

# Sierra Rutile Limited

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## Sierra Rutile Project Area 1- Environmental, Social and Health Impact Assessment

### Specialist Rapid Health Impact Assessment





**For SRK Consulting**

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# Executive Summary

## ***Introduction***

SHAPE Consulting Limited (SHAPE) was appointed by SRK Consulting (South Africa) (Pty) Ltd. (SRK) to conduct a rapid Health Impact Assessment (HIA) for the Sierra Rutile Limited (SRL) Project (Project) in Sierra Leone, as part of the updated Environmental, Social and Health Impact Assessment (ESHIA).

SRL is wholly owned by Iluka Resources Limited (Iluka) and consists of existing mining operations, a mineral sand processing plant and an export facility. The Project has been operational for over 50 years and is located in the Bonthe and Moyamba Districts in the Southern Province of Sierra Leone.

The ESHIA is being undertaken to meet country legal requirements, Iluka's corporate policies and to align with good international industry practice (GIIP).

## ***Health Impact Assessment Objectives***

In general terms, a HIA seeks to identify and estimate the lasting or significant changes, due to project activities, on the health status of a defined population. This is done by adopting a systematic approach to identifying different health and wellbeing impacts, both positive and negative, and the distribution of these health effects across a potentially affected population.

The specific objectives of the HIA for SRL is to review community health impacts and consider the potential future health impacts (direct and indirect) that the Project may have on Potentially Affected Communities (PACs), including:

- Analysing available evidence from various desktop and field based sources;
- Review potential health impacts of concern that may be influenced by direct and indirect Project activities;
- Categorise the significance of identified health impacts to prioritise management thereof;
- Recommend key management/mitigation measures to enhance potential benefits or to avoid/minimise negative impacts associated with the Project, and
- Develop a community health management and monitoring plan to guide decision making and surveillance of interventions.

The approach used in the HIA was based on an approved methodology endorsed by the International Finance Corporation (IFC) that supports Performance Standard 4 (Community

Health, Safety and Security). This methodology follows a reductionist approach using 12 Environmental Health Areas (EHAs), and is described in more detail in section 4.

### ***Health Impact Assessment Activities***

The HIA activities included a desktop and field component:

- A review of specialist socio-economic and environmental studies / data;
- A review of available literature;
- Grey data that was obtained from the District health authorities and from the SRL site clinic;
- Information gathered by participatory means from key stakeholders and communities; and
- Direct observation of environmental health circumstances in communities and the Project area.

### ***Key Health Determinants, Impacts and Recommended Management Measures***

Table 1 presents a dashboard summary of the key findings and recommendations from the HIA. This is presented in the EHA framework and outlines: i) key potential health impacts; ii) both an inherent and residual risk ranking; iii) and key management / mitigation measures; iii) the level of the intervention, i.e. in the community or linked to Environmental, Health, and Safety (HSE) management in the workforce.

Inherent impacts associated with Sexually Transmitted Infections (STIs) and potential accidents and injuries were recognised as potential critical impacts, with zoonotic and vector related disease ranked as major potential impacts. Moderate negative impacts after proposed management measures were still considered for STIs and potential accidents and injuries, with the remaining EHAs either presenting a minor negative or nett benefit residual impact. Environmental and health determinants (EHA #9 and #10) were ranked qualitatively where adequate information was available, but the reader is referred to individual specialist studies for a more complete model.

The recommended management measures are presented as a high level summary, with more detail in section 7. It is important that a monitoring and evaluation system be established to track relevant impacts and interventions, which may require additional baseline data collection.

Table 1: Summary of inherent and residual health impacts

Impact Assessment±	Inherent Risk Rating*	Management and Mitigation			Residual Rating*
Potential Health Impact	Without Mitigation	Mitigation/ Management Measure	Level		Residual
			Community	HSE	
<b>EHA #1- Communicable Disease Linked to the Living Environment</b>					
Transmission of communicable diseases from workforce to the community; including conditions spread by droplets (tuberculosis (TB), influenza), close contact (meningitis) and poor hygiene (scabies, conjunctivitis).	<b>Moderate negative</b>	Develop a communicable disease strategy and plan that includes employees, contractors and visitors.	√	√	<b>Minor negative</b>
		Effective facilities management in all accommodation camps and mess areas that includes appropriate accommodation, general and food hygiene and sanitation.		√	
		Outbreak preparedness and response plan.	√	√	
Influx management plan.		√	√		
Influx and pressure on accommodation and general environmental hygiene		Initiatives to prevent localised influx and overcrowding in communities due to direct influences from the workforce.	√		
		Gather baseline data and monitor inflation trends on housing.	√		
<b>EHA #2- Vector Related Diseases</b>					
Increased burden of disease associated with malaria due to: i) modification of the environment; ii) influx and unchecked development in communities and iii) pressure on already limited public health services for malaria control.	<b>Major negative</b>	Evaluate the possibility to work with the National Malaria Control Programme to conduct a malaria indicator and baseline entomology study.	√	√	<b>Moderate benefit</b>
		Develop integrated workplace malaria and vector control programmes.		√	
		Develop breeding site control programmes including environmental management and larval source management.		√	
		Evaluate the possibility to extend workplace malaria control interventions into the surrounding communities in partnership with the District Health Management Team (DHMT) and National Malaria Control Programme.	√		
		Influx management plan.	√		
Risk of outbreak of arboviral diseases through transport corridors, environmental management and Project induced influx.	<b>Moderate negative</b>	Integrated vector control as above for malaria, but with focus on <i>Aedes spp.</i> mosquito. This will need to include controls in lay-down yards and at the Port.		√	<b>Minor negative</b>
		Outbreak preparedness and response plans.	√	√	

Impact Assessment±	Inherent Risk Rating*	Management and Mitigation			Residual Rating*
Potential Health Impact	Without Mitigation	Mitigation/ Management Measure	Level		Residual
			Community	HSE	
<b>EHA #3- Water, Sanitation and Waste Related Disease</b>					
Physical resettlement and economic displacement with potential altered access to basic services including water and sanitation.	<b>Moderate negative</b>	Effective planning and implementation of future physical relocation and economic displacement.	√		<b>Minor benefit</b>
Potential pollution of surface and ground water from Project activities including spills and waste management (including sewerage treatment plants).		Maintain access to basic services, and as required support the provision of alternative sources/supply in partnership with relevant authorities and communities.	√		
Project induced influx with increased pressure on the limited water, sanitation and waste management services.		Provision of adequate sanitation facilities and effective waste water management from the Mineral Separation Plant (MSP), mine operations and accommodation villages.		√	
Potential pollution of mine ponds by human activities and waste.		Effective controls to prevent spills or leaks.		√	
		Influx management plan.	√		
		Evaluate the potential to support the improved supply of potable water and improved sanitation facilities in collaboration with the District authorities and DHMT.	√		
		Gather baseline data on water, sanitation and hygiene indicators and support surveillance activities.	√		
<b>EHA#4- High Risk Sexual Practices, STIs, including HIV/AIDS</b>					
A number of indirect factors can influence the potential for an increase in HIV/AIDS and include; i) in-migration and population mixing; ii) the male dominated workforce; iii) transport workers; iv) increased levels and disposable income supporting transactional sex; and v) poor knowledge and practices with high risk sexual behaviour.	<b>Critical negative</b>	Influx management plan.	√		<b>Moderate negative</b>
		Review the current HIV policy and plan including a review of the current partnership with the National AIDS Secretariat (NAS) to determine if interventions are effective and meeting the current and future needs of the Project.	√	√	
		Based on findings from the review implement a comprehensive HIV and STI management plans in the workforce as part of the proposed communicable disease management plan/strategy. Integrate TB into this intervention.		√	
		In association with NAS, support outreach behaviour change communication.	√	√	
		Evaluate hot spots where high risk sexual encounters develop and develop specific controls for these (particularly transport workers).	√	√	
		Support the development of women and young girl empowerment programmes, as well as other outreach programmes focussed on prevention.	√		

Impact Assessment±	Inherent Risk Rating*	Management and Mitigation			Residual Rating*
Potential Health Impact	Without Mitigation	Mitigation/ Management Measure	Level		Residual
			Community	HSE	
		Gather baseline data on selected STI and HIV indicators and develop a surveillance programme in association with NAS to track impacts and interventions.	√	√	
<b>EHA #5- Food and Nutrition</b>					
Project induced influx with reduced available arable land or access to land for subsistence farming, as well as potential food inflation due to supply and demand economics. Changes in traditional practices.	<b>Moderate negative</b>	Influx management plan.	√		<b>Minor benefit</b>
Environmental changes and altered access and use of land due to mining activities.		Gather baseline data and monitor food inflation trends.	√		
Physical resettlement and economic displacement due to mining and creation of mine ponds. This has the potential to have a localised impact on food security due loss of arable land and the inability to collect natural resources.		Continue to support agricultural initiatives through the Agricultural Development Fund and evaluate effectiveness of interventions.	√		
		Perform a baseline nutrition survey to support surveillance of key nutritional indicators in collaboration with the DHMT.	√		
		In collaboration with the DHMT, support information, education and communication programmes in the communities of nutrition and perform outreach nutritional surveillance using community health officers as a resource.	√		
		Effective resettlement planning and implementation where required.	√		
<b>EHA #6- Non-Communicable Diseases</b>					
Potential for an increase in Non-Communicable Disease (NCD) or lifestyle related diseases in the workforce. This may in turn indirectly overburden the public health sector, particularly when workers lose the benefit of SRL supported health services. These conditions may also negatively affect workplace health and productivity.	<b>Moderate negative</b>	Develop wellness programmes in the workforce to address NCDs and reduce modifiable lifestyle risk factors.		√	<b>Moderate benefit</b>
		Maintain workplace health services and ensure an ability to effectively screen for and manage any NCDs (including as part of medical surveillance), especially hypertension and diabetes.		√	
		Limit the referral for NCDs in the workforce or dependents into the local public healthcare system as far as possible.	√	√	
		Support health education programmes on nutrition and lifestyle practices as part of community-based outreach programmes delivered by community health officers. This should include the workforce, dependents and the general community.	√	√	

Impact Assessment±	Inherent Risk Rating*	Management and Mitigation			Residual Rating*
Potential Health Impact	Without Mitigation	Mitigation/ Management Measure	Level		Residual
			Community	HSE	
<b>EHA #7- Injuries and Accidents</b>					
Potential for water related accidents due to direct Project activities in and around Nitti Port and with trans-shipment activities.	<b>Critical negative</b>	Develop community security and safety management plans, based on relevant risk assessments, and include contractor management requirements as part of this.	√	√	<b>Moderate negative</b>
Potential for water related accidents and for drowning on mine ponds.					
Potential for road traffic accidents and associated injuries along transport corridors from Project mobile equipment, including trucks, busses, light duty vehicles etc.		Ongoing management of Project mobile equipment within the framework of the Project's health and safety and contractor management plans.		√	
		Support road safety education and awareness campaigns in area, especially in schools.	√		
		Conduct surveillance of road traffic accidents, water accidents and non-accidental injuries (assault, rape) and adjust interventions based on data.	√	√	
Non-accidental injuries and associated determinants, including assault, gender-based violence, and security force related human rights infringements		Influx management plan.	√		
		Women's and girl's empowerment programmes to limit gender based domestic violence.	√		
Workplace accidents and injuries.		Ensure effective emergency preparedness and response capabilities at the Project.	√	√	
	Managed within the framework of the Project's occupational health and safety and contractor management plans.		√		
<b>EHA #8- Veterinary Medicine and Zoonotic diseases</b>					
Potential risk for the emergence and spread of zoonotic diseases due to inadequate camp facilities and waste management, as well as disturbance of the environment from mining activities	<b>Major negative</b>	Review the risk for Lassa fever.	√	√	<b>Minor negative</b>
		Develop and maintain effective camp/site management controls to include rodent, solid waste and landfill management.		√	
		Develop outbreak preparedness and response plans to address potential zoonotic disease outbreaks. As part of this work, with DHMT to maintain outbreak surveillance activities.	√	√	
Influx management plan.		√			
Potential for the emergence and spread of zoonotic diseases (including Ebola Virus Disease (EVD)) due to indirect Project factors, (e.g. influx with movement of people and animals, stray dogs and bush-meat trade. Compounded by a weak public and		Support strengthening of veterinary public health services.	√		

Impact Assessment±	Inherent Risk Rating*	Management and Mitigation			Residual Rating*
		Mitigation/ Management Measure	Level		
Potential Health Impact	Without Mitigation			Community	HSE
veterinary health system.					
<b>EHA #9- Environmental Health Determinants</b>					
Noise	Moderate negative	Ensure effective monitoring programmes that are well managed and based on appropriate noise modelling as per baseline specialist noise assessment.	√	√	Minor negative
		Ensure effective occupational hygiene monitoring to reduce noise and other emissions through engineering controls to as low as reasonably practical.		√	
Air quality and malodours from direct and indirect Project influences. Fugitive dust from mining and vehicle entrained are major factors that can negatively affect air quality.	Major negative	As per air quality specialist study.	√	√	Minor negative
		Influx management plan.		√	
		Dust control along access and haul roads, and other areas as required.	√	√	
		Mal-odour controls at sewerage treatment plants, and other areas as required.		√	
		Effective occupational hygiene and health programmes.		√	
Radiation from Naturally Occurring Radioactive Materials (NORMs) and radioactive sources on the mine/MSP.	Ranked in separate specialist study	A per specialist radiation assessment.	√	√	Ranked in separate specialist study
Water quality and acid mine drainage.	Ranked in separate specialist study	As per water quality specialist study.	√	√	Ranked in separate specialist study
Potential exposures to Hazardous Chemical Substances (HCS) in workplace with risk for public exposure.	Moderate negative	Appropriate HCS management programmes in alignment with local legislation and good international industry practice.	√	√	Minor negative
		Undertake a risk assessment on all HCS on site and develop requisite programmes to safeguard employee and community health.	√	√	
		Interventions to prevent communities getting access to and reusing containers or potentially contaminated materials.		√	
		Review potential risk of cementous asbestos sheeting.		√	
		Ensure effective occupational hygiene and medical surveillance procedures for workers potentially exposed to HCS.		√	



Impact Assessment±	Inherent Risk Rating*	Management and Mitigation			Residual Rating*
Potential Health Impact	Without Mitigation	Mitigation/ Management Measure	Level		Residual
			Community	HSE	
<b>EHA #10- Social Determinants of Health</b>					
Influence of local economic development, employment and expectations from the Project.	<b>Moderate negative</b>	As per recommendations in the social impact assessment.	√		<b>Minor negative</b>
Physical resettlement and economic displacement.		Develop effective communication interventions with the community and other stakeholders on the role of the Project, and what it will and will not do.	√		
Project induced in-migration and associated influence on the local economy, social ills, pressure on available services and perceptions of well-being.		Effective resettlement planning and implementation.	√		
Altered access to services, land and natural resources.		Influx management plan.	√		
		Evaluate the potential to support local economic development with a focus on improved quality of life and perceived well-being.	√		
<b>EHA #11- Health Seeking Behaviour and Cultural Health Practices</b>					
The Project may have influenced health seeking behaviour in a positive way by improving access to the area and promoting better access to referral care and outreach health services.	<b>Moderate negative</b>	Continue to support maintenance of roads and where possible enhancement of the public transport network.	√		<b>Moderate benefit</b>
The Project may have influenced health seeking behaviour in a negative manner through; i) influx and pressure on limited available health services, ii) reduced access to medicinal plants, and iii) environmental changes from mining and reduced availability of medicinal plants.		Influx management plan.	√		
		Review use of medicinal plants and support environmental management programmes to protect these as required.	√		
		Support health systems strengthening as per EHA #12.	√	√	
<b>EHA #12- Health Service Infrastructure and Programme Delivery</b>					
Project induced in-migration has placed	<b>Moderate</b>	Influx management plan.	√		<b>Moderate</b>

Impact Assessment±	Inherent Risk Rating*	Management and Mitigation		Residual Rating*	
Potential Health Impact	Without Mitigation	Mitigation/ Management Measure	Level		Residual
			Community	HSE	
pressure on the limited available public health services to provide effective care to a sizable and growing population.	<b>negative</b>	Evaluate the potential to support health systems strengthening activities in the public health sector in partnership with the national and District health authorities and potential health development partners.	√		<b>benefit</b>
Limited health baseline to support point of departure for monitoring of impacts or interventions.		Maintain (and upgrade) SRL health services and limit referrals to the local public health sector so as not to overburden limited services.	√	√	
		Select and collect key health indicators as part of focussed survey's or linked to proposed interventions. Develop a monitoring and evaluation element as part of community health management and monitoring plan.	√	√	

\*Direction can be either negative (implying a negative impact) or beneficial (implying a positive impact) HSE- health, safety and environment

± See appendix D for the categorization of significance rankings

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## Acronyms

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-retroviral therapy
BPEHS	Basic Package of Essential Health Services
BCC	Behaviour Change Communication
CDA	Community Development Agreement
CFSVA	Sierra Leone Comprehensive Food Security and Vulnerability Analysis
CHMMP	Community Health Management and Monitoring Plan
DALY	Disability Adjusted Life Years
DHMT	District Health Management Teams
DMO	District Medical Officers
EHA	Environmental Health Areas
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EPI	Expanded Programme of Immunisation
ESHIA	Environmental Social and Health Impact Assessment
ESHMP	Environmental and Social Management Plan
FGD	Focus Group Discussions
GIIP	Good International Industry Practice
HCS	Hazardous Chemical Substance
HIA	Health Impact Assessment
HIV	Human Immunodeficiency virus
HRA	Health Risk Assessment
HSE	Health, Safety and Environment
HSEC	Health, Safety, Environment and Community
IEC	Information, Education and Communication
IFC	International Finance Corporation
IPTp	Intermittent Prophylaxis Treatment to Prevent Malaria during Pregnancy
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Bednet
KSI	Key Stakeholder Interviews
MCH	Maternal and Child Health
MDG	Millennium Development Goals
MoH&S	Ministry of Health and Sanitation
MSP	Minerals Separation Plant

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mSv/yr	milli-Sieverts per year
NAS	National HIV/AIDS Secretariat
NCD	Non-Communicable Diseases
NGO	Non-Governmental Organisation
NMCP	National Malaria Control Programme
PAC	Potentially Affected Community
SARA	Service Availability and Readiness Assessment
SDGs	Sustainable Development Goals
SLDHS	Sierra Leone Demographic and Health Survey
SRL	Sierra Rutile Limited
STH	Soil transmitted helminths (roundworm, whipworm and hookworm)
STI	Sexually Transmitted Infection
TB	Tuberculosis
UNAIDS	Joint United Nations Programme on HIV and AIDS
UNICEF	The United Nations Children's Fund
VHF	Viral Haemorrhagic Fevers
WHO	World Health Organization
YLD	Years Lived with Disability
YLL	Years of Life Lost

# 1 Terms of Reference

SHAPE Consulting Limited (SHAPE) was appointed by SRK Consulting (South Africa) (Pty) Ltd. (SRK) to conduct a rapid Health Impact Assessment (HIA) for the Sierra Rutile Limited (SRL) Project (Project) in Sierra Leone as part of an update to the Environmental, Social and Health Impact Assessment (ESHIA) for the Area 1 concession area (SR Area 1). The HIA was to consider broad community health impacts that may have been caused by past Project activities as well as to anticipate potential future health impacts. Specific objectives include:

- Aligning the health component of the ESHIA with SRL company policies, Good International Industry Practice (GIIP), International Finance Corporation (IFC) Performance Standards, as well as any applicable local legislation and regulations;
- Understand and take stakeholder comments and concerns into account related to health challenges and their determinants in the SR Area 1/Project area, as well as how past and future Project activities have, or have the potential to, impact on human health;
- Anticipate or identify potential health impact areas of concern associated with direct and indirect Project activities, and perform a risk assessment based on the likelihood and consequence of the identified potential impacts so that priority management and mitigation measures can be proposed;
- Identify potential impacts that may pose a material risk to the Project from a business continuity or sustainability perspective; and
- Develop a framework Community Health Management and Monitoring Plan (CHMMP) to outline proposed management measures and monitoring of these interventions and impacts.

The scope of the HIA is limited to the current operational area (SR Area 1) and associated Potentially Affected Communities (PACs). The structure of the report divided into the following sections:

- Section 2: Project description: includes elements of the Project description that are relevant to the HIA. This does not replace the complete Project description described in the ESHIA report;
- Section 3: Legislation and standards: includes relevant legislation and standards, and serves as background information;
- Section 4: Health impact assessment methodology: outlines the standard approach that is followed in HIAs and related terminology used;

- Section 5: Activities conducted in the HIA: describes the activities performed for the HIA and which key stakeholders were engaged as part of field work;
- Section 6: Study limitations;
- Section 7: Baseline health description, impact modelling and associated management measures: presented as a broad overview and in the EHA framework, and provides a summary of baseline health information to describe key health issues and vulnerabilities of PACs, an impact definition and evaluation to define the significance of the impact, and associated management measures;
- Section 8: Summary of recommended plans, data collection and monitoring;
- Section 9: Conclusion;
- Section 10: References, and
- Section 11. Appendices:
  - Appendix A describing the baseline health information in detail following the EHA framework;
  - Appendix B: Health facility assessments;
  - Appendix C: Summary of the Ebola Virus Disease (EVD) outbreak, and
  - Appendix D: Methodology for the characterisation of impacts.

## 2 Project Description

A detailed Project description will be provided in the final ESHIA report. The following section outlines the Project relevant to the HIA.

### 2.1 Project Location and Potentially Affected Communities

#### 2.1.1 Broad Spatial Boundaries

Sierra Rutile Limited (SRL) is an existing mining operation located in the Bonthe and Moyamba Districts of the Southern Province of Sierra Leone. The mine has been in operation for over 50 years and produces rutile, ilmenite and zircon rich concentrate. SRL currently holds seven mining leases covering 559 km<sup>2</sup> with a total of 16 mineral deposits identified. SRL's Area 1 Mine Lease Area (SR Area 1) covers an area of 290 km<sup>2</sup>. The deposits, alluvial in nature, are mainly located around the Gbangbama Hills and the Moyamba Hills [1].

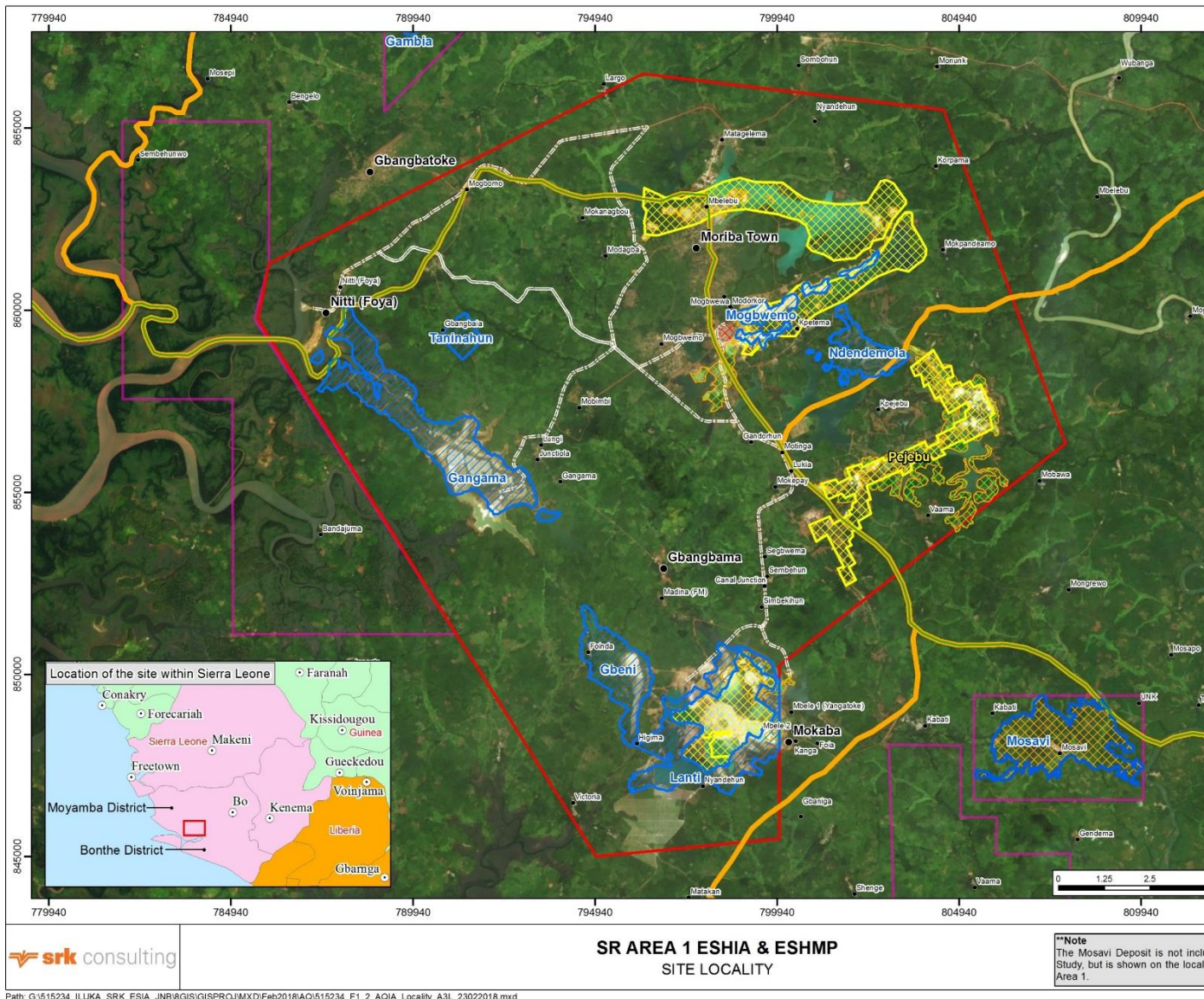


Figure 1 outlines the location of the Project.



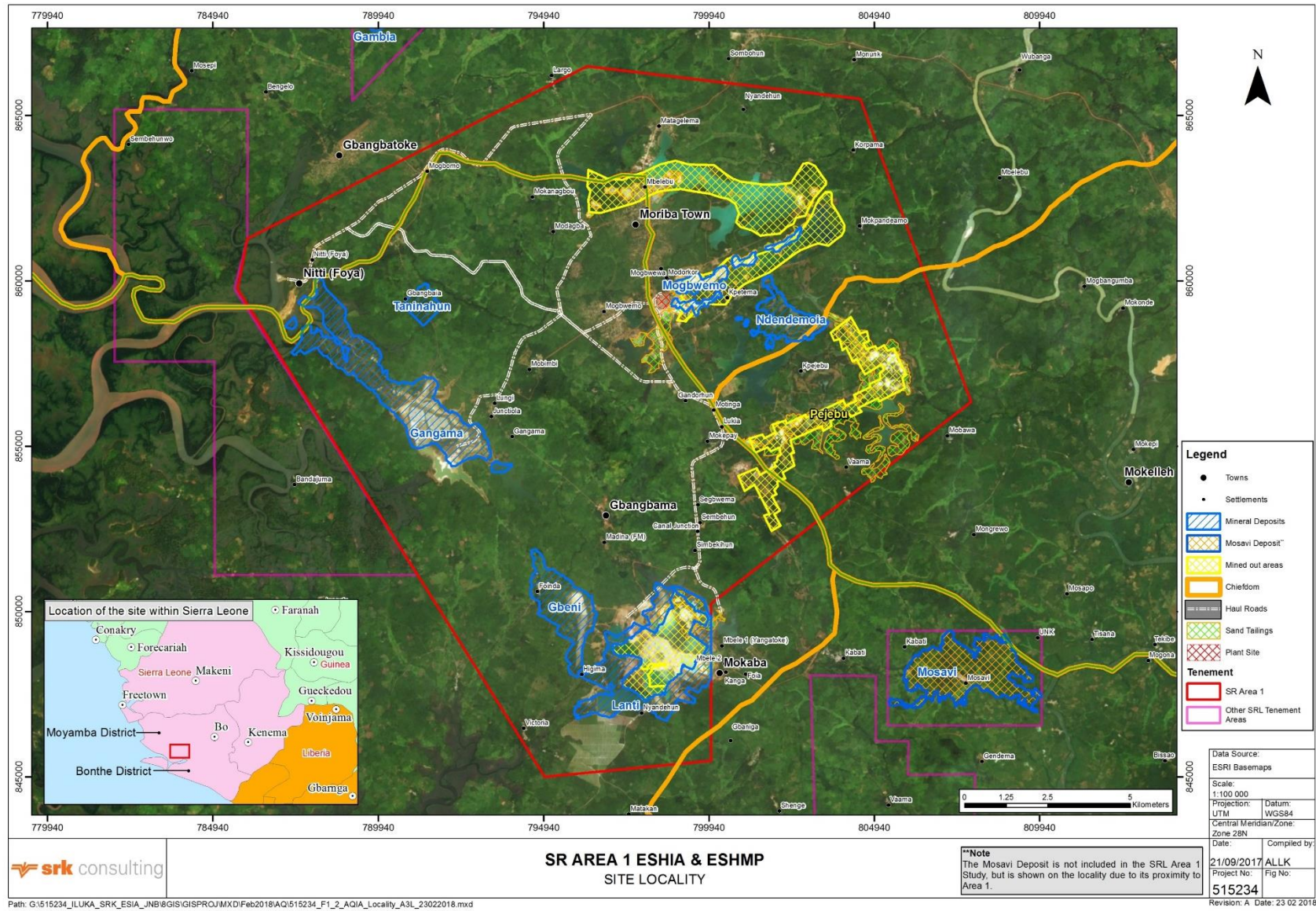


Figure 1: SR Area 1 general site locality map

## 2.1.2 Community Profile and Potentially Affected Communities

### 2.1.2.1 General Demographics

The 2015 National Population Census showed a total population of 7,075,641 people residing in Sierra Leone, an increase from the 4,976,871 in 2004. The 2015 population of Bonthe District was 200,730, an increase from the 139,687 in 2004, with Moyamba District increasing from 260,910 in 2004 to 318,064 in 2015 [23].

Moyamba District is the largest in the Southern Province by geographical area, occupying a total area of 6,902 km<sup>2</sup> and comprising 14 Chiefdoms. It borders the Atlantic Ocean in the west, Port Loko and Tonkolili Districts to the north, Bo District to the east and Bonthe District to the south. Its capital and largest city is Moyamba. The main ethnic groups in the District are Mende, Sherbro, Temne and Loko [57].

Bonthe District comprises several islands and a mainland area, subdivided into eleven Chiefdoms. Its capital is the town of Matru Jong and its largest city is Bonthe, on Sherbro Island. The District occupies a total area of 3,468 km<sup>2</sup> and borders the Atlantic Ocean to the west, Moyamba District to the northwest, Bo District to the southeast and Pujehun District to the south. The main ethnic groups in the District are the Sherbro (indigenous group) and Mende (migrant group) [23, 42].

SR Area 1 is spread over four Chiefdoms; viz. Imperi, Lower Banta, Upper Banta and Jong with the population change per Chiefdom described in Table 2 [23].

**Table 2: Population size in Chiefdoms on SR Area 1**

Chiefdom	Population 2004	Population 2015
Imperi	17,558	33,772
Lower Banta	26,576	37,194
Upper Banta	8,230	10,457
Jong	28,428	33,524
<b>Total</b>	<b>80,792</b>	<b>114,947</b>

The age distribution shows a relatively young population with high birth rates and the majority of the population below the age of 15 years. In terms of gender balance there is the usual slight dominance of females compared to males in both Districts, with 97 and 93 males per 100 females in Bonthe and Moyamba Districts respectively. Of interest is that there were more males than females in Imperi Chiefdom, a potential reflection of job seeking influx of



single men into the area. Jong and Lower Banta had a gender ratio of 94 females to a 100 males, with Upper Banta an even gender ratio [23].

The 2012 ESIA reported that the largest tribal group in SR Area 1 were the Mende tribe, who made up 89.2% of the population. The most common religious belief was Islam at 60% of respondents, followed by Christians at 10%, with the remaining following various traditional beliefs [35].

The reader is referred to the social baseline in the ESHIA for more detailed and updated information of the situation at the SR Area 1 level.

### **2.1.2.2 Project Potentially Affected Communities**

For the purposes of the HIA, the population who may be affected by the Project are stratified into PACs<sup>1</sup>. These communities, which range from larger towns to smaller villages, have been divided into similar exposure groups based on:

- Their relative proximity to Project activities;
- Similar potential direct and indirect health risks from the Project, and
- Similar demographic or community profiles.

These PACs are recognized as a “working model” that may evolve and change as the demographic structure in the communities change due to Project, and non-Project related influences. This implies that the definition of PACs may need further adaptation as the Project moves ahead. Therefore, the specification of a PAC should be viewed as time-dependent and evolving.

The classification of PACs supports the spatial identification of impacts and management measures for each environmental health area, as described in more detail in section 7. However, it is challenging to classify PACs for the Project due to a number of variables:

- Large geographical scale of the Project with heterogeneous communities;
- The historical nature of the Project with old and new mining areas;
- Influence of in-migration and population dynamics, and

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<sup>1</sup> A PAC is a defined community within a clear geographical boundary where project-related health impacts may reasonably be expected to occur. PACs are inherently prospective and simply represent best professional judgments

- The fact that mining activities (or old mined areas) are located within (or close to) the community, the community is within the mine.

The current categorisation of PACs from a health perspective is described in Table 3, with the impact categories of communities are summarised as follows:

- Category one (1) communities:
  - Located within SR Area 1 and have been most affected through direct impacts on land access, physical displacement, high levels of in-migration and direct influence from Project activities. These communities generally require specific more extensive mitigation measures and engagement.
- Category two (2) communities:
  - Located within SR Area 1, but experience more potential indirect impacts from the Project, as well as some potential direct impacts due to their proximity to access and haul roads. These communities generally require generic mitigation and consultation.
- Category three (3) communities:
  - Located outside of SR Area 1, along transport corridors to and from Moyamba junction, along the mine access road.

The spatial distribution of PACs is in **Error! Reference source not found.** The complexity and overlap in similar exposure groups are noted, with these described in more detail in section 7.

**Table 3: Model of Potentially affected communities**

Potentially Affected Communities			
PACs	PACs with similar exposure profiles	Rationale	Impact category
PAC 1	Communities in proximity to: <ul style="list-style-type: none"> <li>• The Minerals Separation Plant.</li> <li>• Historic mining areas in proximity to the MSP,</li> <li>• Mine accommodation camps at Mobimbi and Kpanguma.</li> </ul> These include the communities of Moriba Town, Mogbewa, Mogbwemo, Kpetema and Ndendemoia. The accommodation area at Mobimbi and Kpanguma are included here.	Potential direct impacts from: <ul style="list-style-type: none"> <li>• Process plant activities</li> <li>• Water bodies from old mining activities (mine ponds)</li> <li>• Proximity to where the bulk of mine traffic passes to/from the MSP.</li> </ul> Direct and indirect impacts from in-migration and along larger transit routes.	1
PAC 2	Communities in proximity to current mining activities at Lanti and Gangama. These include the communities of Gangama, Foinda, Nalaguehun, Fobu, Higima, Nyandehun, Kanga, Mokaba, Mbelleh (1&2), Fola, and	Potential direct impacts from mining activities especially: <ul style="list-style-type: none"> <li>• Factors that may influence environmental health (e.g. noise and dust)</li> <li>• Presence of mobile machinery, haul trucks and other vehicles.</li> </ul>	1

Potentially Affected Communities			
PACs	PACs with similar exposure profiles	Rationale	Impact category
	Imperi.	Potential direct and indirect impacts may include influences on past resettlement, displacement from land and altered access.	
PAC3	Communities that have experienced in-migration or who were physically relocated during the historical stages of the Project but have not been classified in PAC1 or 2.  These include Gbangbama and Madina, Gbangbaia and Matagelema.	Potential indirect impacts from in-migration, with Matagelema also experiencing a cumulative impact from the VIMETCO bauxite operation.	1
PAC 4	Communities located on access roads that connect current mining areas to the MSP, and MSP to the port. These include some overlap to some communities in PAC 2 who are located along these roads.  These include the communities of Mokaba, Mbelleh 1 (Yangatoke), Shimbek, Canal Junction, Mokapay, Lukia, Mokanago, Mogbomo and Gbangbaia.	Potential direct impacts from mine traffic with potential safety concerns and impacts on air quality.  Potential indirect impacts from in-migration in areas.	2
PAC 5	Nitti town (Foya) at the Port.	Potential direct impacts activities at the port including material storage and loading, as well as barge activities.  Potential indirect impacts related to influx.	1
PAC 6	Communities located in the broader Project area that may have been directly impacted by historical mining activities, with remaining legacies.  These may include the communities of Gogwema, Mokaba, Pejebu, Vaama, Mokaipi, Motinga and Junctiola.	Potential direct impacts from past activities including water ponds, altered environment and land use practices and access.	2
PAC 7	Communities located in the broader Project area that have limited direct impacts but may experience some indirect impacts.	Potential direct impacts associated with the Project at times (e.g. interaction with vehicles) and indirect influence due to presence of the Project, especially socio-economic factors.	2
PAC8	Communities located outside the Project area that have some potential indirect impacts.	Potential indirect impacts due to presence of the Project, especially socio-economic factors.	3
PAC9	Communities located along the mine access road (transport corridor) from Moyamba junction to the boundary of the Project area.	Potential direct (dust, noise, accidents) and indirect (truck stops) impacts from increased traffic.	3

### 2.1.2.3 Vulnerable or Indigenous Groups

The 2012 ESIA reported that while there are a number of smaller ethnic groups on SR Area1 they are not meaningfully marginalised. Women were noted as vulnerable due to inequality and traditional customs [35].

While the social baseline and impact assessment will describe these groups in more detail, potential vulnerable groups from a health perspective include:

- Women headed households;
- Young girls due to socio-economic and cultural factors;
- The elderly;

- Disabled people;
- Children who may be more vulnerable to certain health effects such as infectious diseases and acute and chronic respiratory tract infections from exposure to dust and other airborne pollutants;
- Poor or dependent households, and
- Migrants or groups in the community that have limited access to, or ability to own, land.

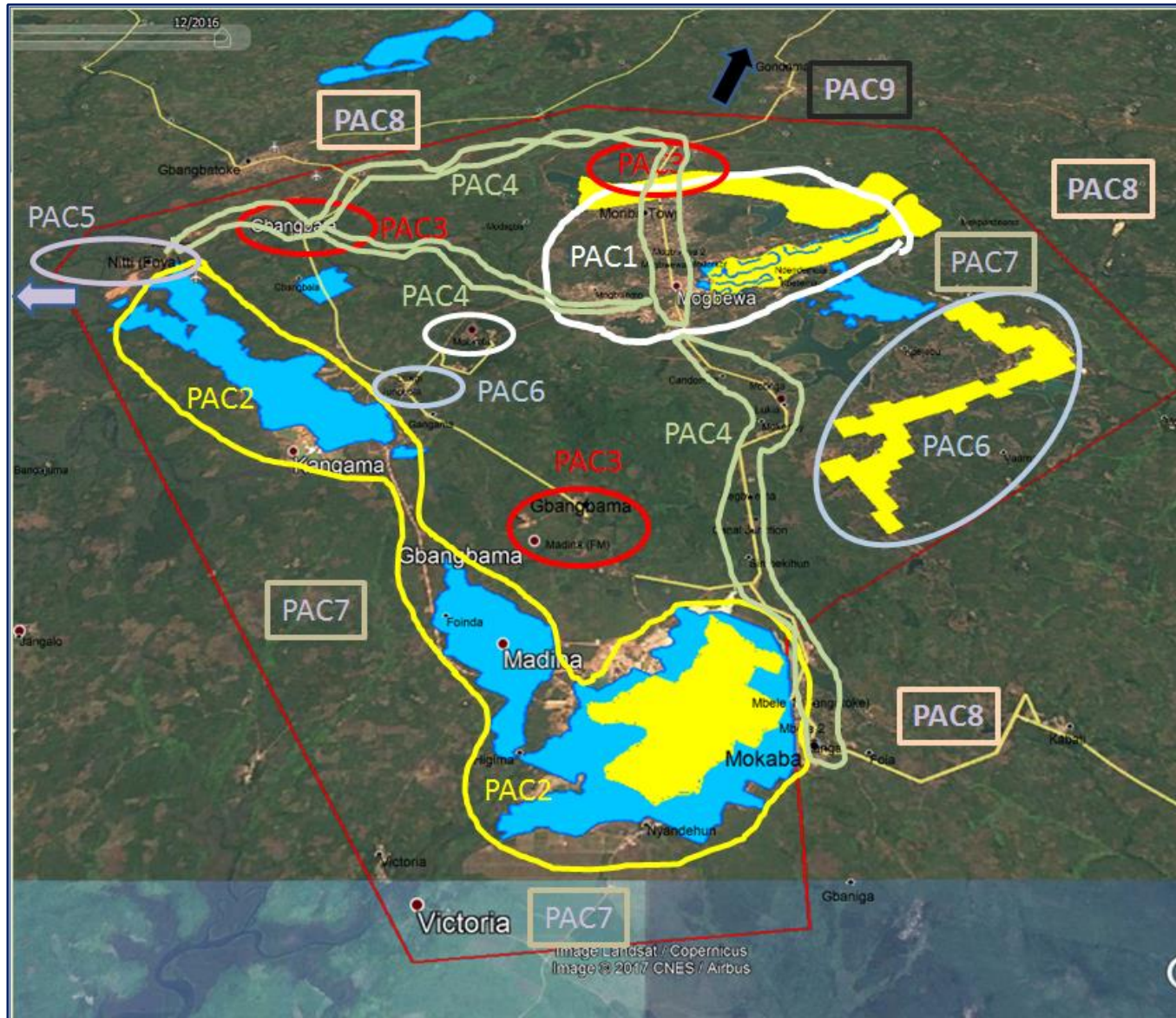


Figure 2: Spatial outline of potentially affected communities

## **2.2 Temporal Boundaries**

The resource life of mine for the current and expansion projects in the immediate SR Area 1 exceeds four years with the potential to increase the life of mine to new deposits outside of SR Area 1 [1].

## **2.3 Climate**

Sierra Leone has a tropical climate with a distinct wet and dry season. The wet season is from April to November, with an annual rainfall of around 2,600mm per year. Rainfall peaks in August where monthly precipitation can reach 1,200mm per month, but averages 579mm [1].

The mean annual average temperature varies from 24.3°C in August to 30°C in February. Humidity is generally high and fluctuates between 70% and 90%, with these high discomfort levels felt for long periods in the wet season.

The north-easterly trade wind, the Harmattan, blows from December to March, with this dry and dusty wind bringing cooler temperatures and drier conditions, but also a marked deterioration in air quality due to the high dust load in the air. Air quality is also affected by slash and burn agricultural practices [1].

## **2.4 Project Components and Infrastructure**

### **2.4.1 Mining Process**

The mine has been in operation for over 50 years and produces rutile, ilmenite and zircon rich concentrate. The SRL operation has an existing Environmental Licence (reference number EPA-SL030) and has undertaken two previous Environmental and Social Impact Assessment (ESIA) studies for their operations in 2001 and an update in 2012 respectively. When these studies were undertaken, the primary mining process was dredge mining (referred to as wet mining). During 2013 SRL commenced a distinct open cast mining operation (referred to as dry mining) as an auxiliary method of ore extraction in conjunction with wet mining. In 2016 a second dry mining operation was commissioned. It is anticipated that, over time, dredge mining will cease, and dry mining would be the primary mining method employed. In 2015, the Environmental Protection Agency of Sierra Leone issued a notification to SRL instructing them to undertake an ESHIA and develop an Environmental, Social and Health Management Plan (ESHMP) for their current and proposed dry and wet mining activities including the proposed expansion areas.

Figure 3 outlines a simplified mining operations and process flow pathway. The end product from the Minerals Separation Plant (MSP) is shipped to the world market from a dedicated port facility at Nitti. The products are stored under product storage domes. The product is then loaded onto barges for transport to ships along the mangrove estuarine system, and finally to ocean going vessels located further along the Sherbro River. The port facilities also receive and ship supplies such as fuel and equipment to the mine. The port facilities include offices, support and storage buildings/silos, loading facilities, fuel storage tanks, barges and push boats. SRL is considering plans to improve the infrastructure at Nitti Port to accommodate the increased production [2, 8].

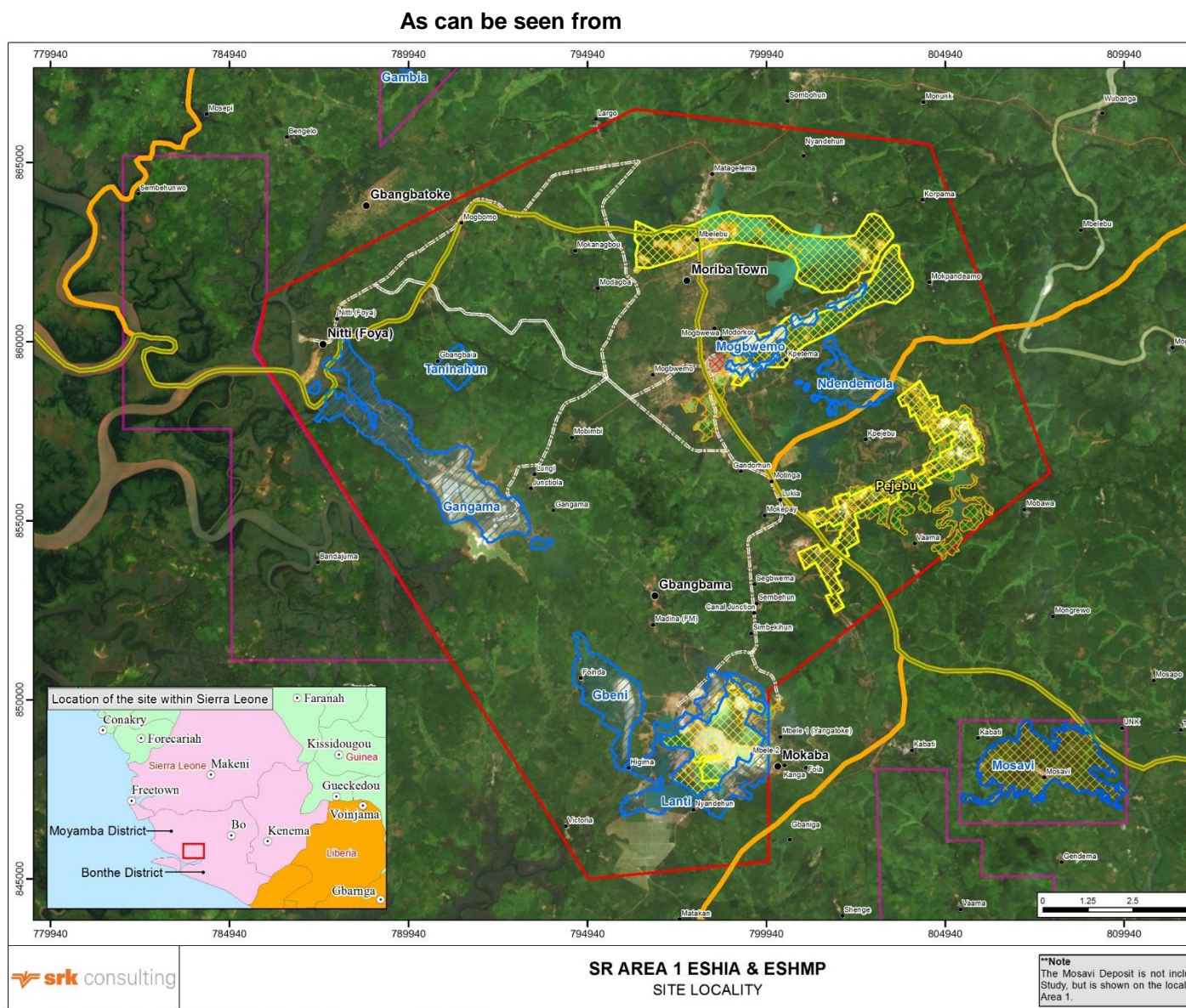


Figure 1 a number of ponds have been created by the historical and current mining operations.

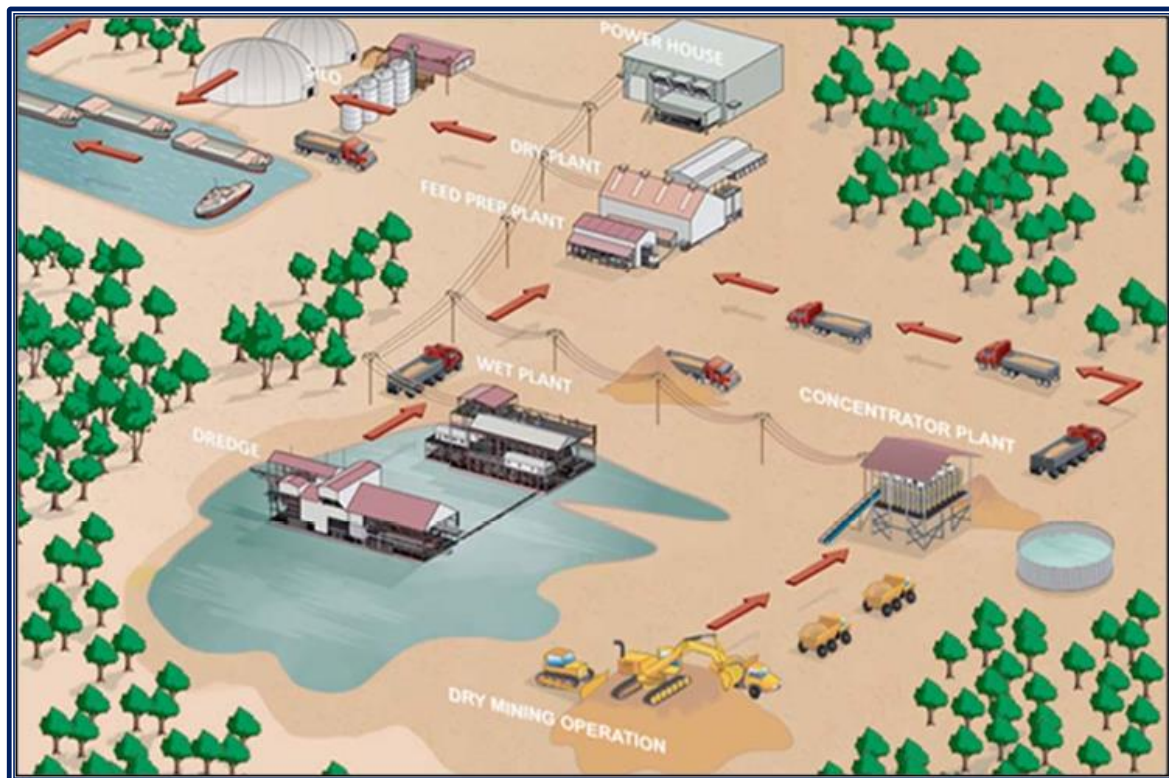


Figure 3: Mining and process flow

## 2.4.2 Transport, Access and Haul Roads

Other than roads within active mining areas, haul and access roads are shared with the general public, forming part of the national road network. Limited private motor vehicle traffic was observed on the various roads around the Project due to low ownership levels in surrounding communities. Motorcycles are the most common form of public transport and reported as a source of livelihood by some key stakeholders.

The bulk of SRL workers are transported by bus to and from the respective work areas (Figure 4), with light duty vehicles also active along the various roads. SRL has strict vehicle control systems (for their owned vehicles) using geographical positioning systems (GPS) to monitor excessive speeding along public roads, in particular through communities as part of its fleet management system. This reduces the risk of accidents and limits vehicle entrained dust. Dust suppression also takes place on roads during the dry season to control fugitive dust, with the Project recently acquiring three new water trucks to support this activity.

As per their agreement with the Sierra Leonean Roads Authority, SRL supports the maintenance of roads on SR Area 1 and the access roads from Moyamba junction to the



Project area. These are unsealed roads and during the field survey, the roads within SR Area 1 were generally well maintained, while the access road to Moyamba junction was in a varying state of repair due to heavy rains.

There is no dedicated truck stop for supply vehicles to the Project area, with most supply trucks parking near the main gate to wait until they off-load their cargo (Figure 5). There is no control of where trucks stop or rest in communities, and on questioning there was no one facility that would cater for accommodation, food or recreation for truck drivers. Supply trucks are not subject to specific contract management that controls their activities in communities [4].

### 2.4.3 Power Supply and Transmission Lines

There is a power generation plant (30MW capacity) located on the MSP site that provides power requirement via transmission lines for mining, plant activities, support services and accommodation facilities. It is powered by marine fuel oil, which is trucked in from Freetown and stored on site.

Neither the site nor the local communities are connected to the national grid.



Figure 4: Bus transport



**Figure 5: Location of truck parking**

#### **2.4.4 Water Supply and Management**

The water supply requirements of the MSP are provided from nearby Mogbwemo mine ponds.

The domestic water supply is also obtained from the Mogbwemo domestic pond source. Potable water in the plant site is managed through the plant water treatment plant. Water is pumped to accommodation areas. The quality of potable water quality was not assured as the piped distribution network was old and rusted potentially leading to contaminated water at the end user.

Surface and ground water baseline testing and monitoring forms part of the specialist studies for the ESHIA.

#### **2.4.5 Wastewater and Sanitation Services**

The 2012 ESIA describes two wastewater treatment plants, at the MSP and at Mobimbi/South Spur developments. The latter is a large scale septic system that collects sewerage from the facilities at Mobimbi/South Spur. The 2012 ESIA reported that there were plans to upgrade and rehabilitate the system [35]. However, due to financial constraints the Mobimbi plant has not been updated to date.

## 2.4.6 Waste Management

All Project waste is managed according to the SRL waste management plan and waste management on site is addressed as part of the specialist studies in the ESHIA.

The Project has a dedicated landfill for the management of non-hazardous waste (Mokula site) which is located about 4km from Moriba Town. This is reportedly not in immediate proximity (within 1km) to any settlements [35]. The landfill is not an engineered landfill but at the time of this report a process was underway to obtain approval from the Sierra Leonean Environmental Protection Agency (EPA-SL) for a new, engineered landfill site. While the site was not visited as part of the health specialist study, it was reported that the landfill has been formalised and fenced, with minimal human scavenging taking place.

The 2012 ESIA reported another waste dump near Mogbewa village where hazardous material, including biomedical waste, was dumped. Scavenging of this site by the local community was reported [35].

All non-biodegradable waste was reported to go to the landfill. However, hazardous waste (e.g. tyres, hydrocarbon waste etc.) is currently stored on site and SRL is evaluating options for third parties to collect and dispose of, or reuse/recycle the waste as there is no dedicated hazardous materials landfill in Sierra Leone.

Medical waste from the SRL clinic is handled through a dedicated incinerator on the clinic property. While the EPA has not raised a specific concern over the incinerator, it has been flagged as a potential health risk due to the low stacks and high levels of smoke emissions showing the potential inadequate burning of material. This is discussed in the air quality specialist study and investigations are on-going to either alter the incinerator or raise stacks as the facility is located in close proximity to the main road, areas where people congregate and other residential areas (including Kpanguma camp) [5].

## 2.4.7 Labour and Accommodation Camps

There are currently approximately 3,000 people working on the Project in various roles. Of these about 1,800 are employees, 800 are contractors and casual workers vary from 300-400.

Most of the workers are Sierra Leonean in origin with a small number of Iluka seconded expatriates and others from South Africa, Ghana, Zimbabwe, Philippines and UK that work

for SRL. There are two accommodation camps; i) Mobimbi camp for expatriates and management staff, located on Mobimbi Hill; and ii) Kpanguma camp for senior staff, located near the SRL clinic in proximity to the MSP.

Staff from outside of the area who do not qualify to live in camps are required to find their own accommodation in the surrounding towns. Those employed from the local communities reside in their normal homes.

The SRL camps are not closed camps, but entrance to non-camp residents is controlled by security. Both camps have messing facilities that include a facility that serves alcohol.

### **2.4.8 Support Infrastructure**

A number of support facilities support the Project in addition to those described above, including:

- Project administration offices at the MSP;
- Site based laboratory to support geological and environmental monitoring;
- Community relations department offices that are located offsite in proximity to the SRL clinic and Kpanguma camp, and
- SRL clinic near the main entrance to the MSP.

## **2.5 SRL Community Development**

SRL established the Sierra Rutile Foundation in 2006 to support sustainable community development initiatives in the surrounding community. This was managed by an independent board of trustees which included the Paramount Chiefs of the various Chiefdoms. It is reported in the 2016 SRL Company Review that the Company contributed \$75,000 (2015) and \$125,000 (2016) supporting projects in healthcare, education and agriculture [8], including:

- A supply of clean water through the construction of hand-pump wells in Kpetema in Lower Banta Chiefdom and Gangama and Semabu in Imperi Chiefdom;
- Rehabilitation and maintenance of key community road networks supporting accessibility;
- Donation of building materials, and
- Construction of a number of primary schools and fabrication of school furniture.

A new Community Development Agreement (CDA) will supersede the Foundation and will include the establishment of a community development committee. The CDA is currently being finalised in consultation with stakeholders.

SRL has a partnership with the National AIDS Secretariat of Sierra Leone, the Mine Workers Union and non- governmental organisations (NGOs) to address the prevention of HIV/AIDS in the Project area [8].

SRL has interacted with the two District Health Management Teams (DHMTs), with a meeting held on the 18<sup>th</sup> of January 2016 aimed at strengthening the relationship between the parties, and for SRL to support government initiatives related to public and environmental health in mining communities, specifically water quality, sanitation and water wells. However, the outcome from this initial meeting is unclear [156].

## **2.6 Socio-economic Determinants**

### **2.6.1 Project-induced In-migration**

Since the start of the mine (1967), the Project area has experienced significant in-migration due to the potential economic and employment opportunities. It is reported that migration to the Project area is still occurring nationally]. The towns that have experienced the bulk of the influx include Moriba Town, Mogbwemo, Gbangbama, Gbangbaia, Matagelema and Kpetema/Ndendemoia [1].

The potential influence of the rapid and generally unplanned development is discussed in more detail in section 7 and Appendix A. The population increase effect of Project induced in-migration is shown in Figures 6 – 8, showing changes over time (2003, 2012 and 2016) especially in PAC1 (see **Error! Reference source not found.**) [7].

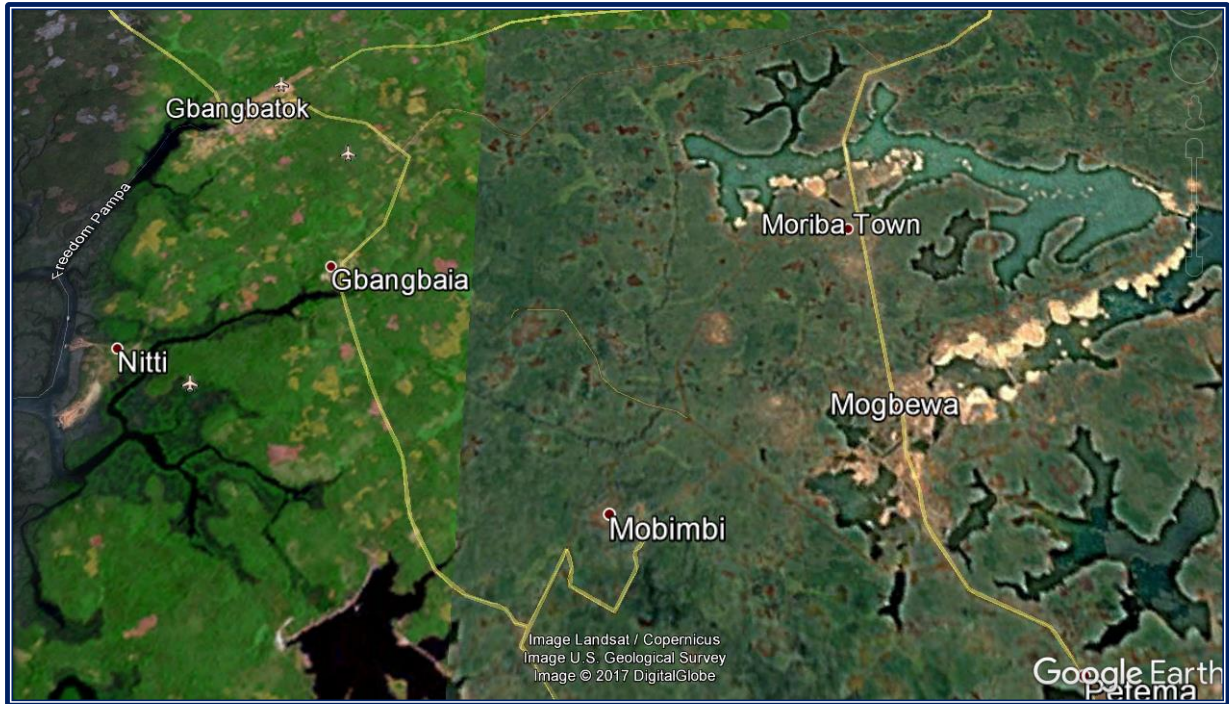


Figure 6: Project area, March 2003

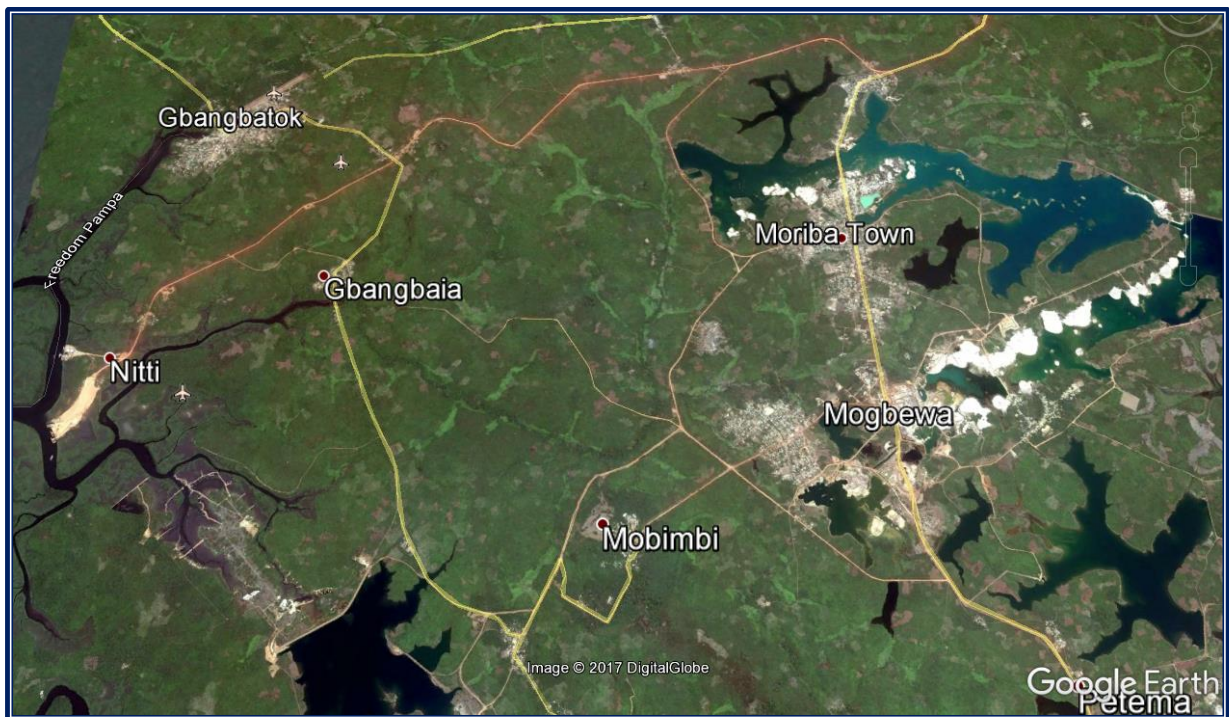


Figure 7: Project area, February 2012



Figure 8: Project area, December 2016

### 2.6.2 Resettlement and Land Take

A total of 19 communities have been physically relocated during the history of the Project [1]. These have included the relocation of entire settlements or a few houses within a village, for example a section of houses in Nyandehun (Figure 9).

Foinda village near the Lanti dry mine area was previously ear-marked for possible relocation due its proximity to an ore body and to the current dry mining operations. The relocation was interrupted by the civil war in 1995 [1].

### 2.6.3 Arable Land

Slash and burn type agriculture is the most common form of land use practice in the Project area, with only a few remnants of forest remaining. Some large-scale farming is taking place in the southern part of the Project area. In addition to community-based agriculture, two commercial agricultural operations exist in the vicinity of the Project area: Firstly, a palm oil project, operating under the entity African Lion Agriculture, of which SRL owns 35%. Secondly, a large pineapple plantation (Figure 9), that is operated by an external commercial farming enterprise.



**Figure 9: Pineapple fields and houses provided for communities resettled in Nyandehun**



### 3 Relevant Legislation, Policies and Guidelines

The ESHIA will provide for a detailed review of the applicable Sierra Leonean legislation and regulations, as well as Iluka's Policies and Project compliance targets and assessment criteria. Elements relevant to community health will be discussed briefly below.

#### 3.1 National Legislation and Regulations

There are a number of laws and regulations that have particular reference to the health component of the ESHIA, as summarised below in Table 4.

**Table 4: Sierra Leonean legislation relevant to HIA**

Legislation	Brief description
National Environmental Protection Act, 2008	<p>Establishes the Sierra Leone EPA and provides for the effective protection of the environment and for other related matters. The agency will have a representative from relevant ministries, including the Ministry of Health.</p> <p>The draft environmental impact assessment (EIA) procedures describe the process of the EIA and section 3.4 (stage 4) includes health impact assessment in the heading and overlap to elements that may impact on human health especially related to the various environmental standards (for example water and air quality etc.).</p>
Mines and Minerals Act, 2009	<p>The Act deals with a host of sections with parts relevant or having an overlap to health including:</p> <ul style="list-style-type: none"> <li>• Part V: Resettlement and access to surface rights, including rights to cultivate and graze stock.</li> <li>• Part XIII: Radioactive minerals including reporting requirements and disposal.</li> <li>• Part XVI: Community development including: <ul style="list-style-type: none"> <li>○ "The licence holder shall assist in the development of mining communities affected by its operations to promote sustainable development, enhance the general welfare and quality of life of the inhabitants, and shall respect the rights, customs, traditions and religion of local communities "</li> <li>○ Develop and implement a CDA.</li> <li>○ Defines a primary host community</li> <li>○ The licence holder shall 'expend for every year that the CDA is in force, no less than 1% of 1% of gross revenue amount earned by the mining operation the previous year...'</li> <li>○ Set outs terms of the agreement with the primary host community on the CDA including: <ul style="list-style-type: none"> <li>▪ Community representation.</li> <li>▪ Objectives.</li> <li>▪ Obligations of licence holder in terms of social and economic contributions, assistance in self-sustaining income generating activities and mine closure considerations.</li> <li>▪ Obligations of community</li> <li>▪ Review CDA 5 yearly</li> <li>▪ Consultative and monitoring framework</li> <li>▪ Disputes and role of Minister.</li> </ul> </li> <li>○ CDA to consider a range of potential issues including: <ul style="list-style-type: none"> <li>▪ Education and technical (vocational) training</li> <li>▪ Financial or other contributory support for infrastructure development on areas such as education, health and</li> </ul> </li> </ul> </li> </ul>

Legislation	Brief description
	<ul style="list-style-type: none"> <li>○ other community services (roads, water, power). <ul style="list-style-type: none"> <li>▪ Small-scale and micro-enterprise</li> <li>▪ Agriculture</li> </ul> </li> <li>○ The CDA may not address monetary or in-kind payment benefits, including: <ul style="list-style-type: none"> <li>▪ Additional rent, fee or tax for the benefit of the host community.</li> <li>▪ Provision of transport/vehicles to any individual in a host community, with the exception of specialised purpose vehicles.</li> <li>▪ Provision of any monetary amount, service, goods, or facility for the sole benefit of an individual or single-family unit.</li> </ul> </li> <li>○ CDA to be signed by stakeholders and submitted to the Minister for approval.</li> <li>● Part XVII: Health and safety: <ul style="list-style-type: none"> <li>○ Addresses workplace health and safety requirements and provisions including a policy for compensation of injured workers.</li> <li>○ Section 142 (d) states: “Every holder of a mineral right shall ensure that persons who are not employees, but who may be directly affected by the activities at the mine are not exposed to any hazards to their health and safety”.</li> </ul> </li> </ul>
Nuclear Safety and Radiation Protection Act, 2012	This Act overlaps into human health but will be addressed in more detail as part of the specialist radiation assessment.
National Water and Sanitation Policy (August, 2008)	This Policy provides overall direction for addressing the challenges facing the water and sanitation sector. It gives a general overview of the water situation in Sierra Leone and its synergy with the Sierra Leone Vision 2025 and the Poverty Reduction Strategy Paper. In addition, it advocates the fundamental human right of access to safe and adequate water, provision of education to improve hygiene practices and careful management of water.
National Lands Policy (February, 2005)	This Policy links into access to land, tenure and sustainable use of land. Subsistence farming plays a direct role in food security, so this is relevant in this policy, as are social health determinants.
The Factories Act, 1974 (Health and Safety Regulation)	Part V and VII of the Act deals with the specific health and safety regulations and measures that are applicable for workers at the factory level. This is purely occupational health and does not consider community health.
Hazardous Material Policies	The Environmental Protection Agency Act (2008) provides for the EPA to monitor, control and regulate the manufacture, sale, transportation, handling and disposal of toxic and hazardous substances. This links relevant occupational and community environmental health risks from hazardous substance use.
The Medical Practitioners and Dental Surgeons (Amendment) Act, 2008	This Act covers the registration and management of health care facilities and monitoring thereof.
The National Drugs Control Act, No. 10 of 2008 and Amendments No. 12 of 2008	This Act supports the establishment of the National Drug Law Enforcement Agency; to provide for the control of and prevention of abuse of narcotic drugs; to implement provisions of International Drug Control Conventions.
The Prevention and Control of HIV and AIDS Act, 2007	This Act provides for the prevention, management and control of HIV and AIDS, for the treatment, counselling, support and care of persons infected with, affected by or at risk of HIV and AIDS infection and for other related matters.
The Public Health (Amendment) Act, 2014	The outbreak of EVD in 2014 and its effect in Sierra Leone has necessitated the amendment of the Public Health Act, 1960 to include EVD (in Section 2) in the definition of notifiable disease. The Act already provided for dealing with outbreaks of notifiable diseases such as yellow fever, plague, cholera, and typhus.
Sierra Rutile Act, 2002	This Act was promulgated specifically for the Project with provisions across a broad range of sectors. No specific health elements were considered as these may be superseded by other laws.

### 3.2 SRL Management Standards

A number of SRL and Iluka policies guide environmental, social, health and safety management of the Project, including:

- Health, Safety, Environment and Community (HSEC) Policy, June 2017 [9].
- HSEC Standard: Social Performance [10]:
  - Requirement 2.11: Social investment, including the development of a site-specific strategy.
  - Requirement 2.14: Community health and safety stating: “*Where there are risks to the health and/or safety of a community as a result of the presence of an Iluka operation and/or personnel, health and safety planning shall identify and appropriately manage and control these risks*”.
  - Requirement 2.17: Involuntary resettlement.
  - Requirement 2.18: Influx management.
- HSEC Group Procedure: Social Performance [11]:
  - This describes the procedural level requirements for meeting the HSEC standard- social performance with community health and safety elements including section 4.2.2 stating that where community health is identified as a potential risk, a HIA should be conducted. The procedure references the guidance from the World Health Organisation (WHO) HIA page<sup>2</sup> with a host of tools and methods described under relevant sections.
  - Section 4.5 describes the requirements for social baselines and monitoring studies, including a health context.

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<sup>2</sup> <http://www.who.int/hia/en/>

### **3.3 International Standards and Guidelines**

#### **3.3.1 Development Financing Institution Guidelines**

There are a number of international guidelines or GIIP guidelines that support an approach to evaluating community health impacts linked to industrial development projects. The 2012 version of the IFC Performance Standard on Environmental and Social Sustainability and specifically Performance Standard four is followed in this assessment [12, 15]. This well-established methodology forms the default guidance for a number of multilateral financial institutions and industry trade associations, and generally represents the default standard used to support the Equator Principles for Financing Institutions.

In 2009, the IFC developed an “Introduction to Health Impact Assessments” Good Practice Note and toolkit on HIA to support Performance Standard 4. The guidance follows a reductionist approach to HIA and has been used as the preferred approach for this assessment [13]. This methodology is referenced on the World Health Organisation (WHO) site as a valid approach.

The IFC and World Bank Group have developed guidelines with respect to environment, health and safety, including guidelines for industry sectors such as mining, which includes open pit mining and milling (December 2007). This includes general guidelines that include a range of factors, which may overlap to human health (such as air quality (which include standards for PM<sub>10</sub> and PM<sub>2.5</sub>) and noise) [14].

#### **3.3.2 International Regulations and Standards**

Sierra Leone is a signatory to certain international conventions that are applicable to the Project and these may be seen to provide additional direction in the absence or limitation of local legislation or policy. Those relevant to health include the following (not exhaustive):

- The International Labour Organization Conventions;
- The United Nations Declaration on Rights of the Indigenous Peoples;
- Other United Nations declarations and agencies including:
  - International Health Regulations as promulgated by the WHO. Updated regulations for 2005;
  - United Nations Environmental Programme including Stockholm Convention on Persistent Organic Pollutants (Resolution No. 19/96 of November 26, 1996);
  - Rotterdam Convention on chemical and pesticides;
  - FAO International Code of Conduct on the Distribution and Use of Pesticides;

- Basel Convention on the Control of trans-boundary movements of hazardous waste and their disposal;
- International Covenant on Economic, Social and Cultural Rights, and
- Partner programmes such as the Sustainable Development Goals (SDGs).
- The Ouagadougou Declaration on Primary HealthCare and Health Systems in Africa: Achieving Better Health for Africa in the New Millennium (2008).

## **4 Health Impact Assessment Framework and Methodology**

### **4.1 Introduction and Definitions**

A HIA seeks to identify and estimate the lasting or significant changes of different actions on the health status of a defined population. A HIA may be defined as “a combination of procedures, methods and tools by which a project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population”. The HIA identifies appropriate actions to manage those effects [15-17]. Thus, HIA has an important role as a key decision-making tool in development planning at project level.

The WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. This is influenced by a complex interaction of social, economic, genetic, and environmental factors [18] and follows a social model of health. A reductionist approach is used to consider all these factors as described in section 4.2.3 [16, 19].

HIA assists extractive industry projects by understanding the existing health needs of the community and considering the consequences of different project processes and activities, and how these may influence community health as a decision-making tool. These consequences will be formulated into a CHMMP so that the negative health effects are avoided or mitigated, and potential positive effects are enhanced.

HIA is generally a participative process and inputs of various stakeholders are sought throughout. The process allows the views of different groups, including vulnerable ones, to be considered and to ensure that the proposed CHMMP is respectful of local cultures, perceptions and requirements.

### **4.2 Health Impact Assessment Methodology**

#### **4.2.1 Workplace Health and Community Health**

At the outset it is important that a distinction is made between HIA and Health Risk Assessment (HRA). HRA is concerned with the identification of hazards and exposure risks to the workforce which relate to occupational health and safety/ engineering design. Generally, HRA is “within the fence” while HIA is “outside the fence”, but there are distinct overlaps with HIA often taking a central position as workplace activities can affect community health and existing community health needs or disease burdens can affect workplace health.

So, while workplace (occupational) health is specifically out of scope for this assessment, the HIA will evaluate commonalities where workplace activities may impact on community health, and where management measures within the workplace can mitigate or enhance community health.

#### 4.2.2 Form and Nature of Health Impact Assessment

Figure 10 outlines the six-phase framework in the HIA process, with the final output a ‘fit for purpose’ and evidence based CHMMP that can be integrated into the Project’s ESHMP. Monitoring and evaluation of project impact management/mitigation plans allow for a continuous risk assessment and re-evaluation of health impacts and the success of management measures.

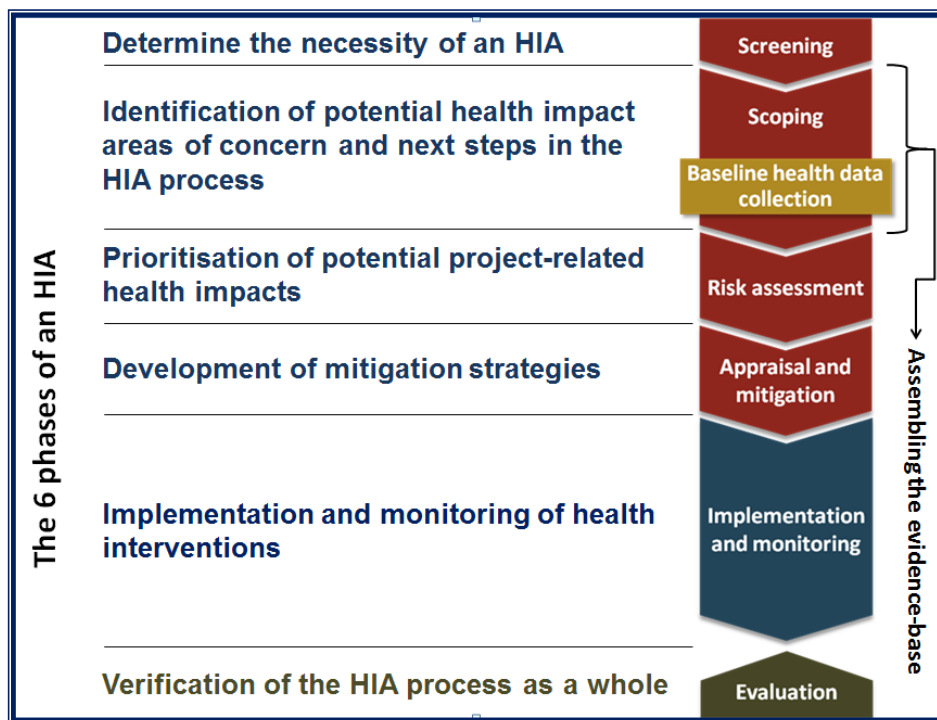


Figure 10: HIA flow chart

HIAs are generally divided into three main levels as described in Table 5. These levels are generally determined at scoping by considering the phase of the project and following three variables (based on the IFC Good Practice Note) [13]

- (i) the range and magnitude of potential health impacts;
- (ii) the social sensitivity of the potentially affected communities (PACs); and
- (iii) the definition of the project and its areas of influence (project footprint), which can include direct actions and activities as well indirect actions that may follow irrespective if they are the direct consequence or responsibility of the project.

The form of the current HIA follows a rapid appraisal approach. While it does not imply a superficial approach, there is a limitation on the amount of primary data collection. As required, or relevant, primary data is generally recommended as part of management measures and occurs after the impact assessment phase.

**Table 5: Levels of HIA**

Level of HIA	Characteristics
Desktop/Scoping HIA	<ul style="list-style-type: none"> <li>• Provides a broad overview of possible health impacts.</li> <li>• Analysis of existing and accessible data.</li> <li>• No new Project specific survey data collection</li> </ul>
Rapid Appraisal HIA	<ul style="list-style-type: none"> <li>• Provides more detailed information of possible health impacts.</li> <li>• Analysis of existing data.</li> <li>• Stakeholder and key informant analysis.</li> <li>• No new Project specific quantitative data collection at household or community level.</li> </ul>
Comprehensive HIA	<ul style="list-style-type: none"> <li>• Provides a comprehensive assessment of potential health impacts.</li> <li>• Robust definition of impacts.</li> <li>• New Project specific survey data collection including specific quantitative data collection at household or community level (generally requires bioethical clearance).</li> <li>• Participatory approaches involving key stakeholders</li> </ul>

### 4.2.3 Environmental Health Areas

The IFC methodology uses 12 Environmental Health Areas (EHAs) to support the systematic analysis of health considerations as summarized in Table 6 [13]. The set of EHAs provides a linkage between project-related activities and potential positive or negative community-level impacts and incorporate a variety of biomedical and key social determinants of health (reductionist approach). In this integrated analysis, crosscutting environmental and social conditions that contain significant health components are identified instead of an HIA focusing primarily on disease-specific considerations. The EHA framework is based on an analysis performed and published by the World Bank, as per the IFC Good Practice Note [13, 19].

While every EHA may not be relevant to a given project, it is still important to systematically analyse the potential for project-related impacts (positive, negative or neutral) across the various EHAs.



**Table 6: Environmental health areas**

<b>Environmental Health Areas (EHAs)</b>	
1.	<b>Communicable diseases linked to the living environment</b> – Transmission of communicable diseases (e.g. acute respiratory infections, pneumonia, tuberculosis, meningitis, plague, leprosy, etc.) that can be linked to inadequate housing design, overcrowding and housing inflation. It also considers indoor air pollution related to use of biomass fuels.
2.	<b>Vector-related diseases</b> – Mosquito, fly, tick and lice-related diseases (e.g. malaria, dengue, yellow fever, lymphatic filariasis, rift valley fever, human African trypanosomiasis, onchocerciasis, etc.)
3.	<b>Soil-, water- and waste-related diseases</b> – Diseases that are transmitted directly or indirectly through contaminated water, soil or non-hazardous waste (e.g. diarrheal diseases, schistosomiasis, hepatitis A and E, poliomyelitis, soil-transmitted helminthiases, etc.)
4.	<b>Sexually-transmitted infections, including HIV/AIDS</b> – Sexually-transmitted infections such as syphilis, gonorrhoea, chlamydia, hepatitis B and HIV/AIDS. Linkages of TB will be discussed where relevant under HIV, but often linked to EHA1.
5.	<b>Food- and nutrition-related issues</b> – Adverse health effects such as malnutrition, anaemia or micronutrient deficiencies due to e.g. changes in agricultural and subsistence practices, or food inflation; gastroenteritis, food-borne trematodiasis, etc. This will also consider feeding behaviours and practices. Access to land plays a major role in developing subsistence farming contexts.
6.	<b>Non-communicable diseases</b> – Cardiovascular diseases, cancer, diabetes, obesity, etc.
7.	<b>Accidents/injuries</b> – Road traffic or work-related accidents and injuries (home and project related); drowning.
8.	<b>Veterinary medicine and zoonotic diseases</b> – Diseases affecting animals (e.g. bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g. rabies, brucellosis, Rift Valley fever, Lassa fever, leptospirosis, etc.)
9.	<b>Exposure to potentially hazardous materials, noise and malodours</b> – This considers the environmental health determinants linked to the project and related activities. Noise, water and air pollution (indoor and outdoor) as well as visual impacts will be considered in this biophysical category. It can also include exposure to heavy metals and hazardous chemical substances and other compounds, solvents or spills and releases from road traffic and exposure to mal-odours. There is a significant overlap with the environmental impact assessment in this EHA. Ionizing radiation also falls into this category.
10.	<b>Social determinants of health</b> – Including psychosocial stress (due to e.g. resettlement, overcrowding, political or economic crisis), mental health, depression, gender issues, domestic violence, suicide, ethnic conflicts, security concerns, substance misuse (drug, alcohol, smoking), family planning, health seeking behaviours, etc. There is a significant overlap in the social impact assessment.
11.	<b>Cultural health practices</b> – Role of traditional medical providers, indigenous medicines, and unique cultural health practices.
12.	<b>Health systems issues</b> – Physical health infrastructure (e.g. capacity, equipment, staffing levels and competencies, future development plans); programme management delivery systems (e.g., malaria-, TB-, HIV/AIDS-initiatives, maternal and child health, etc.)

#### 4.2.4 Community Profiling

To identify and quantify potential health impacts an accurate population profile is required and it is important to distinguish between differences in exposure and susceptibility (the presence of a hazard and potential for exposure). Thus, besides a demographic profile of the at-risk population and the identification of the most vulnerable groups, it is crucial to

understand how project activities are likely to impact at an individual, household and community level. As part of the analysis, the relevant overall population is stratified into PACs, with this described in section 2.1.2.

#### 4.2.5 Baseline Health Studies

It is important that a baseline description of the prevailing health status in the PACs is established as part of the HIA process. This provides for the evidence base to support the modelling of potential impacts and also establishes a point of departure against which future impacts can be measured.

Data collection and analysis needs to consider:

- What data is available to adequately inform the baseline;
- What (if any) new data may need to be collected to support the baseline, and
- The adequacy of available data to support future monitoring and evaluation of potential impacts and mitigation/management measures.

Data collection requirements are generally defined at the scoping stage, with data collection activities performed in subsequent phases of the HIA. However, data collection and analysis are generally an iterative process with new information added as it becomes available. For a rapid appraisal assessment, additional data collection may be recommended as a ‘condition subsequent to the HIA’ and be recommended as part of the management measures

The analysis and reporting of baseline information is generally presented in the EHA framework, which supports a systematic review of data and allows for flexibility in approach. Baseline data collection can be from various primary and secondary data sources as described in Table 7.

**Table 7: Sources of baseline health data**

Baseline Health Data Collection and Sources			
Primary Data		Secondary Data	
Type of data	Source of data	Type of data	Source of data
Qualitative from participatory discussions	Key informant interviews with broad range of stakeholders including health authorities, local authorities and health development partners.	Health data	Literature review of health data in public domain including: <ul style="list-style-type: none"> <li>• Standard open source literature (such as WHO reports etc.)</li> <li>• Published peer review studies.</li> <li>• Health statistics and records from national, District and local sources.</li> <li>• Health studies performed by agencies and NGOs.</li> </ul>

	Group meetings with local authorities and communities.	Social data	<ul style="list-style-type: none"> <li>Social baseline and impact assessment reports as well as community development reports.</li> <li>Other data such as traffic and crime reports.</li> </ul>
	Focus group discussions with key sections of the community, including vulnerable groups. Women are often used as the default group.	Environmental data	<ul style="list-style-type: none"> <li>Specialist biophysical reports on aspects such as water and air quality.</li> <li>Environmental monitoring data on aspects such as water and air quality.</li> <li>Maps and spatial areas of influence.</li> </ul>
	Direct visualisation of communities, prevailing environmental health and social challenges.	Similar projects	Evaluating similar projects in similar settings and understanding their potential and actual impacts and what mitigation measures were applied.
Quantitative	Epidemiological cross-sectional baseline health surveys focussed at specific objectives.	Stakeholder engagement and reports	Analysis of minutes or reports from stakeholder meetings.
	Data sources from social and environmental baselines and impact assessments.		Community grievance or concerns register.
	Routine health information systems.		

#### 4.2.6 Risk Assessment and Impact Categorization

The risk assessment process analyses, models and ranks the potential impacts associated with a project, as well as their potential influence on PACs. The risk assessment follows a standardised approach, considering:

- Identification of health-related issues where project activities may impact on a variety of receptors. This generally includes a description of prevailing community health vulnerabilities and burden of disease trends (baseline information);
- A prediction of what may happen to the PACs as a result of the direct and indirect activities of the project - the impact definition. This will include a project specific cause and comment that describes how an impact may be caused, and
- The impact evaluation which considers the significance of the health impacts based on a consequence and likelihood modelling. This initial inherent ranking considers the risks at baseline and the project related impacts without mitigation; and the residual risks consider the significance of risks after the successful implementation of mitigation measures.

The evaluation of the significance of the impacts will also consider the confidence/uncertainty of the assessment. The precautionary principle was adopted in analysing and modelling impacts [20, 21]<sup>3</sup>.

<sup>3</sup> If an action or policy has a suspected risk of causing harm to the public or to the environment, and in the absence of reliable evidence that the action or policy is harmful, then the burden of proof that it is *not* harmful falls on those taking the action. In addition, when an activity raises threats of harm to human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

The methodology for assessing and categorizing the significance of impacts is described in Appendix D. This approach is entirely subjective and relies on the evidence base as well as the opinion and experience of the HIA practitioner. The outcome allows for the presentation of risks in a dashboard so that they can be identified based on their relative importance and prioritised for management.

The nature of impacts may differ from direct/indirect to cumulative, with these described as relevant as part of the impact evaluation.

## 4.2.7 Management and Mitigation

### 4.2.7.1 Impact Evaluation and Recommended Mitigation Measures

Mitigation refers to measures that avoid, minimize, eliminate an adverse effect, or maximize a potential benefit. Mitigation should be reviewed and adjusted on an on-going basis as per the *plan, do, check, act* (or similar) management cycle.

Recommendations for mitigation/management will focus on identification of measures that can be taken to reduce potential impacts to As Low as Reasonably Practicable (ALARP) both from a technical and financial perspective. These are generally presented based on a hierarchy of controls with avoidance as the priority.

For the purposes of the Project, mitigation measures have been divided into three categories based on the focus of the intervention, namely:

- **Project impact mitigation:** Interventions required in order to mitigate the future health impacts of the Project on PACs. Due to their influence, these mitigation measures are deemed as required (may be regulatory requirements) and not merely voluntary contributions, and thus the precautionary principle will apply where relevant.
- **Occupational health, safety and environmental management:** Interventions aimed at ensuring a healthy, safe and productive workforce. In addition, it considers aspects that can be controlled in the workforce to prevent community health impacts occurring from a health, safety and environmental perspective.
- **Social development mitigation and management:** Interventions suggested that will improve the existing health status of the communities. These can be in the form of negotiated commitments made by the project proponents as well as

extended benefits, which should bring about health benefits and improve social license to operate in the receptive communities.

While there is often an overlap between impact mitigation and negotiated commitments the scope of the HIA does not include the development of a plan to support strategic community investments related to community health. Therefore, any recommendations in the social development mitigation and management section will be limited to highlighting suggestions or opportunities. These recommendations can be used as required as part of the CDA, as a legal requirement described in section 3.1.

#### **4.2.7.2 Community Health Management and Monitoring Plan**

The impact evaluation will determine priorities for health impact management based on the significance of the ranking and the residual impacts. Thus, impacts with higher significance can be prioritised for intervention ahead of the less significant impacts. This will allow the development of short and medium term CHMMP which can be presented to stakeholders and developed for planned implementation of health programmes; with assigned accountabilities.

The CHMMP will have a monitoring element to ensure that the associated mitigation measures and interventions are meeting the desired objectives. This surveillance should consider monitoring of impacts as well as any health management interventions. It may be prudent to establish a separate health monitoring plan for each intervention that can then feed key indicators back to the CHMMP.

#### **4.2.8 Stakeholder Consultation**

Stakeholder engagement and consultation is a crucial element of the HIA process. Project stakeholders are defined by the IFC as ‘those individuals and groups that are affected by, or express an interest, in the project’ [22]. Stakeholder consultation in an impact assessment improves the quality and relevance of the findings by providing insights into the likely positive and negative health impacts both from stakeholder experience of the locality, as well as their experiences of other projects [14].

## 5 Activities Conducted in Health Impact Assessment

The HIA followed a rapid assessment approach as described in Table 5.

### 5.1 Desktop Activities

Desktop activities was initiated in early July 2017 with a literature review of national, provincial, District and (where available) local level data, where information on standard source health data in the public domain was available. This initial review had the intent to describe the broad health status and health priorities, following the EHA framework, considering the following core documents (with findings presented in section 6 and Appendix A):

- Project documentation and specialist studies:
  - Sierra Rutile Scoping Report completed in March 2017 by SRK [1], and
  - Sierra Rutile Review 2016 [2].
- Literature on key health determinants:
  - Sierra Leone 2015 National Population and Housing Census [23];
  - Sierra Leone Demographic and Health Survey (SLDHS) 2013 – Key Findings and Main Report [24];
  - Sierra Leone Health Sector Annual Performance Report 2015 [25];
  - Sierra Leone EVD Outbreak Progress Report 2015 [26];
  - Sierra Leone Maternal Death Surveillance and Response: Annual Report 2016 [27];
  - Sierra Leone WHO Country Cooperation Strategy 2017-2021 [28];
  - Sierra Leone Malaria Control Strategic Plan 2016-2020 [29];
  - Sierra Leone HIV Epidemiology Report 2016 [30];
  - Sierra Leone Health Facility Survey 2014 [31];
  - Sierra Leone Comprehensive Food Security and Vulnerability Analysis 2015 Report [32], and
  - Burden of Disease Estimates 2015, Sierra Leone Profile [33].

The desktop work was supplemented by reports and data from the Project including:

- Past ESIA's, including Knight Piésold in 2001 [34], and CEMMATS Group in 2012 [35];
- Environmental monitoring data;
- Health reports or documents that SRL has conducted;
- Workplace health information and data from the SRL clinic;

- Information from programmes with government health agencies or health development partners;
- Any specific community grievance related to health concerns;
- Any Project commitments related to health, and
- Any reports or minutes of stakeholder engagements with the Sierra Leone Ministry of Health and Sanitation (MoH&S) or at a decentralised District level.

## **5.2 Field Work and Stakeholder Engagement**

A field component was conducted from the 24<sup>th</sup> of July to the 1<sup>st</sup> of August 2017, with the objectives to:

- Gain a high-level impression of the health status in the Project area and to understand the specific direct and indirect influences that may Project may have on community health;
- Identify and engage with key stakeholders;
- View and assess available health services;
- Understand the availability and quality of health data, and
- Obtain a broad understanding of the Project and its activities.

The field work was initiated with a letter distributed to both the Moyamba and Bonthe District Medical Officers (DMOs) to introduce the planned study, its objectives and approach, and to request support and collaboration from the respective DHMTs. In addition, specific data and information was requested so that this could be discussed during the planned meetings. Specific activities are summarised below.

### **5.2.1 Key Stakeholder Interviews**

A crucial part of the field visit was to consult stakeholders with special knowledge of the health status as well as socio/cultural behaviours and norms of the communities in the Project area. The key stakeholders that were consulted during the field visit are shown in Table 8.

Stakeholder engagement was initiated by consulting with the Bonthe and Moyamba District health authorities in Mattru and Moyamba towns. It was important that meetings were initiated at this level so that correct permissions could be obtained to consult at lower levels within the health structure, and so that further engagement with the health authorities could be facilitated by following appropriate channels.

The visit to Mattru took place on the 25<sup>th</sup> of July and unfortunately the DMO requested that further permission be obtained from the Chief Medical Officer of the MoH&S in Freetown before any information could be shared or grant permission to visit public health facilities located in the Bonthe District. Some limited qualitative information was obtained. This was a significant limitation for the assessment as it restricted the ability to gather baseline data and qualitative participatory data, and to understand the health strategy or development priorities of the District.

Key Stakeholder Interviews (KSI) were also conducted with the Moyamba DHMT and selected public health institutions. In addition, some SRL managers and staff were interviewed.

**Table 8: Key stakeholders consulted during field work**

Name of key stakeholder	Function of key stakeholder	Date of interview
<b>SRL</b>		
	Chief Executive Officer	26.07.2017
	Community Relations and Sustainability Manager	25/26.07.2017
	HSE manager	26.07.2017
	Community Development Superintendent	26.07.2017
	Community Relations Supervisor	26.07.2017
	Medical Doctor- SRL clinic	24.07.2017
	Head Nurse- SRL clinic	24/26.07.2017
	Community Health Supervisor	25.07.2017
	Medical Doctor- SRL clinic	26.07.2017
	Community Development Superintendent	25.07.2017
<b>Health Authorities and Personnel</b>		
Dr Samuel Massaquoi	Bonthe District DMO	25.07.2017
Dr Hfeanyi Udenweze	WHO Field coordinator- Bonthe District	25.07.2017
Dr Charles Lissa	Health information and epidemiologist- Bonthe District	25.07.2017
Dr Jonathan Yader	Chief Medical Officer Mattru VBC hospital	25.07.2017
Dr Harrison Iminabo	Medical Officer Mattru VBC hospital	25.07.2017
Rev. Joseph Gbando	Hospital administrator- VBC hospital	25.07.2017
Dr Ronald Marsh	District Medical Officer – Moyamba District	26.07.2017
Elsie Thomas	District Assistant Nutritionist (Moyamba DHMT)	26.07.2017
Mohammed Kanu	District Monitoring and Evaluation Officer (Moyamba DHMT)	26.07.2017
Braima Dassama	District Public Health Superintendent – Moyamba DHMT	26.07.2017
Solomon Rogers	District CHWs Focal Person – Moyamba DHMT	26.07.2017
Kadie Kandoh	District Nutritionist – Moyamba DHMT	26.07.2017



Name of key stakeholder	Function of key stakeholder	Date of interview
Alhassan Jalloh	Disease Surveillance Officer II – Moyamba DHMT	26.07.2017
Fronas Puhinde	District Logistics Officer – Moyamba DHMT	26.07.2017
Bockarie Kobba	District Pharmacist – Moyamba DHMT	26.07.2017
Khama Bockarie	District Malaria Focal Person – Moyamba DHMT	26.07.2017
Marvel Vincent	District Health Sister – Moyamba DHMT	26.07.2017
Agnes Kallon	MCH-Aide in Charge – Moriba Town CHP	29.07.2017
Alhaji Jawara	Community Health Assistant – Gbangbatoke CHC	31.07.2017
Mohammed Kamara	Community Health Officer – Mokelleh CHC	31.07.2017

CHC – Community health centres; CHP – Community health post

## 5.2.2 Focus Group Discussions

Focus Group Discussions (FGDs) were conducted in SR Area 1 to understand how the communities form opinions on health, and to provide a preliminary assessment of the health status and health knowledge of the PACs. These were held with women, as they are considered the primary gatekeepers of family health and usually have a good understanding of critical issues that influence health at the community and household level.

The groups were interviewed using a semi-structured questionnaire, which allowed issues of concern to be addressed in a more efficient way. Responses were rapidly analysed to determine the major health themes/challenges. This approach allowed for a high-level understanding of the health challenges, from both a biophysical and social health perspective. The FGDs were conducted primarily in Krio. Table 9 outlines the locations and number of FGDs conducted.

**Table 9: Location, date, gender, age and number of participants of the FGDs**

Location	Gender of participants	Number of participants	Age range of participants	Date
Moriba Town	Females	21	20-52	26.07.2017
Mogbwemo	Females	18	19-65	27.07.2017
Junctuiola	Females	18	20-65	27.07.2017
Gbangbaia	Females	15	16-53	28.07.2017
Gbangbama	Females	16	14-45	28.07.2017
Foinda	Females	15	20-60	29.07.2017
Nyandehun	Females	17	18-70	29.07.2017
Gangama	Females	12	18->50	30.07.2017
Ndendemoia	Females	14	15-40	30.07.2017
Mataglema	Females	15	16-57	31.07.2017

### 5.2.3 Health Facility Assessment

The local health services in the Project area were evaluated using an assessment tool adapted from the WHO Service Availability and Readiness Assessment (SARA) index, including an evaluation of the following variables:

- Quantity and skills of healthcare personnel;
- Availability and range of general health services;
- Availability of services;
- Referral networks and the quality and cost of access to the health system, and
- The most common diseases or burden of disease at the facility.

An assessment was conducted in the following four facilities: Mattru VBC Hospital, Moriba Town Community Health Post, Mokelleh and Gbangbatoke Community Health Centres. The SRL clinic was also visited and a basic SARA assessment was conducted. As mentioned, it was not possible to visit the health centres or maternal and child health posts in Moriba town, Mogbewa, Gangama, Gbangbaia, Junctuiola, Gbangbama or Victoria.

Detailed reporting of the SARA assessments is presented in Appendix B.

### 5.2.4 Direct Observations

A drive through to visit the current and historic mining areas was conducted to gain a working understanding of current and planned activities (albeit from a distance). In addition, the communities were also visited (generally as part of the FGD) and observed for general environmental health and hygiene conditions such as waste (garbage) management, housing, water supply etc. with the support of a basic instrument. These findings are presented under each relevant EHA in Appendix A.

## 6 Study Limitations

A number of limitations are noted in the assessment process, with associated measures to address these limitations summarised in Table 10.

**Table 10: Limitations of baseline health data**

Limitations	Mitigation or Management Factor
<p>This assessment is the first comprehensive health study performed for the Project, so there is no reliable health baseline to describe how health factors may have changed in the Project area since it started over 50 years ago.</p> <p>The current baseline reflects the current status and conceptually considers how the Project may have influenced changes in community health over time. However, this is based on qualitative information as there is limited evidence data to inform how health indicators have changed.</p>	<p>There is no real mitigation strategy to address this limitation, with the current baseline and suggested data collection opportunities serving as an updated point of departure.</p>
<p>Inability to consult with the Bonthe DHMT and health facilities which fall under Bonthe District management. This was due to challenges gaining permissions.</p> <p>This limits the ability to describe a robust baseline as secondary data was not obtained and participatory data collection was not possible with staff in the DHMT or health facilities in the Project area.</p>	<p>This should be considered as a condition subsequent to the current study after required permissions have been obtained.</p>
<p>There was a limitation on key health indicator data at the micro PAC level, which limits an understanding of the true burden of disease and further limits the surveillance of impacts and interventions.</p>	<p>Collect data at the level of the PAC to define a robust baseline, or as part of interventions to support effective monitoring and evaluation.</p>
<p>There was limited data available on a host of environmental health determinants. It was thus not possible to define any potential human health impacts in these areas at the current stage.</p>	<p>One reliable baseline data is available and various impact assessments have been completed, a review should be completed to ensure that potential human health impacts have been considered. This will be a condition subsequent to the current HIA.</p>

## 7 Baseline Health Description, Impact Modelling and Associated Management Measures

This section details both the baseline health description as well as the analysis, modelling and ranking of potential health impacts that may be associated with the Project. It also outlines recommended management measures to mitigate potential negative and enhance potential positive impacts.

### 7.1 Baseline Health Description

The baseline health description will be divided into the following sections:

- A summary of the national health profile, health system and demographic profile of SR Area 1- presented in section 7.1.1- 7.1.3;
- A detailed description of the national health profile and indicators, the health system- presented below as background reading to understand the general burden of disease and structure of the health system;
- A detailed baseline health profile following the EHA framework considering data collected from desktop and field activities- presented in Appendix A;
- A summary of health facility assessments from SR Area 1- presented in Appendix B;
- A description of the EVD outbreak and how it influenced the health system- presented in Appendix C, and
- Summary of relevant baseline information to highlight specific burden of disease trends and community vulnerabilities in the impact assessment. This supports the evidence base to model impacts and to propose mitigation measures. This will be presented in section 7.2

#### 7.1.1 National and District Health Profile and Indicators

Years of conflict and the recent EVD epidemic have had a major impact on the health sector in Sierra Leone. Life expectancy at birth stands at 50.1, increasing by 11 years between 2000 and 2012, but still below the African average of 58 years and much lower than the global average of 70 years [28]. Some gains have been made on health, with data from the 2013 SLDHS showing that infant mortality decreased from 152 deaths per 1,000 births between 1999 - 2003, to 92 in the 5-year period from 2009 - 2013. Over the same period, under-five mortality decreased from 227 to 156 per 1,000 live births [24, 36]. Table 11 gives a brief summary of selected socio-demographic and health indicators for the country.

**Table 11: Key health and socio-demographic indicators for Sierra Leone**

Indicator	Year	Sierra Leone 2015
World Bank income group	2016	Low income
Human Development Index <sup>4</sup>	2016	Rank: 179 out of 187 Value: 0.420
Population size (thousands)	2015	7,075
Annual population growth rate (%)	2015	2.3
Gross national income per capita (\$)	2015	1,560
Poverty headcount ratio (% of population below national poverty line)	2011	53
Life expectancy at birth (years)	2015	50.1 (both sexes) 50.8 (females) 49.3 (males)
Population living in urban areas (%)	2015	41
Population under 15 years (%)	2015	40.9
Population over 60 years (%)	2015	5.1
Total fertility rate	2015	5.2
Crude birth rate (per 1,000 populations)	2015	35.45
Crude death rate (per 1,000 populations)	2015	13.27
Infant mortality rate (per 1,000 live births)	2013	92
Under-5 mortality rate (per 1,000 live births)	2013	156
Maternal mortality ratio (per 100,000 live births)	2013	1,165
Adult literacy rate (%)	2014	57
Gross primary school enrolment (%)	2015	105
Access to safe drinking water (% of population)	2015	63
Access to improved sanitation (% of population)	2015	13
HIV prevalence (per 100,000 population)	2013	1.5
TB prevalence (per 100,000 population)	2012	1,304

Sources: World Bank, WHO [28, 37], Sierra Leone DHS 2013 [36], National Population Census 2015 [23], Millennium Development Goal Report [38], United Nations Development Programme (UNDP) [39]

Communicable diseases are the leading cause of disease burden nationally of which malaria is the single biggest killer, accounting for 38% of all hospital admissions. Tuberculosis (TB) is another significant public health problem, with an estimated three new infections per 1,000 people each year. The national HIV prevalence rate stands at 1.5% (2013 statistic). Sierra Leone was severely hit by the most widespread EVD epidemic in history, where a total of 8,706 people were infected and 3,590 died (as described in more detail in Appendix C). The risk of epidemics and other public health concerns remains high [28].

<sup>4</sup> The Human Development Index is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. (Score range is 0 to 10 with 1 being best score)

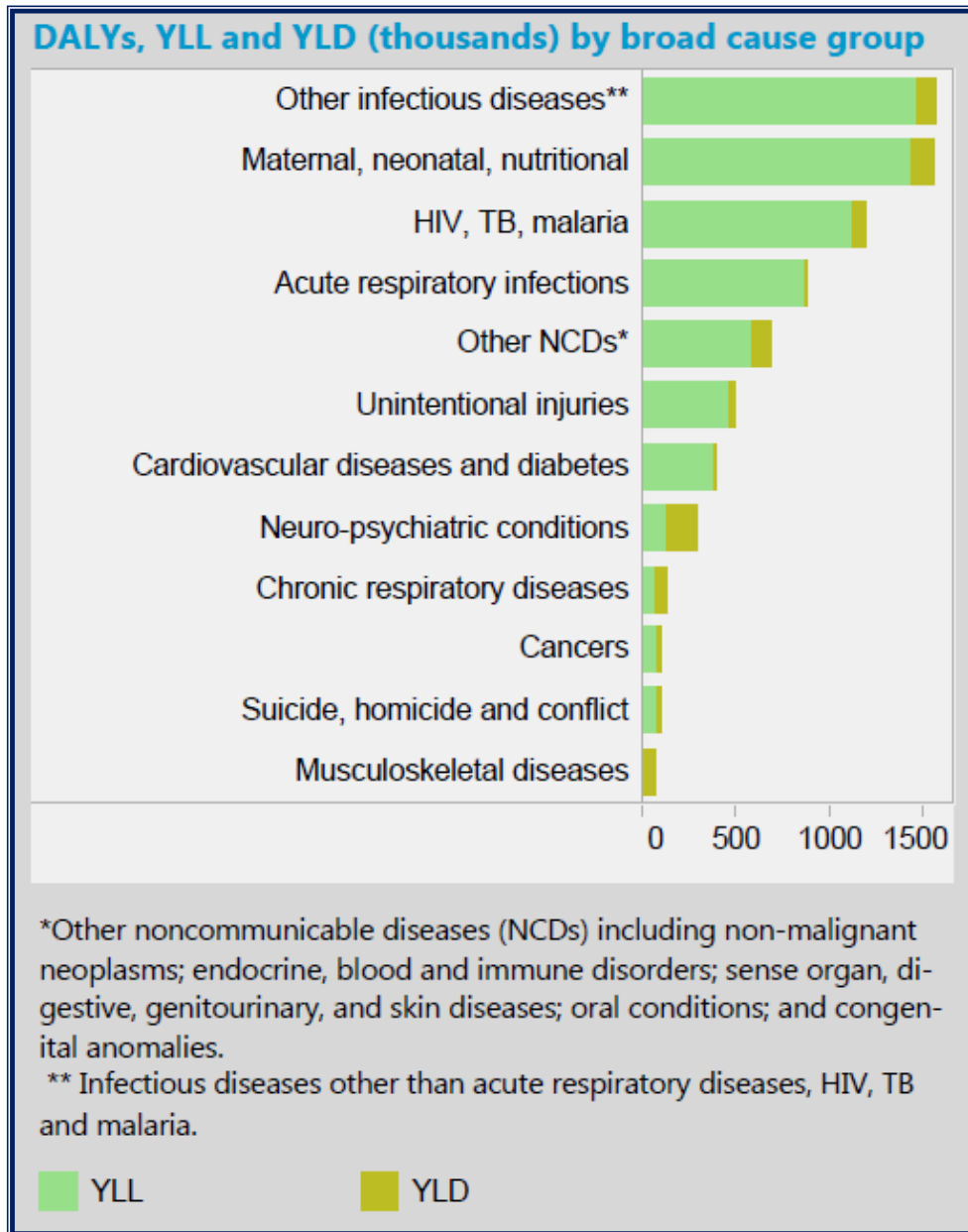
The country is estimated to have the world's highest maternal mortality ratio, at 1,360 maternal deaths per 100,000 live births in 2015 [27]. Child mortality is also high, with over 150 of every 1,000 children dying before the age of five years. Malnutrition is widespread with almost one third of under-five children having stunted growth. Non-Communicable Diseases (NCDs) and injuries are increasing in significance, with cardiovascular diseases, cancer, diabetes and chronic respiratory disease, as well as injuries, are increasingly responsible for premature death and disability contributing to a double burden of communicable and non-communicable disease [28].

The Disability-Adjusted Life Year (DALY) is a measure of overall disease burden. It is designed to quantify the impact of premature death and disability on a population by combining them into a single, comparable measure. The DALY extends the concept of potential Years of Life Lost (YLL) due to premature death to include equivalent years of 'healthy' life lost by virtue of being in state of poor health or disability, quantified as years lived with disability. Figure 11 shows the broad causes of DALYs in Sierra Leone (2012 data) [37].

Figure 12 [33] shows the leading causes of deaths nationally, according to latest estimates (2015 data). Malaria remains the single biggest cause, followed by lower respiratory infections and diarrhoeal diseases. EVD emerged as the 4<sup>th</sup> leading cause of deaths in 2015. NCDs particularly cardiovascular disease and ischaemic heart disease<sup>5</sup> also rank among the top ten causes of deaths. HIV/AIDS, meningitis and neonatal sepsis complete the list [33].

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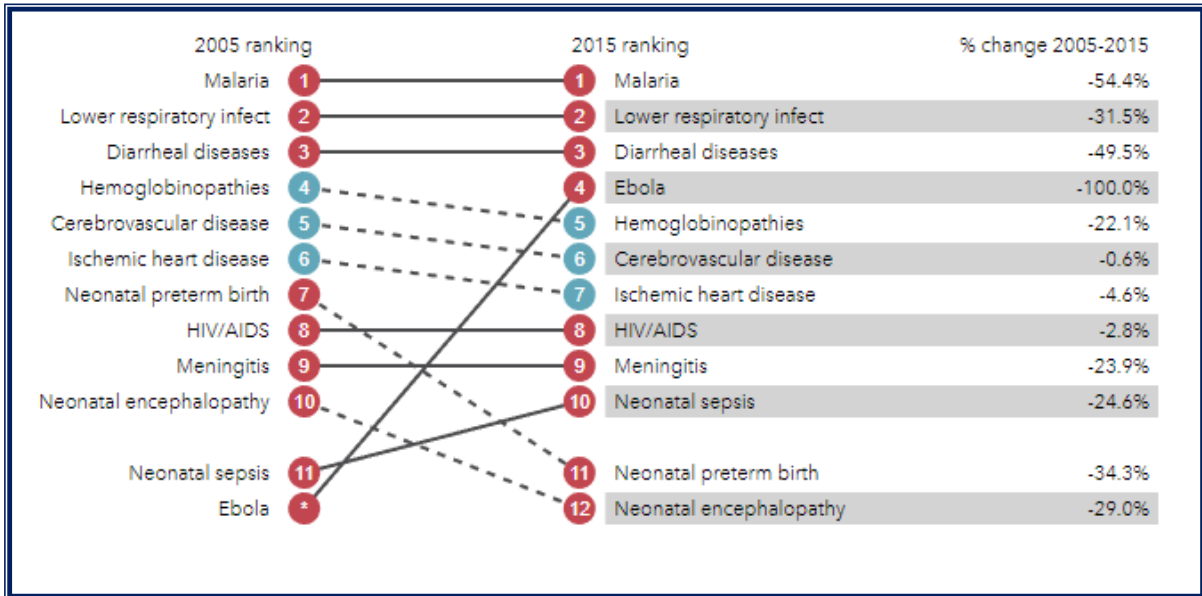
<sup>5</sup> Ischaemic heart disease is a disease characterized by reduced blood supply to the heart.



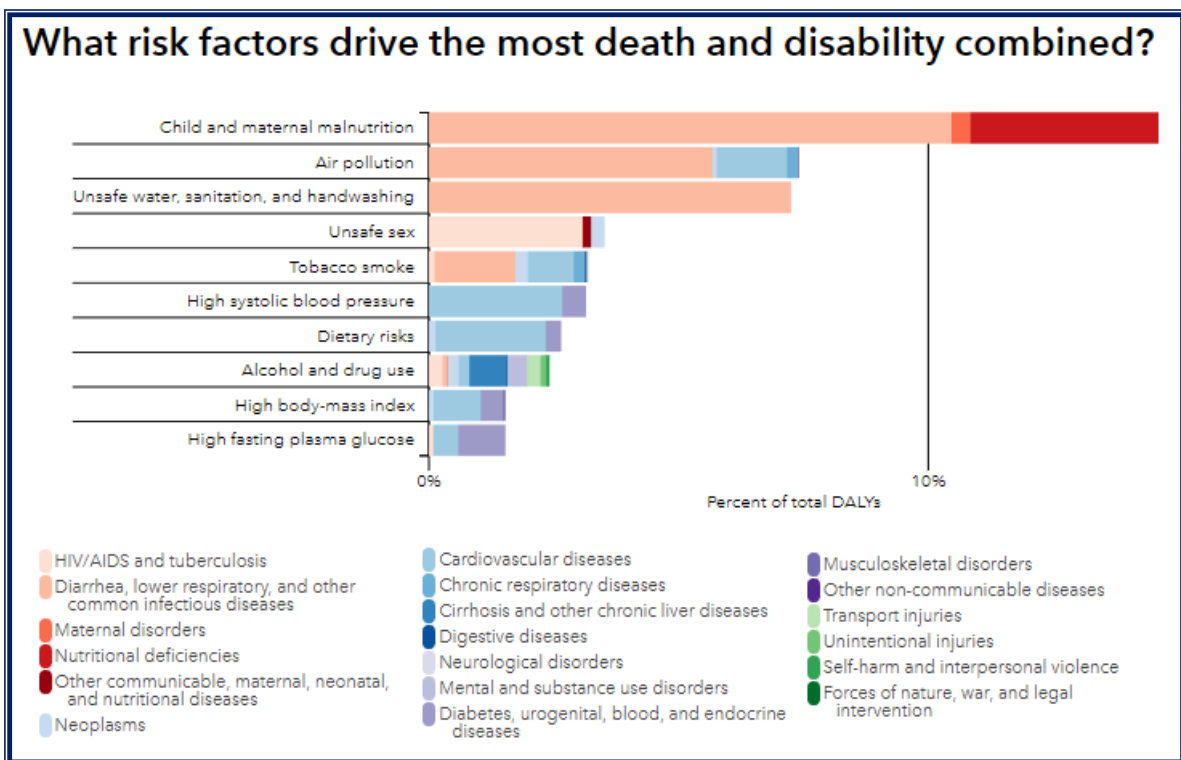
**Figure 11: Broad causes of disease burden in Sierra Leone, 2012**

Source: WHO

Malnutrition, air pollution, unsafe water and sanitation, unsafe sex, tobacco smoking and high blood pressure are among the leading risk factors for disease nationally (Figure 13) [33].



**Figure 12: Top ten causes of deaths in Sierra Leone and percent change 2005-2015**  
Source: Institute for Health Metrics and Evaluation (2015 Global Burden of Disease estimates)



**Figure 13: Risk factors for disease burden in Sierra Leone, 2015**  
Source: Institute for Health Metrics and Evaluation (2015 Global Burden of Disease estimates)

According to the Moyamba District Council, the top ten diseases/illnesses in the District are malaria, diarrhoeal diseases, skin diseases, hypertension, pneumonia, anaemia,



intestinal worms, rheumatism, ear infection and onchocerciasis<sup>6</sup> [58]. The cause for these conditions has been attributed to a suitable habitat for mosquitoes to breed in, poor sanitation services and weak hygiene, lack of access to potable water, poor dietary habits and poor health prevention practices [58].

### 7.1.2 Health System and Infrastructure

Access to quality health care is a major national or public health. This is attributed to inadequate human resources, limited health expenditure, and problems with the drug and medical supply chain [25]. While the country had embarked on the process of rebuilding and rehabilitating its health system, following a decade-long civil, the vulnerability in the health sector was exposed during the 2014-2016 EVD epidemic. This highlighted many gaps in service delivery, and the lack of preparedness to respond to disease outbreaks [25]. Post-EVD, the country has embarked on another recovery plan and review of various health policies and plans [40].

The public health system follows a primary health care approach organised into three tiers, summarised in Figure 14 [41]:

- Level one: Peripheral health units that are devolved to district councils with the following sub-categorisations:
  - Maternal and Child Health (MCH) posts that are situated at village level and serve a population of 500 to 5,000 within a 3-mile radius. They are staffed by MCH aides who are trained to provide services including: antenatal care; supervised deliveries; postnatal care; family planning; child growth monitoring; child immunisation; health education; management of minor ailments and referral of cases to the next level.
  - Community health posts that are usually situated in small towns serving a population of 5000 to 10,000 within a 5-mile radius. They are generally staffed by community health assistants, state-enrolled community health nurses and MCH Aides. With the addition of prevention and control of communicable diseases, they offer the same service as MCH posts.
  - Community health centres are located at Chiefdom level and serve a catchment population of 10,000 to 30,000 or more within a 5-10 mile radius. These centres are staffed in a similar way to community health

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<sup>6</sup> Eye and skin disease also known as River Blindness caused by a parasitic worm

posts with the addition of laboratory staff, epidemiological disease control assistants and environmental health assistants. With the addition of environmental sanitation and basic laboratory services they offer the same services as community health posts, with five centres per District designated for to support basic emergency obstetric and new-born care.

- Level two: District hospitals. These provide secondary care and serve as referral points for the management of more complicated cases outside the competency of the peripheral health units.
- Level three: Regional and National hospitals. These provide tertiary/specialised care and act as referral points for District hospitals. There are three tertiary hospitals nationally all located in Freetown.

Level of Care	Facility Type	Number
<b>Tertiary</b>	Referral Hospital	3
<b>Secondary</b>	Hospital (including regional referral hospitals)	21
<b>Primary</b>	Community Health Centre	229
	Community Health Post	386
	Maternal Child Health Post	559
<b>Community</b>	Community Health Worker	~15,000

**Figure 14: Distribution of public health facilities by level of care, 2016**

Source: MoH&S, 2017

The public health sector accounts for about 50% of health care services nationally, with the other half provided through the private sector, mainly NGOs, health development partners and faith-based organisations and the private-for-profit institutions. Figure 15 shows the distribution of health facilities at District level as of 2010, with an inequitable distribution and the rural areas suffering neglect. The informal health sector plays an important role in the health system, especially traditional healers (THs) [42].

District	Govt. Hospitals	CHC	CHP	MCHP	Government Clinics	Military Hospitals	Private Hospitals	Community Hospitals	Industrial Clinics	Mission Clinics	Mission Hospitals	NGO Clinics	Private Clinics	Total
Bo	1	23	15	55				1		7	1		3	105
Bombali	1	18	21	41		1				3	3		4	93
Bonthe	1	11	9	17					1	2	1	2		44
Kailahun	1	13	36	15							1	1		67
Kambia	1	15	10	26						2		1		55
Kenema	1	19	21	47	1							1		90
Koinadugu	1	12	6	29								1	1	50
Kono	1	10	20	50	1							2		84
Moyamba	2	12	11	56						5		1	1	88
Port Loko	2	11	21	59						3	2	1	1	100
Pujehun	1	12	11	35										59
Tonkolili	1	9	10	57							2		1	80
Western Area	12	21	16	28	9	1	2		1	13	2	4	27	136
<b>TOTAL</b>	<b>26</b>	<b>186</b>	<b>207</b>	<b>515</b>	<b>11</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>35</b>	<b>12</b>	<b>12</b>	<b>38</b>	<b>1,051</b>

**Figure 15: Distribution of health facilities by Districts, 2010**

Source: Statistics Sierra Leone, 2014

Sierra Leone suffers from extreme shortages of trained healthcare providers, having only 2 skilled providers per 10,000 population, compared to the WHO recommended critical threshold of 23 skilled healthcare providers (doctors, nurses, and midwives) per 10,000 population [25]. A situational analysis conducted by the MoH&S in 2016 show that the total number of health workers below the minimum requirement for every clinical occupation. Staffing gaps are particularly significant for higher-skilled occupations such as doctors, specialist nurses, and midwives (Figure 16) [41]. Figure 17 shows the health workforce density by District, with both Bonthe and Moyamba Districts well below target [41]. The MoH&S initiated plans to establish a postgraduate medical training college to train specialist medical doctors locally to address some of these challenges, with legislation (The Act for the establishment of the Postgraduate Medical Training College) passed to guide this [25].

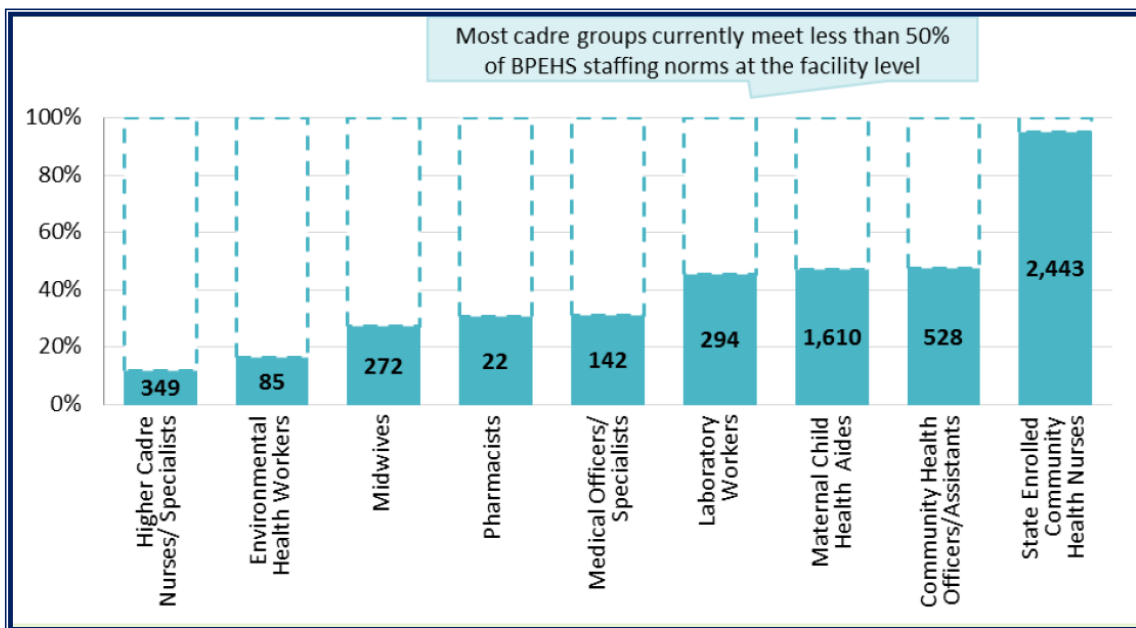


Figure 16: Facility level staffing gaps for clinical occupations (cadres), 2016  
Source: MoH&S

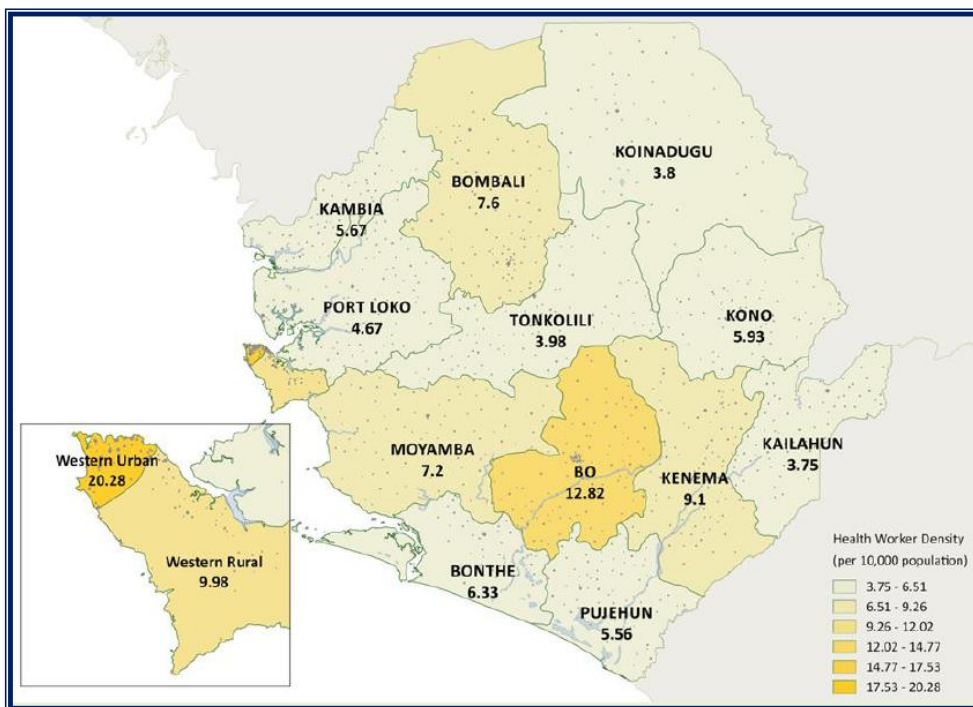


Figure 17: Health workforce density in Sierra Leone by District (per 10,000 population)  
Source: MoH&S, 2016

### 7.1.3 Health Policies, Strategies and Plans

The MoH&S adopted the ‘Primary Health Care’ approach as a platform for ensuring inclusiveness and reducing inequalities in health, with the introduction of the Basic Package of Essential Health Services (BPEHS) in 2010 as the guiding document. This

supported the implementation of the National Health Policy and the Free Health Care Initiative.

The main focus of the BPEHS was to reduce mortality rates, particularly infant and maternal mortality through the commitment to providing a minimum set of health care services. Since its introduction in 2010, the MoH&S has scaled up interventions defined in the package relating to maternal, new-born, child and adolescent health, including nutrition; sexual and reproductive health including family planning; HIV/AIDS, TB and malaria; mental health and disability services; and environmental health and sanitation [24].

However, the EVD epidemic necessitated a review of the BPEHS to ensure it remained relevant, so it was revised in 2015 with an added focus on emerging health issues including surveillance and management of epidemics, improving health worker safety and an increased emphasis on NCDs. In addition, a 2015-2020 Health Sector Recovery Plan was developed to support the termination of the EVD outbreak and in restoring essential health services [25]. The national Community Health Officer programme was also revitalised in 2015 to increase the engagement of key community groups and stakeholders in community-based surveillance and to bring effective health services closer to the community. This included a plan to establish a national medical emergency service to provide pre-hospital care and transportation of patients to hospital, as well as strengthening the referral system [25].

The Free Health Care Initiative involved the targeted removal of user fees to promote access to and utilisation of healthcare for the most needy and vulnerable in society. This programme is managed by the MoH&S with support from various health development partners, with data showing a significant increase in utilisation [24, 25].

The MoH&S has strengthened coordination with stakeholders and health development partners since 2015. Every implementing partner in the health sector is required to sign a service level agreement at central level, as well as with the DHMT and the District Councils. The objective is to document and coordinate all projects to ensure that they are aligned with national priorities, equitable distribution and adherence to quality standards[25].

#### **7.1.4 EVD Outbreak**

As mentioned, the country experienced an unprecedented EVD outbreak between 2014 and April 2016. The outbreak affected health systems, infrastructure and numerous social determinants, with these described in detail in Appendix C.

#### **7.1.5 Baseline Health Profile Based on Environmental Health Areas**

A detailed description of the baseline health status based on the EHA framework is attached in a series of tables in Appendix A. This serves as the current baseline reference considering national, regional and local data where this was available, both from the desktop review, a review of grey data, data from past and current specialist studies and participatory data collected in the field. In addition, this information is used to support the summary baseline description and summary of community vulnerabilities in section 7.2.

## **7.2 Impact Assessment/Modelling and Associated Mitigation/Management Measures**

This section details the modelling and ranking of potential health impacts, limited to the current and future production phase, with impacts into closure and post closure of the Project out of scope.

The impact assessment will follow the EHA framework and specific methodology described in section 4.2.6, including:

- The identification of health-related issues/ community vulnerabilities in the PACs from baseline data/information;
- impact definition;
- impact evaluation including inherent and residual ranking;
- key recommendations, and
- the spatial distribution of impacts in the different PACs.

The following general principles should be considered in the management of potential community health impacts:

- Any community-based intervention must be aligned with public health policy and strategy, whether at a National or District level;
- SRL must avoid becoming entangled in the role of government in planning and implementing health programmes. Ideally, these should be devolved to government departments and/or health development partners, with SRL retaining a supporting role. This supportive role should still ensure effective management of interventions;
- Maintain effective communication and stakeholder engagement with partners and PACs;
- Effective contractor management to ensure compliance to interventions, and
- Effective surveillance systems to monitor impacts and also effectiveness of management measures.

A summary of the impact assessment presented in the EHA framework is described in Table 12. This outlines both inherent and residual risks in a dashboard so that priority areas can easily be identified.

Table 12: Summary of inherent and residual health impacts

Environmental Health Area		Before Management				After Management			
		Severity	Probability	Significance±	Direction*	Severity	Probability	Significance±	Direction*
EHA #1	Communicable diseases linked to the living environment	Moderate	Possible	<b>Moderate</b>	Negative	Minor	Possible	<b>Minor</b>	Negative
EHA #2	Vector-related diseases: malaria burden	Moderate	Definite	<b>Major</b>	Negative	Minor	Possible	<b>Moderate</b>	Benefit
EHA #2	Vector-related diseases: arbo-viral diseases	Moderate	Possible	<b>Moderate</b>	Negative	Minor	Unlikely	<b>Minor</b>	Negative
EHA# 3	Soil, water- and waste-related Diseases	Moderate	Probable	<b>Moderate</b>	Negative	Minor	Possible	<b>Minor</b>	Benefit
EHA# 4	Sexually transmitted infections (STIs) including HIV/AIDS	Major	Definite	<b>Critical</b>	Negative	Moderate	Possible	<b>Moderate</b>	Negative
EHA #5	Food and nutrition	Moderate	Probable	<b>Moderate</b>	Negative	Minor	Possible	<b>Minor</b>	Benefit
EHA #6	Non-communicable diseases	Moderate	Possible	<b>Moderate</b>	Negative	Minor	Possible	<b>Moderate</b>	Benefit
EHA #7	Accidents, injuries and violence	Major	Definite	<b>Critical</b>	Negative	Moderate	Possible	<b>Moderate</b>	Negative
EHA #7	Work-related illness/injury	Not ranked as occupational health and safety issue							
EHA #8	Veterinary medicine and zoonotic diseases	Major	Possible	<b>Major</b>	Negative	Minor	Possible	<b>Minor</b>	Negative
EHA #9	Noise	Minor	Definite	<b>Moderate</b>	Negative	Minor	Possible	<b>Minor</b>	Negative
	Air quality and mal-odours	Major	Probable	<b>Major</b>	Negative	Minor	Possible	<b>Minor</b>	Negative
	Radiation	Minor	Possible	<b>Minor</b>	Negative	Minor	Possible	<b>Minor</b>	Negative
	Water quality/quantity	Moderate	Possible	<b>Moderate</b>	Negative	Minor	Possible	<b>Minor</b>	Negative
	Hazardous chemical substances	Moderate	Possible	<b>Moderate</b>	Negative	Minor	Unlikely	<b>Minor</b>	Negative
EHA #10	Social determinants of health	Moderate	Possible	<b>Moderate</b>	Negative	Minor	Possible	<b>Minor</b>	Negative
EHA #11	Health seeking behaviour and cultural health practices	Minor	Possible	<b>Moderate</b>	Negative	Minor	Possible	<b>Moderate</b>	Benefit
EHA #12	Health systems issues	Moderate	Probable	<b>Moderate</b>	Negative	Moderate	Possible	<b>Moderate</b>	Benefit



## 7.2.1 EHA #1 – Communicable Diseases linked to the Living Environment

### Health Issues/ PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - Acute respiratory infections (including pneumonia) are listed among the top three diseases in Moyamba and Bonthe Districts;
  - TB is highly endemic nationally and ranked in the top 10 high burden countries globally [62, 63]. TB is reported to be increasing in both Districts, with mining areas cited as a 'hot-spot' for TB transmission. Dual infection with TB and HIV is common. However, the SRL clinic did not report cases of TB commonly, and
  - Measles outbreaks have occurred in both Districts, with respondents from FGD reporting that cases occur commonly. The area is noted to be susceptible to future outbreaks.
- Health system:
  - Inadequate TB diagnostic centres and weak systems to support adequate case management in confirmed TB cases;
  - Sub-optimal vaccination programmes including cold chain management, inability to reach populations due to inadequate outreach services and poor health seeking behaviour related to the inability to access or afford services (especially transport to services), and
  - Limited ability to extend communicable disease control programmes into communities.
- Contributing factors:
  - Dust is noted to contribute to respiratory disease, especially in the dry season and in communities along haul/access roads;
  - Influx of job and opportunity seeking migrants places pressure on; i) the availability of local housing; ii) general environmental hygiene due to limited basic services; iii) the (already weak) health system; and iv) introduction of communicable diseases and creation of conducive conditions for disease transmission due to mixing of people;
  - While the quality of housing is reported to have improved in recent times, a number of challenges related to housing and general environmental hygiene were noted:
    - There is inadequate town planning in some communities with housing structures built in close proximity to one another, leading to overcrowding (Moriba Town and Mogbwemo);

- Due to pressure on housing availability and the ability to afford/build houses, overcrowding did occur in housing structures with 5-7 people sharing 2-3 rooms, and
- Ventilation in housing is generally inadequate.
- Rental fees for accommodation were increasing with it common for people to share rooms, or different families to share the same house, and
- Communities do not have access to electricity from the national grid. Cooking is performed using wood or charcoal that affects local air quality.

### **Impact Definition:**

The Project may potential impact on communicable disease transmission in the following direct and indirect ways:

- **Direct:**

- Potential for communicable disease transmission from within the workforce:

There is the potential for the introduction of communicable diseases that are not common or circulating locally from the workforce who are hired/or travel from outside the immediate Project area. This can include conditions such as seasonal influenza, meningitis, TB (especially multi drug resistant TB) and other novel diseases (such as pandemic influenza). This potential risk may be magnified by the weak local public health system.

There is the potential for transmission of these communicable diseases from the workforce to the community. This risk is more marked where people live/work in close contact with one another (e.g. accommodation areas).

- Local housing and rentals:

The workforce who chose to, or need to, rent local accommodation may choose to share accommodation or live in close quarters to one another to save on rental costs. This may promote overcrowding, potentially supporting transmission of communicable diseases.

- Air quality:

Reduced air quality has the potential to increase susceptibility to acute respiratory infections, with these impacts discussed in section 7.9.2.2.

- **Indirect:**

- Project induced influx:

The Project is an attractor for job and opportunity seeking migrants, which has led to movement of people in and out of the area and resulted in the unplanned development of settlements. This has led to challenges with housing and general environmental health conditions. There is limited capacity in local and District authorities to support or implement effective town planning. Impacts may include

- Introduction of communicable disease due to high movement of people and mixing of people who live in close association to one another [139].
    - Supply and demand constraints due to pressure on the availability of housing due to rental cost and costs of building materials. Members of the community that cannot afford rentals/housing will be particularly vulnerable, as they may be forced to build make-shift structures.
    - Weak health services and inability to support health prevention or curative health services.

- Use of biomass fuels:

Increased use of biomass fuels for cooking has the potential to impact on air quality due to an increase in particulate matter and products of inadequate combustion. The potential is higher in Moriba Town, Mogbwemo and Mataglema. This has the potential to increase the vulnerability to acute and chronic airway/lung conditions, with children and the elderly particularly vulnerable.

- **Benefit:**

It is likely that housing in certain areas would have improved from baseline due to the economic benefit of the Project. This will be described in the social impact assessment.

**Impact evaluation and management measures:**

<b>EHA # 1 Communicable disease linked to the living environment</b>											
<b>Current operations. If unmitigated may extend into closure</b>											
	<b>Consequence/Effect</b>						<b>Probability/Likelihood</b>		<b>Total Score</b>	<b>Overall Significance</b>	<b>Confidence</b>
	<b>Temporal Scale</b>		<b>Spatial Scale</b>		<b>Severity of Impact</b>						
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Possible	2	10	Moderate negative	Medium
<b>Management Measures</b>											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Develop a communicable disease strategy and plan that includes employees, contractors and visitors. The strategy should include elements that reduce the risk for local introduction of communicable disease.</li> <li>Develop an outbreak preparedness and response plan that includes business resilience elements. This should include cooperation with the DHMTs.</li> <li>Develop an influx management plan.</li> <li>Consider completing a housing rental cost baseline and evaluate potential vulnerable groups who may be vulnerable to inadequate housing due to cost pressures (elderly, single women, child headed households). Develop a process to monitor housing inflation trends.</li> <li>Develop a monitoring system as part of the CHMMP to monitor specific health indicators.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Develop a workplace TB management plan that includes employee, contractors and short-term labourers. This should incorporate screening as well as education campaigns. Integrate this into Project's HIV plan and develop metrics to monitor effectiveness.</li> <li>Screen local employees/contractors for TB at recruitment as part of the Project's fitness to work procedures. Suspicious cases should be referred to the public health service for confirmatory diagnosis, with care and treatment provided by the public health service, but with support from the SRL clinic.</li> <li>Develop an agreement with the DHMT(s) to support the care and treatment of employees/ contractors for TB (and HIV) so that when employees/contractors leave the Project that they can be referred back into the public health system or traced to their place of origin (this is particularly important for people undergoing treatment).</li> <li>Ensure adequate camp facility management in company accommodation so adequate environmental health/hygiene standards are maintained. The IFC and European Bank for Reconstruction and Development have guidance on this, which can be used as a reference [140].</li> <li>Develop a vaccine preventable disease programme for all employees and contractors.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>Evaluate opportunities for health systems strengthening in the public health service including improved laboratory services, supply chain management of commodities and medications etc.</li> </ul> </li> </ul>											
	<b>Consequence/Effect</b>						<b>Probability/Likelihood</b>		<b>Total Score</b>	<b>Overall Significance</b>	<b>Confidence</b>
	<b>Temporal Scale</b>		<b>Spatial Scale</b>		<b>Severity of Impact</b>						
<b>Impact after management</b>	Medium term	2	Localised	1	Minor negative	2	Possible	2	7	Minor negative	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

There is limited capacity to detect and manage an increase in communicable diseases. Their introduction poses a risk to vulnerable sectors of the population (young children, elderly and those with a weak immune system). The poor socio-economic and local living conditions compound this risk. No specific gender risks are anticipated.

The impacts associated with communicable diseases linked to the living environment are more likely to occur where influx is more prominent, as per the PACs in the attached table.

	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
<b>Communicable diseases linked to the living environment</b>	Yes	No	Yes	Yes	Yes	No	No	No	No

## 7.2.2 EHA #2 – Vector Related Diseases

### 7.2.2.1 Malaria Burden

#### Health Issues / PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - Malaria is endemic and is regarded as the biggest public health threat and the number one cause of disease morbidity and mortality, nationally; and
  - While there are no formal studies available to report the actual prevalence of disease as a proxy for burden of disease locally, it would appear if rates in SR Area1 may be higher than models predict [74].
- Health system
  - The National Malaria Control Programme (NMCP) supports a number of interventions in the Districts including free distribution of Insecticide Treated Bednets (ITNs), intermittent preventive treatment in pregnancy and free malaria diagnosis and treatment. Indoor residual spray programmes were however not conducted under the NMCP;
  - In 2013, ITN coverage was just over 70% in both Districts, with utilisation at 56% and 59% in Bonthe and Moyamba Districts, respectively [73]. A mass distribution campaign was conducted in both Districts in June 2017;
  - SRL supported the distribution of ITNs in the workforce and selected groups (Chiefs and vulnerable groups) in the PACs;
  - No known entomology studies have been performed to describe the most common disease transmitting species of *Anopheles* , their behaviour or susceptibility to insecticides; and
  - Frequent stock-outs of anti-malarial medications were reported from local public health facilities due to challenges in the supply chain. This was generally because demand exceeded the amount provided.
- Contributing factors:
  - Weak health system;
  - The environment is suited to the breeding of mosquitoes and transmission of malaria due to:
    - High rainfall and humidity;
    - Areas of stagnant water or puddles in the community due to poor environmental hygiene;
    - Poor housing that allows for easy entry of mosquitoes into dwellings, and

- Movement of people into and out of area, with the potential constant reintroduction of the parasite.
- Transmission occurs throughout the year, with a peak in the wet season from April to January, and
- The high burden of disease is attributed to low utilisation of ITNs. It was reported that the community do not use them due to the hot environment. Inappropriate use of ITNs (for e.g. fishing) was noted.

### Impact Definition:

- **Direct:**

- Environmental changes:

Changes to the environment from mining and associated activities have the potential to create localised mosquito breeding areas. As vector densities increase, so may the potential for disease transmission.

This may occur where there is ground disturbance including general clearing, rutting on access/haul roads, construction yards, dredge ponds, etc. The mine ponds may also influence mosquito breeding patterns, with this most likely to occur on the margins or backwaters, or when dams dry out to leave puddles in the dry season. Human and animal activities on the banks of dams may also create a suitable habitat. The main body of water does not constitute a suitable breeding habitat.

- Workforce health:

While out of scope, malaria poses a significant health risk to employees and an economic risk to the Project. These risks should be considered as part of the Projects workplace health programme.

- **Indirect:**

- Project induced influx may influence malaria transmission patterns by:

- Unchecked development in communities with creation of breeding sites through poor environmental management and inadequate waste management;
- Poor housing that allows for easy entry of mosquitoes into dwellings;
- increased population limiting the effectiveness of public health controls (for e.g. new arrivals not having ITNs, or not enough ITNs as population has increased in size after planning), and
- Pressure on public health services due to increased malaria case-loads and a larger population.

- **Benefit:**

Improved access to SR Area1 from the maintained roads supports the delivery of outreach public health interventions as well as access to the health referral network.

### Impact evaluation and management measures:

EHA # 2		Malaria and associated determinants									
Operations, potential to extend into closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Definite	4	12	Major negative	High
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Evaluate opportunities to work with the NMCP and DHMT including: <ul style="list-style-type: none"> <li>Perform a malaria indicator study to determine the local burden of disease.</li> <li>Conduct a baseline entomology study to determine the presence of disease transmitting mosquitoes (and other vectors); their behaviours; and what controls could be effective.</li> </ul> </li> <li>Based on results of the entomology study, develop breeding site control programmes including environmental and larval source management.</li> <li>Develop an influx management plan that may consider environmental management and health systems strengthening in collaboration with the DHMT.</li> <li>Develop a monitoring programme to evaluate the impact of malaria and associated interventions.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Develop an integrated workplace malaria and vector control programme that has a focus on focus on environmental management, integrated vector control, bite prevention, behaviour management and effective case management.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>Evaluate opportunities to extend the workplace malaria control interventions into the surrounding communities in partnership with the DHMT and NMCP.</li> <li>Support health systems strengthening by supporting the supply chain of medications and diagnostic consumables.</li> <li>Encourage source reduction in communities by promoting or sponsoring "Clean Community Campaigns".</li> </ul> </li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact after management</b>	Medium term	2	Project area	2	Minor benefit	2	Possible	2	8	Moderate benefit	Medium

### Vulnerabilities and Spatial Effects of Impacts:

Communities located in proximity to mining areas, the MSP and haul roads are at risk for increased malaria transmission due environmental changes. In addition, communities that may be impacted by influx are also at risk, with PACs at risk summarised in the table.

Children, pregnant women and people with a lowered immune system are particularly vulnerable to malaria. No specific gender risks are anticipated.

Malaria and associated determinants	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No



### 7.2.2.2 Arboviral and other Vector-related Diseases

#### Health Issues/ PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - Arboviruses are poorly described, but diseases such as dengue, yellow and chikungunya fevers are emerging and represent significant public health threats; and
  - The Districts in SR Area1 are considered as low risk zones for the transmission of lymphatic filariasis and onchocerciasis. Human African Trypanosomiasis remains a general threat, but no cases have been recorded for over a decade in the Districts.
- Health system:
  - The weak health service and surveillance system limits the recognition of certain arboviral diseases due to lack of diagnostic capability; and
  - Routine childhood vaccination against yellow fever only started in 2002, with large sections of the population unprotected in the event of an outbreak.
- Contributing factors:
  - The environment is suitable for the transmission of arboviruses, with the vector (the *Aedes* mosquito) likely to be widely distributed.

#### Impact Definition:

- **Direct:**
  - Transport corridors:

There is the potential for arboviruses to be introduced into SR Area1 through goods and equipment (especially items that can hold water such as tyres) that are shipped from endemic areas (China and South-East Asia). Infected larvae and eggs may be transferred in these goods, with the emerging mosquito vector able to transmit disease immediately as the virus can be transferred through infected eggs. The Port area is specifically at risk as goods may be transferred at this location, but goods shipped from other areas (such as Freetown port) also pose a risk.
  - Environmental management:

The *Aedes* vector prefers to breed in man-made containers. A number of suitable breeding sites were noted on site, such as equipment laydown yards. However, suitable breeding sites were also noted in the surrounding communities.

- **Indirect:**

- Project induced influx:

Movement of people from areas where arbo-viral diseases are circulating may result in the local introduction of the disease. This potential risk is present regardless of the presence of the Project, but increased migration of people due to the Project exacerbates the risk.

In addition, unplanned development and poor environmental hygiene conditions may lead to the increase in mosquitoes, with a potential risk for disease transmission.

### Impact evaluation and management measures:

EHA # 2		Arboviral and other vector related diseases									
Operations											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Possible	2	10	Moderate negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>• Include vector control measures in the proposed integrated workplace vector control programme but ensure a focus for <i>Aedes spp.</i> control. This can include source reduction where water may collect (tyres, lay down yards etc.) with environmental controls the main intervention (draining water or preventing collection) and chemical larval controls may also be considered as required.</li> <li>• Include the potential transmission of arbo-viral disease in the proposed outbreak preparedness and response plan. This is especially important for yellow fever as it can mimic other viral haemorrhagic fevers, such as EVD.</li> <li>• Influx management plan.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>• As part of the entomology study proposed in section 7.2.2.1 include screening for other species that have the potential to transmit disease and develop vector control actions based on findings.</li> <li>• Develop capacity in the workforce to diagnose and manage suspected or confirmed cases of arbo-viral disease.</li> <li>• Based on the threat of a (or a confirmed) yellow fever outbreak, vaccinate the workforce. This will require collaboration with the National or District health authorities.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>• Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>○ Based on the threat of a (or a confirmed) yellow fever outbreak support the local authorities in vaccinating the community at risk.</li> </ul> </li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact after management</b>	Medium term	2	Localised	1	Minor negative	2	Unlikely	1	6	Minor negative	Medium

### Vulnerabilities and Spatial Effects of Impacts:

PACs located in proximity to the Port and those who may be impacted through influx are at an increased potential risk. Communities at the Port site are also vulnerable to the potential 'importation' of infected mosquitoes.

There are no specific vulnerable groups and no specific gender risks are anticipated.

Arboviral diseases	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	No	Yes	No	No	No	No

### 7.2.3 EHA #3 – Soil-, Water- and Waste-related Diseases

#### Health Issues/ PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - Diarrhoeal disease is reported in the top five causes of morbidity in Moyamba District and the peripheral health units in SR Area1;
  - Typhoid fever is endemic, with it reported as the second most common condition seen at the SRL clinic. Due to limited diagnostics it may be over-reported;
  - Cholera outbreaks occur sporadically (last one in 2012), with the districts and especially SR Area1 considered to be at high risk for potential future outbreaks;
  - Soil transmitted helminthiases, or parasites, were common in the Districts, and
  - Bilharzia does occur, but the risk is low.
- Health system and institutional capacity:
  - SRL supported the development of water well and latrines prior to the civil-war, but these have either not been maintained or were damaged, so the majority are no longer in use;
  - There is limited capacity in the District authorities to support access to improved water, sanitation and hygiene services. This includes health education and health promotion activities;
  - There is limited capacity in the community to support the development or maintenance of water and sanitation services, and
  - Moyamba District is implementing initiatives to improve sanitation coverage including sensitisation and modelling of low cost latrine structures.
- Contributing factors:
  - Poor access to safe drinking water and inadequate sanitation is listed among key public health risk factors in the Districts, as the majority of households don't have access to improved sources/services;
  - The sources of, and access to, drinking water varied between communities. The relatively large Moriba Town was reported to have a single functional borehole, with a number of villages reporting non-functional ground water sources;
  - Only Matagelema reported using mine pond water as a drinking water source. Other communities reported to using the mine ponds purely for domestic purposes (bathing and washing clothes);

- Very few households have access to improved sanitation services and open defaecation is common. Access to latrines is better in more urban settlements (Moriba Town, Mogbwemo, and Matagelema) but poor in more rural communities (no toilet facilities in Gangama and only two latrines in Foinda);
- Disposal of household waste/ refuse is a major problem, and
- The general hygiene and sanitary situation in both Moriba Town and Mogbwemo is poor.

**Impact Definition:**

Access to a safe water supply is regarded as a basic human right and the PACs are sensitive to impacts on water availability and quality. The following potential direct and indirect impacts are considered:

- **Direct:**

- Water quality associated with Project activities:

The potential impacts related to water quality due to Project activities are discussed in section 7.2.9.4.

- Workplace impacts:

There is the potential for activities in the workplace and from the workforce to impact on water, hygiene and sanitation conditions in the communities:

- Chemical and hydrocarbon spills from workshops or from accidents while transporting goods;
    - Potential pollution of surface and ground water sources from inadequate sewerage management or inappropriate discharge of waste water from sewerage treatment plants;
    - Poor garbage and waste management, and
    - Indiscriminate defecation and urination of the workforce due to inadequate or available facilities.

- Reduced access to water:

Access to surface water or superficial ground water sources that were used traditionally may be impacted due to mining activities resulting in an increase distance and time to collect water in certain communities.

- Physically resettled communities:

Communities that have been physically resettled to allow for mining activities may have reduced access to water and sanitation services in their host sites. This is especially relevant where water and sanitation services have not been maintained after the resettlement process. Future physical resettlement planning will need to consider access to these basic services.

- **Indirect:**

- Mine ponds:

The mine ponds are mainly used for domestic purposes with the potential that people urinate or defecate in the water body. This has the potential to promote the localised transmission of bilharzia, noting that SR Area1 is located in a low risk area.

- Project induced influx:

Influx into SR Area1 and an increased population size has placed pressure on the already limited water, sanitation and waste management services due to an increased demand. This has resulted in poor environmental health and hygiene conditions such as open defecation and inadequate garbage management. The PACs who have experienced the bulk of influx are most susceptible to these impacts.

These factors have the potential to increase water, sanitation and hygiene related diseases including diarrhoeal disease (e.g. dysentery, cholera and typhoid outbreaks), intestinal parasites (especially hookworm), as well as skin (scabies, fungal infection) and eye infections.

- **Benefits:**

While it is difficult to quantify, the development of the Project has potentially led to an improvement in water and sanitation services in the broader area. This is due to economic development, but also due to the direct support in the provision of improved water sources and latrines by SRL. However, these gains may have been offset by the impacts associated with influx.

**Impact evaluation and management measures:**

EHA #3		Soil, water and waste related disease									
Operations through to closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Probable	3	11	Moderate negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>As per management measures in section 7.2.9.4 and the specialist water studies conducted for the ESHIA.</li> <li>Ensure adequate water supply and sanitation services in groups that will be physically resettled in the future as part of the resettlement action plan.</li> <li>Where relevant and possible, revisit communities who were historically resettled and review their current access to water, hygiene and sanitation services. Based on findings review support options, with any interventions supported by a sustainability element.</li> <li>Review statistics on bilharzia in local clinics and health posts to determine if there are any trends in burden of disease in communities that are closer to mine ponds.</li> <li>Consider conducting baseline studies to determine the burden of disease from bilharzia and soil transmitted helminths.</li> <li>Consider conducting baseline studies to determine the water quality at household source and end-user based on biological indicators (presence of coliforms and faecal coliforms).</li> <li>Influx management plan</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Effective controls to prevent spills or leaks from chemicals or hydrocarbons, including during transport.</li> <li>Ensure that accommodation camps and all work areas have adequate potable water facilities, sanitation services and the ability to maintain good personal and hand hygiene. This must include the provision of adequate facilities for workers who are in remote areas to prevent indiscriminate defaecation.</li> <li>Ensure proper disposal of human waste through the selection and proper management of sewerage treatment plants, with these facilities having the capacity to manage the expected throughput with adequate contingencies (such that if there is a failure, that the risk of direct exposure to communities and their water sources is minimised).</li> <li>Develop Information Education and Communication (IEC) campaigns in the workforce on proper water use, hygiene and sanitation.</li> <li>Ensure effective garbage management from camps and work areas as per waste management recommendations.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>Consider developing a partnership with the District water utility and the DHMT to support integrated water, sanitation and hygiene programmes in SR Area1.</li> </ul> </li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact after management</b>	Medium term	2	Project area	2	Minor benefit	2	Possible	2	8	Minor benefit	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

Impacts associated are likely to be experienced in specific areas, viz.: i) where influx has occurred; ii) where mining/Project activities are on-going; and iii) in communities that have and may be physically resettled. Children, the elderly and chronically unwell may be disproportionately affected by water and sanitation related conditions. No specific gender risks are anticipated.

Access to potable water sources/safe drinking water and sanitation services/general hygiene	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	No	Yes	Yes	No	No	No

## 7.2.4 EHA #4 – Sexually-transmitted Infections and High Risk Sexual Practices, including HIV/AIDS

Mining and construction projects have a well-described legacy of increasing the transmission of Sexually Transmitted Infections (STIs) due to altered social and economic determinants. To address this potential issue, the United Nations Development Programme released a guidance note to promote the linkages between health and the environment as part of EIAs [196].

### Health Issues/ PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - In 2015, the national HIV prevalence is 1.25% [24]. This is above the WHO threshold of 1%, defining the epidemic as a public health emergency [30]. Nationally, the prevalence is higher in women (1.7%) than men (1.3%), and higher in urban (2.3%) compared to rural areas (1.5%) [24];
  - A 2010 study found the following key population groups at high risk for HIV transmission; i); sex workers; ii) clients and partners of sex workers; iii) men who have sex with men; and iv) people who work in the mining sector [30];
  - A 2012 study conducted on HIV prevalence and behaviour by SRL and the National HIV/AIDS Secretariat (NAS) in SR Area1 found [138]:
    - The HIV prevalence is disproportionately high at 2.4%, and
    - The area is a high-risk environment for the transmission of HIV and STIs due to opportunities for multiple sexual partnerships, commercial and transactional sex work and poor condom use.
  - Data on the burden of disease from STIs was limited, with a 2013 study reporting that 18% of women and 11% of men in Bonthe respectively; and 17% of women and 18% of men in Moyamba, respectively; experienced an STI or related symptoms/signs during the 12 months preceding the study [24];
  - The increasing trend of HIV is mentioned as significant public health concern in both Districts. This is despite prevalence being similar to national figures (~1.3%), but localised areas of concern were noted:
    - The Moyamba DHMT considered SR Area1 ('mining areas') as a 'hot-spot' for HIV transmission. It is reported that the prevalence of HIV and STIs were significantly higher than in the rest of the district, and
    - This is supported by the Bonthe DMO who considered the area around Moriba Town as a high-risk area as it was a 'mining town' (see contributing factors below).

- STIs were also a concern, with the Moriba health post reporting urethral discharge diseases (generally gonorrhoea) in the top 5 diagnoses in adults who presented to the clinic.
- SRL programmes and response:
  - SRL has a policy on HIV/ AIDS in the workforce and initiated programmes in 2006;
  - SRL is partnered with the NAS and a portion of the SRL clinic is a registered HIV/AIDS control programme centre;
  - Despite good relationships, there is limited insight or involvement of the clinic or community relations staff in the NAS programme, planned activities, metrics, challenges etc., and
  - Data from HIV tests conducted by the NAS at the SRL clinic on the mine workforce (including contractors) show that the HIV prevalence is about 3-4%, significantly higher than National or District rates.
- Health system:
  - There is limited uptake of testing for HIV due to stigma;
  - Health seeking behaviour for STIs is not ideal, with it reported that patients preferring to seek treatment from street pharmacies or THs. Inadequate treatment may result. Contact tracing for sexual partners is also a challenge;
  - There is better uptake of HIV testing during antenatal care as part of prevention of mother to child transmission, but access to antenatal and delivery services may limit these programmes, and
  - There are limited IEC and Behaviour Change Communication (BCC) programmes in the communities, and no proactive condom distribution programme.
- Contributing factors:
  - Key stakeholders reported the following contributing factors for the relatively high of burden of HIV and STIs in SR Area1:
    - Sex is sold for material gain, especially in the bigger towns of Moriba Town, Mogbwemo, and Matagelema;
    - Cultural practice of polygamy- more common in the Muslim sector of the community;
    - Multiple sexual partnerships;
    - Mining areas promote influx of people and an increase in commercial or transactional sexual activity;
    - Bars and restaurants were areas where high risk sexual encounters were initiated, and
    - Poverty and ignorance of the community, limiting safe sex behaviours.



- Responses from the FGD support comments from key stakeholders including:
  - Commercial sex work was common. Money in the area attracted women;
  - Transactional sex is also common. Women from Moriba Town, Mogbwemo and Matagelema indicating that it is common for men to ‘pay for sex’, with women in more rural communities reporting that men generally give women ‘a token of their appreciation’;
  - Women in the area target men who work on the mine as they have money;
  - Polygamy is very common and generally an accepted cultural practice, and
  - Condom use is generally low.

### Impact Definition:

The historical presence of the Project has indirectly influenced transmission patterns of STIs, and has the potential to do so in the future in the following indirect ways:

- **Indirect:**

- Mobility and transport corridors:

Transport workers, especially long-distance truck drivers are a well described high risk group, commonly termed “core-spreaders”. This is due to the potential for them to develop sexual networks along transport corridors and especially at truck stops or areas where they commonly overnight. However, the risk for transport workers is not limited to long distance truck drivers, but also includes local transport workers, and drivers of light duty vehicles.

The transport corridor from Freetown and along the access route from Moyamba junction is a potential high-risk transport corridor. In addition, there is no dedicated truck stop for supply vehicles to the Project Area, with truck drivers generally overnighing in the larger towns (Moriba Town and Mogbwemo) due to the availability of accommodation, food and recreational services in these communities. These are likely to represent high risk areas as sex workers may target the drivers as they are generally male, single<sup>7</sup> and have disposable income. In turn, the drivers may also seek out sexual encounters, potentially targeting local women and young girls, with these encounters often transactional in nature.

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<sup>7</sup> This can include a geographical single status as the individual is often away from their usual partner, but may also include those individuals that do not have partners in other areas.

○ Population migration and mixing:

The nature of the Project supports the movement of people in and out of the area. Mixing of people, especially those who have higher rates of STIs and HIV than the local population, may give rise to increased rates of disease transmission. Groups may include:

- The workforce who are contracted from outside of the Project area and rent accommodation in the local community. They are generally hired on a single status basis or do not bring their families with them due to the lack of basic services locally. This group are at risk to engage in casual sexual relationships as they are away from their family unit, have disposable income and are targeted by sex workers, or seek out relationships with local women (often transactional);
- Influx of opportunity seeking migrants, and
- Influx of commercial sex workers looking for local opportunities, especially around periods when people are paid.

○ High risk groups and areas:

High risk areas include single accommodation facilities as well as restaurants, taverns etc. where food and entertainment facilities are provided. These areas may attract sex workers, and women who work in these establishments are especially vulnerable to transactional sexual advances from men. Bars, taverns and other areas of entertainment are likely to be more frequented by those with disposable income, with those that benefit directly and indirectly from the Project more likely to be patrons.

The bulk of the mine and contracted workforce are male, with men more likely to engage in high risk sexual encounters. Due to the cultural / social standing of women, they are locally vulnerable, and it may be challenging for women to negotiate safe sex practices such as the use of condoms, resulting in casual sexual encounters, that are more likely to be high risk in nature. Women are also physiologically more vulnerable to contracting STIs and HIV.

○ Burden on public health services:

An increased burden of disease from STIs and especially HIV may extend the already limited public health care service. HIV is essentially a chronic disease that requires regular follow up and long-term care and treatment, with the increased burden to deliver these services adding to the human resource and financial resource requirements.

○ Workplace and company reputational risk:

The workplace health risk related to HIV/AIDS and the impacts on business from a health, productivity and business resilience perspective have been well described. In addition, there is a potential reputational risk for SRL that the Project may have led to increased rates of STIs and HIV.

These should prompt interventions both from a workplace and community perspective.

### Impact evaluation and management measures:

EHA #4	High risk sexual practices, STIs including HIV/AIDS										
Operations and into post closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
Impact before management	Long term	3	Regional	3	Major negative	8	Definite	4	18	Critical negative	High
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>As part of the proposed communicable disease strategy and plan, review the HIV policy and plan to ensure it is meeting the potential risks and the needs of the Project.</li> <li>SRL should review their partnership with NAS and become more involved with activities and review effectiveness of interventions. As part of the review consider upgrading IEC and BCC interventions; support effective care and treatment; undertake baseline surveys and develop metrics to design and track interventions to review if they are effective.</li> <li>Target specific interventions in the sector of the workforce that is hired from outside the Project area to reduce risks where rental accommodation is most commonly sourced. Interventions can include IEC and BCC programmes as well as distribution and social marketing of condoms to the workforce and community.</li> <li>Develop strategies and interventions to limit the development of transactional sexual relationships in both the workforce and the community. This can consider IEC programmes and the development of codes of conduct. These codes of conduct should be extended to include potential fraternization within the workforce (towards female cleaning/ catering staff).</li> <li>Develop HIV and STI prevention strategies and interventions for transport workers, especially long-distance truck drivers. These may include IEC and BCC programmes as well as condom distribution interventions.</li> <li>Identify 'hot-spots' in communities where high risk sexual encounters are likely to originate from and develop targeted interventions at these locations (for e.g. bars/taverns/nightclubs, guesthouses, truck stops, road junctions and markets etc.).</li> <li>Work with contracted transport companies to reduce the number of trucks that overnight in the immediate area around communities such as Moriba Town, Mogbewa, Mogbwemo and Mataglema. Administrative controls should support the driving in and delivery of loads to limit the amount of time that trucks spend in the Project area where this is possible.</li> <li>Develop a contractor management plan to support these strategies in the contracted workforce, with effective enforcement and monitoring to track compliance as relevant.</li> <li>Develop and implement an influx management plan.</li> <li>Consider developing women and young girl support programmes to support the decision-making capacity of local women so that transactional sex is limited as a means of livelihood and improve their ability to negotiate for safe sex.</li> <li>Develop self-help groups in the local community, driven by community health officers to conduct IEC programmes and promote behaviour change, support access to care and treatment of STIs and support for groups living with HIV.</li> <li>As part of the CHMMP, develop a monitoring system for specific health indicators related to STIs and HIV.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Promote HIV counselling and testing in the workforce through various means, with support to accessing and initiating care and treatment and thereby promoting HIV and STI prevention. These will need to be supported by the NAS, with the</li> </ul>											

SRL clinic staff involved in care and treatment as well as adherence monitoring. SRL should aim to meet the 90:90:90 target<sup>8</sup>.

- Support widespread availability and social marketing of condoms in the workplace.
- Develop a blood borne pathogen control procedure in the SRL clinic and for the emergency response team that includes prevention practices for exposure to blood (e.g. needle stick injuries) and provide post exposure prophylaxis as required.

#### **Social development mitigation and management:**

- Consider voluntary contributions as part of the CDA, including the following options:
  - Support health systems strengthening of HIV and STI initiatives in the Project area in partnership with the DHMT and NAS.
  - Increase the capacity of community health officers in the PACs as a resource to extend programme interventions.

	Consequence/Effect					Probability/Likelihood	Total Score	Overall Significance	Confidence		
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact after management</b>	Long term	3	Regional	3	Moderate negative	4	Possible	2	12	Moderate negative	Medium

#### **Vulnerabilities and Spatial Effects of Impacts:**

The impacts associated with transmission of STIs and HIV will be experienced in all PACs in some form, with impacts more prominent in communities where influx is experienced, where rental accommodation is more common and those closer to the mine accommodation camps. The impacts in PAC7 and PAC8 will be less marked, and PAC 4 and 9 will have associated transport corridor risks.

Women and young girls are specific vulnerable groups.

	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
<b>High risk sexual practices, STIs including HIV/AIDS</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

<sup>8</sup> The 90:90:90 target aims to address HIV transmission by setting the target that 90% of all people living with HIV will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained ART, and 90% of all people receiving ART will have viral suppression (measured by CD4 and viral load)

## 7.2.5 EHA #5 – Food- and Nutrition-related Issues

### Health Issues/ PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - A 2015 study found that >50% of the national population are food insecure. Only 8.9% and 5.5% of the population in Moyamba and Bonthe Districts, respectively, were reported to be food secure [93];
  - In the KSIs, both the Bonthe DMO and the Moyamba DHMT reported that malnutrition is a key challenge in their Districts. The Bonthe DMO reported that the District had limited data on the burden of disease due to malnutrition, but as he was concerned about it, he is considering commissioning a study to evaluate possibly causes;
  - Stunting (as an indicator of chronic malnutrition) in Bonthe District is 41%, significantly above the national (38%) and Moyamba District level (33%) [24];
  - Wasting (as an indicator of acute malnutrition and a proxy for food insecurity) in Moyamba District at 9.8% is similar to national levels (9.3%), but Bonthe is significantly lower at 3% [24];
  - Anaemia (as a micro-nutrient indicator) in children < 5 years is higher in Moyamba District (85.4%) compared to Bonthe District at 79.4%, with national levels at 80% [24]. KSI from Bonthe DMO and the Moyamba DHMT reported anaemia to be common, and that it often presented as a complication with other conditions (malaria), and
  - The SRL clinic reported that cases of malnutrition were rare, but this was not surprising as the children they generally see are dependents from the workforce, so there is adequate income to follow a balanced diet.
- Health system:
  - The Moyamba DHMT reported that 70 of the 102 health facilities in the District had the capacity to recognise and manage cases of malnutrition;
  - Growth monitoring is routinely done for children up to the age of 5 years and attendance is generally good for those that have reasonable access to healthcare services. No outreach nutritional surveillance is conducted;
  - There is inadequate data on nutritional indicators in the Project area, and therefore it was not possible to determine how nutritional indicators have changed in the area over time, and
  - Ready to use food supplements were supplied to children recognised as malnourished or as vulnerable to develop malnutrition.

- **Contributing factors:**
  - Inadequate dietary intake, with respondents from the FGD reporting that in general they do not have sufficient food for their household, with scarcity of food worse from July to September;
  - Poor dietary variation due to limited variety of food products and cultural feeding practices;
  - Lack of education and awareness on good feeding practices;
  - Lack of available land that is suitable for farming;
  - The FGDs reported that subsistence crop farming and small-scale fishing is the main form of livelihood for those not employed or benefiting from the mines. Hunting is practiced but has reduced as bush-meat is less available, expensive and there is less demand after the EVD outbreak, and
  - Participants in the FGDs also reported that food inflation is significant and limited their ability to support a balanced diet.

### **Impact Definition:**

The Project may have a potential impact on nutritional determinants in the following direct and indirect ways:

- **Direct:**
  - Resettlement and economic displacement:

The social baseline will discuss this in more detail, but there is the potential for economic displacement and physical relocation of households to impact on agricultural practices and access to natural resources. This may have a potential impact on livelihoods and food security. This is particularly important in the community of Foinda as it may be relocated in the future.
  - Environmental changes:

Historical mining activities have created large mining ponds that have reduced access to potential arable land that could be used for agriculture. While these ponds are on the SR Area 1 mine concession area, the fact that the 'mine is in the community and the community is within the mine' creates challenges, when access to land to support subsistence agriculture is central to local livelihoods.

Alteration of the environment due to mining and reduced access or displacement to areas that provided natural resources (fishing and gathering of natural food products) may also play a role in food security.

- **Indirect:**

- Economic development and change of traditional practices:

Economic development due to the presence of the Project may impact on food security and nutrition through:

- Food inflation as discussed below, and
- A shift of traditional practices away from agriculture in people who are, or may have been, employed by the Project, or derive an income through indirect benefits. On closure, or if employment benefits stop for whatever reason, it may be challenging for the person / family to return to subsistence / small scale farming as a form of livelihood. This is compounded by limited access to arable land.

- Project induced influx:

Project induced influx may influence food security and nutrition in a number of ways:

- Supply and demand economics may influence food inflation and increase the cost of basic food stuffs. It is noted that some aspects of food inflation are influenced by external factors, such as currency devaluation and poor supply chain due to the poor road network and transport. Vulnerable groups may be more susceptible to these escalating food prices;
- Continuing pressure that may lead to overexploitation of natural resources; for example, fish, plant products in the forest and even bush-meat, and
- Limited access to land for farming, especially in larger settlements due to lack of space and availability of arable land.

- Infectious disease burden:

Malnutrition plays an important comorbid role in infectious diseases, especially in children (e.g. pneumonia, TB, malaria and HIV). They are more likely to acquire infections through low levels of inherent resistance and potentially die from common childhood illnesses like diarrhoea and respiratory infections. Therefore, any increase in these conditions due to direct and indirect Project activities (described in other EHAs) may be influenced by, or influence, malnutrition.

- **Benefits:**

- Economic development:

The direct and indirect benefit of the Project has improved the economic situation in SR Area1, more broadly into the surrounding Districts, and even nationally. Food security at the local level has been improved by:

- Employment with SRL and the ability to afford food products;
- Indirect employment opportunities due to the presence of the Project;
- Improved local purchasing power with the creation of markets where people can buy and sell goods, and
- Improved access to markets and traders through better transport corridors. The enables selling of products as well as a greater variety of food products.

### Impact evaluation and management measures:

EHA #5	Food and nutrition related issues including access to land and food security										
Operations, into closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Probable	3	11	Moderate negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>• Evaluate opportunities to support farming ventures in the Project area to offset the loss of land through the SRL Agricultural Development Fund. This should focus on food crops, with the type of crop chosen to support local demand, access to markets and promote food security.</li> <li>• Effective resettlement planning and execution that considers access to arable land and support of farming as a key livelihood. This will be addressed in more detail in the social impact assessment.</li> <li>• In partnership with the respective DHMTs, perform a baseline nutritional indicator survey and develop a surveillance system to monitor changes in important nutritional indicators.</li> <li>• Develop an influx management plan.</li> <li>• Monitor inflation trends of essential foodstuffs by conducting market surveys, or similar, and as part of this monitor vulnerable groups. As required and in partnerships with the DHMTs and health development partners, support these groups to avoid local cases of malnutrition.</li> <li>• Develop and implement a communicable disease strategy and plan as per previous sections.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>• Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>○ Support programmes that promote local farming practices to increase yields through improved farming techniques, with the focus on food crops.</li> <li>○ Support livelihood practices and economic development in women, and especially in young girls to prevent them dropping out of school. Educational attainment in women promotes better child care and nutrition.</li> <li>○ Evaluate possible interventions to manage local food inflation, by for example supporting access to local markets for locally grown products.</li> </ul> </li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact after management</b>	Medium term	2	Localised	1	Minor benefit	2	Possible	2	7	Minor benefit	Medium



**Vulnerabilities and Spatial Effects of Impacts:**

The direct impacts associated with physical resettlement and economic displacement are more localised to specific communities or households. However, environmental changes and indirect impacts will be experienced across the broader Project area, with certain PACs more likely to be impacted than others (for example those who have been impacted by influx). Impacts are less likely to be experienced in the transport corridor and in some of the more remote communities.

No specific gender risks are anticipated. Vulnerable groups will include those who are exposed to food inflation (poor, elderly, women and child headed households) and those without access to land or an alternative livelihood.

	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
<b>Food and Nutrition</b>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No

## 7.2.6 EHA #6 – Non-communicable Diseases

### Health Issues/ PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - Hypertension and cardiovascular disease contribute significant to the national burden of disease, with strokes and ischaemic heart disease ranking among the top 10 causes of deaths [33];
  - The national prevalence of hypertension is estimated at 36% in both males and females [96], with another study reporting a national prevalence of 47% in adults >20 years of age [99];
  - The prevalence of diabetes is estimated at 2.4%, nationally [101];
  - There is a lack of data on the burden of disease of NCDs at District(s) level, with key stakeholders reporting these conditions as an emerging health challenge, with hypertension especially prevalent with an increasing trend. Diabetes is less common, but the peripheral health units have no diagnostic tools, so cases may not be recognised and therefore under reported, and
  - The SRL clinic reported that hypertension is especially common, with an increasing trend, and that diabetes is an emerging concern.
- Health system:
  - Key stakeholders reported that the health system is poorly capacitated to address the emerging challenge from NCDs, including:
    - Poor health education and awareness in the community limits health seeking behaviour and the early recognition of these conditions;
    - There are no outreach health screening activities to actively diagnose conditions like hypertension and diabetes, which are often asymptomatic until complications present;
    - Diagnostic tools were not routinely available in peripheral health units;
    - Treatment and follow up is a challenge in peripheral health units, limiting effective clinical care;
    - There is limited ability to diagnose and treat any form of cancer in the District(s), and
    - There is limited capacity to support health promotion / prevention activities.
- Contributing factors:
  - Key stakeholders attributed the increased trend of NCDs to changes in lifestyle and stress, but also to excessive alcohol consumption, and
  - Obesity is a noted concern from the SRL clinic.

**Impact Definition:**

The Project may impact NCDs in the following ways:

- **Direct:**

- Impacts of NCDs on the workforce

A well worker effect<sup>9</sup> with an increase in modifiable risk factors related to change in lifestyle (eating habits, sedentary practices and smoking etc.) has the potential to increase the risk for the development of hypertension, diabetes, cardiovascular diseases and even some cancers. This poses a significant business risk in a similar manner to HIV/AIDS.

- **Indirect:**

- Increased disposable income with current lifestyle practices:

Improvement in the local economy due to direct and indirect Project benefits has supported better socio-economic conditions with a likely increase in life expectancy. This supports a transition to a more “urbanized” lifestyle with causal factors potentially predisposing sectors of the community to an increase in lifestyle related diseases such as obesity, hypertension, diabetes, dental caries and some forms of cancer.

- Impact on the health system:

The local public healthcare system is poorly resourced to manage any increase in the burden of disease from NCDs. This includes financial capital in terms of the supply of chronic medications and cost to manage complications, and human capital in terms of skills and adequate numbers of medical staff to deal with the increased case load and long term follow up of patients.

Referral of patients from the SRL clinic to the public sector has the potential to place an added burden on this already over-stretched service.

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<sup>9</sup> A well worker effect is the improved socio-economic status and profile that an individual or family can develop due to earning of a stable and living wage. The ‘well workers’ often have a better health profile than members in the same community who have not benefited in the same direct way.

**Impact evaluation and management measures:**

<b>EHA #6 Non-communicable diseases linked to life style changes and demographic changes</b>											
<b>Operations into post closure</b>											
	<b>Consequence/Effect</b>						<b>Probability/Likelihood</b>		<b>Total Score</b>	<b>Overall Significance</b>	<b>Confidence</b>
	<b>Temporal Scale</b>		<b>Spatial Scale</b>		<b>Severity of Impact</b>						
<b>Impact before management</b>	Long term	3	Project area	2	Moderate negative	4	Possible	2	11	Moderate negative	Medium
<b>Management Measures</b>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Initiate wellness programmes in the workplace.</li> <li>Evaluate opportunities to reduce modifiable risk factors as part of the wellness programme including; i) management of the type of food and size of portions in company canteens; ii) smoking cessation; and iii) exercise programmes etc.</li> <li>As part of the occupational health programme screen for hypertension and diabetes as a health promotion intervention.</li> <li>Ensure the SRL clinic is capacitated to effectively manage NCDs as far as possible. Referrals should be to at least level two facilities.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options (with possible extension to impact mitigation): <ul style="list-style-type: none"> <li>Evaluate opportunities for health systems strengthening with the DHMTs to address the emerging threat from NCDs, especially hypertension and diabetes.</li> <li>Consider supporting IEC programmes in schools and other sectors to support health promotion and prevention activities. This should again be conducted in collaboration with the DHMTs.</li> </ul> </li> </ul>											
	<b>Consequence/Effect</b>						<b>Probability/Likelihood</b>		<b>Total Score</b>	<b>Overall Significance</b>	<b>Confidence</b>
	<b>Temporal Scale</b>		<b>Spatial Scale</b>		<b>Severity of Impact</b>						
<b>Impact after management</b>	Medium term	2	Project area	2	Minor benefit	2	Possible	2	8	Moderate benefit	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

The impacts associated with NCDs will be experienced broadly in the Project area but will be more marked in communities where economic activity has increased the most, or in areas where people have benefitted from the Project. Remote communities and communities in the broader transport corridor will be less affected. There are not likely to be specific gender impacts.

<b>NCDs linked to life style and demographic changes</b>	<b>PAC 1</b>	<b>PAC 2</b>	<b>PAC 3</b>	<b>PAC 4</b>	<b>PAC 5</b>	<b>PAC 6</b>	<b>PAC 7</b>	<b>PAC 8</b>	<b>PAC 9</b>
	Yes	Yes	Yes	No	Yes	No	No	No	No

## 7.2.7 EHA #7 – Accidents/Injuries

### 7.2.7.1 Road Traffic Accidents and other Accidental Injuries

#### Health Issues/ PAC Vulnerabilities:

Key findings include:

- Burden of disease:
  - While data is limited, it is estimated at 8% of deaths nationally are due to accidents [33, 96];
  - There is limited data on injuries and deaths due to road traffic accidents nationally, with anecdotal evidence suggesting that these were common with an increasing trend [111];
  - Key stakeholders reported that:
    - Road traffic accidents were more common in SR Area1, than in other areas in the District(s). This was due to a better road network, a higher volume of traffic and more pedestrians on and along the road reserve;
    - Road traffic accidents involving motorcycles were common, with children an especially vulnerable group for pedestrian vehicle accidents;
    - Accidents involving motor vehicles were less common, but probably due to the low ownership of cars and a low traffic density;
    - Domestic violence is a common form of injury. The community health centre in Moriba Town reported that 5-6 cases of assault were registered every month. Participants in FGD considered that 'wife beating' and general assault is a significant local issue;
    - Few cases of drowning or near drowning were reported, but stakeholders consider the mine ponds as a risk area as there is unrestricted access to the public, and
    - There was no mention of boating accidents with Project vessels along the Sherbro River.
  - No data is available on road traffic accidents involving the community and SRL vehicles.
- Health system:
  - The public health care system in the Project area has limited capacity to manage accidents and injuries. There is no pre-hospital ambulance service to transport injured people to medical care, and the units were poor capacitated due deal with trauma. Referral to more specialised hospitals is challenging due to distance, lack of an ambulance service and costs, and

- SRL has adequate safety systems in place to prevent over-speeding or poor driving practices in Project vehicles (light duty vehicles, busses, and trucks). In addition, a procedure is in place to collect and stabilise an injured person by the Project ambulance, provision of treatment in the SRL clinic, and as required referred (with costs for referral and treatment paid) to the appropriate hospital. As discussed in section 7.2.12 and the baseline summary, the Bonthe DMO rejected that the procedure is followed in all cases.
- Contributing factors:
  - Poor visibility from dust, especially in the dry season was mentioned as a major factor that contributes to road traffic accidents;
  - The poor road network was mentioned as a contributing factor for accidents;
  - Poor general road safety awareness and practices in both drivers and pedestrians. This includes the use of helmets in motorcycles and adherence to common road laws, and
  - Alcohol is a central factor in domestic violence

### **Impact Definition:**

Risks related to road traffic and other accidents will be addressed in other sections of the ESHIA, but Project activities may influence the risk for accidents and injuries in the following direct and indirect ways:

- **Direct:**

- Accidents associated with Project vehicles:

As the community is located in close proximity to the mining activities and haul roads, there is the potential for accidents to occur between Project vehicles and community vehicles and pedestrians. This includes trucks and other vehicles travelling along haul roads and access roads, including busses and light duty vehicles. The mine access from Moyamba junction and beyond also poses a risk as it is used by both SRL and contracted transport vehicles.

While controls are in place to reduce fugitive dust generated by Project and other vehicles, there is the potential that poor visibility due to dust may lead to an increased risk for accidents.

- Water related accidents in mine ponds:

The presence of old mine ponds poses a risk for drowning or near drowning in the community as they are unfenced and used by the public for various activities.

- Water related accidents due to Port and shipping activities:

There is the potential risk for accidents at Nitti Port and during trans-shipment activities up and down the Sherbro River. Fishing plays an important role in local livelihoods, with the risk that small fishing vessels (boats/canoes) can collide with, or be capsized by, Project related vessels.

- **Indirect:**

- Influx with increased traffic ownership and movement:

Project induced influx and development has increased the number of vehicles on roads, with this likely to continue with local economic development. Growing traffic densities increases the risk for human / vehicle interaction and associated accidents. Motorcycles currently pose the biggest risk, but this may change if the relatively low ownership of motor vehicles changes.

- Crime and domestic violence:

Influx and a change in traditional values and social harmony in sectors of the community have given rise to increased levels of gender based domestic violence as well as common assault. This is more marked in Moriba Town, Mogbwemo, and Matagelema with social ills, such as alcoholism and substance abuse, an important contributing factor.

- Influx with risk of fire in unplanned settlements:

Housing is described in section 7.2.1, with settlements that have experienced influx having housing structures built in an unplanned manner in close proximity to each other. This poses a potential risk for the development of uncontrolled fires that can easily spread to large sections of the community. There are no public fire brigade services.

- **Benefit**

- Improved access roads

SRL has supported the development and maintenance of roads in SR Area1 as well as the access road from Moyamba junction. These roads are generally in far better condition than other public roads and have improved access to the area, which in turn promotes numerous sectoral benefits, but also reduces the potential risk for road traffic accidents.

**Impact evaluation and management measures:**

<b>EHA # 7 Accidents and Injuries in the community, including crime and non-accidental injuries</b>											
<b>Operations to closure</b>											
	<b>Consequence/Effect</b>						<b>Probability/Likelihood</b>		<b>Total Score</b>	<b>Overall Significance</b>	<b>Confidence</b>
	<b>Temporal Scale</b>		<b>Spatial Scale</b>		<b>Severity of Impact</b>						
<b>Impact before management</b>	Medium term	2	Regional	3	Major negative	8	Definite	4	17	Critical negative	Medium
<b>Management Measures</b>											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Review the Project community security and safety management plan to include workplace / community related road traffic accidents as well as fire, rescue and chemical spill response capability, and water rescue efforts for potential accidents in the mine ponds and at port/ transshipment activities. Where possible integrate these with the public emergency response systems.</li> <li>Communicate the plan with stakeholders so there is a clear understanding of what SRL will, and will not do in emergency situations, thereby managing expectations.</li> <li>Consider engineering controls to reduce risks of road traffic accidents and pedestrian vehicle accidents along access and haul roads. These may include traffic calming measures, building of over-passes for pedestrians, dedicated pedestrian or bicycle lanes on roads, etc.</li> <li>Plan shift changes and transport to and from the Project site so that it restricts road travel at night, especially in busses.</li> <li>Support controls on dust suppression so the risk of accidents from poor visibility related to dust are minimized.</li> <li>Support road safety campaigns in SR Area1 and the access route, targeting both roads-users and pedestrians through various media.</li> <li>Consider placing life saving devices at dams to be used in the event of an emergency. Consideration should be given to placing these in areas where a lot of people gain access to the water, or at known high risk areas.</li> <li>Develop an influx management plan.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Effective management of mobile equipment and machinery as part of the Projects health and safety procedures, including fitness to work of drivers, vehicle maintenance and roadworthiness, driver training, drug and alcohol and fatigue management procedures. Include contractor management requirements as part of this.</li> <li>Review or develop social code of conduct procedure for all employees to ensure that violence and other threatening behaviour is not tolerated on the site, or within the broader community.</li> <li>Considerations of the Voluntary Principles of Security and Human Rights for the security department.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>Evaluate opportunities to improve emergency response services in the SR Area1 to include fire services, pre-hospital and referral care.</li> <li>Evaluate opportunities to improve in facility trauma management in both SRL and public health facilities.</li> <li>Extend road safety campaigns.</li> </ul> </li> </ul>											
	<b>Consequence/Effect</b>						<b>Probability/Likelihood</b>		<b>Total Score</b>	<b>Overall Significance</b>	<b>Confidence</b>
	<b>Temporal Scale</b>		<b>Spatial Scale</b>		<b>Severity of Impact</b>						
<b>Impact after management</b>	Medium term	2	Regional	3	Moderate negative	4	Possible	2	11	Moderate negative	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

The impacts associated with accidents and injuries will be experienced in most PACs, with the exception of those with a limited road network, or where influx has been limited. The communities along haul roads and where indirect Project traffic is the highest will be most affected. Communities that will experience influx will be indirectly affected. Children and pedestrians are a specific vulnerable group.

<b>Accidents and Injuries</b>	<b>PAC 1</b>	<b>PAC 2</b>	<b>PAC 3</b>	<b>PAC 4</b>	<b>PAC 5</b>	<b>PAC 6</b>	<b>PAC 7</b>	<b>PAC 8</b>	<b>PAC 9</b>
	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes



### **7.2.7.2 Work related Illness and Injuries**

#### **Impact Definition:**

The occupational health and safety requirements of the workforce are out of scope for the HIA and are anticipated to be addressed as part of the Projects health and safety management plans. These should include applicable contractor management plans.

### **7.2.8 EHA #8– Veterinary Medicine and Zoonotic Diseases**

There is significant outbreak potential for zoonotic diseases nationally. A recent publication, titled 'Emerging Infectious Diseases and HIAs' which was commissioned by the United States Agency for International Development in 2012, addresses the potential threats from wildlife to project development, due to the fact that nearly 75% of emerging infectious disease have an animal origin. The report discusses factors where the extractive sector activities can contribute to the emergence of zoonotic diseases, and activities that are congruent with the Project include [142]:

- An altered environment that may increase human: animal contact;
- Road and corridor development;
- Development of Project accommodation camps;
- Expansion of local communities, and
- Project induced influx.

#### **Health Issues/ PAC Vulnerabilities:**

Key findings include:

- Burden of disease:
  - Viral haemorrhagic fevers are generally regarded as the most significant zoonotic diseases due to their ability to cause severe illness with high mortality rates. EVD and Lassa fever are the viral haemorrhagic fevers of concern nationally [112-114];
  - EVD and the national outbreak is described in Appendix C, with the outbreak also affecting both Moyamba and Bonthe Districts:
    - Moyamba recorded 211 suspected cases, with deaths in three health personnel, and
    - Bonthe recorded five confirmed cases.
    - No cases were recorded in the immediate Project area.
  - Lassa fever is not documented to have recently occurred in the District(s). It is not known whether the reservoir host (rodent) is present, but this is likely given the altered habit due to urbanisation and poor household waste management;
  - Cases of rabies were rare, with dog bites were seen occasionally at the peripheral health units: and

- Other known zoonotic diseases such as brucellosis and leptospirosis are a potential threat associated with the movement and increase in domestic livestock. They are not described locally, but this may be due to diagnostic constraints.
- Health system:
  - The EVD outbreak has improved the capacity to anticipate, detect and manage epidemics. However, there are the concerns that as health development partners wrap up their support and funding that this capacity will be weakened;
  - The EVD outbreak affected the health system and programmes, such as childhood vaccination, which did not function optimally during the outbreak. Health seeking behaviour of the population moved away from the conventional public health sector, with a delay in seeking treatment. This affected morbidity and mortality rates from common conditions (pneumonia, malaria etc.);
  - SRL developed good relationships with the DHMT(s) during the EVD outbreak to proactively address local risk in SR Area1;
  - There is a weak veterinary public health system locally. Dogs are not routinely vaccinated or sterilised, which increases the risk of rabies, and
  - Post exposure prophylaxis for rabies and snake anti-venom were not available in either District(s).
- Contributing factors:
  - Outbreaks of zoonotic diseases are unpredictable and there is limited capacity to detect cases at an early stage;
  - Many factors, such as environmental changes, human and animal demography / migration patterns, changes in farming practices, the consumption of bush-meat as well as human social and cultural factors (burial practices) influence the emergence of zoonotic diseases;
  - There has been a reported increase in the number of stray dogs since the EVD outbreak: and
  - Participants in FGDs reported that they understood the importance of personal hygiene after the EVD outbreak, with some acknowledging that they have stopped consuming bush-meat. However, key stakeholders reported that bush-meat consumption is common again, as was the resumption in traditional burial practices, although gloves are used more commonly as a form of protection.

**Impact Definition:**

Potential Project related impacts may include:

- **Direct:**

- Domestic waste and camp facilities management:

Poor hygienic conditions and ineffective management of especially food waste from mine accommodation and work areas, may attract rodents and other wild animals to the camps, or to the waste management facility / landfill. The localised density of rodents may rise with an increased risk for potential zoonotic disease transmission.

An increased number of rodents may also attract snakes into the area, with an increased potential for snake bites in both the workforce and community.

- Disturbed habit or environment:

Clearing of forest and bush, as well as the disturbance of the environment has the potential to disturb snakes and other forms of wildlife. This may increase human / animal contact in both the workforce and the community in proximity to these activities. This may increase the risk for bites.

- **Indirect:**

- Animal husbandry:

There is limited animal husbandry in and around the Project area, but with changing socio-economic circumstances and migration, ownership patterns of poultry and livestock may change. The weak local veterinary service limits the potential management of livestock conditions that may present as zoonotic disease risks.

- Dogs:

Altered or improved socio-economic conditions may increase ownership or the presence of stray dogs (as was seen, with an increase in stray dogs after the EVD outbreak). With the weak public veterinary health system there is the potential for an increased risk of rabies transmission due to weak vaccination programmes, and for the population of dogs to grow due to the lack of sterilisation services.

- Project induced influx:

Influx and movement of animals with incoming migrants may pose a risk for the introduction of zoonotic diseases locally (that can affect other animals and potentially humans).

Poor sanitation and domestic waste management in settlements that experience the bulk of influx may lead to a proliferation of rodents, with a risk for transmission of Lassa fever and other diseases related to hygiene.

○ Bush-meat:

In-migration, food inflation and pressure on local food sources (especially sources of protein) may increase hunting and consumption of bush-meat. This may pose a risk for the transfer of various zoonotic diseases, including EVD and possibly novel infections.

### Impact evaluation and management measures:

EHA # 8	Zoonotic diseases										
Operations and into closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Medium term	2	Project area	2	Major negative	8	Possible	2	14	Major negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Consider conducting studies with the Lassa Fever Research Centre (in Kenema) to determine the presence of the reservoir host in the general community, accommodation camps and around land-fill / waste disposal sites. If the species is present, it would be beneficial to conduct further studies to determine if rodents are carrying the virus.</li> <li>Implement rodent controls in accommodation camps, work areas and landfill areas.</li> <li>Develop an influx management plan.</li> <li>Support the strengthening of local public health veterinary services, especially vaccination and sterilisation of dogs / cats and vaccination / disease prevention in livestock.</li> <li>Continue to support the DHMT(s) with outbreak preparedness and response as a strategic intervention as discussed in section 7.2.1.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Effective camp facility management to prevent rodents from gaining access to accommodation, kitchens and food / water storage area.</li> <li>Effective waste management practices in all accommodation, work areas and landfills to reduce the risk for pests being attracted or proliferating in these locations.</li> <li>Limit the presence of pets (dogs and cats) in accommodation areas, and if they are present ensure they are properly vaccinated. Dogs that may be used for security should also be appropriately vaccinated.</li> <li>Develop procedures to avoid or avoid the risk of snake bites. Protocols should be developed for immediate first aid and management of snake bites in the SRL clinic (including assuring correct anti-venoms are present).</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>Extend the health systems strengthening support with the DHMT(s) to support outbreak response (as an extension of impact mitigation measures).</li> <li>Work with local authorities to limit the bush-meat trade.</li> </ul> </li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact after management</b>	Medium term	2	Localised	1	Minor negative	2	Possible	2	7	Minor negative	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

With the exception of the communities along the transport corridor, there is the potential for most PACs to be impacted by zoonotic diseases. Those who have experienced influx, have poor sanitation and overcrowding are most at risk. No specific vulnerable groups or gender sensitivities are anticipated.

Zoonotic diseases	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No

**7.2.9 EHA #9 – Environmental Health Determinants****7.2.9.1 Noise**

A noise study was performed to establish a baseline and model potential noise impacts as part of this ESHIA [147]. Key findings for SR Area 1 include:

- The ambient noise is characteristic of a mining area interspersed with rural villages;
- Background noise in communities originates from four main sources:
  - Direct noise intrusion from Project vehicles, mainly trucks, in villages intersected by haul roads;
  - Natural sounds (rain, wind, insects, birds etc.);
  - Noise from community activities (trade, speech, children, music etc.), and
  - Local traffic, which was predominantly from motorcycles. Although motorcycles were noisy, the traffic volumes were generally low and confined to a single road in a village.
- In villages not intersected by haul roads, there was little evidence of audible noise from the MSP, mining or other Project activities;
- Modelling for potential noise impacts concluded:
  - No significant impact is expected on sensitive receptors from noise generated from the MSP, mining, dredging, Nitti Port and excavation operations.
  - There were significant impacts from noise on sensitive receptors caused by trucks passing along haul roads that intersect villages. The first row of houses along these roads experience high levels of truck noise, with impacts of over 5 dB. While this noise is intermittent in nature, occurring every 20-40 minutes, it is likely to cause significant disturbance.

**Impact Definition:**

The physical effect of hearing loss and impairment due to noise exposure is an important workplace occupational health consideration. However, this is not a community health risk as noise

levels required to cause hearing loss only occurs at levels above 85 dB(A), which would be intolerable for any community. However, exposure to lower levels of noise has the potential to cause cardiovascular disease, hypertension and psychological conditions [148-150]. Noise annoyance can lead to stress related impacts on health and general well-being and may have an influence on mood, performance, fatigue and cognition [151]. Sleep can be disturbed by as little as 35dB of noise [151].

While hard to quantify, the communities located along haul roads will experience these potential direct health impacts. The health impacts for these localised communities are ranked below, but the ranking in the specialist noise study must be considered in addition.

#### Impact evaluation and management measures:

EHA # 9	Environmental Noise										
Operations (MSP, mining, dredging, Nitti Port and trucks on haul roads)											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
Impact before management	Medium term	2	Localised	1	Minor negative	2	Definite	4	9	Moderate negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Mitigation measures as per the specialist noise study.</li> <li>Ensure appropriate vehicle and truck maintenance to reduce noise to as low as reasonable practical.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Develop effective occupational hygiene programmes to reduce noise exposures to the workforce.</li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
Impact after management	Medium term	2	Localised	1	Minor negative	2	Possible	2	7	Minor negative	Medium

#### Vulnerabilities and Spatial Effects of Impacts:

Noise impacts are anticipated to occur in communities who are located along haul roads.

Noise	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	No	No	No	Yes	Yes	No	No	No	No

#### 7.2.9.2 Air Quality and Malodours

An air quality study was undertaken to establish a baseline and model potential air quality impacts as part of this ESHIA [152]. Key findings for SR Area 1 include:

- There were exceedances in the World Bank / IFC guideline 24-hour values for particulate matter (PM) including PM10 and PM2.5. The 24-hour PM10 and PM2.5 concentrations were exceeded 16 and 31 times respectively, with all of the exceedances occurring during

the dry season (December 2017.) The sulphur dioxide (SO<sub>2</sub>) or nitrogen dioxide (NO<sub>2</sub>) concentrations were below the respective World Bank / IFC guidelines. It was noted that the majority of the monitoring period was in the wet season, so results were expected to be low. Ongoing monitoring is being conducted;

- Dust fallout was measured in six residential and four non-residential areas. In all locations levels were recorded below the relevant guideline values, but it is noted that the monitoring period was in the wet season, so results were expected to be low;
- Dust fallout was measured in six residential and four non-residential areas. In all locations levels were recorded below the relevant guideline values, except at sample point SRLDM02 (adjacent to Gangama and northwest of the settlements of Lungi and Junctiola) (September and November 2017) and Mogbwemo Village (November 2017) (see Figure 6-1 of the air quality study [152]). It is noted that the monitoring period was in the wet season, so results were expected to be low;
- Sources of potential airborne emissions include:
  - Mining activities resulting in the generation of dust, with PM the main pollutant of concern;
  - Gaseous emissions around the MSP, including from the power plant, MSP dryer and medical waste incinerator at the SRL clinic. Pollutants of concern may include NO<sub>x</sub>, SO<sub>2</sub>, volatile organic compounds and carbon monoxide, as well dioxins and furans from the medical incinerator;
  - Vehicle emissions with potential pollutants including PM, NO<sub>x</sub>, SO<sub>2</sub>, carbon dioxide, carbon monoxide and volatile organic compounds. Project vehicles are mainly diesel powered so diesel PM may be an additional pollutant. Communities who are located in proximity to haul roads are at most risk, with the access road to Nitti Port having a cumulative impact due to activities of VIMETCO;
  - Fugitive dust sources along haul roads in SR Area1, with vehicle entrained dust and dust blown from road surfaces the primary source. PM is the main pollutant of concern. This is especially important in villages that are intersected by haul roads, but dust fall out is mitigated by vehicle speeds, vegetation on the side of roads and the long wet season that suppresses the entrainment of dust;
  - Fugitive dust that is generally windblown from bare or eroded areas. Sources may include tailings, mining areas or agricultural activities;
  - Household fuel combustion, with wood and charcoal the primary sources. Combustion may produce PM and gaseous pollutants (NO<sub>x</sub>, SO<sub>x</sub>, carbon dioxide and carbon monoxide);
  - Charcoal manufacturing with release of carbon dioxide;

- Biomass burning, as part of slash and burn agricultural practices. The incomplete combustion process may cause emission of pollutants including PM, carbon monoxide and NO<sub>2</sub>;
- Medical incinerator located at the SRL clinic. Pollutants of concern may include NO<sub>x</sub>, SO<sub>2</sub>, volatile organic compounds and carbon monoxide, as well dioxins and furans. Although dioxins and furans will be emitted from the medical incinerators, Section 8.5.4 of the air quality study [152] states that, although models were run, due to the low to negligible emission rates, no isopleths could be generated by the model. Hence no results are presented for dioxins and furans in Section 9 of the air quality study. The recommendation is therefore that stack tests be undertaken to determine the concentration of dioxins and furans.]
- An additional source not mentioned in the air quality impact assessment is potential malodours from the landfill and sewerage treatment plants.
- Air quality impacts were considered based on dispersion modelling:
  - With no management measures in place, exceedances in air quality thresholds (PM<sub>2.5</sub> and PM<sub>10</sub>) were anticipated to occur to the southwest of Gangama and Lanti mining areas. Potential sensitive receptors include Foinda, Nyandehun and Kpetema villages;
  - With the exception of Foinda village (due to its proximity to the Lanti mining area), PM<sub>10</sub> concentrations will be below the threshold values after management measures have been implemented;
  - Villages located along haul roads that intersect villages will be impacted by entrainment of dust (PM<sub>10</sub>) without management measures in place. Only Foinda village had PM<sub>10</sub> values above threshold ranges with no mitigation in place. Modelled values of PM<sub>2.5</sub> and PM<sub>10</sub> will fall below threshold ranges with the implementation of management measures;
  - Before management the significance of air quality impacts from dust emissions during the current and planned operational phase was anticipated to be high. The significance drops to low after management measures have been implemented; and
  - No impacts on air quality are anticipated from the power plant, MSP dryer or from the medical incinerator.

**Impact Definition:**

The air quality impact assessment describes the potential impacts in detail and will not be ranked in the HIA.



**Impact evaluation and management measures:**

EHA # 9	Air quality and malodours										
Current operations, and may extend into closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Long term	3	Localised	1	Major	8	Probably	3	15	Major negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>As per mitigation measures proposed in the specialist air quality impact assessment.</li> <li>Develop and implement an influx management plan.</li> <li>Evaluate options for the introduction of efficient stoves to reduce the use of charcoal as a fuel for cooking and improving combustion efficiency to reduce air pollution.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Ensure effective odour control at landfills and sewerage treatment plants.</li> <li>Develop effective occupational hygiene and health programmes to manage exposures to airborne pollutants in the workplace.</li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact after management</b>	Medium term	2	Localised	1	Minor	2	Possible	2	7	Minor negative	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

The spatial effects of air quality impacts are discussed in the air quality specialist study. The communities to the southwest of the Gangama and Lanti mining areas and those along the haul road alignments are most susceptible. Children and people with pre-existing cardio-respiratory disease are especially vulnerable to potential impacts from reduced air quality.

	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
<b>Air quality</b>	No	Yes	No	Yes	Yes	No	No	No	No

### **7.2.9.3 Radiation**

The SR Area 1 operations involve the mining, processing and beneficiation of heavy mineral sands ore bodies, which contain Naturally Occurring Radioactive Material (NORM). The NORM present as radionuclides of the uranium and thorium decay chains. These radionuclides are mainly associated with monazite and zircon minerals and through progressive concentration processes, are upgraded in some of the product and tailings streams.

To support the ESHIA, SRL conducted a Radiological Assessment and Gap Analysis [153] with key findings including:

- Limited data is available on the uranium and thorium content of the ore and tailings streams, as routine in-house X-ray Fluorescence (XRF) analysis is only done on SRL's products, and on some of the tailings materials. Initial indications from a quality control bench-marking exercise, confirmed that the SRL in-house thorium and uranium analysis are biased toward the higher end. Previous studies aimed at characterising tailings materials, have only evaluated gross alpha ( $\alpha$ ) and gross beta ( $\beta$ ) content and to date, no full decay chain radionuclide analysis are available on any of the process streams;
- Potential doses to workers and members of the public from relevant pathways of exposure were calculated using available analytical data. The following was concluded:
  - The largest contributing exposure pathway for workers is from external gamma, followed by dust inhalation. Inadvertent soil ingestion dose (hand-to-mouth), as well as radon inhalation dose, was shown to be negligible contributors to total dose;
  - The estimated total dose to workers at mining and wet concentrator plant operations, was shown to be 0.1 milli-Sieverts per year (mSv/y). For the tailings storage area, Nitti Port and the MSP, the estimated worker doses are 1.2 mSv/yr, 0.7 mSv/yr, and 1.5 mSv/yr respectively;
  - At the MSP and Nitti Port, it was determined that the largest dose from an individual material, would be incurred from exposure to zircon product. At the tailings storage area, the largest dose would be incurred from exposure to Coarse Electrostatic Tailings (CET);
  - All doses calculated for the workforce is an order of magnitude below the annual dose limit of 20 mSv/yr, and in line with the doses measured at Iluka's Australian operations;
  - The estimated total dose for members of the public on roads or in villages close to dry mining, wet mining, wet concentrator plant, MSP, tailings and Nitti Port, is below the public exposure limit of 1 mSv/yr;

- Gamma screening level surveys conducted of the SRL operational areas, confirmed that the areas with the highest gamma radiation exposure are the MSP; the tailings storage area; and Nitti Port;
- The emanation of radon from heavy minerals has been found to be very low and therefore not considered to be significant for workers or members of the public, and
- With respect to other potential pathways of exposure, such as from the ingestion of surface or groundwater by members of the public, is not expected to be significant, but would nonetheless need on-going monitoring and assessment.

### Impact Definition:

While more detailed studies are recommended based on current information it would appear that radiation from mining and processing does not pose a significant risk to community health. This will need to be validated and an updated risk assessment conducted as part of on-going studies.

### Impact evaluation and management measures:

EHA # 9	Radiation										
Operations into post closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
Impact before management	Medium term	2	Localised	1	Minor	2	Possible	2	7	Minor negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>As per mitigation measures proposed in the specialist Radiological Assessment and Gap Analysis [153].</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Continue implementation of workplace controls and monitoring systems as part of occupational hygiene and health programmes for potential exposures to radiation.</li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale	Spatial Scale		Severity of Impact							
Impact after management	Medium term	2	Localised	1	Minor	2	Unlikely	1	6	Minor negative	Medium

### Vulnerabilities and Spatial Effects of Impacts:

Potential sensitive receptors will be discussed in more detail as the radiation risk assessment progresses. Based on current information, there is no exceedance of the annual dose rate for either workers or communities in the vicinity of the operations.

#### **7.2.9.4 Water Quality and Quantity**

Studies to establish a baseline for surface and groundwater as well to model potential water quality and quantity impacts for the ESHIA have been undertaken with longer term sampling being ongoing [154, 157]. The 2012 ESIA also reported relevant data [35]. Key findings included:

- Most villages abstract their drinking water from shallow groundwater sources;
- Groundwater levels are less than 12 meters below ground level (mbgl) and the gradients generally mimic the topography.
- Where challenges in water quality from the groundwater sources have been noted, SRL has constructed additional wells to mitigate any impact on access to water and water quality;
- The slightly to moderately acidic groundwater with the associated low total dissolved solids (TDS) concentrations are attributed to the heavily leached soils which are typical in humid tropical climates;
- Groundwater quality is generally within WHO drinking water standards, with a few exceptions near the MSP tailings deposit with elevated sulphate and lowered pH values. Water in supply wells generally meet WHO drinking water standards with iron and aluminium concentrations exceeding the standards, and pH levels below reference ranges in certain areas (due to natural conditions) [35];
- SRL sampling indicates bacteriological contamination in the community wells which is attributed primarily due to human impact;
- Surface water sampling from July, August and October 2017 shows low pH values in most areas, with samples around and to the north-east of the MSP (Mogbwemo pond), especially acidic. Values of sulphate are also high in Mogbwemo pond [154];
- There is the potential for secondary process tailings to be acid generating [155];
- Results from surface water studies in 2017 show raised levels of total dissolved solids (due to sediment) and with the exception of aluminium, heavy metal results were below WHO drinking water guidelines [154];
- The issues and response report had comments from stakeholders<sup>10</sup> on water quality, including [146]:
  - Mining activities had contaminated shallow groundwater sources or affected their flows, and
  - Sediment polluted both surface and groundwater sources.

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<sup>10</sup> The above comments are being investigated as part of the ongoing ground and surface water monitoring programme.

**Impact Definition:**

The impacts on surface and ground water will be updated when the specialist reports are completed. Potential human health impacts related to water quality and potential pollutants should be considered when these are available. The impacts associated with potable water quality are discussed in section 7.2.3.

**Impact evaluation and management measures:**

EHA # 9	Water quality and quantity										
Current operations. If unmitigated may extend into closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Long term	3	Localised	1	Moderate negative	4	Possible	2	10	Moderate negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Mitigation and management as per the specialist surface water and groundwater studies [154, 157].</li> <li>Provide alternative water supply if community boreholes in the immediate vicinity exceed drinking water standards.</li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact after management</b>	Medium term	2	Localised	1	Minor negative	2	Possible	2	7	Minor negative	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

The spatial effects of impacts associated with water quality will be discussed in the respective specialist study.

### **7.2.9.5 Hazardous Chemical Substances**

#### **Health Issues / PAC Vulnerabilities:**

A detailed Hazardous Chemical Substance (HCS) risk assessment at the Project is out of scope for the HIA. HCS are managed within a framework plan, and while this was not formally assessed the following important baseline observations and risk factors were noted:

- Mining and processing does not involve any specific large scale chemical activity. No potentially toxic chemical or by products from the process are anticipated to cause a risk to human health;
- The SRL clinic has a limited understanding of HCS management. For example, the clinic did not have a list of Safety Data Sheets of products that are used on site and had no protocols to manage the medical components of any HCS exposure (including emergency measures for acute exposure or medical surveillance requirements for chronic exposure);
- While it is not the intent of the HIA to evaluate each product in use at the Project individually, the following groups of chemicals or hazardous products are anticipated to be on site, with the potential for risk to human health:
  - Chemicals used for water treatment, including chlorine;
  - The site-based metallurgy laboratory;
  - Material used for construction and maintenance, including paints and solvents as well as flux and welding rods;
  - Binders for conveyer belts;
  - Petroleum products to support vehicles on site, including diesel fuel, mineral oils, grease, degreasers etc.;
  - The site based medical services including cleaning agents, laboratory equipment as well as medications (especially expired ones requiring disposal), and
  - Rodenticides in camps and work areas.
- Waste material and products may also pose a risk to human health including:
  - Potentially contaminated surface water from MSP, workshops and wash-down areas etc., and
  - Solid waste including contaminated rags, florescent light tubes, batteries etc.
- Pesticides were used for vector control activities, with Malathion® used for space spraying in the accommodation camps. This product is a potent organophosphate that requires careful storage, handling and disposal to avoid potential human health risks.
- The Mobimbi camp was built in pre-war times and the roofing of a number of old buildings were constructed with asbestos cement sheeting (fibro). While not inspected in detail the material appeared to be in good condition.

**Impact Definition:**

Potential Project related impacts from HCS may include:

- **Direct:**

- Direct contamination through inadequate materials handling:

There is the potential for direct exposure of the community through inappropriate materials handling. This can include spills during transport, inadequate disposal or management of waste water, etc.

- Re-use of containers that contained HCS:

There is potential for the community to re-use containers that stored HCS for domestic purposes, including storage of water or food products.

- Workplace exposure:

Potential occupational exposure to HCS in Project workers are out of scope of the HIA and addressed as part of SRL's health and safety management plans.

- **Indirect:**

- Public exposure:

There is the potential for public exposure to HCS on clothes of workers if these are not changed prior to departing the worksite. The risk depends on the nature of work and substances that are handled. Direct family members are particularly vulnerable to these exposures, especially children.

**Impact evaluation and management measures:**

EHA # 9	Hazardous chemical substances										
Operations into post closure											
	Consequence/Effect					Probability/Likelihood		Total Score	Overall Significance	Confidence	
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Possible	2	10	Moderate negative	Low
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Review the current HCS management plan and ensure it is aligned with local legislation and good international industry practice.</li> <li>Develop controls on the selection and procurement of HCS so that risks are understood prior to purchase. This should be supported by an integrated review of the safety data sheets so that risks can be evaluated from an environmental, health and safety perspective, and as required, alternatives recommended.</li> <li>Review the vector control programme with the choice of chemical for fogging activities. Ensure adequate controls are in place and evaluate opportunities for alternative products.</li> <li>Develop systems to ensure that the community do not use containers from the Project for collection or storage of products. Any community-based reuse/recycling programme must have requisite controls in place, and all containers that stored hazardous substances must be spiked or crushed so that they cannot be re-used.</li> <li>Commission a formal inspection of roofing material at Mobimbi camp and other areas where cementous asbestos or other asbestos containing products may have been used. Develop an asbestos management plan based on the outcomes of the inspection that includes recommendations for maintenance, control and disposal.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>Undertake a risk assessment on all HCS on site and determine the specific human health risks that may potentially result from exposure to a product, or a by-product of chemical use.</li> <li>Ensure adequate personal protective, hygiene and washing facilities for employees that handle hazardous substances. This should include dedicated personal protective clothing as well as showering and changing room facilities so that personnel do not wear potentially contaminated work clothes outside of the site.</li> <li>Medical surveillance of employees handling insecticides and other HCS must be incorporated into the Projects health and safety plans, including biological monitoring as required (for example pesticides including organophosphates).</li> <li>Based on findings of the asbestos inspection, include asbestos management in the workplace occupational hygiene and medical surveillance programmes.</li> </ul>											
	Consequence/Effect					Probability/Likelihood		Total Score	Overall Significance	Confidence	
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact after management</b>	Medium term	3	Site/ Localised	1	Minor negative	2	Unlikely	1	7	Minor negative	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

Impacts associated with exposure to HCS will be in the immediate area around the MSP and mining areas. However, with transport, all communities along the transport corridor may be at risk if an accident occurs with a spill. Communities at the Port site may also be at risk as products may be offloaded or stored at this location.

Hazardous chemical substances	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	No	Yes	No	No	No	Yes



## 7.2.10 EHA #10 – Social Determinants of Health

Health, well-being and quality of life are affected by a number of factors known as social determinants. These are varied and include socio-economic, cultural, community and environmental factors as well as individual and lifestyle conditions as shown in Figure 18 [143]. These have significant overlap to elements discussed in the social baseline, with this section focussed on well-being and quality of life.

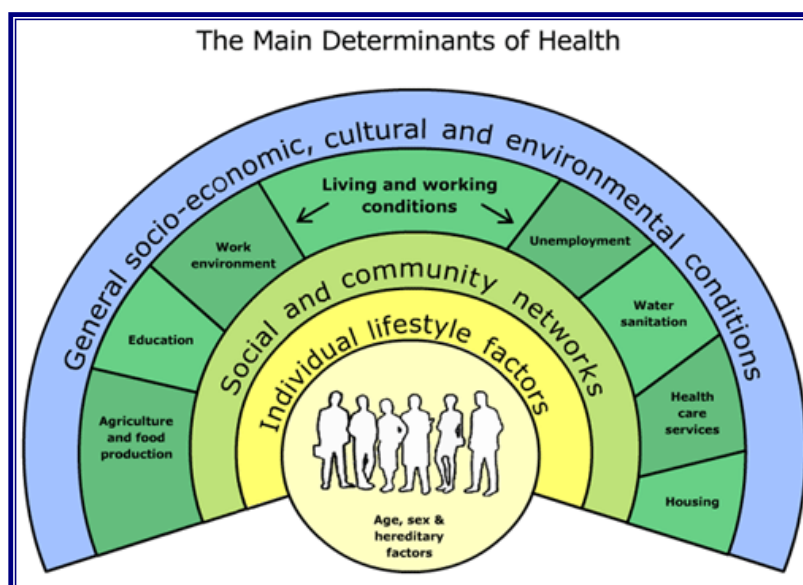


Figure 18: Determinants of health

### Health Issues / PAC Vulnerabilities:

Key baseline findings and risk / contributing factors include:

- Influence of the EVD outbreak on social determinants:

The EVD outbreak caused significant economic and social challenges nationally, which extended into rural communities, including [144]:

- Economic slowdown that impacted on the national gross domestic product with shrinking of the rural economy and the exacerbation of poverty;
- Significant mental health challenges including post-traumatic stress for families of victims and significant stigmatisation of survivors and orphans of parents who died from the disease, and
- Cultural and traditional practices were affected including religious customs and rituals.

While cases were reported in both Bonthe and Moyamba districts, no cases were reported in the immediate Project area. However, the outbreak did affect social determinants locally:

- Closure of other mines and other companies led to a localised influx of job and opportunity seeking migrants;
- Effects on the macro-economy affected the local economy influencing factors such as food inflation, and
- Poor health seeking behaviour to the public health system or to outreach services due to suspicion and taboos.

- Local economic development and employment:

The 2012 ESIA reported that local infrastructure, road systems, social services and employment opportunities had all improved due to the presence of the Project [35]. However, the 2017 issues and response report on socio-economic issues and the HIA field work outlined the following opinions and perceptions from stakeholders [146]:

- There is an acknowledgement of direct benefits from the Project, such as creation of infrastructure and telecommunications that improved access to information and the ability to communicate;
- The Project has conferred significant economic benefits to the area, but this perception is not felt uniformly, especially by those who don't benefit directly;
- The loss of land and livelihoods from farming has had a negative effect on traditional practices and also a disturbance in the 'sense of place';
- Influx has placed pressure on social and basic services, which has negatively affected local development;
- A lack of employment opportunities, especially for the youth;
- Inflation is a challenge with an increased cost of living, and
- Poverty is noted to be very high and a key determinant to various health challenges, including; i) nutrition; ii) access to healthcare due to transport; iii) healthcare services outside of free healthcare benefits; iv) housing; v) hygiene and sanitation; and vi) information on health promotion/prevention activities.

- Expectations of the Project:

There is significant expectation for the Project to support a range of community and local development initiatives. This expectation has origins in the historical support (pre-civil war) that SRL used to provide the community including free healthcare and basic services. Further, it was mentioned that as government lacks capacity there is a preference / expectation for SRL to support local development as it is part of the community. There were also high expectations for the Project to provide employment opportunities.

The origin of the expectations includes the local community as well as key stakeholders, such as the Bonthe DMO.

- Social ills and gender inequality:

The presence of social ills and their impact on other health determinants (e.g. STIs) are discussed in other EHAs, with important findings relevant to well-being and quality of life:

- Substance abuse is a major national and local concern. Alcohol abuse is common. Abuse of illicit drugs is also reported, especially in the youth, with cannabis the most common drug used locally. Key stakeholders mentioned that drug abuse is more common in communities in proximity to mining activities, with respondents from FGD validating this, and mentioning Moriba Town and Mogbwemo as specific areas. Respondents from the current social baseline all reported alcohol abuse as a problem, with 63% considering similar challenges due to drug abuse [145];
- As mentioned in section 7.2.4 commercial and transactional sex is an issue, with 15% of respondents in the social baseline reporting this as a community issue [145], and
- Crime and related violence was not reported as concern from the HIA field work, but 25% of respondents in the social baseline reported that they have felt insecure in their community in the past 12 months [145].

Women are marginalised nationally and despite new laws to promote women empowerment, gender inequality is a challenge, with local issues including:

- Traditional beliefs that limit opportunities for girls such as education, employment and arranged marriages at an early age, etc.;
- Traditional practices such as female genital circumcision;
- Teenage pregnancy is noted as a major concern, with the Moyamba DHMT reporting that the District has one of the highest rates nationally, mainly due to early marriage. Teenage pregnancy was a major theme in the FGD with young girls vulnerable to advances from single men, with girls having to drop out of school once pregnant and often needing to raise the child as a single mother, and
- As mentioned in section 7.2.7, domestic violence is a common challenge and generally linked to substance abuse. Sexual violence was not reported.

- Altered access:

It is acknowledged that physical access to the wider Project area has improved due to the presence of the Project. This is due to improvement in roads and transport services. While the public transport system is weak at the local level, motorcycle taxis play an important role in the

development of the sector, supporting local livelihoods. Access to information had also improved due to better telecommunication services.

While impacts related to these social determinants are discussed in a cross-cutting manner in the social specialist studies, potential impacts and benefits from a well-being and quality of life perspective include:

- **Direct:**

- Physical relocation and resettlement:

Physical relocation has the potential to impact on cultural and traditional values in a community linked to where they live potentially eroding perceptions of well-being and a 'sense of place'. This may include significant traditional features or sites of cultural importance (e.g. proximity to burial sites and sacred shrines), links to other communities and access to services (such as healthcare, schools, water etc.).

- **Indirect:**

- Project induced influx:

Impacts related to influx have been discussed in numerous other sections (environmental health areas), with potential negative psychosocial impacts on well-being / lifestyle and perceived quality of life, including:

- Erosion of cultural and traditional values;
    - Lifestyle changes including moving away from traditional forms of livelihood (e.g. subsistence farming);
    - Pressure on and access to limited basic services, including education, healthcare, housing and water / sanitation etc.;
    - An increase in social ills, with potential increase in levels of crime, and
    - Loss of access to land and overcrowding in certain settlements due to unplanned development.

- Expectations of the Project and perceived inequality:

Expectations of SRL will remain high as there are limited alternative economic or employment opportunities. The limited capacity of the local and District(s) authorities creates an expectancy that SRL will fulfil the role of uplifting the local community and the associated quality of life through a range of social development and community investment programmes. Any unfulfilled and unrealistic expectations may create resentment towards SRL and a perception of inequality to people that benefit from the

Project, and those who don't. This includes those who have access to the SRL clinic and the perceived role of what the clinic should play in supporting community health needs.

- Altered access:

The creation of the mining ponds and current mining activities may have created barriers between communities and potentially restricted access to services. This is however unlikely as the communities appear to have grown around the mining area but needs to be considered for new mining activities.

- **Benefits**

The development and presence of the Project has created a number of benefits that support improved well-being and quality of life, including:

- Direct employment opportunities;
- Development of the local economy;
- Training and upskilling of sectors in the community;
- Improved infrastructure;
- Improved transport links through improvements in the road network and public transport system, which has facilitated access to markets and for products to be traded in and out of the area, stimulating the local economy;
- Improved access to information, with the presence of the Project a major factor in the development of communication infrastructure such as mobile phone and internet connectivity. This supports better transfer of information, enhancing education, which may in turn promote and support improved lifestyles, health seeking behaviour and health knowledge, and
- Improved services by supporting easier access and the ability for authorities to deliver services in areas that may have been otherwise hard to reach. This includes outreach health services such as vaccination and malaria control (ITN distribution) programmes.

**Impact evaluation and management measures:**

EHA # 10	Social determinants of health										
Operations											
	Consequence/Effect					Probability/Likelihood		Total Score	Overall Significance	Confidence	
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Possible	2	10	Moderate negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Consider perceptions and well-being and traditional values in the management of physical resettlement of communities.</li> <li>Develop an influx management plan.</li> <li>Support effective communication strategies to manage community expectations on realistic extended benefits from the Project.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>Evaluate local economic development opportunities that consider the benefits of transport and improved access as well as use of access to information.</li> </ul> </li> </ul>											
	Consequence/Effect					Probability/Likelihood		Total Score	Overall Significance	Confidence	
	Temporal Scale	Spatial Scale		Severity of Impact							
<b>Impact after management</b>	Medium term	2	Localised	1	Minor negative	2	Possible	2	7	Minor negative	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

Impacts associated with social determinants will vary in their spatial dimension, as well as in direction as some may cause a negative impact, while others may extend benefits.

Social determinants of health	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No

## 7.2.11 EHA #11 – Cultural Health Practices and Health Seeking Behaviour

Health seeking behaviour, and the manner in which people select a health provider and when to consult them, depends on a variety of supply and demand factors. On the supply side, there is the availability of healthcare services, the cost of care, the availability of equipment, the quality of management, and the attitude of staff. On the demand side, there are the individual and household characteristics, perceptions and beliefs of the community, affordability (treatment, transport, and daily income), decision-making responsibility, accessibility, and how health needs are prioritized.

Traditional medicine plays an important role in health seeking behaviour at the local level, with cost and access to healthcare service a major supply factor, and cultural and social belief a major demand factor. These factors often play a role in the use of the informal health sector as the primary consultation route.

### Health Issues / PAC Vulnerabilities:

Key baseline findings and risk / contributing factors:

- Health seeking behaviour:

While direct costs are the major factor that influences healthcare utilisation, certain indirect costs also play an important role; including, transport costs, cheaper alternatives, multiple service / cost points (e.g. paying for consultation and medication at separate facilities) and waiting times / queues [126].

Key stakeholders reported that the majority of the population prefer to use conventional medicine, but traditional medicine was still used commonly and often concurrently. Local factors influencing health seeking behaviour to the public health sector includes:

- Supply factors:
  - Poor supply chain and frequent stock out of medications. Medications were then procured from private street pharmacies. Patients then opt for a self-medication option to save on costs;
  - Access to healthcare services, especially in communities who don't have a peripheral health unit locally, and
  - Cost of services at the peripheral health units if out of the free healthcare benefit.
- Demand factors:
  - Cultural preference, with a clear preference for traditional medicine for certain conditions. This practice includes relatively wealthy people as well as

SRL employees and dependents that have access to free healthcare services, and

- General health awareness and education on health prevention activities was poor, which often supports use of traditional medicine, and delays access to conventional care.

- **Traditional medicine and cultural practices:**

Additional information on traditional medicine and cultural health practices at the local level includes:

- The use of traditional medicine often resulted in a delay in receiving care, which complicates or increases morbidity from certain conditions;
- A variety of traditional healers are active and used by the community, including; herbalists, those who perform scarification's, 'bone setters' and 'marabouts' (who deal with sorcery);
- Traditional forms of family planning are still practiced;
- Traditional birth attendants play an important cultural role in delivering children. Incentive programmes encouraging traditional birth attendants to support the delivery of expectant mothers in conventional health facilities are on-going, and
- Female circumcision is widely practiced, reported at rates of 90% in Moyamba and 85% in Bonthe District [24]. The practice is largely accepted with reports that girls / women face immense social pressure to undergo the procedure, and those who don't are regarded as unclean and socially stigmatised.

### **Impact Definition:**

The Project is unlikely to influence cultural health practices significantly but may play a role in influencing health seeking behaviour.

- **Direct:**

- Mining activities may have affected the natural habit and possibly the availability of medicinal plant products.

- **Indirect:**

- Improved access due to road and transport infrastructure (as discussed in section 7.2.10 and 7.2.12) will have a nett benefit as it will support improved access to health facilities, outreach health programmes as well as referral facilities;
- Project induced influx:



- An increasing population may negatively impact on health seeking behaviour due to an inability to meet the increasing demand, and
- The development of unplanned settlements may also impact on the availability of natural resources including medicinal plants, potentially limiting certain traditional medicine practices.

### Impact evaluation and management measures:

EHA # 11	Cultural health issues and health seeking behaviour										
Operations into post closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Medium term	2	Project Area	2	Minor Negative	2	Possible	2	8	Moderate negative	Low
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>• Develop an influx management plan.</li> <li>• Review what important medicinal plants are used in the area and as required, support environmental management programmes to maintain these habitats and support access to these areas.</li> <li>• Management measures as per 6.2.12 under health systems and infrastructure.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>• Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>◦ Support health systems strengthening in the formal healthcare sector as per recommendation in 6.2.12.</li> <li>◦ Evaluate opportunities to develop the local public transport sector.</li> </ul> </li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact after management</b>	Medium term	2	Project Area	2	Minor benefit	2	Possible	2	8	Moderate benefit	Low

### Vulnerabilities and Spatial Effects of Impacts:

Impacts associated with cultural health issues may be experienced in all communities that may experience influx and altered access.

Cultural health practices	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No

## 7.2.12 EHA #12 – Health Systems Issues

The structure of the health system is described in detail in section 7.1.2, with important local findings outlined below.

### Health Issues / PAC Vulnerabilities:

Key baseline findings and risk / contributing factors include:

- Weak health infrastructure:

Both the Bonthe DMO and the Moyamba DHMT reported weak health infrastructure and a lack of skilled health professionals as major challenges in the ability to deliver healthcare services. Lack of financing was cited as a key constraint.

Appendix B describes the peripheral health units in the Project area (with the exception of those in Bonthe district) in detail, with the following key findings:

- Staffing is inadequate in the peripheral health units, with no doctors working in any of these facilities. The only doctors are the two who work at the SRL clinic;
- Healthcare services were inadequate for the demands and size of the population. The Moriba Town community health centre is the biggest facility in the area, but services offered, and the size of the facility is inadequate;
- There are frequent stock-outs of essential medications, which limits the functioning of the free healthcare initiative. This is due to lack of supply in some areas, but also due to the demand for medication exceeding the supply from government stores. If facilities have run out patients are required to purchase medications from private pharmacies, or the facilities run a 'cost recovery' programme where patients need to pay for drugs that staff at these facilities have procured. This played a significant factor in affordability and community acceptance of the services and influenced health seeking behaviour;
- With the exception of the SRL ambulances, there are no ambulance services operating in the area, with the closest ambulances available from Serabu and Moyamba hospitals. In general, the community relies on private transport, which is expensive or limited to motorcycles that may not be appropriate;
- Structural aspects varied with Moriba Town community health post not having running water or solar power, and the general state of the building is poor. Other facilities did have running water and power, but through solar systems;
- Access to healthcare facilities varied based on the presence of a facility in the community or access to roads. The majority of respondents in the social baseline reported that they had access to a health facility with 5km of their home [145]; and

- The improvement of healthcare services was noted as a community development need from stakeholder comments in the issues and response report [146].
- Key health indicators:
  - Sierra Leone has one of the highest maternal mortality rates globally [128]. In 2016, Bonthe District recorded the highest rate nationally, but this has improved in 2017. This is also a challenge in Moyamba District with a recorded average of three maternal deaths per month for the year, up until the end of July 2017. The main contributing factor is limited access to delivery care and lack of emergency transport for obstetrical emergencies, and
  - While showing a downward trend, the national <5 mortality rate in 2013 was 156 deaths per 1,000 live births. Bonthe district recorded the lowest <5 mortality nationally at 99 deaths per 1,000 live births, with Moyamba above the national average at 199 deaths per 1,000 live births [24].
- Health programmes:
  - A collaborative forum has been established in Bonthe District to improve engagement and coordinate programmes between various health development partners and the MoH&S / DHMT;
  - SRL supports a range of health awareness and health education activities in the community, especially Moriba Town, Mogbewa and Mogbwemo. These are conducted in schools and appear to be well received even no formal arrangement is in place with either DHMT;
  - The EVD outbreak affected health programme delivery;
  - Child health programmes:
    - The majority of children are reported to attend routine child health services and receive scheduled vaccines and have their growth monitored. It was acknowledged that this is limited to children whose parents have reasonable access to healthcare facilities, with those that don't generally not accessing these services;
    - Outreach health services are limited by lack of transport, and
    - Vaccine coverage across Bonthe District is at about 80%. There are significant gaps in hard to reach areas, with these groups vulnerable to measles outbreaks. Inadequate cold chain management hampers outreach vaccination programmes.

- Maternal health programmes:
  - Reproductive health services are offered at clinics, and while uptake is low, a health development partner is supporting increased use of family planning services, and
  - Uptake and attendance of antenatal care is generally good.
- Outreach:
  - Community health officers play an important role in healthcare delivery in hard to reach areas, with these staff non-paid volunteers selected from within communities. Not all communities have functional programmes.
- SRL clinic role and expectations:
  - SRL clinic stabilizes all emergency cases irrespective of Project involvement. After initial stabilisation cases are referred, with on-going costs for management not the responsibility of SRL, and
  - There are expectations from the community, the Bonthe DHMT and community leaders that the SRL clinic should play a more active role in providing healthcare services in the community. This is in part due to inadequate local services and infrastructure.

### **Impact Definition:**

The Project has the potential to impact on the health service infrastructure and delivery mechanisms in the following ways:

- **Direct:**

- Employment of skilled staff:

While the SRL clinic is not a large facility and currently has a full complement of staff, there are plans to expand the service. As healthcare human resources are scarce in the Districts, SRL must be cautious when hiring additional staff that it does not exclusively hire local staff, so that there is not a detrimental impact on the local public health service.

- **Indirect:**

- Project induced influx:

Influx and the impact on basic services, including healthcare services have been mentioned previously. The increased population size and demand for services has placed pressure on the available healthcare services, with the trend likely to continue, or worsen if population numbers continue to rise. This includes demands for health

programmes such childhood vaccination. There is limited institutional capacity in the DHMT(s) to support the required healthcare service to meet this growing demand from a planning, budget or delivery perspective.

- Health service delivery expectations:

There is the expectation that the SRL clinic should support a more active role in supporting local healthcare service delivery. As there is limited institutional capacity in the DHMTs, there may be the expectation on SRL to cover any gaps in the Project area, as their responsibility, with the DHMT then able to focus on other areas. Unmet or false expectations have the potential to create animosity and potential conflict with the DHMT, and by extension the community.

- Perceptions of inequality:

Perceptions of inequality may present from:

- Sectors of the community who don't have access to the SRL clinic, with potential resentment towards those members who do have access. As discussed in section 7.2.10 this has the potential to effect social determinants and feelings of well-being, and
- Communities that may benefit less from Project supported outreach services. It is logical that SRL focus initiatives in more impacted communities but there is the risk for certain communities to feel marginalised.

- **Benefit:**

As discussed in section 7.2.10 and 7.2.11 the development of the Project has generally improved access to healthcare services through the improved road network and supported the ability to deliver outreach health programmes such as vaccination programmes. The better road network also allows better access to referral health networks.

**Impact evaluation and management measures:**

EHA # 12	Health service infrastructure and programme										
Operations and into closure											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Medium term	2	Project area	2	Moderate negative	4	Probable	3	11	Moderate negative	Medium
Management Measures											
<b>Project impact mitigation:</b>											
<ul style="list-style-type: none"> <li>Develop an influx management plan.</li> <li>Develop an effective communication strategy on the role and responsibility of the Project in supporting healthcare service delivery in the area to manage government and community expectations.</li> <li>SRL should join the collaborative forum as a key stakeholder in the District(s).</li> <li>Consider specific health systems strengthening on health facilities and health service delivery where the Project has, or may potentially have a direct impact- for example resettlement.</li> <li>In collaboration with the DHMT, develop a monitoring system to support surveillance of selected indicators as part of the CHMMP.</li> </ul>											
<b>Occupational health, safety and environmental management:</b>											
<ul style="list-style-type: none"> <li>As per Project plans, upgrade and maintain an appropriate workplace medical service so that referrals into the local health public health sector (health post/centre level) is not required for work related or primary health conditions.</li> <li>Referrals from the Project should continue to be directed towards major centres (Serabu, Bo and Freetown) so as not to overburden the local public health facilities.</li> <li>Limit the hiring of healthcare human resources from SR Area1 and the Districts for the SRL clinic. Ideally, all staff (medical, paramedical and nursing staff) should be hired external to the Districts to avoid an impact on local service delivery.</li> </ul>											
<b>Social development mitigation and management:</b>											
<ul style="list-style-type: none"> <li>Consider voluntary contributions as part of the CDA, including the following options: <ul style="list-style-type: none"> <li>Evaluate opportunities to supporting community health officer programmes as these are known to be effective in supporting a range of community health interventions. As staff are recruited from within communities, they understand local cultural factors. Interventions that can be supported include health promotion and prevention messaging, support of environmental health issues ('clean community campaigns'), community based first aid and care, and collection of health or social data.</li> <li>Evaluate health systems strengthening opportunities to support outreach health programmes and/or health infrastructure. Any interventions should be planned and implemented considering sustainability criteria and with a clear exit strategy. SRL must not assume the role of the MoH&amp;S or DHMT in any programmes and should seek opportunities to outsource functions to health development partners.</li> </ul> </li> </ul>											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact after management</b>	Long term	3	Project area	2	Moderate benefit	4	Possible	2	11	Moderate benefit	Medium

**Vulnerabilities and Spatial Effects of Impacts:**

Impacts will be experienced broadly across SR Area1, but will be more marked where influx has occurred or areas where access to healthcare services may have been restricted. Impacts are not likely along the transport corridor. No gender specific impacts are anticipated, but poor sectors of the community and those with limited access to healthcare facilities may be vulnerable.

Health service infrastructure and programme delivery	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5	PAC 6	PAC 7	PAC 8	PAC 9
	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No

## **8 Summary of Recommended Plans, Additional Data Collection and Monitoring**

A number of recommendations are made in section 7.2 under each EHA, with this section summarising; i) recommended management plans/procedures; ii) additional data collection opportunities; and iii) considerations for monitoring and evaluation. These are summarised in Table 13 and divided into a main theme and related sub-element. The relevance to each separate EHA is also provided so that cross-cutting elements are demonstrated. It is noted that this is not a complete summary of all recommended management and monitoring measures, with this anticipated to be completed in the CHMMP.

Table 13: Summary of management measures, data collection and monitoring plans

Summary of management plans and data collection, monitoring activities	Sub-elements	Environmental Health Areas (EHA)												
		1	2	3	4	5	6	7	8	9	10	11	12	
<b>Combined workplace and community health plans</b>	Communicable disease strategy and plan	√	√	√	√	√			√					
	Outbreak preparedness and response plan	√	√	√					√				√	
	Community security and safety management plan							√						
	Contractor management requirements	√	√	√	√			√	√	√				
<b>Community health plans</b>	Influx management plan	√	√	√	√	√		√	√	√	√	√	√	
	Communication strategy and plan								√	√			√	
	Women and young girl support programme				√								√	
<b>Workplace health plans</b>	HIV policy and plan	√			√									
	TB management plan	√												
	Project's fitness to work procedure	√			√		√	√		√				
	Vaccine preventable disease programme	√			√								√	
	Camp facilities and general waste management plan	√	√	√					√					
	Integrated workplace malaria and vector control programme		√							√				
	IEC and BCC campaigns for various health areas	√	√	√	√		√	√	√					
	HIV and STI prevention strategies and interventions for transport workers				√									
	Wellness programme				√	√	√							√
	Radiation management plan									√				
	Asbestos management plan									√				
	Hazardous chemical substances management plan									√				
	Occupational health, hygiene and safety plan							√		√				
<b>Data collection</b>	Food cost baseline					√					√			
	Housing/rental cost baseline	√									√			
	Malaria indicator study		√											
	Baseline entomology study		√											
	Baseline studies to determine the burden of disease			√										



Summary of management plans and data collection, monitoring activities	Sub-elements	Environmental Health Areas (EHA)											
		1	2	3	4	5	6	7	8	9	10	11	12
	from bilharzia and soil transmitted helminths												
	Baseline studies to determine the water quality at household source and end-user based on biological indicators			√						√			
	Baseline STI and HIV indicator survey				√								
	Baseline nutritional indicator survey					√							
	Lassa fever survey								√				
	Radiological analysis of soils, sediments, surface water, groundwater and air									√			
<b>Monitoring and evaluation</b>	Monitoring system to track impacts and interventions across various EHAs	√	√	√	√	√		√					
	Monitor trends for housing and food inflation	√				√							

## 9 Conclusions

Based on the findings of the assessment the following was concluded:

- The Project has played a historical significant role in influencing community health, both from a beneficial and negative perspective.
  - Beneficial elements include:
    - Employment;
    - Local economic development;
    - Improved local infrastructure, roads and communication, and
    - Improved social services.
  - Negative elements include:
    - Project induced influx with development of unplanned settlements, with numerous impacts:
      - ✓ Pressure on basic services due to demand and inability of the local authority to plan for and deliver services to meet this;
      - ✓ Increase in communicable diseases due to environmental health factors and mixing of people;
      - ✓ Inflation and increased cost of living;
      - ✓ Introduction of social ills, and
      - ✓ Changes in traditional practices and an altered sense of place.
    - Impact on the environment from mining with Project activities, creation of mine ponds and lack of available arable land to farm. The altered environment has also improved conditions for the transmission of vector related conditions.
    - Transmission of communicable disease due to influences and behaviours of the workforce.
    - Accidents and injuries due to road traffic accidents and risk of drowning in mine ponds.
    - Unfulfilled or unmet expectations from the community and other stakeholders.
- The most important future impacts are associated with; i) the potential transmission of STIs including HIV; ii) increased risks for accidents and injuries; iii) increased localised transmission of malaria; and iv) environmental health impacts from air and water quality.
- SRL has not managed potential community health impacts in a co-ordinated manner and the proposed management measures presented in this report should facilitate the development of a CHMMP as part of the ESHMP.

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## **11 Appendices**

### ***11.1 Appendix A: Baseline Health Profile Based on Environmental Health Areas***

#### **11.1.1 EHA #1 Communicable Diseases Linked to the Living Environment**

Communicable diseases (e.g. Acute Respiratory Infections (ARIs), pneumonia, TB, EVD, meningitis, influenza, leprosy, etc.) rely on fluid exchange, contaminated substances, or close contact to travel from an infected carrier to a healthy individual. Therefore, they are directly linked to housing design, overcrowding and inflation in the cost of housing, with the housing environment a determinant that affects human health.

**Desktop findings****Findings from literature review:**

- Housing:
  - Average household size is 5.6 persons (6.0 persons in rural and 5.1 persons in urban areas) decreasing from 5.9 in 2008. Average household size in Moyamba and Bonthe Districts at 5.1 and 6.2 persons, respectively [23].
  - Housing conditions vary greatly. 46% of households (74% in rural; 12% in urban areas) have floors made of earth or mud [23]. Floor materials like earth, sand, and animal dung pose a health problem as it acts as breeding grounds for pests and may be a source of dust.
  - On average, 55% of households occupy just 1 or 2 rooms [23]. The number of rooms used for sleeping gives an indication of the extent of crowding in households. Overcrowding increases the risks of contracting communicable diseases.
  - 40% of urban households have electricity compared with 1% of rural households [23].
  - 97% of households use solid fuels for cooking, mainly wood (65%) or charcoal (32%) [23]. Indoor air pollution from use of solid fuels has been documented as one of the leading risk factors for ARIs, especially in young children [59-61].
- ARI's, particularly pneumonia, is a leading cause of death in children worldwide and affects adults of all ages. Bacterial infections are most important, but viral and fungal infections can also occur:
  - Globally, lower respiratory infections are the leading cause of disease burden, with ARI responsible for 17% of deaths of children under-5 years [37].
  - The 2013 SLDHS shows that 5% of children under-5 years nationally, 3% in Moyamba District and 1% in Bonthe experienced symptoms of ARI within the 2 weeks preceding the survey [24].
- TB is an infectious bacterial disease caused by *Mycobacterium tuberculosis*, transmitted through the airborne route. Crowding, poor ventilation, and duration of exposure increase the risk of transmission. One of the SDGs adopted by United Nations in 2015 is to end the global TB epidemic. The goal calls for a 90% reduction in TB deaths and 80% reduction in the TB incidence rate by 2030. Leprosy and TB control are integrated under the National Leprosy and Tuberculosis Control Programme:
  - TB is highly endemic. Sierra Leone recorded an estimated 20,000 new TB cases and 3,300 TB-related deaths in 2015. This gives an incidence rate of 307 per 100,000 population, placing it among top 10 countries with the highest number of TB cases per capita. 3% of TB cases are multidrug resistant [62, 63].
  - Treatment success rate (2015 data) stands at 85% for new cases and 62% among retreatment cases. 14% of the TB cases are co-infected with HIV [62, 63].
  - Sierra Leone adopted the Directly Observed Therapy Short course (DOTS) strategy in 1992 and has reached 100% coverage of notified patients.
  - The country's TB control programme is facing challenges of low case detection rates, high

**Field based findings****Findings from KSI:**

- Poor housing and crowding in Moriba Town/Mogbwemo were cited as a key predisposing factor for communicable diseases in the Project area KSI.
- ARI was consistently listed among the top three morbidities affecting young children presenting at the local health facilities.
- TB was mentioned as an important concern:
  - Moyamba DHMT reported that cases of TB are increasing in the District and most of the cases are co-infected with HIV. It was reported that mining areas are becoming hotspots for HIV and TB co-infections.
  - Only 12 facilities in Moyamba District have the capacity to diagnose and treat TB, the DHMT indicating that this was inadequate.
  - In Mokelleh community health centre one case of TB has been seen in 2017. The case was also HIV positive.
  - The Bonthe DMHT reported that the District indicators on TB case detection were lagging and not meeting public health targets. Despite these deficiencies most cases of TB were considered to be co-infections with HIV [136].
  - SRL clinic reported that not many cases of TB are seen, with these generally co-infected with HIV.
- Measles outbreak occurs in the Project area. Moyamba DHMT reported that cases are seasonal and largely attributable to suboptimal coverage of measles vaccine (80% in 2016). Inadequate cold storage facilities were reported and likely to affect potency of vaccines.
- SRL clinic reported a few relevant opinions [135]:
  - Moriba town is overcrowded with limited space between houses, but as far as they can recollect (on prompting) no run away fires had spread through this or other settlements, although it acknowledged as a potential risk.
  - Measles is generally not seen commonly in the Project area (or in patients that access the SRL clinic) as vaccination programmes had improved, but were still seen in Mattru hospital and surrounds.
  - Influx management was handled well during the EVD outbreak as new arrivals (or harbouring of people) in the area were immediately

proportion of patients without sputum results, inadequate capacity to screen for resistance strains, and high defaulter rates. The programme is 100% dependent on donor funding [62, 63].

- Leprosy is a disease of poverty and overcrowding. It is caused by the slow-growing bacillus *Mycobacterium leprae*, which is not highly infectious. The disease is targeted for global elimination by 2020, defined as a registered prevalence rate of less than 1 case per 10,000 population [64]:
  - Sierra Leone has a relatively low burden of leprosy. Between 2011 and 2015, the number of new leprosy cases decreased from 274 to 133. Elimination efforts are well on course [65].
- Measles is a highly contagious viral disease transmitted through inhalation of airborne respiratory droplets from an infected person's cough or sneeze, and despite an effective vaccine is still an important cause of childhood death:
  - Measles remains a public health challenge. Studies have demonstrated a spike in measles cases during the 2014-2016 EVD outbreak as a result of disruption of vaccination programmes and underreporting of measles cases, which were probably related to effects of EVD on health care system [67]. The country's measles vaccination coverage dropped to 85% in 2015 compared to 99% in 2010 [68].
  - An outbreak in 2016 resulted in 977 cases (64 laboratory confirmed) and some deaths. Majority of the cases came from Western Area, Bombali, Kenema, Bo, Koinadugu and Kambia Districts [68].
- Meningitis, an infection of the thin lining around the brain and spinal cord is transmitted through direct contact with infected respiratory droplets. Infections caused by *Haemophilus influenzae type b* (Hib), *Streptococcus pneumoniae* and *Neisseria meningitidis* are responsible for high morbidity and mortality among children in Sub-Saharan Africa (SSA) [68]. Viral, fungal and protozoal causes also occur.
  - The highest burden of meningococcal disease occurs in an area of Sub-Saharan Africa known as the 'Meningitis Belt', which stretches from Senegal and Guinea in the West to Ethiopia in the East [69].
  - Sierra Leone is not formally part of the African meningitis belt. The risk of meningococcal meningitis outbreak remains generally low with no case recorded since 2007 [70]. Other forms of meningitis (non-meningococcal) occur.

#### **Findings from Project documentation:**

- Housing in the Project area is a mix of traditional and modern structures. Those villages that have not been relocated tend to have more traditional housing, which is round in shape and constructed of wattle or mud plastered walls and thatch roofing. Newer rectangular constructions of mud or cement brick are found more often in the relocated or larger villages. Roofing material is usually zinc sheeting, with SRL having supplied this sheeting for roof materials in relocated villages [35].

noted, with reports of a few suspected cases (or known contacts under surveillance) detected and sent back to areas where they were under monitoring.

- When other mines closed during the EVD outbreak, a lot of people descended on the Project area in search of opportunities.
- No outbreak of meningococcal meningitis has been reported in the area. However, isolated cases of other forms of meningitis occur.

#### **Findings from FGDs:**

- According to participants, most households in the area consist of 5-7 persons. Majority of housing structures consist of 2 or 3 rooms.
  - In Moriba Town and Mogbwemo it was reported that housing was inadequate because of high demand.
  - Participants living in rental accommodation especially in Moriba Town, Mogbwemo and Matagelema reported that rental fees were increasing every year (housing inflation).
  - Quality of housing was said to be improving compared to 5 years ago.
  - Nearly all households cook using wood (predominantly) or charcoal. Majority cook outside their main dwelling in a separate structure.
- Coughs and colds (symptoms of ARI) were consistently mentioned among top 5 ailments affecting young children. Participants attributed this to dust during the dry season, weather changes, and poor housing.
- It emerged that measles outbreaks are common in the area – spontaneously mentioned in 8 out of 10 discussions. Children were the most affected, more cases have been experienced this year.
- There was no specific mention of TB, meningitis or leprosy.

#### **Findings from direct observations:**

- Housing varied across the area. The more urbanised communities (Moriba Town, Mogbwemo and Matagelema) had predominantly solid housing made of cement and zinc sheet roofing. The more rural villages (Foinda, Gbangbaia, Junctiola, etc.) had a mix of traditional structures made of mud walls and grass thatch roofing as well modern semi-solid or solid structures.

- The current social baseline has reported a challenge in the collection of natural material that is traditionally used for roofing, as mining activities has reduced its availability locally according to the community members. The issues and response report supported this with stakeholders commenting that as wetlands had been replaced there was no thatch available for roofing [146].
- In addition, other respondents reported that zinc roof sheeting was generally of poor quality (and leaked) and was not always preferred due to the heat it generated inside the dwelling.
- None of the local settlements has access to the national power grid. The mine accommodation camps of Mobimbi and Kpanguma are supplied with electricity from the power plant at the mine [35].
- Overcrowding was evident in some parts, especially Foinda and some sections of Moriba Town and Mogbwemo.
- Some of the housing structures were small and poorly ventilated.
- Cooking arrangements was predominantly outside, in a detached structure designated as the kitchen. All used firewood for cooking. The sale of firewood was also evident.

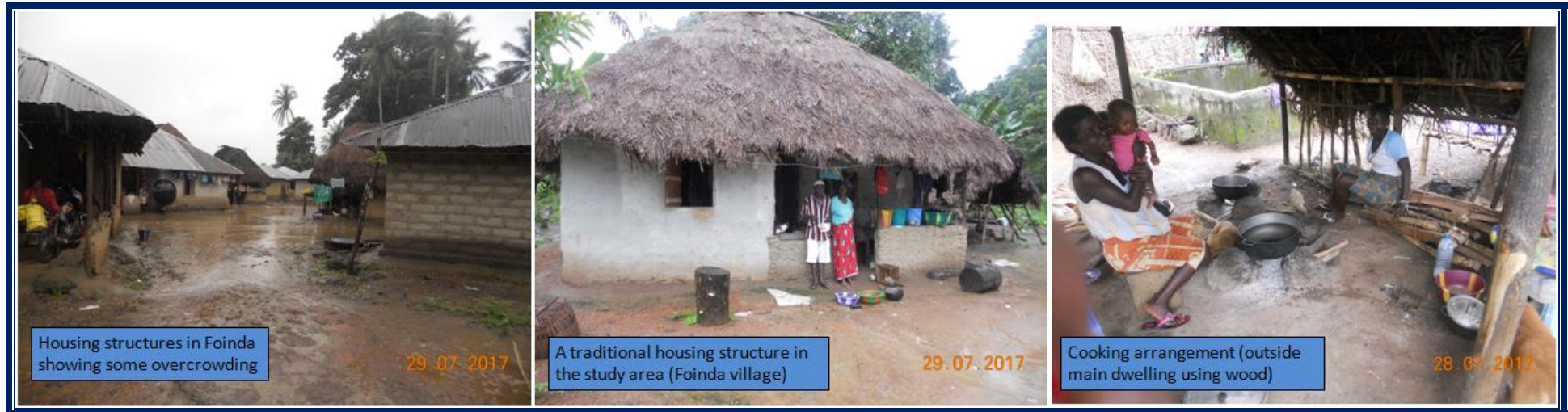


Figure 19: Observation picture plate: Living environment

## 11.1.2 EHA #2 Vector-related Disease

Vector-borne diseases are infections transmitted by the bite of infected arthropod species, such as mosquitoes, ticks, sand flies, and blackflies. Climatic factors influence survival and reproduction rates of vectors, in turn influencing habitat suitability, distribution and abundance, intensity and temporal pattern of vector activity.

### Desk-top findings

#### Findings from literature review:

- Malaria, a protozoan infection transmitted by female anopheles mosquitoes, is the most important human parasitic disease from a public health perspective. Nearly half of the global population is at risk of malaria infection, mainly in Sub-Saharan Africa. In excess of 200 million cases and 0.5 million malaria deaths occurred globally in 2015 [71, 72].
  - Malaria is endemic with stable and perennial transmission in all parts of the country. It accounts for 40% of outpatient morbidity for all ages, 47% of outpatient morbidity for children under-5 years, and 38% of hospital admissions. Although pregnant women and children under-5 are the groups most affected, the entire population is at risk of malaria [25].
  - In 2015, the country recorded nearly 1.5 million cases of malaria (increasing from 1.3 million in 2014) and 5,800 malaria deaths [71, 73].
  - *Plasmodium falciparum* spp (>99%) is the major parasite and *Anopheles* mosquito is the predominant vector, particularly *A. gambiae*, *A. funestus*, and *A. melas* [20].
  - Transmission occurs throughout the year with a peak period from April to January.
  - Spatial analysis from the Malaria Atlas Project shows how the parasite rate for *P. falciparum* (in 2-10 year olds) has changed from 2011 to 2015 (Figure 21, Figure 22). As can be noted there has been a dramatic drop with rates dropping to a prevalence approaching < 20% in some areas. It is also noted that the prevalence is lower in the coastal areas (including Bonthe and Moyamba) than interior areas [74].
  - Figure 20 shows the distribution of *P. falciparum* malaria prevalence (2013 data) [29]. Of importance are the yellow and red dots that show rates > 30% and > 75% in surveys that have been conducted in and around the inland areas of Bonthe and Moyamba and possibly on the Project area. Therefore, it can be assumed that malaria in the Project area may significantly higher than modelled rates.
  - The NMCP has adopted a number of intervention measures as summarised in Figure 23 [73] including:
    - Vector control measures: free distribution of ITNs or Long Lasting Insecticidal Nets and Indoor Residual Spraying (IRS);

### Field based findings

#### Findings from KSI:

- Malaria was reported as the number one cause of morbidity in the Project area, with the following information:
  - The high burden of malaria was attributed to low utilisation of ITNs and environmental risk factors (occurrence of pools of stagnant water, artificial ponds and heavy vegetation).
  - Malaria cases were reported to be higher during and after the rainy season (Apr to Dec).
  - Interventions for malaria control in the area include: free distribution of ITNs and free diagnosis and treatment (for all in the public sector). Coverage of ITN was reported to be generally high following a recent mass distribution campaign conducted in June 2017.
  - No entomological studies have been conducted in the districts.
  - No IRS activities are conducted in the District.
  - The Bonthe DMO reported that an attempt had been made to pilot IRS but the focus was now on environmental controls, health education and promotion and access to effective diagnosis and appropriate treatment (generally based on a positive test) [136].
  - Frequent stock-outs of anti-malarials at the public health facilities were a noted challenge due to supply chain issues.
  - Communities along the rivers retire early and sleep under ITNs due a type of nuisance fly that bites. Malaria rates are generally lower in the Bonthe District as a result (a reported 26% prevalence in the District).
  - Bonthe District is doing well with various neglected tropical diseases including onchocerciasis (which was in the eradication phase) [136].

- Intermittent Preventive Treatment (IPT<sub>p</sub>) using Fansidar to prevent malaria during pregnancy; and
    - Free malaria diagnosis and treatment with artemisinin combination therapy in the public health sector.
  - The coverage of ITN and IRS is shown in Figure 24, with a clear trend showing the increased access nationally [73]. Findings from the 2013 SLDHS indicate that 64% of households own at least one ITN, up from 37% in the 2008 SLDHS. Between 2008 and 2013, ITN utilisation increased from 26% to 49% among children under-5, and 27% to 53% among pregnant women [24].
  - National coverage of IRS stood at 5% in 2013. IRS is mostly implemented in Bo (17%), Bombali (13%), and Western Area (12%) in line with policy to concentrate on areas of higher prevalence [24].
  - Table 14 shows the coverage of malaria control measures in Bonthe and Moyamba Districts based on data from 2013 SLDHS. There was similar ITN coverage in both Districts but in general better utilisation and coverage to IPT<sub>p</sub> in Moyamba compared to Bonthe [24].
  - Arboviral diseases such as dengue, West Nile, yellow fever, Rift Valley fever, chikungunya, and Marburg viruses have been documented:
    - A recent study of 253 samples (suspected cases of acute viral fevers) submitted to the Lassa Diagnostic Laboratory found the prevalence of dengue fever antibodies at 4.3%, chikungunya fever at 4% and yellow fever at 2.5% [75].
    - Yellow fever is endemic with the country subject to sporadic outbreaks. In 2009, Médecins Sans Frontières participated in a targeted vaccination campaign targeting 525,000 people (population of Bo District) in response to 2 cases that were diagnosed and managed at Bo hospital. It was further reported that routine vaccinations for yellow fever only started in 2002, targeting babies, with the bulk of the population remaining unprotected [131]. In 2011, 2 cases were reported from Jahun village in Bonthe District, and in response 144,479 people aged 9 months and above were vaccinated. A mass vaccination campaign in 2009 covered 11 of 13 Districts, but excluded Bonthe and Bombali [132].
  - Filarial diseases result from infections with vector borne tissue dwelling nematodes called *filariae*. Lymphatic filariasis and onchocerciasis are the most important in this part of Sierra Leone.
    - Lymphatic filariasis, commonly known as elephantiasis, is a neglected tropical disease. It is transmitted from bites by infected mosquitoes - often from the same group that transmit malaria and most commonly, *Anopheles* spp. The disease can also be transmitted by the *Culex* mosquito, which has a preference to breed in foul or polluted water bodies more common in urban areas. In West Africa, the filarial worm responsible for the infection is *Wuchereria bancrofti*.
      - Lymphatic filariasis is widely distributed with the entire population at risk [76].
  - SRL clinic reported that:
    - SRL supported the distribution of ITNs to their workforce and selected groups in PACs, including vulnerable groups and Paramount Chiefs and their dependents. This was not done in any coordinated manner with the NMCP and it was not sure if the ITNs provided were similar to those given out as part of the national programme.
    - The community does not like using ITNs for sleeping under due to the heat, and that they are often used inappropriately (fishing and gardening).
  - Only a few cases of lymphatic filariasis have been recorded, which is considered a low risk zone.
  - Onchocerciasis is also a low risk with current efforts focused on elimination of the disease.
  - Arboviral diseases did not emerge as an issue of concern and there was no data at the District level. It was however acknowledged that diagnostic tests to detect these conditions were limited.
- Findings from FGD:**
- Malaria was unanimously and consistently mentioned among the top three ailments in the Project area – affecting both children and adults.
    - Participants attributed the high burden of malaria to: lots of mosquitoes in their surroundings, stagnant water, poor housing, and too much vegetation.
    - The majority of participants knew that malaria is transmitted by mosquito bites. There were a few misconceptions that malaria can be transmitted by drinking dirty water and eating palm oil.
    - ITN coverage was generally high with nearly all participants reporting to have at least one ITN for their household. The majority of the bed nets were received from a mass distribution campaign in June 2017. Participants also acknowledged that pregnant women and children under-5 often receive at least one ITN during routine clinic visits.
    - ITN utilisation ranged from 13% in Matagelema, 42% in Ndendemoia and 53% in Moriba Town to 100% (Gbangbama, Junctiola, and Gbangbaia).
    - Access to free treatment for malaria was limited as a result of frequent lack of medication at the local health facilities. Participants reported that they often buy anti-malarials from private pharmacies as the

- A national mapping project conducted in 2005 found an overall prevalence of 21% and a prevalence >1% in all Districts [77]. The findings are represented on map in Figure 26 [25]. Spatial distribution shows a higher prevalence in the northeast: Bombali (52%), Koinadugu (46%), Tonkolili (37%) and Kono (30%) and lower prevalence in the southwest: Bonthe (3%) and Pujehun (4%).
- Lymphatic filariasis control has been integrated with onchocerciasis control since 2006 [76].
- Onchocerciasis, or river blindness, is caused by vector borne filarial worm (*Onchocerca volvulus*). The infection is transmitted through the bite of an infected female blackfly (*Simulium damnosum*). These flies lay their eggs in the rapids of fast flowing rivers and streams that are highly oxygenated. It is endemic in 32 African countries, including Sierra Leone. Mass drug administration is currently the core strategy to eliminate the disease [79].
- Human African Trypanosomiasis is a vector-borne protozoan disease (commonly referred to as sleeping sickness) caused by *Trypanosoma brucei*, transmitted through the bite of blood feeding tsetse flies (*Glossina spp.*). *T. brucei gambiense* species occurs most commonly in West Africa. The infection remains a general public threat but no new cases have been recorded in Sierra Leone for over a decade [80].

#### **Findings from Project documentation:**

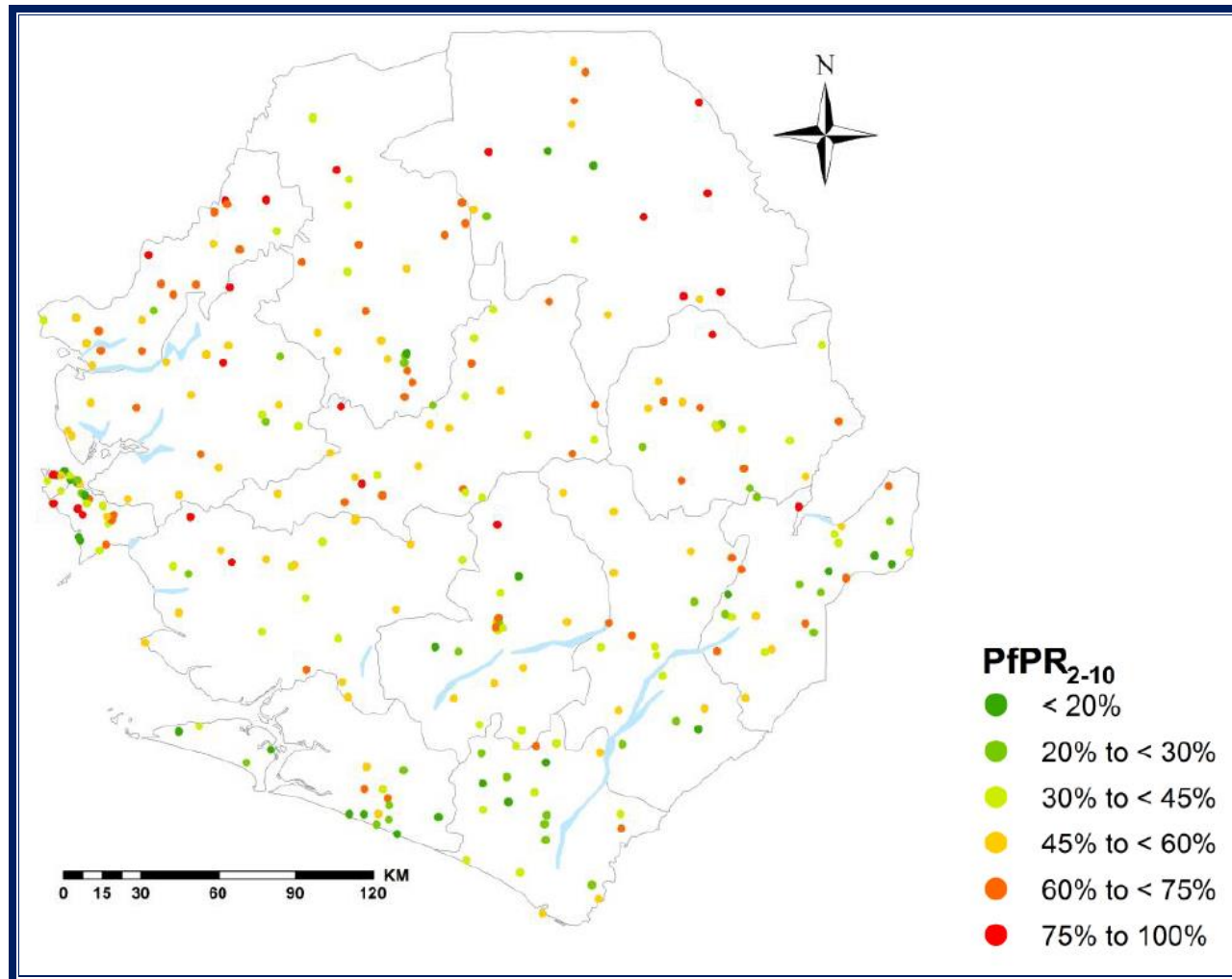
- Malaria accounts for > 20% of all cases seen at the SRL clinic, the biggest contributor to the burden of disease.
- The issues and response report had comments from stakeholders that the presence of mine ponds had increased the potential for the breeding of vectors (mosquitoes and flies) that may increase the risk for transmission of disease [146].
- The household survey conducted as part of the social baseline reported that the majority of respondents had heard about malaria, with those who had ITNs receiving them from a clinic/hospital [145].

- government facilities do not have these available.
- There was no spontaneous mention of any other vector-related disease apart from malaria.

#### **Findings from direct observations:**

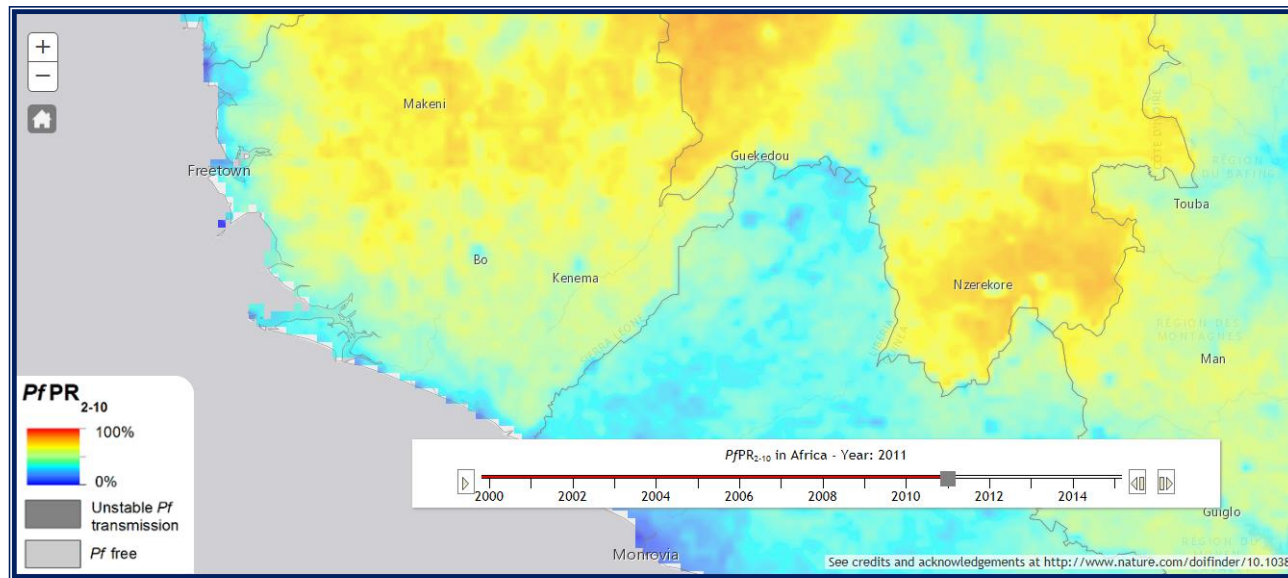
- Environmental risk factors for mosquito breeding were largely evident. The study was conducted during the rainy season and pools of stagnant water were observed in all the villages.
- Several artificial dams (mining ponds) were observed – most of these from previous wet mining activities. These are generally large water bodies, but water may pool in back waters
- The majority of dwellings were surrounded by bushy vegetation.
- None of the observed community housing structures had windows or doors screened against entry for mosquitoes.



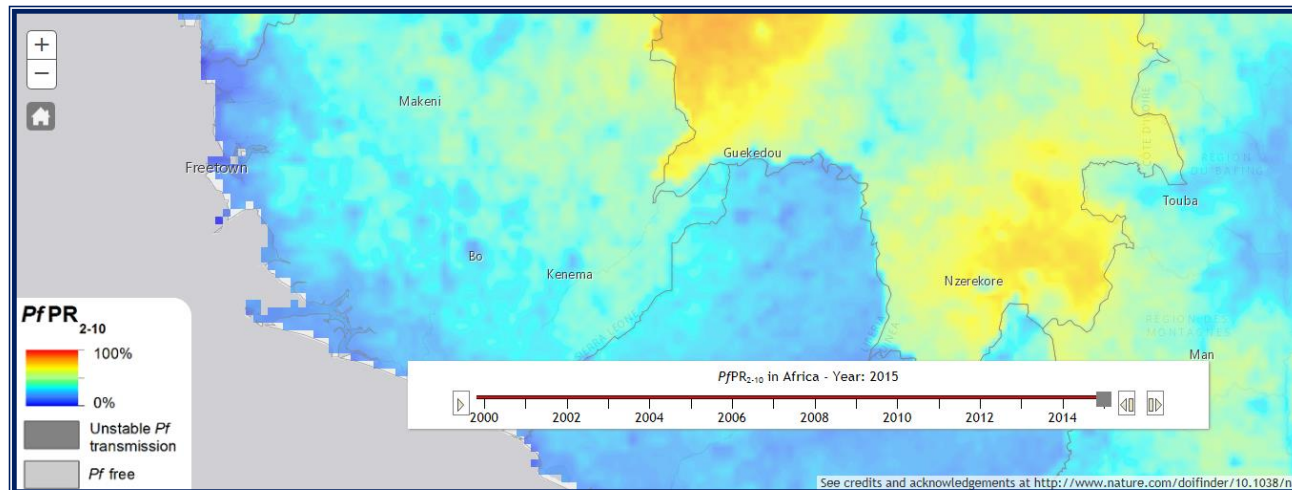


**Figure 20: Malaria : *P. falciparum* parasite prevalence, 2013**

Source: NMCP, 2015



**Figure 21: Malaria: Modelled *P. falciparum* parasite prevalence in 2-10 year olds, 2011**

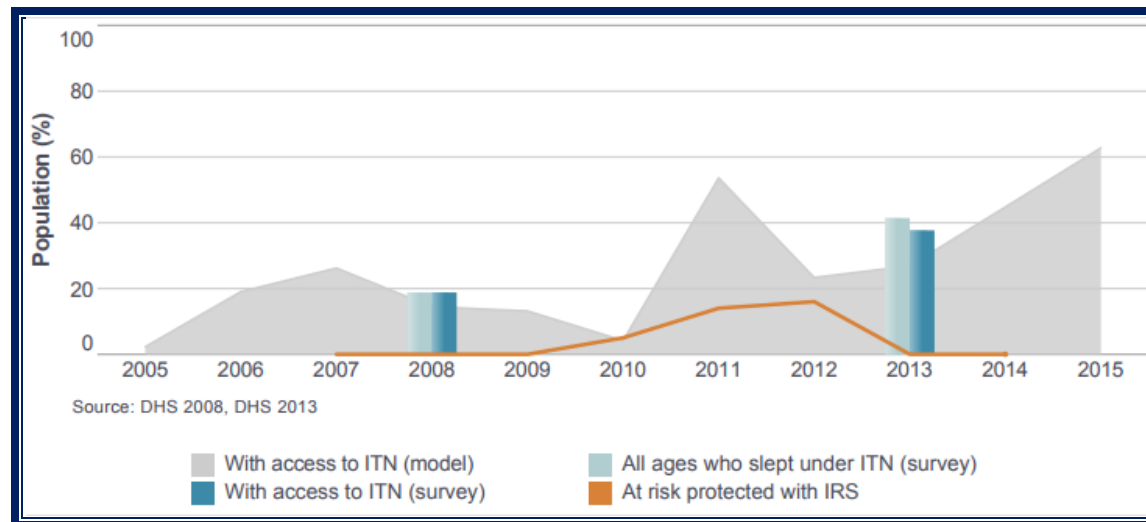


**Figure 22: Malaria: Modelled *P. falciparum* parasite prevalence in 2-10 year olds, 2015**

Intervention	Policies/strategies	Yes/No	Adopted
ITN	ITNs/ LLINs distributed free of charge	Yes	2002
	ITNs/ LLINs distributed to all age groups	Yes	2010
IRS	IRS is recommended	Yes	2010
	DDT is authorized for IRS	No	-
Larval control	Use of larval control recommended	No	-
IPT	IPT used to prevent malaria during pregnancy	Yes	2005
Diagnosis	Patients of all ages should receive diagnostic test	Yes	2010
	Malaria diagnosis is free of charge in the public sector	Yes	2010
Treatment	ACT is free of charge for all ages in public sector	Yes	2010

**Figure 23: Malaria intervention and control measures**

Source: WHO, Sierra Leone Malaria Profile 2016

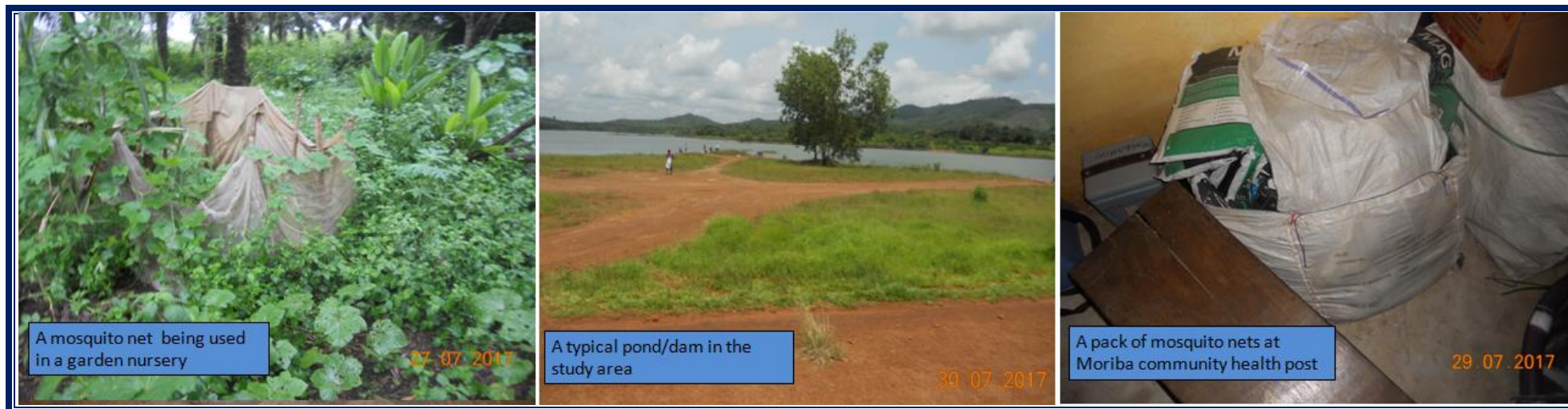


**Figure 24: National coverage of insecticide treated nets and indoor residual spraying**

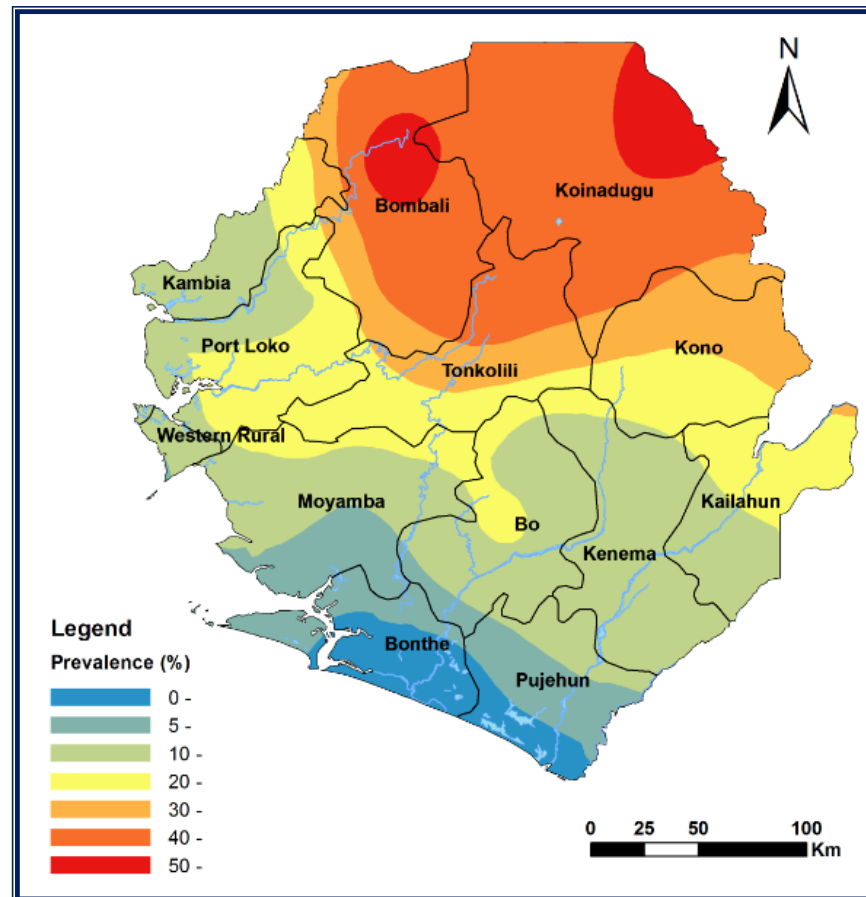
Source: WHO, Sierra Leone Malaria Profile 2016

**Table 14: Coverage of malaria control interventions in Bonthe and Moyamba Districts, 2013**

Intervention	Bonthe District	Moyamba District	National Average
ITN Coverage	72%	71%	64%
Number of ITNs per household	1.3	1.5	1.2
ITN utilisation by children under-five years	56%	59%	49%
ITN utilisation by pregnant women	59%	65%	53%
IRS Coverage	0.2%	0%	4.8%
IPT Coverage (at least one dose)	53%	71%	62%



**Figure 25: Observation picture plate 2: Vector related disease**



**Figure 26: Geographical distribution of lymphatic filariasis point prevalence in Sierra Leone.**  
Source: Koroma et al (2012).

### 11.1.3 EHA #3 Soil-, Water- and Waste-related Diseases

The prevalence of soil, water and waste-related diseases highly depend on sanitation facilities and access to safe drinking water, factors which often show strong variations at local, national and regional levels.

#### Desk-top findings

##### Findings from literature review:

- 72% of households have access to safe drinking water, an increase from 61% reported in 2013 [23, 24]. Access to improved water sources is much higher in urban (96%) compared to rural areas (44%).
- 13% (22% urban; 7% rural areas) have access to improved, not shared sanitation facility, showing relative stagnation compared to 10% in 2013 and 11% in 1990. Nearly three-quarters (74%) of the households' sanitation facilities comprised pit latrines. 13% practice open defecation [23, 24].
  - In the Southern region, 28% of households use piped water as principal source for drinking, 35% use other protected sources and 37% use unprotected sources [23].
  - 6% of households in the Southern region use improved sanitation facilities, 60% use pit latrine, 31% practice open defecation and 3% use other means (bucket, etc.) [23].
  - Table 15 shows the coverage of safe drinking water and sanitation in Bonthe and Moyamba Districts. There is a similar coverage of improved water and sanitation sources, but Bonthe has a far lower coverage of any form of latrine and far higher rate of open defecation (4 times the national rate) [23].
- Diarrhoeal disease is the 2<sup>nd</sup> leading cause of death in children under-5 years globally. The disease is largely attributed to three major environmental causes; poor sanitation, poor hygiene, and contaminated water and food [81].
  - Globally, diarrhoeal disease ranks among the top-five causes of disease burden and is responsible for an estimated 14% of deaths among children under-5 years [37].
  - Findings from the 2013 SLDHS show that 11% of children under-5 experienced diarrhoea in the 2 weeks preceding the survey, including 3% with dysentery. Cases were highest among children age 6-23 months. Two-thirds of the children with diarrhoea received treatment. 14.8% of children in Moyamba and 3.9% in Bonthe experienced diarrhoea within the 2 weeks before the survey [24].
- Cholera, a disease caused by the bacteria *Vibrio cholerae* is the main cause of dehydrating diarrhoea in adults. The disease is endemic and has caused several outbreaks. The last major cholera outbreak occurred in 2012 affecting 12 of the 13 Districts (including Bonthe and Moyamba) with a total of 20,736 confirmed cases and 280 deaths [82].
- Typhoid fever is a severe febrile illness that follows infection by a gram-negative bacillus,

#### Field based findings

##### Findings from KSI:

- Poor access to safe drinking water and inadequate sanitation was listed among key risk factors for disease burden in the Project area:
  - It was reported that less than half of households have access to improved water sources – principally boreholes and protected deep wells. The other half relies on unsafe sources such as shallow wells and surface water (rivers, ponds and dams).
  - The Moyamba District public health superintendent indicated that very few households in the area have sanitation facilities and that open defecation was prevalent. The District is implementing initiatives to improve sanitation coverage including sensitisation and planning of introduction of low cost latrine structures.
- Diarrhoeal disease was mentioned among the top 5 ailments seen at the local health facilities. However, cases were decreasing, as a result of widespread adoption of hygiene practices such as hand washing (after the EVD outbreak).
- Cholera remains an important risk in the area, with the last outbreak occurring in 2012.
- Typhoid fever was reported to be highly prevalent in the Project area. However, it was acknowledged that this may be over reported as the diagnostic tools used in the health facilities (Widal test) cannot confirm the diagnosis and many of the reported cases were likely to be false positives. Despite this, the Moyamba DHMT considered typhoid as an important local disease.
- STHs are prevalent in the area. This was attributed to low coverage and utilisation of toilet facilities. A MDA deworming programme is in place targeting preschool and school-age children. This has reduced the burden.
- Bilharzia also occurs in the area, the key predisposing factor being contact with contaminated surface water in ponds or streams.

*Salmonella spp.* The disease continues to be a public health problem. Transmission is via ingestion of food or water contaminated by infected faeces. Typhoid is expected to be endemic in the Districts, given the underlying poor coverage of safe drinking water and sanitation.

- Schistosomiasis, also known as bilharzia, is a neglected tropical disease caused by parasitic trematode worms of the genus *Schistosoma*. Two common forms of the disease occur in Africa: the urogenital form (caused by *Schistosoma haematobium*) and the intestinal form (caused by *S. mansoni*). Infection is prevalent in tropical and sub-tropical areas, especially in poor communities without potable water and adequate sanitation:
  - Bilharzia is an important disease especially in 6 Districts (Kono, Koinadugu, Kenema, Kailahun, Bo and Tonkolili) according to a mapping survey conducted in 2008. Both forms of the parasite occur [83, 84].
    - The risk is higher in the north-eastern half of the country (Figure 27). Low risk areas (<10% prevalence) occupy most of the coastal and central Districts, which includes the Project area.
    - Past surveys have shown that Moyamba and Bonthe Districts fall within low risk areas for bilharzia with an estimated prevalence of <10%.
- Soil Transmitted Helminthiases (STH) or intestinal worm infection is the most common parasitic infection worldwide, often affecting the most deprived communities. The common helminths are roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*) and hookworm (*Necator americanus*). Infection is caused by ingestion of eggs from contaminated soil or by active penetration of the skin by larvae in the soil (hookworms):
  - STH are endemic nationally and their transmission by contact with human faeces in the soil is promoted by the lack of adequate sanitation. Studies have shown a high prevalence of up to 96% in school children nationwide [83].
  - STH is highly prevalent in 5 coastal Districts justifying the need for biannual preventive deworming treatment following MDA principles and targeting pre-school, school-age children and at risk adults. The remaining areas are at moderate risk of STH infection, justifying the need for annual mass treatment of children at risk [83].
  - Figure 28 [85] shows the prevalence of STH with Bonthe and Moyamba Districts with a high overall prevalence of >20%.
- Buruli ulcer is thought to be common, but the burden of disease is not well known. The disease is caused by *Mycobacterium ulcerans*, a bacterium related to the causative agent of TB and leprosy. It has been found elsewhere that its prevalence is higher in environments with raised arsenic levels in surface water and soil [86].
- Poliomyelitis (polio), a highly infectious viral disease which mainly affects children, is transmitted through contaminated food and water and multiplies in the intestine from where it can invade the nervous system. There is no cure for polio and it can only be prevented by vaccination.

- SRL clinic reported a few relevant opinions:
  - Typhoid was reported as one of the most common conditions, noting the relative limitation in the diagnostic technique used.
  - The general hygiene and sanitary situation in both Moriba Town and Mogbwemo was poor, with refuse disposal a major problem as are the lack of sanitary facilities.
    - A mass outbreak of cholera or dysentery cannot be recalled, with only isolated cases reported, but the potential for a significant outbreak is considered to be high.
    - The high rates of disease are influenced by the poor environmental and sanitary conditions

#### **Findings from FGD:**

- Poor access to safe drinking water emerged as a major theme:
  - Sources of drinking water varied from boreholes with hand-pumps, protected wells, shallow wells, dams and streams. Rain water was only available during the wet season and collected in containers during rains, rather than harvesting into storage tanks.
  - Moriba Town was reported to have only one functional borehole. Mogbwemo had several functional boreholes and protected deep wells. Some of the villages had boreholes that were not functional (3 in Matagelema, 2 in Ndendemoia, 1 in Gangama). In Foinda, there was only 1 borehole (hand-pump) and 3 wells.
  - Use of surface water for drinking was reported in Gangama (river water) and Matagelema (mine pond water). The other villages reported that they use mine pond water only for bathing and washing.
- Few households have sanitation facilities – predominantly pit latrines:
  - Ownership and use of sanitation facilities was higher in the urban settlements (Moriba Town, Mogbwemo, and Matagelema) and lowest in the more rural villages.
  - Open defecation is prevalent in the Project area (in all the villages). In Gangama village it emerged that there were no toilet facilities while in Foinda there were only 2 latrines.
- Diarrhoea was mentioned among the most common ailments affecting young children in the Project area.
- Disposal of household waste was a challenge. Some households had garbage pits while others burnt or disposed waste near the dams, in the

- Sierra Leone was granted provisional polio-free status in 2007. However, 11 cases of the wild poliovirus type 1 were confirmed in 2009 and another case in 2010 risking a reversal by the WHO of its polio free status.
- Polio eradication strategies in the country include routine oral polio vaccination and acute flaccid paralysis surveillance.
- The hepatitis A virus is the most common viral cause of hepatitis worldwide and is hyper-endemic in many parts of the developing world. Transmission is via the faecal-oral route including ingestion of contaminated food or water. Childhood infection is mild or subclinical but infection as an adult can be severe and result in symptoms of acute hepatitis. Due to the prevailing low sanitation coverage, the virus is expected to be endemic nationally even though statistics are scarce.

#### **Findings from Project documentation:**

- A 5-year project that was supported and funded by SRL was implemented prior to the war by the NGO, Care. This involved the construction of 56 water wells and 1,785 pit latrines in 41 villages. Some of this infrastructure was destroyed during the war or is no longer used by residents due to suspicions of contamination, particularly for those wells without hand pumps [35].
- A shortage of latrines was also reported in the Project area, with many residents disposing of human waste in the bush (open defecation).
- Household refuse was burnt, dumped into compost, or disposed of in the bush [35].
- In the issues and response report, provision of safe drinking water was noted as a community development need [146].

bush or garden. There were no garbage collection services.

#### **Findings from direct observations:**

- Various types of water sources were observed in the area – mainly hand-pumps and protected deep wells. Some of the hand-pumps were not functional.
- The environment in most of the settlements was generally clean. In some communities' garbage was piled up in designated areas.
- Pit latrines were the predominant form of sanitation facility, where these facilities were in fact available.
- SRL has provided water tanks in Foinda village as the community has expressed concern that their normal drinking water sources have been contaminated by mining activities.
- On observation during the field visit the mine ponds were not used for any commercial purpose, but people using the water bodies to wash clothes and vehicles was noted.

**Table 15: Coverage of safe drinking water and improved sanitation in the Project area Districts, 2015**

Indicator	Bonthe District	Moyamba District	National Level
Improved sources of drinking water (% of households)	45%	44%	72%
Improved sanitation coverage (% of households)	4.3%	3.3%	13%
Latrine/toilet coverage (any type)	42%	72%	76%
Open defecation (% of households)	58%	28%	13%

Source: Statistics Sierra Leone, 2015 National Census



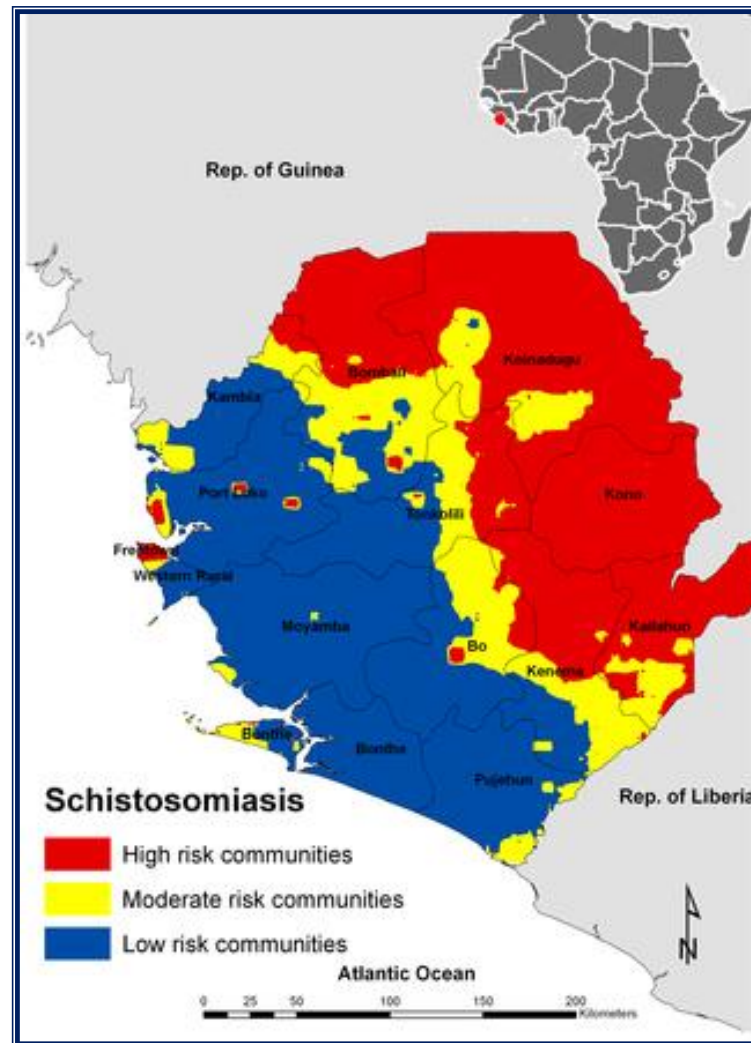
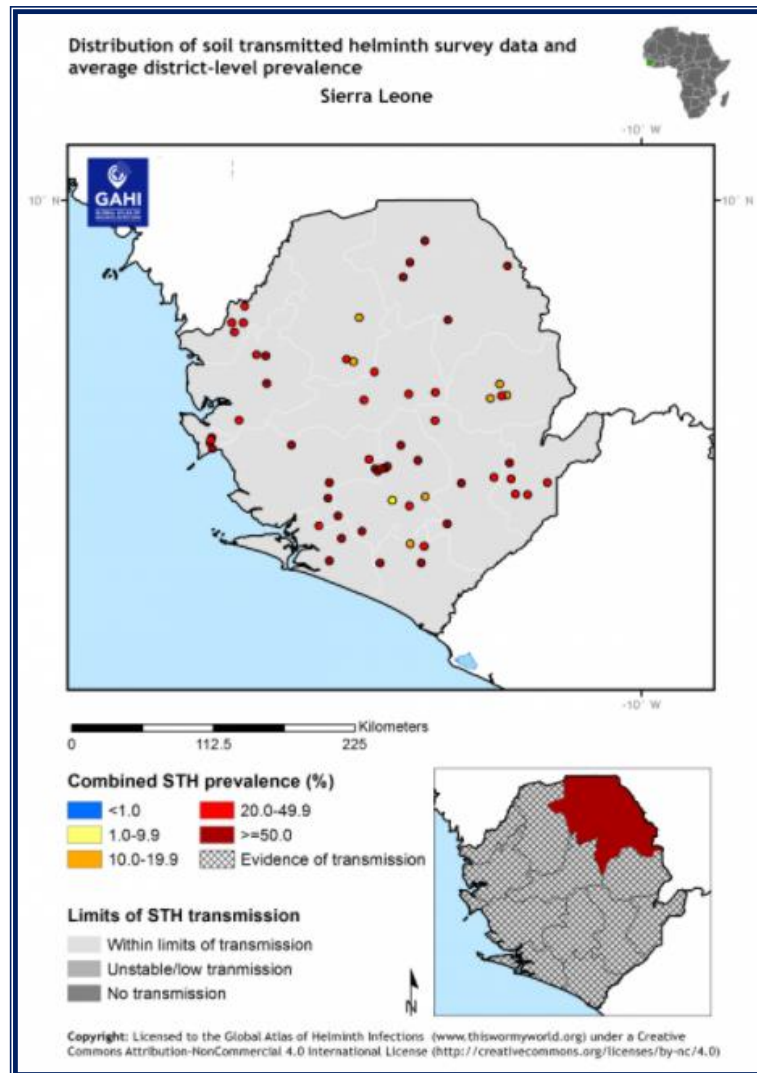


Figure 27: Spatial variation in combined bilharzia prevalence in Sierra Leone, 2010.

Source: Hodges et al (2012)



**Figure 28: Prevalence of soil transmitted helminth in Sierra Leone**  
Source: Global Atlas of Helminth Infection (GAHI), 2017



Figure 29: Observation picture plate 3: water and sanitation

### 11.1.4 EHA #4 Sexually-transmitted Infections including HIV/AIDS

Mining and related developments in developing countries have a well described legacy of increasing transmission of these diseases as a consequence of various social and economic impacts.

Desk-top findings	Field based findings
<p><b>Findings from literature review:</b></p> <ul style="list-style-type: none"> <li>• HIV/AIDS remains a global epidemic and 69% of the approximately 37 million people living with HIV/AIDS are in Sub-Saharan Africa [87]. There is neither a vaccine nor cure for HIV infection, however, effective treatment with anti-retroviral therapy can control the virus and prevent or delay progression to AIDS.             <ul style="list-style-type: none"> <li>○ The first case of HIV/AIDS in Sierra Leone was diagnosed in 1987. In response, the government has taken great efforts to address the epidemic. Although programmatic data is gathered annually, the most recent behavioural and epidemiological studies related to HIV/AIDS is from the 2013 SLDHS, the 2014 ANC Sentinel Surveillance report and the 2013 Bio-Behavioural Sentinel Survey [30].                 <ul style="list-style-type: none"> <li>▪ According to the 2013 SLDHS, 1.5% adults age 15-49 are HIV-positive [24]. Latest estimates (2015) put the prevalence at 1.25% [30].</li> <li>▪ The prevalence is higher among women (1.7%) than men (1.3%), higher in urban (2.3%) compared to rural areas (1.5%), among widows and those who are divorced or separated (2.9%) and among those in concurrent sexual partnerships (2.2%) [24].</li> <li>▪ In the 2013 SLDHS, the Western region recorded the highest HIV prevalence at 2.7%. By District, Western Rural had the highest HIV prevalence, at 3.3%. Bonthe and Moyamba Districts both recorded a low prevalence of 1.3% [24].</li> <li>▪ HIV incidence rate stands at 0.4% nationally. The number of new infections is steadily decreasing, following a peak in 2000-2005 [36].</li> </ul> </li> <li>○ According to a Modes of Transmission Study conducted in 2010, the key populations for HIV transmission are sex workers, their clients and partners, men who have sex with men, and miners [30].</li> <li>○ Figure 30 shows a summary of national HIV indicators, based on 2015 estimates [30].</li> <li>○ Figure 31 shows the trend in new HIV infections, with the peak in early 2000's and gradual decline over the years [30]</li> <li>○ Awareness of HIV/AIDS is generally high: more than 90% of men and women in all 4 regions have heard about AIDS [24].                 <ul style="list-style-type: none"> <li>▪ In 2013, 25% of women and 31% of men have comprehensive knowledge about HIV/AIDS prevention and transmission.</li> </ul> </li> </ul> </li> </ul>	<p><b>Findings from KSI:</b></p> <ul style="list-style-type: none"> <li>• HIV/AIDS was mentioned among public health concerns in the Project area, though the burden was generally low. The Moyamba DHMT identified 'mining areas' as a hotspot for HIV infection, with prevalence higher than the District average of 1.3%.</li> <li>• STIs were reported as a significant challenge. Gonorrhoea was specifically mentioned as a frequent diagnosis. Cases of syphilis are also recorded. Mining areas were identified as hotspots for the transmission of STIs.</li> <li>• At the Moriba Town community health post, it was reported that STIs - particularly gonorrhoea - are among the top-5 diagnoses in adults. The facility records 7-10 cases of STIs per month. This often necessitates contact tracing and treatment, which is not always possible. It was thought that stigma and concerns related to confidentiality would affect health seeking behaviour in STIs, with patients potentially seeking treatment from street pharmacies or traditional medicine. They may also travel out of the immediate area to seek treatment.</li> <li>• Contributing factors to the high burden of STIs were identified as:             <ul style="list-style-type: none"> <li>○ Cultural practice of polygamy – related more commonly to Muslim sectors of the community.</li> <li>○ Multiple sexual partnerships.</li> <li>○ Mining areas promote influx of people and increase in commercial or transactional sexual activity.</li> <li>○ Low uptake of condom usage despite free availability at all health facilities.</li> </ul> </li> <li>• Hepatitis B vaccine (a component of pentavalent vaccine) is routinely administered to children with coverage recorded above 80%.</li> <li>• Blood for transfusion is routinely screened for hepatitis B infection (data of prevalence was not available).</li> </ul>

- This comprehensive HIV knowledge has increased from the 2008 finding of 14% and 24% in women and men, respectively.
  - Comprehensive knowledge about HIV in both Districts was generally low; 28% among women and men in Bonthe; and 15% among women and 38% among men in Moyamba [24].
- Uptake of voluntary HIV Counselling and Testing is still generally low: 38% of women and 14% of men have ever been tested and received results. Compared to 2008, the uptake of testing has increased from 13% and 8% among men and women, respectively [24].
- Condom utilisation is very low, 12% among men and 5% among women acknowledging to using a condom with multiple sexual partners [24].
- Transactional sex work is practiced more commonly by men as clients, with rates higher in Moyamba (18%) compared to Bonthe (8%) [24].
- Sierra Leone established the National HIV/AIDS Secretariat (NAS) in 2002 by an act of Parliament to coordinate a multi sectoral effort to reduce the spread of HIV and mitigate the potential developmental threat. A clear mission statement is spelt out including the development, implementation and coordination of an effective strategic plan that addresses prevention, treatment, care and assures the protection of human rights. This includes fostering linkages among partners, spearheading advocacy, national planning and monitoring, development of guidelines and technical assistance and promoting HIV/AIDS related research. Important elements and information include [88]:
  - Key partners include:
    - The Global Fund Sierra Leone was set up in 2005 as a funding agency to complement existing programmes, such as the Sierra Leone HIV/AIDS Response Project that was funded by the World Bank, with NAS as the principal recipient, together with 51 implementing partners including groups such as NGOs (Marie Stopes, CARE) various faith-based groups. The country is currently in the last year of Round 4 funding, with Round 6 having 3 more years.
    - Others including the International Labour Organisation, UNICEF and UNAIDS.
  - There are 2 major national plans that are guiding the current response to HIV/AIDS:
    - National HIV and AIDS Monitoring and Evaluation Plan: 2016-2020 [89].
    - Sierra Leone National Strategic Plan on HIV/AIDS 2016-2020 [90].
  - With regard to prevention and control, key interventions are implemented nationwide through the National HIV/AIDS Control Programme which functions under the Directorate of Disease Prevention and Control under the MoH&S. The programme works in close partnership with the DHMT, UNICEF, WHO and various NGOs, with interventions including [25, 88]:
    - Voluntary testing: there are currently 386 counselling and testing centres across the country, with testing free of charge using rapid HIV antibody tests.
- The Bonthe DMO reported that [136]:
  - Polygamy and multiple sexual partnerships were common, with both men and women having at least 2-3 boy/girlfriends.
  - Burden of disease or prevalence of HIV in the Project area was far higher than reported. This was regarded as a very serious issue in the District, with the area around Moriba Town especially a hot spot, as it was a 'mining town', with poverty and ignorance being added drivers to high risk sexual behaviour.
  - Sex is sold for material gain in the bigger towns around the Project area. The civil war also affected transactional sexual practices, as orphans resorted to this practice as a form of livelihood.
  - Teenage pregnancy was however not considered to be a major issue, although this contradicts what other key stakeholders mentioned.
  - STIs that were becoming increasingly resistant to standard treatment antibiotic regimes, were emerging.
  - There is a large nursing school in Mattru that attracts men from around the country in search of young single women. These young girls were highly vulnerable to advances of men with money, which leads to numerous 'transactional' sexual type relationships. It was apparently not uncommon to have many cases of STIs (even HIV) amongst nursing students. The DMO thought this relevant as young girls may be similarly vulnerable to advances from men with money around the mine.
- SRL clinic:
  - The NAS have a portion/room in the clinic where their activities are conducted from. While there appears to be a good relationship with the individual and other than joint advocacy activities to celebrate World AIDS Day (1<sup>st</sup> of December annually), there is limited insight or involvement of the clinic or community relations staff in the programme, planned activities, metrics, challenges etc.
  - The NAS staff are contracted and paid by the government but there appears to be limited integration of outreach health activities between the various public health facilities in the Project area.
  - It was reported that HIV was routinely tested for during pre-employment medical examinations (as a compulsory test). While apparently it does not influence the decision regarding employment, individuals who have tested positive, are obliged to take ART.

- ART: Drugs are procured through Global Fund resources and due to doctor shortages, nurses have been trained to dispense ART, with 111 private and public health centres providing this medication to patients. The availability of free ART has reportedly led to an increased uptake of HIV Counselling and Testing and a reduction in stigma
  - Prevention of mother-to-child transmission was adopted in 2002, with ART prophylaxis introduced for pregnant women and babies introduced in 2007. A number of goals have been set and by the end of 2009, 5% of the facilities offering antenatal, delivery and postnatal services were offering prevention services. 51% of positive pregnant women have received a complete course of ART prophylaxis. In rural areas, the programme works closely with traditional birth attendants.
  - Blood safety initiatives in conjunction with the National Safe Blood Service. The programme is a recipient of Global Fund funding, with the target that 100% of donated blood is screened for HIV/AIDS, syphilis, hepatitis B & C. 27 blood transfusion centres are monitored and supported.
  - Condom advocacy and promotion (male and female) as part of prevention: Condoms are reportedly distributed freely and with social marketing and are generally available through all District health centres and clinics. There is a Business Coalition Against AIDS in Sierra Leone who is reportedly supporting advocacy for condom distribution in the workplace.
  - Care of orphans and vulnerable children.
  - Syndromic management of STIs.
  - Management of opportunistic infections
  - Management of medical waste
  - IEC and BCC.
- STIs are an important global health priority because of their devastating impact on women and infants, and their interactions with HIV/AIDS. Infection with certain STIs can increase the risk of HIV, as well as alter the progression of HIV.
    - Statistics on prevalence of STIs are scarce. Data from the 2013 SLDHS show that 23% of women and 14% of men age 15-49 years experienced an STI or related symptoms/signs during the 12 months preceding the survey [24].
    - Findings from the 2013 SLDHS show that 18% of women and 11% of men in Bonthe and 17% of women and 18% of men in Moyamba experienced an STI or related symptoms/signs during the 12 months preceding the survey [24].
  - Hepatitis B virus infection is the largest cause of acute and chronic liver disease, globally. An estimated 240 million people are chronically infected and about 780,000 die each year from the infection. It is predominantly transmitted through sexual contact, contaminated blood products, or trans-placentally from mother to child; in a similar fashion to HIV. The virus far more infectious than
    - HIV prevalence rate in the workforce is about 3-4%, higher than the District or national averages.
    - Prevention of mother to child transmission is offered at the NAS centre as a referral from the SRL clinic if discovered during routine antenatal care. There is an option to opt out of ART but the uptake is reportedly good. The clinic does not have insight into the rates of HIV at antenatal care or the effectiveness of the prevention of mother to child programme.
    - HIV Counselling and Testing is available through the NAS, but while there is no insight into the level of uptake, it was anticipated to be low as stigma was common.
    - SRL has procured a CD4 analyser unit to assist in treatment decisions, but it is not functional yet as reagents are still being procured by the NAS.
    - Condoms:
      - Are available in the SRL clinic and these are distributed to both Kpanguma and Mobimbi camps by the camp facilities management company ATS. However, condoms were not noted in any public areas in Mobimbi camp (bathrooms, gym etc.) nor in workplace areas.
      - The clinic has a discreet condom dispenser in the pharmacy as there is a stigma is openly asking for condoms. While no statistics are available uptake is reported to be high.
    - Situation in Moriba Town and Mogbwemo [135]:
      - There are numerous entertainment areas and the impression of the settlements is one of where commercial sex work, drugs and alcoholism are common.
      - Girls from other places come into the area to look for sex work opportunities, but transactional sex also occurs as a form of livelihood for local women given the high levels of poverty.
      - It was not uncommon for commercial sex workers to extort money from SRL workers/contractors, with the community relations team needing to intervene in the situation at times.
- Findings from FGD:**
- STIs emerged a major theme in most of the discussions particularly in Moriba Town, Mogbwemo, and Matagelema.

HIV. A safe, effective vaccine is available, but currently, there is no cure [91].

- HBV is a high risk, alongside other hepatitis viruses (A, C and E) [92].
- Routine vaccination is included in the childhood immunisation package with a coverage of 86% in 2015 [25].

#### **Findings from Project documentation:**

- The SRL clinic has partnered with the NAS and is a registered HIV/AIDS control programme centre. It is staffed by a NAS health professional (Diploma in HIV management) who supports the programme objectives. These local programme interventions are described in more detail in the KSI section.
- In 2012, SRL conducted a HIV prevalence and behaviour survey in partnership with the NAS, the ILO AIDS and the OFIC (OPEC Fund for International Development), with the following key findings [138]:
  - SRL's response to HIV/AIDS was initiated in 2006, within the HSE department, and as part of the company's CSR strategy. This was supported by the United Mine Workers Union and co funded by the OFID-ILO partnership programme. SRL has a policy on HIV/ AIDS in the workforce (reported to be the first mining company to do so nationally, based on international best practice).
  - The report was the second biological and behavioural surveillance performed, and it was conducted with the aim of defining the current baseline and what intervention strategies could be used to strengthen the SRL's programme to "*start a reversal in the HIV prevalence rate*". The survey focussed on company employees and contractors, but evaluated links between workers and the community.
  - Due to the social dislocation from the civil war, a significant number of employees stay at the mine site away from their spouse and family.
  - Mine workers and the SRL mining community is a high risk environment for the transmission of HIV due to opportunities for multiple sexual partnerships, transactional sex and low rates of condom use.
  - In the first study (in 2007) conducted on mine workers across the country (in which SRL participated), the HIV prevalence was noted to be 1.1%, but with SRL having a disproportionately higher prevalence at 2.4%.
  - Both quantitative (from questionnaires) and qualitative (KSIs and FGDs) data was collected with the following findings:
    - Demographics: 77.5% of the sample were male, 32.3% were single and 44.6% non-

- Participants reported that polygamy is very common and generally an accepted cultural practice.
- Multiple sexual partnerships emerged a big issue with women claiming that most of the men are not faithful, and also admitting that women also have extramarital affairs. Women reported that in the context of polygamy, the men are less available for them hence they (women) "have to compensate" by having other partners.
- Transactional sex is common in the area. Women in Moriba Town, Mogbwemo and Matagelema indicated that it is very common for men to "pay for sex" and that women (some of them identified as commercial sex workers), often target mine employees because they "have more money". It was also reported that workers from SRL and VIMETCO are clients.
- In rural villages (Foinda, Gangama, Junctiola, Gbangbama and Gbangbaia) it was reported that outright commercial sex work was not common, but the women often receive some "token of appreciation from their other partners", affirming the practice of transactional sex.
- Participants in Moriba town and Mogbwemo reported that the mining boom in the area has attracted commercial sex workers from other parts of the country. This is further facilitated by increasing presence of lodges and night clubs.
- Condoms were reported to be available for free at the local health facilities, and on sale at shops and private pharmacies. Condom utilisation was generally very low with women indicating that "men don't like to use condoms" and that "only God can protect us".
- HIV testing was available for free at the local peripheral health units but the uptake was generally low, citing "fear of knowing status".

#### **Findings from direct observations:**

- Multiple pubs and lodges were evident in Moriba town.
- A big night club was present in Mogbwemo, and a vibrant social night life was reported.

migrant workers.

- The overall HIV prevalence was 2.4%, with males higher (1.5%) compared to females (0.9%)<sup>11</sup>. Ages between 25-29 years appear to be the most affected. The assumption is made that as the prevalence rate in workers has remained stable at 2.4% that the company's programme is paying dividends.
  - Condom use was relatively low (37% in men; 41% in women) given the higher proportion of single people, with condom use in multiple sexual partnerships low at 39%. 51% agreed that it was easy to obtain condoms in the workplace (with a high proportion obtaining condoms at the SRL clinic (69.4%)). Use of condoms to prevent STIs was reported in 76% of responses, compared with 21% responding that they used it to prevent pregnancy.
  - In the 6 months preceding the survey, 49% of respondents (39% male and 10% females<sup>11</sup>, reported to have experienced STI symptoms, 62% of those seeking treatment. 41% of these sought treatment at the SRL clinic.
  - HIV knowledge was good, with the SRL clinic reported as the primary source of information. No disaggregation was done to check consistent responses. Stigma was still relatively high, with 31% reporting that they would not have anything to do with a person known to be HIV positive.
  - When asked about personal HIV vulnerability, 42% indicated that there was no chance of being HIV+, with 31% and 27% low and moderate risk, respectively. 64% reported changing behaviours to reduce risk, but the proportions of actual self-reported safe sex practice was low. Good knowledge has thus not necessarily resulted in effective behaviour change.
  - In terms of the HIV response, all respondents agreed that there was goodwill from SRL management and a large proportion had good trust in the SRL clinic, but this dropped to < 50% when asked about the thoroughness of examinations and levels of privacy. There was an identified opportunity to address gaps in healthcare service provision to be in line with packages offered by government services, including X-ray facilities, TB diagnostics and specialised blood tests (CD4 counts).
- Recommendations were made in the report, but while the scope of the assessment was not to audit the HIV programme, it would appear that some of these proposed interventions have not

<sup>11</sup> This data validity is concerning as the gender splits should not total 2.4% but a proportion of the overall mean. It would be useful to view the raw data to validate this. There is the potential that the denominator has been incorrectly applied. For reported experience of STIs symptoms the likely correct figures would be; women at 44% and men at 50.5%.

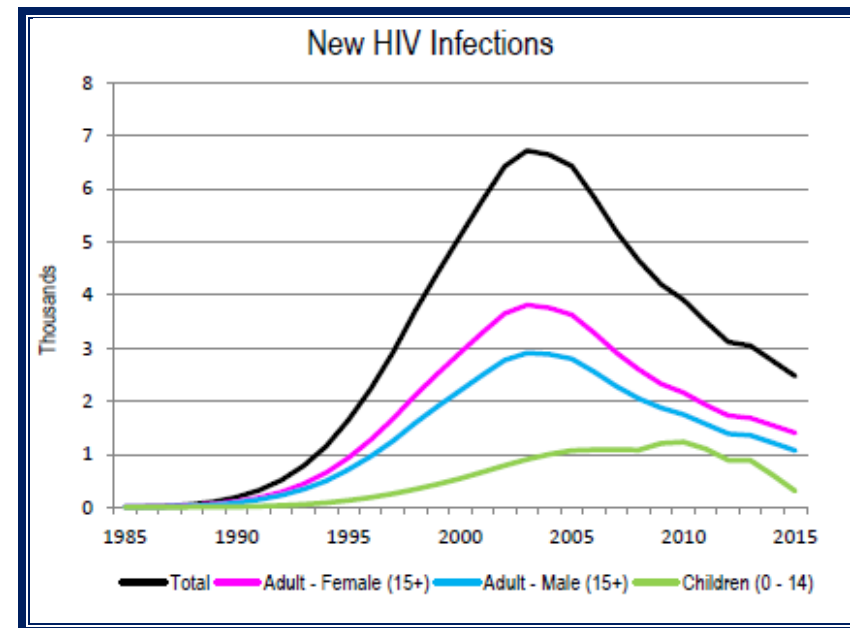


been realised as yet.

- Documents noting activities during the commemoration of World AIDS day were presented, that includes awareness activities and HIV Counselling and Testing linked to sporting activities.
- The household survey completed as part of the social baseline reported that polygamy was more common in respondents that reported a Muslim religion, but that monogamy was in the majority [145].
- The household survey also sought to understand some key indicators on HIV / AIDS knowledge, behaviours and practices as described in Table 16 , with key findings [145]:
  - Adequate knowledge was low across a number of questions, with 49% not thinking that condom use could be protective, 77% consider HIV could be transmitted by mosquito bites and 89% consider HIV could be transmitted by sharing food. Based on various misconceptions it is evident that consistent knowledge was very poor, with this limiting effective behaviour change. The effectiveness of the NAS outreach programmes in the community are also of concern based on these findings.
  - Knowledge was better on transmission from mother to child and the benefit of medication in managing a HIV infection.
  - Indirect stigma was low with 87% prepared to buy food from a known HIV infected person, but direct stigma was high with 45% reporting that they would keep it a secret if a family member contracted HIV.
  - 58% of respondents reported that they had tested for HIV during their last pregnancy.

Indicator	Estimated Value
HIV Population (Adults + Children)	50,885
HIV Population (Adults 15+)	46,486
HIV Population (Children)	4,399
Prevalence Adult (15+)	1.25
New HIV infections- Adult	2,166
New HIV infections- Children	304
Need for ART- Adult (15+)	27,594
Need for ART- Children	1,894
Mothers needing PMTCT	3,854
AIDS orphans	22,870
Annual AIDS deaths	2,502

**Figure 30: Summary of HIV indicators in Sierra Leone, 2015**  
Source: MoH&S, 2015



**Figure 31: National trends in new HIV infections**  
Source: MoH&S, 2015

**Table 16: Key HIV and AIDS indicators from social baseline household survey**

	Yes		No	
	Frequency	Percent	Frequency	Percent
People can reduce their chances of getting HIV/AIDS by having just one uninfected partner who has other partners	74	87.1	11	12.9
People can reduce their chances of getting HIV/AIDS by using a condom every time they have sex	43	50	42	48.8
People can reduce their chances of getting AIDS by abstaining from sex	79	92.9	6	7.1
People get HIV/AIDS from mosquito bites	66	76.7	19	22.1
People get HIV/AIDS because of witch-craft or supernatural means	23	27.7	60	72.3
People get HIV/AIDS by sharing contaminated injected needles, sharps/razors	10	12.2	71	86.6
People get HIV/AIDS by sharing food	73	89.0	9	11.0
The AIDS virus can be transmitted from mother to baby during pregnancy	23	27.7	60	72.3
The AIDS virus can be transmitted from mother to baby during delivery	68	81.9	15	18.1
The AIDS virus can be transmitted from mother to baby during breastfeeding	71	85.5	12	14.5
There are special drugs that a doctor or a nurse can give to a woman infected with the AIDS virus to reduce the risk of transmission to the baby	71	86.6	11	13.4
It is possible for a healthy-looking person to have HIV/ AIDS	69	84.1	13	15.9
I would buy fresh vegetables or fruit from someone who has HIV/ AIDS	71	86.6	11	13.4
Would keep it a secret if a family member gets HIV/AIDS	35	44.9	43	55.1
Something has been done in this community specifically to prevent HIV/Aids	39	47.0	44	53.0
Institutions doing HIV Programmes/interventions	482	85.6	53	9.4

### 11.1.5 EHA #5 Food- and Nutrition-related Issues

While mining plays an important role in national domestic product, two-thirds of the population survives on subsistence agriculture, which represents more than half of the national income. The 2015 National Census found that 56% of households are engaged in agriculture (85% practice crop farming, 74% engage in livestock keeping, and 34% in fishery) [23].

#### Desk-top findings

##### Findings from literature review:

- According to the results of the 2015 Sierra Leone Comprehensive Food Security and Vulnerability Analysis (CFSVA) [93], >50% of population, (> 3.5 million people), are food insecure. Of these, 600,000 (17%) are severely food insecure, and unable to cope with new shocks (e.g. drought, floods and fluctuating food prices). The number of severely food insecure people has increased by 60% since 2010. The Districts of Kailahun, Kambia, Port Loko, Pujehun, and Tonkolili have the highest levels of food insecurity.
- Levels of food insecurity doubled from the 2010 CFSVA in the Districts of Bombali, Bonthe, Kailahun and Kenema [93].
- While the EVD outbreak accounted for the decline in food security in some Districts, in the majority of Districts, food insecurity is a chronic problem, caused by deficiencies in the food production system [93].
- Figure 32 shows the food security situation in the Districts based on results of the 2015 CFSVA. Both Moyamba and Bonthe have very similar levels of food security, with those who are severely food insecure just less than the national average, with other indicators worse and even with the national average. 8.9% and 5.5% were food secure in Moyamba and Bonthe Districts, respectively [93]
- Malnutrition is one of the largest contributing factors to child mortality in less developed countries. Socio-economic, climate, geography, agricultural and many other factors all contribute to malnutrition. It develops due to a combination of insufficient intake, mal-absorption and increased energy requirements. There is often interplay between malnutrition and ill health. Children's nutritional status has a positive correlation with the mother's health, mother's education, and household wealth. Key findings include:
  - Anthropometric indicator definitions:
    - Stunting (too short for age): reflects failure to receive adequate nutrition over a long period of time (chronic malnutrition).
    - Wasting (too thin for height): reflects recent lack of adequate nutrition (acute malnutrition).
    - Underweight (too thin for age): takes into account both acute and chronic malnutrition.

#### Field based findings

##### Findings from KSI:

- Food security is a challenge in the Project area. This was attributed to inadequate food production and reliance on subsistence agriculture. Livestock rearing is done at very small scale.
- The Moyamba DHMT reported that malnutrition is a key challenge in the District. This was particularly manifest in young children and attributed to:
  - Inadequate dietary intake.
  - Poor dietary diversification occasioned by food taboos and availability of food.
  - Loss of farming land in mining areas.
- At Moriba community health post and Mokelleh community health centre, malnutrition was listed among the top-5 diagnosis among young children.
- The Moyamba DHMT reported that:
  - 70 out of the 102 facilities in the District had capacity to manage cases of malnutrition.
  - Anaemia was reported to be prevalent, often presenting with severe malaria or as a result of micronutrient deficiencies. This has increased the demand for blood transfusion services.
  - Growth monitoring is routinely done for children up to the age of 5 years and attendance is generally good. During the visits, mothers are often educated on proper child feeding practices.
  - Vitamin A supplementation is routinely given to children under-5 years together with deworming medication. Pregnant women routinely receive iron and folic acid supplements to prevent anaemia in pregnancy.
- The Bonthe DMO reported that malnutrition was a challenge in the District, which was surprising given its proximity to the sea and the available source of protein. They are doing some research on this to

- Malnutrition is a leading risk factor for disease burden in Sierra Leone [33].
- According to the 2013 SLDHS, 38% of children under-5 are stunted, 16% underweight and 9% are wasted. The proportion of children who are underweight has decreased from 21% in 2008, while stunting and wasting have remained generally unchanged (Figure 33) [24].
- Stunting ranges from 28% in Bombali and Western Area Rural to 52% in Kono Districts [24].
- Nutritional indicators for Bonthe and Moyamba show [24]:
  - High level of stunting in Bonthe (41.4%), significantly above the national level (38%) and level in Moyamba (33.6%).
  - Wasting in Bonthe was less prevalent (3%) compared to the Moyamba (9.8%) and national levels.
- 32% of children under 6 months are exclusively breastfed and 7% of children age 6-23 months are fed appropriately, based on recommended infant and young child feeding practices [24].
- A national nutrition programme is in place and some of its activities include distribution of vitamin A and iron supplements and regular deworming of children and pregnant women.
- Anaemia is a severe health concern especially among children and women. Due to its broad range of variables (in causality), anaemia is a very good indicator of the general status of health in a community.
  - Anaemia is a leading risk factor for disease burden in Sierra Leone [33].
  - The 2013 SLDHS found that 4 in 5 children were anaemic. Anaemia was most common among children in Kono (95%) and Koinadugu (91%), and least common in Bo (67%) and Western Area Urban (69%) While similar to national levels, the prevalence of anaemia in children was high (> 80%) in both Districts, as shown in Table 17 [24].
  - The 2013 SLDHS also found the prevalence of anaemia among women at 45% and was higher among women in rural (49%) compared to urban areas (37%) [24].

#### **Findings from Project documentation:**

- The local communities in the Project area typically rely on subsistence agricultural practices to provide their household food and income, with agriculture the mainstay of the local economy [35]. Agricultural areas (and consequently food production) has been significantly impacted by mining operations due to pressure on land (due to influx) and shortages of available farmland due to mining activities. Not all households are able to grow sufficient food to meet their household needs and are required to purchase supplementary food [35].

determine the burden of disease and potential contributing factors [136].

- SRL clinic reported that cases of malnutrition were rare and that cases were referred to Serabu.

#### **Findings from FGD:**

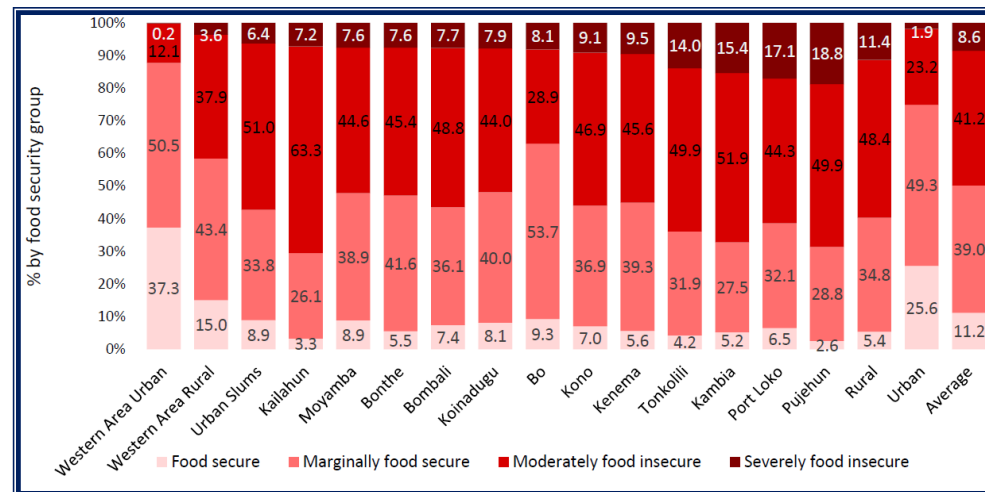
- Participants in all the FGDs reported that they do not have sufficient food for their household. It emerged that majority eat 2 meals a day – in the morning and evening. The morning meal is often a left over from the previous evening. Food scarcity worsens during the rainy season from July – September.
- The main source of livelihood is subsistence crop farming (cassava, beans, sweet potatoes, okra and rice), supported by small scale fishing, petty trading, and employment at the mines (SRL or VIMETCO). Hunting is still done in some areas, but the practice has diminished.
- A typical meal consists of “fufu” (made from cassava flour) and cassava leaves, beans, or dry fish. Rice is also frequently consumed. Beef or chicken is rarely available and only consumed on special occasion. Milk is generally not available and is hardly consumed (very little cattle farming in the area). Bush meat is less available and considered expensive. Some reported that they no longer eat bush meat since the EVD outbreak.
- The majority of participants reported that they buy food and that the price of food has been increasing. For instance, it was reported that the price of rice (one of the staple foods) has increased by 20% compared to last year (from 1,000 Leones per cup in 2016 to 1,200 Leones per cup in 2017). The increase in the price of food was attributed to bad road networks hampering food delivery and increasing transportation costs, as well as high demand and “strong dollar”.
- Malnutrition is common among young children. Mothers attributed this to a lack of food. It was reported that a number of children have been treated for malnutrition using “plumpy-nut<sup>12</sup>”.

<sup>12</sup> This is a ready to use nutritional supplement, aimed specifically at treating or preventing protein energy malnutrition.

- Slash and burn type of agriculture predominates. Farm plots were noted across the Project area, with some noted to be planted along the edges of mine ponds on a rotational basis. Farming is the traditional source of income with most farmers involved in rice farming, but also cassava, potato, yam, maize, sorghum, pineapples and groundnuts [35].
- Fishing is carried out in the area through the use of open weave fish traps and static fish traps in small streams, but fishing from boats using hooks, lines and nets occur in the deeper mine ponds. Local fisheries represent the second most important source of income in the region, although primarily for subsistence [35]. SRL supported fish breeding and stocking with an aquaculture area noted.
- Small number of domestic livestock are kept, such as sheep, goats, pigs, chickens and ducks, with cattle being rare [35].
- The current social baseline describes land use and livelihoods in more detail, with agriculture the most important contributor to livelihoods. Fishing was also important, but it is relevant to note that the communities do not easily change their practices from fishing to agriculture, or vice versa.
- The issues and response report had comments on soil quality and its effects on agriculture in section 11.1.9. Access to land for farming or to support livelihoods made up a major portion of the comments as subsistence farming played such a crucial role in local livelihood. Support to improve food security was highlighted as a major community development need [146].

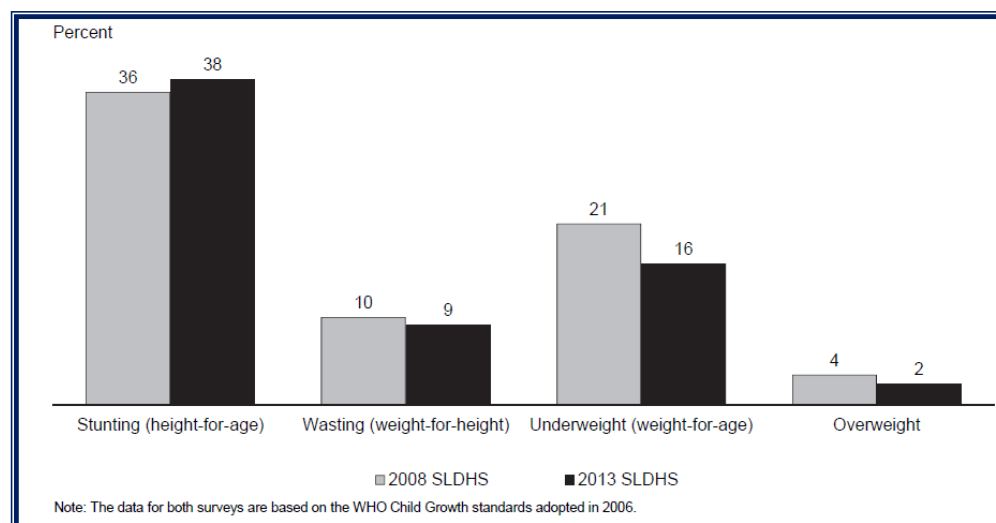
**Findings from direct observations:**

- Most households in the rural settlements had small vegetable gardens, with this less common in the more urbanised settlements- likely due to less available space.
- A few children with features of malnutrition were noted among those who were present with their mothers at the FGDs.
- Markets were not common in the Project area and generally restricted to those in the larger settlements – Moriba Town, Mogbwemo and Gbangbatoke. One of the markets visited on a market day was lacking in variety of food products.



**Figure 32: Food security in Sierra Leone by District, 2015**

Source: CFSVA 2015



**Figure 33: Trend in nutritional status of children under-five years in Sierra Leone (2008-2013)**

Source: 2013 SLDHS

**Table 17: Summary of nutritional indicators in Bonthe and Moyamba Districts**

Indicator	Bonthe District	Moyamba District	National Level
Stunting (% of children under-5 years)	41.4	33.6	38.0
Underweight (% of children under-5 years)	9.2	11.7	16.4
Wasting (% of children under-5 years)	3.0	9.8	9.3
Anaemia (any) in children under-5 years (%)	79.4	85.4	80.0
Anaemia (any) in women aged 15-49 years (%)	65.5	40.0	44.8

Source: 2013 SDHS



Figure 34: Observation picture plate 4: food and nutrition



### 11.1.6 EHA #6 Non-communicable Diseases

The burden of disease attributable to chronic NCDs is on the increase globally, with a predication that NCDs and injuries may cause up to 60% of morbidity and 65% of mortality by 2020 in Sub-Saharan Africa, with poverty, urbanization and changes in lifestyle all playing a role [94]. Four major NCDs: cardiovascular diseases, diabetes, cancer and chronic respiratory conditions, are responsible for majority of the deaths. The risk factors underlying the major chronic NCDs are well documented and include an unhealthy diet, physical inactivity, alcohol consumption and smoking [95]. Cardiovascular diseases, cancer, diabetes and chronic respiratory disease, as well as injuries, are increasingly responsible for premature death and disability Sierra Leone, contributing to a double burden of communicable and NCD [28]. It is estimated that NCDs account for a quarter (26%) of all deaths in Sierra Leone [44].

#### Desk-top findings

##### Findings from literature review:

- Cardiovascular disease, including stroke and heart failure has become an increasing burden in sub-Saharan Africa, fuelled by rapid urbanization and lifestyle changes. At least two-thirds of cardiovascular deaths now occur in low- and middle-income countries, bringing a double burden of disease to poor and developing world economies [97]. Exposure to modifiable risk factors: tobacco smoking, harmful alcohol consumption, physical inactivity and unhealthy diet accounts for 75% of all cardiovascular diseases. Figure 35 shows the mortality attributable to major risk factors for cardiovascular disease.
  - High blood pressure is the most common underlying risk factor [98].
  - Stroke and ischaemic heart disease rank among the top 10 causes of deaths in Sierra Leone.
  - National prevalence of hypertension is estimated at 36% in both males and females [96]. Some studies have reported a higher prevalence of 47% among adults ≥ 20 years old [99].
  - The prevalence of overweight is reported at 18% among women (including 5% obese) and 8% among men [24].
  - The prevalence of tobacco smoking is reported at 27% among men and 9% among women [24].
  - Data from the 2013 SLDHS show that 28% of men and 12% of women in Moyamba District smoke tobacco compared to 22% and 4% in Bonthe, respectively [24].
- The prevalence of diabetes in the African region is estimated to vary between 1% and 5%. The number of diabetes cases is expected to double by 2025, particularly in developing countries [100].
  - Prevalence of diabetes among adults in Sierra Leone is reported at 2.4% [101].
  - A separate study conducted in the Southern Province (Bo District) found a diabetes prevalence

#### Field based findings

##### Findings from KSI:

- NCDs are an emerging health challenge in the Project area, especially increasing cases of hypertension. Stakeholders attributed this to changes in lifestyle and stress.
- Risk factors for NCDs such as excessive alcohol consumption and tobacco smoking are prevalent in the area.
- Local peripheral health units have capacity to diagnose hypertension (blood pressure measurement), but treatment remains a challenge.
- Moyamba DHMT reported they see only few cases of diabetes. Local peripheral health units had no capacity to diagnose diabetes.
- The SRL clinic reported that hypertension and diabetes was common, with an increasing trend. A large stock of anti-hypertensive and diabetic medications was noted in the SRL pharmacy store. Obesity was apparently also on the increase [135].
- Few cases of asthma or chronic obstructive pulmonary disease have been recorded.
- The Bonthe DMO reported that [136]:
  - There was hardly any data on NCDs in the District, with under reporting likely as the disease burden is not well recognized.
  - There were opportunities to collaborate with SRL on this as the DMO considered these conditions a significant emerging health threat.

of 2.4% in the urban population, and 0% in the rural villages.

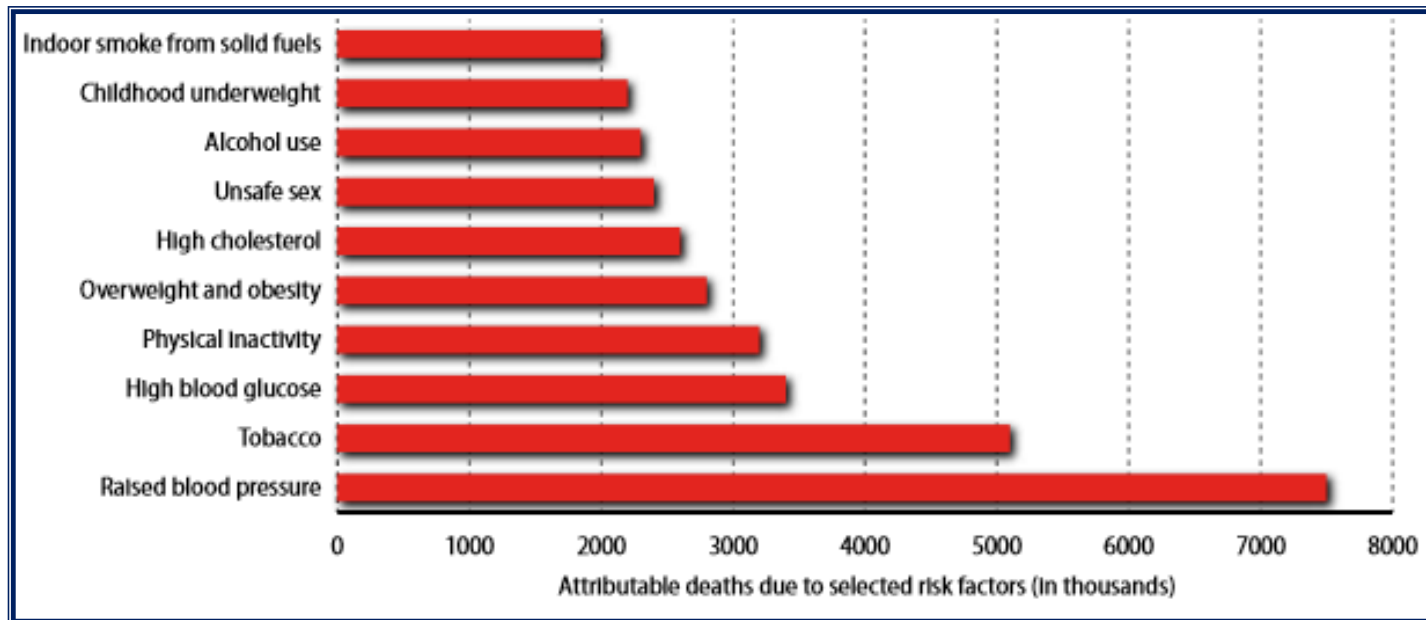
- The mean body mass index was recorded at 22.3 kg/m<sup>2</sup> with obesity at 5% [102].
- The global burden of cancer continues to increase, largely because of the aging and growth of the world population alongside an increasing adoption of behaviours that increase cancer risk, particularly smoking [103]. 60% of global cancer occurs in developing countries, which is approximately 10 million new cases per year. This number is likely to double by 2020 [104]. Overall, the estimated portion of preventable cancer is 40%, and linked to 9 leading modifiable risk factors, which is shown in Figure 36 [105].
  - Cancers account for an estimated 2% of all deaths in Sierra Leone [96].
  - In 2012 the country recorded an estimated 2,797 new cases [106]. Cancer of the prostate, liver and stomach are most common among men, while cervical and breast cancers are common among women [106].
- Chronic obstructive pulmonary disease refers to a group of respiratory diseases that cause airflow blockage and breathing-related problems. This includes emphysema, chronic bronchitis, and asthma. Chronic respiratory diseases as a group account for 5% of global burden of disease [107]. The most important risk factor for chronic obstructive pulmonary disease is smoking, although air pollution from burning domestic waste, exhaust fumes and indoor air pollution as a result of cooking and heating with biomass fuels also contribute.
- Because of the high occurrence of risk factors such as tobacco smoking and predominant use of solid fuels for cooking and heating, chronic obstructive pulmonary disease is likely to be common nationally, even though data is scarce.

#### **Findings from FGD:**

- High blood pressure and palpitations was spontaneously mentioned among health conditions affecting adults in the Project area. Participants attributed this to stress while others did not know the cause.
- No other NCD was mentioned.

#### **Findings from direct observations:**

- Alcohol consumption was evidenced by the presence of empty packets of spirits and bottles in the environment especially in Mogbwemo and Moriba town. Smoking was evident and it was observed that most of the local shops sold cigarettes.
- Exposure to smoke from burning firewood was also observed commonly in most communities.



**Figure 35: Mortality attributable to major risk factors of cardiovascular disease, nationally**

Source: Cappuccio *et al*, 2016

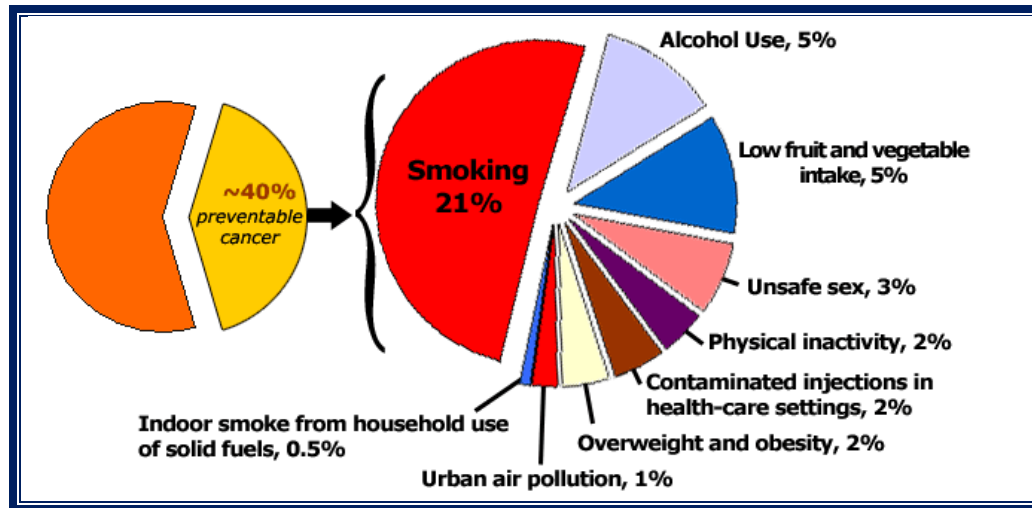


Figure 36: Modifiable risk factors for cancer prevention  
Source; Danaei *et al*, 2005



Figure 37: Sample of alcohol sachets and cigarette on sale in the Project area

### 11.1.7 EHA #7 Accidents and Injuries

Traffic accidents and domestic or other forms of violence are generally of particular relevance in this type of setting where mine access roads are shared with the general public. Domestic violence is addressed in section 11.1.10. It is estimated that nationally, general injuries contribute 10% of the global disease burden [108] and 8% of deaths in Sierra Leone [96].

#### Desk-top findings

##### Findings from literature review:

- Half of the world's road traffic deaths occur among "vulnerable road users" which include motorcyclists, pedestrians and cyclists [109]. The road traffic mortality rate is highest in Africa at 28.3 per 100,000 population compared with 11.0/100,000 in Europe for instance [110].
- Although there is limited data on the road traffic situation in Sierra Leone, anecdotal evidence indicates a high trend in fatal road accidents. According to the Sierra Leone Roads Transport Authority, an estimated 1,035 fatalities occur on the roads annually [111].
- Physical assault and injuries from domestic and interpersonal violence remains a concern nationally.
- Occupational accidents and injuries are not in scope of the assessment.

##### Findings from Project documentation:

- The issues and response report outline numerous comments, including [146]:
  - There were numerous requests to upgrade or repair roads.
  - Another stakeholder mentioned that lives had been lost due to accidents as a result of poor visibility from dust due to vehicle movements.
  - Safety concerns were raised about drowning in mine ponds, with vehicles ending up in dams in accidents. Boat accidents (especially at the pond at Gangama) were also highlighted. One stakeholder mentioned that areas are unprotected and local communities use the ponds for a variety of reasons.
  - There is a risk of accidents from SRL vehicles, especially to children who walk to school.

#### Field based findings

##### Findings from KSI:

- Road traffic accidents did not emerge as a major concern in the Project area owing to the poor road network and seemingly less road traffic. However, it was reported that Project areas see more cases, often involving motorcycles, the predominant means of transport.
- SRL clinic reported that traffic accidents were relatively common, especially from motorcycles. Children are often victims of pedestrian vehicle accidents.
- The Bonthe DMO reported that while there is no data, the trend of traffic accidents appeared to be increasing, with motorcycles especially being a high risk. It was mentioned that the motorcycles played an important role in supporting the livelihoods of ex-combatants [136].
- The poor road network was cited as an important concern. This was considered one of the negative impacts of mining in the area. This was regarded as a surprising comment as roads on the SR Area 1 mine concession were generally maintained and in good condition and unmaintained public roads were found to be in a very poor condition.
- All local health facilities lack the capacity to manage trauma or fractures that may be associated with traffic accidents, and therefore cases are referred to secondary facilities, generally Serabu.
- Inter-personal violence is not reported to be common [135].
- A few cases of drowning or near drowning were reported. The ponds in the area were seen as an important risk for drowning because they are accessible to the public.

##### Findings from FGD:

- Poor road network emerged as an important theme:
  - Participants reported that mining activities in the area have contributed to the bad roads.
  - Cases of traffic accidents were reported, mainly motorcycle-related. Children are also

- victims of pedestrian accidents.
- Roads become very dusty in the dry season, and with reduced visibility accidents occur.
  - It emerged that fractures are sometimes managed traditionally by practitioners who know how to reduce, realign or set fractures (bone-setters) or treat ailments with herbs.
  - Cases of drowning rarely occur but the mining ponds were noted as risk areas as they were easily accessible.

**Findings from direct observations:**

- The road network in the Project area consists of unsealed roads. Roads in the mine SR Area 1 concession are generally in a good state as they are maintained by SRL, but as one leaves SR Area 1, road conditions deteriorate. The roads to Mattru were little more than a track and in a very poor condition. The roads to Moyamba junction are maintained to some extent by SRL and were in a varying state with some areas severely potholed and other sections in good condition. The off-concession roads were also narrow with single carriage bridges with no side barriers. The condition of the roads clearly deteriorated in the wet season, with dust was not evident on the wet roads (as visit was in wet season).
- Motorcycles constituted majority of road traffic on public roads in the Project Area. Very few public transport vehicles were observed, with private motor vehicles also not noted commonly.
- American style yellow school busses transported SRL workers.
- Road signs were largely present and clearly evident within the Project area.
- Roads used by the mine, including haul roads used by heavy vehicles, were accessible to the public. It was noted that these were public roads that were maintained by SRL, but shared by all users.

### 11.1.8 EHA #8 Veterinary Medicine and Zoonotic Diseases

Zoonotic diseases are diseases caused by infectious agents that can be transmitted between animals and humans. Many factors, such as environmental changes, human and animal demography/migration patterns, pathogen changes and changes in farming practices, as well as human social and cultural factors (burial practices), influence the emergence of zoonotic diseases. It is estimated to 80% of new emerging infectious disease have a zoonotic origin, and these may have potential serious human health and economic impacts.

Desk-top findings	Field based findings
<p><b>Findings from literature review:</b></p> <ul style="list-style-type: none"> <li>• Viral haemorrhagic fevers (VHFs) is a general term for a severe illness, sometimes associated with bleeding and that may be caused by a number of viruses especially Lassa fever, Crimean-Congo, Marburg and EVD viruses. The main VHFs of concern in Sierra Leone are Lassa fever and EVD.</li> <li>• Lassa fever is an acute viral haemorrhagic illness caused by the Lassa virus. It is transmitted to humans from contacts with food or household items contaminated with infected rodent excreta. Contact occurs when a person touches, consumes, or inhales these excretions. Most infections are mild, though 20% of all those infected develop a serious illness that may lead to severe side events such as bleeding, deafness, coma or death. Person-to-person infections and laboratory transmission can also occur. The disease is endemic in the rodent population (particularly in mice (<i>Mastomys natalensis</i>)) that are endemic to parts of West Africa [112, 113]. <ul style="list-style-type: none"> <li>○ Lassa fever remains a major public health threat [114], and is particularly endemic in the eastern part of the country [115, 116]. The area of endemicity is a triangle defined by Kailahun, Tongo and Kenema, also known as the “Lassa belt” [113].</li> <li>○ Figure 38 outlines a predicted risk map (orange to red) where Lassa fever had been sampled for, with positive localities indicated by stars. As can be seen, the Project area is located in a risk area [117].</li> <li>○ A recent investigation of 253 samples submitted to the Lassa diagnostic laboratory in Sierra Leone in 2006–2008, found the prevalence of antibodies to the Lassa virus at 30%-40% [75].</li> </ul> </li> <li>• EVD is discussed in detail in Appendix C.</li> <li>• Leptospirosis is a bacterial disease that affects both humans and animals. Rodents are implicated most often in transmission to humans. The infection in man is contracted through skin abrasions and the mucosa of the nose, mouth and eyes. It occurs through direct contact with the urine of infected animals, or through contact with a urine-contaminated environment, such as surface water, soil and plants. It is most common in urban slum areas, where there is inadequate sewage disposal and water treatment [65]. The disease has not been described in Sierra Leone but is likely to occur.</li> </ul>	<p><b>Findings from KSI:</b></p> <ul style="list-style-type: none"> <li>• Cases of VHFs occur in the area, but data is scarce due to challenges with diagnosis. Suspected cases are often managed in isolation and samples are sent to a reference laboratory for diagnosis.</li> <li>• The EVD outbreak posed a significant challenge to the entire health system in Sierra Leone. According to the Moyamba DHMT: <ul style="list-style-type: none"> <li>○ The outbreak affected performance and coverage for routine programmes such as vaccinations.</li> <li>○ Moyamba District recorded 211 suspected cases and some deaths, including 3 health personnel.</li> <li>○ At the start of the epidemic Moyamba District had only 1 holding centre. A new EVD treatment centre opened in the District in December 2014 and helped to contain the outbreak.</li> <li>○ An upsurge of non-EVD patients were seen in the late phases of the outbreak.</li> <li>○ In the aftermath of the EVD outbreak, surveillance and response to disease outbreaks has significantly improved, as well as infection prevention control measures.</li> <li>○ Personal hygiene at community level, health seeking behaviour and reporting of home deaths has also improved. However, communities reinstated previous burial practices and consumption of bush meat.</li> </ul> </li> <li>• The Bonthe DMO reported [136]: <ul style="list-style-type: none"> <li>○ The District had 5 confirmed cases of EVD, with 136 contacts that were followed up as part of disease surveillance.</li> <li>○ SRL supported the District prior to and during the outbreak, specifically in terms of surveillance and reporting of suspected cases, supporting</li> </ul> </li> </ul>

- Rabies is endemic, though reliable data is scarce. The country has one of the largest stray dog populations in Africa, in the background of poor coverage of veterinary services. The situation has worsened following the EVD crisis with the number of stray dogs increasing by double - abandoned by owners for fear of infection [118]. A recent documentary highlighted the challenges of dog rabies control [119] in Sierra Leone.

**Findings from Project documentation:**

- Bush-meat was an important source of protein [35].
- The following findings on EVD were noted from the household survey conducted as part of the social baseline [145]:
  - There was good knowledge on how EVD was transmitted, but still some misconceptions, with air-borne transmission reported by 12.5% of respondents.
  - There were misconceptions of the cause of EVD with 61.5% reporting that it was caused by God/a higher power.

- by-laws regarding harbouring of suspected cases and communication and sensitization related to the disease.
  - While health programmes such as the vaccination programme suffered during the outbreak, other areas have been strengthened including data management and reporting/surveillance, as well as the outbreak response system.
  - The DMO acknowledged that as the surveillance system was currently supported by partners (such as the WHO), there is the potential for it to erode/ reduce in efficacy if partner support was withdrawn.
- The SRL clinic reported that bush-meat consumption was still common for those able to afford it. [135].
- Lassa fever was not specifically mentioned or documented to have occurred in the Project area, but recognition and diagnosis may be the main challenge. It is not known whether the reservoir host is present, but this is likely given the altered habit due to urbanisation and mining.
- Dog bites and snake bites are common in the area. Outright cases of rabies are rare. Post exposure prophylaxis for rabies and snake anti-venom were not available in entire Moyamba District. Rabies vaccine was available in the clinic.
- The number of stray dogs increased after the EVD outbreak.

**Findings from FGD:**

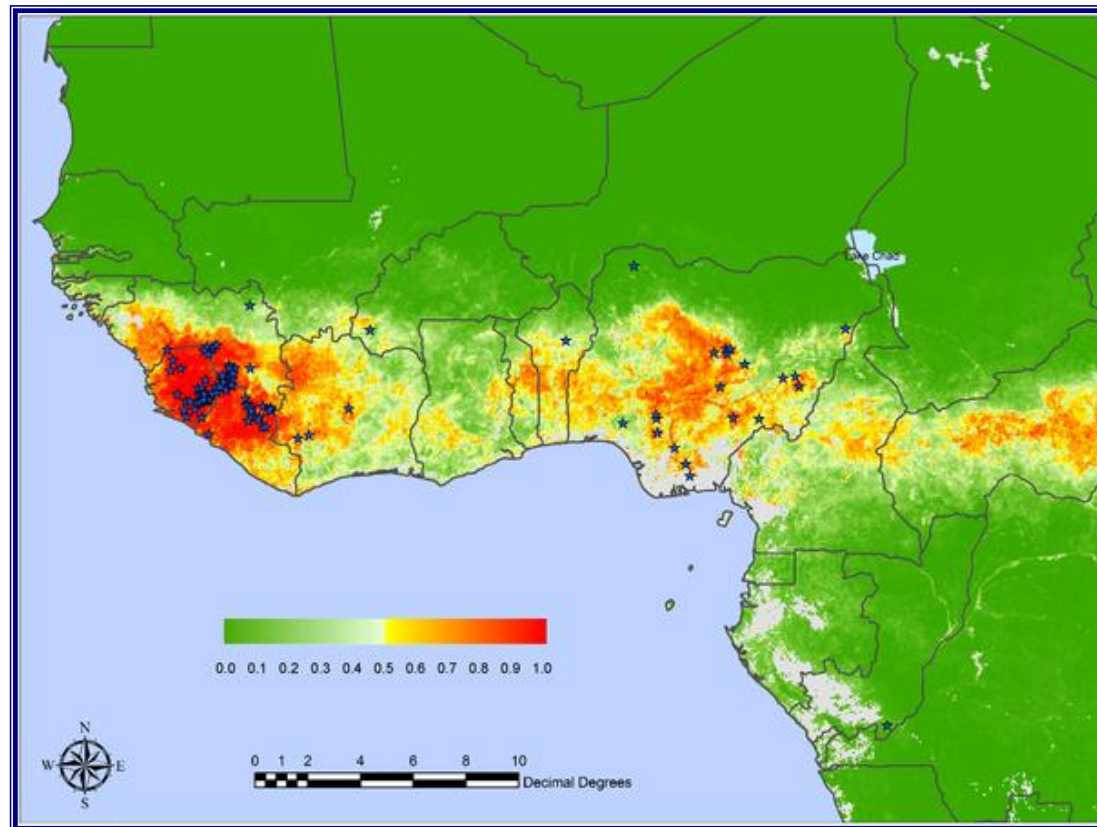
- All participants reported that they have heard of EVD and were very aware that the outbreak ended in March 2016.
  - Since the outbreak, people have become more conscious of their hygiene especially hand washing with soap.
  - Some participants reported that they no longer consume bush meat.
  - Participants reported that they have gone back to their previous burial practices but mentioned that they now handle corpses with gloves.
- Snake bites are common in the area. Access to treatment was a challenge and some deaths (from snake bites) have occurred.

**Findings from direct observations:**

- Isolation facilities were seen at the secondary health facilities including Mattru VBC. Peripheral health units (Moriba Town Community Health Post, Mokelleh Community Health Centre and Gbangbatoke) did not have isolation rooms.



- At Moyamba DHMT headquarters there was a large EVD treatment centre. The facility is now used for storage of equipment and parking for motorcycles.
- Stray dogs were noted on the streets.



**Figure 38: Mean predicted Lassa fever risk map**

Source : Fichet-Calvet, E. and D.J. Rogers, 2009

### 11.1.9 EHA #9 – Environmental Health Determinants: Potentially Hazardous Materials, Noise and Malodours

These environmental health determinants include factors such as air, soil and water pollution as well as possible exposure to radioactive material, pesticides or other organic / inorganic pollutants, noise and malodours. The pathway of human exposure to pollutants can be complex and can occur from a variety of sources such as ambient air, drinking water, soil and food products. Water and air quality, noise and radiation management are crucial environmental health factors associated with the Project. These are addressed as part of the ESHIA, with the reader referred to various specialist studies for more detail on baseline conditions under each respective discipline. Environmental health factors that may have an influence on human health are discussed in the relevant impact assessment section (section 7.9).

#### Desk-top findings

##### Findings from Project documentation:

##### Soil [35]:

- The local soil types have low agricultural potential due to low fertility, are generally acidic and have low water holding capacity.
- Topsoil overlying the ore deposits have historically been mined rather than set aside for rehabilitation purposes. Soil erosion is a concern due to topsoil losses and impacts on surface water. This potential impact is exacerbated by high annual rainfall, but has been mitigated by sedimentation control structures and the quick growth of ground covering vegetation.
- Soil contamination (from transformer oils, acid, petroleum products etc.) was likely to have happened, and it was recommended to remediate contaminated soils.
- The issues and response report had comments on soil quality, with a number of stakeholders mentioning that soils were degraded and agriculture was not possible on available land, or on land that had been previously mined.
- In addition, it was mentioned that inundation from ponds had increased the loss of potential farm land, limiting the availability of productive land [146].

##### Surface and ground water [35]:

- Hydrological studies have been conducted at the Project, with the baseline ground and surface water studies conducted as part of the ESHIA.
- Groundwater levels are less than 12 meters below ground level (mbgl) and the gradients generally mimic the topography.
- Many of the local villages in the Project area abstract their drinking water from shallow groundwater sources. The creation of large water ponds by past mining activities has altered groundwater levels

#### Field based findings

##### Findings from KSI:

- Soil erosion and pollution was reported as one of the contributing factors of food insecurity. Stakeholders attributed this to negative impacts of mining activities in the area.
- The occurrence of artificial ponds from mining activities was seen as “damage to the environment” with stakeholders reporting that the activities are moving to new areas without reclaiming mined areas.
- Noise pollution from mining activities was reported among the negative impacts.
- There was no mention of air or water pollution.
- Stakeholders mentioned that communities generally want to live close to roads as this promotes access, but it is a challenge in the dry season due to dust that is generated from passing vehicles.

##### Findings from FGD:

- Poor soil quality was mentioned in some of the FGDs as a factor that has contributed to diminishing crop yields.
- Noise pollution was a concern in some communities, and mentioned specifically in Foinda and Nyandehun where noise from mining operations emerged as a major concern. Participants in Matagelema and Moriba town were more concerned about noise from the road affecting sleep.
- Participants in Foinda reported that the local stream has been polluted and water wells have been contaminated.

and flow direction in the shallow alluvial systems.

- Where challenges in water quality from the groundwater sources have been noted, SRL has constructed additional wells to mitigate any impact on access to water and water quality;
- The slightly to moderately acidic groundwater with the associated low total dissolved solids (TDS) concentrations are attributed to the heavily leached soils which are typical in humid tropical climates;
- Groundwater quality is generally within WHO drinking water standards, with a few exceptions near the MSP tailings deposit with elevated sulphate and lowered pH values. Water in supply wells generally meet WHO drinking water standards with iron and aluminium concentrations exceeding the standards, and pH levels below reference ranges in certain areas (due to natural conditions) [35];
- SRL sampling indicates severe bacteriological contamination in the community wells which is attributed primarily due to human impact;
- Surface water resources have been altered by mining activity through the creation of water ponds and other mining activities.
- Surface water sampling from July, August and October 2017 shows low pH values in most areas, with samples around and to the north-east of the MSP (Mogbwemo pond), especially acidic. Values of sulphate are also high in Mogbwemo pond [154];
- There is the potential for secondary process tailings to be acid generating [155];
- Results from surface water studies in 2017 show raised levels of total dissolved solids (due to sediment) and with the exception of aluminium, heavy metal results were below WHO drinking water guidelines [154];
- The issues and response report had comments from stakeholders on water quality, including [146]:
- Mining activities had contaminated shallow groundwater sources or affected their flows, and
- Sediment polluted both surface and groundwater sources.
- The above comments are being investigated as part of the ongoing ground and surface water monitoring programme.
- The issues and response report had comments on water quality, including:
  - Numerous comments on how mining activities had contaminated water sources either from chemicals or alteration of shallow groundwater flows.
  - A stakeholder from Foinda reported a death in their community, which was allegedly due to the consumption of contaminated water. This allegation has not been confirmed,
  - Solid and dissolved substances were noted to pollute both surface and groundwater. The creation of mining ponds had also allegedly lead to water contamination, with very acidic water in the mining ponds that affect both surface and groundwater pH.
- The current social baseline reported that the local community utilise surface water from ponds and streams for everyday use [146].

- Air quality was reported to be good except for dust in the dry season - reported by communities along the main road.

#### **Findings from Direct Observations:**

- It was observed that some mining activities were very close to the communities – particularly in Nyandehun where dredging was ongoing and Foinda where mining/exploration activities were ongoing.
- The main road in Matagelema was busy and there was a lot of noise from road traffic including mining trucks from VIMETCO.
- Air quality in all the communities was generally good (noting that the field visit was in the wet season) and there were no obvious malodours noted at the time of the survey.

- The above comments are being investigated as part of the ongoing ground and surface water monitoring programme.

#### Noise:

- Noise is recognised as a significant factor that may affect human health due to disturbed sleep patterns and stress.
- Background noise in communities originates from four main sources:
  - Direct noise intrusion from Project vehicles, mainly trucks, in villages intersected by haul roads;
  - Natural sounds (rain, wind, insects, birds etc.);
  - Noise from community activities (trade, speech, children, music etc.), and
  - Local traffic, which was predominantly from motorcycles. Although motorcycles were noisy, the traffic volumes were generally low and confined to a single road in a village.
- In villages not intersected by haul roads, there was little evidence of audible noise from the MSP, mining or other Project activities;
- Modelling for potential noise impacts concluded:
  - No significant impact is expected on sensitive receptors from noise generated from the MSP, mining, dredging, Nitti Port and excavation operations.
  - There were significant impacts from noise on sensitive receptors caused by trucks passing along haul roads that intersect villages. The first row of houses along these roads experience high levels of truck noise, with impacts of over 5 dB. While this noise is intermittent in nature, occurring every 20-40 minutes, it is likely to cause significant disturbance.
- The issues and response report had comments on noise, with a number of stakeholder commenting that there is a lot of noise from the mines (Gangama and Lanti) and that the noise from mining had chased wild animals away that had resulted in a shortage of bush-meat.

#### Air quality:

- Direct air quality impacts could be from emissions from the MSP; dust along haul roads and from mining activities [35].
- Indirect factors in the Project area may also affect air quality, including slash and burn agriculture that is practiced by the local residents, especially in the late part of the dry season (March - April). The smoke creates a haze and is compounded by dust due to vehicle movements on unsealed roads and wind effects, including from the dry Harmattan wind.
- Seasonality significantly affects air quality. Dust is less common in the wet season with air quality deteriorating in the dry season [35].
- The issues and response report had comments on air quality, including [146]:
  - High levels of dust were the major concern, noting that it is worse in the dry season and that dust is generated by SRL vehicles and machinery.

- Numerous comments were made about the potential health hazards that may be associated with dust and requests were made to SRL to reduce dust on roads.
- Suggestions were made to seal certain roads as road watering was not effective.

Radiation:

- Potential doses to workers and members of the public from relevant pathways of exposure were calculated using available analytical data. The following was concluded:
  - The largest contributing exposure pathway for workers is from external gamma, followed by dust inhalation. Inadvertent soil ingestion dose (hand-to-mouth), as well as radon inhalation dose, was shown to be negligible contributors to total dose;
  - The estimated total dose to workers at mining and wet concentrator plant operations, was shown to be 0.1 milli-Sieverts per year (mSv/y). For the tailings storage area, Nitti Port and the MSP, the estimated worker doses are 1.2 mSv/yr, 0.7 mSv/yr, and 1.5 mSv/yr respectively;
  - At the MSP and Nitti Port, it was determined that the largest dose from an individual material, would be incurred from exposure to zircon product. At the tailings storage area, the largest dose would be incurred from exposure to CET;
  - All doses calculated for the workforce is an order of magnitude below the annual dose limit of 20 mSv/yr, and in line with the doses measured at Iluka's Australian operations;
  - The estimated total dose for members of the public on roads or in villages close to dry mining, wet mining, wet concentrator plant, MSP, tailings and Nitti Port, is below the public exposure limit of 1 mSv/yr;
  - Gamma screening level surveys conducted of the SRL operational areas, confirmed that the areas with the highest gamma radiation exposure are the MSP; the tailings storage area; and Nitti Port;
  - The emanation of radon from heavy minerals has been found to be very low and therefore not considered to be significant for workers or members of the public, and
  - With respect to other potential pathways of exposure, such as from the ingestion of surface or groundwater by members of the public, is not expected to be significant, but would nonetheless need on-going monitoring and assessment.

Other:

- A number of other workplace health and safety values (heat and illumination) were reported, but these had limited reference to community health [35].

### 11.1.10 EHA #10 – Social Determinants of Health

The health status of a population is affected by factors known as health determinants. These are varied and include natural and biological factors (age, gender and ethnicity); behaviour and lifestyles, such as smoking, alcohol consumption, diet and physical exercise; the physical and social environment, including housing quality, the workplace and the wider urban and rural environment; and institutional factors such as the access to medical care. Extractive sector projects in general have the potential to impact on social determinants of health through changes in (i) socio-economic status, (ii) accessibility of health and other services, (iii) life styles, and (iv) educational levels.

Desk-top findings	Field based findings
<p><b><u>Findings from literature review:</u></b></p> <ul style="list-style-type: none"> <li>• Moyamba and Bonthe Districts were significantly affected by the decade long civil war. Some of the negative legacy of the civil war include psychological trauma, social ills such as sexual vices, displacement, deaths, loss of livelihood and increased poverty levels [120]. Further, the country is also reeling from the effects of the recent EVD epidemic that took a toll on many lives. All these may have a negative effect on mental health and play a role in high levels of post-traumatic stress disorder that has a further association with depression.</li> <li>• Neuropsychiatric conditions, especially major depression and epilepsy are listed among the top causes of disease burden, nationally [33]. The Sierra Leone Psychiatric Hospital in Freetown is the only dedicated mental health facility in the country, and it is functioning under very severe human resource constraints. Medical treatment for mental illness is often a last resort with most patients being managed “in the bush” by traditional healers, or spiritual/faith practitioners [121].</li> <li>• Substance abuse is a major concern in Sierra Leone, with reports indicating that there are over one million drug addicts in the country. It is furthermore reported that nearly 90% of psychiatric admissions are drug related illness [122]. Cannabis abuse is widespread, and the drug is locally grown, with Sierra Leone being the chief exporter in West Africa. Law enforcement officers lead in the abuse of illicit drugs with reports indicating that 60% of soldiers and 55% of policemen actively smoke cannabis, a practice that has persisted since the civil war. Cocaine and heroin abuse is an emerging problem with the country serving as a major traffic corridor. Alcohol abuse and tobacco smoking are also prevalent [122, 123].</li> <li>• Apart from the widespread poverty and geographical inequalities (in rural vs. urban areas), gender inequality is an issue. Despite the existence of laws to promote women empowerment, the road to equality for women and girls in Sierra Leone is laden with different hurdles and as such there is no tangible change in their social status. This is because they still have to contend with traditional</li> </ul>	<p><b><u>Findings from KSI:</u></b></p> <ul style="list-style-type: none"> <li>• Mental health was not considered a major concern. Stakeholders reported that while people could be having mental health issues, most of these do not present at the local health facilities. Cases identified are often referred to the Freetown psychiatric hospital because of the limited capacity for mental health care at the District level.</li> <li>• Substance abuse emerged as a big concern. Alcohol abuse and smoking are particularly common. Abuse of illicit drugs such as cannabis and cocaine was reported, especially among the youth. Key stakeholders observed that drug abuse was higher in mining areas.</li> <li>• Poverty was reported to be very high and a key health determinant– with this cited as a contributor to various health challenges including malnutrition and water/sanitation and hygiene.</li> <li>• Domestic violence was reported as an important concern. At Moriba community health centre, 5-6 assault related cases are seen every month. Cases are often referred to the police.</li> <li>• Teenage pregnancy was seen as a major concern. Moyamba DHMT reported that the District has one of the highest rates of teenage pregnancies in the entire country. He expressed an opinion that it was particularly a problem in the Project area, due to the cultural practice of early marriage.             <ul style="list-style-type: none"> <li>○ Moriba community health post recorded 8 cases of teenage pregnancy in June and 12 cases in May 2017. The facility has also recorded increasing cases of clandestine abortions.</li> </ul> </li> </ul>

practices such as female genital circumcision and customary and/or religious laws that constrain them, inequalities in education, training and resources, and gender stereotypes. Women and girls therefore remain a vulnerable group in this society [124].

- The Sierra Leone school system operates as a three-level system: primary, secondary, and tertiary. The law requires attendance through primary school; however, the inability of families to afford formal or informal school fees, is a negative factor in attendance and literacy rates. Findings from the 2013 SLDHS show that more than half of women (56%) and two in five men (40%) age 15-49 years in Sierra Leone have no formal education [6]. The 2015 population and housing census also showed that nearly half (44%) of the population (3 years and above) have never been to school [23]. Women and men in urban areas are most likely to achieve higher levels of education. Less than two-thirds (60%) of men and less than half (44%) of women are literate [23].
- The country relies on mining as its economic base. However, the majority (61%) of the workforce is employed in poorly remunerated, low-productivity jobs in the agricultural sector. A further third of the workforce is employed in non-agricultural self-employment, mostly in petty trade. Only a small percentage of the workforce (9%) is engaged in wage employment [125].

#### **Findings from Project documentation:**

- Local and regional infrastructure, road systems, social services and employment opportunities had all improved due to the presence of the Project [35].
- In the Mende society, married women do not have the right to inherit, with preference given to male heirs or unmarried daughters. The widow of a man who dies intestate receives only one third of the property while the children receive two thirds. Furthermore, under the Land Ownership Act, women are not allowed to own land. Despite the social and structural barriers, Mende women do have the right to hold the position of Paramount Chief and several have done so in the southern province. For instance, the current Paramount Chief of the Imperi Chiefdom in the Project area [16].
- The 2012 ESIA report indicates that 75% of respondents (from the Project area) attained a primary education, 22% got some secondary education, and only 3% had tertiary education. There are 133 primary schools, and 4 secondary schools in the different Chiefdoms of the Project area. Enrolment in the secondary schools had a male predominance, with more than double boys than girls [35].
- SRL supports technical and vocational training through the Jackson and Devon Anderson Technical and Vocational Institute (JADA), as well as adult literacy and library facilities through an educational resources centre [35].
- The following findings were noted from the household survey conducted as part of the social baseline [145]:
  - All respondents reported that alcohol abuse was a problem, with 63% considering that drug abuse was a challenge.
  - 15% of respondents reported that transactional sex is an issue in their community.

- Key stakeholders from the SRL clinic reported that [135]:
  - Before the civil war, SRL used to provide a host of services to the general community, including free healthcare. It was felt that the community had some sense of expectation that this paternalistic practice could be extended again.
  - Alcohol abuse was not that common, but smoking marijuana was.
  - There is a feeling in government and the community that the Company should address community related issues as the government often lacks capacity to do this. The community generally understand it is the role of government, but prefers/expects the support from SRL as the Company is 'more part of the community'.
  - When asked about benefits and negative effects of mining in the local area, the following responses were shared:
    - There has been a real economic benefit to the Project area, in those employed by the Project as well as in those who benefit indirectly. However, the perception of this benefit is not as obvious to members of the community who don't receive direct benefits. Income from property rentals was a noted benefit.
    - Negative issues include:
      - ✓ Destruction of land that could be used for farming, even if surface rent is paid;
      - ✓ Disturbance in the 'sense of place'; and
      - ✓ Inflation and spiralling costs due to supply and demand and general inflation.

#### **Findings from FGD:**

- Mental health did not emerge as a theme.
- Poverty and lack of employment was mentioned as a key concern. This has limited access to health care in terms of transportation, and purchase of medication. This has pushed some to use traditional medicine.
- Substance abuse emerged as a big challenge. Alcohol abuse was by far the most common, and this ranged from local brews and palm wine to cheap spirits. Tobacco smoking is common among men. Marijuana is widely consumed by the youth and sold locally (Moriba town and Mogbwemo). Use of heroine was reported but on a small scale.
- Women felt that they were "disadvantaged" because of poor education and limited access to employment. Women also expressed the burden of

- 25% has felt insecure or feared for their life in the community in the past 12 months.
- The issues and response report had comments on socio-economic issues, including [146]:
  - The host communities should benefit from the Project, as they have had to endure some negative impacts, including loss of land and livelihood from farming, relocation, poor water quality and dust.
  - An increased cost of living.
  - Unfulfilled expectations.
  - Influx of job seekers that has placed pressure on social services. Preference should be given to hiring local people to prevent influx and the growing incidence of social ills in the area.
  - Lack of employment, and especially youth employment opportunities, was a major source of comments, underscoring the lack of other opportunities in the area.
  - Loss of cultural heritage.
  - Benefits included certain infrastructure (town halls) and improved telecommunications from cell phone companies.

caring for children, reporting that men are abandoning their responsibilities yet they seek to marry more wives.

- Teenage pregnancies emerged a major theme. Young girls were said to be vulnerable to the many young men who come to the mining area to look for jobs and mine employees who offer them favours. Most of these girls drop-out of schools to assume the role of child rearing as single mothers with no support from the men.
- Domestic violence was considered a big issue. Women reported that cases of wife-beating and assault are common. Participants attributed this to alcohol abuse, problems in marriages and “jealousy” linked to infidelity. Sexual violence was not reported.

**Findings from direct observations:**

- Sale of alcohol and cigarette was evident. One of the participants in the FGDs came to the meeting with her merchandise (sachets of spirits and cigarettes) and reported that the demand was good.
- Some of the FGD participants were teenage mothers themselves and a few others were evidently pregnant.
- Poverty was evident in most of the rural villages.



### 11.1.11 EHA #11– Health Seeking Behaviour/Cultural Health Practices

Health seeking behaviour, and the manner in which people select which health provider to consult, and when to consult them, depends on a variety of factors. This supports an understanding of entry points into the formal and informal health sectors and is essential in planning interventions, as behaviours, culture and spirituality all influence health seeking behaviour. People may believe that western medicine may be effective in curing their ailments, but their conviction is that mystical causes have also intervened; this obliges them to combine visits to the health care facilities with visits to traditional healers. Several supply and demand factors influence health seeking behaviour. Traditional medicine plays an important role in local health provision and for a number of reasons this is often the primary health consultation route.

Desk-top findings	Field based findings
<p><b>Findings from literature review:</b></p> <ul style="list-style-type: none"> <li>• Beyond direct costs (partly addressed through elimination of user fees for children and women), there are several critical factors that impact upon healthcare utilisation in Sierra Leone. These include indirect costs such as transportation; availability of cheaper alternatives such as private (clandestine pharmacies, traditional healers and allopathic remedies; caregiver factors and non-caregiver factors (long queues and complicated referral process), etc. [126].</li> <li>• It has been demonstrated that the recent EVD epidemic had a profound effect on health seeking behaviour in Sierra Leone, with the practice of self-medication increasing six fold at the height of the epidemic (from 4% to 23%) [127].</li> <li>• Traditional medicine plays an important role in many African countries, especially in rural areas. For a number of reasons this is often the primary route of health consultation. Where access and cost is a major factor in accessing modern health care, this may reinforce the use of traditional medicine as the primary route for consultation. In the wake of the EVD epidemic, it was reported that the widespread embracing of certain traditional and religious practices among West African communities had a tremendous negative effects on the spread of the disease, but that interventions had to be culturally and religiously acceptable to the community to be effective, and therefore there is the need to align measures with cultural norms and values of affected communities [127].</li> <li>• Female genital mutilation also known as female circumcision is nearly universal in Sierra Leone, with 90% of women age 15-49 having been circumcised. One in five women underwent female genital mutilation before the age of four. The practice is more common in rural areas (94%) than urban areas (86%) and highest in Northern region (96%). <ul style="list-style-type: none"> <li>○ Female genital mutilation is also widespread in the Project area, at a prevalence of 90% in Moyamba and 85% in Bonthe District [24].</li> </ul> </li> </ul>	<p><b>Findings from KSI:</b></p> <ul style="list-style-type: none"> <li>• Health seeking behaviour is generally good and appears to be improving. Majority of the population prefer to use conventional medicine, and this is evidenced by increasing demand for these services.</li> <li>• While the use of traditional medicine is still common, it is sometimes used concurrently with conventional medicine.</li> <li>• However, according to the Moyamba DHMT, the use of traditional medicine contributes to delays in care seeking. Contributing factors included poor health awareness and education on health prevention activities and regular stock-outs of medication.</li> <li>• Self-medication is common, supported by drug shops.</li> <li>• The key stakeholder at the SRL clinic provided some good insight into traditional medicine practices [135]: <ul style="list-style-type: none"> <li>○ Cost and access to healthcare services, drives traditional medicine practices. However, some has a clear cultural basis.</li> <li>○ Traditional medicine is commonly practiced in the area, even by SRL employees and dependents who had access to free healthcare services. Even well-educated and wealthy people go to traditional healers for certain things.</li> <li>○ Traditional forms of family planning are often used.</li> <li>○ A variety of traditional healers practice in the area including; herbalists, those who perform scarification, ‘bone setters’ and ‘marabouts’ (who</li> </ul> </li> </ul>

- The practice is performed by 'soweis'- women who perform the procedure.
- The acceptability of female genital mutilation continues despite its violation of women's rights and potential for causing serious medical complications and harm to women's reproductive health. There are reports that girls/women in Sierra Leone face immense social pressure to undergo the procedure. Those who have not undergone female genital mutilation are regarded as "unclean" and face social stigma. UNICEF reports that 88% of women nationally have undergone female genital mutilation, with those who have not had their clitorises removed facing intense social stigma.
- It was reported that the EVD outbreak ended female genital mutilation as a nationwide ban was declared in November 2014. This ban was enforced during EVD times, and while it officially remains in place, enforcement is now non-existent. It was reported that the practice is so deeply entrenched that it will be hard to remove, and there is no political will due to the fear of losing votes [133].

**Findings from Project documentation:**

- According to the 2011 ESIA report [35], each of the villages in the Project area has sites of traditional / cultural importance. These include ancestral cemeteries, the society bush where initiation ceremonies are held, and the shrine bush where religious ceremonies are held. While little forest remains in the Project area, there were remnants of forest along streams and creeks as well as around site of cultural importance, with the forests mentioned as an important source of natural resources, including medicinal substances.
- The 2011 ESIA describes that the use of traditional medicine (mainly herbs) and drug peddling in communities increased after the war as much of the health infrastructure was damaged [35].

deal with sorcery).

- Traditional birth attendants play a cultural important role in delivery care. This has been recognised and Marie Stopes (an NGO) in conjunction with the MoH&S and others is supporting an incentive programme to encourage traditional birth attendants to bring expectant mothers to deliver in health facilities.

**Findings from FGD:**

- Majority of participants reported that they prefer modern health care. A lack of medication at the local public health facilities was a predominant theme.
- Traditional medicine is still widely used and even preferred in the management of some conditions such as migraine, mental illness and fractures.
- Traditional medicine is also used in the treatment of convulsions, abdominal pains, malaria and during pregnancy. Participants however reported that the use of traditional medicine is declining, but this could have been in response to the drive from health authorities to use conventional medicine, rather than reflecting the actual practice.
- Self-medication with over the counter medication is common.
- Female circumcision is culturally practiced and largely acceptable.

**Findings from direct observations:**

- An assessment of the local health facilities revealed that some of the essential drugs were out of stock, including anti-malarial treatments and first line antibiotics.
- A number of drug shops were seen in Moriba Town.

### 11.1.12 EHA #12 – Health Systems Issues

The Sierra Leonean health system was described in section 7.1.2, with the table below expanding in information from both desktop and field based activities.

Desk-top findings	Field based findings
<p><b>Findings from literature review:</b></p> <ul style="list-style-type: none"> <li>• Universal access to reproductive health has been a key target of the 2015 Millennium Development Goals (MDGs) and remains so as the world transitions to the SDGs looking towards 2030.</li> <li>• Key indicators for Sierra Leone include: <ul style="list-style-type: none"> <li>○ The total fertility rate is estimated at 5.2 children per woman, decreasing from 6.1 in 2004 [23]. The fertility rate is higher in rural areas (5.7) compared to urban areas (3.5), and decreases with increasing level of education and household wealth [24].</li> <li>○ The fertility rate in Moyamba is among the highest in the country at 6.2, compared to 4.2 children per woman in Bonthe [24].</li> <li>○ Contraceptive prevalence rate (for women aged 15–49, married or in union) has increased from 5% in 2005, and 8% in 2008 to 17% in 2015, against an MDG target of 30% [125].</li> <li>○ One-fifth (20%) of women in Bonthe use some family planning method, compared to just 10% in Moyamba, according to data from the 2013 SLDHS [24].</li> </ul> </li> <li>• Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period. It encompasses the health care dimensions of preconception, prenatal, and postnatal care. It is an important measure of health system functionality. <ul style="list-style-type: none"> <li>○ Sierra Leone has one of the highest maternal mortality rates in the world. The main causes are intra and post-partum haemorrhage, obstructed labour, sepsis and hypertension in pregnancy [128]. <ul style="list-style-type: none"> <li>▪ <b>Trends:</b> The maternal mortality rates decreased from 2,300 deaths per 100,000 live births in 1990 and 1,800 deaths in 2005 to 1,165 deaths in 2013 and an estimated 1,360 in 2015, against an MDG target of 657 deaths per 100,000 live births [125]. Figure 39 [128] shows the trend in maternal mortality in the country.</li> </ul> </li> <li>○ 97% of pregnant women receive ante-natal care from a skilled provider [24, 125]. <ul style="list-style-type: none"> <li>▪ <b>Trends:</b> Access to skilled ante-natal care increased from 87% in 2008 to 97% in 2013 but stagnated in 2015, thus falling short of the MDG target of 100% [75].</li> </ul> </li> <li>○ 54% of deliveries occur in health facilities, primarily in public sector facilities [24]. <ul style="list-style-type: none"> <li>▪ <b>Trends:</b> Births attended by skilled health personnel increased from 33% in 2004 and 42% in 2008 to 60% in 2013, against an MDG target of 100% [125].</li> </ul> </li> <li>○ The targets on maternal health (except maternal mortality) were on course towards achievement</li> </ul> </li> </ul>	<p><b>Findings from KSI:</b></p> <ul style="list-style-type: none"> <li>• Reproductive health services are available at the local health facilities. <ul style="list-style-type: none"> <li>○ The uptake of family planning services is increasing, supported by regular health education and sensitisation. Activities are supported by Marie Stopes.</li> <li>○ Condoms are largely available for free at the peripheral health units. At the Moriba Town community health post, it was reported that a health talk is conducted every week targeting women who have brought their children in for routine care. At the end of the session women are handed a number of condoms.</li> </ul> </li> <li>• Maternal mortality remains a challenge. The Moyamba DHMT reported that the District recorded 36 maternal deaths in 2016 and 19 over the period January to July 2017. This is an average of 3 maternal deaths per month. <ul style="list-style-type: none"> <li>○ Limited access to emergency obstetric care was reported as the biggest challenge to maternal health. This is compounded by lack of emergency transport. Moyamba District for example, has only one functional ambulance.</li> <li>○ The majority of women access antenatal care as required. Moriba community health post sees an average of 15 antenatal women per month.</li> <li>○ The majority of women deliver at the health facilities. Moriba community health post conducts around 20 normal deliveries per month.</li> </ul> </li> <li>• The majority of children under-5 years attend routine clinics where they receive the necessary vaccines and growth monitoring.</li> <li>• Outreach services are offered to some communities with limited physical access to facilities. However, this is often challenged by lack of transport means (motorcycles or fuel).</li> <li>• In Moyamba health care delivery is well supported by community health</li> </ul>

- of the MDGs, but were curtailed by various circumstances including the EVD epidemic. It is envisioned that these targets will be reached as part of the SDGs [125].
- Sierra Leone has made significant progress in child survival, with indicators showing a downward trend in child mortality. The under-5 mortality rate decreased from 286 deaths per 1,000 live births in 2005 to 156 deaths in 2013, against a target of 95 deaths per 1,000 live births. Similarly, infant mortality decreased from 170 per 1,000 live births in 2005 to 92 per 1,000 in 2013, against a target of 50 per 1,000 in 2015 [24, 125]. Figure 40 [6] shows the trend in child mortality.
    - Data from the 2013 SLDHS show that under-5 mortality is lowest in Bonthe at 77 deaths per 1,000 live births, while it is over 200 deaths per 1,000 live births in Kenema (224), Pujehun (217), and Koinadugu (202 deaths per 1,000 births). Moyamba recorded a high under-5 mortality rate of 199 per 1,000 live births [24].
    - The top causes of child deaths are malaria (20%), pneumonia (12%), diarrhoea (10%), prematurity (9%) and birth asphyxia (8%). Over a quarter (29%) of child deaths occur in the neonatal period [128].
    - Children living in rural areas and those whose mothers have less education, are more likely to die young. Child spacing (<2 year interval) is also an important factor.
    - Although the MDG4 goal on child mortality was not met, the country remains committed to this course, as it moves forward with the implementation of the SDGs [125].
  - Childhood immunisation against common ailments is important as it reduces the episodes and severity of most common infections that would otherwise lead to significant mortality and morbidity. The desired goal (as recommended by WHO/UNICEF) is to ensure full immunisation of 90% of children under one year of age at the national level, with at least 80% coverage in every District or equivalent administrative unit [129].
    - Sierra Leone's Expanded Programme of Immunisation package is well aligned to the WHO and UNICEF guidelines<sup>13</sup>. More recently, pneumococcal conjugate vaccine, yellow fever and rotavirus vaccines have been included [25].
    - Between 2008-2013, full immunisation rate increased from 40% to 68% [24]. Following the EVD outbreak, immunisation coverage declined significantly, increasing the risk of vaccine preventable diseases [66, 25]. In response, the programme intensified routine immunisation services in 2015 to restore pre-EVD immunisation rates.
    - Table 18 shows vaccination coverage at national and District level, based on statistics from officers who are represented by a focal person in the DHMT.
  - The Bonthe DMO reported [136]:
    - The main challenges in the District were:
      - A lack of skilled health professionals.
      - Poor health infrastructure.
      - A lack of health financing/funding due the District being smaller and not receiving funding equitably.
      - Poor road and transport infrastructure making access to healthcare and referrals challenging. There are only 3 ambulances in the District and they are planning to get a speedboat to improve care to communities located along waterways (a broken boat was noted in the DHMT office yard).
    - The Bonthe DMO suggested potential opportunities including:
      - Good partnerships and collaboration with various partners. There is a current health development partner/NGO collaborative forum in the District where there is a real opportunity to improve engagement as it was currently not functioning well.
      - Plans to improve referral network through boats and strategic placement of ambulances.
      - Plans to improve healthcare infrastructure through improved healthcare resourcing and financing.
    - In 2016, Bonthe District had the highest maternal mortality rate nationally, but this had improved as only four maternal deaths had been reported in 2017 to date.
    - There are currently nine doctors in the District, which is an improvement to the pre-EVD period, where one or two used to be the norm. This is attributed to support from WHO and others with:
      - 3 public health doctors.
      - 4 clinicians at Bonthe hospital.
      - 2 clinicians at Mattru VBC.

<sup>13</sup> BCG vaccination at birth to protect against TB; three doses of DPT-HepB-Hib to protect against diphtheria, pertussis (whooping cough), tetanus, hepatitis B and Haemophilus influenzae type b (Hib), respectively; three doses of polio vaccine; and a measles vaccine - all by the age of 12 months

MoH&S (2015) and the 2013 SLDHS [24, 25].

#### **Findings from Project documentation:**

- The 2012 ESIA report [35] describes a number of NGOs currently active in the SRL area, and mentions a July 2009 meeting between representatives of the various organisations to investigate potential synergies with SRL. Health related interventions from various NGOs included World Vision, Global Outreach Mission, Methodist Church of Sierra Leone, Sierra Leone Red Cross Society and UNAIDS. There were also a number of community based organisations mentioned, with these noted to be few with some focussed on service delivery of basic services, and the Initiative for Community Development active in Moriba Town and partnering with SRL.
- In the November 2011, CEMMATS conducted a survey on disease data from 4 clinics (including SRL clinic) close to the mine to determine the prevalence of common ailments and diseases for the 2010 period. Results indicated that the most common conditions were; i) malaria (55%); ii) pneumonia (19%); iii) typhoid (11%); iv) STIs (4.3%); v) anaemia (3.5%) and vi) diarrhoea (1.5%). Skin infections, intestinal parasites, malnutrition, hypertension, onchocerciasis, TB and HIV at around or less than 1% [35].
- The following findings were noted from the household survey conducted as part of the social baseline [145]:
  - The majority of respondents reported that they sought medical advice at a formal health facility.
  - While not fully answered by the bulk of respondents, the majority who did answer reported that a health facility is available within 1-5km.
  - Of those who were questioned, 22% had access to the SRL, but 94% questioned expressed a desire to access the facility for medical services.
  - Of those questioned, all respondents reported that they delivered their youngest child in a health facility. In those who did not respond, various reasons were provided with the main ones that they could not afford the cost (32%), cultural reasons (36%), with only 8% mentioning that distance or lack of transport was an issue.
  - Of those respondents who did not take their child to a health facility the last time their youngest child was ill, the most common cited reason was the lack of access, with 6.3% and 3.8% stating that they would prefer to self-treat or use a TH, respectively.
- The issues and response report outlined a stakeholder comments on health systems [146]:
  - Development of healthcare facilities was highlighted a number of times as a community development need. This included the supply of medication, development or rehabilitation of health facilities.
  - The lack of access for the general community to the SRL clinic was highlighted as a concern by a number of stakeholders and created the feeling of inequality.
  - Transport was an issue as mentioned by staff in some of the health centres.
- The DMO and District epidemiologist.
  - Healthcare services in and around SR Area 1 were inadequate. The biggest facility (the community health centre in Moriba Town) was too small and offered limited services to cater for the healthcare needs of the growing population.
  - Community health officers play an important role, especially in hard to reach areas, with these staff having been trained with the support of UNICEF. These staff are volunteers for now but there is a plan to try and pay them in the future. They are selected based on literacy, status in the community and their skills.
  - Some areas are supporting community based integrated management of childhood illness, with 30% of anti-malarials dispensed by community health officers.
  - Traditional birth attendants have been integrated into the health system as part of the community health officer's initiative.
  - There is a drive to try and get communities to improve health seeking behaviour and to support and participate in health initiatives.
  - The community cohesion is improving as the DMO has realized the need to reach out to people, but also to improve access to health services by shortening distance to care.
  - There was a concern about vaccine coverage, as while the District coverage was above 80%, there were hard to reach communities who were not adequately covered. Measles outbreaks were more common in these areas. Weak cold chain maintenance was a noted challenge in the District that influences the vaccination programme
- The following insights were obtained in discussions with the SRL community relation team and the SRL clinic staff [135]:
  - As part of SRL business continuity planning at the start of the EVD outbreak, the Company took the initiative and started sensitization and capacity building activities in the broader Project area to support prevention, and also effective outbreak response if cases emerged. These activities were planned and implemented in conjunction with the respective DHMT's, with good cooperation and extensive engagement reported from both sides. No formal agreements were put in place and any current or future activities are planned more in an ad-hoc manner rather than following a planned structured approach. The EVD outbreak was the factor that promoted the need for close co-operation.

- One of the senior registered nurses is a community health nurse and supports a range of health awareness and health education activities in the PACs, especially in Moriba Town, Mogbewa and Mogbwemo. These are often conducted in schools and do not appear to be formally scheduled. Based on feedback, they seem to be welcomed and effective, despite no metrics being available to determine any success factors.
- The SRL clinic receives and stabilizes all emergency cases that are brought to them, irrespective of their status. Cases are referred (generally to Serabu) and the on-going cost of non-SRL related cases, are not the responsibility of SRL.
- Unfulfilled expectations and the role that the SRL clinic should play in the community was mentioned by a number of stakeholders, with the following comments:
  - There is a perception of inequality between those who can access the clinic and those who can't. This stems from poor access to, and a perceived lower level of service in the available alternative facilities.
  - The local communities have very high expectations of the mine and the clinic. This may be due to the poor local services and also the expectation that SRL should fulfil the paternalistic practices that were in place before the war.
- Criticisms and high expectations were also raised during the brief consultations with the Bonthe DHMT, including:
  - The SRL clinic does not attend general emergency cases and at times do not attend to cases of accidents involving company vehicles.
  - SRL does not support continuity of care of cases that are referred to external hospitals.
  - There was an expectation amongst the community (mentioned by the DMHT) in the Project area that SRL should do more for healthcare as they have a facility in the area.
  - It was acknowledged that SRL had supported the District a lot during the EVD outbreak and that general outbreak preparedness was better since the outbreak, but there was an expectation for these types of partnerships to extend into the future.

**Findings from FGD:**

- Participants have witnessed maternal deaths in their community. Some of these occur at home while others occur at health facilities. Excessive bleeding was cited as common cause.
- Nearly all pregnant women attend antenatal care and receive routine services including blood boosters and IPTp.
- Women reported that they experience health problems during pregnancy citing malaria infection, vaginal infections and at times miscarriage (linked to heavy work load).
- Family planning services were generally available, accessible and acceptable. Modern methods such as hormonal injections, pills or implants are commonly used. Challenges to the uptake of contraceptives include lack of support from men and “bad experiences” with some methods.
- Nearly all births occur at a health facility. It was reported that home delivery attracts a “huge penalty” and this has been aggressively enforced by the Chiefs. Traditional birth attendants have been educated to refer or accompany their clients to a health facility.

**Findings from direct observations:**

- Local health facility infrastructure and service capabilities are described in Appendix B.
- None of the local peripheral health units visited during the field work had capacity to test for anaemia.
- While a survey was not conducted, there were a notable number of women in the FGDs that were either pregnant, or had young babies.

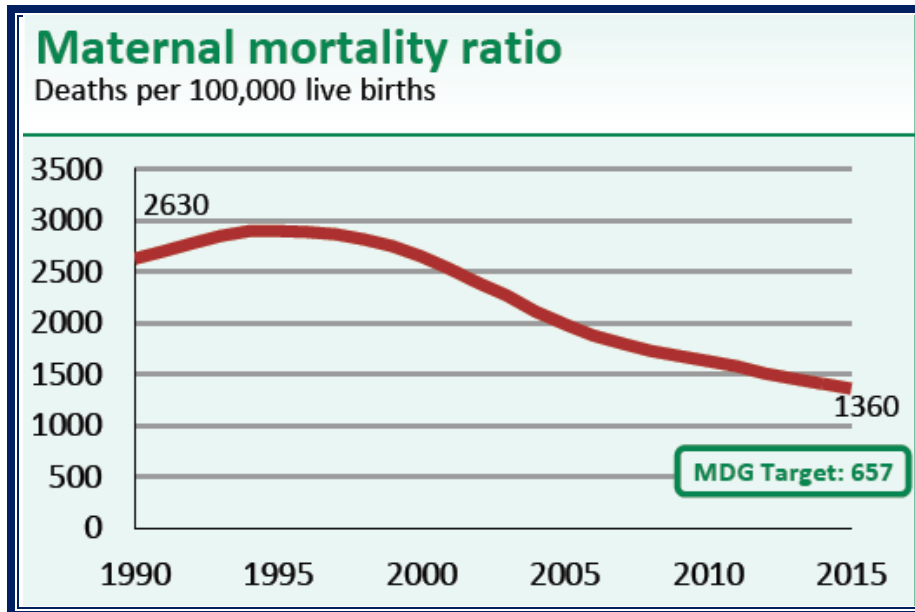


Figure 39: Trends in maternal mortality rate in Sierra Leone

Source: Countdown to 2015, Final MDG Report, 2015

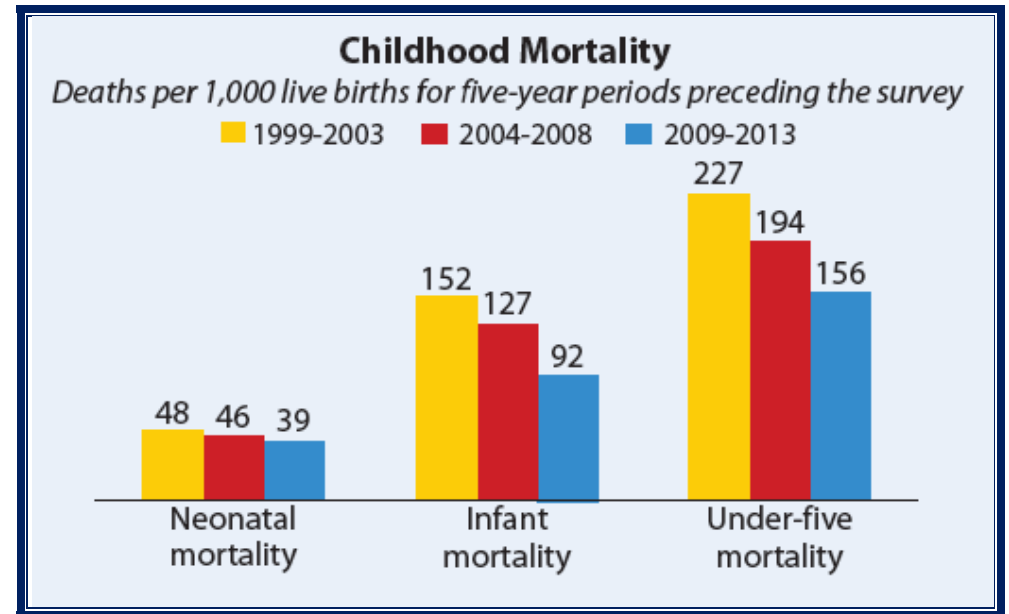


Figure 40: Trends in childhood mortality in Sierra Leone

Source: 2013 SLDHS



**Table 18: Immunisation coverage (%) in Bonthe and Moyamba Districts, 2013 vs. 2015**

Vaccine	National Coverage		Bonthe District		Moyamba District	
	2015	2013	2015	2013	2015	2013
<b>Fully immunized</b>	-	<b>68</b>	-	<b>77</b>		<b>66</b>
BCG	89	96	84	97	120	95
DPT - 3 <sup>rd</sup> dose	86	78	69	81	120	79
Haemophilus Influenza – 3 <sup>rd</sup> dose	86	78	69	81	120	79
Hepatitis B – 3 <sup>rd</sup> dose	86	78	69	81	120	79
Polio (oral) – 3 <sup>rd</sup> dose	85	78	69	81	120	80
Measles	82	79	67	93	117	78
Yellow fever	83	-	67	-	119	-
Pneumococcal vaccine (3 <sup>rd</sup> dose)	86	-	69	-	120	-
Rotavirus (2 <sup>nd</sup> dose)	85	-	71	-	122	-

Source: Data from MoH&amp;S 2015 Report and 2013 SLDHS



Broken down speedboat ambulance at Bonthe DHMT



EVD response unit signs at Bonthe DHMT

**Figure 41: Bonthe District health management team**

## **11.2 Appendix B: Health Facility Assessment**

A health care quality assessment was carried out in five health facilities serving the Project area: Mattru Hospital, Sierra Rutile Clinic, Moriba Town community health post, Mokelleh Community health centre and Gbangbatoke community health centre. It was not possible to visit any health facilities in Bonthe District.

The facilities were assessed in regard to human resources, quality and continuity of services, availability of essential medical equipment, diagnostic equipment, drugs and supplies, general infrastructure and access to referral services. The assessment was conducted using a modified SARA tool, a conceptual framework of measuring quality in health care [25]. The indicators assessed can be monitored over time as required. Key stakeholders at the respective health facilities, generally the person in charge, were interviewed to gain an understanding of the main health challenges in their target population but also on potential structural and operational challenges they face within the facility.

A brief overview of the findings is presented below and a summary shown in Table 19.

### **Secondary Facility: Mattru Hospital**

Mattru Hospital was founded as a dispensary in 1950 by missionary nurses from the United Brethren in Christ (UBC). The facility grew to become a secondary hospital before it was destroyed during the civil war. After the war, it was rebuilt and reopened by Médecins Sans Frontières and handed back to UBC in 2002. It has been co-opted by the government and is one of the facilities mandated to implement the free care initiative. However, according to the hospital administrator the facility receives very little support from government, other than a sporadic supply of medication that is not adequate support patient requirements [134].

#### **Staffing**

The hospital is fairly well staffed with about 76 health personnel and 21 support staff. The highest qualified medical personnel are general doctors. At the time of the assessment, the hospital had no medical or surgical specialist, with two general doctors that provide general medical care.

#### **Services and accessibility**

The hospital is strategically located and fairly accessible to the public. It operates 24 hours daily and has a catchment population of approximately 98,000 people. It offers a range of

services including general out-patient and inpatient services, laboratory (basic), emergency, referral and outreach services. The facility does not offer dental or ophthalmology services. Radiography is currently limited to ultrasound examinations. The facility has one functional ambulance and has been instrumental in supporting emergency health care in the District. The main challenges include lack of reliable electricity supply, erratic supply of medication and inadequate resource support by the government [134].

#### Costs and affordability of services

A large majority of patients seen at the facility are covered by the government's free health care initiative. These include pregnant and lactating mothers, children under-five years and the elderly, all of whom are exempted from paying user fees. The amount of revenue generated is inadequate and the facility is facing resource challenges and continues to rely on partners [134].

#### Medical supplies

Part of the drugs and essential medical supplies are received from the government medical stores - supplied quarterly. The government supply has been very erratic and inadequate thus challenging provision of free care initiative. The facility also runs a fairly well stocked private pharmacy.

#### Referral services

Matru Hospital is a major secondary referral facility in the Project area particularly those in Bonthe District. It has capacity to manage majority of cases without the need for referral to tertiary facilities. It does not generally refer to the District hospital in Bonthe due to access challenges (on the island) and therefore referrals to Serabu and Bo are more common.

#### Structural aspects

The hospital, and indeed entire Bonthe and Moyamba Districts have not been reached by the national power grid. The facility relies on diesel generator for electricity but this is quite expensive to run. Running water is generally available, with this pumped from a borehole into a header storage tank, but power constraints and the associated costs of running the generator limit this. The facility has a functional incinerator for management of medical waste. It also has a small mortuary.

## **Peripheral Health Units**

All the three peripheral health units assessed were in Moyamba District.

### **Staffing**

Moriba community health post is a small facility served by one health personnel (MCH-Aide). Mokelleh and Gbangbatoke Community health centres are served by four and five health personnel, respectively; the highest qualified personnel in both facilities being CHAs.

### **Services and accessibility**

The peripheral health units are basic facilities and generally offer primary health care services. All the three facilities were centrally located and accessible to their catchment areas. Moriba Town community health post serves a larger catchment area of 7,031 including parts of Moriba town, Mataglema and Ndendemoia villages. Mokelleh has a much smaller catchment of 2,091 people. The three peripheral health units fully operate during daytime (from 8am to around 5pm) but can respond to an emergency at any time. Moriba Town Community health post does not offer inpatient services but can observe patient for hours. Gbangbatoke and Mokelleh Community health centres offer basic inpatient services and were properly equipped for their service level.

### **Costs and affordability of services**

Majority of patients seen at the peripheral health units fall under the government's free care initiative and are therefore managed free of cost. Treatment for malaria is free for all in the public sector. The remaining group pays some small user fees.

### **Medical supplies**

Drugs and medical supplies are received from the District medical stores on a quarterly basis. Frequent stock-out of essential medication and supplies is the biggest challenge that limits implementation of free care initiative. At Moriba Town community health post, it was reported that the demand for medication was far more than the supply from the government and many times patients are given prescriptions to purchase medicine from private pharmacies. Mokelleh community health centre supplements government drug supply with private stock of medication it what it called "cost recovery" with patients needing to pay for these supplies.

### Referral services

Referrals are mainly to Serabu Hospital, and in a few cases Moyamba Hospital. Ambulance services are available from the two hospitals. Moriba Town community health post refers to Gbangbatoke community health centres or Serabu depending on severity of illness.

### Structural aspects

Gbangbatoke and Mokelleh Community health centres had reliable supply of running water through solar powered borehole water to tank system. Moriba Town Community health post had no running water and draws water from a protected well at the facility. The two community health centres are supplied by solar power and this was being upgraded during the survey. Moriba Town Community health post has no electricity supply and relies on torch light for any procedures or deliveries at night. The facility occupies a private building and there is an ongoing dispute with the owner threatening to repossess the building because of rent arrears.

Table 19: Health facility assessment summary

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
Contact Person	Dr Jonathan Yonda Dr Harrison Iminabo Rev. Joseph Gbando	Mr Concern Hamakala	Mohamed Kamara	Alhaji Jawara	Dr Joseph Kallon Dr Raheen Kamara Elizabeth Atarrah
Function	Medical superintendent Medical doctor Hospital administrator	MCH-Aide in charge	Community health officer in charge	CHA	Medical doctor Medical doctor Nurse in charge
<b>Health care provider availability</b>					
General doctor	2	Nil	Nil	Nil	2
Medical specialist	Nil	Nil	Nil	Nil	Nil
Community Health Assistant	1	Nil	Nil	1	Nil
Community Health Officer	1	Nil	1	1	Nil
Surgical Technologist	1	Nil	Nil	Nil	Nil
State Enrolled Community Health Nurse (SECHN)	53	Nil	Nil	1	16
Nurse Midwife	1	Nil	1	Nil	2
Nurse (MCH) Aide	4	1	2	2	Nil
Nurse specialist/public health nurse	1	Nil	Nil	Nil	1
Registered Nurse (RN) anaesthetist	1	Nil	Nil	Nil	Nil
Pharmacist	1	Nil	Nil	Nil	1-planned
Laboratory technologist	5	Nil	Nil	Nil	2
Laboratory assistant	1	Nil	Nil	Nil	Nil
Data clerks	2	Nil	Nil	Nil	Nil
Psychosocial specialist	1	Nil	Nil	Nil	Nil
HIV Counsellor	1	Nil	Nil	Nil	1- NAS
Public health officer	Nil	Nil	Nil	Nil	Nil
Radiographer	Nil	Nil	Nil	Nil	Nil
Dental technician/officer	Nil	Nil	Nil	Nil	Nil
Physiotherapist	Nil	Nil	Nil	Nil	Nil

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
General support staff	15	1	2	3	5
Administrators (non-clinical)	6	Nil	Nil	Nil	Nil
<b>Total</b>	<b>97</b>	<b>2</b>	<b>6</b>	<b>8</b>	<b>29</b>
<b>Service availability</b>					
Out-patient services	√	√	√	√	√
In-patient services	√	Nil, only observation	√, limited to one bed	√	√-- 11 beds. 3 private, 4 male and 4 female
24 hour emergency	√	√, limited (on call)	√, limited (on call)	√, limited (on call)	√- three staff shift system with one doctor on call from Mobimbi
Emergency surgery	√	Nil	Nil	Nil	Nil
Caesarean section	√	Nil	Nil	Nil	Nil
Assisted vaginal delivery	√	Nil	Nil	Nil	Nil
Blood transfusion	√	Nil	Nil	Nil	√- whole blood donation based on need from friends/family
Neonatal resuscitation with bag and mask	√	√	√	√	√- limited
Pharmacy	√	Only a small drug store	√	√	√- limited stock of certain essential drugs
Immunization	√	√	√	√	√- no EPI. Only for employee with typhoid and HBV given.
Growth monitoring	√	√	√	√	√
VCT for HIV/AIDS	√	Nil	√	√	√- through NAS
PMTCT of HIV/AIDS	√	Nil	√	√	√- through NAS. No idea of uptake or insight of programme in clinic.
Primary health care	√	√	√	√	√
Maternal health care	√	√	√	√	√
Ambulance service (functioning)	√	Nil, relies on ambulance from Serabu Hospital	Nil, relies on ambulance from Moyamba Hospital	Nil, relies on ambulance from Serabu Hospital	√- One functional, one non-functional. New unit



Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic on order
Intensive care	Nil	Nil	Nil	Nil	Nil
Laboratory services	√	Only rapid test for malaria	Basic	Basic	√
General surgery	√	Nil	Nil	Nil	Nil
Orthopaedic surgery	Limited to basic procedures	Nil	Nil	Nil	Nil
Specialist services	Nil	Nil	Nil	Nil	Nil
Radiology	Ultra Sound only	Nil	Nil	Ultrasound only	Nil
Isolation facility	√	Nil	Nil	Nil	√
Number of in-patient beds	80	1	2	3	11
<b>Diagnostic ability</b>					
Malaria RDT	√	√	√	√	√
Malaria microscopy	√	Nil	Nil	Nil	√
HIV RDT	√	Nil	√	√	√- through NAS
HIV ELISA	Nil	Nil	Nil	Nil	Nil
HIV CD4 count	Nil	Nil	Nil	Nil	√- awaiting reagents/cartridges
TB diagnostic	√	Nil	Nil	Nil	√- routine acid fast bacilli
Haematology	√ (only haemoglobin test)	Nil	Nil	Nil	√
Biochemistry	√ (basic urinalysis)	Nil	Nil	Nil	√
Parasitology	√	Nil	Nil	Nil	√- basic microscopy
<b>Availability of drugs (always in stock)</b>					
ACTs	Out of stock	√	√, frequent stock-outs	Out of stock	√
Parenteral quinine	√	√	√	Nil	√
IPT <sub>p</sub> (Fansidar/SP)	√	√	√	Out of stock	√
ART (Zidovudine, Nevirapine, Efavirenz)	√	Nil	√	√	√- through NAS. No idea on uptake in clinic.
TB drugs	√	Nil	Nil	√	Referred to government
EPI vaccinations	√	√	√	√	Nil
Antihelmintic drugs	√	√	√	√	√

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
Oral rehydration solution	√	√	√	Out of stock	√
Oxytocin/Misoprostol	√	√	√	√	√- misoprostol is banned due to clandestine abortions.
Penicillin/Ampicillin/Benzathine P	√	Nil	Nil	√	√
Erythromycin	√	Nil	√	√	√
Doxycycline	√	Nil	√	Nil	√
Vitamin A	√	√	√	√	Nil
Vitamin K	√	√	Nil	√	√
Iron supplements	√	Out of stock	√	Out of stock	√
Folic acid	√	Out of stock	√	√	√
Insecticide treated bed nets	√	√	√	√	√
Hypertension drugs	√	√, limited to metformin	√, limited to methyldopa	Nil	√
Antipyretics	√	√	√	Out of stock	√- nil intravenous
Injectable diazepam / valium	√	√	√	√	√
Injectable magnesium sulphate or other anticonvulsant	√	√	√	√	√
Injectable ergometrine	√	Nil	√	Nil	√
Tetanus anti-toxin injection	√	√	√	Out of stock	√
Adrenaline injection	√	Nil	Out of stock	Nil	√- but expired
Anti-protozoa drugs	√	√, limited to metronidazole	Out of stock	Out of stock	√
Anti-histamines	√	√, only chlorpheniramine	√, only chlorpheniramine	Nil	√
Dermatological preparations	√	√	√	√	√
Opioid analgesia	Not asked	Not asked	Not asked	Not asked	Yes, but personal stock of morphine, not ordered through mine.
Injectable anaesthesia (Ketamine)	√	Not asked	Not asked	Not asked	Nil

Health Facility	Matru Hospital		Moriba Town CHP		Mokelleh CHC		Gbangbatoke CHC		SRL Clinic	
Availability and functionality of medical equipment										
A=Available; F=Functional	A	F	A	F	A	F	A	F	A	F
Table for gynaecological examination	√	√	Improved		Improved		√	√	√- use maternity delivery bed	√
Fetoscope	√	√	√	√	√	√	√	√	√- basic, not doppler	√
Autoclave	√	√	√	√	√	√	√	√	Nil- major concern with one on order as previously soaked instruments in alcohol	
Pressure cooker for sterilisation	√	√	√	√	√	√	√	√	Nil- as above	
Speculum	√	√	Nil		√	√	√	√	√	√
Blood giving set	√	√	Nil		Nil		Nil		√	√
Delivery forceps	√	√	√	√	√	√	√	√	Not used	
IV sets	√	√	√	√	√	√	√	√	√	√
Vacuum extractor	√	√	Nil		√	No	√	√	Nil	
Manual vacuum aspirator	Nil		Nil		√	No	√	√	Nil	
Dilatation and curettage kit	√	√	Nil		Nil		√	√	Nil	
Operating table	√, improvised	√	Nil		Nil		Nil		Nil	
Operating light	√	√	Nil		Nil		Nil		Nil	
Anaesthesia equipment	Manual ventilator	√	Nil		Nil		Nil		Nil	
Oxygen equipment	√	√	Nil		Nil		√	√	Only oxygen concentrator in emergency room. No O <sub>2</sub> in labour ward. No bottled O <sub>2</sub> available.	
Bag valve mask and resuscitator	√	√	√	√	√	√	√	√	Nil	
Blood pressure apparatus	√	√	√	√	√	√	√	√	√	√
Stethoscope	√	√	√	√	√	√	√	√	√	√
Thermometer	√	√	√	√	√	√	√	√	√	√

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
Weighing scale	√	√	√	√	√
Glucometer	√	√	Nil	Nil	√
Endo-tracheal tube/Laryngeal mask	Nil		Nil	Nil	Nil
Intercostal drain	Nil		Nil	Nil	Nil
Urinary catheter/Naso-gastric tube	√	√	Nil	Nil	Nil
Central line or high gauge IV catheter (16G and below)	Nil		Nil	Nil	Nil
<b>Infrastructure</b>					
Regular/reliable running water	√	No running water. Relies on a protected well at the facility	√ (pumped from borehole to tank)	√ (pumped from borehole to tank)	Yes, from SRL plant. Pipes rusted and water turbid. Planning to upgrade system.
Regular/reliable electricity	Nil (no grid power supply)	Nil	Nil	√, high capacity solar power recently installed	Yes, from mine. No back-up generator but power from mine generally reliable.
Solar power	Nil	Only for vaccine fridge	Solar power currently being installed with capacity of 52 cells	√	Nil
Generator	√, expensive to run because of fuel costs	Nil	√, rarely used because of lack of fuel	Nil	Planning to get
Any type of electricity	√	Nil	√	√	√
Functioning refrigerator	√	Solar powered vaccine fridge	Solar powered vaccine fridge	Solar powered vaccine fridge	√
Functioning landline	√	Nil	Nil	Nil	Nil
Functioning mobile	√	Uses personal mobile	Uses personal mobile	Uses personal mobile	√
Functioning 2-way radio	Nil	Nil	Nil	Nil	Nil
<b>Continuity of services</b>					
In-patient services 24/7	√	Nil, observation only	Nil, observation only	√ (limited)	√
Emergency services 24/7	√	Available on call	Available on call	Available on call	√
Official opening hours per day (in hours)	24 hours	8AM-4PM (8 hours)	8AM-5PM (9 hours)	8AM-4.30PM (8.5 hours)	7am to 5pm

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
Staff lives in proximity to HF	√	√	√	√	Yes, in camps or in local communities.
<b>Access to a referral hospital</b>					
Proximity of referral hospital (in hours)	Seldom refer to tertiary hospital	One and half hours. Delays because of bad road	One and half hours. Delays because of bad road	One hour depending on availability of transport and status of the road	Serabu hospital. About 45km away but roads are very poor. Can take up to 2hours.
Transportation possibility to referral hospital	Yes, has one functional ambulance	Yes, requests ambulance from Serabu Hospital	Yes, requests ambulance from Moyamba Hospital	Yes, requests ambulance from Serabu Hospital	Ambulance. Only one functional and when away from mine area the Project is exposed
Cost of referral (both ways)	Free ambulance service	Free ambulance service	Free ambulance service	Free ambulance service	Free
<b>Staff in-service training</b>					
Staff trained in life saving skills	√, several staff	√, one staff	√, one staff	√, one staff	One doctor is surgeon, but no specific training.
<b>Process of health care</b>					
Use of disposable gloves	√	√	√	√	√
Use of protective eye wear and aprons	√	Nil	√	√	√- but not enough. They are using stock procured for EVD outbreak
Evidence of use of cleaning disinfectant in wards and casualty	√	√	√	√	√- challenge with tiles and grout
Evidence of soap in wash basins, or hand sanitizer in wards	√	√	√	√	√
Hand washing	√	√	√	√	√
Use of autoclave	√	√	√	√	Nil
General state of building and state of cleanliness	Good	Poor	Good (facility was constructed by SRL)	Very good (New building and standard equipment)	Not ideal. Floors old. Housekeeping poor.
<b>Cost of health care</b>					
How much does a basic outpatient consultation cost	No standard costs. Majority are treated for free	Majority of patients (pregnant and lactation mothers, children under-five)	No standard cost. Majority are exempted under the free care	Minimal charges. Majority are treated for free	Nil for SRL employees and dependents. Contractors pay 40,000

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
		are exempted from paying user fees	initiative		for consultation. Community are seen for free in an emergency (community access is limited to emergencies)
How much does diagnosis and treatment for malaria cost (with RDT use)	Free of charge	Free of charge	Free of charge	Free of charge	Free
How much does an admission for a child cost?	Free of charge	Free of charge	Free of charge	Free of charge	Free
General Questions					
How many people have access to this health care facility- the target population?	98,000 people (largely from Bonthe District)	7,031 people	2,091 people	Not specified (Stakeholder needed time to check on records)	Mine workforce (+-1800) and dependents (policy is one spouse plus 4 children under 18).  Contractors do not generally access the facility with only ATS employees conducting food handler checks (with no typhoid vaccination, chest XR or stool tests).
What are the 3-5 main health challenges facing the community	<ol style="list-style-type: none"> <li>1. Accessibility – poor road network and terrain</li> <li>2. Delays in seeking and giving care</li> <li>3. Transport challenges</li> <li>4. Resource challenges</li> <li>5. Access to safe drinking water in some areas</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Poor access to safe drinking water</li> <li>3. Inadequate sanitation</li> <li>4. Transport challenges for emergencies</li> <li>5. Inadequate health facilities</li> </ol>	<ol style="list-style-type: none"> <li>1. Accessibility due to bad terrain, water bodies</li> <li>2. Poor access to safe drinking water</li> <li>3. Poor sanitation</li> <li>4. Limited access to emergency care</li> </ol>	<ol style="list-style-type: none"> <li>1. Shortage of medication</li> <li>2. Malaria</li> <li>3. Delay in seeking care</li> <li>4. Transport challenges</li> </ol>	<ol style="list-style-type: none"> <li>1. Poor water, sanitation and hygiene conditions.</li> <li>2. Poor health services- with lack of adequately skilled staff, poor health infrastructure.</li> <li>3. Poor access to health services. Affordability is an issue as often need to pay for medications due to stock outs. There is a weak public transport system with</li> </ol>

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
					limited local busses and private cars. People rely in motorcycles. 4. Expectation in community for SRL clinic to service them. 5. Poor health education.
If you had 3-5 wishes to improve health care in the communities that you serve in, what would they be?	<ol style="list-style-type: none"> <li>1. Health education</li> <li>2. Improve transportation and emergency services</li> <li>3. Improve access to drinking water</li> <li>4. Address staffing challenges and payment (to improve motivation)</li> <li>5. Power supply</li> </ol>	<ol style="list-style-type: none"> <li>1. Improve transport services for emergencies</li> <li>2. Improve health infrastructure</li> <li>3. Improve access to drinking water and sanitation</li> <li>4. Health education</li> <li>5. Improve supply of essential drugs at the facilities</li> </ol>	<ol style="list-style-type: none"> <li>1. Improve supply of drugs</li> <li>2. Improve access to safe drinking water</li> <li>3. Health education</li> <li>4. Improve emergency care</li> <li>5. Improve road network</li> </ol>	<ol style="list-style-type: none"> <li>1. Improve supply of medication</li> <li>2. Access to improved sources of drinking water</li> <li>3. Health promotion</li> </ol>	
What are the 5 most common diseases or causes of morbidity in children under 5 years?	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Upper respiratory tract infections</li> <li>3. Pneumonia</li> <li>4. Diarrhoea</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Pneumonia</li> <li>3. Diarrhoeal diseases</li> <li>4. Malnutrition</li> <li>5. Anaemia</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Acute respiratory tract infections</li> <li>3. Diarrhoea</li> <li>4. Malnutrition</li> <li>5. Skin infections</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Upper respiratory tract infections</li> <li>3. Pneumonia</li> <li>4. Diarrhoeal diseases</li> <li>5. Skin diseases</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. ARIs</li> <li>3. Diarrhoeal diseases</li> <li>4. Skin diseases linked to poor hygiene</li> </ol>
What are the 5 most common diseases or causes of morbidity in adults	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Respiratory infections</li> <li>3. Hypertension</li> <li>4. Typhoid</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. STIs</li> <li>3. Diarrhoeal diseases</li> <li>4. Hypertension</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Body aches</li> <li>3. STIs</li> <li>4. Respiratory infections</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Urinary tract infections</li> <li>3. STIs</li> </ol>	<ol style="list-style-type: none"> <li>1. Malaria</li> <li>2. Typhoid</li> <li>3. Musculo-skeletal disorders</li> </ol>

Health Facility	Matru Hospital	Moriba Town CHP	Mokelleh CHC	Gbangbatoke CHC	SRL Clinic
	5. Diabetes		5. Hypertension	4. Respiratory infections	4. Hypertension 5. STIs <sup>14</sup> 6. Skin diseases including scabies 7. Peripheral neuropathy <sup>15</sup>
Are there measures in place to deal with disease outbreaks? How has this changed post-EVD?	Not asked	Active surveillance and emergency response mechanisms. These have improved following the EVD outbreak.	Active surveillance has improved together with infection prevention practices.	Surveillance, reporting and emergency response procedures are in place. Infection prevention measures have significantly improved.	Not asked

CHC- Community health centre

CHP- Community health post

<sup>14</sup> These conditions are more common in men and are generally in the form of urethral discharges, rather than an ulcerative condition. Contact tracing is rarely performed and their sexual contacts are generally not entitled to receive care at the clinic, as there is commonly not the declared spouse or a commercial sex worker. The declared spouse is rarely bough in as a contact for treatment as this will create potential conflict.

<sup>15</sup> This is a recent observation where people working on the mine are reporting symptoms. There is no clustering and histories are not clear, but there is a sense that most people with the condition come from the mining or dredge area.





Figure 42: Picture plate (1) of various health facilities



Figure 43: Picture plate (2) of various health facilities



Ward in Mattru UBC



Incinerator at Mattru UBC

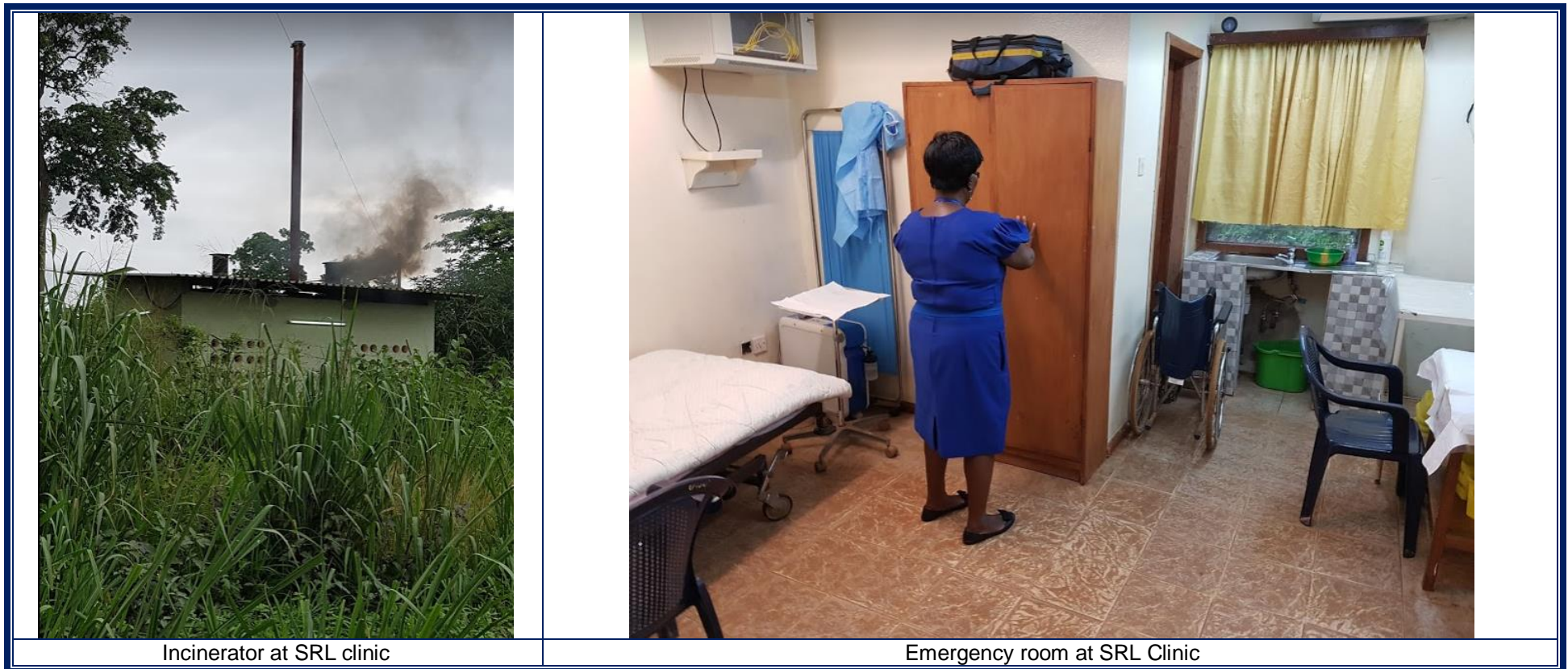


Figure 44: Picture plate (3) of various health facilities

## **11.3 Appendix C: EVD Outbreak**

Sierra Leone was one of the West African countries that experienced an unprecedented EVD outbreak between December 2013 and April 2016. The outbreak affected health systems, infrastructure and numerous social determinants.

### **11.3.1 General Information on EVD**

EVD is a severe, often fatal illness in humans caused by the EVD virus, a member of the highly virulent filovirus family. The virus is transmitted to people from wild animals and spreads in the human population from person to person. It first appeared in 1976 in simultaneous outbreaks in South Sudan and Democratic Republic of Congo. The 2014-2016 outbreak in West Africa is the largest and most complex outbreak to date. There are five known species of the bola virus, some of which are more infectious to humans. Half of people infected with EVD die (case fatality rate of 50%). The death rate has varied from 25% to 90% in past outbreaks [43].

It is thought that fruit bats are natural EVD virus hosts. The disease is introduced into the human population through close contact with blood, secretions, organs or other bodily fluids of infected animals. EVD then spreads in humans through direct contact (through broken skin or mucous membranes) with the blood, secretions, organs or other bodily fluids of infected people, and with surfaces and materials (e.g. bedding, clothing) contaminated with these fluids [43]. Considering the mode of transmission, the risk of infection is greatest in [44]:

- Healthcare providers caring for infected patients especially where infection control measures are not adequate.
- People in laboratories or processing medical waste from EVD treatment units.
- Family and friends caring for or transporting patients infected with the EVD virus.
- People attending funerals, especially burial ceremonies in which mourners have direct contact with the body of a person who has died of the disease.

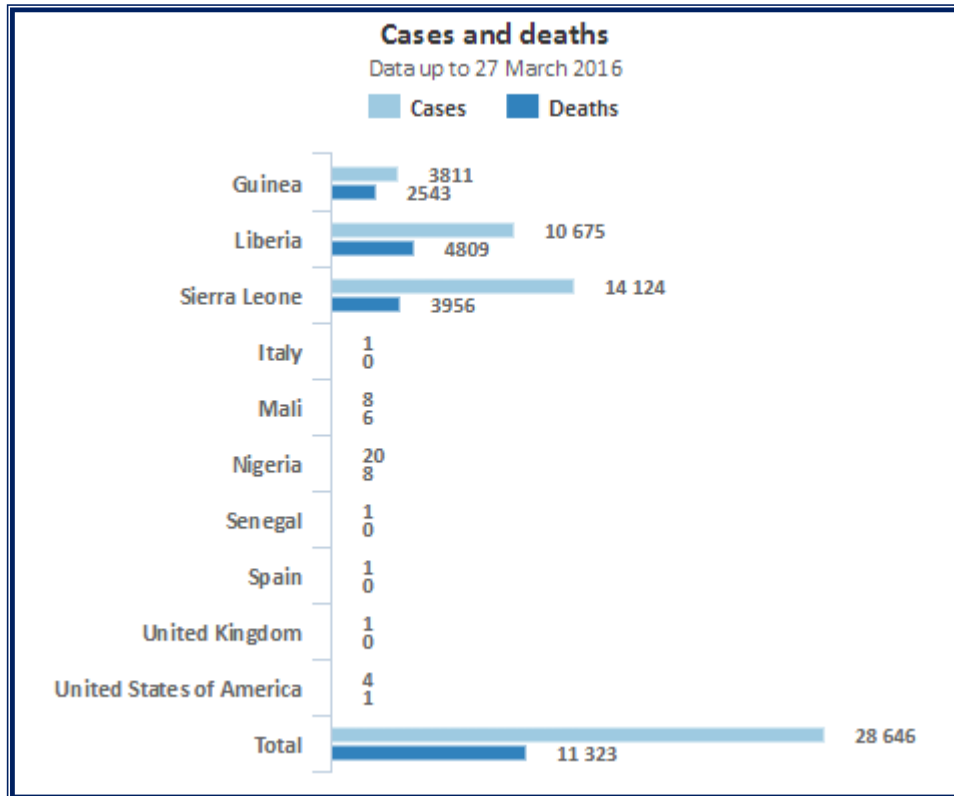
The EVD virus has a wide incubation period of 2-21 days (usually 4-10 days) with symptoms ranging from mild to severe. The early stages of the disease can mimic other common febrile conditions, with a sudden onset of fever, muscle pain, headache and sore throat. The disease can progress to affect multiple organ systems with haemorrhagic manifestations developing as a late sign. The diagnosis requires specialised tests that are often not available outside of major centres. Treatment is generally supportive, but a number of trials including blood products, immune therapies and drug therapies are being evaluated [43, 44].

A vaccine has been developed and in December 2016 a paper was published in The Lancet showing that the WHO led ring vaccination trial provided substantial protection to potentially exposed individuals. The approach of the vaccine is to protect potential contacts (hence the term 'ring') and prevent the spread outbreaks rather than vaccinating large populations to prevent the spread of a disease (such as with measles) [45].

Community engagement is essential to successful control of outbreaks. This include a package of interventions including case management, infection prevention and control practices, surveillance and contact tracing, a good laboratory service, safe burials and social mobilisation [44].

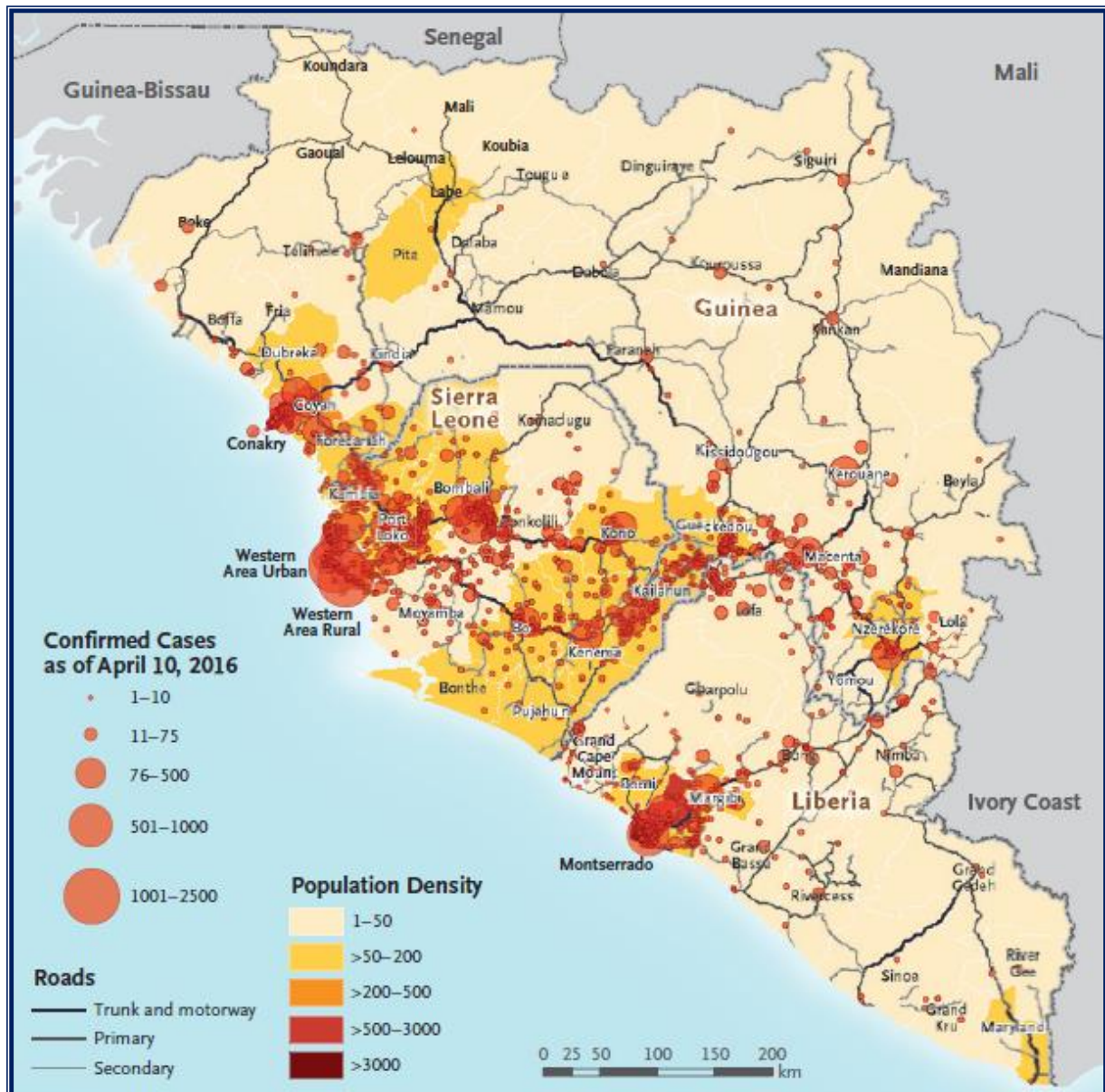
### **11.3.2 History and Spread of EVD Outbreak in West Africa**

The outbreak is believed to have started from an index case in Guinea around December 2013 and spread across porous borders to Liberia and Sierra Leone. The outbreak which officially ended in April 2016 resulted in more than 28,000 cases and more than 11,000 deaths. Some regional and global spread did occur, but these were either from healthcare workers or ill people that had travelled for care [46]. Figure 45 shows the number of cases and deaths recorded with Sierra Leone recorded 14,124 cases and 3,956 deaths [46].



**Figure 45: Number of cases and deaths from the 2014-2016 EVD epidemic**  
Source: WHO, 2016

Figure 46 [31] shows the geographic distribution of cases and although the first case of human infection was probably acquired from an animal, all subsequent cases are likely to have arisen from human-to-human transmission [47]. Ignorance about the means of transmission of the disease, exacerbated by cultural practices such as unsafe burial of the dead, led to high rate of infection and death in the population. Due to the inadequacy of infection prevention and control measures at various health facilities, there was a high rate of nosocomial infections leading to deaths of health care workers [25, 48]. As a result, the disease spread rapidly.



**Figure 46: Geographical distribution of cases of EVD in Guinea, Liberia, and Sierra Leone**  
Source: WHO, 2016

### 11.3.3 Impacts and Legacy of the Outbreak

EVD has had a severe impact on the health systems and economies of the three West African countries. At the height of the epidemic, the countries are believed to have experienced higher than usual morbidity and mortality from conditions such as malaria, TB, maternal deaths, enteric and respiratory illnesses and vaccine-preventable diseases as a result of disruption of health care service and delivery of routine intervention measures [49–52]. The disease has also left a legacy of psychological trauma, fear and a ‘shadow of death’ [53].



**Direct and indirect health impacts [54]:**

- 881 health care workers in West Africa were infected with EVD of which 513 died.
- There was an 8% reduction in healthcare workforce in Liberia and 23% decrease in healthcare delivery in Sierra Leone.
- Over 1000 additional estimated deaths from HIV, 2714 additional estimated deaths due to TB and 6,818 additional estimated deaths from malaria.
- The reduction in access to healthcare services caused an estimated 10,600 additional deaths due to untreated conditions in Guinea, Liberia, and Sierra Leone.
- 30% decline in childhood vaccination coverage.

**Direct and indirect socio-economic impacts [54]:**

- An estimated \$2.2 billion in gross domestic product was lost in Guinea, Liberia, and Sierra Leone as a result of lower investment and a substantial loss in private sector growth, a decline in cross-border trade, and declining agricultural production that led to concerns about food security.
- More than 33 weeks of education were lost due to school closures.
- Over 17,000 children lost one or both parents to EVD.

**11.3.4 Data Specific to Sierra Leone**

Sierra Leone suffered the highest number of cases, with each of its 14 Districts affected. Its first case was declared on 25 May 2014 in a region bordering Guinea, and its final one was recorded in the last week of January 2016 [55]. The highest number of cases occurred in Bombali, Port Loko, Kanema and Western Area Districts. Moyamba and Bonthe Districts registered tens of cases (Figure 46) [30, 31]. The country was first declared EVD free on 7<sup>th</sup> November 2015 after 42 days elapsed without a new case. However, in January 2016 two new cases emerged that were immediately contained. The country was declared EVD free for a second time in March 2016 [46,55].

As mentioned above, the outbreak severely tested the country's health system. A study conducted during the epidemic between April 2014 and September 2014 found that [40]:

- The number of antenatal care visits declined by 27% nationally during the period from May to September 2014. Western Area (33%) and the Northern Province (32%) were the worst affected areas. Bonthe recorded a high decline of 39%, while Moyamba registered a low decline of 10%.

- The number of women coming to health facilities to deliver a child also declined significantly, by 27% nationally. Northern Province experienced the strongest decline at 30%.
- The number of children coming to health facilities for vaccination declined by 21% nationally.
- The number of children under-five treated for malaria declined by 39% between May and September 2014. The decline occurred at the height of the malaria season, which normally witnesses a spike in malaria cases.
- Figure 47 provides a summary of findings.

		ANC4	Penta 3	Deliveries	U5 children treated for malaria
	District				
Northern	Bombali	-15%	-19%	-20%	-16%
	Kambia	-48%	-49%	-41%	-46%
	Koinadugu	-34%	-22%	-24%	-42%
	Port Loko	-37%	-26%	-41%	-50%
	Tonkolili	-23%	-22%	-26%	-39%
	Northern	-32%	-27%	-30%	-39%
Eastern	Kailahun	-21%	-12%	-21%	-25%
	Kenema	-25%	-11%	-21%	-38%
	Kono	-31%	-27%	-19%	-51%
	Eastern	-25%	-16%	-21%	-37%
Southern	Bo	-22%	-14%	-13%	-41%
	Bonthe	-39%	-40%	-38%	-42%
	Moyamba	-10%	-2%	-16%	-38%
	Pujehun	-16%	-12%	-5%	-37%
	Southern	-20%	-14%	-15%	-40%
Western	WA Rural	-36%	-24%	-33%	-41%
	WA Urban	-31%	-20%	-19%	-48%
	Western	-33%	-21%	-24%	-45%
National	-27%	-21%	-23%	-39%	

**Figure 47:** Percentage change in essential maternal and child health interventions in Sierra Leone during the EVD epidemic from May to September 2014

Source: MoH&S, 2014

### **11.3.5 Response and Control of EVD in Sierra Leone**

The initial response to the outbreak was characterized by confusion, chaos and denial. The WHO and the rest of the international community were slow to rally. The window of opportunity to contain the outbreak through conventional control approaches closed, and the outbreak became a humanitarian crisis.

The earliest response coordination mechanism was the National Ebola Task Force, established by the MoH&S in March 2014 when the disease emerged in Guinea, but before the first case was detected in Sierra Leone. The task force's strategy included starting awareness campaigns and surveillance in the border areas. Other preparations, such as the training of lab technicians, healthcare workers and community surveillance teams, were undertaken with the assistance of WHO and other partners. When the first case was confirmed in the country, the MoH&S through the task force organised the response around four technical 'pillars' that covered the classic response activities to an outbreak: surveillance, case management, social mobilization and logistics. The initial response was insufficient and ineffective [55].

By July 2014 the MoH&S established an EVD operations centre to serve as the response command-and-control centre. The government declared a state of emergency on 30<sup>th</sup> July 2014 and established a Presidential Task Force on EVD, to which the EVD operations centre reported. This was followed by the WHO declaring EVD a Public Health Emergency of International Concern on the 8<sup>th</sup> of August 2014. On the 18<sup>th</sup> of September the UN Security Council declared EVD a threat to security and established a mission for emergency response. The EVD operations centre was later replaced with the National Ebola Response Centre (NERC) and rolled out a decentralised response strategy under the management of District Ebola Response Centres (DERCs). With resource mobilisation and international support the outbreak was arrested after 18 months [55].

### **11.3.6 Post-EVD Surveillance in Sierra Leone**

As Sierra Leone moved from emergency response to recovery, the outbreak provided valuable lessons about best practices, reinforced health system infrastructure and innovative solutions for future outbreaks. The outbreak called for rapid adoption of Integrated Disease Surveillance Response early warning system. Consequently, as of August 2015, standard operating procedures were developed for implementation of surveillance at national and District levels. WHO and other partners are supporting the MoH&S to reactivate essential

health services and strengthen the health system. In achieving this end, the government initiated a 24-month health recovery plan that was launched on 24<sup>th</sup> July 2015 [56].

## **11.4 Appendix D: Methodology for Assessing and Categorizing the Significance of Impacts**

### **1.1.1 Introduction**

The impact significance methodology discussed below presents the process whereby health outcomes and determinants that may be influenced by the project, or its activities, are ranked to support the prediction, evaluation and ultimate mitigation of potential health impacts.

The categorisation of impacts is based on a ranking system that evaluates the direction (positive versus negative) of the impact, the consequence of the impact itself, as well as the likelihood that the impact will occur. These predictions are made based on the evidence collected in the HIA process and the sensitivity/susceptibility of receptors to the proposed project activities- whether direct, indirect or cumulative. The process will consider the different life stages of the project, as the direction, and area of influence of impacts may differ related to these phases.

The ultimate objective of the impact assessment rating process is to provide a subjective assessment of the comparative health impacts so that their significance can be determined based on the criteria above. This significance ranking allows for prioritisation of impacts, as well as mitigation and management measures, and can support the project proponent in critical project design and process considerations before the project starts so that these impacts can be avoided where possible.

### **1.1.2 General Reporting**

In general, each potential impact will be reported on in the following manner:

- **Identification of issues:** which include those health issues where project activities impact on a variety of receptors. The issues will be presented in the EHA framework but will only describe relevant issues; neutral impacts will not be discussed. Some of the issues will be addressed in a separate manner; while others may be addressed broadly as many of the health determinants/outcomes are interdependent.
- **Impact definition.** Positive and negative impacts associated with these issues (and any others not included) then need to be defined – the definition statement will include a cause and comment on the project activity (source of impact), how this may create an impact and who the receptor group is. Impacts are identified and defined where there is a plausible pathway between the activities and receptors. The “base

case” scenario will describe the present health status of communities, or the existing health needs.

The impact definition will address direct, indirect and cumulative impacts. In general, the direct impacts will be addressed in the quantitative impact evaluation while the indirect and cumulative impacts will be discussed in a more qualitative fashion.

It is essential that an impact definition is set in context, and to achieve this, the impact assessment will seek to describe the sensitivity of the receptors and any stakeholder concern (where relevant).

- **Impact evaluation:** This is the final step in the process where the significance of the impact is ranked. This is described in detail in the section below.

### 1.1.3 Impact Evaluation

The impact assessment process adopted by SHAPE uses a structured process through the following steps:

#### 1.1.3.1 *Part A: Defining the Consequence or Effects of a Health Impact*

The impact consequence is defined using three primary impact characteristics including:

- **Magnitude:** this considers the intensity/severity of the health effect on receptors as well as the ability of the community to adapt to the pre-impact level of health. In addition, the degree of stakeholder concern to the level or severity of the health effect is considered. As health effects can be detrimental or beneficial to the receptor this element evaluates how severe negative impacts might be, or how beneficial positive impacts maybe on a particular receptor or a potentially affected community.
- **Temporal scale/duration:** this defines the significance of the impact at various time scales, as an indication of the duration of the impact.
- **Spatial scale/ extent of influence on the population:** This defines the physical extent of the impact. This is relevant to support the description of the magnitude as the specific impact may influence different levels; from an individual; to a small community; and even extend to influencing national and cross boundary effects.

The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word ‘mitigation’ means not just

'compensation', but also the ideas of containment and remedy. For beneficial impacts, optimisation means anything that can enhance the benefits. However, mitigation or optimization must be practical, technically feasible and economically viable.

### **1.1.3.2 Part B: Defining the Probability of a Health Impact or Impact Consequence**

The **likelihood/probability** of the impact occurring as a result of project actions differs between potential impacts. There is no doubt that some impacts will occur (alteration in environment), but other impacts are not as likely to occur (e.g. vehicle accident), and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

The likelihood rankings are linked to the temporal rankings as described in the consequence and effects section in Part A.

### **1.1.3.3 Part C: Determination of the Significance Ranking**

Each criterion in Part A and Part B is assigned a ranking score to evaluate the overall **significance** of an activity as shown in Table A-1. This is an additive score based on the specific effect and likelihood rankings which are then analysed in the matrix presented in Table A-2 and Table A-3. These total scores are then evaluated to determine the significance of the impact and based on the overall cumulative score the significance ranking is divided into four categories as discussed in Table A-4. The importance of the ranking is discussed based on the overall significance to the receptor and the proposed development. The overall significance can either be positive or negative depending on the effect of the magnitude and these are divided into different colour codes in Table A-2 (for negative impacts) and Table A-3 (for positive impacts).

This evaluation is used to prioritize which impacts require mitigation, with critical and high impacts generally requiring some form of mitigation or proposal for an alternative approach. The approach also allows the determination of the benefit of mitigation measures that may actually manage a negative impact to bring about benefits. It can also highlight beneficial impacts as a result of interventions, generally on the residual rankings though.

These high impacts may also affect decision makers in whether to proceed with the proposed activity. Moderate impacts require an investigation on mitigations or alternatives.

Low impacts will require minimal intervention but it is essential that these elements remain of low significance.

#### **1.1.3.4 Part D: Confidence Level**

A confidence level is assigned to the assessment based on the amount and quality of the evidence and the confidence of the impact assessor on predicting the significance of the ranking. These are limited to low, medium and high ratings.



Table A-1: Consequence/effect and likelihood/probability matrix

Part A: Define the consequence/effect in terms of intensity of health effect, duration and spatial scale				
Impact characteristics	Definition	Criteria		Rating
		Negative impact	Beneficial impact	
<b>A. Magnitude/Intensity of Health Effect</b>	Nil	Prevailing baseline	Prevailing baseline	1
	Minor (impact/benefit)	Minor deterioration (nuisance, annoyance) in health or harm to receptors. The receptors will adapt with ease to the influence of the determinant and maintain pre-impact levels of health.	Minor improvement in the health and well-being of receptors. The changes are not significant and thresholds are maintained. No stakeholder approval or appreciation.	2
	Moderate (impact/benefit)	Moderate/measurable deterioration in health or harm to receptors. Acute conditions. The influence of the determinant will result in some difficulty in adapting to the health effects, and maintaining pre-impact levels of health will require support. Moderate stakeholder concern. Moderate exceedance of thresholds.	Moderate improvement in the health and well-being of receptors. The changes are within or better than thresholds. Minimal stakeholder approval or appreciation	4
	Major (impact/benefit)	Substantial deterioration in health or harm to receptors. The influence of the determinant will result in the inability to adapt to the health effects or to maintain a pre-impact level of health. Chronic or terminal conditions. There is substantial stakeholder concern. An identified threshold is often exceeded.	Substantial improvement in the health and well-being of receptors. The changes are within or better than thresholds. Stakeholder approval/appreciation and favourable publicity	8
<b>C. Temporal scale/duration</b>	Short term	Short term, <1-4 years. Low frequency		1
	Medium term	Between 5 and 20 years		2
	Long term	Between 20 and 40 years (generational) and from an individual human perspective permanent		3
	Permanent	Over 40 years and resulting in a long term and lasting change (generational)		4
<b>D. Spatial scale/extent/population</b>	Site/localised scale	Site specific or confined to a sensitive receptor at the local scale. This is generally limited to an individual/ small number of households/ a discrete community or number of homogenous communities		1
	Project area	This is localised to the Project area as well as the immediate area around the Project.		2
	Regional	District and Provincial level		3
	National/Cross boundary	National or influence across international borders		4
Part B: Define the likelihood or probability of exposure to impacts				Rating
<b>Probability of exposure</b>	Unlikely/Improbable	The likelihood of these impacts occurring is slight		1
	May occur/Possible	The likelihood of these impacts occurring is possible		2
	Probable	The likelihood of these impacts occurring is probable		3
	Definite	The likelihood is that these impacts will definitely occur		4

**Table A-2: Determination of the Negative Significance Ranking**

Part C: Determination of the significance ranking: based on a comparison between likelihood and consequence															
Likelihood/ Probability		Consequence/effect of health impact													
		3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
4	7	8	9	10	11	12	13	14	15	16	17	18	19	20	

Keys: Light blue: negligible; Green: minor negative; Yellow: moderate negative; Orange- high negative; Red: critical/very high negative

**Table A-3: Determination of the Beneficial Significance Ranking**

Part C: Determination of the significance ranking: based on a comparison between likelihood and consequence- Beneficial															
Likelihood/ Probability		Consequence/effect of health impact													
		3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
4	7	8	9	10	11	12	13	14	15	16	17	18	19	20	

Keys: Aqua: negligible benefit; Lilac: minor benefit; Blue: moderate benefit; Navy blue- high benefit; Purple: very high benefit

**Table A-4: Description of Significance Rating**

Significance Ranking	Description of significance	Cumulative score
<b>Minor</b>	The impact magnitude is sufficiently small and is within acceptable limits and mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in either positive or negative medium to short term effects on health and well-being.	<b>4-7</b>
<b>Moderate</b>	An important impact which requires mitigation to levels as low as reasonably possible. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in either a positive or negative medium to long-term effect on health and well-being.  As residual impacts these are of lower importance but warrant careful attention to conditions regarding mitigation and monitoring.	<b>8-11</b>
<b>Major</b>	A serious impact, if not mitigated, may prevent the implementation of the project (if it is a negative impact). These impacts would be considered by society as constituting a major and usually a long-term change to health and well-being and may result in severe effects.  As residual impacts these should play a role in project development and they require strict controls and monitoring. Beneficial impacts should be fully delivered.	<b>12-15</b>

<b>Critical/Very High</b>	<p>A very serious impact which, if negative, may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. At times these impacts are unable to be mitigated.</p> <p>As residual impacts these need to be avoided. Beneficial impacts should be fully delivered.</p>	<b>16-20</b>
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### 1.1.3.5 Reporting on Impacts

An example of the reporting format is provided below. For most impacts summary tables for each project phase (the phases can be integrated or separated as required) are produced to present the rating results.

The first row of the rating table presents the impact definition. This is presented in the form of the environmental health areas framework based on the relevant health outcome or determinant. The second row presents the rating categories as presented in Table A-1.

The third row presents the actual ranking or impact definition. The impact before management is presented first in row three to outline the **inherent risk** from the potential impact.

Management measures are listed in row four of the table. These management measures are divided into three management components based on the focus of the intervention; namely:

- **Project impact mitigation:** Interventions required to manage the potential health impacts on the receptors. These are required by the project and are not voluntary contributions. The precautionary principle will apply whilst analysing these.
- **Occupational health, safety and environmental management:** Interventions aimed at ensuring a healthy, safe and productive workforce. In addition, it considers aspects that can be controlled in the workforce to prevent community health impacts.
- **Social Development Initiatives:** Interventions suggested that will improve the existing health status of the communities. These are voluntary contributions and should bring about health benefits and improve social license to operate in the receptive communities. It should also promote project sustainability if developed based on sustainability principles.

The fifth row of the table will present the impacts after management or the so called **residual risks**. This follows the steps from Part A to D with the ranking that assumes that the recommended mitigation measures are successfully implemented. When voluntary contributions are recommended that may enhance the baseline these will be stipulated as they are likely to result in beneficial impacts.

The confidence ranking is included in the summary table which provides the reader with an indication of the assurance level placed on the rating process and addresses the concept of uncertainty.

### Example of the Rating Scale:

EHA #1	Communicable disease linked to overcrowding and poor environmental health										
Pre-Construction and Construction											
	Consequence/Effect						Probability/Likelihood		Total Score	Overall Significance	Confidence
	Temporal Scale		Spatial Scale		Severity of Impact						
<b>Impact before management</b>	Short term	1	Study Area	2	Moderate	2	Definite	4	9	Moderate	High
Management Measures											
Project impact mitigation:											
<ul style="list-style-type: none"> <li>• G</li> <li>• G</li> </ul>											
Occupational health and safety:											
<ul style="list-style-type: none"> <li>• G</li> <li>•</li> </ul>											
Corporate social investment:											
<ul style="list-style-type: none"> <li>• G</li> <li>• G</li> </ul>											
<b>Impact after management</b>	Short term	1	Localised	1	Slight	1	Unlikely	1	4	Minor beneficial	Medium

The final element is to consider which communities are affected by the potential impact. Where it is possible to classify the PACs for the specific project these will be presented as a summary based on the potential for impact. For example, in a project with a linear road feature only the PACs located on the road will be impacted. This will be presented as follows.

	PAC 1	PAC 2	PAC 3	PAC 4	PAC 5
<b>Accidents and injuries:</b>	Yes	Yes	No	No	No