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ROAD GEOHAZARD RISK MANAGEMENT

SIERRA LEONE CASE STUDY

GFDRR
Global Facility for Disaster Reduction and Recovery

THE WORLD BANK
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ROAD GEOHAZARD RISK MANAGEMENT

CASE STUDY OF SIERRA LEONE

INSTITUTIONAL CAPACITY REVIEW AND TARGET SETTING



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LIST OF ABBREVIATIONS AND ACRONYMS

CBO	Community-Based Organization
EPA	Environmental Protection Agency
FCC	Freetown City Council
GEF	Global Environmental Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information System
MASADA	Waste Management Company
MET	Meteorological Agency Sierra Leone
MoF	Ministry of Finance
ONS	Office of National Security
RAMS	Road Asset Management System
RMFA	Road Maintenance Fund Administration
SATCC	Southern African Transport and Communication Commission
SLP	Sierra Leone Police
SLRA	Sierra Leone Roads Authority
SLRSA	Sierra Leone Road Safety Authority
UNDP	United Nations Development Programme
UNOPS	United Nations Office for Project Services

ACKNOWLEDGMENTS

This production report was led by Fatima Arroyo Arroyo, Senior Urban Transport Specialist, and Xavier Espinet Alegre, Senior Transport Consultant, with the support of Akiko Toya, Program Officer.

The report was carried out by Ing. Obafemi B. A. Davies, Senior Lecturer of Civil Engineering at the Fourah Bay College in Sierra Leone, in association with Ing. Alpha Badamasi Savage, local Senior Transport Expert. It is part of the deliverables of the Technical Assistance (TA) for Building Transport Resilience in Freetown team is preparing for the Ministry of Transport and Aviation of Sierra Leone. The TA was financed through a grant provided by the Global Facility for Disaster Reduction and Recovery (GFDRR).

The team would like to acknowledge the timely and valuable support, guidance and advice they received from Gayle Martin, Country Manager of Sierra Leone and Nicolas Peltier, Practice Manager for AFR. The team also received logistics support from Konjit Negash Gebreselassie, Program Assistant, Balume Alpha Abonabo, Team Assistant, and Allan Dunstant Odulami Cole, CO Program Assistant.

Most importantly, the team would like to acknowledge the support and contributions they received from their counterparts in Sierra Leone: the Ministry of Transport and Aviation (MoTA), Sierra Leone Roads Authority, Freetown City Council, Sierra Leone Police and the Sierra Leone Environmental Protection Agency.

The report greatly benefited from the professional graphic design by Carlos Plaza Design Studio.



EXECUTIVE SUMMARY

Introduction

This project, "Institutional Capacity Review and Target Setting for road geohazards Management" aims at assessing the current capability of various key institutional actors—but primarily the Sierra Leone Roads Authority—in Sierra Leone's roads and transport sector, with the intent of evaluating their capability to formulate and implement policies and plans in the area of road geohazards management. Financed by the Global Facility for Disaster Reduction and Recovery (GFDRR) through the World Bank, the project also involves a physical assessment of potential risk sites along a number of major road corridors in the capital, Freetown, primarily through observation of both naturally occurring and human-generated activities and events around these sites.

The findings of the assessment are used to offer a set of recommendations to the above-mentioned institutions for improving the mitigation effectiveness of their policies, plans and initiatives. The project evaluates both institutional and technical capacity, as well as examine climate change-related issues such as landslides and flooding that are negatively impacting the urban transport infrastructure.

General

Sierra Leone's population of about 3 million people in 1975 has burgeoned to about 7.8 million in 2019. Between 2003 and 2014, the country's economy grew at an impressive average annual rate of 7.8 percent, but in 2015 it sharply contracted, by 21 percent, following a combination of the 2014–2016 Ebola outbreak and a decline in the price of iron ore, Sierra Leone's main export product. Per capita annual income, estimated at US$506 in 2018, remains below its pre-Ebola level of $660. The difficulties generated by such low income are compounded by an annual population growth rate of about 2 percent. In 2018 the Leone, the national currency, depreciated by 12.0 percent year-on-year, underpinned by the widening of the current account deficit to 14.0 percent of GDP (from 11.7 percent in 2017), following a sharp drop in exports earnings.

Understanding Sierra Leone's road geohazards

The economic hardships of the past half-decade, along with Sierra Leone's tropical monsoon climate, work together to create a potential powder keg of road geohazards that is continually waiting to explode given the right circumstances. Yet the budgetary limitations of the country's low-income economy is one factor that constrain its ability not only to respond post-crisis if a destructive climatic event were to strike, but to put in place pre-crisis, preventive and resilience-building infrastructural measures in the first place.

Freetown averages 3,657 mm (144 in.) of rain a year—well over three times the global average of 990 mm (39 in.). That amount of rainfall—from July to September it rains almost every day—would be a challenge to any road geohazards risk management program, and can generate a range of potential issues—from floods, landslides, debris flows, and siltation to landslides, erosion of embankment slopes, damage to road surfaces, and impaired access to critical buildings and locations throughout the city. A number of these geohazards are further exacerbated by human-initiated activities, including garbage deposition in street gutters, siltation of storm drains, unplanned construction on hilly terrain, and deforestation that accelerates erosion by exposing the soil directly to heavy rain, and by ridding forest floors of the dense network of roots that stabilized the top soil and kept it in place.

FREETOWN'S ROAD GEOHAZARDS

The geohazards that put much of Freetown's road network at risk of disruption can be summarized as

1. Potential slope failure (landslide, rockfall and erosion)
2. Erosion of embankment slope
3. Siltation and blockages of roadside gutters and storm drainages
4. Stone-mining activities

The vulnerability of Freetown to geohazards was vividly uncovered in the catastrophic landslide that occurred in August 2017. A November 2017 World Bank report, "Rapid Damage and Loss Assessment of August 14th 2017 Landslides and Floods in the Western Area," summarizes the institutional, infrastructural, policy, and programmatic challenges that amplified the physical effects of the landslide and resulted in the deaths of 1,141 people:

- The road system in Freetown suffers from three major deficiencies: inefficient and inadequate network, poor design and construction, and no effective maintenance
- The institutional arrangements for the delivery of infrastructure and services are complex and inadequate, with several agencies having responsibility for various aspects of urban transport, hence overlapping of mandates while some functions are not specifically allocated to any one agency
- Roads need to be reviewed, repaired, and reconstructed to better withstand future flooding risk and enhance the resilience of the road network
- Institutional strengthening is needed to enhance the transport asset management system and to maintain the transport infrastructure network

Summary of Current Approach to Road Geohazard Risk Management Practices

Several institutions support road geohazards / natural disaster management in Sierra Leone. These are the Office of National Security (ONS), Sierra Leone Roads Authority (SLRA), Road Maintenance Fund Administration (RMFA), Freetown City Council (FCC), Sierra Leone Police (SLP), and the line ministries of these institutions.

The current approach (not guided by any formalized strategy) to road geohazard risk management practices is not effective; there is no specific structure or framework. At SLRA and other institutions, personnel and equipment may be available to address issues of geohazards or natural hazards but they respond only when the need arises. Therefore, geohazard risk management practice is more reactive than proactive. In some cases, due to the re-occurring event of flooding as a result of blocked gutters and storm drainages, proactive actions are taken by SLRA and FCC for drainage/gutter-clearing before the rains get heavy during the months of July and August.

Assessment of Current Practices and Capability

There is no specific assessment process currently employed for geohazard risk management by the institutions. A reactive situational process is what seems to be in existence. Events triggered by geohazards are reacted to rather than mitigated. Emergency and prevention risk response can be slow—likely due to overlapping responsibilities among the institutions, resulting in "who is to do what" and other bureaucratic protocols before action is finally taken.

Almost all roadside cuttings within Freetown are unprotected – this is a major factor in geohazards risk such as rockfalls, erosion, debris and mudflow into gutters and on road surfaces, especially when it rains heavily. Current road designs make use of the Southern African Transport and Communication Commission (SATCC) standards.

Even though the legal instruments (acts, regulations and policies) on land use for construction, planning, deforestation and protected areas are all adequate, strict enforcement of the regulations has been challenging.

Human activities (in planned and unplanned settlements) such as construction of "baffas" (traditional temporary shelters) for street trading, dumping of household waste and garbage, and stone mining from exposed rock surfaces along the road all contribute significantly to geohazard risks in Freetown.

In terms of financing road geohazard risk management practices, it is worth noting that geohazard risk management is not specifically budgeted for within Ministries, Departments and Agencies' (MDA) institutional budgets; it is financed from other operational contingencies. In cases of emergencies, the Ministry of Finance may provide some funding and their effort is complemented by donor support agencies, local private companies and individuals.

Target Setting and Improvement Actions

The word "geohazard" was relatively new to almost all the institutions that were interviewed and most individuals working for them. Therefore it makes it difficult and a challenge to relate the roles of these institutions towards road geohazards.

As our team found out from interviews with senior personnel at these institutions whose activities and mandate—as documented in the checklist tables in the appendix—are supposed to be geared towards road geohazard risk management, the level of competency among them can generally be classified in the low to medium range, skewing mainly towards the low range.

SLRA, being the focal institution for road geohazard risk management, has qualified staff that are knowledgeable in risk management but are deployed in other work areas where they are less utilized, with no responsibilities in the area of road geohazard risk management.

Statement on the Target Capability for Assessed Item(s)

Institutional capacity and coordination

Generally, SLRA and the Office of National Security have adequate technical and coordination staffs but their expertise is limited when it comes to managing road geohazards risks and events. Therefore the institutional and coordination capacity is low for managing risks and events relating to road geohazards that will affect the transport sector.

Systems planning, engineering and design

There is no mechanism in place to identify risk on the road network; data are scarce for making informed, data-driven decisions, or evaluating all sites in order of priority to know which of them most urgently need proactive measures. Solutions to mitigate or respond to road geohazard events are therefore ad hoc and often only temporary in the form of a Band-Aid while the cut requires sutures. There is a need for reviewing road engineering practice and design if road geohazards should be mitigated; very little use is made of currently available road slope design and protection methods (for example, interlocking block walls or gabbion baskets). There is no comprehensive database that holds information about the condition and status of all paved roads; existing data are either incomplete or inadequate for decision making.

Operation and maintenance

The technical capabilities for operation and maintenance within SLRA are adequate but the shortfalls are the lack of an asset management framework and the omission of road geohazards in its operations and maintenance strategy. Information dissemination to the public about road geohazard risks due to climate change events, for example, is not effective. It is more of a reactive action done by radio broadcasts and sometimes through community-based organizations. Warning signs and traffic management during geohazard events are inadequate due to challenges in rerouting traffic to alternative roads.

Contingency programming

There is an existing emergency response plan with ONS for security and other disasters but not for road geohazards. The emergency response plan requires reviewing. Emergency response activities are coordinated by ONS by alerting relevant institutions to go into operation. Remedial or recovery measures do not necessarily involve a "build-back better" method but a quick fix. A "build-back" approach is normally limited to very high-priority sites or areas in the case of road geohazards, and this is usually a slow process due to inadequate funding.

Conclusion

An assessment of the institutional capacity of the SLRA and other MDA's with regards to their response to geohazards emergencies and management was conducted successfully. It was found out that there is need for a documented national framework including emergency response plan for natural disaster and specifically for road geohazard risk management.

It can be concluded that, lack of proper management system for data collection; inadequate funding for geohazards and natural disaster; low staff skills to meet current practices in disaster and risk management; the need to review engineering designs for construction of slopes with better aesthetics and stability; inadequate use of non-structural measures (e.g. early warning systems) and enforcement of laws, regulations and policies regarding land use and management are contributing factors leading to the very low performance in road geohazards risk management.

Recommendations

It is recommended that a standalone agency for national geohazard risk management be setup under the Ministry of Transport and Aviation. SLRA, the institution whose mandate is to manage all major roads, must have a well-functioning department for road geohazards risk management and that other key supporting institution should have a clear knowledge about their roles, responsibilities and contribution(s) expected towards geohazards and natural disasters. Adequate funding for geohazard risk management should be provided for in the national budget and should be available to fund planned activities in institutions concern with geohazard risk management.

INTRODUCTION

1.1 Project Background

Freetown has long been under pressure from the fast-moving dynamics of urbanization and urban sprawl, resulting in number of negative environmental impacts and social developments, including spontaneous settlements living on the edge in risk-prone areas and unsanitary environmental conditions. Freetown is built around the lower slopes of a forested mountain called Sugar Loaf. The location, together with intense deforestation, city growth pressure, and uncontrolled and unplanned urban development in the mountainous area, has caused intense drainage problems downstream and slope destabilization. This has often had fatal consequences, as experienced by the country in the devastating landslide of August 2017, when the side of Mount Sugar Loaf collapsed after heavy rain, burying parts of Regent Village on the outskirts of the capital, and leaving more than 1,100 people dead or missing. This was one of Africa's worst flooding-related disasters in years.

Freetown's transport system is one of the most vulnerable sectors and one of the most exposed to climate change and natural disasters, especially flash floods and landslides. The city's geographic status as a coastal city in a mountainous peninsula results in high exposure of the transport system to climate change and natural disasters, because many waterways draining from hilly areas cross the city. Additionally, many roads are exposed to rainfall-induced landslides and other forms of mass movement of soils and rocks as the slopes in the central highland are steep and unstable. The urban transport system in Freetown is at very significant risk from natural disasters. Its exposure to climatic change creates high vulnerability, exacerbated by poorly engineered and constructed roads, and drainage structures in very poor condition due to deficient maintenance. Climate change will aggravate this risk as projections indicate an increase of the maximum 1- and 5-day rainfall especially during July-September[1]. This risk posed on the transport system was evidenced by the dramatic occurrence in August 2017 of a landslide and floods in the west of Western Area and other occasional floods within the city center and east of the capital city of Freetown; various communities in the city were isolated because of collapsed bridges and damaged roads that made the task of recovery all the more difficult.

The current project is geared towards assessing the capability of primarily the SLRA and other institutions that are relevant actors in the roads sector and transport industry in Sierra Leone with regards to their policies and plans towards road geohazards management. It also caters for physical assessment of potential risk sites and areas along some major road corridors in Freetown either by observing activities (both natural and man-made) around these sites or otherwise. The findings of the assessment are used to offer recommendations to government institutions to improve their policies, plans and activities in mitigating road geohazards.

[1] https://climateknowledgeportal.worldbank.org/country/sierra-leone/climate-data-projections

1.2 Project Outcome

The expected outcome of this project is to verify that the SLRA (and roads related institutions) in fact has the vision and capacity to tackle road geohazard risk management in the way that it needs to be. Where there are deficiencies and lapses, we plan to identify and assess them and present ways of improvement and bringing them up to standard.

1.3 Project Goal

The goal of the project is to address both institutional and technical capacity and climate change-related issues (mainly landslides and flooding) that have a negative impact on urban transport infrastructure.

1.4 Project Objectives

The objectives of the assignment are as follows:

- To formally assess the capability of the Road Authority (and any entity contracted to provide parts of the geohazard response) across the full range of competencies required to successfully deliver the outputs specified in the Road Geohazard Risk Management Handbook
- To set appropriate targets for the competencies needed for every category of geohazard risk management activity
- To identify and recommend ways to address any deficiencies between the assessed and target competencies
- To prepare a prioritized and cost-effective improvement plan for action by the relevant transport sector participants.

COUNTRY AND SECTOR CONTEXT

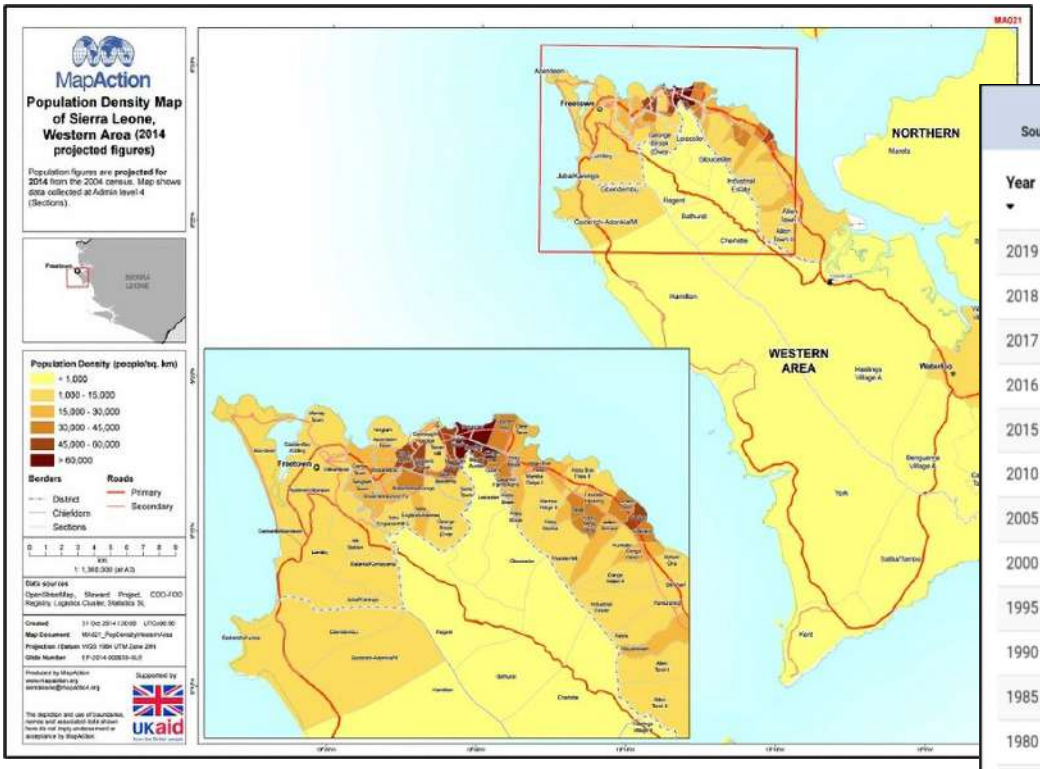
2.1 Outlook on Sierra Leone

Sierra Leone is a country on the West Coast of Africa, with an area of 73,326 sq. km. It is bounded on the west and south-west by the Atlantic Ocean, on the northwest, north and northeast by the Republic of Guinea, and on the east and south-east by the Republic of Liberia. The total population is 7,813,215 people, with Freetown, its capital city, having the largest concentration of population with more than 60,000 people/sq km population density in some parts of the city (see Figure 1).

Sierra Leone is one of the poorest countries is the world with a GDP per capita of 1,600 international $ and a Human Capital index of 0.35. The 2018 Sierra Leone Integrated Household Survey provisionally puts the overall poverty headcount at 56.7 percent compared to 53.8 in 2011. The poverty rate remains higher in rural areas (72.2 percent) than urban towns (18.4 percent in Freetown). Sierra Leone's economy grew by 7.8 percent on average during 2003–2014 but contracted by 21 percent in 2015 following the Ebola outbreak and a decline in the price of iron ore, the main export product. Growth rebounded to 6.4 percent in 2016 only to decelerate to 3.8 percent in 2017 and remaining roughly stagnant at 3.7 percent in 2018. Adding to the challenge of recovery, a large landslide hit Freetown in August 2017, further disrupting economic activity and slowing the pace of the recovery. (Source: World Bank website - as of July 15, 2019)

The country is divided in four provinces Western Area, Northern, Southern and Eastern. Western Area is the smallest provinces and comprised the capital city. This study focuses mainly in the Western Area (see Figure 2).

Figure 1 Freetown Density Map 2014 (left) and Population by year (right)



Sierra Leone Population by Year (Historical)

Source: World Population Prospects (2019 Revision)

Year	Population	% Male	% Female	Density (km²)
2019	7,813,215	49.89%	50.11%	108.91
2018	7,650,150	49.88%	50.12%	106.64
2017	7,488,423	49.86%	50.14%	104.38
2016	7,328,834	49.85%	50.15%	102.16
2015	7,171,914	49.83%	50.17%	99.97
2010	6,415,634	49.76%	50.24%	89.43
2005	5,645,624	49.69%	50.32%	78.70
2000	4,584,571	49.60%	50.40%	63.91
1995	4,303,957	49.49%	50.51%	59.99
1990	4,319,762	49.38%	50.62%	60.21
1985	3,805,311	49.28%	50.72%	53.04
1980	3,388,495	49.19%	50.81%	47.23
1975	3,037,154	49.11%	50.89%	42.34

Source: Map Action

Figure 2 Western Area District



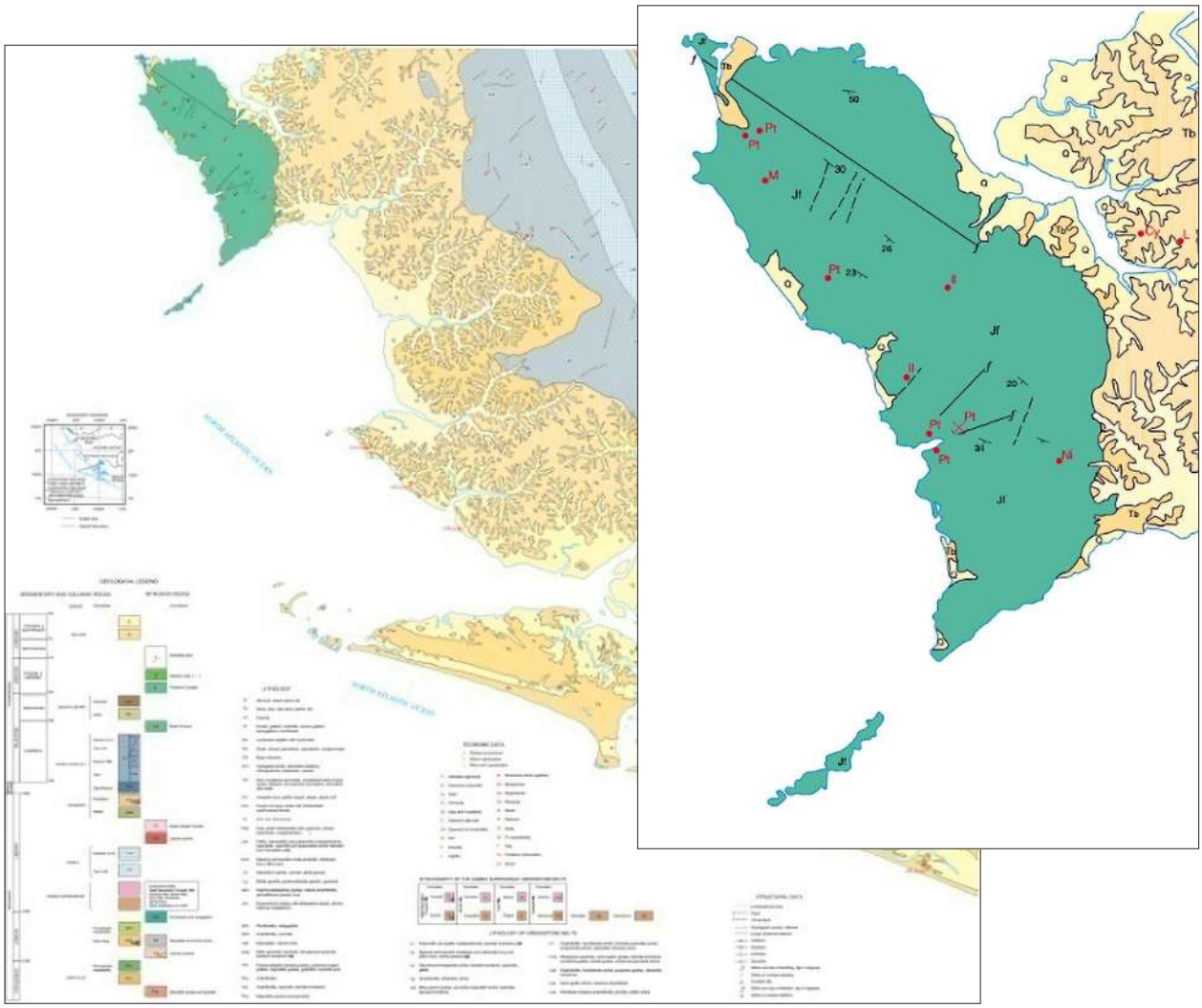
Source: Revenue Development Foundation

2.2 Geology

The Freetown Complex (mostly shaded green in the Geology map below) consists of rocks that are mainly gabbro, leucogabbro and anorthosite. These rocks are basic and alkali intrusive and are in forced contact with the Bullom group along the coastline. Goodenough et al (2018), in stating the age of the igneous rocks forming the Freetown Complex, estimated it to be dated around the end of the Triassic period which is 202 Ma. The peaks of the mountainous hills of the Freetown complex are observed to be declining from around the longitudinal section of Freetown towards the sea at varying orientation and dip.

The rock outcrops of the Freetown complex are observed to exhibit discontinuities (which can be fractures, bedding planes, joints or faults) with the propensity of triggering soil mass or rock movement due to any external influence. The rocks can be overlain mainly with in-situ weathered rock material called laterite soil of thickness ranging from as low as 300 mm to greater than 3000 mm thick as observed from dynamic cone penetrometer tests done on some of the mountainous slopes.

Figure 3 Geology Map of South-West of Sierra Leone and Western Area (left)



Source: Strategic Water Supply and Sanitation Framework - Design Report, June 2009

2.3 Environment

Sierra Leone is one of the countries at most risk to be negatively affected by climate change primarily due to widespread deforestation in and around Freetown. Such rapid and substantial change in land cover has created extensive surface runoff, which now affects the livelihoods of thousands of farmers and other people living in low-lying areas of the city. Rising above the coastal swamp is the Freetown Peninsular Mountain, most of whose peaks are over 610 m in height. Most of the mountains are rugged and steep with narrow valleys and plunging waterfalls.

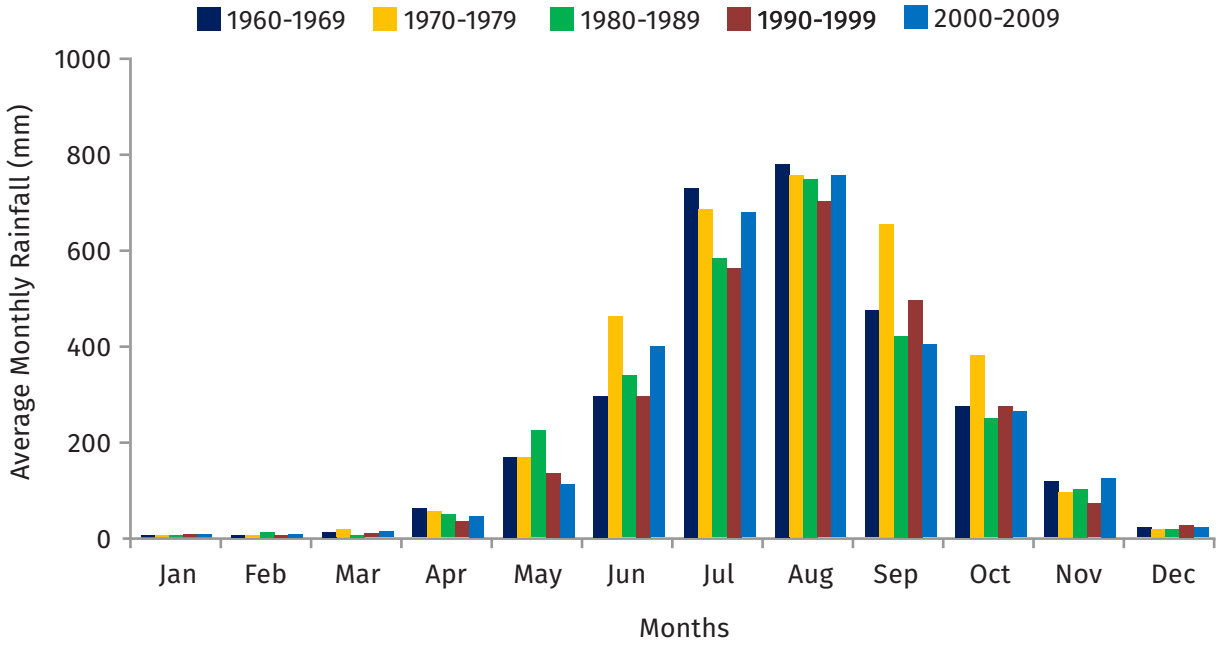
Following the August 2017 Regent landslide, rehabilitation of the affected area involved a risk-reduction strategy that centered on reducing population exposure. Such events are a reminder that the steep slopes and valleys across the Freetown Peninsula are highly susceptible to rainfall-triggered landslides which, given the topography, have a high propensity to generate high-intensity landslides and debris-laden floods. Future urbanization must consider whole-catchment management, flooding and slope engineering issues to provide lasting landslide risk reduction.

2.4 Climate

Road geohazards in Sierra Leone are directly related to climatic conditions. Sierra Leone has a humid tropical climate. Average annual rainfall is approximately twice the average annual potential evapo-transpiration. Rainfall is highly seasonal, with a peak in August and a dry season from December to March (Figure 4). Inter-annual variation in rainfall is generally small, but there are some extreme rainfall events (Upton, Ó Dochartaigh, Thomas and Bellwood-Howard, 2018.)

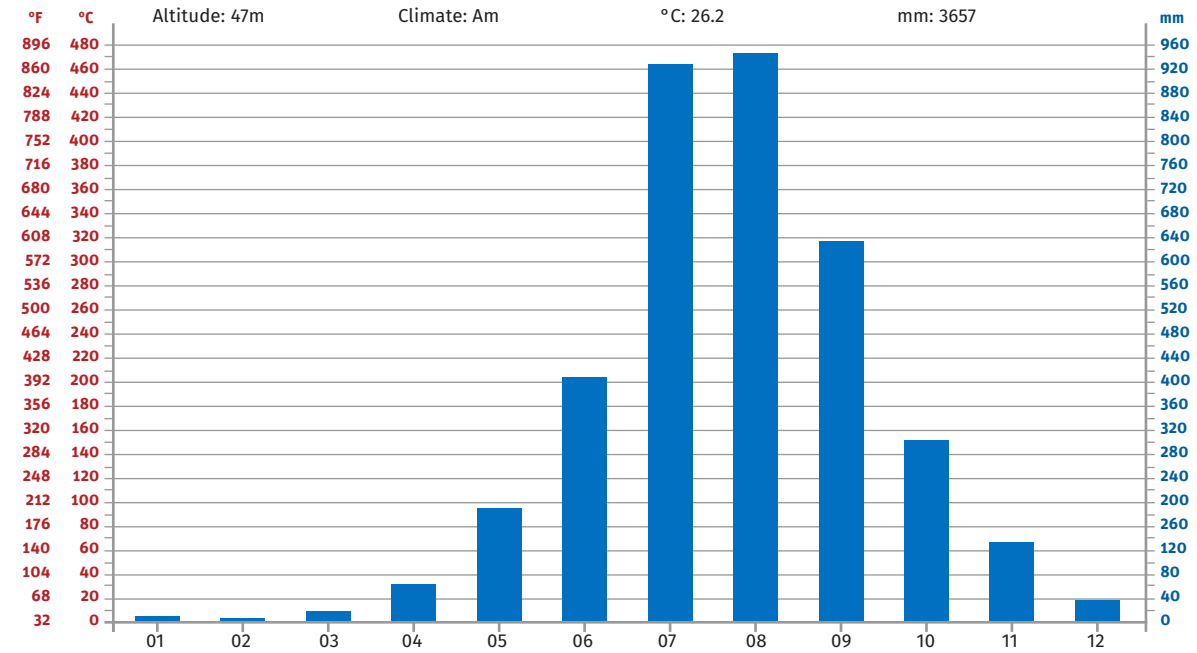
Like the rest of Sierra Leone, Freetown has a tropical climate with a rainy season from May through to October. The beginning and end of the rainy season is marked by strong thunderstorms. Under the Köppen climate classification, Freetown has a tropical monsoon climate primarily due to the heavy amount of precipitation it receives during the rainy season. The rainfall averages 3657 mm.

Figure 4-A Mean monthly rainfall distribution for Freetown between 1960 and 2009



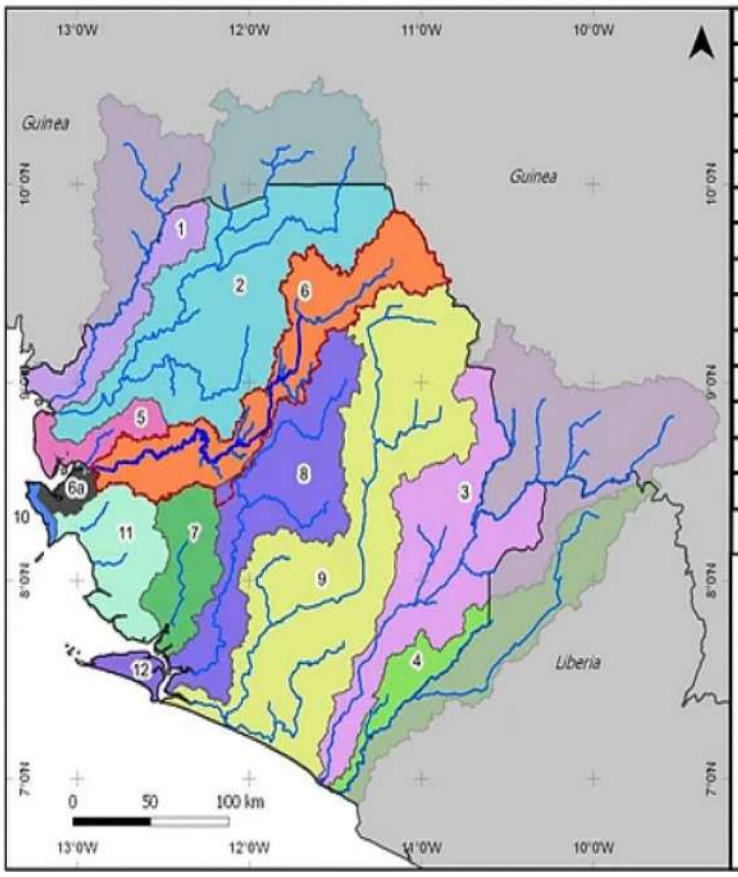
Source: Taylor et al 2014

Figure 4-B Mean monthly rainfall distribution for Freetown, 2018



Source: Climatedata.org

Figure 5 Sierra Leone's River Basins



Basin	Name	Country Area	Total Area
B 1	Great Scarcies Basin	2979	8303
B 2	Little Scarcies Basin	13383	18955
B 3	Moa Basin	9583	19835
B 4	Mano Basin	1959	7776
B 5	Lokko Basin	1565	1565
B 6	Rokel Basin	8236	8236
B 6a	Rokel Estuary (South)	579	579
B 7	Gbangbaia Basin	3121	3121
B 8	Jong Basin	8288	8288
B 9	Sewa Basin	19022	19022
B 10	Western WRA	223	223
B 11	Ribbi/Thauka WRA	3670	3670
B 12	Sherbro WRA	612	612
	Totals	**73220**	**100185**

Notes:
* Source HydroSHED catchment boundaries http://hydrosheds.cr.usgs.gov/index.php
* Rokel basin area has been modified after manually digitising the Rokel boundary (Red line)
* All areas are in square kilometres
* WRA - Water Resources Area
* "Country Area" is basin area inside Sierra Leone
* "Total Area" is total basin area
* Basin 6a is part of the Rokel River management area shown in GOSL documents. It is subdivided here for clarity

Source: National Water Resources Management Agency Sierra Leone

2.5 Drainage Network and Flooding Scenario

The general flow pattern of the drainages in Sierra Leone is from north-east to south-west. All the main rivers empty into the Atlantic Ocean (Figure 5). The Western Area with its six kilometer stretch of coastline, mountainous ranges, and high hills overlooking Freetown has its valley and streams meandering through steep-sloped hills, constraining the path of overland flows to low-lying settlements before reaching the Atlantic Ocean.

2.6 Road Network

The Road network in the Western Area is comprised of approximately 200 kilometers of roads. Most of them falls within the Class A (primary roads) and Class B (secondary roads) categories. The class A roads are trunk roads with high traffic volume and they convey long distance trips between districts, intra- and international regions. The secondary roads are linked to the class A roads as primary collector or distributor roads. Due to the topography of Freetown, most of these roads are susceptible to geohazards as they traverse mostly at mid-slope and the toe of the slope. The SLRA has the mandate of maintaining these two categories of roads (The road map in the Appendix shows the recently rehabilitated road networks in Freetown).

Another class of road is the class F roads (mainly feeder roads); these are land-service roads used mainly to access farming areas, chiefdom centers, community health clinics and other facilities and also traverse varying types of terrain. Some of these roads can be cutoff completely from communities during the raining season either as a result of weak and loss of subgrade strength due to poor cambering for drainage or flooding from heavy rains. These roads are maintained by the local councils.

2.7 Recent Geohazard /Natural Disaster information on Western Area

The combination of environment, climate, geology and drainage flow as described above results in high presence of geohazard in the Western Area. Several geohazard events have been impacted in recent years the vulnerable population on the area leading to life, economic and social losses. The following section describes some of the most critical events.

Review of previous studies on road geohazard events

The report on the "Rapid Damage and Loss Assessment of August 14th 2017 Landslides and Floods in the Western Area" was produced after the Landslides of August 2017, and describe some of the main challenges of the region in terms of disaster risk management and highlights specifically some of the problem that impact the road network:

Three major deficiencies are identified in the road system within Freetown. These are: (1) inefficient and inadequate network; (2) poor design and construction, and (3) poorly implemented maintenance practice.

1. Inefficient and inadequate network. Cross-town connectivity roads are few and inadequate. They are inefficient when in good condition due to high vehicular traffic volume thereby resulting in slow movement of vehicles. Some secondary roads have very low or no vehicle traffic and traversing them will only increase vehicle maintenance cost and risk of damage to vehicles. This is as a result of complete deterioration of the carriage-way.

2. Poor design and construction. Generally, due to poor design and construction practices, the road system in Freetown is exposed to blocked drains from eroded soil, flooding and very bad waste disposal practice.

3. Poorly implemented maintenance practice. To improve the national road network within Freetown and have it as an all year-round resilient infrastructure, there is the need for detail inventory and data collection on all roads and bridges to help plan for proper maintenance, rehabilitation and reconstruction work. Mitigating the urban flooding that the roads are now exposed to requires the regular cleaning of existing storm drains and construction of new ones. All these activities can be achieved through adequate funding and clearer define roles, responsibilities and mandates of all transport related institutions.

Additionally, the following figures (see figure 6 to 10) describe some of the most common geohazard problem along the transport network in the Western Area.

Figure 6 Hillslope failure in Freetown



At 06:50 on Monday 14 August 2017, a hillslope on the Freetown Peninsula, Sierra Leone, collapsed, sending 300 000 m3 of debris into the flooded valley below. As this debris mixed with floodwater, it became a sediment-laden flood that entered a drainage channel and travelled 6 km to the coastline. The event destroyed nearly 400 buildings, claimed the lives of an estimated 1100 people and affected 5000 people.

Figure 7 Roadside cutting along Barham road



In August 2019, a roadside cutting along Barham Road failed with a shallow slip, dislodging part of an existing concrete foundation after a heavy downpour.

[2] Sierra Leone - Rapid damage and loss assessment of August 14th, 2017 landslides and floods in the western area (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/523671510297364577/Sierra-Leone-Rapid-damage-and-loss-assessment-of-August-14th-2017-landslides-and-floods-in-the-western-area

Figure 8 Erosion of stream bank along Savage Street bridge



Erosion of a stream bank over time along the Savage Street bridge, and destruction of boundary fencing and buildings between 2012 and 2014.

Figure 9 Urban Flooding in Freetown



Flooding of streets and storm drainages on the outskirts of Freetown's central business district (Pademba Road – Mends Street Junction) during the rains of August 2019, leaving the streets impassable to both vehicles and pedestrians.

Figure 10 Asphalt damage in Freetown



In September 2016, a heavy downpour washed away the asphaltic overlay pavement (laid only about two years earlier) at the top end of Dundas Street.

UNDERSTANDING OF ROAD GEOHAZARD PRACTICES

3.1 What are geohazard practices and risks?

As described in Komac and Zorn 2013, geohazards are:

”Geohazard is the term related to Natural Hazard studies and indicates a geomorphological, geological, or environmental processes, phenomena, and conditions that are potentially dangerous or pose a level of threat to human life, health and property or to the environment."

"Generally, Geohazards include sub-aerial and submarine processes, such as earthquake, volcanic eruptions, floods, erosion, debris flows, rock-falls and other types of landslide and Tsunami. Human induced processes may also be considered as geohazards."

In Sierra Leone, geohazard processes experienced are floods, erosion, debris flows, rock-falls, landslide and human-induced processes (which may include but are not limited to garbage deposition and siltation in gutters, unplanned construction on sloppy terrain and deforestation).

3.2 Summary of the characteristics of road geohazards

The topography of Freetown is hilly and mountainous; coupled with its geology, major roads traversing in the east-west direction are constructed near or at the foot of steeply sloped hills, or midway along the slope. Lateral roads connecting to major roads traverse the same gradient as the hills. Human activities in planned and unplanned settlements also contribute significantly to road geohazards risk; this is exacerbated by massive deforestation of forest reserves for housing construction, exposing the hills to geohazard characteristics. Summary of the characteristics of road geohazards that are present on the network are highlighted thus.

Potential slope failure (landslide, rockfall and erosion)

Slope failure is a common geohazard along many roads in the Wester area due to unprotected slopes, poor drainage and exacerbated by the intense rainfall and hilly topography of the area. Almost all roadside cuttings in Freetown lack safety measures. Figure 11 shows the example of a slope failure and rock fall that occurred in September 2016 along the Regent–Grafton road around Bathurst village. It happened during a heavy downpour that started a few days before the event took place. In order cases, such as along Regent– Grafton road around Regen village, shallow slope failure and mudflow occurs frequently (Figure 12) , where there has been increased deforestation and building construction on the hilly environs. During the wettest months of July and August there is frequent debris and mudflow from hilly feeder roads that render half of the two-lane main road impassable.

Figure 11 Slope failure along the Regent–Grafton



Figure 12 Shallow slope failure around Regent village



Erosion of embankment slope

Erosion of embankment slope is a very common risk along road in the Wester Area driven by its hilly topography. In general, slope surface of the road cutting is not protected and coupled with deforestation at levels above, it causes increased overland flow of water, which erodes the cut surface. Figure 13 left shows the effect of gradual erosion of an existing vertical cut along a hillside bypass road by collapsing the boundary fence and leaving a tree barely holding on by few tree roots and exposing the foundation of the fence. On the right, The erosion at the road shoulder over the culvert drain occurred near Waterloo in July 2019, along the ongoing reconstruction of the Wellington–Maciak highway toll road during the rainy season that year.

Figure 13 Erosion of embankment slopes



Siltation and blockage of roadside gutters and storm drainages

Freetown experience severe urban flooding problems. The most common causes are siltation of the drain or gutters from eroded surfaces from the mountaintops and hilly areas, and garbage deposition due to improper waste disposal. Figure 14 left is showing a silted gutter along the 'Rue de paye' (New London Street) at Leicester (in the Freetown Mountain villages) due to bare land surfaces resulting from construction activities. On the right shows a colonial storm-water drain between the houses at Dundas street and Point Street in the West-end Central 2 area of Freetown that have been overtopped during the rains in August 2019.

Figure 14 Example of Urban flooding in Freetown



Stone-mining activities and other human activities

Human activities such as construction of "baffas" for street trading, dumping of household waste and garbage, and stone mining from exposed rock surfaces along the road, all pose geohazard risks to people and infrastructure in Freetown (see Figure 15 and Figure 16).

Figure 15
Stone-mining activities by residents along the road corridor serve as a means of livelihood for some families.



Figure 16
Roadside "Baffa" structures adjacent near-vertical road-cut with eroded surface



3.3 Review of Institutional mandates on Road Geohazard

Institutions that support geohazards / natural disaster management in Sierra Leone are presented in the table below giving a general idea of their mandate according to the Acts that established them and the supervising ministry overseeing their activities.

	NAME OF INSTITUTION	GENERAL MANDATE ACCORDING TO THE ACTS ESTABLISHING THE INSTITUTION	LINE MINISTRY /
1	Office of National Security (ONS)	To provide for the internal and external security of Sierra Leone and other related matters (including disaster management)	Functions under the Office of the President
2	Sierra Leone Roads Authority (SLRA)	To provide—through the control, development, maintenance, efficient planning and reliable management of the national road network—safe, reliable and sustainable means of transport (including providing technical guidance and support to local councils in the maintenance of roads devolved to them under the Local Government Act, 2004)	Functions under the Ministry of Works and Public Assets
3	Freetown City Council (FCC)	To provide local/municipal government services in accordance with the Local Government Act, 2004 and other related matters (including collection of taxes, responsible for city cleaning and trash collection)	Functions under the Ministry of Local Government
4	Road Maintenance Fund Administration (RMFA)	For financing the maintenance of the core road network and to provide for other related matters (which may include financing drainage clearing, garbage clearing and disposal; revenue collection from road user charges on fuel levy, vehicle registration and licenses)	Functions under the Ministry of Finance
5	Sierra Leone Environmental Protection Agency (EPA)	To provide for the effective protection of the environment and for other related matters (including conducting investigations into environmental issues, promoting studies, surveys and analyses for the improvement and protection of the environment and maintenance of sound ecological systems)	Ministry of Lands, Housing and the Environment
6	Sierra Leone Police (SLP)	To enforce law and order and investigate crime and provide for other related matters (including protect life and property, ensure national safety and security and to keep Sierra Leone roads and drivers safe)	Ministry of Internal Affairs

	NAME OF INSTITUTION	GENERAL MANDATE ACCORDING TO THE ACTS ESTABLISHING THE INSTITUTION	LINE MINISTRY /
7	Sierra Leone Meteorological Agency	Established to serve as the sole authority for the provision of meteorological and climatological services throughout Sierra Leone (for surface and marine transport in order to mitigate the effects of natural disasters such as floods, storm and droughts)	Ministry of Transport and Aviation
8	Sierra Leone Road Safety Authority (SLRSA)	To regulate and develop the road transport industry and other related matters (including promotion of road safety by administering traffic rules and regulations, vehicle registration and licensing of drivers and vehicles)	Ministry of Transport and Aviation
9	MASADA	A private-owned company engaged in waste management business	Not Applicable

The current approach (not guided by any formalized strategy) to road geohazard risk management practices is summarized below. Different institutions that are considered to be active and responsive in the case of geohazard emergencies are each discussed briefly.

- The Office of National Security (ONS) coordinates all forms of emergencies.
- The Freetown City Council (FCC), a local government institution responsible for the Freetown municipality, coordinates support (in the form of donated items) to individuals and families in cases where lives and property have been seriously affected by the geohazards. FCC also contracts out and supervises garbage clearing from areas prone to flooding, which is then carted away to dumpsites.
- Sierra Leone Roads Authority (SLRA), the institution set up to manage all road-related activities, usually does take the necessary actions to address road geohazards emergency situations (see annex for detailed overview of SLRA). However, these actions are mainly reactive. As part of the institution's maintenance strategy and depending on the availability of funds, proactive measures—that is, routine maintenance activities (clearing of roadside gutters and storm drainages) contracted out to companies, youth groups and community-based organizations (CBO)—are carried out.
- The Road Maintenance Fund Administration (RMFA) is the government institution set up for securing funds (for example from oil marketing companies, road user charges, and so on.) for financing road maintenance activities planned by SLRA. However, it has seen itself financing major road rehabilitation and reconstruction works leaving virtually no funds for management of road geohazard risks.
- The Environmental Protection Agency–Sierra Leone has been proactive towards geohazards since the landslide of August 2017. They have conducted studies together with other support and professional institutions and have been mapping disaster -prone areas in Freetown.

- The Sierra Leone Police provides support to ONS and institutions such as SLRA, EPA, SLRSA and FCC whose activities are related to road geohazards as and when they are needed. Their support comes mainly from the traffic division and in securing lives and properties where need be.
- Until recently, 2019, the meteorological department was not able to give the public alerts through radio stations (and other media) of thunder storms that might have negative impact on lives and property. For about 30 years now, ever since the weather station at Tower Hill was destroyed in 1991, weather and environmental data collection has been poor or almost non-existent.
- MASADA, a private business in garbage collection and disposal, is understood to have some contractual arrangement with FCC and RMFA. Unfortunately, in-depth discussion to understand and review any such contractual arrangement proved to be a challenge.

ASSESSMENT OF CURRENT PRACTICES AND CAPABILITY

There is no specific assessment process currently employed for geohazard risk management by the institutions. A reactive situational process is what seems to be in existence. Events triggered by geohazards are reacted to rather than mitigated. Emergency and prevention risk response can be slow—likely due to overlapping responsibilities among the institutions, resulting in "who is to do what" and other bureaucratic protocols before action is finally taken. The capability assessment of institutions is presented in the checklist tables in the appendix.

With regards to private sector involvement in geohazard risk management, none has been assessed. However, it is the prior knowledge of the consultant that some construction companies registered with the SLRA are contracted as and when necessary to de-silt roadside and storm drainages. MASADA is also contracted by FCC to undertake garbage clearing and disposal.

Recently, the Freetown City Council has been very active in the coordination of some construction companies and individual truck owners in the use of their vehicles to clear drainages, collect garbage, and clean markets and other roadside areas commonly used for deposition of garbage by communities.

4.1 Design Standards and Engineering

SLRA has been working on developing its own design manual; however, current designs are aligned to regional international standards and make use of the Southern African Transport and Communication Commission (SATCC) standards.

Despite current design mandates, mitigation measures in terms of slope protection (for example, by using gabion baskets or geosynthetics) are rarely implemented, even if considered. However, in Figure 17, a gabion basket is being used to rehabilitate a high road embankment constructed in 2018 from compacted fill material and it has already started to fail. This is as a result of slope surface erosion due to heavy rains, coupled with further erosion at the embankment toe due to exit water from a pipe culvert at the base of the slope.

Figure 16 Roadside "Baffa" structures adjacent near-vertical road-cut with eroded surface



4.2 Information on Geohazard Data

Characterized information about which geohazard risks the road network is exposed to is not accessible. Discussion with senior management staff at SLRA reveals that such data are either not in coherent form, wherever they exist, or not available. However, from the consultant's experience, a survey of these characteristics are captured and annotated in the pictures below (some of which can also be seen in previously annotated photos, above).

The legal instruments (Acts, regulations and policies) on land use for construction of residential facilities, and so on; on planning; on deforestation and protected areas are all adequate (irrespective of the overlapping of some responsibilities assigned to MDAs); however, strict enforcement of the legal instruments has been challenging to assist in preventive road geohazards risk and management.

4.3 Contractual arrangements with the private sector relevant to geohazard risk management

No contractual documents were reviewed. However, the consultant notes here that there has been some form of institutional contractual arrangement geared towards road geohazard risk management, either in the long or short term, with private companies. This is confirmed by MASADA affirming to having a garbage and debris clearing and disposal contract with FCC. MASADA took over the activities of the Freetown Waste Management Company in 2012 and since then has been actively involved in garbage collection, clearing and disposal. The company signed an MoU with the Freetown City Council and should be able to create jobs for unemployed youths who could serve as door-to-door garbage collectors, moving around with pushcart collecting household waste for a minimal fee no less than five thousand Leones (SLL 5,000) per household. Garbage collectors transport the collected waste to a central location where MASADA's trucks pick up waste for disposal. MASADA's operational cost for any duration of engagement is financed by the RMFA either directly or indirectly based on payment request from FCC, and supervision is done by FCC when they contracted MASADA.

Also, unofficial interviews with private contractors affirmed contract with SLRA for drainage clearing; road surface clearing of mudflow and debris after flash floods from heavy downpour. In this case, SLRA has local contractors registered with their institution for such work, and they are contracted by SLRA for specific tasks (for example, drainage-clearing after heavy rain, which usually leaves gutters highly silted, or for road maintenance premix patching of potholes). These SLRA contracts, being routine or periodic maintenance contracts, are budgeted and supervised by SLRA and financed by the RMFA. When drainage-clearing contracts are being implemented, SLRA maintenance contractors are encouraged to employ youths from within the community or engage with CBOs where the contract is implemented. A list of some of these contracts implemented under such arrangements are presented in tables 1, 2 and 3 below (source: RMFA maintenance report) and gives an overview of the development status (rehabilitation and maintenance work) generally on roads within Freetown.

"Four (4) other agencies are engaged in relevant road maintenance activities as approved by the Board of RMFA so that the objectives of the institution can be achieved. These agencies are Ministry of Youth Affairs; Ministry of Social Welfare, Gender and Children Affairs; National Commission of Social Action and MASADA"

In terms of financing road geohazard risk management practices, the following are noted:

- Not specifically budgeted for within MDAs institutional budgets
- Other operational contingencies may sometimes be used in cases of emergencies
- Ministry of Finance provides available funds to address emergency situation to institution(s)
- Government usually calls on donor agencies for support
- Office of National Security may rally around private companies, locally operating INGOs/NGOs, and regional / world institutions for support
- Individuals sometimes make contributions to win public appeal.

TARGET SETTING AND IMPROVEMENT ACTIONS

The events and terminology "road geohazards," according to its definition, are not new and some institutions may be aware of these events happening globally; however, the word itself "geohazard" was relatively new to almost all institutions that were interviewed (and to most other individuals working for them) - thus making it difficult and a challenge to relate the role of these institution(s) to road geohazards.

As our team found out from interviews with senior personnel at these institutions whose activities and mandate—as documented in the checklist tables in the appendix—are supposed to be geared towards road geohazard risk management, the level of competency among them can generally be classified in the low to medium range, skewing mainly towards the low range.

SLRA, being the focal institution for road geohazard risk management, has qualified staff generally. Road geohazard risk management has not been a constant commitment among its responsibilities (except for reactive response in emergency situations). The result is that staffs knowledgeable about risk management are re-deployed in other work areas where their expertise is less utilized.

The recommended action here is for setting up a road geohazard risk management department within the organizational structure of SLRA, and a geohazard risk management center in the Ministry of Transport and Aviation.

For target setting and action for road geohazard risk management by life-cycle stage, presented below is a guide extracted from the GFDRR handbook, which can be used.

STAGE	INSTITUTIONAL ASPECT	TECHNICAL ASPECT
SYSTEMS PLANNING (INSTITUTIONAL SETUP)	No or insufficient Laws, regulations, or technical standards, including assignment of responsible organizations No or insufficient national or subnational government plans or strategies No or insufficient mechanisms, funding	No or insufficient expertise, or lack of essential data, for road geohazard risk management (such as historical weather data and disaster records) No or insufficient risk evaluation practices
ENGINEERING AND DESIGN	No or insufficient mechanisms or funding for proper design and construction	No or inappropriate highway and risk management planning No or insufficient engineering investigation for design Lack of proper design and construction
OPERATIONS AND MAINTENANCE	No or insufficient mechanisms or funding for proper nonstructural measures or for operations and maintenance responses	No or insufficient mechanism and system (staff, machinery, equipment, asset management information system (AMIS), information gathering and communication systems, guidance manuals, training, coordination, and partnership system) for nonstructural measures Weak or nonexistent domestic road maintenance contracting industry
CONTINGENCY PROGRAMMING	No or insufficient mechanisms or funding for proper postdisaster response and recovery	No or insufficient contingency planning for both technical and physical response to events, including intelligent transport systems (ITS) and related AMIS

5.1 Statement on the target capability for assessed item(s) and improvement actions

Systems Planning – Institutional Set-up

Generally, SLRA (the institution responsible for all roads) and the Office of National Security (which is responsible for coordinating response to disaster events and security) respectively have adequate technical and coordination staffs. However, their expertise together with those from other auxiliary institutions in road geohazards management is limited when it comes to managing road geohazards risks and events. This makes their institutional and coordination capacity low. Therefore, there is the strong need to bolster the capacity of government institutions in managing risks and events relating to road geohazards that will affect the transport sector.

High-priority actions to strengthen institutional capacity and coordination should include: (i) developing and establishing an adequate institutional framework for the management of road geohazards, (ii) supporting various institutions for data collection, (iii) reviewing and updating the Disaster Manual / Handbook to include road geohazards, and (iv) offering support for setting up a National Disaster & Risk Management Agency. The estimated budget for these activities is around US$750,000 (more details in section 5.2).

Engineering and Design

There is no mechanism in place to identify risk on the road network, and data are scarce to make decisions or prioritize sites for proactive measures. Solutions to mitigate or respond to road geohazard events are ad hoc and only temporary. The strong need for reviewing road engineering practice and design if road geohazards are to be mitigated generally cannot be overemphasized. The current design standards and guides adopted and used for designing and locating highways that traverse mountainous terrain involving deep cuts and valleys with high embankments, needs reviewing. Currently, very little use is made of currently available road slope design and protection methods (for example, interlocking block walls, gabion baskets, and so on). A comprehensive database of the condition of all paved roads is not available; existing data are either incomplete or inadequate in terms of relevant details required for decision making.

High-priority actions to strengthen engineering and design include: (i) purchase of equipment and training in identification and assessment of road geohazards sites, (ii) review of highway design manual to include for slopes design and protection, including geotechnical investigation work (iii) training in the use of GIS in road geohazard management and (iv) setting up a road geohazard GIS database station, and purchase of software, computers and accessories. The estimated budget for these activities is around US$500,000 (more details in section 5.2).

Operation and maintenance

The technical capabilities for operation and maintenance within SLRA are adequate but the shortfall is the lack of an asset management framework that does not include road geohazards. Information dissemination to the public about road geohazard risks due to climate change events, for example, is not effective. Information dissemination by radio broadcast and sometimes through community-based organizations is most times reactive rather than proactive. Warning signs and traffic management during geohazard events are inadequate due to challenges in rerouting traffic to alternative roads.

High-priority actions to strengthen operations and maintenance include: (i) support to Sierra Leone Road Authority, Road Assets Management Department, in the development of systems, software and plans. The estimated budget for these activities is around US$500,000 (more details in section 5.2).

Contingency programming

There is an existing emergency response plan with ONS for security and other disasters but not for road geohazards. The emergency response plan requires review. Emergency response activities are coordinated by ONS by alerting relevant institutions to go into operation. Remedial or recovery measures do not necessarily involve a "build-back-better" method but rather a quick fix. In the case of road geohazards, a "build-back-better" approach is normally limited to very high-priority sites, and even then, this is usually a slow process due to inadequate funding.

Suggested priority actions to strengthen contingency programming and planning include: (i) development of a national disaster response guide to provide clear responsibilities to MDAs within and outside the road sector, (ii) short courses, training and upgrading of staff in current trends and practices, (iii) drills and test runs of emergency plans and procedures, and (iv) support for developing post-disaster response plans and procedures. The estimated budget for these activities is around US$180,000 (more details in section 5.2).

5.2 Target setting, activities, improvement action(s) and provisional financial budget

I. SYSTEMS PLANNING - INSTITUTIONAL SET-UP

INSTITUTIONAL ASPECT	TECHNICAL ASPECT	ACTIVITY(IES)	ACTION(S)	COST (USD)
(a) No specific / clear framework for management of road geohazards. (b) Plans and strategies to manage road geohazards are more institutionalized if any. (c) Laws and regulation(s) do overlap for some institution(s) - creating a jittery position as to who is responsible for what or to do what. "There are Laws regarding environmental degradation generally but not related specifically to Geohazard risk management." Also, "Bye-laws drafted and waiting for approval by parliament." (d) Funding for Road Geohazard risk management is not available. However, there is some funding on a critical case-by-case basis for repair work(s)	(a) There is need for a clear and documented framework. (b) Data are insufficient, only in recent times that data are being collected. (c) Personnel are available to undertake and to be trained in risk evaluation. (d) Current disaster manual/handbook used by ONS needs review to incorporate aspects of road geohazards management. (e) Strengthen the capacity of the proposed National Disaster & Risk Management Agency and ensure that road geohazard risk management is integrated in this new agency with support from relevant MDAs	1) Development and establishing adequate institutional framework for management of road geohazards	HIGH	100,000
		2) Support to various institutions for data collection	HIGH	300,000
		3) Training of personnel in conducting risk evaluation	MEDIUM	50,000
		4) Review and update Disaster Manual / Handbook to include for road geohazards	HIGH	50,000
		5) Support for setting up National Disaster & Risk Management Agency/Institution	HIGH	300,000
INSTITUTIONAL SET-UP		SUB-TOTAL	HIGH	800,000

II. PLANNING, ENGINEERING AND DESIGN

INSTITUTIONAL ASPECT	TECHNICAL ASPECT	ACTIVITY(IES)	ACTION(S)	COST (USD)
(a) SLRA is planning to establish a manual for disaster risk management (or geohazard risk management) (b) There is capacity gap in geospatial and data collection; there is lack of equipment in the other MDAs and staffing is not adequate (c) There is funding but it is inadequate for complete execution of proactive management activities for Geohazards: funds obtained through MoF, ONS, UNDP and GEF. (d) Early warning systems for the MET office. (e) Critical sites are identified and prioritized for proactive measures depending on availability of funds.	(a) "The SLRA do have sufficient technical capacity to address most issues in most situations. (b) However, there are constraints with the availability of analytical equipment and the skills to inform decision making." (c) Vulnerability assessment and hazards profiles for some communities as well as slope analysis in certain areas within Freetown were done recently by EPA. (d) Road designs for highway do not incorporate protection and beautification of slopes. Review design standard in use. (e) GIS is not used by all institutions	1) Purchase of equipment and training in identification and assessment of road geohazards sites	HIGH	200,000
		2) Review of highway design manual to include for Slopes design and protection (including Geotechnical Investigation work)	HIGH	150,000
		3) Training in the use of GIS in Road Geohazard Management	HIGH	50,000
		4) Setting up a road geohazard GIS data base station, purchase of software, computers and accessories	HIGH	100,000
ENGINEERING AND DESIGN		SUB-TOTAL	HIGH	500,000

III. OPERATIONS AND MAINTENANCE

INSTITUTIONAL ASPECT	TECHNICAL ASPECT	ACTIVITY(IES)	ACTION(S)	COST (USD)
(a) Insufficient mechanism and funding for proper non-structural measures (b) Insufficient mechanism and funding for operations and maintenance response	(a) Through radio announcement, the public is made aware of disaster areas. (b) Traffic warning / caution signs are put up (c) Institutions coordinated by the ONS have expertise but there are some gaps (d) The maintenance capacity and expertise of SLRA is reasonably good. The institution is only constrained with analytical tools for decision making which is being currently pursued (e) Has established a Road Assets management department which is managed by a specialist staff.	1) Institutional Support to Municipal Councils and the SLP force for proper execution of non-structural measures	MEDIUM	500,000
		2) Provision for interface with community based organizations (CBOs) and the Media	MEDIUM	100,000
		3) Support to SLRA Road Assets Management Department	HIGH	500,000
OPERATIONS AND MAINTENANCE		SUB-TOTAL	HIGH	1,100,000

IV. CONTINGENCY PROGRAMMING

INSTITUTIONAL ASPECT	TECHNICAL ASPECT	ACTIVITY(IES)	ACTION(S)	COST (USD)
(a) Emergency response is not properly planned and coordinated. (b) Effectiveness on emergency response issues is low due to lack of cooperation between members. (c) Some Technical expertise is available at the SLRA for planning; biggest constraint is lack of funds (d) No mechanism or funding for proper post-disaster response and recovery to emergency events	(a) There is need for an emergency response guide (b) ONS, the institution responsible for coordination, alerts relevant MDAs in the case of emergency (c) Sufficient expertise available but staff needs to be updated with current trends and practices (d) Regular testing of the plans and procedures for responding to emergency events has never been done	1) Development of a National disaster response guide to provide clear responsibilities to MDAs within and outside the road sector	MEDIUM	50,000
		2) Short Course(s), training and upgrading of staffs in current trends and practices	MEDIUM	60,000
		3) Carry out and test run of emergency plans and procedures.	MEDIUM	30,000
		4) Support for developing post-disaster response plans and procedures.	MEDIUM	40,000
CONTINGENCY PROGRAMMING		SUB-TOTAL	MEDIUM	180,000

CONCLUSION AND RECOMMENDATION

Conclusion

In conclusion, the institutional capacity of SLRA and other MDA's that are tasked with responding to geohazards emergencies and natural disasters has been assessed across a full range of competencies required to successfully deliver outputs towards road geohazards risk management.

The assessment brings out, among other things, the following:

- The need for a documented national framework for managing road geohazards.
- The need for proper setting up and management system for data collection.
- Lack of provision of funds for addressing geohazards and natural disaster activities.
- Filling the technical capacity gaps of institutional staff to match up with current trends and practice.
- The need to review engineering design standards and incorporate protection and beautification of slopes.
- The need to improve on non-structural measures for warning and mitigating geohazards.
- The need to enforce existing laws, regulations and policies on land use and its management.
- The need to have in place an emergency response plan.

Recommendations

The recommended action here is for setting up a road geohazard risk management department within the organizational structure of SLRA and a standalone national geohazard risk management agency under the Ministry of Transport and Aviation. This department and the agency will be responsible for setting up a national framework for geohazards and natural disaster; clearly define mandates for supporting institutions; data collection and dissemination; public alerting and sensitization, and coordination of all geohazards and natural disasters as part of their core functions.

Road geohazard risk management should be sufficiently provided for in the national budget. Those institutions that are currently in charge of managing geohazards and natural disasters should make greater provision in their budgets for financing activities that genuinely mitigate and reduce the risks of geohazards in the long term.

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APPENDICES

8.1 SLRA Organogram

According to the Sierra Leone Roads Authority (Amendment) Act – 2010, the main functions and "the object for which the Authority is established is the control, development, maintenance, efficient planning and reliable management of the national road network to provide safe, reliable and sustainable means of transport."

It is reported in the Sierra Leone Integrated Transport Policy, Strategy and Investment Plan that:

The Authority's systems appear weak in general, including the financial and project management systems. Activities are not driven by procedures and programming. Given the responsibility of the SLRA to predict road condition and plan interventions accordingly, the feeble condition of the road asset management system (RAMS) is especially worrisome. Data on the system is not up-to-date, and it has low predictive ability. The effect is that planning is short-term, and project-focused, rather than a long-term focus on system optimization.

The Sierra Leone Roads Authority recently reviewed its institutional Organogram (see page in the appendix). This comes as a result of lapses in and overlapping of responsibilities of some departments and also in view of the National Transport Strategy that the "Action Plan needs to be revived and a fresh commitment made to restructure the SLRA to be an efficient road asset manager."

Management

The management of SLRA comprises of the director general, who is the chief executive, the deputy director general, and the heads of the various departments, who are also directors.

The major departments within the institution, mandate(s) and their current heads are shown in Table 3.1 below. The revision now includes the Research and Quality Department. The revised organogram is shown in the appendix. It is the expectation of management that the revised organogram will clarify the specific roles and responsibilities of the different departments, thereby avoiding the dilemma of 'who is responsible for what'

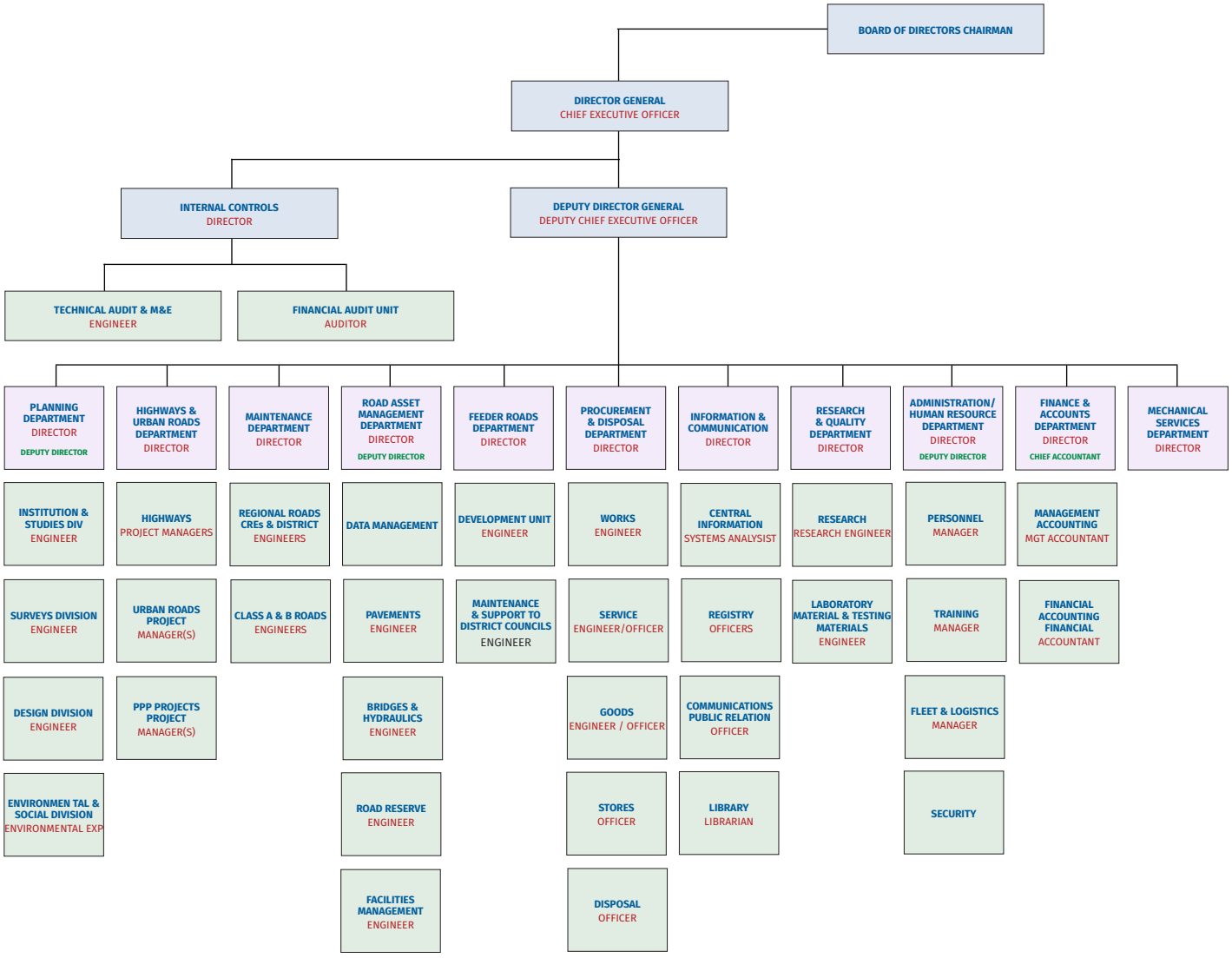
Table 3.1 - SLRA MAJOR DEPARTMENTS AND MANDATES

DEPARTMENT/UNIT	FUNCTIONS OF DEPARTMENT/UNIT
Director General	• Coordinate activities of each department and units to ensure delivery of institutional goals and objectives. • Collaborate with line ministries to actualize institutional goals and objectives. Also seek funding from donor supports and development partners through the Ministry of Planning.
Deputy Director General	• Deputize the Director General in performing the above assignments in his absence. • Supervise the activities of the regional engineers.
Maintenance Department	• Coordinate, monitor and supervise all maintenance activities in the country, which includes the following: • Routine maintenance of all roads and related structures such as bridges and culverts within the national road network. • Periodic maintenance of all roads and related structures such as bridges and culverts within the national road network. • Recurrent maintenance of all roads and related structures such as bridges and culverts within the national road network.

DEPARTMENT/UNIT	FUNCTIONS OF DEPARTMENT/UNIT
Feeder Roads Department	• Construction of roads leading to agricultural settings and roads with less than 200 vehicles/day. • Reconstruction of roads leading to agricultural settings and roads with less than 200 vehicles/day. • Rehabilitation of roads leading to agricultural settings and roads with less than 200veh/day.
Operations Department	• Construction, reconstruction and rehabilitation of trunk roads (primary and secondary) within the national road network. • Construction, reconstruction and rehabilitation of urban roads (primary and secondary) within the national road network.
Asset Management Department	• Monitor the performances of pavements, bridges, culverts to ensure that it is in line with the design outlines. Also monitor the use of the right-of-way and ensure that it does not affect the performance of the roads. • Identify any change in the design parameters and inform the management of SLRA accordingly to consider them in future road projects. • Liaise with the Maintenance Department to report any defects that must be addressed.
Planning, Policy and Research Department	• The development of policies that guide the implementation and management of road projects. • Conducting research on the performance of pavements and other assets; and also how to maximize revenue generation for the improvement of roads.
Engineering Services	• Conduct prefeasibility and feasibility studies to inform decisions of donors to support road projects. • Prepare and review unit rates for road works based on the trends of markets.
Internal Controls Department	• Quality assurance and control of expenditures in the institution. • Quality assurance and control of processes including procurement in the institution
Procurement Department	• Conduct the process of selecting a contractor to undertake or implement road works on a fair basis to ensure value for money. • Conduct the process of selecting a supplier to undertake the supply of goods on a fair basis to ensure value for money. • Conduct the process of selecting a consultant to render supervision services for the implementation of a road project, on a fair basis, to ensure value for money.
Information and Communication	• Establish and manage a computer system consisting of hardware and software and obtain all required information that serves as the backbone of the institution. • Relay or communicate all information needed for the public; in some cases, to educate on the use of the road. • Collects data from multiple operations and departments/units and analyze the information; and then reports the information to the management of SLRA for decision making.

DEPARTMENT/UNIT	FUNCTIONS OF DEPARTMENT/UNIT
Administration Department	• To enhance the office staff's ability to manage and organize office effectively and professionally. • Develop an appropriate office management strategy and administrative procedures for the effective operation of the institution.
Finance Department	• Responsible for all financial matters within and outside the institution
Mechanical Services Department	• Responsible and provide mechanical equipment services to contactors and the general public
Monitoring & Evaluation Unit	• Responsible for all monitoring and evaluation activities undertaken by the institution

SLRA PROPOSED REVISED MANAGEMENT ORGANIZATIONAL CHART



8.2 Completed checklists tables from institutions

Table 3.2 - Checklist: Capability Assessment for Road Geohazard Risk Management

Interviewed Agencies: Sierra Leone Roads Authority (SLRA), Sierra Leone Police (SLP), Road Maintenance Fund Administration (RMFA),

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
PART II: INSTITUTIONAL CAPACITY AND COORDINATION				
1.	Is there a clear institutional framework for management of road geohazards?	Clear and documented framework—either stand-alone or integrated with overall road authority management documents	0. Not yet started **1. Formulating** 2. Formulated 3. Utilizing partially 4. Utilizing fully	Low
			4.Utilizing fully	Moderate
			0. Not yet started	No
			0. Not yet started	No
			3. Utilizing partially	Moderate
2.	Have laws and/or regulations been formulated?	Laws of disaster risk management (or geohazard risk management)	**0. Not yet started** 1. Formulating 2. Formulated 3. Enforcing partially 4.Enforcing fully	No
			3. Enforcing partially	Moderate
			3. Enforcing partially	Moderate
			1. Formulating	Moderate
			3. Enforcing partially	Moderate

Environmental Protection Agency (EPA), Freetown City Council (FCC) and Office of National Security (ONS)

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
Current status is that this is not effective as there is no specific structure or framework at SLRA for management of road geohazards; however, personnel and equipment are available to address such issues as they occur. SLRA is now in the process of formulating such a framework.	SLRA
The police force has regulations that will need review to address issues of emerging road geohazards	SLP
There is no documented framework for management of road geohazards at EPA.	EPA
There is no definite framework. FCC responds as and when need arises regarding road geohazards; however, there is a structure now in place at FCC to effect clearing of drains and cleaning of drainage channels to prevent blockage which mostly cause flooding of roads.. FCC is trying to be proactive in these cases.	FCC
Will alert SLRA when situation arises concerning roads	ONS
No laws or regulations for geohazard risk management	SLRA
Police have laws to act in cases of disasters in general; however, enforcement of these laws especially regarding hazard is challenging due to lack of equipment	SLP
There are Laws regarding environmental degradation generally but not related specifically to Geohazard risk management	EPA
Bye laws drafted and waiting for approval by parliament	FCC
Have a disaster management handbook that is being used nationwide by district councils	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
3.	Have technical standards, guidelines, or manuals been prepared?	Technical standards, guidelines, or manuals for disaster risk management (or geohazard risk management)	**0. Not yet started** 1. Preparing 2. Prepared 3. Utilizing partially 4. Utilizing fully	No
			0. Not yet started	No
			0. Not yet started	Moderate
			0. Not yet started	No
			3. Utilizing partially	Moderate
4.	Is an overall plan or strategy in place to address road geohazards?	Documented and well-understood plan or strategy in place	0. Not yet started **1. Preparing** 2. Prepared 3. Utilizing partially 4. Utilizing fully	Low
			0. Not yet started	No
			2. Prepared	Moderate
			0. Not yet started	No
			2. Prepared	Moderate
5.	Are roles and responsibilities clearly understood?	Job descriptions for various roles, including geohazard responsibilities and appropriate expertise, in place	0. Not yet started 1. Preparing job descriptions **2. Roles under preparation** 3. Roles defined but often not appropriately staffed 4. Roles defined and appropriately staffed	Low
			3. Roles defined but often not appropriately staffed	Moderate
			0.Not yet started	
			0.Not yet started	
			0.Not yet started	Low
			3. Roles defined but often not appropriately staffed	

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
The institution is planning to establish a manual in that regard	SLRA
No such guidelines but activities are guided by the National Road Safety strategy.	SLP
There are Regulations prepared for issues such as sand mining, masts construction and other environmental impacts; transformation to policies is ongoing; not specifically for geohazard risk management.	EPA
No. Have plans to develop manual	FCC
Have a disaster management handbook that is generally being used nationwide by district councils	ONS
There is a plan to address the problems of geohazards although it is currently being reviewed and a maintenance strategy is being developed to include it.	SLR
National road safety strategy guides actions of SLP	SLP
Documents prepared regarding geohazards but these are still with the law officers r	EPA
No definite strategy in place. Only mitigates disaster such as flooding in a proactive way by clearing drains.	FCC
As part of the decision to transform the ONS disaster management department into an agency	ONS
Job descriptions and roles for staff are clearly described and understood for road works. However, no specific roles are defined for staff for geohazard responsibilities in particular. No established Department for geohazard issues at SLRA.. This is now under consideration.	SLRA
Roles and responsibilities not clear with respect to geohazards; road safety institutions e.g. - SLRSA, SLP-Traffic, normally takes the lead in such disasters.	SLP
The EPA compliments management of geohazards through the Office of National Security (ONS)	EPA
Roles understood but not carried out effectively	FCC
Roles may be clearly defined at the SLRA, but effectiveness is a bit limited. Probably some over lapping with City Councils. RMFA provides funding to SLRA for all Road related issues.	RMFA
Roles and responsibilities are defined in institution(s) Acts. However, there are some overlaps that needs to be addressed	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
6.	Where some roles and responsibilities have been contracted out, do the contractual arrangements clearly specify their geohazard duties?	Contract documents for any external consultants or contractors involved in any aspect of the geohazard risk management activities	0. Not yet started **1. Vague reference to geohazard duties** 2. Clearly defined but not well understood duties 3. Clearly defined and well understood, but contractual barriers remain 4. Contractual arrangements do not pose any negative impact on the delivery of geohazard risk management	Low
			1. Vague reference to geohazard duties	No
			0. Not yet started	
			2. Clearly defined but not well understood duties	High. Prompt on calls
			3. Clearly defined and well understood, but contractual barriers remain	Moderate
			3. Clearly defined and well understood, but contractual barriers remain	Moderate
7.	Is a funding mechanism in place to proactively manage geohazards?	This pertains to funding for the management of geohazards and not the physical works to repair or mitigate them.	0. No 1. Limited to investigating areas of previous failure **2. Funding available to manage some high-risk sites** 3. Funding available to proactively manage all high-risk sites 4. Sufficient funds to manage all aspects of geohazards	Low
			0. No	No
			0. No	No
			2. Funding available to manage some high-risk sites	Moderate
			3. Funding available to proactively manage all high-risk sites	Moderate
			3. Funding available to proactively manage all high-risk sites	

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
Some roles are sometimes outsourced to private contractors although we have had disappointments with output on some occasions. The authority is thinking of conducting all planning for its road works since expertise is in place	SLRA
No sub contracting by the Police Department regarding geohazard duties.	SLP
Execution of sub contracting roles has not been done yet. Other MDAs provide solutions and EPA compliment the efforts	EPA
Yes FCC contract roles out to the Military for example to effect clearing of waterways and bridges. Masada, a garbage collection company normally provides vehicles. Construction companies also provide vehicles	FCC
Contracts submitted to RMFA mainly contain clear responsibilities for contractors. Contractor Capacity is limited at times	RMFA
Since ONS coordinates disaster issues, any events that has got to do with roads is coordinated with the SLRA	ONS
Currently, only the road fund is available and some aspect is used to address all road related issues. There is no dedicated fund for geohazard. Another constrain is that the forced account system of implementation of works no longer exists at SLRA, except contracting of works.	SLRA
	SLP
No funding for Geohazard but seek funds through MoF, ONS, UNDP, GEF; for early warning systems work with MET office. Vulnerability assessment for Freetown, done	EPA
Funds can be obtained from RMFA, but with difficulty to access it. Also, Ministry of Finance.	FCC
Funding is limited and there are some documentation and procedural challenges when funds are requested.	RMFA (Department of Finance)
There is funding but it is inadequate for complete execution of proactive management. ONS also works with local and international partners	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
8.	Is funding in place to undertake proactive repairs to stop geohazard risks from occurring?	This pertains to installing measures (often engineering) ahead of a geotechnical failure. How long would it take, with current annual funding, to proactively address all known high- and medium-risk sites?	**0. No funding available** 1. 20 years 2. 10 years 3. 10 years 4. All sites have been addressed	No
			0.No funding available	No
				Low
				Low
			0.No funding available	Low
				Low

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
There is a Road Fund in place that deals with the proactive implementation of road works and maintenance including repairs of damaged roads due to any event that causes closure of roads, but not specifically for works to install systems to prevent geohazards; however, there is a serious constraint with respect to timely release of funds. If Funding is available, it will take less than 10 years to address the risk sites.	SLRA
No specific funding for geohazard prevention.	SLP
Done vulnerability assessment and hazard profiles for communities as well as slope analysis. Some funding from EPA but bulk comes from donor funds	EPA
Take action such as cleaning of drains to mitigate flooding of roads before they occur	FCC
Known high and medium risk sites are limited due to data limitations	RMFA
With some funds from international partners, studies have been done to identify potential hazard areas and they have been mapped out for some area within Freetown	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
9.	Is funding in place to undertake reactive repairs after geohazard risks failed?	This pertains to funding for the removal of materials and repairs at a single site to restore network operations.	**0. No base funding, requires budget reallocation** 1. Funding in place for key routes only and only when traffic operations are impeded 2. Funding in place for all key routes 3. Funding in place for all reactive repairs, but authorization to spend is slow 4. Funding in place for all reactive repairs with quick authorization to undertake works	No
			0. No base funding, requires budget reallocation	No
			3. Funding in place for all reactive repairs, but authorization to spend is slow	
			0. No base funding, requires budget reallocation	No
			1. Funding in place for all reactive repairs with quick authorization to undertake works	Low
			1. Funding in place for key routes only and only when traffic operations are impeded	

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
Funding from RMFA for normal maintenance activities are used for reactive interventions for geohazard incidents	SLRA
Part of committee in disaster management at ONS	EPA
Funding in place for repairs to police equipment used during our support service for emergency, but authorization to spend is slow	SLP
No Funding in place for FCC for reactive interventions; most activities funded for FCC are for proactive interventions such as clearing channels and drains.	FCC
Funds are mostly available for most reactive maintenance works, especially on highly trafficked routes	RMFA
With support from the government and donor partners, reactive repairs are being taken care of for most critical situations	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
10.	Is funding in place in the event of a major natural disaster event?	This pertains to funding following areawide natural disasters that may have geotechnical failures.	**0. No fund exists** 1. Fund exists but only likely to cover 25% of the cost of a major disaster 2. Fund exists but only likely to cover 50% of the cost of a major disaster 3. Fund exists but only likely to cover 75% of the cost of a major disaster 4. Fund exists and considered appropriately sized to cover a major natural disaster	Low
			0. No fund exists	No
			0. No fund exists	
			0. No fund exists	No
			1.Fund exists but only likely to cover 25% of the cost of a major disaster	Low
			1.Fund exists but only likely to cover 25% of the cost of a major disaster	

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
For major disasters, Funding provided by RMFA for normal road maintenance are used. No specific funding is ring – fenced for these events.	SLRA
No specific funding in place; only provide support for major natural disaster	SLP
No specific funding in place at EPA for such events.	EPA
No special funding at FCC for these events.	FCC
Depends on the scope and intensity of what has been defined as a major natural disaster event. 100% may be available in some cases and less than 25% for others.	RMFA
Initial funds to do preparatory work can be sourced from government but is not adequate to cover such major event	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
11.	Is the overall arrangement effective?	When considering the overall arrangement, is it working effectively, or is it disjointed and ineffective?	**0. Ineffective arrangements in place** 1. Arrangements rely on personal relationships rather than document methods 2. Key processes work okay, but obvious gaps exist 3. Overall processes and arrangements are good but not delivering effectively 4. Overall processes are effective, without obvious weaknesses	Low
				Low
			2.Key processes work okay, but obvious gaps exist	
			0.Ineffective arrangements in place	Low
			2.Key processes work okay, but obvious gaps exist	Low
			2.Key processes work okay, but obvious gaps exist	Low

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
There are very serious challenges with the overall arrangements.	SLRA
Disjointed arrangements;	SLP
There are gaps in the overall process, especially with respect to coordination of activities and response time.	EPA
There are challenges with the overall system of disaster risk response and mitigation	FCC
Coordination needs to improve among agencies and data led decision - making needs to be effected	RMFA
This works to some extent, but there are limitations.	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
12.	Is sufficient technical expertise available for institutional capacity activities?	Considering both the capability and capacity of those involved; including both Road Authority staff and those outside the Road Authority who play key roles	0. No 1. Okay for simple situations 2.Limited ability to investigate cause of failures **3. Sufficient expertise for most situations** 4. Technical expertise is not a constraint	Moderate
			No (0)	No
			No (0)	No
			Sufficient expertise for most situations (3)	Moderate
			Limited ability to investigate cause of failures (2)	Moderate
PART III: SYSTEMS PLANNING				
13.	Is a program in place to identify risks on the existing road network?	Register of risks is available for inspection, with evidence of regular checking and updating of contents	0. Never done **1. Planning** 2. Planned 3. Conducting partially 4. Conducted fully	No
			Never done (0)	No
			Never done (0)	No
			Conducting partially (3)	Moderate
			Never done (0)	Moderate
			Planning (1)	Moderate

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
The SLRA do have sufficient technical capacity to address most issues in most situations. However, there are constraints with the availability of analytical equipment to inform decision making	SLRA
There is capacity gap in geospatial and data collection; there is lack of equipment in the other MDAs and staffing is not adequate.	EPA
Shortage of Technical expertise at FCC	FCC
For most situations, yes, expertise exists	RMFA
ONS may not have the capacity but work with other institutions to tackle disaster problems	ONS
There are plans to develop such a program; but none exist at present	SLR
None exists	SLP
Not for roads but yes, there is a program in place for monitoring risk in the environment and provide advice to communities for new road projects. Environmental impact Assessment is a requirement for clearance to implement such projects and to renew license such as for mining	EPA
Collecting information on flood flash point Conduct site visit and assess the problems. Recording of data for use.	FCC
Not aware of any specific programme. However, this may be covered in proposed data collection by SLRA for optimization of Road Management Systems	RMFA
General risks are noted based on community alert and information from monitoring officers	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
14.	Is GIS used in the management of risks on the network?	GIS is a key technology to store and manage data pertaining to geohazard risk management.	0. No 1. Just to plot geohazard sites 2. Only contains data relating to the road authority **3. Contains all necessary data, but limited analysis undertaken** 4. Fully used in all aspects of risk management, including analysis	Moderate
			No (0)	No
			Fully used in all aspects of risk management, including analysis (4)	Moderate
			Contains all necessary data, but limited analysis undertaken (3)	
			No (0)	
			Contains all necessary data, but limited analysis undertaken (3)	Low
15.	Is a methodology in place to prioritize sites for proactive measures?	Is a documented prioritization method in place?	**0. No** 1. Just on AADT or road hierarchy 2. Considers wider social services (hospitals, schools etc) accessed via the route? 3. Based on network level analysis of criticality of road links 4. Considers both probability and consequence of failure	No
			0. No	No
			0. No	No
			0. No	NO
			3. Based on network level analysis of criticality of road links	Low
			0. No	No

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
The SLRA uses GIS technology in appropriate situations and can easily apply it for data collection and geohazard risk management.	SLRA
Not available for the police	SLP
Always in the field to monitor. Have a system called Environmental Cadastral to monitor field activities like mining, agriculture etc.	EPA
Sometimes used by support partners such as UNOPS to help identify and map out areas	FCC
Not Aware. However, RMFA is in the process of potentially utilizing GIS based project management software for FY2020	RMFA
Disaster risk areas are mapped out and plotted on the national map.	ONS
So far, The SLRA has been more reactive than proactive in addressing geohazard incidents.	SLRA
Police only provides support service.	SLP
Collect data from the field and analyze them with respect to the effects on roads and provide advice;	EPA
Not for FCC	FCC
Road Maintenance Management System(RMMS)may be utilized for 2020, process is ongoing and is in the preliminary stages	RMFA
When critical sites are identified, prioritize proactive measure depends on availability of funds	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
16.	Is there a methodology for the selection of optimal solutions at a project level?	How is the solution selected for a given geohazard risk site?	**0. No documented methodology** 1. Standard designs or solutions applied 2. Lowest initial cost 3. Full life-cycle costing of a range of options 4. Full life-cycle costing of a range of options and considering both Road Authority and road user impacts	No
			No documented methodology (0)	Moderate
			No documented methodology (0)	
			No documented methodology (0)	No
			No documented methodology (0)	No
17.	Is sufficient technical expertise available for systems planning activities?	Considering both the capability and capacity of those involved; including both Road Authority staff and those outside the Road Authority who play key roles	0. No 1. Okay for simple situations 2. Limited ability to investigate cause of failures **3. Sufficient expertise for most situations** 4. Technical expertise is not a constraint	Moderate
			Limited ability to investigate cause of failures (2)	Low
			Okay for simple situations (1)	
			Okay for simple situations (1)	

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
None	SLRA
Standard safety measures are applied by the police	SLP
Provide advice on impacts of projects on the environment.	EPA
RMMS may be utilized for 2020, process is ongoing and is in the preliminary stages	RMFA
This is based on the expertise advice within the institutions connected to the problem	ONS
Network level and Project Level planning technical expertise is reasonably adequate. Only funding for implementation has been the issue.	SLRA
	SLP
Limited staffing in the planning department	EPA
There are experts. Sufficiency depends on the scale of activities considered and there are individual capacity gaps	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
PART IV: ENGINEERING AND DESIGN				
18.	How are solutions designed?	Where engineered solutions such as retaining walls are to be constructed, what is the basis of the design?	0. No design, just try something on-site 1. Use standard design solutions 2. Some basic investigations are undertaken, but modeling of complex failure modes is not undertaken 3. Based on modeling and analysis of a small number of options **4. Based on extensive modeling and analysis to yield "optimized" design**	High
19.	Is sufficient technical expertise available for engineering and design activities?	Considering both the capability and capacity of those involved; including both Road Authority staff and those outside the Road Authority who play key roles	0. No 1. Okay for simple situations 2. Limited ability to investigate cause of failures 3. Sufficient expertise for most situations 4. Technical expertise is not a constraint	High
			Limited ability to investigate cause of failures (2)	No
PART V: OPERATIONS AND MAINTENANCE				
20.	Is a program for road disaster awareness in place?	Does the Road Authority actively engage with road users and stakeholders to raise awareness of geohazards?	0. Never done 1. Planning 2. Planned **3. Conducting partially** 4. Conducted fully	No
			Never done (0)	No
			Conducted fully (4)	Moderate
			Conducting partially (3)	Moderate
			Conducting partially (3)	

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
Currently, solutions are adequately designed and plans are on the way to seek funds for further training of personnel.	SLRA
Technical expertise is usually no problem for design although there is no systemic implementation. In other words, we do have the individuals but they are wrongly placed for implementation. The current structure is considering the establishment of a department for such works	SLRA
Not available	SLP
There is currently no special road disaster awareness program for road users. This should be a function for the SLRSA, but their programs are on road safety issues mainly.	SLRA
	SLP
Yes. have radio programmes reaching to the grassroots	EPA
Carry out sensitization, community engagement informing danger of rubbish deposition and planting of trees at slopes or hills	FCC
Not specifically for road disaster, but reach out to communities through the radio and local organizations / Authorities	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
21.	Is land-use control in place to minimize geohazard risks?	Does the Road Authority engage with landowners and government bodies to control land use that could negatively affect geohazard locations?	0. Never done 1. Planning **2. Planned** 3. Conducting partially 4. Conducted fully	Moderate
			0.Never done	No
			0.Never done	No
			3.Conducting partially	
22.	How is geohazard information communicated to road users?	What different tools and technologies are used to communicate updates to road users about geohazard events?	0. Never done 1. Road Authority website 2. ITS signage in the local proximity of the geohazard location 3. ITS signage across the network to permit rerouting of trips by road users **4. Full use of social media, SMS, website, ITS signage, and so on**	Low
			4. Full use of social media, SMS, website, ITS signage, and so on	Low
			4. Full use of social media, SMS, website, ITS signage, and so on	
			4. Full use of social media, SMS, website, ITS signage, and so on	Moderate
			4. Full use of social media, SMS, website, ITS signage, and so on	Moderate

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
SLRA only has Right of Way restrictions	SLRA
	SLP
Not done	FCC
Working with the Ministry of lands in making decision on critical land areas that pose risks.	ONS
Through Radio programs and news papers and signages.	SLRA
Traffic warning / caution signs are put up	SLP
Sensitization	EPA
Media radio, “city parrot”	FCC
Through radio announcement, the public is made aware of disaster areas.	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
23.	Are previously engineered solutions inspected and maintained according to the recommended schedules?	Engineered solutions will typically have recommended inspection and routine maintenance regimes with them. Are these being followed through on?	0. Never done 1. Planning 2. Planned **3. Conducting partially** 4. Conducted fully	Low
			Conducting partially (3)	Moderate
			Conducted fully (4)	
			Conducting partially (3)	
			Planning (1)	Low
			Conducting partially (3)	
24.	Does the asset management framework within the Road Authority specifically consider geohazards?	Ideally, geohazard risk management should form part of the overarching asset management activities.	0. No asset management framework **1. Planning** 2. Planned 3. Parallel but not integrated processes 4. Full integration of geohazard management into the asset management framework	Low
				Low
25.	Is sufficient technical expertise available for operations and maintenance activities?	Considering both the capability and capacity of those involved; including both Road Authority staff and those outside the Road Authority who play key roles	0. No 1. Okay for simple situations 2. Limited ability to investigate cause of failures **3. Sufficient expertise for most situations** 4. Technical expertise is not a constraint	Moderate
			Okay for simple situations (1)	Moderate
			Sufficient expertise for most situations (3)	Moderate

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
The SLRA do not have continuous inspection of road assets methods. The new structure has established a Road Assets management department which is managed by a specialist staff.	SLRA
Traffic solutions are monitored partially	SLP
Recommendations from studies are implemented and monitored	EPA
Partial monitoring of garbage disposal	FCC
Huge challenge due to funding constraints	RMFA
Solutions carried out in mitigating or reaction to disaster are monitored but not rigorously	ONS
The Road Asset Management is currently being developed to incorporate all the needed requirements for operation	SLRA
Police asset management consider hazards alongside its operation but not an integrated process	SLP
The maintenance capacity and expertise of SLRA is reasonably good. The institution is only constrained with analytical tools for decision making which is being currently pursued	SLRA
Police provides appropriate support	SLP
Institutions coordinated by the ONS have expertise but there are some gaps	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
PART VI: CONTINGENCY PLANNING				
26.	Is an emergency response plan in place?	Is a documented emergency response plan in place that covers all stakeholders?	**0. Never done** 1. Planning 2. Just covers the Road Authority 3. Fully documented, covering all relevant stakeholders 4. Fully documented and followed in event of an emergency	Moderate
			Never done (0)	Low
			Never done (0)	
			Never done (0)	
			Never done (0)	
			Planning (1)	
27.	Are emergency inspection arrangements in place?	In the event of an emergency, do all necessary parties know what to inspect and whom to report to, and do they have authority to close roads if unsafe situations identified?	0. Never done **1. Planning** 2. Documented but not yet consistently followed 3. Inspections occur, but no authority to act on what is found 4. Fully documented and followed in event of an emergency	Moderate
			Planning (1)	No
			Planning (1)	Low
			Planning (1)	Low
			Planning (1)	
			Planning (1)	

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
Our district and regional offices in the country usually respond to emergency situations. However, the response is not properly planned and coordinated. There is need for an emergency response guide	SLRA
Respond as and when the need arises	SLP
No. Provides support when it comes to disaster.	EPA
No response plan in place	FCC
Not that RMFA is aware of	RMFA
An emergency response plan is in place but needs to be review. It has not been reviewed since it was formulated.	ONS
In the event of an emergency, road supervisors report issues accordingly and a response team will be established to address the issue.	SLRA
	SLP
Worked in partnership with Office of National Security (ONS) . EPA was Part of a committee on emergency response issues, but effectiveness is low due to lack of cooperation between members.	EPA
Attend emergency meetings and act with directives	FCC
Coordination between / among agencies need to improve	RMFA
As the institution responsible for coordination, in the case of emergency, relevant institutions are alerted and they go into operation immediately.	ONS

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
28.	Do recovery measures include the concept of "build back better"?	After an event, is the focus on rebuilding as it was before, are enhancements included to lower the risk of future events?	0. Never done 1. Planning to introduce **2. Only for high-priority routes** 3. Only for high- and medium-priority routes 4. Always done	Moderate
			Only for high-priority routes (2)	Moderate
			Only for high-priority routes (2)	No
			Only for high-priority routes (2)	
			Only for high-priority routes (2)	Moderate
29.	Do test runs of the preparedness plans occur?	Is their regular testing of the plans and procedures for responding to emergency events?	**0. Never done** 1. Planning to introduce 2. Only for deemed 'key' risks 3. For all risks, but not regular 4. Regular complete testing	No
			Only for deemed 'key' risks (2)	Moderate
			Never done (0)	
			Never done (0)	No

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
A recovery measure to restore structures after disasters is in place; however, rebuilding is sometimes done hurriedly to restore some normalcy; in a few cases only attempts are made to improve and build better for high priority roads	SLRA
For high priority routes, traffic enhancement are done to minimize risk	SLP
EPA recommends other methods be used to protect side slopes along roads to prevent slippage and rock falls.	EPA
Cleaning and clearing continues to improve drainage of roads.	FCC
This is based on institution(s) most concerned / connected with the disaster situation	ONS
A test run has not been experienced but planning to introduce it. A maintenance strategy is currently being developed to include all of these methods.	SLRA
Once in awhile preparedness to respond to emergency situations is conducted	SLP
Not done	EPA
Not done	FCC

No.	Question	Check items	Answer options Status (1–4) Choose one of the answer options from the left column	Effectiveness or appropriateness 0. No 1. Low 2. Moderate 3. High
30.	Are there sufficient technical expertise available for contingency planning activities?	Considering both the capability and capacity of those involved. Including both road authority staff and those outside the road authority that play key roles.	0. No 1. Okay for simple situations 2. Limited ability to investigate cause of failures 3. Sufficient expertise for most situations **4. Technical expertise is not a constraint**	Moderate
			Limited ability to investigate cause of failures (2)	Moderate
			Okay for simple situations (1)	
			Sufficient expertise for most situations (3)	
			Sufficient expertise for most situations (3)	Moderate

Description on the current status *Summarize current status, effectiveness, problems, and so on. Add comments if necessary.*	**Reference materials or name of respondent, position, and agency** *Author (year):* *Title of reference* *or* *Name, position, agency*
Some Technical expertise is available at the SLRA for planning; biggest constraint is lack of funds	SLRA
Enough trained personnel at the Police Department, the Army, the Health Workers.	SLP
Not sufficient expertise	FCC
Some technical expertise exist at RMFA	RMFA
Sufficient expertise available but staff needs to be updated with current trends and practices	ONS

CONTACT

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GFDRR is a global partnership that helps developing countries better understand and reduce their vulnerabilities to natural hazards and adapt to climate change. Working with over 400 sub-national, national, regional, and international partners, GFDRR provides grant financing, technical assistance, training, and knowledge sharing activities to mainstream disaster and climate risk management in policies and strategies. Managed by the World Bank, GFDRR is supported by 37 countries and 11 international organizations.

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The World Bank Tokyo Disaster Risk Management (DRM) Hub supports developing countries to mainstream DRM in national development planning and investment programs. As part of the Global Facility for Disaster Reduction and Recovery, the DRM Hub provides technical assistance grants and connects Japanese and global DRM expertise and solutions with World Bank teams and government officials. The DRM Hub was established in 2014 through the Japan-World Bank Program for Mainstreaming DRM in Developing Countries – a partnership between Japan's Ministry of Finance and the World Bank.

Layout/graphic design by Carlos Plaza Design Studio

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