines Limited (MML) Environmental Monitoring Programme plays a crucial role in ensuring the environmental sustainability of the project expansion from 3.25 to 3.75 mdtpa. This programme shall undergo a revision and update annually allowing for a more accurate definition and confirmation of the proposed monitoring stations based on the final project design. The monitoring of the MML operation is an integral part of the Environmental and Social Management Plan, which is designed to comply with various legislative requirements such as the EPA Act of 2022, the Mines and Minerals Act of 2009, and the Mines and Mineral Regulations of 2013.

The objectives of the Monitoring Programme are multifaceted:

- It aims to provide reliable measurements of environmental parameters within and around the MML concession and its sphere of influence. This is crucial in understanding the potential impacts of the project construction and operation on the environment.
- The programme collects and reports environmental data, allowing for a comprehensive assessment of the ongoing activities. Additionally, it ensures pre-emptive control measures are in place to prevent environmental pollution, promoting sustainable practices throughout the construction process.
- To test the performance of the Environmental Management System (EMS) implemented for the mining project. By evaluating its effectiveness, necessary improvements can be made to enhance environmental protection measures. Furthermore, the programme assesses the efficiency of the Environmental Management Plan, providing insights into its effectiveness and identifying areas for improvement.
- It serves as a valuable source of information for state authorities and stakeholders, ensuring they are well-informed about environmental matters related to the M3.75 construction and operation.

The scope of the Environmental Monitoring Programme is comprehensive. Weather monitoring is conducted to understand the influence of climate conditions on the construction and operation of the mines. Air monitoring includes assessing air quality and monitoring non-fugitive emissions from point sources, such as haul roads, processing plant, ROM pad, mining pits and machineries used in the construction and operation process.

Noise and vibrations from blasting activities are also monitored to minimize potential disturbances to the surrounding areas. Waters, including surface water, groundwater, and wastewater, undergo monitoring to ensure their quality is maintained and prevent any contamination. Wastes, such as hazardous, construction, and household (municipal) wastes, are closely monitored to ensure proper disposal and minimize their environmental impacts. Soils are also monitored to assess their quality and prevent any degradation. Lastly, biodiversity monitoring is conducted to understand and protect the diverse range of flora and fauna in the area.

In summary, MML Environmental Monitoring Programme is a vital component of the Marampa M3.75 mdtpa construction and operation plan. Through its systematic monitoring and assessment, it ensures the project's compliance with environmental regulations, prevent pollution, and promote sustainable practices. By addressing various environmental aspects, such as weather, air, noise, water, waste, soil, and biodiversity, the programme provides a comprehensive understanding of the project's environmental impact and facilitates informed decision-making for the benefit of all stakeholders.

9.2 Cost of Environmental Monitoring

Table 9-2 provides a comprehensive breakdown of the cost associated with annual environmental monitoring. This crucial aspect of environmental management involves various expenses, including procurement of equipment and tools, consultants contracting costs, and the cost of training employees responsible for conducting monitoring tasks. Each of these components plays a vital role in ensuring the effectiveness and efficiency of environmental monitoring efforts. The procurement of equipment and tools is necessary to equip monitoring teams with the necessary resources to collect and analyse data accurately. This may encompass items such as air quality monitors, water testing kits, or soil sampling tools. Additionally, consultants contracting costs are essential for bringing in external experts who possess specialized knowledge and skills in environmental monitoring. These consultants can provide valuable insights, guidance, and support to ensure that monitoring activities align with best practices and regulatory requirements. Lastly, the cost associated with training employees is crucial for building internal capacity within an organization.

Overall, the comprehensive breakdown provided in Table 9-1 serves as a valuable resource for MML and the Environmental Protection Agency.

Table 9- 1: Environmental Monitoring Aspects

No	Particulars	Monitoring Frequency	Duration of Monitoring	Important Parameters for Monitoring
I	Air quality			
1	Ambient Air quality at Project premises	Once in a month	48 hours (2 consecutive days)	PM10, PM2.5, NOx, SO2, CO, VOC, NH3

II	Surface and Ground Water			
1	Water monitoring within the island	Once in a month	Grab	Physical/ Inorganics/ heavy metals
III	Noise Environment			
1	In the periphery/boundary of the Facility.	Once in a month	Day and Night	Records reasons for abnormal values and identify sources which cause abnormality.
2	DG set	Once a Month	Day and Night	Take corrective action if there is any increase.
3	Machines which generate noise beyond 60 dB.	Once a month or when the necessity arises.	Day and Night	Take corrective action if there is any increase.
IV	Wastewater quality			
1	Raw effluent	Once in a quarter	Grab	pH, TSS, TDS, COD, BOD.
2	Treated effluent	Once a month		pH, TSS, TDS, COD, BOD.
V	Soil quality			
1	Within project premises at one location around.	Once in a year	Composite sample	EC, Organic carbon, pH, N, P and K.
	Hazardous waste storage site.			
2	At material and solvent storage area.	Once in a year	Composite sample	pH, EC, N, P & K, organic carbon.

Table 9- 2: Summary of Environmental Monitoring Cost for 2023

Description	UOM	Total
Health and Safety	USD	366,045
Medical Supplies	USD	659,238
Environment	USD	777,903
Overheads - Camp & Site	USD	52,549
Fuel - Camp & Site	USD	27,632
Staff Costs - Camp & Site	USD	295,758
Total HSE Opex	USD	2,179,126

Table 9- 3: Detailed Breakdown for Monitoring Cost

Detailed HSE Breakdown Cost		
Description	**UOM**	Total
Medical expenses	USD	641,738
Software Licenses and subscriptions	USD	16,000
Training & development	USD	1,500
Medical expenses	USD	12,298
Other overhead expenses	USD	6,200

Stationery & Printing	USD	48,900
Training & development	USD	107,804
Office expenses	USD	6,000
Professional Fees - Other	USD	94,200
Consumables and small tools	USD	259,391
Other overhead expenses	USD	6,100
Professional Fees - Other	USD	134,000
Protection equipment	USD	1,000
Rice and other contributions	USD	3,000
Equipment hires	USD	80,120
Third party maintenance services	USD	29,000
Other miscellaneous licensing and permits	USD	40,291
Environment protection license fee	USD	225,000
Communication - mobile airtime and data	USD	3,649
Third party maintenance services	USD	3,878
Fuel	USD	23,754
Travel - Other expenses	USD	217
Travel - Airfare	USD	17,333
Catering Expenses	USD	159,472
Travel - Accommodation	USD	3,098
Rice and other contributions	USD	35,780
Temporary Staff hire	USD	79,858
Consumables and small tools	USD	139,543
Total HSE Opex Cost	USD	2,179,126

9.3 SUSTAINABILITY INITIATIVES

Sustainability and ESG (Environment, Social and Governance) performance criteria drive progress for MML by integrating the mine site's separate functional areas through strategy and structured cross-departmental collaboration, including between MML's Community Relations & Development department, our Local Content Plan, Procurement, Human Resources, Environmental Monitoring, and Health & Safety, among others. In 2023, the company hired two dedicated Sustainability/ESG professionals to lead the department, plus a Biodiversity Supervisor who sits within the Environment department.

MML's Sustainability activities also include environmental monitoring, nature-based and climate-based solutions, and continuous execution against the Mine Closure and Rehabilitation Plan, including land progressive land remediation. MML embraces the mentality that the 'whole is greater than the sum of its parts,' which speaks to sustainability as a value creation proposition and as a core strategy to solidify MML as a world class iron ore concentrate producer. MML reports on our Sustainability performance on an annual basis by publishing a Sustainability Report on our website. The 2022 report is appended to this document and the 2023 report is to be published by the end of the first quarter of 2024.

9.3.1 On-site Farm

MML is developing a 70-hectare farm to produce fruit, vegetables and livestock that will meet the daily needs of our 2,612 employees/contractors. The operation will encompass four production systems: fish, chickens, cattle, and fruit/vegetables – all built on nature-based solutions and regenerative/integrated agriculture practices. MML is performing extensive work to improve soil composition, which has low organic content, low water holding capacity and low nutrient availability. Once soil preparation is complete, livestock rotation prepares pastures and vegetable production areas while naturally controlling parasites. Vegetable production waste is in turn used to feed livestock, creating a positive feedback loop that improves fertility while using one production system's waste as a free input for another. Some elements of the farm are already operating, and the project is expected to be fully operational by the second half of 2024.

The farm project is emblematic of MML's integrated approach to sustainability. It will accelerate progress in moving towards more circular systems (repurposing materials, reduced landfill waste, increased composting, and drastically reduced reliance on imported foods) that will improve our sustainability performance overall. It is a value-adding proposition for our Community Relations & Development (CR&D) Department, which has and will continue to hire people from adjacent primary host communities for the project, contributing to MML's Local Content Plan goals. Those hired will gain valuable and transferable agricultural skills and work experience.

Figure 9- 1: MML Farm

Figure 9- 2: Pictorial view of Pineapple at MML Farm

10 CONCLUSIONS

After conducting a thorough Environmental Social and Health Impact Assessment by an integrated team of experts in various disciplines for the Marampa M3.75 expansion project, potential impacts and risks that must be addressed to ensure the project's sustainability and minimize negative effects on the environment, communities, and public health, have been carefully evaluated. Through our analysis and evaluation of the available information, data, survey, sampling, sites visit and field visits of host communities; the ESHIA study team has reached several key conclusions and recommendations that should guide the decision making process for MML and its stakeholders.

This ESHIA has been developed to identify and manage potential negative impacts and propose measures to enhance positive impacts. Furthermore, the ESHIA has taken into account the laws of Sierra Leone and has identified all the necessary licensing and permitting requirements based on the current project concepts and designs. In addition to the laws of Sierra Leone, the ESHIA has been developed to conform to the IFC Performance Standards, the IFCs General Environmental, Health and Safety (EHS) and industry-specific guidelines, guidelines and policies, as well as MML's policies and procedures.

Its main objectives (undermentioned) are to serve as a comprehensive document outlining the findings and recommendations of the ESHIA process:

- Present a detailed baseline review of the physical, biological and socioeconomic characteristics of the Project Area of Influences in respect of the Marampa M3.75 project expansion.
- Assess the impacts (including cumulative impacts) of the physical, biological and socio-economic environments related to the different phases of the proposed Project expansion; and
- Provide mitigation measures and associated management plans that aim to avoid /minimise/manage the severity of identified impacts, and enhance the positive impacts.

The comprehensive analysis and thorough evaluation of potential impacts on the environment and communities demonstrate MML's commitment to responsible and sustainable practices. By identifying and addressing potential issues, MML aims to minimize any negative impact that may arise from the Marampa M3.75 Project expansion. Such responsible actions will not only help to secure a social license to operate but also promote sustainable development and long-term success.

The Marampa M3.75 Project expansion can be developed without perverse environmental or social impediments, provided that the mitigation and management measures/plans outlined in this ESHIA report are implemented effectively. This assessment confirms the dedication of MML to responsible and sustainable practices, ensuring the well-being of both the environment and the local communities. The implementation of the recommended measures will not only enable MML to operate responsibly can pave the way for a brighter future by facilitating the creation of long-term benefits for all stakeholders involved.

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12 APPENDICES

1 Grade Control Assay Resul

Hole ID	from	to	TYPE	al2o3pc	fepc	k2opc	mnopc	na2opc	samp_id	si02pc	tio2pc
BLDH001	0	2	BH	8.07	39.15	0.47	0.18	0.02	1	26.28	0.35
BLDH002	0	2	BH	5.68	45.36	0.3	0.24	0.01	2	16.72	0.32
BLDH003	0	2.4	BH	4.79	52.8	0.46	0.44	0.03	3	13.05	0.26
BLDH004	0	4.6	BH	4.34	51.16	0.41	0.2	0	4	15.79	0.27
BLDH005	0	2.9	BH	1.98	49.08	0.07	0.07	0.03	5	25.53	0.11
BLDH006	0	2.9	BH	2.94	51.77	0.23	0.05	0.01	6	18.54	0.19
BLDH007	0	2.5	BH	5.33	47.06	0.2	0.07	0.01	7	18.94	0.29
BLDH008	0	3.8	BH	3.14	29.57	0.33	0.03	0.05	8	12.54	0.16
BLDH009	0	4.3	BH	13.74	35.44	0.59	0.96	0.01	9	23.53	0.48
BLDH010	0	4.5	BH	10.95	29.92	1.31	0.2	0.03	10	35.11	0.44
BLDH011	0	3	BH	6.29	45.23	0.21	0.43	0.02	11	22.13	0.36
BLDH012	0	4.2	BH	4.81	47.86	0.36	0.36	0.02	12	16.34	0.25
BLDH013	0	2.5	BH	3.5	55.42	0.17	0.07	0.02	13	12.39	0.21
BLDH014	0	3.9	BH	2.17	51.69	0.06	0.06	0.01	14	21.44	0.16
BLDH015	0	5	BH	2.24	50.32	0.17	0.05	0.02	15	23.26	0.14
BLDH016	0	4	BH	4.77	48.76	0.37	0.06	0.02	16	20.45	0.23
BLDH017	0	2.2	BH	5.53	46.86	0.75	0.05	0.03	17	23.61	0.3
BLDH018	0	4.6	BH	14.14	25.38	1.83	1.3	0.05	18	34.11	0.46
BLDH019	0	5	BH	8.02	44.41	0.25	1.4	0.02	19	19.83	0.38
BLDH020	0	4.7	BH	5.91	48.34	0.47	0.59	0.01	20	17.41	0.32
BLDH021	0	3.6	BH	2.59	55.92	0.18	0.12	0.01	21	14.23	0.16
BLDH022	0	2.9	BH	2.17	51.39	0.17	0.05	0.01	22	22.85	0.14
BLDH023	0	2.5	BH	5.68	48.58	0.23	0.16	0.02	23	17.17	0.26
BLDH024	0	4	BH	4.14	53.09	0.32	0.1	0.03	24	16.79	0.22
BLDH025	0	5	BH	3.75	52.17	0.48	0.03	0.02	25	19.16	0.21
BLDH026	0	4	BH	4.45	48.38	0.43	0.08	0.03	26	20.34	0.27
BLDH027	0	5	BH	11.09	37.74	0.84	0.46	0.03	27	24.74	0.36
BLDH028	0	4.3	BH	9.78	40.91	0.6	0.4	0.02	28	23.23	0.42
BLDH029	0	5	BH	6	49.23	0.18	1.58	0.01	29	15.11	0.3
BLDH030	0	3.6	BH	5.68	47.6	0.33	0.39	0.02	30	19.21	0.31
BLDH031	0	4.8	BH	3.93	55.86	0.5	0.1	0.04	31	13.25	0.19
BLDH032	0	4.5	BH	4.08	49.91	0.21	0.14	0.02	32	18.61	0.23
BLDH033	0	4.5	BH	4.31	52.7	0.29	0.06	0.02	33	16.11	0.2
BLDH034	0	4.5	BH	3.25	54.17	0.23	0.04	0.01	34	17.46	0.17
BLDH035	0	4.5	BH	6.38	43.3	0.89	0.11	0.03	35	25.14	0.28
BLDH036	0	3	BH	8.11	46.57	0.35	0.28	0.01	36	17.08	0.34
BLDH037	0	4.8	BH	7.27	47.16	0.43	1.05	0.01	37	16.84	0.35
BLDH038	0	5	BH	5.52	49.71	0.34	0.8	0.02	38	16.36	0.32
BLDH039	0	3	BH	5.18	51.34	0.26	0.2	0.02	39	15.32	0.27
BLDH040	0	3.7	BH	2.28	56.34	0.2	0.15	0.02	40	15.18	0.17

BLDH041	0	4.5	BH	4.12	51.82	0.33	0.11	0.02	41	17.73	0.26
BLDH042	0	5	BH	5.41	49.72	0.41	0.06	0.01	42	17.09	0.27
BLDH043	0	4.9	BH	4.69	50.05	0.37	0.04	0.02	43	20.22	0.22
BLDH044	0	2	BH	5.19	48.45	0.34	0.09	0.02	44	19.09	0.26
BLDH045	0	3.6	BH	10.76	41.59	0.63	0.24	0.02	45	19.9	0.4
BLDH046	0	5	BH	11.72	36	1.14	0.23	0.04	46	26.97	0.44
BLDH047	0	5	BH	7.08	45.07	0.19	2.21	0.02	47	19.8	0.33
BLDH048	0	4.5	BH	3.78	53.94	0.44	0.42	0.03	48	14.37	0.23
BLDH049	0	4.6	BH	3.58	49.23	0.2	0.1	0.02	49	21.78	0.21
BLDH050	0	3.9	BH	3.38	50.35	0.17	0.06	0.01	50	20.06	0.17
BLDH051	0	3.5	BH	7.07	47.33	0.59	0.22	0.04	51	18.41	0.3
BLDH052	0	4.6	BH	2.57	55.56	0.27	0.09	0.02	52	15.2	0.18
BLDH053	0	4.1	BH	3.39	53.5	0.3	0.06	0.02	53	17.2	0.19
BLDH054	0	4	BH	5.46	46.68	0.38	0.21	0.03	54	21.07	0.26
BLDH055	0	2.5	BH	4.98	52.34	0.34	0.09	0.03	55	15.31	0.28
BLDH056	0	4	BH	3.17	53.49	0.55	0.12	0.02	56	16.45	0.15
BLDH057	0	4	BH	2.45	50.35	0.26	0.05	0.02	57	23.91	0.16
BLDH058	0	3.1	BH	4.35	52.15	0.45	0.22	0.02	58	16.54	0.24
BLDH059	0	3.5	BH	4.75	53.49	0.33	0.06	0.01	59	13.91	0.3
BLDH060	0	4.8	BH	5.49	49.86	0.5	0.06	0.02	60	18.17	0.28
BLDH061	0	5.1	BH	3.97	54.85	0.24	0.05	0.02	61	12.84	0.21
BLDH062	0	5.1	BH	7.46	47.27	0.58	0.06	0.02	62	17.67	0.36
BLDH063	0	4.5	BH	5.66	49.95	0.5	0.08	0.04	63	17.71	0.31
BLDH064	0	5	BH	6.75	46.65	0.96	0.16	0.03	64	19.46	0.38
BLDH065	0	5	BH	4.16	55.13	0.15	0.11	0.03	65	11.04	0.26
BLDH066	0	5.2	BH	3.71	53.03	0.4	0.04	0.02	66	17.58	0.2
BLDH067	0	5	BH	4.28	48.25	0.49	0.05	0.02	67	22.05	0.25
BLDH068	0	4	BH	2.91	52.98	0.2	0.05	0.02	68	18.48	0.16
BLDH069	0	5	BH	6.98	46.61	0.35	0.36	0.02	69	17.57	0.31
BLDH070	0	3.4	BH	7.04	36.46	0.21	0.09	0.02	70	30.32	0.33
BLDH071	0	3.7	BH	3.9	53.57	0.33	0.2	0.01	71	14.69	0.25
BLDH072	0	4.3	BH	6.19	39.76	0.34	0.61	0.02	72	15.11	0.29
BLDH073	0	2.9	BH	7.63	44.69	0.36	1.35	0.02	73	17.95	0.37
BLDH074	0	3.8	BH	10.12	33.26	1.16	0.63	0.04	74	30.37	0.38
BLDH075	0	4.3	BH	6.13	47.3	0.26	0.93	0.02	75	16.91	0.33
BLDH076	0	4.8	BH	5.57	46.56	0.35	0.73	0.03	76	17.83	0.31
BLDH077	0	5	BH	4.29	52.18	0.28	0.8	0.02	77	14.94	0.23
BLDH078	0	4.1	BH	6	42.04	0.23	0.5	0.02	78	13.55	0.27
BLDH079	0	5.1	BH	7.96	45.1	0.34	0.8	0.02	79	18.28	0.36
BLDH080	0	5.1	BH	7.45	42.69	0.45	0.72	0.04	80	15.46	0.23
BLDH081	0	4	BH	3.51	54.77	0.33	0.25	0.02	81	14.31	0.17
BLDH082	0	4.2	BH	2.91	47.15	0.13	0.21	0.02	82	22.97	0.16
BLDH084	0	4.5	BH	11.44	35.65	0.78	0.27	0.07	84	22.49	0.38
BLDH085	0	4.5	BH	7.05	44.85	0.29	0.44	0.02	85	19.34	0.35
BLDH086	0	5.2	BH	2.11	45.98	0.11	0.04	0.05	86	15.53	0.14
BLDH087	0	4.7	BH	5.16	51.06	0.47	0.31	0.04	87	11.76	0.26

BLDH088	0	5.2	BH	3.88	51.31	0.44	0.19	0.04	88	16.8	0.2
BLDH089	0	4.7	BH	2.16	54.51	0.1	0.14	0.01	89	17.05	0.15
BLDH090	0	5.5	BH	3.34	51.21	0.3	0.06	0.06	90	16.82	0.21
BLDH091	0	4.1	BH	8.73	39.73	0.54	0.67	0.02	91	24.09	0.39
BLDH092	0	2.5	BH	6.78	43.1	0.26	0.24	0.07	92	21.05	0.39
BLDH093	0	5.2	BH	6.09	49.47	0.26	0.73	0.03	93	13.97	0.29
BLDH094	0	4.5	BH	4.52	50.69	0.43	0.23	0.02	94	16	0.24
BLDH095	0	4.5	BH	3.72	52.62	0.31	0.15	0.03	95	13.55	0.2
BLDH096	0	5.2	BH	3.65	50.05	0.3	0.11	0.03	96	18.68	0.21
BLDH097	0	5	BH	4.34	48.54	0.31	0.07	0.01	97	20.12	0.27
BLDH098	0	5	BH	7.43	46.89	0.19	2.56	0.01	98	14.07	0.35
BLDH099	0	4.5	BH	12.28	35.48	0.84	2.71	0.04	99	20.39	0.47
BLDH100	0	5	BH	11.48	34.9	1.4	0.29	0.15	100	27.95	0.49
BLDH101	0	4.1	BH	7.34	46.61	0.14	4.42	0.02	101	12.17	0.36
BLDH102	0	5.1	BH	5.97	49.31	0.52	0.24	0.03	102	15.6	0.33
BLDH103	0	5	BH	4.9	51.07	0.56	0.23	0.03	103	16.11	0.29
BLDH104	0	4.5	BH	2.23	52.37	0.15	0.24	0.03	104	18.97	0.16
BLDH105	0	4.4	BH	3.29	52.09	0.24	0.05	0.01	105	18.27	0.23
BLDH106	0	3.7	BH	3.82	53.21	0.36	0.16	0.02	106	13.5	0.24
BLDH107	0	5	BH	4.75	51.25	0.43	0.08	0.03	107	16.1	0.26
BLDH108	0	5	BH	4.58	49.19	0.58	0.07	0.03	108	18.68	0.26
BLDH109	0	5	BH	5.95	41.06	0.41	0.06	0.06	109	28.81	0.31

Attendance Record of Stakeholders and Community Engagement sessions at Marampa Section

ATTENDANCE ROOSTER

NAME OF COMPANY: MARAMPA MINES LIMITED

PROJECT TITLE: MML PROJECT ~~EXPANSION~~ EXPASION UPDATE

PURPOSE OF MEETING: Marampa Section Stakeholders' Engagement Meeting

LOCATION OF MEETING: MAGBIL VILLAGE DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
1	Chief Pa Kapr Sankoh	Magbil	Section Chief	07754622	
2	Pa Kapr Sheriph Kamara	Chaindata	caramonial chief.	077-795-181	
3	Sullay Sesay	Robellah	Head Man.	033-15 22-08	
4	Mohamed Bangura	Magbil	Head Man	08851613 8	M.B
5	Brima Kabia	Chaindata	Land Owner.	030820113.	
6	Abdul S. Kanu.	Maforki	Land owner	07840117	
7	Pa Shaka Kamara	Marforki.	Youth Man.	077801850	
8	Joseph Nwokelo	✓	Youth Leader.	030868859	
9	Mariatu Kamara	✓	Chairlady	080354432	
10.	Abdulai Tarawalie	Magbil	Youth	030644914	
11	Sheku Turay	Mathukia	Land owner.	030306868	
12	Dauda Kabia	Chaindata	Youth Leader	07720389 6	
13	Mar Hellen Mariatu Conteh	Chaindata	Chairlady	033399182	Hellen
14	John Kamara	Magbail	Youth	077906752	
15	Rugiatu Kamara.	Magbail.	H/Wife.		
16	Yabu Koroma	✓	H/Wife		

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: MARAMPA MINES LIMITED

PROJECT TITLE: MML PROJECT EXPANSION UPDATE

PURPOSE OF MEETING: Marampa Section Stakeholders' Engagement Meeting

LOCATION OF MEETING: MAGBIL VILLAGE DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
17	Hawa Koroma	Magbail	H/Wife	-	
18	Fatmata Bangura	Mag✓	H/Wife	-	
19	Mariatu Kamara	Magbail.	H/Wife.	-	
20	John M. Kabia	Maforki	Deputy youth leader.	077268994	
21	Osman Bangura	Robellah.	Youth leader.	090446530.	
22	Isatu Kamara	Robellah.	Chairlady.	03014 1729	
23	Samuel M. Fofanah	Manonkoh	Landowner.	077040425	
24	Mohamed Turay	Mathukia	Head Man	099184422	
25	Abu Kanu	✓	Youth Leader	088640117	
26	Alie Sesay	Mathukia	Land Owner.	077453837	ALP
27	Aminata Conteh.	Magbail	H/Wife	- -	
28	Pa Sheik Musa Conteh	Magbanthoki	Chief Imam.	030840433	
29	Sallieu Conteh	✓	Head Man	077500330	
30	Isatu Tarawalie	✓	Landowner/Chairlady	099548794	
31	Kadiatu Kamara	✓	Landowner.	-	
32	Abdul Kargbo	Manonkoh	Head Man.	08082 25 65	

Environmental Management Ventures

Attendance Rooster of Stakeholder and Community Engagement Meetings

ATTENDANCE ROOSTER

NAME OF COMPANY: MARAMPA MINES LIMITED
PROJECT TITLE: MML Project Expansion ESHIA Update
PURPOSE OF MEETING: Community Engagement meeting of stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
1	Mohmoh Kabia	Mamanso	Teacher/Landowner	072744917	
2	Alu Sesay	Head/man ✓	H/man	079127305	
3	Mohamed morray Sesay	Mamanso	former section chief	079127305	
4	Ishmail Kroma	Mamanso	farmer	079 84 3006	
5	Pa Alpha Kamara	Mamanso	Imam	072011282	
6	Gibrilla Bangura	✓	not H/man	078 573117	
7	Murray M. Sesay	✓	Student	080662964	
8	Foday Kabia	✓	landowner		
9	Almamy M. Sesay	✓	Student	088959878	
10	Sulaiman A Kamara	✓	Student		
11	Mohamed fullah	✓	farmer		
12	Sorie A Koroma	✓	Student		
13	Almamy Bangura	✓	farmer		
14	Mohamed Koroma	✓	farmer		
15	Mr. Sorie B. Bangura	✓	ferry headman		
16	Abdulai fullah	✓	farmer		

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: MARAMPA MINES LIMITED
PROJECT TITLE: MML project Expansion update
PURPOSE OF MEETING: Community Engagement of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
17	Alusine M. Sesay	✓	Student	078118196	
18	Idrissa fullah	✓	farmer		
19	Mohamed Hardin	✓	farmer		
20	Abdul fofanah	✓	farmer		
21	Aruna Koroma	✓	Student		
22	Kapr Koroma	✓	Community leader		
23	Santigie Koroma	✓	farmer		
24	Pamaray Sesay	✓	healder		
25	Santigie Bangura	✓	farmer youth leader		
26	Ishmail Kabba	✓	Healder/landowner		
27	Sidique Kabba	✓	Student		
28	Mohamed M. Conteh	✓	Student		
29	Alie Kuyateh	✓	farmer		
30	Mohamed Conteh	✓	ferry man		
31	Samuel Macauley	✓	ferry man	077 662315	
32	Mbalu Murray Sesay	✓	Student	072600872	

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: MARAMPA MINES LIMITED
PROJECT TITLE: MML project Expansion ESHIA Update
PURPOSE OF MEETING: Community Engagement Meeting of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/1/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
33	Gibrilla Kabia	Mapolie	land owner	099119493	
34	Alhaji Kamara	✓	youth leader	090276286	
35	Ibrahim Kalokoh	✓	H/man	034 868888	
36	Abdulai Sesay	Maboki	H/man	030789627	
37	Isatu Kargbo	Mawullay	H/wife		
38	Isatu fullah	Mamanso	H/wife		
39	Kadiatu Kamara	Mawullay	H/wife		
40	fatmata Kamara	Mawullay	Land owner	088392389	
41	Zainab Kabia	Mamanso	H/wife		
42	Santigie Tarawallie	Mawullay	youth	073 514800	
43	Isatu Turay	Mawullay	Healder		
44	Mabinty Koroma	Mawullay	Trader		
45	Isatu Kargbo	Mamanso	Trader		
46	Alpha Sesay	Katick	youth	088 519001	
47	Bampia Bangura	Konta Banah	youth leader	~~03044~~4898	
48	PA Mustapha Kamara	Moria	Chairman	088443959	

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: MARAMPA MINES LIMITED
PROJECT TITLE: MML project Expansion ESHIA Update
PURPOSE OF MEETING: Community Engagement meeting of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
49	Ya marie fofanah	Mawullay	Healder		
50	Mohamed Kamara	Moria	youth leader	090837110	
51	Mariatu Kamara	Mawullay	H/wife		
52	Aminata Tarawallie	Mawullay	H/wife		
53	Aminata Kamara	Mamanso	H/wife		
54	Mariatu Koroma	Mamanso	H/wife		
55	Hawa Kanu	Mawullay	Healder		
56	fatu Kabia	Mawullay	Healder		
57	fatmata Sesay	Mawullay	H/wife		
58	Almamy Kanu	Mawullay	Land owner		
59	Bai Koroma	Mawullay	farmer	079 278275	
60	Tamimu Sesay	✓	farmer		
61	Marie Dawo	✓	H/wife	079 543883	
62	Alie B. Koroma	✓	Student		
63	Makapri Kanu	✓	Healder		
64	Mariatu Kamara	✓	H/wife		

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: MARAMPA MINES LIMITED
PROJECT TITLE: MML project Mines Expansion update
PURPOSE OF MEETING: Community Engagemeeting of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023.

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
	Hassan Sankoh	Mabala.	Head Man	077860558	
	Aminata Kamara	Kontabana	Deputy head Woman	030459160	
	Ibrahim Tarawalie	Mawullay	Head man	099253780	
	Mohamed Fofanah	Magblak	Head man	076484745	
	Hassan Kabia	Magblak.	Youth Leader.	—	
	Santigie Sankoh	Mawullay	Farmer.	079522816	
	Hassan Kamara	Mahonta	Head man	—	
	Isatu Bangura	Mawullay.	Chairlady	—	
	Mohamed Koroma	Masu.	Headman	075023265	
	Aminata Conta	Mawullay	H/Wife.	—	
	Idrissa Kamara	Magblik	Youth man.	—	
	Pa Sallu fofanah	Masu	Town Chief	077466131	
	Isatu Koroma	Mawullay.	H./Wife.	—	
	Osman Sankoh	Katick	Head man	077053954	

ATTENDANCE ROOSTER

NAME OF COMPANY: Marampa Mines Limited
PROJECT TITLE: MML Project Expansion ESHIA Update
PURPOSE OF MEETING: Community Engagement Meeting of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
1	Mohamed Kabia	Mamanso	Teacher/Landowner	077744497	
2	Alie Sesay	Head/man	H/man	099129305	
3	Mohamed Morray Sesay	Mamanso	former section chief	079127307	
4	Ishmail Koroma	Mamanso	farmer	079 84 3006	
5	Pa Alpha Kamara	Mamanso	H/man	072 011282	
6	Gibrilla Bangura	✓	not H/man	078 573117	
7	Morray M. Sesay	✓	Student	080662949	
8	Foday Kabia	✓	Landowner		
9	Alimamy M. Sesay	✓	Student	088959876	
10	Sulaiman A. Kamara	✓	Student		
11	Mohamed Fullah	✓	farmer		
12	Sorie A Koroma	✓	Student		
13	Alimamy Bangura	✓	farmer		
14	Mohamed Koroma	✓	farmer		
15	Mr. Sorie B. Bangura	✓	ferry headman		
16	Abdulai Fullah	✓	farmer		

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: Marampa Mines Limited
PROJECT TITLE: MML Project Expansion Update
PURPOSE OF MEETING: Community Engagement of Stakeholder
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
17	Alusine M. Sesay	✓	Student	076118196	
18	Idrissa Fullah	✓	farmer		
19	Mohamed Hardi	✓	farmer		
20	Abdul Fofanah	✓	farmer		
21	Aruna Koroma	✓	Student		
22	Kapr Koroma	✓	Community leader		
23	Santigie Koroma	✓	farmer		
24	Pamaray Sesay	✓	headelder		
25	Santigie Bangura	✓	farmer youth leader		
26	Ishmail Kabba	✓	Healder/landowner		
27	Sidique Kabia	✓	Student		
28	Mohamed M. Conteh	✓	Student		
29	Alie Kargbo	✓	farmer		
30	Mohamed Conteh	✓	ferry man		
31	Samuel Macaulay	✓	ferry man	077 662315	
32	Mbalu Morray Sesay	✓	Student	072 600872	

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: Marampa Mines Limited
PROJECT TITLE: MML Project Expansion ESHIA Update
PURPOSE OF MEETING: Community Engagement Meeting of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/1/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
33	Gibrilla Kabia	Mapolie	land owner	079119493	
34	Alhaji Kamara	✓	youth leader	090776286	
35	Ibrahim Kabokoh	✓	H/man	034 869885	
36	Abdulai Sesay	Maboki	H/man	030 787627	
37	Isatu Kargbo	Mawullay	H/wife		
38	Isatu Fullah	Mamanso	H/wife		
39	Kadiatu Kamara	Mawullay	H/wife		
40	Fatmata Kamara	Mawullay	Land owner	088392589	
41	Zainab Kabia	Mamanso	H/wife		
42	Santigie Tarawallie	Mawullay	youth	073 514800	
43	Isatu Tiny	Mawullay	Healder		
44	Mabinty Koroma	Mawullay	Trader		
45	Isatu Kargbo	Mamanso	Trader		
46	Alpha Sesay	Katick	youth	088519001	
47	Bampia Bangura	Konta Bamal	youth leader	030~~44~~4898	
48	PA Mustapha Kamara	Mamie	Chairman	088443959	

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: Marampa Mines Limited
PROJECT TITLE: MML Project Expansion ESHIA Update
PURPOSE OF MEETING: Community Engagement Meeting of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
49	Ya mamie Fofanah	Mawullay	Healder		
50	Mohamed Kamara	Mamie	youth leader	090 837110	
51	Mariatu Kamara	Mawullay	H/wife		
52	Aminata Tarawallie	Mawullay	H/wife		
53	Aminata Kamara	Mamanso	H/wife		
54	Mariatu Koroma	Mamanso	H/wife		
55	Hawa Kanu	Mawullay	Healder		
56	Fatu Kabia	Mawullay	Healder		
57	Fatmata Sesay	Mawullay	H/wife		
58	Alimamy Kanu	Mawullay	Land owner		
59	Bai Koroma	Mawullay	farmer	079 778275	
60	Tamba Sesay	✓	farmer		
61	Marie Daniro	✓	H/wife	079 543883	
62	Alie B. Koroma	✓	Student		
63	Makapri Kanu	✓	Healder		
64	Mariatu Kamara	✓	H/wife		

Environmental Management Ventures

ATTENDANCE ROOSTER

NAME OF COMPANY: Marampa Mines Limited
PROJECT TITLE: MML Project Mines Expansion Update
PURPOSE OF MEETING: Community Engagement Meeting of Stakeholders
LOCATION OF MEETING: Mawullay Community DATE: 22/01/2023.

NO	NAME	LOCATION	POSITION	PHONE #	SIGN
	Hassan Sankoh	Mabala	Head Man	077 860558	
	Aminata Kamara	Kontabama	Deputy head woman	030 459160	
	Ibrahim Tarawalie	Mawullay	Head man	077 253780	
	Mohamed Fofanah	Magblak	Head man	076 484745	
	Hassan Kabia	Magblak	Youth Leader.	–	
	Santigie Sankoh	Mawullay	Farmer.	079 522816	
	Hassan Kamara	Mafonda	Head man	–	
	Isatu Bangura	Mawullay	Chairlady	–	
	Mohamed Koroma	Masu.	Headman	07502 3265	
	Aminata Conteh	Mawullay	H/ wife.	–	
	Idrissa Kamara	Magblik	Youth man	–	
	Pa Sallu Fofanah	Masu	Town Chief	077466131	
	Isatu Koroma	Mawullay	H/ wife	–	
	Osman Sankoh	Katick	Head man	077053754	

13 ANNEXURES

Annexure 1: Environmental Management Plan
Annexure 2: Environmental Monitoring Plan
Annexure 3: Waste Management Plan
Annexure 4: Chemical Management Plan
Annexure 5: Resettlement Action Plan
Annexure 6: Emergency Response Action Plan
Annexure 7: Community Development Action Plan Activities Update
Annexure 8: Occupational Health and Safety Plan
Annexure 9: Grievances Redress Mechanism
Annexure 10: Mine Closure and Rehabilitation Plan
Annexure 11: Biodiversity Policy
Annexure 12: 2022 Sustainability Report