



NORTHERN CORRIDOR
TRANSIT AND TRANSPORT
COORDINATION AUTHORITY



SURVEY REPORT ON PRIORITY BLACK SPOTS ALONG THE NORTHERN CORRIDOR ROUTE IN KENYA

February 2020





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FOREWORD

On behalf of the Permanent Secretariat of the ACTTC-CN I am pleased to present the report on the ten (10) priority black spots along the Northern Corridor route in the member state of Kenya. This report is in line with the NCTTCA 2017-2021 Strategic Plan especially under its strategic objective # 2 related to improving safety in all modes of transport. In addition it meets one of the recommendations of NCTTCA Executive Committee which considers road safety as a major concern within the Northern Corridor member states, thus relaying the charter on road safety adopted at the African Union level during its Summit held in Addis Ababa, Ethiopia, 31 January, 2016.

Data from National Transportation Safety Authority (NTSA) indicates that in Kenya, traffic accidents cause more than 3,000 deaths yearly with a huge impact on health and development. Conducting a survey to identify black spots is therefore a crucial step in discovering the real causes of accidents, with a view of proposing adequate measures to mitigate the risks and damage observed along the Northern Corridor route.

Surveys in Kenya have shown that the factors at the origin of accidents come either from the careless driving, or from vehicles condition, or from road infrastructure conditions, and finally from pedestrians behavior. Based on the findings at each black spot surveyed, this report suggests specific recommendations for improvement of the situation observed.

For better management of black spots Guidelines will also be developed. They will reflect our conviction that most issues related to road safety can be resolved if the Government, in collaboration with the development partners and the NCTTCA join their efforts and work to educate road users on road safety by enforcing the regulations in our member states.

I would be remiss if I did not mention that this report is the result of close collaboration between the Permanent Secretariat of NCTTCA, Kenya National Highways Authority of (KeNHA), National Transport Safety Authority (NTSA), Kenya National Police and Kenya Transporters Association (KTA) whom I would like to thank in particular for their active participation in the surveys conducted in Kenya from March 4 to 8, 2019 but also, for their inputs to this report.

I finally renew NCTTCA commitment to work with our member states and development partners towards improvement of road safety along the Northern Corridor.

Omae NYARANDI
Executive Secretary.

EXECUTIVE SUMMARY

The Northern Corridor Transit and Transport Coordination Authority Permanent Secretariat in collaboration with Kenya National Highways Authority (KeNHA), National Transport and Safety Authority (NTSA), Kenya Transporters Association (KTA) and the Kenya Traffic Police conducted a survey on priority black spots along the Northern Corridor route in Kenya, from 4th to 8th March, 2019.

Prior to the survey, a joint study conducted by Safe Way Right Way (SWRW), National Transport and Safety Authority (NTSA), Kenya National Highways Authority (KeNHA), Kenya Urban Roads Authority (KURA) and Kenya Traffic Police mapped out a total of one hundred and ninety nine (199) hazardous (black) spots along the Kenyan Northern Corridor and around Nairobi County. The ten (10) priority black spots along the Northern Corridor were identified on the basis of crash frequency, crash rate, crash severity and intensity (Equivalent Property Damage Only (EPDO) index), in a study carried out by KeNHA in September 2016.

The objectives of the Survey were to; confirmation of priority Hazardous (Black) spots; diagnosis of crashes to establish likely cause of accidents; propose appropriate remedial measures to address safety concerns; prepare country guidelines on Hazardous (Black) Spots Management (BSM) along the Northern Corridor route in Kenya; and advocate for funds mobilization in order to address safety concerns at priority black spots identified in Kenya.

The methodology of the survey involved; review of existing Road Safety Studies and Audit Reports (Reports by KeNHA and NTSA); collection and analysis of collision data; site inspections and identification of safety deficiencies; and recommendation of appropriate remedial measures. The survey team adopted simplified checklist which was used to record features of the road environment, that is, geometric alignment, junction configuration, road furniture etc; traffic conditions and general road user behavior; interaction between vehicles and non-motorized traffic including pedestrian crossing habits; and previous site conditions that have since been rectified.

The Survey team made stops and assessed all the earmarked locations in a bid to further assess and diagnose the spots for possible remedial actions. At each stage, detailed observations were made by all participating experts. For every location, a discussion on likely causes of accidents ensued to consensually agree on factors might be contributing to crash occurrences.

The survey established that the main factors which contribute to most fatal accidents at identified spots are insufficient or absence of road signs and markings, insufficient designation of pedestrian crossings and Non-Motorized Traffic (NMT) facilities, reckless use of roadway and road facilities by motorists and failure of geometric and traffic design provisions. The team upon analysis of accident cases at the priority hazardous (black) spots observed that some of the interventions require engineering methods while others call for public awareness.

The study recommends that KeNHA in collaboration with NTSA endeavour to carry out routine inspection and maintenance of road furniture, that is, safety guardrails, road signs, road markings, traffic rumble strips and bumps to ensure their serviceability.

The survey also recommends that KeNHA will provide sufficient Non-Motorized Traffic facilities like footbridges, central barriers, road underpasses and sidewalks to safeguard pedestrians where appropriate.

Finally, KeNHA is urged to redesign and correct sections where horizontal and vertical alignments have failed to meet the traffic utility needs.

NTSA and Kenya Traffic Police are urged to work together to keep public informed on safe use of roads and to ensure effective enforcement of road safety regulations to safeguard proper utilization of the roads.

CHAPTER ONE

1. INTRODUCTION

1.1 Background Information

The Northern Corridor is the busiest and most important transport route in the region as it provides a gateway to the landlocked economies of Uganda, Rwanda, Burundi, South Sudan as well as Eastern DR Congo from the Kenyan sea port in Mombasa.

The multi-modal trade route consists of the rail network from Mombasa to Kampala, the oil pipeline from Mombasa to Nairobi, Eldoret and Kisumu, the inland waterway system on Lake Victoria and most importantly, the road network from Mombasa through Nairobi to Kampala, Kigali, Bujumbura, Juba, Goma, Beni and Kisangani in the Democratic Republic of the Congo.

Road Safety has posed one of the major challenges along the Northern Corridor with numerous studies showing that road traffic accidents along the route constitute a significant loss of human lives and property within the region. Road fatalities present a significant impediment to the achievement of some of the key development goals of the East African Community (EAC) such as expansion of health capacities owing to big drain on national resources allocated to health. It is this severity that led the 4th EAC Development Strategy to target reduction of road related fatalities by 20% by the year 2015 in line with the African road safety performance target which aims to reduce road related fatalities by 50% by the year 2020.

In Kenya for instance, road crash statistics from the National Transport and Safety Authority (NTSA) show that an average of 3,000 lives are lost annually with thousands more injured from road accidents. The Northern Corridor alone contributes up to 22% of all fatal injuries sustained in the entire country.

According to data from the World Health Organization (WHO), approximately 1.35 million people die every year on the world's roads as a result of road traffic crashes, with between 20 to 50 million more sustaining non-fatal injuries as a result of the crashes. Further, it approximates that about 93% of the world's fatalities on the roads occur in low- and middle-income countries, even though these countries have approximately 60% of the world's vehicles.

The crashes are mainly attributed to human error as well as other factors such as unsafe road designs, poor condition of vehicles, unsafe road user behavior, inadequate infrastructure for non-motorized traffic and missing or ineffective road signage. In view of the above, one of the targeted objectives of the NCTTCA is 'to improve Transport Infrastructure and Facilities' along the Northern Corridor.

It is in this line that the NCTTCA Executive Committee during its 45th meeting held from 30th July to 3rd August, 2018 in Mombasa directed the Permanent Secretariat ‘To improve safety in all transport modes’ in furtherance of the NCTTCA Strategic Plan 2017-2021.

Following this directive, the NCTTCA Permanent Secretariat in collaboration with Kenya National Highways Authority (KeNHA), National Transport and Safety Authority (NTSA), Kenya Transporters Association (KTA) and the Kenya Traffic Police conducted a survey on priority black spots along the Northern Corridor route in Kenya from 4th to 8th March, 2019, with an aim of extending the activity to the remaining member states.

1.2 Objectives of the Survey

The objectives of the Survey were as outlined below:

- i. Identification of priority Hazardous (Black) spots;
- ii. Diagnosis of crashes to establish likely cause of accidents;
- iii. Propose appropriate remedial measures to address safety concerns;
- iv. Prepare country guidelines on Hazardous (Black) Spots Management (BSM) along the Northern Corridor route in Kenya;
- v. Advocate for funds mobilization in order to address safety concerns at priority black spots identified in Kenya.

1.3 Methodology of the Survey

The scope of the survey covered top Ten Black Spots on the Kenyan section of the Northern Corridor from Mombasa through Nairobi, Mau Summit to Kisumu with stops and detailed assessments of the spots listed in **Table 2** below.

For purposes of this survey, the team adopted the Black Spot definition given in KeNHA’s Black Spot Management Report, 2018, as *“any location that has a higher number of crashes than other similar locations because of local risk factors which are based on observed or recorded number of crashes in an area and not the expected number of accidents”*. This definition was fortified by the Kenya Traffic Police Department which identified a black spot as *“any location that experiences at least five crashes in a given calendar year.”*

The principal purpose of the survey was to conduct a comprehensive diagnosis and analysis of the selected priority spots to identify safety concerns, diagnose them and propose appropriate remedial measures to address them.

The methodology of the survey entailed the following activities;

- i. Review of existing Road Safety Studies and Audit Reports (Reports by KeNHA and NTSA);
- ii. Collection and analysis of collision data;
- iii. Site inspections and identification of safety deficiencies;
- iv. Recommendation of appropriate remedial measures.

1.4 Survey Team

The Priority Black Spots survey team consisted of the following members:

Table 1: Survey team assessing the priority black spots

| S/No. | Name | Institution | Designation |
|-------|---------------------------|--------------------------------|--|
| 1. | Prof. Liêvin Chirhalwirwa | NCTTCA | Director - Infrastructure Development and Management (Team Leader) |
| 2. | Fred Tumwebaze Hunter | NCTTCA | Director - Private Sector |
| 3. | Eng. John Deng Diar Diing | NCTTCA | Deputy Director - Infrastructure Development and Management (Secretary of the Survey Team) |
| 4. | Eng. Christine A. Ogut | NTSA | Deputy Director - Safety Audit and Inspection |
| 5. | Doris Sabaya | NTSA | Road Safety Officer |
| 6. | Eng. Monica A. Abonyo | KeNHA | Deputy Director - Highway Safety and Planning |
| 7. | Peter Wanyoike | KeNHA | Engineer - Highway Safety and Planning |
| 8. | Gilbert Njeru | Traffic Police | Chief Inspector |
| 9. | Boniface Andai | Traffic Police | Inspector |
| 10. | Walter Misama | Kenya Transporters Association | Technical Support Officer - Simulation Services |

1.5. Scope of the Survey

In September, 2016, KeNHA commissioned a consultancy study on Technical Assistance on Road Safety for which a Black Spot Management & Crash Data Collection, Analysis and Management Reports were developed. The study identified a list of thirty (30) high crash locations in Kenya based on collision statistics over a six-year period (2011 – 2016).

Based on three (3) high crash location identification criteria including crash frequency, crash rate as well as crash severity and intensity (Equivalent Property Damage Only (EPDO) index), the top ten (10) crash locations were identified and ranked; incidentally all being along the Northern Corridor. The Ten (10) priority black spots assessed by the survey team are listed in Table 2 below.

Table 2: Ten priority black spots assessed by the Survey team

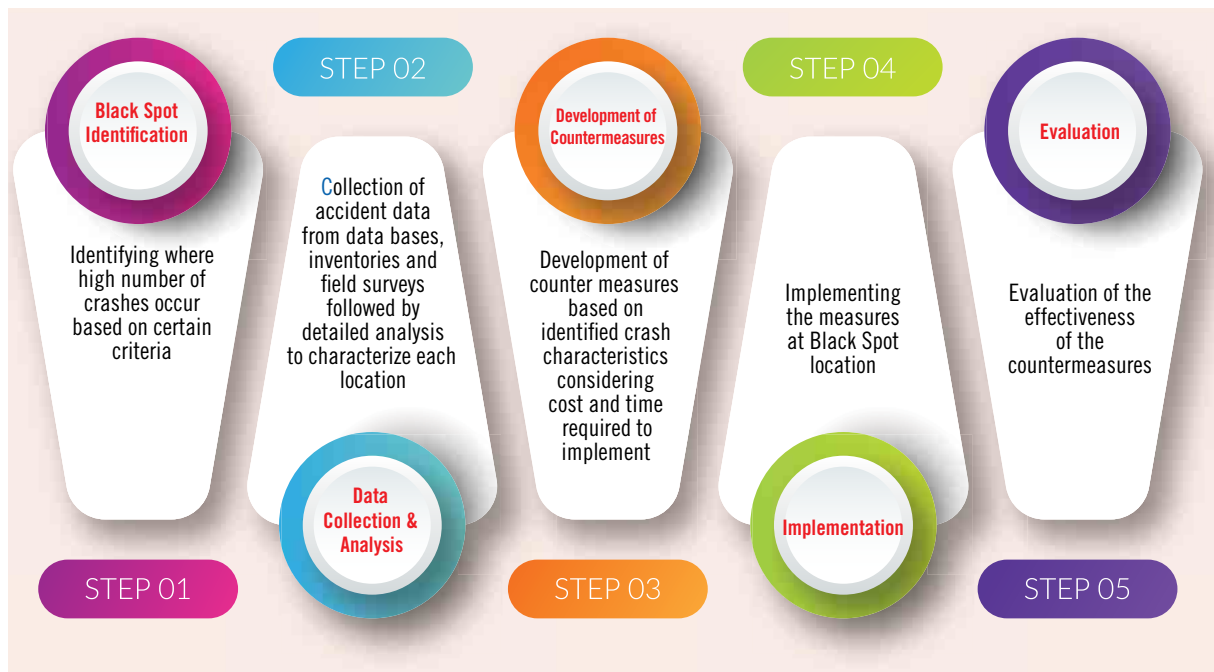
| Rank | Region | Black Spot Location | Length (Km) | No. of Crashes (Frequency) | Crashes per Km (Rate) | Crash Severity (EPDO Index) |
|------|-------------|---|-------------|----------------------------|-----------------------|-----------------------------|
| 1. | Rift Valley | Mukinya – Migaa – Sobe – Salga – Sachangwan | 20.7 | 152 | 7.34 | 1330 |
| 2. | Central | Gitaru – Rungiri | 2.7 | 117 | 43.33 | 1094 |
| 3. | Coast | Kibarani – Makupa Causeway | 5.5 | 107 | 19.45 | 921 |
| 4. | Nyanza | Molem – Namba Okana – Nyamasaria – Kasagam | 9.4 | 100 | 10.64 | 932 |
| 5. | Eastern | Emali – Pipeline | 3.0 | 89 | 29.67 | 806 |
| 6. | Coast | Bonje | 5.0 | 85 | 17.00 | 700 |
| 7. | Coast | Maji ya Chumvi | 6.8 | 75 | 11.03 | 641 |
| 8. | Eastern | Konza – Malili | 10.3 | 69 | 6.70 | 572 |
| 9. | Eastern | Ngokomi – Kalimbini | 0.9 | 68 | 75.56 | 640 |
| 10. | Eastern | Mlolongo | 4.0 | 65 | 16.25 | 559 |

CHAPTER TWO

2. CRASH DATA ANALYSIS & CONFIRMATION OF PRIORITY BLACK SPOTS

2.1 Crash Data Analysis

The process of Black Spot Management is a crucial process in the mitigation of frequency and severity of crashes on a road network. It involves identification, analysis and development of countermeasures in the remedying of the hazardous locations. Black Spot Management can be summarized in the following series of steps;



Source: KeNHA Black Spot Management Report, 2018

The categorization of a hazardous spot encompasses three major aspects: -

2.1.1. Collision Frequency

A road section is categorized as a hazardous/black spot if the number of collisions recorded exceeds a threshold number over a specified period. Collision frequency can hence be defined as the number of crashes occurring at a site, facility or network within a one-year period.

2.1.2. Collision Rate

A road section is considered a hazardous/black spot if the collision rate exceeds a set threshold. By definition, collision rate can be described as the number of crashes that occur at a given site during a certain period in relation to a measure of exposure (for instance, per billion vehicle kilometres of travel for a roadway segment). It is thus the probability of a crash occurring per instance of exposure based on past events.

Where AADT – Annual Average Daily Traffic

2.1.3. Collision Severity and Intensity

This criterion attaches a weightage factor that is a function of the worst injury sustained by one of the crash victims. In this regard, for example, a fatal or serious injury crash has a higher weightage factor as compared to a slight injury or a Property Damage Only (PDO) crash. If the number and frequency of fatalities or severe injury crashes at a spot exceeds the threshold, then the location can be considered a hazardous/black spot.

2.2 Black Spot Identification

This process involves determination of the most hazardous locations within a road network and forms the basis for road safety analysis. Prior to the survey, a joint study conducted by Safe Way Right Way (SWRW), National Transport and Safety Authority (NTSA), Kenya National Highways Authority (KeNHA), Kenya Urban Roads Authority (KURA) and Kenya Traffic Police mapped out a total of one hundred and ninety nine (199) hazardous (black) spots along the Kenyan Northern Corridor and Nairobi County Route in 2017.

Following a detailed review of collision data for the entire country for the period between 2011 and 2016, the study conducted by KeNHA ranked the top thirty (30) high crash locations on roads under their mandate based on collision frequency with each of the locations recording at least five (5) collisions in a calendar year. Amongst the top thirty high ranking locations, the survey team prioritized on the top ten locations for the purpose of this exercise.

2.3. Data Collection and Analysis

Collection and analysis of available crash data is an essential procedure as it provides a better insight on the general issues surrounding and experienced by road users at the time of the crash. Parameters such as general trends, crash severity, causal factors and distribution of parties involved can therefore be deduced from the analysis.

It is however important to note that such analysis procedures need to be initiated and concluded before the field visit and site inspection as they may influence the observations made. The crash data analysis, nonetheless, should be carried to site for reference purposes and to inform discussions between the team members.

The following tools are important for the analysis of collision data:

2.3.1. P41 Forms

These are standardized data collection forms that should be filled by the Traffic Police department as and when collisions occur. The date, time and location of the collision is captured in the document. The details of the vehicles, particulars of the drivers involved including their age, sex and if suspected intoxicated are also filled in the form. The severity of injury sustained as well as the position in the vehicle and whether safety belts had been in use at the time of the collision are also recorded. The officer is also expected to capture a pictorial representation of the site of the accident through a sketch plan. Furthermore, the prevailing conditions of the site including the weather, condition of the road surface and other road features should also be filled in the form.

A sample P41 form from the Kenya Traffic Police department is attached as **Appendix 1** to the Report.

Accident data analyzed by National Transport and Safety Authority (NTSA) from P41 forms provided by the Traffic Police department between 2016 and 2018 indicate an alarming number of fatalities along the Northern Corridor route as shown in **Table 3** below. In spite of the decline in fatal injuries over the duration, the number of fatal crashes still remains a concern and it is paramount that mitigation measures be instituted.

Table 3: Fatal injuries along the Northern Corridor route in Kenya

| Year | 2016 | 2017 | 2018 |
|------------|------|------|------|
| Fatalities | 828 | 790 | 606 |

The nature of crashes over the period following crash data characterization show speeding-related factors as the major cause of collisions along the Northern Corridor route in Kenya. Head-on collisions, vehicle-pedestrian collisions, loss of control, rear-end collisions as well as motorists ramming into stationary vehicles account for a significant number of crashes as well.

2.3.2. Stick Diagram

This is a Road Safety Engineering tool that provides an even more detailed and comprehensive analysis approach to collisions. It consists of two sets of forms which are complementary to each other and are best stored in Microsoft Excel database format. The first form captures on site collision characteristics more or less like the P41 form only that the causation factors and manoeuvre of the parties involved are filled using a scientific methodological approach that assigns different number codes and pictorial representations respectively. Following data collection over a given period of time, the statistics are then translated into a summary form. At this point, it is easier to determine the years, months, days of the week and hours when collisions are most prevalent. Accident patterns and trends for a location over a given duration including severity of the crashes, lighting conditions during their occurrence, road surface characteristics, and distribution of the parties involved and the manoeuvres of the vehicles can therefore be inferred. Ranking of the high-risk locations and the necessary intervention measures can hence be informed from such analysis procedures.

A sample stick diagram is annexed to the Report as **Appendix 2**.

Note: *This analysis approach should only be used by persons with appropriate Road Safety Engineering training.*

2.4. Statistical Tests and Analysis

Additionally, the following Statistical Tests may be used to determine risk rating and probability of collision recurring:

$$\text{Collision Rate, } x = \frac{\text{Average Collisions per year} \times 10^9}{365 \text{ days} \times \text{AADT} \times \text{Length of Scheme under consideration (Km)}}$$

2.4.1. Collision Rate per billion vehicle kilometres

The collision rate for a given roadway segment can be determined using the formula below;

2.4.2. Poisson's Test

This Poisson distribution is used to check a sudden increase or decrease in collision data based on comparison with the long-term average. It is carried out to determine the probability of collisions recurring in a given year by use of the Poisson tables.

2.4.3. Chi-Squared Comparative Test

This test is used to compare characteristics at a particular problem site against the local control data. It is typically used to compare data, for instance, wet and dry, before and after, dark and light; whereby the formula below is used to calculate the chi-squared value:

$$\chi^2 = \frac{\left\{ \frac{[ad-bc] - \frac{N}{2}}{2} \right\}^2 N}{efgh} = \frac{\left\{ \frac{[ad-bc] - \frac{N}{2}}{2} \right\}^2 N}{efgh}$$

Where **a** and **b** - site data for the two instances

c and **d** - control data for the two instances

e - sum of the site data

f - sum of the control data

g - sum of data for the first instance

h - sum of data for the second instance

N - sum total of the site and control data for the two instances.

Following calculation of the chi-squared value, chi-squared distribution tables are then used to determine the probability level.

Note: *Statistical tests and analysis methods, like the stick diagram analysis, require specialized training in Road Safety Engineering for effective use.*

CHAPTER THREE

3. METHODOLOGY

3.1. Field Review of the Hazardous/Black Spots

A field visit and site inspection were carried out on all the ten-priority hazardous (black) spots for the purpose of identifying the safety concerns with a view of diagnosing the likely cause of collisions and hence propose appropriate remedial measures. The survey incorporated representatives from the major stakeholders in road safety in Kenya. It was important to harness the initiatives from the different organizations and integrate their various viewpoints in a bid to develop more effective solutions.

A simplified checklist was adopted for recording of site characteristics and conditions (refer to **Appendix 3**). It was thus possible to conduct a comprehensive assessment of the hazardous spots with the survey team members taking the following factors into consideration;

- Features of the road environment, for instance, geometric alignment, junction configuration, road furniture etc;
- Traffic conditions and general road user behaviour;
- Interaction between vehicles and non-motorized traffic including pedestrian crossing habits;
- Previous site conditions that have since been rectified.

Records of the same were thereafter used to generate the survey findings and recommendations. Photographs were also taken during the site visit to act as reference during reporting and also provide any information that might have been overlooked during the actual inspection.

3.2. Development of Corrective Measures

Countermeasures can be described as strategies adopted to mitigate or reduce the collision frequency and/or severity for a given location. This procedure is preceded by analysis of crash data and the field visit as the characteristics of each site and crash patterns are clear at this stage. Subsequent development of the countermeasures should however be evaluated from an economic point of view.

In view of budgetary constraints, prioritization of remedial measures is done through application of the Benefit Cost Ratio (BCR) analysis method. The intervention with the highest First Year Rate of Return (FYRR) is preferred:

$$\text{First Year rate of Return (FYRR)} = \frac{\text{Annual Collisions saved} \times \text{Average collision Cost} \times 100}{\text{Scheme Cost}}$$

Benefit Cost Ratio, in principle, assumes that the sum of all positive effects (benefits) of an investment is set against all negative effects (costs). Quantification of the benefits is carried out by converting the estimated change in crash frequency to a monetary value by basing it on societal cost of crashes.

Kenya, however, is yet to establish a basis for determining the societal cost of crashes. Nevertheless, International Road Association Programme (iRAP) proposes two (2) methods that countries should generally apply in estimating the Value of Statistical Life (VSL) namely: -

- i. **Human Capital Approach (Lost Output) - Ex post approach:** The value of a fatality or serious injury emanating from the crash is attached to the loss in economic value incurred.
- ii. **Willingness to Pay - Ex-ante approach:** This approach estimates the value that individuals attach to safety improvement by approximating the amount of money that individuals would be prepared to pay to reduce the risk of loss of life.

While causes of road crashes are attributable to human factors, roadway characteristics and vehicle conditions, it is important to note that only the roadway characteristics can be sufficiently addressed by this procedure in mitigating occurrence of crashes at a given location. To guide the implementation framework, countermeasures can further be categorized into three tiers namely; short-term (immediate), intermediate and long-term measures.

3.3. Implementation of Corrective Interventions

After the development of suitable countermeasures for a given hazardous/black spot, the subsequent step involves execution of appropriate remedial works. In light of budgetary constraints occasioned by limited financial resources, interventions with the highest Benefit Cost Ratio should be prioritized on, followed by the other measures identified to address the safety concerns.

3.4. Monitoring and Evaluation

This phase entails periodic assessment of implemented works to evaluate their effectiveness. It requires sound data collection and analysis techniques as well as synergies between key stakeholders in road safety. In addition, regular road safety audits need to be carried out to identify emerging safety concerns. To this end, timely reports should be prepared and submitted to relevant agencies for any further action that might be necessitated.

3.5. Confirmation of top ten priority Black Spots

The Survey team made stops and assessed all the earmarked locations in a bid to further assess and diagnose the spots for possible remedial actions. At each stage, detailed observations were made by all the stakeholders present. A diagnosis of likely causes was done for every location to identify influential factors which might be contributing to crash occurrence.

Non-conformity to best practices and standards was flagged and the degree of their consequences evaluated. Finally, appropriate countermeasures and recommendations for improving the spots were proposed as captured in the *Survey Findings and Recommendations*. For all the locations surveyed, significant gaps were identified taking into consideration the general behavior, capabilities and limitations of all the road users. By implication, these gaps predisposed the locations to occurrence of crashes thus affirming them as priority black spots.

CHAPTER FOUR

4. FINDINGS AND ANALYSIS

4.1. Survey Findings

The Survey on the hazardous/black spots was carried out between 4th and 8th March, 2019, during daytime hours. The weather throughout the site inspection was sunny and dry with temperatures ranging from moderate to high. The road surface was therefore dry for the entirety of the exercise. The existing road condition from Mombasa to Mau Summit (A8) and Mau Summit to Kisumu (A12) can generally be classified as good to fair. However, pavement condition varies from section to section. Makupa roundabout – Miritini, Maungu – Voi and a section through Tsavo National park were all observed to have deteriorated with potholes, cracks and ruts, amongst other pavement distress signs.

At the time of the survey, upgrading of Mombasa – Kwa Jomvu section which forms part of the greater Mombasa – Mariakani project and capacity enhancement and rehabilitation of the James Gichuru – Rironi section were ongoing. Road safety enhancement works including pavement widening and separation of lanes into a dual carriageway and provision of road furniture at the notorious Salgaa area hazardous/black spot area from Molo River bridge through Sachang'wan to Kibunja was also in progress to address some of the safety concerns at the Mukinya – Migaa – Sobe – Salgaa – Sachang'wan stretch.

Except for sections under construction/rehabilitation, the existing road has been put on Performance Based Maintenance Contracting to attend to both routine and periodic maintenance needs.

The specific survey findings, analysis as well as suggested recommendations for improvement for each of the ten priority hazardous spots have been attached as **Appendix 4** to the Report. However, the following general road safety concerns were identified as common to the hazardous/black spots under assessment;

- Faded road markings;
- Inadequate/missing road signs;
- Damaged/missing safety fences;
- Deteriorated road pavement/surface;
- Insufficient visibility splays;

- Unsafe junction layouts;
- Numerous accesses and illegal turnings;
- Inadequate/Lack of NMT facilities;
- Reckless driving and overtaking;
- Excessive speeding;
- Obstruction by Trucks and Public Service Vehicles (PSVs);
- Encroachment into the road reserve and invasion of the same by vendors;
- Picking and dropping of passengers at undesignated bus stops;
- Blatant violation of traffic rules.

Selected site photographs taken during the activity have also been attached as **Appendix 5** to this Report.

As part of the exercise, the survey team also conducted interviews with various stakeholders along the Corridor including truck drivers and transporters with the view of establishing challenges encountered in daily operations from a road safety point of view. This would form a basis for appropriate areas of improvement from a road user standpoint. A record of the discussions and suggested recommendations for improvement from the stakeholders is annexed to this Report as **Appendix 6**.

4.2. Interview with Trucking Companies

4.2.1. Interview with the Director of One 2 One Logistics , Newton Wang'oo

Date of Interview: 4th March, 2019:

The company has a fleet of 115 trucks which operate along Northern Corridor routes in the region.

Challenges encountered by drivers

- Lack of proper signage along the Corridor
- Harassment by traffic officers
- Unroadworthy trucks on the roads (could be blamed on corruption to a large extent)
- Some of the trucks operating along the Corridor lack the necessary twist locks to fasten containers. This poses a huge safety hazard to other motorists and truck drivers plying the route.
- Fatigue: This was explained to be the main cause of accidents. As a remedial measure, roadside stations equipped with amenities would go a long way to alleviate the problem according to the Director.

Measures taken by the Company

The director reported that up to the year 2016, the company was recording an average of two serious accidents monthly involving their fleet. The following measures have since been taken:

- The company made it a policy to only employ drivers whose age was at least thirty-five (35) years. Drivers above the age of 35 were deemed to be more cautious on the roads as compared to their younger counterparts. The eldest driver is approximately sixty (60) years of age.
- Change of driving hours: As a company policy, driving hours start from 6.00 a.m to 10.00 p.m. In the festive season, no driver is expected to be on the roads past 8.00 p.m. as a safety precautionary measure.
- Monitoring of speed using a 24-hour tracking system. Drivers have also been discouraged from freewheeling as the practice has been established to be a major causal factor for crashes along the roads. Truck drivers running out of gear run the risk of losing control of their vehicles.
- Driver training: The Company has invested in training for their drivers in liaison with Kenya Transporters Association (KTA).
- Withdrawal of 'turn boys' (driver assistants): This was found to translate to reduced accidents on the roads. It was observed that during transit, drivers would hand over to the relatively less skilled 'turn boys' who were more prone to causing accidents due to lack of necessary experience and qualifications.

Further proposals

- The Director noted that driving has no academic qualifications meaning that anyone who has acquired a driving license is eligible. He further highlighted that the literacy gap might pose a challenge, for instance in interpretation of road signs as well as influencing driver behavior. In this regard, he proposed the introduction of an education threshold and more so for truck drivers to the effect that only persons with a specific academic qualification can undergo training for truck driving.
- In addition, he recommended the introduction of health tests for truck drivers. It was explained that this would go a long way in curbing road carnage.

4.2.2. Interview with Seven Stars:

Date of Interview: 4th March, 2019

Interview with the General Manger

Background

Logistics entity incepted in June, 2017 following acquisition of Coast Couriers. It was explained that the objective of the interview was to establish the challenges encountered in daily operations from a safety perspective and hence propose potential improvements.

Challenges encountered by drivers

- Vertical obstructions to the trucks by flyovers, advertisement banners, signage gantries etc. According to the Transporter, the ideal clearance was 6.3 m. It was however clarified that a clearance of 5.5 m is allowable and is usually factored in the design of gantries and overhead structures. In this regard, low base trailers would be an ideal option to mitigate the challenge.
- Delays in acquiring bookings for inspection.
- Difficulties in load reconstitution where axle load limits had been exceeded but within the allowable Gross Vehicle Weight (GVW). It was however explained that in such an instance, the transporter would have to incur fines for exceeding the limits.

4.2.3. Interview with Drivers at Masimba

Date of Interview: 5th March, 2019

This interview presented a forum for drivers to raise their concerns and issues in regard to road safety along the Northern Corridor.

Issues/Challenges encountered by drivers

- Lack of necessary warning signage especially when approaching speed humps. Vandalism of road signs was explained to be a challenge too as the drivers are not forewarned or notified early enough as they approach safety hazards.
- Poor quality of the road especially along the Mtito Andei to Voi section.
- Dangerous overtaking by buses and matatus. In some cases, the drivers reported that they had to veer of the carriageway at the expense of their safety to avert head on collisions.
- Frustration due to low pay and meagre allowances.
- Erection of road blocks along descents in contravention of the Traffic Act Cap 403.
- Lack of clarity on rules and regulations by the Kenya Revenue Authority (KRA) Customs Department.
- Difference in road and traffic standards amongst the member states, for instance, lack of climbing lanes in some countries.

Recommendations proposed by the drivers to address the challenges

- Installation of appropriate signs along the corridor and sustained maintenance of the same. This includes prompt repair/replacement of damaged/vandalized road signage especially where safety hazards exist. It was also suggested that relevant authorities endeavour to install non-metallic signs as a measure to curb vandalism.
- Rehabilitation of deteriorated pavement sections along the Corridor especially between Mito Andei and Voi.
- In the long term, dualling of the Corridor should be prioritized according to the drivers. This would go a long way in reducing transit time as well as minimize accidents caused by dangerous overtaking.
- Pay increment to the drivers taking into consideration the exigencies of their job.
- Erection of road blocks at suitable locations as provided for in the Traffic Act. This includes sections where the gradient is favourable and sight distance sufficient.
- Clear and concise rules and regulations by the KRA Customs department.
- Harmonization of design and operational standards between the member states.

Further recommendations/requests by the Survey team

In light of the proposals made by the drivers, the Survey team members also noted that drivers had a role to play to safeguard their safety and that of other motorists along the roads. The drivers were urged to take the following issues into consideration:

- Refrain from using mobile phones or other electronic gadgets while driving; It was noted that accidents occur in split seconds and simple lapses in concentration would possibly result in serious and fatal crashes.
- Drivers were advised against parking on shoulders or carriageway as this would compromise the safety of other motorists.
- Reckless overtaking by the truck drivers was also discouraged albeit being associated with untrained drivers. As much as possible, the truck drivers were impressed upon to refrain from overtaking dangerously as the risk factor is higher when trucks are doing so.
- Freewheeling by truck drivers was earmarked as a major cause of accidents. Drivers were urged to avoid the practice to avoid losing control of their vehicles.

4.2.4. Interview with Comtrade Hauliers

Date of Interview: 6th March, 2019

Background

15 No. fleet.

Challenges encountered by drivers

Hazardous spots along the corridor pose a huge safety concern to the Transporter's drivers. Amongst the most notorious black spots highlighted were the Mombasa-bound descent at Salama area and along the Mai Mahiu road where the carriageway was deemed to be too narrow.

Recommendations/requests by the Company

- Better management of traffic at accident scenes.
- Traffic officers to avoid flagging off/stopping vehicles on the carriageway.
- More courtesy from the traffic officers. As compared to their region's counterparts, officers from Kenya were deemed to be less courteous.

Measures taken by the Company

It was reported that the transporter had not recorded a major accident involving its fleet. This was attributable to:

- Constant communication with the drivers and promptly addressing issues they might face while in transit. In this regard, the transporter had managed to foster a healthy relationship with its drivers
- Monitoring of driver behaviour during transit by use of a tracking system.
- Training of drivers to equip them with necessary skills. It was reported that training is done approximately twice a year.
- Allowing adequate leave days for the drivers. The drivers were allowed up to thirty (30) working days leave.

4.2.5. Interview with Drivers at Salgaa

Date of Interview: 7th March, 2019

The main objective of the interview was to establish challenges encountered along the Northern Corridor in regard to road safety and to propose recommendations to address some of the challenges.

Issues/Challenges encountered by drivers

- Missing speed limit signs along sections where certain speed limits should not be exceeded. Some have been pulled down or vandalized creating conflict between the drivers and traffic police.
- Delays in withdrawing vehicles that have stalled along the carriageway. It was proposed that such vehicles be towed away in good time since they act as safety hazards and more so to truck drivers.
- Narrow carriageway along some bridges. A case in point of the bridge at Chemoi area was cited. The drivers proposed that speed calming measures or necessary warning signs be installed at the approaches to such bridges to forewarn all motorists.
- Frivolous charges by traffic police. They contested that some traffic officers were harassing truck drivers by preferring non-existent charges only to extort money from them.
- Deteriorated pavement structure in some sections of the Corridor. It was reported that potholes in particular presented a huge safety concern especially when drivers try to evade them.
- Inappropriate parking by large trucks on the shoulders effectively narrowing the carriageway.
- Vandalism of vehicle parts and spares.
- Levies by the County Government at Malaba as trucks await to cross the border towards Uganda.
- Lack of roadside facilities. In this regard, roadside stations with amenities and parking for the trucks was a welcome idea by the drivers.

4.2.6. Interview with Rongai Workshop and Transport Ltd.

Date of Interview: 7th March, 2019

As with the other transporters, it was explained that the objective of the interview was to establish challenges they face from a safety perspective and hence propose areas of improvement with an aim of achieving optimum road safety conditions.

Issues raised

- Absence of a road safety culture in the country. It was however acknowledged that cultivation of such a culture was a multi-faceted work in progress that needs to be nurtured and sustained by all the parties involved.
- Slow flow of traffic which is commonly associated with driver frustration and fatigue.
- Missing/faded road markings to delineate the traffic lanes. Missing central road marking to separate the directions of traffic for instance poses a challenge to the truck drivers as the extent of the lanes is not defined.
- Non-standard and non-retroreflective road signage making it difficult to view the signs from a distance especially at night.
- Dumping of garbage/litter by the roadside
- The carriageway at Salгаа centre has been constricted by bodaboda riders.
- Abrupt transition of the dual carriageway into a single carriageway as you approach the Molo River Bridge from the Eldoret direction. No warning signs are in place to forewarn the drivers accordingly.
- High number of road blocks and harassment by traffic officers.

Recommendations/requests by the Company

- Sensitization and enforcement in regulating behavior of motorists and other road users. Where, regulations and policy framework are in place, implementation should be emphasized on.
- Request for review of regulations governing the lift axle mechanism.
- Installation of retro-reflective road marking throughout the Corridor to delineate traffic lanes accordingly.
- Replacement of non-standard and non-retroreflective road signage with high intensity signs for easier visibility especially at night. The Transporter in particular also requested for installation of necessary warning signs at the transition from dual to single carriageway near the Molo River Bridge further noting that it lies at the end of the Sachang'wan – Salгаа descent; a confirmed notorious hazardous spot.
- Better traffic management for all forms of traffic at Salгаа centre.
- Reduction of the number of road blocks.

Measures taken by the Company

The Transporter has cultivated a culture of courtesy and respect amongst its drivers. For instance, in case of incidents and accidents, the drivers have been encouraged to be polite to traffic officers translating to better service.

4.2.7. Interview with Swan Carriers Ltd. at the Kisumu Yatch Club

Date of Interview: 8th March, 2019

Issues raised

- Delays by traffic officers when checking the heavy commercial vehicles resulting into longer transit times.
- Extortion/harassment by traffic officers. A proposal was fronted to have an instant fine system for minor traffic offences such as a non-functional brake light.

4.3. Analysis

The survey at all the ten (10) top priority hazardous (black) spots along the Northern Corridor route in Kenya registered interesting trends on what could be the most frequent cause of accidents.

The most common feature at observed dangerous sites was insufficient or absence of road signs and markings. It was observed that most of the dangerous spots either are not sufficiently marked with no signs to forewarn motorists of the danger ahead or the marks had faded with signs vandalized or uprooted. This was found to contribute to most head-on, rear-end and skidding off accidents along the Corridor.

Another trending observation which is a leading cause of fatal accidents along the Northern Corridor route was absence of designated areas for pedestrian crossings and Non-Motorized Traffic (NMT) facilities. Absence of footbridges and/or speed calming measures like speed humps and rumble strips was observed to contribute to most accidents that involve pedestrians and NMT. This was found to be very common at black spots closer to busy urban centers and along straight stretches where vehicles overspeed.

Additionally, reckless use of the roadway and road facilities by motorists was also attributable to a significant number of collisions. It was observed that most motorists and especially Public Service Vehicles (PSVs) pick and drop passengers at areas that are not designated for stopping. The irregular picking and dropping off of passengers consequentially leads to unregulated crossing at dangerous points leading to frequent vehicle-pedestrian collisions. Long-distance truck drivers were also found culpable of parking at the carriageway leading to obstruction of other road users, insufficient visibility splays for both motorists and pedestrians and throttling of the carriageway making it insufficient for other road users.

Among other road sundries that contribute to frequent accidents is failure of geometric and traffic design provisions. There were cases of unsuitable junctions for splitting traffic, for example in Emali and Sobea which often contribute to head-on, rear-end and side impact accidents. Dangerous combination of both horizontal and vertical curves was also deemed a significant causation of skidding off and head-on collisions at some hazardous spots including the Kibunja – Sachangwan – Salгаа stretch, Salama and Bonje area.

5. RECOMMENDATIONS, INTERVENTIONS AND MONITORING AND EVALUATION

5.1. Recommendations

The team upon analysis of accident cases at the priority hazardous (black) spots observed that some of the interventions require engineering methods while others call for public awareness.

It is recommended that KeNHA in collaboration with NTSA endeavour to carry out routine inspection and maintenance of road furniture like safety guardrails, road signs, road markings, traffic rumble strips and bumps to ensure their serviceability.

KeNHA should also undertake to provide engineering facilities like footbridges, central barriers, road underpasses and sidewalks to safeguard pedestrians and NMT. Moreover, KeNHA needs to realign sections where dangerous horizontal and vertical curves are found.

NTSA and Kenya Traffic Police should work together to ensure effective enforcement of road safety regulations to safeguard proper utilization of the roads. Other measures that the survey team deemed necessary to sustain road safety at the hazardous spots and along the entire Corridor include:

- i. Development of collision data repository. Collaboration between NTSA and the Kenya Traffic Police is required to achieve this milestone;
- ii. Continuous collision investigation and analysis by the Traffic Police department to ensure safety decisions are evidence based;
- iii. Regular Road Safety Audits by KeNHA in collaboration with NTSA to ensure a proactive approach in the management of black spots;
- iv. Mobilization of finances from development partners to address identified hazardous (black) spots;
- v. Routine Monitoring and Evaluation of effectiveness of interventions by KeNHA and NTSA;
- vi. Sustained road safety sensitization and awareness campaigns by government agencies;
- vii. Development and implementation of Road Safety Strategies and Action Plans;
- viii. Development and mainstreaming of Hazardous (Black) Spot Management Guidelines;

- ix. Research and development;
- x. Stakeholder collaboration and increased synergies between organizations;
- xi. Capacity building for all the stakeholders in the road safety sector including development of skills, technology transfer between organizations and departments as well as general institutional development.

5.2. Implementation of Recommendations

The survey team noted that at the time of the exercise, various interventions were being undertaken by KeNHA in a bid to enhance the capacity at some sections of the Corridor through pavement widening as well instituting emergency road safety measures at some of the hazardous spots. The following works were ongoing:

- Upgrading of the Mombasa – Kwa Jomvu section (Lot 1) which forms part of the greater Mombasa – Mariakani project. Ongoing works entailed strengthening and construction of additional lanes to a 6-lane dual carriageway separated by a raised median to remove capacity constraints and enhance smooth and uninterrupted flow of traffic. Interchanges, grade separators, underpasses and overpasses were also being constructed to facilitate safe movement of cross road traffic. To facilitate access, service roads on either side of the road were to be constructed with footpaths along the outer edge of the carriageway in addition to footbridges at critical road crossing locations. The procurement process to undertake similar works for Lot 2 (Kwa Jomvu – Mariakani section) was ongoing at the time of the survey.

It is expected that the road safety concerns at Kibarani – Makupa Causeway and Bonje area will be addressed following completion of the above project.

- Rehabilitation and Capacity Enhancement of James Gichuru Road Junction to Rironi Highway. Works that were being executed under the Contract included pavement widening and dualling of the section, construction of interchanges, underpasses and overpasses as well as provision of pedestrian facilities and footbridges at critical crossing locations.

The safety hazards identified at the Gitaru – Rungiri hazardous spot mostly involving pedestrians are expected to be mitigated once the works are completed.

- Emergency Road Safety Enhancement along Kabarak Junction to Kibunja (A8) Road. The intervention had been necessitated by the high number of crashes, mostly fatal, previously recorded at the Salgaa – Sachangwan section especially during the festive seasons. The scope of the works being carried out entailed widening of the carriageway and separation of traffic directions using New Jersey crash barriers for the approximately 10 Km long climbing lane section, construction of truck run away ramps and installation of speed humps and rumble strips across the descending lanes as a speed calming measure.

The emergency safety works were almost substantially complete at the time of the survey. Following installation of the pending road furniture including road signage and application of road marking, road condition factors that were identified by the team as having contributed to frequent occurrence of road crashes at the location were expected to be addressed.

Further to the above ongoing works at four of the surveyed priority hazardous spots, the civil works below (both short and long term) have been proposed to sufficiently address road safety at the remaining six hazardous locations:

Table 4: Proposed civil works at the priority hazardous (black) spots

| Rank (in terms of Collision Frequency) | Hazardous (Black spot) Location | Proposed Short-Term Intervention | Proposed Long-term intervention | Cost Estimate (USD) |
|--|--|---|---|--|
| 4. | Molem - Namba Okana - Nyamasaria - Kasagam | Road markings, signs, safety fences, NMT facilities | Dualling of the section, Construction of Grade separated junctions | 30,000,000 |
| 5. | Emali – Pipeline | Road markings, signs, safety fences, NMT facilities | Construction of Grade separated Junction at Emali - Oloitoktok Junction | 15,000,000 |
| 7. | Maji ya Chumvi | Road markings, signs, safety fences, NMT facilities | Construction of a second carriageway | Expected to be addressed under the proposed Nairobi - Mombasa Expressway |
| 8. | Konza – Malili | Road markings, signs, safety fences, NMT facilities | | |
| 9. | Ngokomi – Kalimbini | Road markings, signs, safety fences, NMT facilities | | |
| 10. | Mlolongo | Construction of NMT facilities/service lanes, road markings, signs, safety fences | Capacity enhancement, service lanes, NMT facilities | 50,000,000 |

Note: *The cost estimates for the long-term interventions are mere estimates and are not based on actual studies.*

It is recommended that KeNHA continues to liaise with relevant agencies to secure funding for implementation of corrective works as well as sustain Performance Based Contracting (PBC) road maintenance to attend to both the routine and maintenance needs of the Corridor.

It is also instructive to note that the hazardous spots along the Northern Corridor extend beyond the ten (10) locations surveyed. In particular, regular application of road marking and installation/replacement of road signage should be prioritized throughout the Corridor as a measure to guide

and forewarn motorists and other road users accordingly. Moreover, where pavement distress symptoms are observed or capacity constraints encountered with time, KeNHA should undertake to institute upgrading and rehabilitation programmes based on a need basis to continually enhance road safety in the future.

5.3. Monitoring and Evaluation Framework

As a measure to continually assess road safety along the Northern Corridor, it is recommended that KeNHA in partnership with NTSA conducts periodic road safety audits and assessments. The findings should be compiled into reports for easy monitoring of the implementation status. Inspection exercises should also be carried out routinely by KeNHA and quick wins acted upon to prevent minor safety hazards from aggravating.

Partnership and collaborative efforts between government agencies such as NTSA and KeNHA as well as other stakeholders are critical in order to address road safety concerns along the Corridor. Finally, it is also recommended that relevant agencies continually engage and participate in road awareness campaigns to sensitize all road users in order to realize a safe road network in line with the recommendations of the UN Decade of Action for Road Safety.

6 APPENDICES

6.1 Appendix 1: Sample P41 Form from Traffic Police Department

7955

Police Form 51c
Revised May 90

**The Kenya Police - Traffic Department
Accident Report Form**

ALD: /91

| | | | | | | | |
|-----------------|--|----------------|-----------------|----------------|-------------|----------|----------|
| Police Station | | Police Station | | Date and | | Location | |
| Time (24 hours) | | Day of week | Time (24 hours) | Road Number(s) | Speed Limit | Age | U.S. No. |

Duration of Accident

| Types of Vehicle | | | | | | | Registration No. | Driver Age | Driver Sex M F | Alcohol Suspected Yes No | Damage |
|------------------|---|---|---|---|---|---|------------------|------------|----------------|--------------------------|--------|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |

| Type of Injury | | | Vehicle ref No. U23 | Class of Person | Age | Sex | | Position in Vehicle | Is State Belt Used | |
|----------------|---------|--------|---------------------|-----------------|-----|-----|---|---------------------|--------------------|----|
| Fatal | Serious | Slight | | | | M | F | | Yes | No |
| | | | | | | | | | | |
| | | | | | | | | | | |

Sketch plan

| Driving Licence valid | Veh ref 1 | | Veh ref 2 | | Veh ref 3 | |
|---------------------------|-----------|----|-----------|----|-----------|----|
| | Yes | No | Yes | No | Yes | No |
| PSV licence valid | | | | | | |
| Certificate of Competence | | | | | | |

| | | | |
|---|--|--|---|
| <input type="checkbox"/> Road surface <input type="checkbox"/> Tarmac <input type="checkbox"/> Murrum <input type="checkbox"/> Earth | <input type="checkbox"/> Width of surface <input type="checkbox"/> None | <input type="checkbox"/> Surface was <input type="checkbox"/> Wet <input type="checkbox"/> Dry | <input type="checkbox"/> Pedestrian crossing the road <input type="checkbox"/> On Pedestrian crossing <input type="checkbox"/> 25 metres from crossing <input type="checkbox"/> Over 25 metres from crossing <input type="checkbox"/> Pedestrian walking along road <input type="checkbox"/> In the direction of traffic <input type="checkbox"/> Towards the traffic <input type="checkbox"/> Other |
|---|--|--|---|

| | | |
|---|--|--|
| <input type="checkbox"/> Condition of Road at the Accident site <input type="checkbox"/> Undamaged <input type="checkbox"/> Cracked <input type="checkbox"/> Loose stones on surface <input type="checkbox"/> Damaged edges | <input type="checkbox"/> Traffic Signs and Signals <input type="checkbox"/> One Way <input type="checkbox"/> Stop <input type="checkbox"/> No Sign <input type="checkbox"/> Traffic light signals <input type="checkbox"/> None <input type="checkbox"/> Not operating | <input type="checkbox"/> Railway level crossing <input type="checkbox"/> None <input type="checkbox"/> Uncontrolled <input type="checkbox"/> Controlled |
|---|--|--|

| | | | | | |
|--|--|---|---|--|--|
| <input type="checkbox"/> Junction Type <input type="checkbox"/> Not junction <input type="checkbox"/> T junction <input type="checkbox"/> Roundabout <input type="checkbox"/> 4 leg junction <input type="checkbox"/> Other | <input type="checkbox"/> Road works <input type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> Weather conditions <input type="checkbox"/> Clear <input type="checkbox"/> Foggy | <input type="checkbox"/> Cloudy <input type="checkbox"/> Rainy | <input type="checkbox"/> Illumination <input type="checkbox"/> Daylight <input type="checkbox"/> Night | <input type="checkbox"/> Street Lights <input type="checkbox"/> On <input type="checkbox"/> None |
|--|--|---|---|--|--|

Original: Traffic Commissioner Copy 1: Police Commissioner Copy 2: P41

6.2 Appendix 2: Sample Stick Diagram



SURVEY/ROAD SAFETY AUDIT OF 10 NO. PRIORITY HAZARDOUS/BLACK SPOTS ALONG THE NORTHERN CORRIDOR ROUTE

Location:

Road collisions between and sheet of

| Collision No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----------------|---|---|---|---|---|---|---|---|---|----|
| Reference No. | | | | | | | | | | |
| Date | | | | | | | | | | |
| Day | | | | | | | | | | |
| Time | | | | | | | | | | |
| Severity | | | | | | | | | | |
| Dark/light | | | | | | | | | | |
| Weather | | | | | | | | | | |
| Road Surface | | | | | | | | | | |
| No. vehicles | | | | | | | | | | |
| Vehicle 1 | | | | | | | | | | |
| Vehicle 2 | | | | | | | | | | |
| Vehicle 3 | | | | | | | | | | |
| No. casualties | | | | | | | | | | |
| Casualty 1 | | | | | | | | | | |
| Casualty 2 | | | | | | | | | | |
| Casualty 3 | | | | | | | | | | |
| Causation | | | | | | | | | | |
| Manoeuvre | | | | | | | | | | |
| Location | | | | | | | | | | |



SURVEY/ROAD SAFETY AUDIT OF 10 NO. PRIORITY HAZARDOUS/BLACK SPOTS ALONG THE NORTHERN CORRIDOR ROUTE

Summary of collisions

Location:

Road collisions between and

| Years | |
|-------|--|
| | |
| | |
| | |
| Total | |

| Months | |
|--------|--|
| Jan | |
| Feb | |
| March | |
| April | |
| May | |
| June | |
| July | |
| Aug | |
| Sep | |
| Oct | |
| Nov | |
| Dec | |
| Total | |

| Days | |
|-------|--|
| Mon | |
| Tue | |
| Wed | |
| Thu | |
| Fri | |
| Sat | |
| Sun | |
| Total | |

| Hours | |
|-------|--|
| 0:00 | |
| 1:00 | |
| 2:00 | |
| 3:00 | |
| 4:00 | |
| 5:00 | |
| 6:00 | |
| 7:00 | |
| 8:00 | |
| 9:00 | |
| 10:00 | |
| 11:00 | |
| 12:00 | |
| 13:00 | |
| 14:00 | |
| 15:00 | |
| 16:00 | |
| 17:00 | |
| 18:00 | |
| 19:00 | |
| 20:00 | |
| 21:00 | |
| 22:00 | |
| 23:00 | |
| Total | |

| Severity | |
|----------|--|
| | |
| | |
| | |
| | |

| Light conditions | |
|------------------|--|
| | |
| | |

| Road surface conditions | |
|-------------------------|--|
| | |
| | |

| VRU collisions | |
|----------------|--|
| | |
| | |

| Collision manoeuvres founded | |
|------------------------------|--|
| | |
| | |
| | |
| | |

Other factors

Collision problem(s)

6.3 Appendix 3: Simplified Checklist

SIMPLIFIED CHECKLIST

Site location: _____

Date of site inspection [DD/MM/YYYY]: _____

| SNo. | Observed Location | Time | Observations (please give details) | Related sketches (please specify) |
|------|-------------------|------|---------------------------------------|--------------------------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

6.4 Appendix 4: Specific Survey Findings and Recommendations

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
|-----------------------------------|--|--|--|---|
| Kibarani – Makupa Causeway | | | | |
| 1 | Non-existent Road marking(faded) | Traffic lanes have not been delineated for both carriageways. It is difficult to ascertain errant motorists in the event of conflict. | <ul style="list-style-type: none"> Application of retroreflective road marking Installation of delineator retroreflective road studs to improve on visibility at night Sustained maintenance of the same | To be addressed under the ongoing construction of Mombasa – Kwa Jomvu project (Lot 1) |
| 2 | Missing/ineffective road signs | Critical road signs at the junction and along the causeway are lacking. Temporary signage warning motorists of ongoing construction works are inappropriately placed in some sections. | <ul style="list-style-type: none"> Installation of appropriate retroreflective signs Sustained maintenance | ” |
| 3 | Deteriorated road surface especially at the Makande/ Shimanzi junction coupled with pavement edge concerns | The existing pavement is characterized by a deteriorated surface with some sections being pothole ridden. The shoulders are absent and edges highly run-down. | <ul style="list-style-type: none"> Repair of deteriorated roads section Routine maintenance | ” |
| 4 | Unsafe junction layout at Makande | The junction has no speed changing lanes with the weaving length into the main highway being too short for heavy goods vehicles. | <ul style="list-style-type: none"> Channelization of traffic Provision of road marking to clearly demarcate and separate lanes and direct safe flow of traffic through the junction Installation of adequate road signs Routine maintenance of all road signs In the long-term, a grade separated junction should be considered | ” |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
|------|---|---|--|---------------------------------------|
| 5 | Narrowed carriageway occasioned by accumulation of silt on the road edges as well as the ongoing construction works | The road width along the causeway ranges from 5.5m to 6.3m mainly due to the accumulation of silt deposits on the edges. In effect, the 2-lane carriageway has been reduced to 1-lane translating to traffic snarl ups. | <ul style="list-style-type: none"> De-siltation and cleaning of the carriageway edges Widening of the existing carriageway | ,, |
| 6 | Lack of designated pedestrian crossing points and NMT facilities | Lack of marked pedestrian crossings and walkways have forced pedestrians to cross at arbitrary locations and walk on road edge oblivious of their safety. | <ul style="list-style-type: none"> Provision of safe marked pedestrian crossings at appropriate locations. Provision of adequate appropriate signs to guide all road users Separation of NMT from motorized transport (provide footpath, cycle tracks, footbridges etc) | ,, |
| 7 | Poor Traffic Management plan on an active/live construction area. (Lack of temporary traffic signs/barriers to safeguard road users from construction area) | The site is characterized by deep excavations which pose a safety hazard especially to school going children using the causeway. Site management operations are lacking. | <ul style="list-style-type: none"> Reflective tapes to cordon off the excavations. Provision of temporary road signs to appropriately inform, caution and guide all road users around live construction zones. Traffic marshals and flagmen should be put in place to guide traffic | ,, |
| 8 | Unsafe picking up and dropping off of passengers | Matatus are observed to pick up and drop off passengers at none designated zones especially at the Makande junction. In effect, the passengers will tend to cross the road at these locations. | <ul style="list-style-type: none"> Provision of well designated bus bays preferably adjacent to the footbridge or pedestrian crossing zones. | ,, |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 9 | Close proximity between the causeway and the railway line; both running parallel to each other | Absence of safety barriers between the two modes of transport presents a safety hazard to both motorists plying the causeway and pedestrians walking on or adjacent to the railway line | <ul style="list-style-type: none"> • Installation of appropriate retroreflective speed control and warning signs • Realigning the railway line and/or the road as a long-term measure. | ” |
| 10 | Presence of pipe outcrops, hazardous debris and overgrown vegetation | The pipe outcrops pose a safety concern to motorists that might veer of the road. Uncollected litter/garbage creates a safety concern to pedestrians with overgrown vegetation reducing visibility for the motorists using the route. | <ul style="list-style-type: none"> • Liaison with the Government agency responsible for relocation of damaged and protruding pipe outcrops and with the County Government of Mombasa to collect garbage within the road reserve. • Overgrown vegetation should be cleared and the hazardous debris removed. | ” |
| 11 | Lack of traffic safety barriers/fences on the high embankment separating the two carriageways | Along the causeway, there is a significant height difference between the two carriageways separated by a high embankment with no safety barriers. Motorists from the island side who veer of the road might easily collide with oncoming traffic from the mainland as no barriers are in place. | <ul style="list-style-type: none"> • In the interim, crash barriers marked with hazard marker paint should be installed both at the median and at the edges. | ” |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| Bonje Area | | | | |
| 1 | Successive combination of horizontal and vertical curves | Vehicles might encounter difficulties negotiating the tight curves and ultimately lose control. | <ul style="list-style-type: none"> Run-away ramps should be installed at strategic locations in the interim to cater for motorists that might veer of the road. Re-alignment of the section (as a long-term measure) to eliminate the dangerous succession of horizontal and vertical curves | To be addressed under the planned construction of Kwa Jomvu – Mariakani road project (Lot 2) |
| 2 | Non-existent/faded road markings | The lanes are not delineated to guide motorists with existing markings faded and invisible. | <ul style="list-style-type: none"> Application of retroreflective road marking. Installation of delineator retroreflective road studs to improve on visibility at night. Sustained maintenance of the same. | ” |
| 3 | Inadequate/lack of road signs | Warning/speed control signs are absent increasing the likelihood of accidents happening. Matatus also pick up and drop off passengers at non-designated zones further exacerbating the safety problem. | <ul style="list-style-type: none"> Installation of appropriate retroreflective signs at appropriate locations with priority given to warning and speed control signs Provision of bus bays to allow for safe picking up and dropping off of passengers Sustained maintenance | ” |
| 4 | Speeding, careless and dangerous overtaking and freewheeling | Vehicles on both directions tend to overspeed and overtake dangerously. Further, disregard of lane discipline is also common especially by slow moving vehicles who fail to drive on the left lane and on the climbing lane. | <ul style="list-style-type: none"> Installation of speed calming measures i.e. rumble strips on steep descent sections Installation of appropriate warning and informative signs, for instance, ‘Kept Left Unless Overtaking’ and ‘Observe Lane Discipline’ sign boards Collaboration with law enforcement agencies Construction of off-road safe runaway truck ramps/emergency escapes ramp/clear zones at strategic locations Realignment of road section to improve on the geometric alignment | ” |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 5 | Absence of a central median barrier at some sections to separate the opposite directions of traffic | The median is too narrow creating a threat of vehicles that lose control crossing to the opposite carriageway and ramming onto oncoming traffic. Presence of a barrier at the median would negate the threat of traffic crossing over to the opposite direction. | <ul style="list-style-type: none"> Consider installation of rigid central crash barriers painted with retroreflective paint/tapes to enhance visibility at night. | ” |
| 6 | Damaged central median barrier The two carriageways are separated by a narrow central median. Flex beam guardrails that were installed in the central median to act as a crash barrier and safeguard traffic in the opposing carriageways have all since been knocked down or are damaged. | Risk of vehicle losing control, veering off into the opposite carriageway and crashing into oncoming traffic. Head-on, side-impact, side-swipe and multi-vehicle pile-ups collisions are all possible. | <ul style="list-style-type: none"> Repair/replacement of damaged guardrails Installation of hazard marker signs on guardrails in the central median. | ” |
| 7 | Lack of/damaged safety fences The Survey team observed that guardrails in the entire stretch have either been damaged beyond repair or are completely missing. Further, the damaged guardrails have been left exposed with no end pieces and protruding sharply against the direction of traffic posing great danger to all road users. | Risk of vehicles rolling over high embankment. Risk of vehicles ramming into protruding guardrails which might in turn piercing through the vehicle. The following collisions are therefore probable: head-on, side-impact, side-swipe and roll-over | <ul style="list-style-type: none"> Repair/replacement of broken guardrails complete with end pieces and delineators. Sustained maintenance of the same | ” |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 8 | Poor transition from single to dual carriageway. The team observed that transition from single to dual carriageway at Mazaras is on both a horizontal and vertical curve just at the beginning of busy Mazaras centre. This has compromised visibility of Nairobi bound traffic. Further, there are no signs to mark the beginning and end of dual carriageway. | Risk of head-on, side-impact, side-swipe and multi-vehicle pile-ups collisions are all possible due to the road condition factor. | <ul style="list-style-type: none"> Installation and sustained maintenance of appropriate retroreflective signs to mark beginning and end of dual carriageway Re-design of the dual carriageway section to improve on the geometric alignment of the section | '' |
| Maji ya Chumvi | | | | |
| 1 | At the time of mapping of black spots in 2016/2017 (refer to NTSA report on mapping of black spots along the Northern Corridor), the section was under reconstruction. The works have since been completed and road condition factors that were identified then as to having contributed to frequent occurrence of road crashes at the location were addressed. For example, the road was realigned at Maji ya Chumvi bridge greatly improving the geometric alignment. However, some safety concerns and hazards still remain including: | | | |
| 2 | Over speeding traffic with no speed calming measures in place | The section is characterized by sloping approaches on either side of the bridge. Vehicles tend to overspeed and heavy trucks freewheel as they approach the bridge posing a threat of head-on as well as roll-over collisions. | <ul style="list-style-type: none"> Installation of speed calming measures; rumble strips for instance would reduce the likelihood of motorists over speeding Installation of retroreflective speed control signs and hazard marker signs at the bridge abutments to guide safe movement of traffic at night. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | Reduced skid resistance due to bleeding of the road surface | Bleeding is a phenomenon characterized by a shiny black film on the road caused by upward movement of asphalt in the pavement surface. Coupled with the prevalent high temperatures at the area, the surface tends to be slippery thereby provides low skid resistance. | <ul style="list-style-type: none"> Repair of affected sections | |
| 4 | Damaged guard rails/safety fences | The guard rails on the LHS of the Nairobi bound traffic are damaged ostensibly due to previous crashes. This poses a risk of vehicles rolling over the embankment as the rails are not structurally sound. | <ul style="list-style-type: none"> Replacement of damaged/warped guard rails complete with fishtail end pieces | |
| 5 | Missing/inadequate road signage | Critical road signs are lacking at the location (hazard signs at bridge abutments/approaches). This presents a threat of motorists ramming onto the bridge abutments especially due to reduced visibility at night. | <ul style="list-style-type: none"> Installation of appropriate retroreflective signs at the approaches to the bridge with priority given to warning and speed control signs Sustained maintenance | |
| 6 | Deep open lined drains too close to the edge of the road (near Road-over-rail Bridge) | Motorists who veer off the road are highly likely to roll over into the drains | <ul style="list-style-type: none"> Installation of vehicle restraints i.e guardrails to prevent motorists from plunging into the drains. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| Emali - Pipeline | | | | |
| Emali/Oloitoktok Junction | | | | |
| 1 | Unsuitable Junction configuration/layout | <p>The junction is located on a combination of horizontal and vertical curves and on the crest of the Standard Gauge Railway (SGR) road over rail bridge.</p> <p>Mombasa bound traffic descending on the vertical curve tends to accelerate creating a risk of rear-end, side-impact, side-swipe, roll-over and multiple vehicle pileup collisions with vehicles queuing and waiting to turn right towards Oloitoktok.</p> <p>The junction is characterized by skid marks apparently due to the difficulty encountered by motorists exiting to the road towards Oloitoktok</p> | <p>As a long-term measure, consider:</p> <ul style="list-style-type: none"> • Re-aligning the junction to a safer location (relatively flat area especially towards the Mombasa side) • Provision of a grade separated junction to enhance separation and safe passage of traffic. | |
| 2 | Confusing/ambiguous road marking and multiple lanes | <p>The road is widened (has multiple lanes in addition to old carriageway which is still in use) at the junction and there exists elaborate and visible road marking to separate, channelize and guide flow of traffic at the junction.</p> | <ul style="list-style-type: none"> • The road markings should be rectified to enhance safe flow and movement of traffic through the junction • Provision of appropriate road signs to guide on usage of old realigned road that is adjacent to the new carriageway • Sensitization and enforcement by the relevant agencies to prevent over speeding and overtaking at the junction. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | | <p>However, the Survey team observed that:</p> <ul style="list-style-type: none"> • There are too many confusing road markings some which cross each another; • Road making on old realigned Mombasa road has not been merged with those on newly constructed carriageway. They cross each other, some terminating abruptly and right turning arrows leading to nowhere; • Old road making leading to unused temporary road and which crosses markings on main road still exists and confuses motorists; • Section of old realigned road is still in use and Mombasa bound traffic uses this to overlap and overtake. <p>These existing and ambiguous road markings create confusion and complicate safe movement and flow of traffic at the already complicated junction.</p> | | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | <p>Ineffective informative (directional) road signs</p> | <p>The directional signs are too close to the junction and hence do not serve the intended purpose</p> | <ul style="list-style-type: none"> • Installation of appropriate retroreflective signs at a safe distance before the junction restricting speed and notifying motorists of the junction ahead. • Sustained maintenance | |
| 4 | <p>Numerous roads/accesses (access to SGR station and Curio shop) joining main A8 Road at the junction at the location</p> <p>Existence of several roads/accesses encourages unsafe and dangerous turnings in and out of the main road.</p> <p>The survey team observed vehicles making the following unsafe and illegal turns:</p> <ul style="list-style-type: none"> • Vehicles from Nairobi branching into the curio shop and SGR station cut across traffic from Oloitok heading towards Nairobi thereby forcing them to apply emergency brakes • Vehicles from Curio shop cut across traffic from Oloitok heading towards Nairobi to join Emaili-Oloitok road and to join main A8 road towards Mombasa. | <p>Risk of head-on, side-impact, side-swipe collisions as well as rear-end and multi-vehicle pile-ups as vehicles from Oloitok side make emergency braking to avoid hitting vehicles cutting across</p> | <ul style="list-style-type: none"> • Consider completely blocking paved access road to curio shop and provide alternative entry point at safer location. • Installation of appropriate warning and prohibitory signs • Collaboration with law enforcement agencies to impound vehicles making illegal and unsafe turnings. • Relocation of the junction to a relatively flat area especially towards the Mombasa side • In the long-term, a grade separate junction at a safe distance from the road over rail bridge should be considered. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | <ul style="list-style-type: none"> Entry point to Curio shop access is located on a crest thereby limiting visibility as one joins the main road. <p>It is also important to note that convergence of this access with A8 road is located on a combination of both on a vertical and horizontal curve, is on high embankment and very close to road over SGR rail bridge.</p> | | | |
| 5 | <p>Damaged safety fences, handrails and crash barrier. Several lines of guardrails on turning towards Oloitoktok from Mombasa and to Nairobi from Mombasa were knocked down, damaged with some pieces completely missing. Turning into A8 road from Oloitoktok is on high embankment.</p> | <p>Risk of vehicles rolling over high embankment</p> <p>Risk of vehicle ramming into protruding guardrails and piecing through the vehicle</p> | <ul style="list-style-type: none"> Repair/replacement of broken guardrails complete with end pieces and delineators Painting with retro-reflective paints, old guardrails to enhance visibility at night. Sustained maintenance of the same | |
| 6 | <p>Exposed pedestrian footpath cum shoulders on Road over rail bridge</p> <p>Wider shoulders that also serve as footpaths are provided on both sides. However, this is not separated to shield pedestrians from errant motorist</p> | <p>Risk of pedestrians being knocked down by errant or overlapping vehicles</p> | <ul style="list-style-type: none"> Consider installing barriers to shield pedestrians and bar motorist from driving on the shoulders. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | Pipeline Area | | | |
| 1 | Over speeding and dangerous overtaking | The section is long, straight and on a generally level terrain prompting motorists to overspeed and overtake dangerously. Most crashes recorded at the area are head on. | <ul style="list-style-type: none"> • Installation of speed calming measures; rumble strips for instance would reduce the likelihood of motorists over speeding • Installation of retroreflective speed control signs preferably in form of overhead sign gantries. • Enforcement of speed limits by relevant agencies • Improve crash data gathering and management for comparative analysis | |
| 2 | Faded road markings | Road markings at the edges and median have faded. Delineation of the lanes should be done afresh to guide the motorists. | <ul style="list-style-type: none"> • Application of retroreflective road markings • Installation of delineator retroreflective road studs to improve on visibility at night • Sustained maintenance of the same | |
| 3 | Non-existent/inadequate road signs | Speed limit signs are conspicuously absent along this stretch. Over speeding and reckless overtaking should be highly discouraged to avert crashes in the area. | <ul style="list-style-type: none"> • Installation and sustained maintenance of appropriate retroreflective signs along the section; speed control and warning signs should be prioritized. | |
| Ngokomi - Kalimbini | | | | |
| | Kalimbini | | | |
| 1 | Over speeding and dangerous overtaking | The section is long and straight with a gentle descent from the Nairobi side. Vehicles and especially heavy trucks from the Nairobi side tend to overspeed and overtake dangerously at the area. | <ul style="list-style-type: none"> • Installation of speed calming measures; rumble strips for instance would reduce the likelihood of motorists overspeeding • Installation of retroreflective speed control signs • Reinforce police road patrols in hot spots of pedestrian crashes • Enforcement of speed limits by relevant agencies | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 2 | Lack of a designated pedestrian crossing | A small market centre exists along the stretch. Speeding traffic tends to pose difficulties to pedestrians crossing the road. | <ul style="list-style-type: none"> Provision of a safe and marked pedestrian crossing at an appropriate location near the market Provision of appropriate signs to notify motorists of an existing pedestrian crossing. | |
| 3 | Faded road markings Road markings on the main carriageway and designated pedestrian crossings are completely faded in most of the sections | Application of fresh road marking needs to be done to delineate the lanes. | <ul style="list-style-type: none"> Application of retroreflective road markings Installation of delineator retroreflective road studs to improve on visibility at night Sustained maintenance of the same | |
| 4 | Lack of/Inadequate road signs | Speed limit signs are absent along this stretch. Over speeding and reckless overtaking should be highly discouraged to avert crashes in the area. | <ul style="list-style-type: none"> Installation and sustained maintenance of appropriate retroreflective signs along the section; speed control and warning signs should be prioritized. | |
| 5 | Smooth road surface | The road surface is generally in good condition and as such prompts motorists to overspeed. However, in the event of an emergency, the smooth surface provides low skid resistance meaning that emergency brakes might fail. | <ul style="list-style-type: none"> Application of surface dressing to provide better skid resistance. | |
| 6 | Hanging road shoulders | There is a significant height difference between the existing shoulders and the ground level. In the long run, the edges tend to erode and wear away effectively reducing the carriageway width. | <ul style="list-style-type: none"> Perform routine maintenance checks along the Corridor as a mitigating measure | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | Ngokomi | | | |
| 1 | Lack of a designated pedestrian crossing at Ngokomi market center | The stretch is long and straight with two sloping approaches on either side of the shopping centre prompting pedestrian fatalities. | <ul style="list-style-type: none"> Provision of a safe and marked pedestrian crossing at an appropriate location within the centre. Provision of appropriate signs to notify motorists of an existing pedestrian crossing. | |
| 2 | Over speeding and dangerous overtaking | The section is characterized by gentle vertical curves with the horizontal curves being minimal. This might prompt motorists to overspeed and overtake recklessly posing a safety hazard. | <ul style="list-style-type: none"> Installation of speed calming measures; rumble strips for instance would reduce the likelihood of motorists over speeding Installation of retroreflective speed control signs Enforcement of speed limits by relevant agencies | |
| 3 | Faded road markings | The traffic lanes have not been delineated with the median marking in particular appearing faded. | <ul style="list-style-type: none"> Application of retroreflective road markings Installation of delineator retroreflective road studs to improve on visibility at night Sustained maintenance of the same | |
| 4 | Missing road signage | Speed limit signs are lacking along this stretch. Over speeding and reckless overtaking should be highly discouraged to avert crashes in the area. | <ul style="list-style-type: none"> Installation and sustained maintenance of appropriate retroreflective signs along the section; speed control and warning signs should be prioritized. | |
| 5 | Damaged safety fences Several lines of guardrails at box culverts crossings are knocked down, damaged and some pieces missing. Some section of road along Ngokomi stretch is on high embankment but have guardrails completely missing. | Risk of vehicles rolling over high embankment Risk of vehicle ramming into protruding guardrails and piecing through the vehicle | <ul style="list-style-type: none"> Repair/replacement of broken /missing guardrails complete with end pieces and delineators and sustained maintenance of the same | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 6 | Aging road pavement and hanging road shoulders Isolated potholes in addition to rutting, cracks, rutting (low skid resistance) raveling were observed to be developing along the wheel paths on Nairobi bound carriageway especially along Pipeline and Ngokomi stretches | The shoulders are high as compared to the surrounding ground level. Speeding vehicles are likely to roll over after veering off the road. Moreover, in the event of an emergency, motorists are less likely to move to the road side for fear of rolling over increasing the propensity of crashes. | <ul style="list-style-type: none"> Repair of deteriorated road section and sustained maintenance | |
| Konza - Malili | | | | |
| 1 | Over speeding and dangerous overtaking | Generally long straight stretch which encourages reckless over speeding and overtaking | <ul style="list-style-type: none"> Installation of speed calming measures; rumble strips for instance would reduce the likelihood of motorists over speeding Installation of retroreflective speed control signs preferably in the form of overhead sign gantries. Enforcement of speed limits by relevant agencies | |
| 2 | Faded road markings Road markings at the edges and median have faded. Delineation of the lanes should be done afresh to guide the motorists. | Risk of vehicles involved in head-on, rear-end, side-impact, side-swipe collisions and pedestrians being knocked down as they cross the road | <ul style="list-style-type: none"> Application of retroreflective road markings Sustained maintenance of the same Installation of delineator retroreflective road studs to improve on visibility at night | |
| 3 | Inadequate road signage | Speed limit signs are absent along this section. Over speeding and reckless overtaking should be highly discouraged to avert crashes in the area. | <ul style="list-style-type: none"> Installation and sustained maintenance of appropriate retroreflective signs along the section; speed control and warning signs should be prioritized. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 4 | <p>Damaged/missing safety fences</p> <p>Most lines of guardrails in the entire stretch have either been damaged beyond repair or are completely missing. Further, the damaged guardrails have been left exposed with no end pieces and protruding sharply against the direction of traffic.</p> | <p>Risk of vehicles rolling over high embankment</p> <p>Risk of vehicle rammings into protruding guardrails and piecing through the vehicle</p> <p>The following collisions are therefore probable: head-on, side-impact, side-swipe and roll-over.</p> | <ul style="list-style-type: none"> • Repair/replacement of broken guardrails complete with end pieces and delineators • Repainting of non-reflective old guardrails to enhance visibility at night | |
| 5 | <p>Deteriorated pavement and worn out road shoulders</p> | <p>Team observed pavement is already showing signs of distress and failure. Failures observed along the wheel path on Nairobi bound lane included: emerging potholes, cracks, raveling, rutting, eroded/worn out & hanging shoulders</p> <p>Risk of Head-on, Side-impact, Side-swipe, Rear-end, Multi-vehicle pile-ups collisions exist as vehicles swerve to avoid damaged sections</p> | <ul style="list-style-type: none"> • Repair of deteriorated roads section and sustained regular maintenance | |
| 6 | <p>Silted/inadequate drainage capacity</p> <p>Poor drainage resulting in water ponding within the road cross section and reducing effective width of the road.</p> | <p>Reduced road width greatly increases risk of Head-on (water splashing and blocking view of motorist), Rear-end, Side-impact, Side-swipe, Multi-vehicle pile-ups collisions and Roll-over collisions</p> | <ul style="list-style-type: none"> • Clean/enhance capacity of existing drainage structures • Sustained maintenance of the drainage system | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 7 | Obstruction by Heavy trucks and PSV Trucks parking on the roadside and PSV pick and drop commuters on the road thereby reducing visibility of motorists and obstructing road signs | Rear End, Side-swap, side impact collisions and vehicle-pedestrian accidents | <ul style="list-style-type: none"> • Collaboration with law enforcement agencies | |
| 8 | Steep vertical curves with limited sight distances | Kapiti plains sections is on a relatively straight alignment with gentle terrain. However, there exists some steep vertical curves with limited sight distances Risk of Head-on, Side-swipe, Side- impact, Rear-end, Multi-vehicle pile-ups collisions exists. | <ul style="list-style-type: none"> • Redesign of sections with limited sign distances as a long-term measure • Provision of adequate requisite warning signs • Collaboration with law enforcement offices to monitor and regulate speed along the stretch. | |
| Mlolongo | | | | |
| 1 | At the time of the Survey, 1No. foot bridge was under construction at Olympic petrol crossing in Mlolongo. In addition, the service lane was also under construction between Mlolongo and Sabaki area on Mombasa bound carriageway side and within Mlolongo centre on Nairobi bound carriageway) | | | |
| 2 | Missing/non-existent road signs | A considerable number of road signs have been knocked down and those remaining are often blocked by parking trucks and cannot therefore relay intended messages No signs to direct traffic through service lanes Vehicles make dangerous and illegal turns at undesignated places Risk of Head-on, Rear-end, Side-impact, Side swipe collisions is imminent along the area | <ul style="list-style-type: none"> • Installation and sustained maintenance of appropriate and requisite retroreflective signs along the road section • Install barriers to deter illegal turnings. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | Faded road marking | Existing road marking is completely faded. Markings on few provided raised pedestrian crossings/ speed humps are also faded. Risk of Pedestrians collision, Head-on, Side-impact, Side-swap Roll-over and Multi-vehicle pile-ups | <ul style="list-style-type: none"> Application of retroreflective road markings on carriageway and designated pedestrian crossings and sustained maintenance of the same to guide movement of vehicles and pedestrians at market centres Installation of delineator retroreflective road studs to improve on visibility at night on both carriageways. | |
| 4 | Confusing U-turn on Nairobi bound carriageway near Syokimau railway station stage | Even though a gantry sign has been provided to show existence of a U-turn near Syokimau railway station stage on Nairobi bound carriageway, design of the U-turn lane is confusing. The U-turn lane is long and confuses motorists as it terminates abruptly. Risk of Roll-over, Head-on with Mombasa bound traffic, Side-impact, Side-swipe, Roll-over and Multi-vehicle pile-ups exists as result. | <ul style="list-style-type: none"> Remarking of the road to direct road users through the U-turn As an addition to the gantry sign already provided, consider providing additional road signs to caution on abrupt termination of the lane Need to redesign the U turn as a long-term measure Application of road markings on the carriageway and designated pedestrian crossings and sustained maintenance of the same to guide movement of vehicles and pedestrians at market centres Installation of delineator retroreflective road studs to improve on visibility at night | |
| 5 | Insufficient/lack of pedestrian crossings (Mlolongo, Kapa/Gateway Mall and Syokimau railway station stage) | Provided designated pedestrian crossing are not enough to cover the whole of Mlolongo This has further been aggravated by PSVs that pick/drop at multiple points across the centre. Risk of Pedestrians collision; Rear-end, Side-impact, Side-swipe collisions as vehicle swerve to avoid hitting pedestrians | <ul style="list-style-type: none"> Provision of safe and marked pedestrian crossings at appropriate locations complete with pedestrian crossing signs and road studs to enhance visibility at night. Installation of rumble strips on either side of raised pedestrian crossings where they have been provided. Consider providing foot bridges at Mlolongo, Syokimau and crossing to SGR station as a more sustainable solution | Currently being addressed. 1 No. footbridge under construction at Olympic Petrol crossing. Additional 3 footbridges to be constructed at Mlolongo, Syokimau-Katani and Gateway Mall crossings |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 6 | Lack of bus bays (Mlolongo, Kapa/Gateway Mall) | <p>Mlolongo is a populous trading centre with heavy settlement on both sides. It is also a popular picking and dropping point for commuters</p> <p>There are no bus bays provided along the road within Mlolongo on the Nairobi bound carriageway at Kapa/Gateway Mall.</p> <p>Most PSVs don't use the provided (though small) off road bus park on Mombasa bound carriageway.</p> <p>In the absence of designated bus bays at suitable strategic locations, vehicles therefore pick and drop at any point, thereby aggravating road safety problems that abound the centre.</p> <p>In addition, Nairobi bound PSV pick/drop passengers on the inner median on the Nairobi bound carriageway since trucks diverting into the Weighbridge always use the outer lane.</p> <p>Risk of Pedestrians collision; Rear-end, Side-impact and Side-swipe collisions</p> | <ul style="list-style-type: none"> • Collaboration with law enforcement agencies to compel PSV to use a bus park provided on Mombasa bound carriageway. • Provision of an off-road bus park | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 7 | Encroachment by vendors at Mlolongo | <p>Vendors selling wares on the road carriageway</p> <p>Others standing in the middle of the carriageway to sell their goods to moving traffic oblivious of the danger this pose to them and to other road users</p> <p>Risk of pedestrians being knocked down and vehicles involved in Rear-end, Side-impact, Side-swipe, Multi-vehicle pile-ups collisions as they try to avoid knocking the vendors and other vehicles</p> | <ul style="list-style-type: none"> • Reclamation of RoW by clearing of any encroachment within road reserve. • Sustained maintenance and management of RoW Collaboration with law enforcement agencies • Collaboration with relevant agencies on Road Safety awareness campaigns and sensitization of vendors and other road users | |
| 8 | Obstruction by trucks and PSV vehicles at Mlolongo. | <p>Trucks and PSVs park on the shoulders and edge of carriageway</p> <p>Service lanes have been converted into garages and truck stopping points/parking</p> <p>Risk of Rear end, Side-swipe, side impact collisions and vehicle-pedestrian accidents</p> | <ul style="list-style-type: none"> • Collaboration with law enforcement agencies • As a long-term measure, consider construction of service lanes to separate through traffic from local and reduce congestion • Provision of a road side station at a suitable location | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 9 | <p>Damaged kerbstone/barriers to Weighbridge and hanging shoulders</p> | <p>Several kerbs separating auxiliary lane to static weighbridge station on Nairobi bound carriageway are damaged dangerously exposing steel reinforcement. Some of the barriers have also been knocked down and left dangerously lying beside the narrow auxiliary lane. Markings on the kerbs/barriers are covered in soot and are not clearly visible. Vehicles run the risk of ramming into them. Worn out shoulders have left the road edge hanging. Risk of vehicles ramming into non reflective kerbs, Rear-end, Multi-vehicle pile-ups and Roll-over collisions</p> | <ul style="list-style-type: none"> Repair of damaged and knocked down kerbs/separators/barriers on auxiliary lane Repaint the kerbs/barriers and ensure sustained maintenance of the same. Repair of damaged pavement and shoulders and sustained regular maintenance of the same | |
| Gitaru – Rungiri (Southern Bypass/A8 Junction) | | | | |
| 1 | | | | |
| 2 | <p>Lack of a provision for a designated pedestrian crossing</p> | <p>There is no provision of a safe pedestrian crossing at the location. Instead, pedestrians use a narrow gap between the New Jersey crash barriers notwithstanding the crossing is on a curvy slope.</p> | <ul style="list-style-type: none"> Provision of a footbridge at an appropriate location (a marked pedestrian crossing might not be effective taking the location and volume of traffic into account). | <p>To be addressed under the ongoing rehabilitation and capacity enhancement of the James Gichuru Junction to Rironi road project.</p> |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | Unsafe location of Bus stop on Nairobi bound carriageway | Location of Bus stop on Nairobi bound carriageway is sited on a curve with limited visibility. Section also descends downhill hence speeding motorist are likely to knockdown pedestrians crossing the road at this location and collide with vehicles accelerating from bus bay into main carriageway. Risk of rear-end, side swipe, side impact collision and pedestrian knock down | <ul style="list-style-type: none"> • Providing rumble strips to warn motorists descending downhill to slow down speed in the meantime as the section is under construction • As a long-term measure, improve on visibility at the curve to make the bus bay more visible | ” |
| 4 | Absent/faded road markings | There are no road markings or reflective road studs to delineate the traffic lanes. In addition, the transition lane from the Southern Bypass should be well marked for easy movement of the motorists joining the A8 Highway | <ul style="list-style-type: none"> • Application of retroreflective road markings • Sustained maintenance of the same • Installation of delineator retroreflective road studs to improve on visibility at night | ” |
| 5 | Lack of road signs | Road signage informing the road users of the presence of bus bays and pedestrian crossings are absent. Appropriate signage should be installed to inform all road users accordingly. | <ul style="list-style-type: none"> • Installation and sustained maintenance of appropriate retroreflective signs. | ” |
| 6 | Non-reflective central concrete barriers | The central concrete barriers are not reflective especially during the night. Consequently, they have been constantly hit against as evidenced by the cracks and marks. | <ul style="list-style-type: none"> • The central crash barriers should be painted with retroreflective paint or fitted with retroreflective tapes to enhance visibility at night. | ” |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 7 | Encroachment into the road reserve by vendors | Makeshift/temporary kiosks/sheds have cropped up especially adjacent to the Nakuru bound bus bay as vendors display and sell their wares. | <ul style="list-style-type: none"> Clearing of any encroachment within the road reserve and especially near the carriageway. | ” |
| 8 | Deteriorating road surface | The surface on the A8 Highway has deteriorated and is characterized by an uneven surface. The shoulders have also eroded over time. | <ul style="list-style-type: none"> Repair of deteriorated roads section. For a more wholistic solution, construction of a new pavement structure would be ideal. Sustained maintenance | ” |
| 9 | Blocked/silted gully pots at the foot of the New Jersey crash barriers | The gully pots at the foot of the crash barriers have been blocked by litter/silt. In essence, this implies that storm water that would be otherwise channeled by the gully pots flows over the carriageway causing substantial erosion and deterioration. | <ul style="list-style-type: none"> Regular cleaning/de-siltation of the existing drainage facilities and structures Sustained maintenance of the drainage system. | ” |
| Mukinya – Migaa – Sobea – Salgaa - Sachangwan | | | | |
| Sobea Junction | | | | |
| 1 | No provision of speed change lanes | There is no provision for accelerating lanes for Nakuru bound traffic joining the Highway from Njoro and Eldoret bound traffic from Menengai | <ul style="list-style-type: none"> Construction of speed change lanes for accesses and junctions to allow for gradual entry of vehicles to the highway. | |
| 2 | Inadequate turning radius for heavy trucks | Turning radii from the feeder roads and especially from the Njoro bound road are too narrow for heavy trucks. | <ul style="list-style-type: none"> Geometric design for trucks requires much more generous design in regard to turning radius because of wider and longer wheelbases | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | Missing/non-existent road signs | <p>The team noted that except for gantry sign there are no warning motorists on dangers of over-speeding, there are no adequate signs as well advance directional/informatory signs to inform motorists of major junction at Sobeia or presence of pedestrian crossing on this section which has generally gentle horizontal and vertical curves to.</p> <p>Motorists tend to speed in this stretch</p> <p>Risk of pedestrians being knocked</p> <p>Roll-over, Head-on, Rear-end, Side-impact, Side-swipe, Multi-vehicle pile-ups collisions</p> | <ul style="list-style-type: none"> • Installation of appropriate retro-reflective signs along the road section • Sustained maintenance of the same. | |
| 4 | Lack of a designated pedestrian crossing zone | <p>Despite the provision of bus bays at the Sobeia junction, no designated crossing points have been marked out. The section has commercial and residential establishments that generate significant pedestrian traffic at this section of road.</p> <p>Risk of Pedestrians collisions, Head on, Rear-end, Side-impact, Side-swipe collisions as vehicle swerve to avoid hitting pedestrians</p> | <ul style="list-style-type: none"> • Provision of safe and marked pedestrian crossings at appropriate locations. • Provision of adequate and appropriate signs to guide all road users to and through these designated crossings | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 5 | Dangerous location of the bus bays | The two bus bays are situated on what ideally should be the accelerating lanes from the feeder roads joining the Highway. Rear-end collisions are likely to occur as a result. | <ul style="list-style-type: none"> • Relocation of the bus bays to a safe distance from the junction • Installation of appropriate retroreflective signage showing the location of the bus bays | |
| Sobea – Salgaa Stretch | | | | |
| 1 | This section of road forms one of the most notorious black spots in the country's road network. Arising from numerous catastrophic crashes that have occurred in this area, KeNHA recently installed speed calming measures (speed limit and warning signs, rumble strips, road marking etc) aimed at controlling speeds in this long and straight stretch of the road thereby reducing on number and severity of crashes. The road surface is fairly in good condition. | | | |
| 2 | Speeding and dangerous overtaking | Section between Sobea – Salgaa is fairly in good condition and traverses a fairly level terrain. The road has a long straight section with two and three lanes at the climbing section. As such, vehicles were observed to be over-speeding and overtaking dangerously. Several speed calming measures have been employed though adherence to speed limits by motorists still remains a challenge. Risk of Head-on, Rear-end, Side-impact, Side-swipe, roll-over, Multi-vehicle pile-ups collisions | <ul style="list-style-type: none"> • Repair of smoothened rumble trips as speed calming measures • Collaboration with law enforcement agencies to enforce the speed limits • Provision of audible/vibratory edge road marking at carriageway edges to keep motorists alert • Provision of speed limit signs | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | Long and straight horizontal alignment | <p>The stretch through Margaret Kenyatta farm is on a long straight with gentle vertical curve.</p> <p>This long and straight alignment generally entices motorist to overspeed and overtake dangerously.</p> <p>Roll-over, Head-on, Rear-end, Side-impact, Side-swipe, Multi-vehicle pile-ups collisions are all likely at this location.</p> | <ul style="list-style-type: none"> In addition to the speed calming measures and signs already installed, as a long-term measure, reconsider realigning the stretch or modifying the cross section into a dual carriageway by separating traffic in opposite directions | |
| 4 | Worn out & hanging road shoulders edges | <p>Whereas the carriageway is in good condition, RSA team observed existing road shoulders have been eroded by overlapping motorists and are hanging in some sections</p> <p>Risk of vehicles being involved in Roll-over, Rear-end, Side-impact, Side-swipe, Multi-vehicle pile-ups collisions as vehicles manoeuvre over hanging shoulders</p> | <ul style="list-style-type: none"> Repair of deteriorated roads section Sustained maintenance | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | Salgaa centre | | | |
| 1 | The town section is considerably busy with trucks stopping and parking along the road for large parts of the day. Considerable pedestrian and NMT movements can be observed throughout the town. | | | |
| 2 | Unsafe parking of heavy trucks on the shoulders | <p>The heavy trucks park on the shoulders thereby reducing the effective width of the carriageway.</p> <p>Most of the accidents are associated to the roadside parking which causes reduced visibility for both motorists and pedestrians crossing the road</p> | <ul style="list-style-type: none"> Provision of off-road heavy truck parking facility complete with amenities (Road Side Station) as a long-term measure | |
| 3 | Lack of safe designated pedestrian crossings | There is no provision for designated crossing zones for pedestrians in the town. | <ul style="list-style-type: none"> Provision of marked raised pedestrian crossings at appropriate locations in the town. Provision of appropriate signs to notify motorists of existing pedestrian crossings. In the long term, construction of a footbridge(s) should be considered to safeguard the safety of pedestrians. | |
| 4 | Fading/non-existent road markings | <p>Road marking through the town section of road is faded.</p> <p>Additionally, some of the speed humps along the section may not be clearly visible to motorists.</p> <p>Markings for pedestrian crossing are not visible and therefore motorists are unable to establish the existence of designated pedestrian crossing points.</p> | <ul style="list-style-type: none"> Application of retro-reflective road markings Provision of audible/vibratory edge road marking at carriageway edges to keep motorists alert Provision of retro-reflective delineator road studs to enhance visibility at night Sustained maintenance of the same | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 5 | <p>Inadequate provision of NMT facilities and safe pedestrian crossing points</p> | <p>Risks of pedestrians being knocked by vehicles as they cross the road.</p> <p>Risk of vehicles involved in Head-on, Side-impact, Side-swipe, Rear-end, Multi-vehicle pile-ups collisions</p> <p>Despite the heavy presence of pedestrian and NMT movements along the town section, no designated crossing points have been marked out.</p> <p>There is also no separation of lanes for NMT and motorised transport modes, making it dangerous for both road users.</p> <p>Risk of Pedestrians collision; Head on, Rear-end, Side-impact, Side-swipe collisions as vehicle swerve to avoid hitting pedestrians</p> | <ul style="list-style-type: none"> • Provision of safe and marked pedestrian crossings and NMT features at appropriate locations. • Provision of adequate and appropriate signs to guide all road users to and through these designated crossings | |
| 6 | <p>Unsafe junction layout at Salgaa town</p> | <p>The town section is riddled with numerous accesses and minor road junctions that have no speed change lanes. Additionally, there is a major staggered junction at the town section with stagger less than the minimum 50m requirement.</p> | <ul style="list-style-type: none"> • Channelization of traffic at the junction • Installation of adequate and appropriate signs • Sustained maintenance of the signs • Redesign of access to meet design requirements. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | | <p>The junction is not channelized and has no provision for speed change lanes on Nairobi bound side.</p> <p>Risk of vehicles being involved in Head-on, Side-impact, Side-swipe, Rear-end, Multi-vehicle pile-ups collisions are all probable.</p> | | |
| 7 | Worn out & hanging road shoulders edges | <p>Whereas the carriageway is in good condition, the Survey team observed existing road shoulders have been eroded by overlapping motorists and are hanging in some sections</p> <p>Risk of vehicles being involved in Roll-over, Rear-end, Side-impact, Side-swipe, Multi-vehicle pile-ups collisions as vehicles manoeuvre over hanging shoulders</p> | <ul style="list-style-type: none"> • Repair of deteriorated roads section • Sustained maintenance | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | Molo River Bridge | | | |
| 1 | <p>Dangerous transition from a dual to a single carriageway and vice versa.</p> <p>The bridge is located on a both vertical (sag) and horizontal curve.</p> | <p>There is an abrupt end of the dual carriageway into a single carriageway when approaching Molo River bridge from the Eldoret side.</p> <p>Vehicles on both sides tend to over speed as they descend towards on the bridge. With this constriction/abrupt termination of the dual carriageway, there is high risk of conflict as 2 lanes of traffic merge into a single lane.</p> <p>Risk of Roll-over, Head on, Rear-end, Side-impact and Side-swipe collisions.</p> | <ul style="list-style-type: none"> Installation of appropriate retroreflective signs notifying motorists of the transition from a dual to a single carriageway and vice versa and at a safe distance Provide requisite warning signs to warn motorists of existence of bridge (narrow road) Extend extending the climbing lane past the bridge towards Saigaa side as a long-term measure | |
| 2 | Missing hazard marker signs on the bridge abutments | Hazard signs on the abutments are missing. This presents a hazard especially to motorists using the bridge at night. | <ul style="list-style-type: none"> Installation of retroreflective hazard marker signs on the bridge abutments on either side. | |
| | Molo River Bridge – Sachang'wan | | | |
| 1 | The section was under construction (carriageway widening and separation of lanes using New Jersey Crash barriers into a dual carriageway) | | | |
| 2 | Non-reflective median New Jersey crash barriers | The two directions of traffic are separated using New Jersey crash barriers. However, they might be barely visible at night especially to motorists using the inner lanes. | <ul style="list-style-type: none"> Painting of the New Jersey crash barriers with retroreflective paint/fitting them with retroreflective tapes to enhance visibility at night. | To be addressed under the ongoing Emergency Safety Enhancement works from Kibunja to Kabarak Junction. |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | Encroachment by vendors | Some vendors have taken advantage of the speed calming measures to sell their wares and products to motorists oblivious of the dangers they expose themselves to. | <ul style="list-style-type: none"> Sensitization on the dangers accompanied with enforcement by the relevant authorities | |
| GSU Camp – Kibunja Section | | | | |
| 1 | This section of the highway is treacherous and known for successive combination of windy horizontal and vertical curves. The road surface is fairly good with | little rutting observed near the road hump sections | | |
| 2 | Missing/damaged and wrongly connected safety fences | <p>The survey team observed several locations and especially on bridge crossings with:</p> <ul style="list-style-type: none"> Missing and knocked down guardrails with missing end pieces Missing guardrails on high embankment sections Wrongly connected and terminated guardrails Weak guardrail support, rails covered in soot. Wrong guardrail connection/ termination and damaged guardrails have left critical areas including drainage structures crossings exposed and sharp edges protruding towards direction of traffic. Risk of vehicle rolling over on high embankment Risk of vehicle ramming into protruding guardrails and piecing through the vehicle | <ul style="list-style-type: none"> Repair/replacement of broken and weak guardrails complete with end pieces and delineators Painting of the same with retro reflective paint to enhance visibility at night | To be addressed under the ongoing Emergency Safety Enhancement works from Kibunja to Kabarak Junction |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 3 | Fading and non-reflective road markings | <p>The Survey team observed that existing road marking is fading and require repair.</p> <p>Additionally, section has no retro-reflective delineator road studs to hence visibility at night.</p> <p>Completed sections under constructed have also not been marked.</p> <p>Risks of pedestrians being knocked by vehicles as they cross the road.</p> <p>Risk of vehicles involved in Head-on, Side-impact, Side-swipe, Rear-end, Multi-vehicle pile-ups collisions</p> | <ul style="list-style-type: none"> • Application of retro-reflective road markings and tapes • Provision of audible/vibratory edge road marking at carriageway edges to keep motorists alert • Provision of retro-reflective delineator road studs to enhance visibility at night • Sustained maintenance of the same | |
| 4 | Speeding, careless and dangerous overtaking and freewheeling | <p>Between Sachangwan and Chepsion Vehicles on both directions tend to:</p> <ul style="list-style-type: none"> • Over speed • Overtake carelessly and dangerously, <p>They also barely observe lane discipline (double overlap on climbing lane and opposite lane as well)</p> <p>Risk of Head-on, Rear-end, Side-impact, Side-swipe, roll-over, Multi-vehicle pile-ups collisions</p> | <ul style="list-style-type: none"> • Installation of speed calming measures i.e. rumble strips on Nakuru bound carriageway • Installation of ‘No Overtaking’ and other warning signs • Collaboration with law enforcement agencies • Construction of off-road safe runaway truck ramp/emergency escape ramp/clear zones at strategic locations on Nakuru bound carriageway along the accident-prone section– currently being implemented • Dualling to separation of traffic in opposite directions as a long-term measure – currently being implemented | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 5 | Encroachment of vendors onto the carriageway | <p>Where speed humps have been provided, vendors have invaded the road and are selling wares to moving motorists while standing in the middle of the road, thereby posing a danger to themselves and other road users.</p> <p>Risks of vendors being knocked by vehicles.</p> <p>Risk of vehicles involved in Head-on, Side-impact, Side-swipe, Rear-end, Multi-vehicle pile-ups collisions.</p> | <ul style="list-style-type: none"> Liaison with law enforcement authorities to ensure that the vendors are moved from the main carriageway | |
| Molem – Namba Okana – Nyamasaria – Kasagam | | | | |
| Namba-Okana | | | | |
| 1 | Faded road markings | <p>The road markings especially at the edges are almost completely faded.</p> <p>The lanes should be delineated accordingly to guide the road users.</p> <p>Risk of vehicles being involved in Head-on, Side-impact, Side-swipe, Rear-end, Multi-vehicle pile-ups collisions</p> <p>Risks of pedestrians being knocked by vehicles as they cross the road.</p> | <ul style="list-style-type: none"> Application of road retro-reflective road markings to guide the movement of through and diverting traffic Provision of audible/vibratory edge road marking at carriageway edges to keep motorists alert Installation of delineator retro reflective road studs to enhance night vision Sustained maintenance of the same | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 2 | Inadequate road signs | <p>A speed limit sign of 50 Kph has been provided for the section.</p> <p>Road signage showing the speed humps, pedestrian crossings and other requisite signs have however not been provided</p> <p>Pedestrian-vehicle conflict exists.</p> <p>Risk of vehicles being involved in Head-on, Roll – over, Side-impact, Side-swipe, Rear-end, Multi-vehicle pile-ups collisions</p> | <ul style="list-style-type: none"> • Installation and sustained maintenance of appropriate retroreflective signs. • Enforcement of the speed limits by the relevant agencies | |
| 3 | Lack of designated pedestrian crossings | <p>A provision for raised pedestrian crossings near the local bus bay has only been made for the on one side (towards Kisumu side).</p> <p>For higher effectiveness, pedestrian crossings should be provided on both fronts of the bus bays.</p> | <ul style="list-style-type: none"> • Provision of marked pedestrian crossings (raised) on either side of the bus bays. • Installation of delineator retro reflective road studs at pedestrian crossing points to enhance night vision • Provision of rumble strips between the speed calming humps and the pedestrian crossings to prevent motorists from accelerating as they approach the crossing zones. | |
| 4 | Lack of safety fences/guard rails on high embankment | <p>The road has been constructed on a high embankment with steep slopes on the LHS of the Kisumu bound lane especially at the left turning horizontal curve.</p> | <ul style="list-style-type: none"> • Provision of safety fences/guard rails on the steep sloped embankment | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 5 | Dangerous overtaking especially by <i>bodaboda</i> riders | <p>However, no provision for safety fences/guard rails has been made posing a risk of vehicles that might lose control rolling down the high embankment.</p> <p>The shoulders along the stretch have been widened to provide stability to heavy trucks plying the route.</p> <p>It has however been observed that some <i>bodaboda</i> riders take advantage and overtake on the wrong side subjecting themselves and other motorists to risk.</p> | <ul style="list-style-type: none"> Enforcement of traffic rules by the relevant agencies | |
| 6 | Hanging road shoulders | <p>The road pavement structure has been constructed on a fill. Resultingly, there is a sharp drop from the road edges.</p> <p>With time, the edges are likely to erode eventually reducing the effective carriageway. More so, vehicles that might veer off the road are likely to roll over.</p> | <ul style="list-style-type: none"> Repair or damaged/deteriorated road sections | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | Rabuor | | | |
| 1 | Faded road markings | The median road markings are faded where the edge road markings are non-existent. Delineation of the lanes needs to be done to guide road users. Additionally, markings on the speed humps and pedestrian crossings have faded over time | <ul style="list-style-type: none"> • Application of road retro-reflective road markings to guide the movement of through and diverting traffic • Provision of audible/vibratory edge road marking at carriageway edges to keep motorists alert • Installation of delineator retro reflective road studs to enhance night vision • Sustained maintenance of the same | |
| 2 | Inadequate road signage | Road signs showing the presence of speed calming humps and pedestrian crossings are missing. In addition, marker posts at the culvert edges are not adequately reflective. | <ul style="list-style-type: none"> • Installation and sustained maintenance of appropriate retroreflective signs • Painting of marker posts at the culvert edges with retroreflective paint/fitting them with retroreflective tapes. | |
| 3 | Picking up and dropping off of passengers at non-designated locations | Matatus along the stretch tend to pick up and drop off passengers at non designated zones despite bus bays being provided | <ul style="list-style-type: none"> • Enforcement by the relevant agencies | |
| 4 | Silted drainage structures | The terrain is generally flat with cross and access culverts having no clearly defined outfalls. Most of them have been further clogged by plastics reducing their effective capacity. | <ul style="list-style-type: none"> • Regular cleaning and de-siltation of the culverts • Regular clearing of vegetation around the drainage structures | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 5 | Non provision of speed changing lanes at the junctions | The centre is generally busy with a significant movement of both vehicles and pedestrians. Accesses joining the main highway do not have speed changing lanes as required posing a safety hazard to both motorists joining the highway and exiting into the accesses. | <ul style="list-style-type: none"> • Providing speed change lanes to the accesses • This being an international trunk road serving both through and local traffic, provision of access should be controlled and proper development to be supervised by the Authority • Provision of service lanes to the highway to serve local traffic as a long-term measure | |
| 6 | Hanging road shoulders | There is a significant height difference between the road edges and the normal ground level. As time progresses, they are likely to erode creating rugged road edges | <ul style="list-style-type: none"> • Repair or damaged/deteriorated road sections | |
| 7 | Significant spacings between speed calming humps and pedestrian crossings | Siting of raised pedestrian crossings/speed humps are far off from provided Bus stops, are far apart and from the market center central point where many people cross the road at. Motorists might tend to over speed when approaching the subsequent hump). | <ul style="list-style-type: none"> • Provision of rumble strips between the speed humps and the pedestrian crossings • Provision of rumble strips in between to caution motorists to slow down • Provision of pedestrian crossing at strategic and best locations. • Provide additional safe crossing points at safe locations. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| | Alendu | | | |
| 1 | Unsafe pedestrian crossings | Siting of raised pedestrian crossings/speed humps are far off from provided Bus stops, are far apart and from the market center central point where many people cross the road at. Motorists might tend to over speed when approaching the subsequent hump). | <ul style="list-style-type: none"> Provision of rumble strips between the speed humps and the pedestrian crossings Provision of rumble strips in between to caution motorists to slow down Provision of pedestrian crossing at strategic and best locations. Provide additional safe crossing points at safe locations. | |
| 2 | Faded road markings | The road markings especially at the edges are almost completely faded. The lanes should be delineated accordingly to guide the road users. | <ul style="list-style-type: none"> Application of road retro-reflective road markings to guide movement of through and diverting traffic Provision of audible/vibratory edge road marking at carriageway edges to keep motorists alert Installation of delineator retro reflective road studs to enhance night vision Sustained maintenance of the same | |
| 3 | Inadequate road signage | Road signs showing the presence of speed calming humps and pedestrian crossings are missing. Hazard marker signs at the bridge/box culverts | <ul style="list-style-type: none"> Installation and sustained maintenance of appropriate retroreflective signs Installation of retroreflective hazard marker signs at the bridge | |
| 4 | Hanging road shoulders | There is a significant height difference between the road edges and the normal ground level. As time progresses, they are likely to erode creating rugged road edges. | <ul style="list-style-type: none"> Repair or damaged/deteriorated road sections | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
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| 5 | Speeding motorists and dangerous overtaking | Speeding motorists pose a risk to pedestrians as well as fellow motorists noting that the traffic volume in the area is quite significant. Dangerous overtaking by both motorists and <i>bodaboda</i> riders also presents a risk to the road users. | <ul style="list-style-type: none"> Provision of rumble strips between the speed calming humps Collaboration with law enforcement officers | |
| Nyamasaria | | | | |
| 1 | Unsafe crossing of pedestrians albeit the presence of a footbridge | A steel footbridge has recently been completed but has been rendered redundant by the locals; who instead opt to arbitrarily cross the road at grade below the bridge. | <ul style="list-style-type: none"> Provision of pedestrian safety fences/barriers at Nyamasaria town to prevent pedestrians from crossing the road at grade Sensitization on the need to use the footbridge and enforcement by the relevant agencies. | |
| 2 | Ramps touching the ground are extremely steep making them highly inconvenient for Persons with Disabilities (PWDs) | Entry and exit Ramps touching the ground are extremely steep making them impractical for use by Persons with Disabilities (PWDs) Whereas a footbridge has been provided, pedestrians do not use the provided footbridge and instead cross at grade Pedestrian/PWD tripping and falling over, Foot bridge being abandoned and instead people cross the road at grade | <ul style="list-style-type: none"> Re-design of the ramps to a lower gradient. | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
|------|---|--|---|---------------------------------------|
| 3 | Safety concerns on the bridge rails | <p>The vertical spacing between the bridge rails is significantly large such that open spaces are left between.</p> <p>In addition, there are concerns that the bridge rails are too low.</p> | <ul style="list-style-type: none"> Provision of rails with narrow spacing and sufficient safety provisions | |
| 4 | Encroachment of the service lanes and walkways by vendors | <p>Vendors display and sell their wares on what should otherwise be used as service lanes/walk ways risking their safety and effectively inhibiting vehicular movement within the town</p> <p>Pedestrian-Cyclist/vehicle conflict</p> <p>Rear-end, Side-impact, Side-swipe collisions as vehicle swerve to avoid hitting pedestrians</p> | <ul style="list-style-type: none"> Reclamation of RoW Collaboration with law enforcement agencies to deter vendors from using the road | |
| 5 | Faded road marking | <p>Road markings delineating the lanes has faded. The raised speed humps are not also clearly marked.</p> | <ul style="list-style-type: none"> Application of road retro-reflective road markings to guide movement of through and diverting traffic Provision of audible/vibratory edge road marking at carriageway edges to keep motorists alert Installation of delineator retro reflective road studs to enhance night vision Sustained maintenance of the same | |

| S/No | Survey Observations and Findings | Analysis/Diagnosis | Suggested Recommendation for improvement | Remarks/ Approximate Remedial Cost |
|------|--|--|---|---------------------------------------|
| 1 | Wrongly placed road signage | Some road signs have been placed on the street lighting poles. These might not be visible to all road users. | <ul style="list-style-type: none"> • Installation of appropriate retroreflective signs at appropriate heights for visibility to all motorists • Sustained maintenance of the same | |
| 2 | Damaged storm water drains on the cycle tracks/ foot paths | The concrete covering on the storm water drainage has been damaged at a section within the town. This poses a safety hazard since pedestrians might trip and fall into the drains if they are not repaired early enough. | <ul style="list-style-type: none"> • Repair of the storm water drain by replacing the damaged section using a suitable concrete slab. | |

6.5 Appendix 5: Selected Site Observation Photographs

1. Kibarani – Makupa Causeway



Figure 2: Missing road markings at Makupa Causeway



Figure 5: Site management concerns at the ongoing footbridge construction (Unsecured excavation)



Figure 3: Deteriorated road surface at Makande Junction



Figure 6: Dangerous pipe outcrops along Makupa causeway. Note the close proximity between the carriageway and railway line



Figure 4: Insufficient turning radius for heavy trucks at Makande Junction



Figure 7: Absence of a barrier between the road and railway line posing a safety hazard to pedestrians.

2. Bonje Area



Figure 8: Faded road markings



Figure 9: Successive combination of horizontal and vertical curves



Figure 10: Picking up/dropping off of passengers at non-designated locations (no provision for a bus bay)

3. Maji ya Chumvi



Figure 11: Bleeding road surface



Figure 12: Deep open drains too close to the carriageway



Figure 13: Damaged safety fences/guard rails

4. Emali – Pipeline



Figure 14: Unsafe configuration at Emali/Oloitoktok Junction



Figure 15: Lorry exiting towards Oloitoktok from the A8 Highway (note the skid marks indicating difficulties when making the turn)



Figure 16: Long and straight stretch along Pipeline area. Faded road markings at the stretch also observed

5. Ngokomi - Kalimbini



Figure 17: Kalimbini area (Long and straight stretch with a slight descent from the Nairobi side prompting motorists to overspeed and overtake recklessly)



Figure 18: Ngokomi shopping centre (Long and straight stretch with gently sloping approaches on either side)

6. Gitaru - Rungiri



Figure 19: Dangerous location of the Nairobi bound bus bay



Figure 20: Encroachment of the road reserve by vendors/hawkers



Figure 21: Rushing pedestrian crossing at a non-designated location

7. Mukinya – Migaa – Sobeas – Salgaas – Sachangwan

Sobeas Junction



Figure 22: Heavy truck joining the A8 Highway from Njoro (note the narrow turning radius).



Figure 23: Matatu joining Eldoret bound traffic from Menengai



Figure 24: Lack of a provision for an accelerating lane for Eldoret bound traffic from Njoro

Salgaa centre



Figure 25: Heavy trucks parked on the shoulders effectively narrowing the carriageway and impairing visibility for other road users



Figure 26: Hawkers/vendors selling their products on the carriageway around Sachangwan area oblivious of the safety hazards

8. Molem – Namba Okana – Nyamasaria – Kasagam

(Namba Okana area)



Figure 27: Faded road markings at a pedestrian crossing



Figure 28: Hanging road shoulders



Figure 29: Missing safety fences on a high steep-sloped embankment

Rabuor Area



Figure 30: Dropping off/picking up of passengers at non-designated locations despite provision for a bus bay a few metres away



Figure 31: Silted/blocked access culvert

Nyamasaria town



Figure 32: Damaged slab over a covered storm water drain



Figure 33: Pedestrian dangerously crossing the highway at grade despite provision of a footbridge



Figure 34: An abnormally steep ramp on the footbridge

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