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Ministry of Local Government and Rural Development

## **GHANA URBAN MOBILITY AND ACCESSIBILITY PROJECT**

# **CONSULTANCY SERVICES FOR PREPARATION OF LOCAL AREA TRAFFIC AND PARKING PLANS IN MADINA**



**[DRAFT FINAL REPORT]**

APRIL 2021



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## LIST OF ACRONYMS AND ABBREVIATIONS

GAMA	Greater Accra Metropolitan Area
GUMAP	Ghana Urban Mobility and Accessibility Project
MLGRD	Ministry of Local Government and Rural Development
CSIR-BRRI	Building and Road Research Institute of the Council for Scientific and Industrial Research
NRTCD	National Road Traffic Crash Database
TRL	Transport Research Laboratory
MAAP	Micro-computer Accident Analysis Package
MS	Master Station Counts
TM	Turning Movement Counts
S	Screen-line Classification Counts
V/O	Vehicle Occupancy
CBD	Central Business District
PCU	Passenger Car Units
ATIS	Advanced Traveller Information System
SUVs	Sports Utility Vehicles
LaNMMA	La Nkwantanang Madina Municipal Assembly
UPSA	University of Professional Studies, Accra

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## EXECUTIVE SUMMARY

This Draft Report is presented in fulfilment of the conditions of the contract on “Consultancy Services for the Preparation of Traffic and Parking Plans for Tema and Madina” signed between the Ministry of Local Government and Rural Development (MLGRD), acting on behalf of the Government of Ghana and the Building and Road Research Institute of the Council for Scientific and Industrial Research (CSIR-BRRI), as the Consultants. The overall objectives of the study are to formulate concrete proposals (traffic and parking plan) for greatly improving the efficient use of public road space with due regards to the requirements of all users, particularly pedestrians and non-motorized transport users, and public transport, while serving adequately the needs of the areas’ economic and social activities. This report on Madina presents a discussion of the key results of the traffic and parking surveys, the network and safety conditions and stakeholders’ perspective.

The following specific tasks were used in the development of the traffic and parking plan.



Highlights of the findings for Madina are that:

- The road ways are deficient of road furniture such as signage, road markings, crossings, bus-stops, foot paths, streetlights and so on.
- Cars, taxis, pickups/4WD and mini-buses (carrying, on average, 7 passengers) were the most dominant vehicle types at the study area.
- The average number of persons occupying a vehicle (2.9 persons per vehicle) was generally low at the study area. There is, therefore, a general uneconomic use of road space in the movement of people in Madina.

- Traffic volumes recorded are generally low and technically, are not expected to cause congestion.
- Aside control delays at signalized junctions (primarily at Ritz and Zongo Junctions) and Atomic Roundabout, congestion in the study area is mostly caused by bottlenecks such as traders taking over the sides of the road thereby reducing the effective carriageway width and creating serious side friction for motorists and pedestrians.
- The journeys of about 5% of respondents from the origin – destination survey were within walking distance (1 kilometre or less) and that the commuters could have made the travel without using motorized vehicles. Also, about 34% of respondents were within cycling distances (5 kilometres or less).
- Generally, road traffic crashes were on the increase over the study period with pedestrians being the worst affected road users with the highest share of fatality (50%). Majority (59%) of fatal pedestrian crashes occurred at night-time.
- Some parking lots have been taken over completely by traders and are not available for use by vehicles.
- The community is of the opinion that a high-capacity modern market should be built to accommodate the growing number of traders.

From the foregoing, the following solutions have been proffered:

- Prevention of on-street trading, particularly on the Old Road (Madina Main Market) area to improve traffic flow.
- Redesigning the configuration of the Atomic Roundabout (providing an exclusive right turn lane to the roadway to Haatso) to increase traffic flow.
- A one-way circulatory traffic has been proposed around the Madina main market.
- Introduction of an efficient high occupancy public transport system is necessary since the over reliance on low occupancy vehicles for commuting is not sustainable.
- Leveraging on technology such as the Advanced Traveller Information System (ATIS) to optimise the use of the available road space will improve efficient mobility.
- Taking advantage of the wide right-of-way and redesigning the Ashaley Botwe Road, Old ROAD, Boundary and Social Welfare Roads and the Westland

Boulevard to accommodate pedestrian walkways and/or bicycle facilities will properly integrate non-motorised traffic and ultimately improve road traffic safety.

- Traders occupying parking lots should be removed to make the spaces available for use by vehicles and pedestrians.
- It is proposed that a bigger modern market be built at Bohye Market to accommodate all the street hawkers.

Per the ToR of the project, three conceptual plans to solve the identified problems with due regards for all modes of transport have been prescribed as below:

*Plan A: Removal of Bottlenecks and Efficient Traffic Management to Improve Mobility and Parking* – This will involve the removal of the non-traffic factors resulting in congestion, junction improvement and redesigning signal phasing and timings.

*Plan B: Redesigning and Improving Road Conditions in the Study Area* – Improving on the whole road network in the Madina study area to ensure traffic is distributed to prevent over-relying on few good roads. Redesigning, to take advantage of the wide road shoulders to accommodate pedestrian walkways and cycle facilities. Overall, road improvement should tackle road markings and signs, street lighting, provision of lay-bys and bus stops.

*Plan C: Plan B and the Community One Market Redevelopment.* In addition to Plan B, Plan C proposes the development of the Bohye market into a modern, multi-storey building to accommodate more traders.

*Plan A* can be implemented in the short term to improve the traffic and parking situation whilst *Plans B* and *C* are looked at in the medium term to resolve the problem.

# 1 INTRODUCTION

## 1.1 Background

Mobility is a key factor in social and economic development which provides people with access to markets, employment, education and health care, and plays a significant role in reducing poverty, especially in emerging economies of developing countries. Rapid urbanization has put an enormous stress on the already not too developed transportation system in almost every city in Ghana. During peak periods, road traffic congestion in the major cities is a commonplace. Congestion is undesirable and may cause delay, environmental pollution, noise and even frustrate motorists and commuters which also have health implications. It may also lead to road traffic crashes and degradation of the road infrastructure. An efficient public transportation system is essential for the socio-economic development of any country. Government and local authorities have the responsibility to ensure the free and effective movement of people and goods within the city and beyond.

Every trip by a vehicle results in a parking act at the end of the trip. The vehicle may be parked on-street or off-street. Adequate parking spaces are very important to city managers, business owners and residents. If people cannot find places to park, they probably may not come back to the city to do business. Therefore, every city must do well to meet the transport needs of commuters and automobile users.

The Government of the Republic of Ghana has obtained a grant from the Government of the Swiss Confederation with the intension to improve accessibility and mobility for people and transport of goods in the Greater Accra Metropolitan Area (GAMA) through the Ghana Urban Mobility and Accessibility Project (GUMAP). The implementing agency for the project is the Ministry of Local Government and Rural Development (MLGRD). Road traffic congestion and parking are among the most important urban mobility issues which are expected to be addressed in the Greater Accra Metropolitan Area (GAMA). Poor use of available public and road space in some dense central business areas or corridors of the city, have aggravated the situation. Mixed developments of commercial entities, service activities and major trading markets often attract large volumes of pedestrians and vehicular traffic which impedes free flow of traffic.

Appreciating the need for a thorough and independent approach to the assignment, the MLGRD, acting on behalf of the Government of Ghana, contracted the Building and Road Research Institute of the Council for Scientific and Industrial Research (CSIR-BRRI) to carry out the study: *Consultancy Services for the Preparation of Local Area Traffic and Parking Plans in Tema and Madina*.

This Draft Report for the Madina study area has been prepared in accordance with the Consultant's contractual obligations and the second in the series of reports to be delivered and outlines the approach and outcome of the steps taken at resolving the problems encountered.

## **1.2 Objectives of the Study**

The main objectives of the study are to formulate concrete proposals for greatly improving the efficient use of public space with due regards to the requirements of all users, particularly pedestrians and non-motorized transport users, and public transport, while serving adequately the needs of the areas' economic and social activities.

## **1.3 Detailed Tasks**

- Prepare a detailed description of the road network and associated facilities in the study areas, an inventory of economic and social activities, and an analysis of traffic flows (private vehicles, trucks and public transport vehicles, as well as pedestrians and cyclists), Parking and traffic management; carry out all surveys necessary to prepare a detailed diagnostic.
- On this basis, identify and describe in detail all problems that affect the efficiency of traffic flows in the study areas; present and discuss this diagnostic with all stakeholders.
- Prepare three conceptual plans for each area to address the above issues focusing as much as possible on low cost/high return measures with due regard for all modes of transport including public transport, non-motorized transport, private vehicles, and the transport of goods; in these conceptual plans, consider in particular adjustments in the organization of traffic flows in each area, improvements in the design of main intersections, improvements in traffic

regulation, changes in the location and management of parking, installation of traffic calming devices and improvement of cross walks, and designation of itineraries for trucks and public transport vehicles, if relevant; prepare cost estimates for each option.

- Present the conceptual traffic and parking plans to the local officials and hold at least two public hearings (with high quality visuals) with citizens and stakeholders for each area; on this basis, assist local officials in selecting one option for each area.
- Deepen the analysis of the selected options, taking all received comments into account, prepare a description of the measures to be taken and works to be carried out, including maps, plans, drawings and main technical specifications, and revised cost estimates, all at a level of detail that corresponds to a pre-engineering study.

#### **1.4 Scope of Study**

The assignment as described in the Terms of Reference (ToR) covers the following areas:

- 1) Tema and
- 2) Madina.

This report presents the traffic and parking plan for the Madina area.

#### **1.5 Contract Details**

<i>Employer:</i>	Government of Ghana
<i>Implementing Agency:</i>	Ministry of Local Government and Rural Development (MLGRD)
<i>Consultants:</i>	CSIR - Building and Road Research Institute (CSIR-BRRI).
<i>Project Title:</i>	Consultancy Services for the Preparation of Local Area Traffic and Parking Plans in Tema and Madina.
<i>Commencement Date:</i>	9 <sup>th</sup> September, 2019
<i>Completion Date:</i>	9 <sup>th</sup> March, 2020 (rescheduled to the first week of August, 2021)



## **2 STUDY AREA AND METHODOLOGY**

### **2.1 The Study Area**

The Study Area is under the jurisdiction of the La Nkwantanang Madina Municipal Assembly (LaNMMA). The study perimeter is bounded to the north by the stretch of road starting at a point close to the Accra Mass Transit Office (Ayalolo) through the Ritz Junction and down Ecowas Road. It takes a left turn through the first junction on Ecowas road and down to the Custom's bonded warehouse. It continues down south through Our Lady of Apostles junction and straight to the main intersection on the Atomic-Kwabanya road. It turns left at this junction and continues along the south bound perimeter through the Atomic Junction to Westland Boulevard Avenue to the Action Senior High School junction through the Rawlings Circle. After doing a left turn at the Action School junction, it continues along the Social Welfare Road and turning right at the Social Welfare junction going down Boundary Road and turning left at the cemetery and then it meanders through the residences back to the Metro Mass Transit Office. The Existing Conditions Map of the area is shown in Figure 1. The N4 passes through the area and forms three main junctions at the Atomic, Zongo and Ritz junctions. The area is composed of a network of roads and intersections that distribute the local traffic across the area. Other facilities of major importance are the transport facilities, markets, schools, hospitals, residential, socio-economic activities and so on. The map of the area is as shown in Figure 2-1.

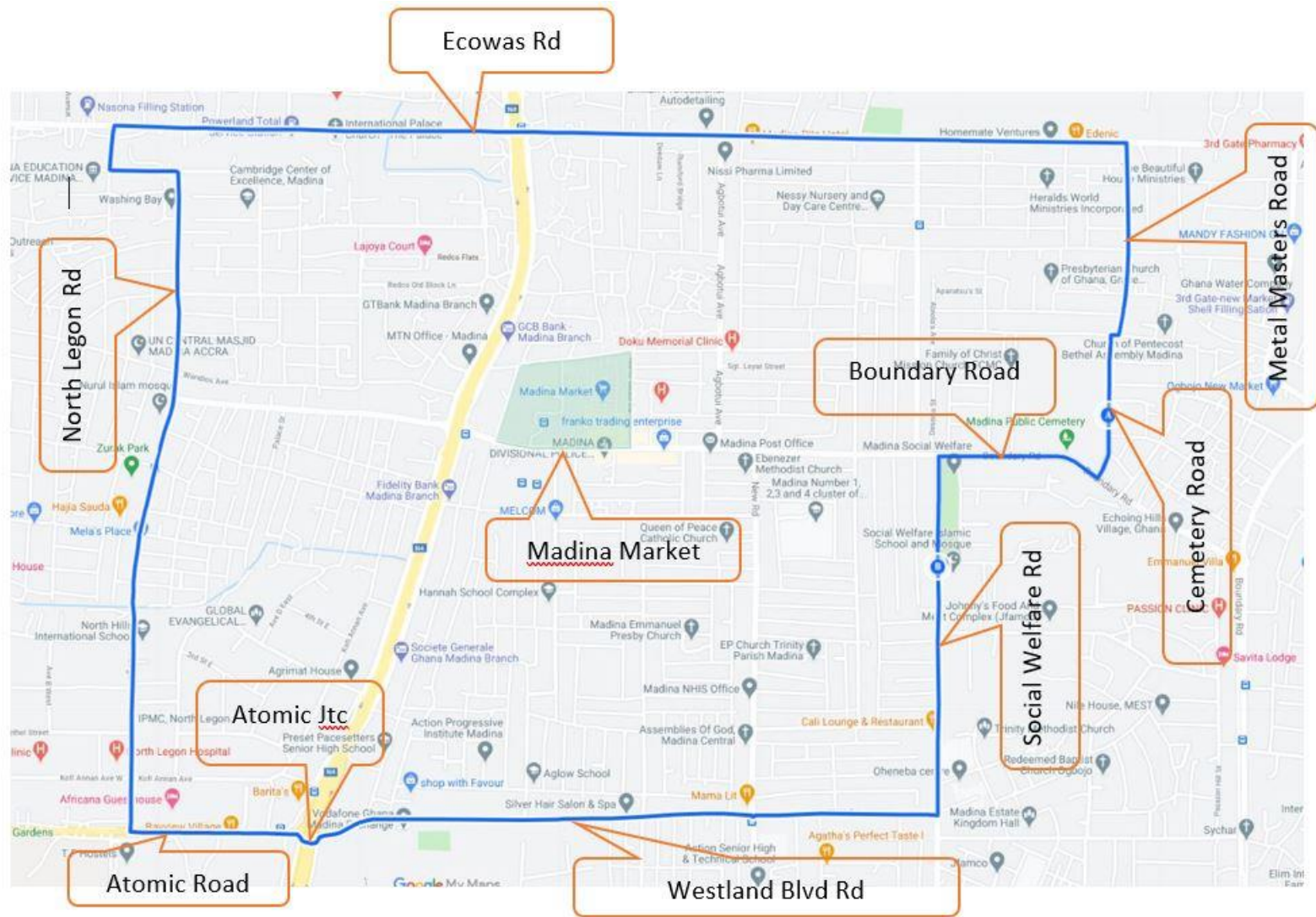
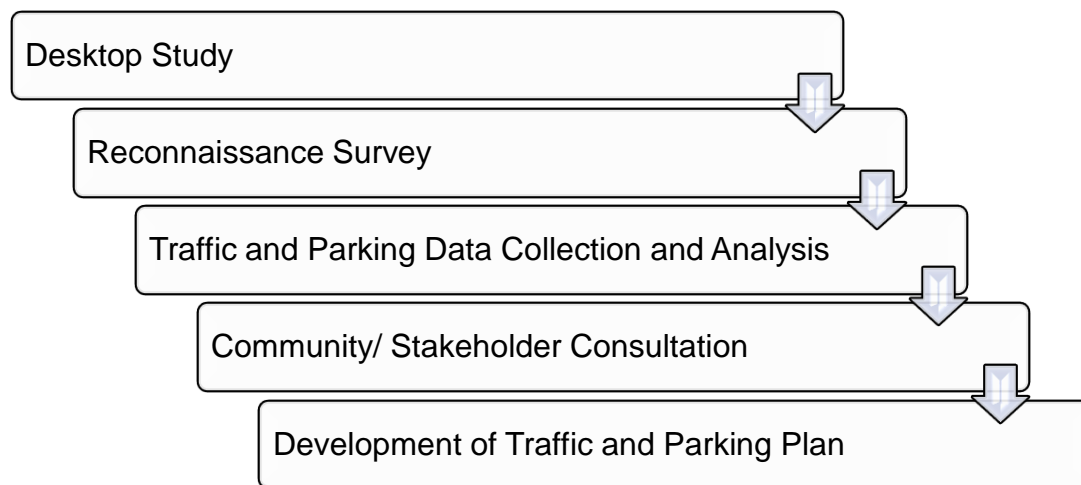


Figure 2-1: Map of study area - Madina

## 2.1 Methodology

In order to understand the traffic and parking problems within the study area and prescribe the appropriate solutions, it is necessary to understand how, why and where these problems are located within the community, who are affected as well as the main contributory factors resulting in the congestion and parking problems. The following specific tasks (see *Figure 2-2*) were used in the development of the traffic and parking plan and details are described below.



*Figure 2-2: Processes for developing traffic and parking plan*

### 2.1.1 Desktop Study

This basically involved the review of project documents available as well as other literature relevant for the successful completion of the project.

### 2.1.2 Reconnaissance Survey

An extensive reconnaissance survey was carried out by the Consultants to familiarize ourselves with the study area so as to gain a better understanding of the traffic and parking situations. The reconnaissance survey was also to identify all possible suitable sites from which data will be collected in the immediate future for the development of the traffic and parking plan.

### **2.1.3 Traffic and Parking Data Collection and Analysis**

The Consultants used both primary and secondary data sources to gather and analyse information relevant to the preparation of the traffic and parking plan. All traffic and parking data (traffic volume and classification, delay, parking accumulation, etc.), with the exception of road traffic crash data, were collected from the field. For the crash statistics, data was retrieved from the National Road Traffic Crash Database (NRTCD) at the Building and Road Research Institute of the Council for Scientific and Industrial Research (CSIR-BRRI). The database is compiled from police files (dockets) using a specially designed form and managed by application of the Micro-computer Accident Analysis Package (MAAP) software developed by the Transport Research Laboratory (TRL), UK. Data for the area was retrieved from the database and analysed for the study.

Field data collected were entered into a database using Microsoft Excel spreadsheet. The results derived for the master station counts, screen line classification counts, pedestrian volume counts, turning movement counts and parking studies were summarized and tabulated at 15-minutes intervals. The peak hours were determined for both the AM and PM periods and the associated classified volumes derived. The results were summarized in tabular and graphical formats. Graphs were used to show variations in traffic volume in the hour of day and day of week for the Master Station (MS).

For the crash study, cross tabulation was used to analyse the general characteristics of crashes within the study area. Link/node analysis was also used to identify worst traffic crash sites for the segments and junctions. These worst crash sites were also further investigated using stick diagram analysis to understand the nature of the crashes in order to recommend low cost and effective counter measures.

### **2.1.4 Stakeholder/ Community Consultation**

Project key stakeholders were identified from the onset and engaged during the course of the project. Consultations were held with the following Institutions/Unions:

- La Nkwantanang Madina Municipal Assembly (LaNMMA),
- Motorized and non-motorized transport users,
- Police,

- Traders and
- Other stakeholders.

In-depth interviews (focused interviews) were used to sample the opinions of stakeholders regarding the traffic and parking conditions in the study area. The effects of roadside hawking on traffic parking, congestion and non-motorized traffic safety were assessed. Purposive sampling technique was used to select stakeholders for the focused interviews. Participants included private car drivers, public transport drivers, non-motorized transport users, residents of the neighbourhood and traders. Perspectives of the police and fire service personnel were also sought to find out how parking, traffic congestion and roadside hawking affect their daily operations in the community.

Snapshot interview surveys were conducted on the roadside to interview motorists, pedestrians and cyclists, market surveys for traders, household surveys for residents and workplace surveys for police and fire-service personnel. In all, 15 stakeholders were interviewed and each interview session lasted for approximately one hour.

Some thematic areas discussed include;

- Impact of street hawking on traffic congestion and non-motorized transport safety
- Adequacy of non-motorized transport infrastructure
- Motorized transport users' attitudes towards non-motorized transport users
- Adequacy of parking space
- Parking and accessibility to the main Madina market.

### **2.1.5 Development of Traffic and Parking Plan**

All the data gathered from both the primary (field data collection) and secondary sources were analysed, synthesised and put together to develop the traffic and parking plan. A workshop was held to present the traffic and parking plan to all the stakeholders. After the workshop, all the relevant comments made were incorporated in the report and submitted to the Client.

### 3 FIELD OBSERVATIONS

#### 3.1 Existing Condition

##### 3.1.1 Road Network and Current Traffic Control

High proportion of arterial and collector roads within the study area are paved. However, the condition of some of the paved roads can be described as poor or bad (e.g., *Figure 3-1*). Some distributors and streets (local roads), for example, the Metal Masters Road and some portions of North Legon Road are also in a deplorable state and will require rehabilitation/construction for the smooth flow of traffic throughout the area. A good network of roads will make it possible for drivers to choose good alternative roads if the major arterial is congested to minimize delay. *Figure 3-2* and *Figure 3-3*, respectively show a disconnection in the road network as a result of lack of culvert and an unmaintained street. An inventory of all major roads in the project area has been compiled and included as *Appendix 1*. In all, there are about 90 kilometres of roads in the Madina Study Area.

Some roads within the study area have been named and signage posted for easy identification but there are no posted road names and signage on other roads.



*Figure 3-1: Bad paved road surfacing*





*Figure 3-2: Disconnection in the road network of Kofi Annan Street.*



*Figure 3-3: Unmaintained road on Metal Masters Road.*

Current traffic controls show the traffic control devices presently in place such as speed humps, footbridge, stop signs and pedestrian crossings within the study area. *Figure 3-4* shows the existing traffic and parking controls in the area. Several traffic controls can be found in the study area. They included the following:

- Footbridge (3no.);
- Roundabouts (2no.);
- Signalized junctions (4no.);
- Speed humps; and
- Traffic or road signs.

The following observations and deductions were made during our visits to the study site:

- Just a few speed limit signs of 50 km/h were located on the N4 (Madina – Adenta Highway), Ecowas and Ashaley Botwe Roads. However, the Road Traffic Regulations of 2012 (L.I. 2180) makes it mandatory for motorists to travel at 50 km/h on a road situated within an urban or built-up area and at a reduced speed limit of 30 km/h if it is within a school, playground, health facility, a church, a mosque, a market or a shopping centre environment. The appropriate speed limit signs must be displayed at such areas to warn drivers.
- Some unsignalized junctions have no yield or stop signs for the minor road traffic. Though it is expected that the basic rules of the road will apply, direct assignment

of right-of-way using YIELD or STOP signs will help manage the traffic and reduce traffic crashes.

- Many “no parking” signs were located on the Old Road. This, the team realised, was as a result of the indiscriminate stopping by motorists, particularly commercial vehicles.
- Just a few bus-stops where passengers can board a vehicle or alight were located within the study area (on the Madina – Adenta Highway and Westland Boulevard).
- There is a general lack of road markings and signage at some junctions and some road sections (*Figure 3-6*). Road markings provide guidance to motorists aside helping drivers to maintain lane discipline on the road at all times.
- Speed humps (see *Figure 3-7*) were located on several local roads within the study area to calm traffic.



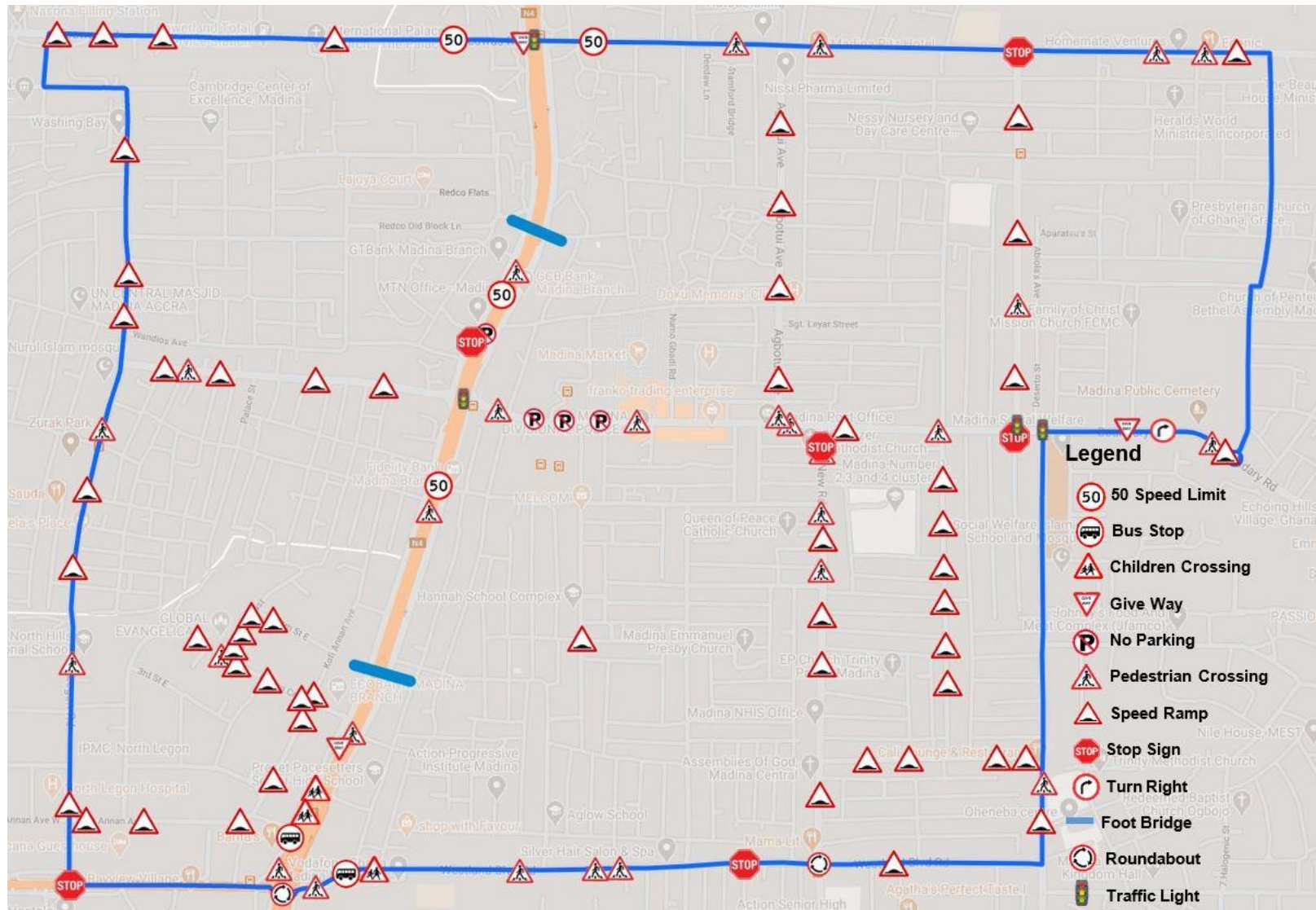


Figure 3-4: Current traffic controls



*Figure 3-6: Roadway with no marking*



*Figure 3-7: Speed hump on a local road*

### **3.2 Major Trip Generators**

In developing an understanding of the probable traffic movements and the traffic and parking problems, the identification of major trip generators within the study area is crucial. Within the study area, there are a number of different trip generators, each with different vehicle composition, peak generation times and parking demands.

A number of these major trip generators are listed below:

- Transport facilities (e.g., stations, etc.);
- Markets;
- Schools;
- Hospitals;
- Residential areas;
- Churches;
- Mosque; and
- Socio-economic activities.

There are a number of terminals, for both intra-city and inter-city travels, located within the study area. A survey was undertaken to locate and map transport stations around the study area. Transport services were delivered from a number of facilities located mainly around the Madina main market. Some of these terminals are well located whilst some are poorly located by the road-side, creating side friction with vehicles on the roadway.

These terminals are expected to generate a number of traffic to the study area. In all, a total of twenty (20) bus and taxi stations (terminals) were surveyed and are listed below:

### **Bus Stations**

- Madina Atomic Dome St. John's Branch
- Nana Krom GPRTU
- Madina – Taifa Local GPRTU
- Teshie Nungua Mini Bus Branch
- Madina Kwabenya Local GPRTU
- Madina Market Aben Woha GPRTU Trotro
- Republicans Co-operative Transport Society
- Amot Transport Company Limited
- Kweiman/Danfa Branch of GPRTU
- Tiger Transport Madina
- Ashongman Estates Brekuso Atomic Madina Branch
- Madina Market Adenta Agbogba Local GPRTU
- Manara Transport Union
- Amot Owners Drivers Union

### **Taxi Station**

- Madina Atomic Junction Taxi
- Madina Market Taxi Cooperative Transport Society
- Baptist School Taxi Rank (GPRTU)
- Hollywood Taxi Drivers Union
- Madina Taxi Rank Drivers Union
- Libya Quarters Washing Taxi Drivers Union of GPRTU

The study area is mainly commercial with also some residential facilities. There are twenty-three (23) school zones within the study area being at:

- Nkwantanang Cluster of Schools
- La-Nkwantanang JHS and Primary School
- Lily of The Roses School
- Elim Cluster of Schools
- Madina Islamic School

- Medina Cluster of Schools
- Madina Senior High School (MASSEC.)
- Queen of Peace Basic School
- Madina Fire Armour Primary School
- Hannah School Complex
- Redco Primary School
- North Hills International School
- Cosby One College
- EP Basic School
- Multimedia and Creative Arts Institute
- Preset Pacesetters Senior High School
- Nessy Nursery and Day Care Centre
- Best Acting School
- Finger of God Preparatory School
- Faith Community Baptist School
- Faith Baptist Senior High
- Trustline Institute
- Pokua Memorial Nursery

Eight (8) health facilities were also sited within the study area. They are:

- Christleads Missions & Medical Services
- Christlead Mission Hospital
- Mighty Clinic Madina
- Doku Memorial Clinic
- Madina Polyclinic-Kekele
- Bethel DCC
- Leonardo Memorial Hospital
- Madina Polyclinic

Within the study area, there are the Madina market (main), Madina New Market and Bohye markets which generate large volumes of vehicles and pedestrians to the area.

There are also businesses and shops which generate a high volume of private and commercial vehicles which need to access the site via the local road network. In addition,

customers and staff generate traffic to sites. *Figure 3-8* shows the locations of the major trip generators to the study area.

Given the high traffic and parking generating characteristics of these land uses, it may be expected to find that traffic volumes and parking demands on many of the streets within the study area are quite high.

The parking demand that is generated by the land uses range from staff, customers, residents, carers and visitors.



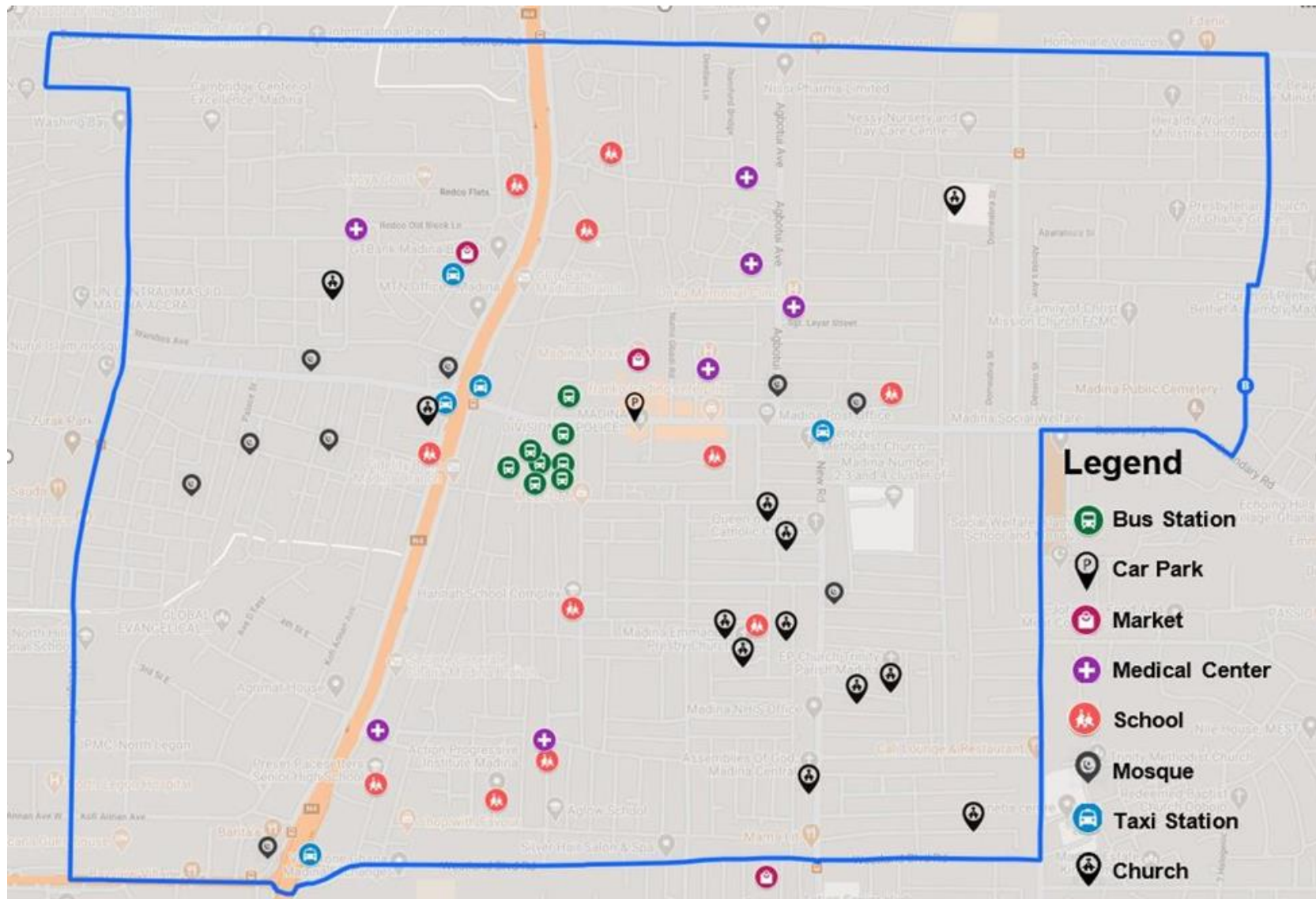


Figure 3-9: Major trip generators to the study area

### 3.3 Pedestrian Walkways

A walk through the study area found the following in terms of pedestrian facility within the area:

- Pedestrian walkways exist along some sections of the roadways, for example, N4 (see *Figure 3-10*) and Old Road (see *Figure 3-11*).
- However, street hawkers and goods of traders are often seen spilling over onto the sidewalks impeding the movement of pedestrians as seen in the example of *Figure 3-10*.
- In addition, road signs and other street furniture were found to have been erected in the pedestrian walkway blocking the efficient movement of people.
- Footpaths may be completely absent on other roads such as Ashaley Botwe and North Legon Road.



*Figure 3-10: Pedestrian/bicycle lane at Madina-Adenta Highway (N4)*



*Figure 3-11: Pedestrian walkway at Old Road.*



*Figure 3-12: Traders spilling into a bicycle lane/ footpath*

### 3.4 Bicycle Facility

The team found the following in terms of bicycle facility within the study area:

- Bicycle facility exist along the N4 highway (see **Error! Reference source not found.**).
- However, some sections of the bicycle lane have been taken over by street traders forcing cyclists to use the roadway with motorists at those sections thereby endangering the former (see *Figure 3-12*).

### 3.5 Sustaining the environment

It was evident that most drains in the study area are open. This is irrespective of the obvious public health hazard open drains pose.

People have turned the open drains into garbage bins and it appears the drains are not regularly maintained (see example in *Figure 3-13*). Old Road and Agbotui Road are some of the places you will observe scenes like this.





*Figure 3-13: Open drains turned into garbage bins*

### 3.6 Parking

The existing parking situation in the project area was reviewed. The LaNMMA is operating an on-street parking scheme on Old Road (*Figure 3-15*) and on the N4 highway (*Figure 3-14*) for revenue generation.



*Figure 3-15: On-street parking at Old Road*



*Figure 3-14: On-street parking at Madina-Adenta Highway (N4)*

- Whereas the on-street parking on the N4 is angular, that of the Old road is a parallel parking, along the street. The Consultant is of the view that the road width on the Old road does not support a two-directional traffic flow and the on-street parking. This is a source of friction impeding the smooth flow of traffic.

There is also an off-street parking in front of the Madina main market as seen in *Figure 3-16*. However, the on-street parking has been turned into a market area.



*Figure 3-16: Off-street parking in front of the Madina main market.*

Parking, across other part of the study area, was haphazard and many a time in precarious locations.

Some institutions such as Ghana Commercial Bank and the Police Station had private parking lots for their customers and visitors.

It was also observed that some traders were selling right on the pavement, earmarked for the on-street parking lots thereby denying drivers places to park their vehicles (see Figure 3-17).



*Figure 3-17: Parking lots taken over by street traders.*

### **3.7 Freight Trucks Loading and Offloading**

The study team observed trucks parked and loading or offloading goods to shops, particularly along the Old Road (Madina Main Market). This also reduces the capacity of the road and results in delays along the stretch.

## **4 DATA COLLECTION**

### **4.1 Introduction**

Data collection involving traffic and other activities was planned as part of this study. This chapter gives an overview of the planned sets of data collected.

### **4.2 Traffic Volume Data**

Five types of traffic volume studies were carried out namely Master Station Counts (MS), Turning Movement (TM) Counts, Screen-line Classification Counts (S), Pedestrian Volume Counts and Parking. The manner in which these were conducted is outlined below.

#### **4.2.1 Master Station Counts (MS)**

Manual classified counts were conducted at the two designated locations over a 24-hour period from 00:00 to 23:59 hrs each day and for seven consecutive days. The field traffic counts were started on Saturday 12<sup>th</sup> October 2019 and concluded on Friday 18<sup>th</sup> October 2019.

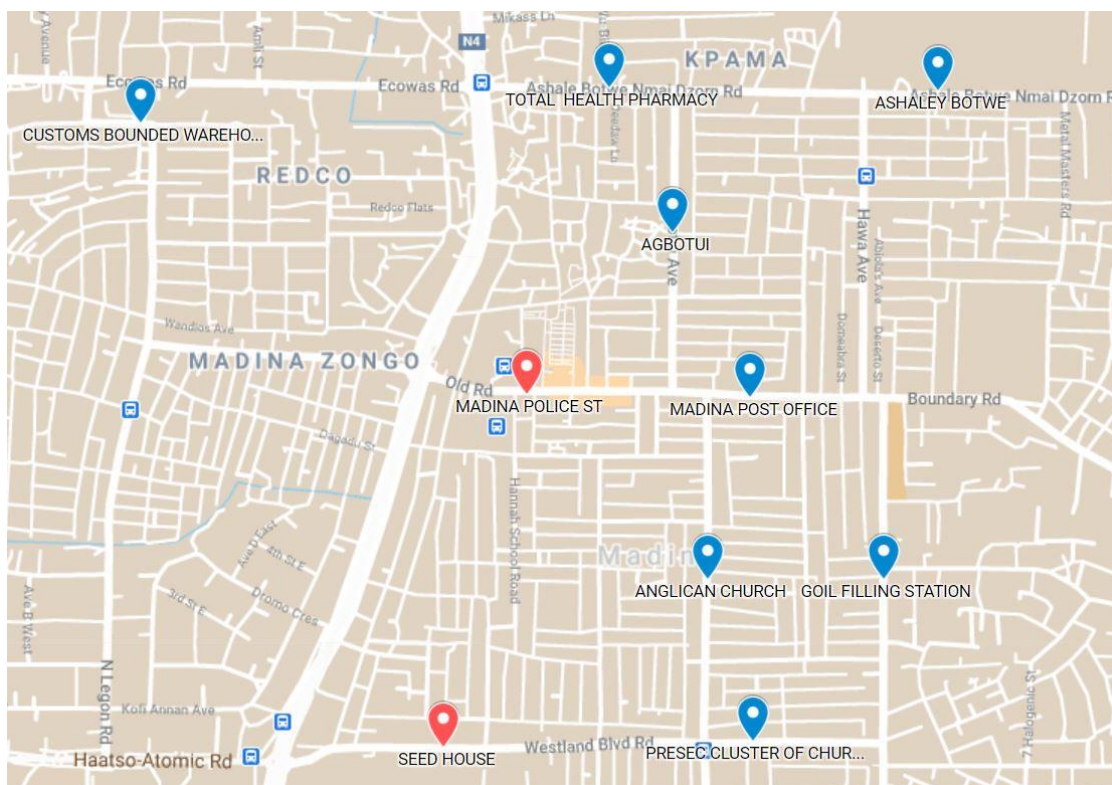
Two (2) enumerators were assigned to each site; one for each direction of travel. The enumerators were scheduled to work in shifts of 4-hours. The vehicle classification system adopted followed the Ghana Highway Authority format and consisted of the following categories of vehicles:

- Cars
- Taxis
- Vans, Pick-ups (2-axles, 4-wheels)
- Troto and Light buses
- Heavy Buses
- Medium Trucks (2 axles, 6 wheels)
- Heavy Trucks (3 or more axles)
- Bicycles
- Motorcycles
- Others



To reduce the possibility of counting errors, all count data were tallied at 15 minutes interval. The counts were conducted at two (2) locations, one each along the following roads as shown in *Figure 4-1*:

- Westland Boulevard Avenue (Near Seed House) and
- Old Road (Madina Police Station).



*Figure 4-1: Locations for Master Station (MS) and Screen-line (S) Counts: Red (MS); Blue (S)*

#### 4.2.2 Screen-line Counts

These were carried out in similar manner as the master station classified counts, except that the counts in this case were limited to 3-hour durations each for the morning and evening peak periods of 6 am - 9 am and 3 pm – 6 pm, respectively. The vehicle classification system used for the MS count was utilized. Screen-line directional counts were conducted at the following eight (8) designated locations as shown in *Figure 4-1*:

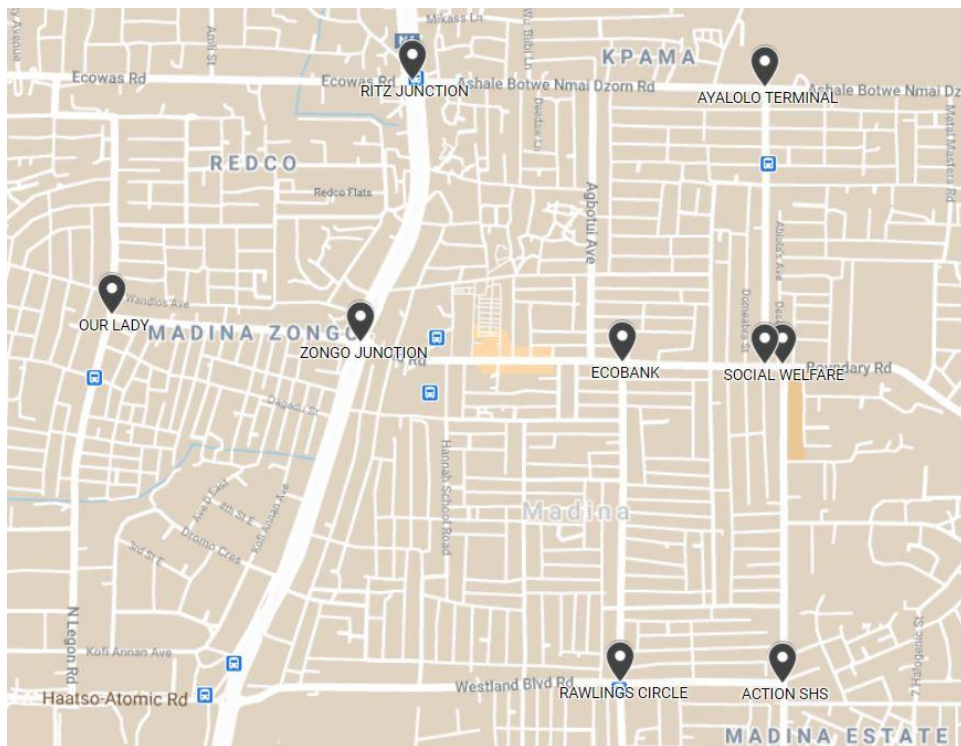
- Westland Boulevard (Presec cluster of schools)

- Social Welfare Road (Goil Fuel Station)
- New Road (Anglican Church)
- Ritz Road (Total Health Pharmacy)
- Old Road (Post Office)
- West by-pass from Ritz Junction (Customs Bonded Warehouse)
- Agbortui Road
- Ashaley Botwe

### **4.2.3 Intersection Turning Movement Counts**

Turning movement counts were conducted at nine (9) designated intersections as listed below. *Figure 4-2* shows the locations of the junctions surveyed. The locations chosen included all the important junctions and those considered to currently, or in the near future, cause particular problems to traffic flow. The locations were:

- Rawlings Circle (Westland Boulevard)
- Action SHS Junction (Westland Boulevard)
- Social Welfare Junction (Social Welfare Road)
- Hajia Hawa / Old Road Junction
- Ecobank Junction (Old Road)
- Hajia Hawa / Asharley Botwe Road Junction
- Ritz Junction (N4)
- Zongo Junction (N4)
- Our Lady of Apostles Junction (Legon Road)



*Figure 4-2: Locations for intersection turning movement counts*

Traffic volumes on all approaches classified by the turning movements through the intersection were recorded. Thus, traffic proceeding through a cross (X) junction from each approach was classified into the three sub-streams of left-turners, right-turners and those involved in straight through movements. At T-junctions, only two turning movements were involved. The proportion of trucks in the main approach traffic streams as well as in their corresponding turning streams was also recorded.

One enumerator was assigned to each traffic stream entering the intersection and the same enumerator was responsible for classifying these streams by the respective turning movement. Intersection turning movement counts were conducted over 3 hours each in the morning and afternoon peak periods, respectively (i.e., 06 – 09 hrs and 15 – 18 hrs). The traffic count data were tallied every 15 minutes to minimise computation errors and to help determine the peak hours and counts disaggregated to record the following vehicle types:

- Car
- Trotro/bus
- Heavy vehicle

- Motorcycle/bicycle.

### **4.3 Delay Studies - Travel Time and Queue Length**

The travel time data on previously defined segments were estimated using the floating car technique in a test vehicle. An android mobile app, My Tracks on a hand-held mobile phone, was downloaded from Google play store, and used to log in waypoints by an observer in a test vehicle. The studies were conducted during the morning and evening peak periods using the “floating car” test vehicle technique. Thus, the test car was driven normally by an observer along the test section but endeavoured as much as possible to pass as many vehicles as would pass it. The travel time within each segment was determined based on the average of five (5) runs of a floating car in each direction for the survey period.

Also recorded and observed during the floating car drives were the queue length and causes of all delays.

### **4.4 Origin Destination Survey**

Roadside survey was employed for the Origin Destination study. A sample of drivers were stopped at the side of the road (interview bay) and asked their origin and destination and whether they will transact any business within the study area which will require them to stop.

The survey was conducted on a week-day during 07 – 12 hrs at the same locations as the master station counts, that is:

- Westland Boulevard Avenue (Near Seed House) and
- Old Road (Madina Police Station).

Since the power to direct traffic resides with the police, the cooperation and continuous presence of the police was solicited during the study period. Stratified random sample was employed in order to capture data for all the different categories of vehicles. Interview bays were set at the two locations where the master station counts were held. A minimum of 400 drivers were interviewed.



The data collected was used to establish the proportion of vehicles which are through traffic (i.e., just passing through the study area) and those which will stop, wait or park.

#### **4.5 Vehicle Occupancy Survey**

The Origin - Destination survey also provided the opportunity to study Vehicle Occupancy (V/O). The interviewers interviewed motorists on their origins and destinations and also observed the fill factor (number of people in the vehicle) of vehicles and recorded them.

The occupancy count survey outputs can be applied to the vehicle counts output in order to estimate total passenger volumes including data by vehicle. This will provide an idea of current passenger demand.

#### **4.6 Pedestrian Volume Counts**

These were carried out at the under-listed two (2) locations:

- Delcom Ltd (Old Road)
- Las Palmas Foods (Old Road)

Counts of pedestrians crossing the specified roads and walking along the sides were carried out for the periods 7:30 am – 9:30 am and 3:00 pm – 5:00 pm on a typical week day and a weekend. The numbers were tallied at every 15-minute interval. The locations for the counts are shown in Figure 4-3.



between all-day and short-stay parking activities. Parking studies was carried out for 12 hours on one week-day during the hours of 06:00 – 18:00 hrs per location.

## 5 RESULTS

### 5.1 Introduction

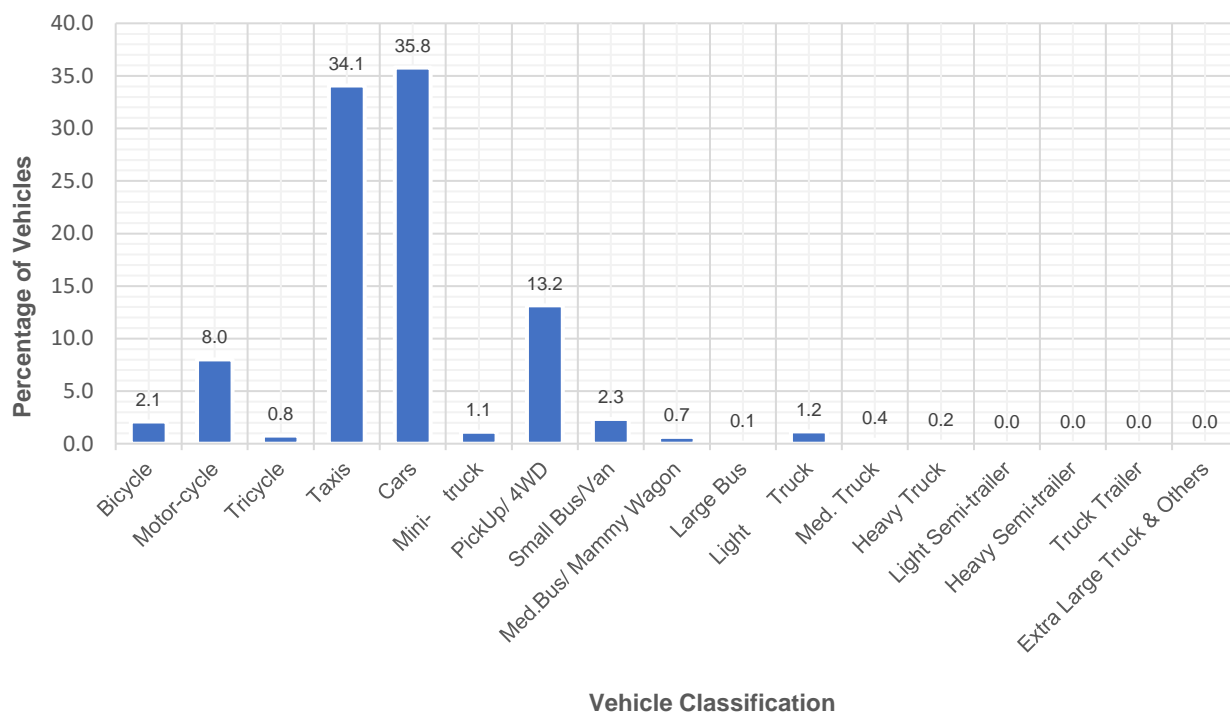
The main objective for carrying out the data collection surveys was to establish the existing nature of traffic, traffic operations, network and others as explained in the previous chapter. It was also expected that the field data results coupled with observations and community consultation, would culminate in recommendations for proposed conceptual plans for traffic management in the short to medium term. It is against this backdrop that the analysis of the survey was conducted and results are presented in the succeeding sections.

### 5.2 Classified Volume Counts – Master Stations

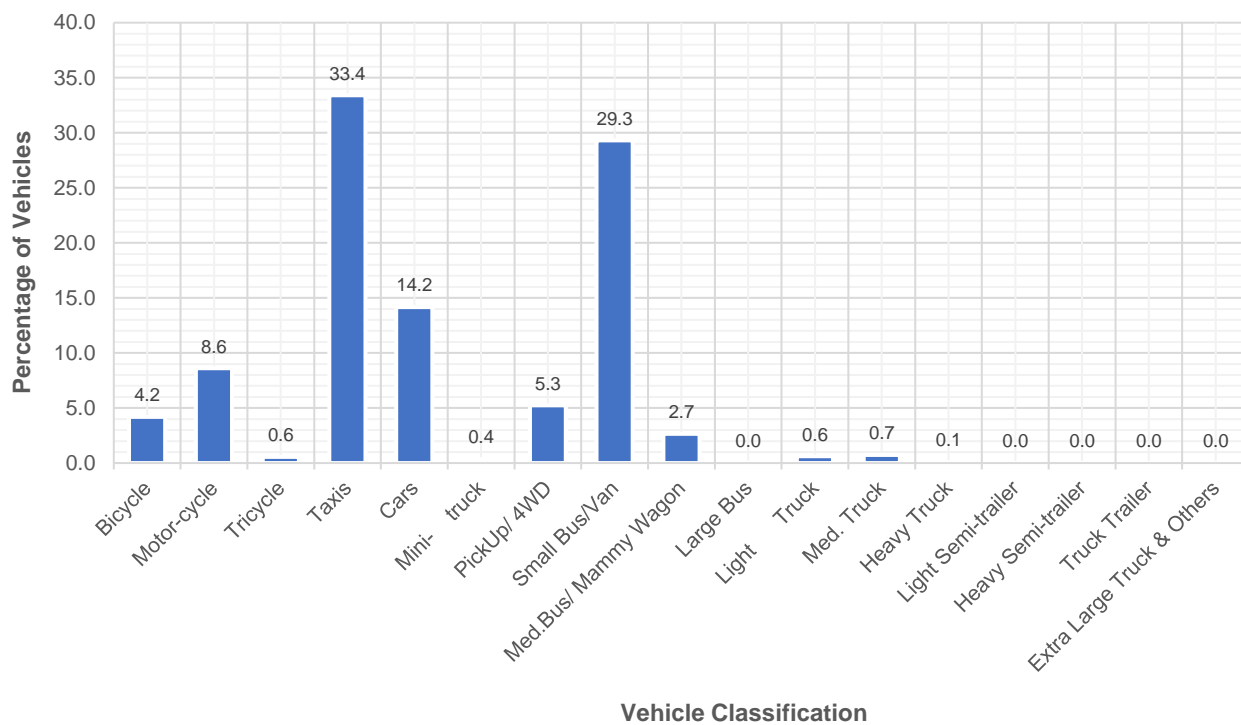
#### 5.2.1 Composition of Vehicular Traffic

The overall composition of vehicular traffic, as captured from the full-day counts across the two master stations, is indicated in *Figure 5-1* and *Figure 5-2*. Overall, 115,386 vehicles passed through the Seed House MS. *Figure 5-1* shows that cars and taxis were the two (2) most dominant modes at Seed House, accounting for 35.8% and 34.1%, respectively of traffic. The pickup/4WD follows distantly behind the two transport modes with a share of 13.2%. Together, the three dominant modes accounted for approximately 83% of the traffic. Further, motor-cycle also post significant proportion, that is, 8.0%. Small vans and bicycles also accounted for 2.3% and 2.1%, respectively of traffic.

*Figure 5-2* (i.e., the Madina Police Station MS) on the other hand shows that taxis and small buses are the most dominant modes posting 33.4% and 29.3% of traffic, respectively. Following distantly behind are cars (14.2%). Motorcycle, pickup/ 4WD and bicycle registered 8.6%, 5.3% and 4.2% in that order. Overall, 85,185 vehicles passed through the Madina Police Station master station over the seven-day period.



**Figure 5-1: Traffic Composition at the Seed House Master Station**



**Figure 5-2: Traffic Composition at the Madina Police Station Master Station**

From the MS counts, it is evident that:

- Cars, taxis and pickups/4WD (low occupancy vehicles) were the most dominant vehicle types accounting for about 83% of all vehicle types counted at the Seed House MS.
- At the Madina Police Station MS, the dominant mode of transport were taxis (33.4%) and mini-buses (29.3%) which are usually used for public transport (trotro) services.
- Whereas private, low occupancy vehicles were the main mode of transport at the Seed House MS, commercial vehicles were the predominate transport mode at the Madina Police Station MS.

### **5.2.2 Daily Variation of Traffic**

The summary data on the variation of traffic by the day of the week for Seed House and Madina Police Station Master Stations are presented in *Figure 5-3* and *Figure 5-4*, respectively.

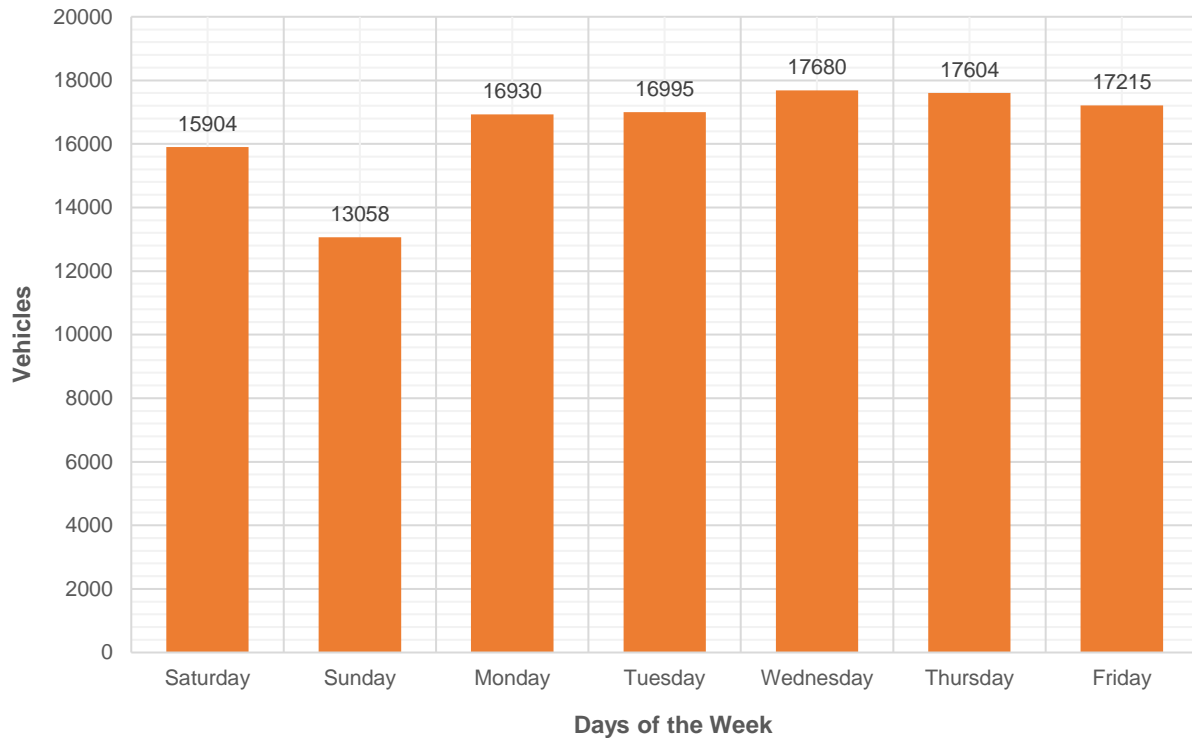
The highest daily volume of traffic in *Figure 5-3* was recorded on Wednesday, which happens to be a market day in Madina. Although Saturday is also a market day, strangely, it recorded rather low traffic volume. It is noted that the traffic volumes of the other week days are marginally different from the Wednesday volume at the Seed House MS. As expected, Sunday recorded the lowest traffic volume.

The situation at the Madina Police Station MS is entirely different from the Seed House MS. From *Figure 5-4*, the typical market days of Wednesday (11,848) and Saturday (11,714) recorded the lowest traffic volumes of the week. Interestingly, Sunday (12,964) recorded the highest traffic volume. The situation defies what is normally the case for weekends where low traffic volumes are seen. This is attributable to the following:

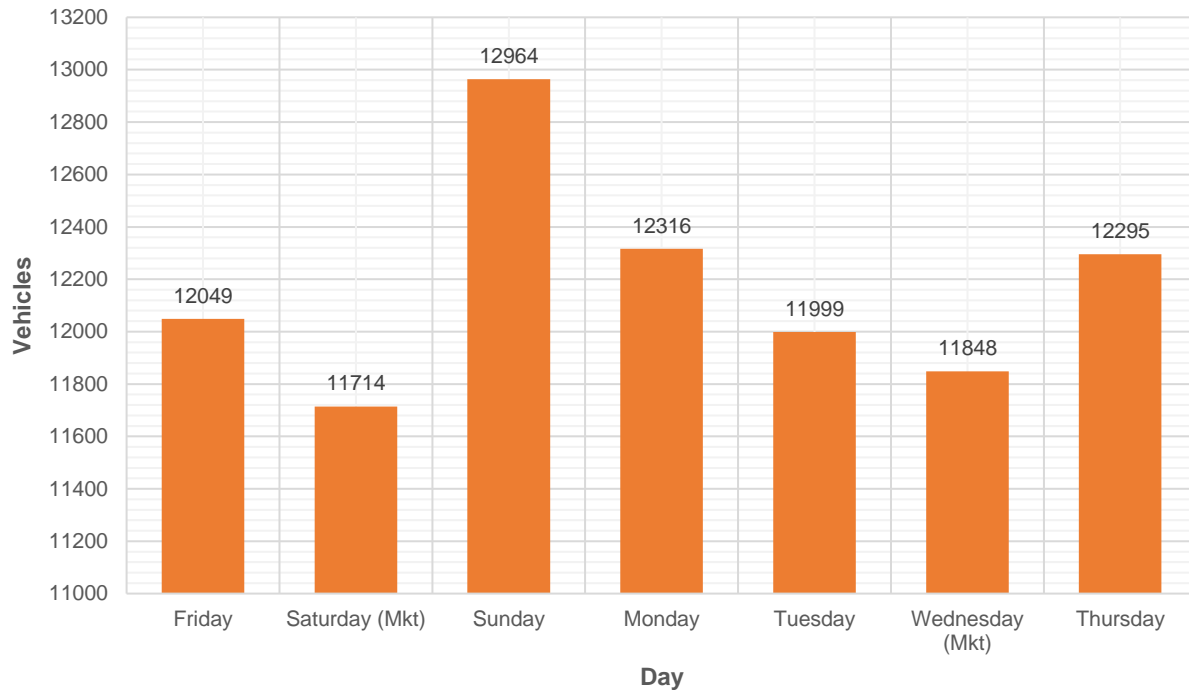
- More traders takeover the Old Road where the Madina Police Station MS is located impeding the smooth flow of traffic. The capacity of the road is reduced and many vehicles, particularly private ones, use other alternative roads to avoid the near jam density traffic. Traffic flows are generally constrained during the market days, thereby registering the lowest traffic levels.

- On Sundays, the street is almost free from street traders thereby ensuring the unobstructed flow of traffic.

It is important to note that traffic volumes by day of week as presented in the chart has not been converted into Passenger Car Units (PCUs).



*Figure 5-3: Daily Traffic Variation – Seed House MS*



*Figure 5-4: Daily Traffic Variation – Madina Police Station MS*

### 5.2.3 Peak Flows and Periods

In the subsequent sections, the traffic flow figures are presented in Passenger Car Units (PCUs) whereby all vehicles are converted into equivalent number of private cars in terms of the area of road space coverage and impact upon on the transport supply. The factors used in the conversion are as shown in Table 5-1.

*Table 5-1: Passenger car units (PCU) factors*

Vehicle type	PCU
Bicycle	0.3
Motorcycle	0.5
Tricycle	0.74
Taxi	1
Car	1
Mini-truck	1.3



Pick-up	1
Small bus or van	1.34
Medium bus/ mummy wagon	1.5
Large bus	3
Light truck	2
Medium truck	2.2
Heavy truck	2.2
Light/ semi-trailer	2.2
Heavy semi-trailer	2.2
Truck-trailer	2.2
Extra-large trucks and others	2.2

Table 5-2 presents the peak daily traffic volumes for the master stations, as well as the morning and evening peak periods, disaggregated by direction. From the Table, it is observed that:

- Peak traffic volumes for the two MS are rather low with a maximum of 788 PCU recorded on Wednesday at the Madina Seed House station and a minimum of 346 registered on Monday at the Madina Police Station MS.
- Average peak hour volume for the seven (7) days ranged from 429 - 693 PCU at both stations.
- Using a relatively low figure of capacity of an urban single carriageway to be 1,800 PCU per lane, the traffic volumes recorded, only, are not expected to cause any congestion. Thus, the current traffic congestion may be traced to non-traffic factors.
- With an annual vehicle increment of 5%, the roads should reach their capacity in about 16 years' time.
- For the Seed House MS, the morning peak hour was mostly between 07:00 and 08.00 hrs on the weekdays whilst the evening peak hour vary widely. At the Madina Police Station MS, both morning and evening peak hour periods varied widely from 06:15 – 10:30 hrs and 12:15 – 20.00 hrs, respectively across the days.

Table 5-2: Daily number of vehicles (Passenger car units)

Location	AM Peak Volume (PCU)		PM Peak Volume (PCU)		Peak Period			
	Out	In	Out	In	AM Out	AM In	PM Out	PM In
<b>Madina Seed House</b>								
<b><u>DAY</u></b>								
1 (Saturday)	463	447	465	488	10:00-11:00	10:30-11:30	12:15-1:15	12:00-01:00
2 (Sunday)	783	646	487	687	09:00-10:00	09:15-10:15	12:15-1:15	03:30-04:30
3 (Monday)	678	666	485	668	07:30-08:30	07:00-08:00	1:00-02:00	03:15-04:15
4 (Tuesday)	761	711	506	664	07:15-08:15	07:15-08:15	12:15-1:15	03:30-04:30
5 Wednesday)	788	695	571	696	07:00-08:00	07:00-08:00	03:00-04:00	02:30-03:30
6 (Thursday)	586	617	571	684	07:00-08:00	07:00-08:00	01:00-02:00	02:45-03:45
7 (Friday)	606	540	500	624	06:45-07:45	10:45-11:45	02:00-03:00	03:00-04:00
<b>Average Peak Volume</b>	<b>666</b>	<b>617</b>	<b>512</b>	<b>644</b>	-	-	-	-
<b>Madina Police Station</b>								
<b><u>DAY</u></b>								
1 (Saturday)	635	455	401	348	07:00-08:00	06:15-07:15	06:45-07:45	05:30-06:30
2 (Sunday)	548	419	507	411	07:00-08:00	06:15-07:15	07:00-08:00	06:30-07:30
3 (Monday)	714	421	390	346	07:45-08:45	09:30-10:30	02:00-03:00	05:30-06:30
4 (Tuesday)	754	419	383	395	06:30-07:30	08:15-09:15	03:30-04:30	05:45-06:45
5 (Wednesday)	740	419	486	362	06:45-07:45	08:30-09:30	12:15-01:15	03:15-04:15
6 (Thursday)	734	430	400	349	06:45-07:45	07:00-08:00	06:15-07:15	04:15-05:15
7 (Friday)	726	488	434	367	06:45-07:45	08:15-09:15	02:45-03:45	03:00-04:00
<b>Average Peak Volume</b>	<b>693</b>	<b>436</b>	<b>429</b>	<b>368</b>	-	-	-	-

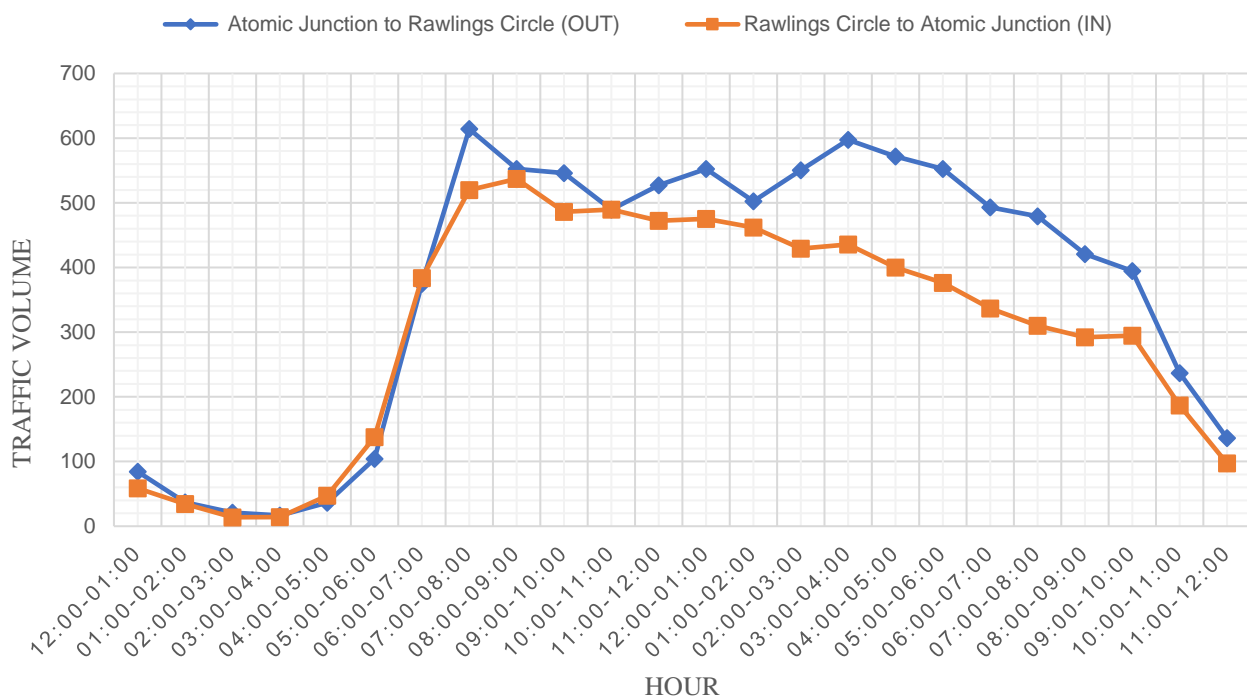
#### 5.2.4 Hourly Variation of Traffic

The pattern of traffic during the day is an important indicator of the intensity of use around the hour and therefore a pointer to both potential problems of capacity during the peak hours and the options for traffic management. This hourly variation of traffic by day was captured by the Master Station counts and the summary per direction of travel is

presented in *Appendix 2*. The average hourly volume of the seven-day count is displayed in *Figure 5-6* and *Figure 5-5*.

As mentioned, at the Seed House MS, the pattern of volumes across the day exhibited a typical morning peak hour profile for the week days, that is, 07:00 – 08:00 hours for the outbound and 08:00 – 09:00 hours for the inbound. However, the evening period profile did not show a clear peak.

At the Madina Police Station MS, two pronounced peak hours can be observed, namely the 07.00 to 08.00 hours for AM and 15.00 – 16.00 hours for the PM with flows highest during the AM peak and PM peak, dipping during the inter-peak and gradually declining in the post peak for the outbound. For the inbound traffic, the AM and PM peaks occurred at 08:00 – 09:00 and 21:00 – 22:00 hours, respectively. There is not much vehicle activity during the night-time. However, traffic levels were somewhat higher at Seed House MS than at the Madina Police Station MS.



*Figure 5-5: Variation in traffic volume by hour of day by direction – Seed House MS*

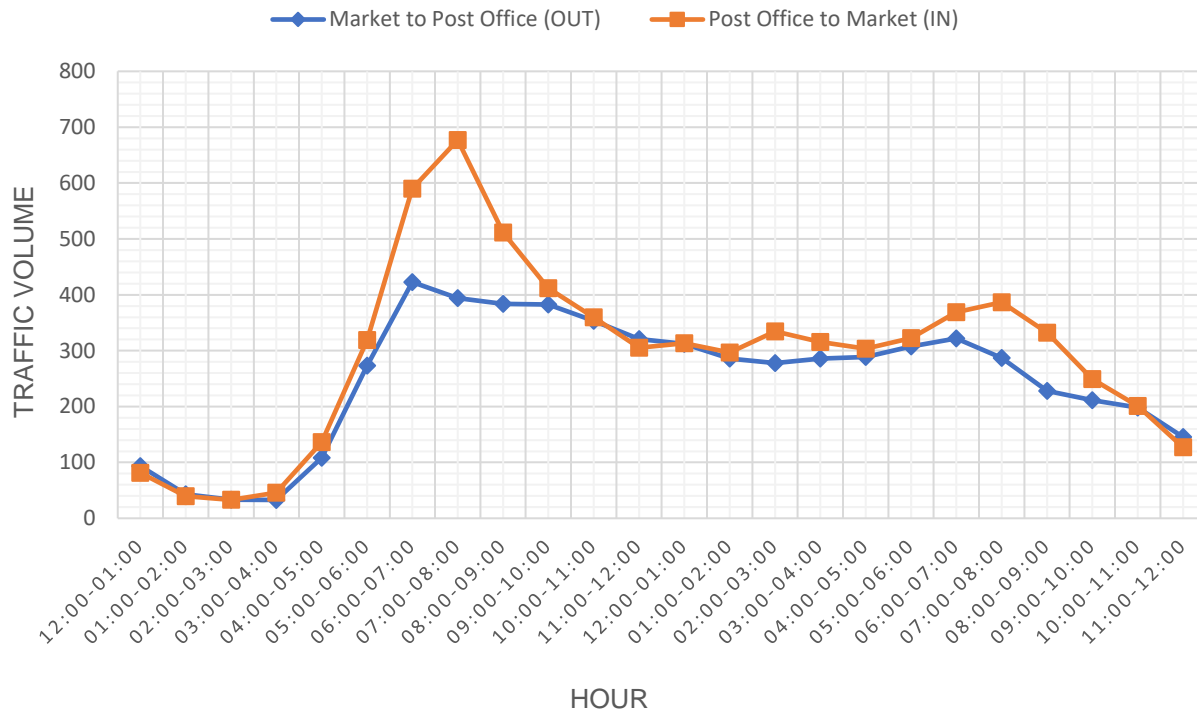


Figure 5-6: Variation in traffic volume by hour of day by direction – Police Station MS.

### 5.2.5 Screen Line Counts

Peak period volume counts were also conducted at screen-line stations for two (2) week days and one (1) weekend. The results of these are presented in *Appendix 3*. Table 5-3 displays a summary of the AM and PM peak period hourly flow by screen line location and road corridor, disaggregated by direction. From the Table, the following inferences are made:

- The Post Office station was the most trafficked road, consistently registering the highest traffic volumes in the three days in the peak periods in the screen line count. This was followed by Anglican Church station.
- Peak traffic volumes for the three-day screen line counts were relatively low with all locations registering less than 950 PCUs per direction in both the morning and evening peak periods.
- Using a relatively low figure of capacity of an urban single carriageway to be 1,800 PCU per lane, the traffic volumes recorded, only, are not expected to cause any

congestion. Thus, the current traffic slow-down movement may be due to non-traffic side frictional factors.

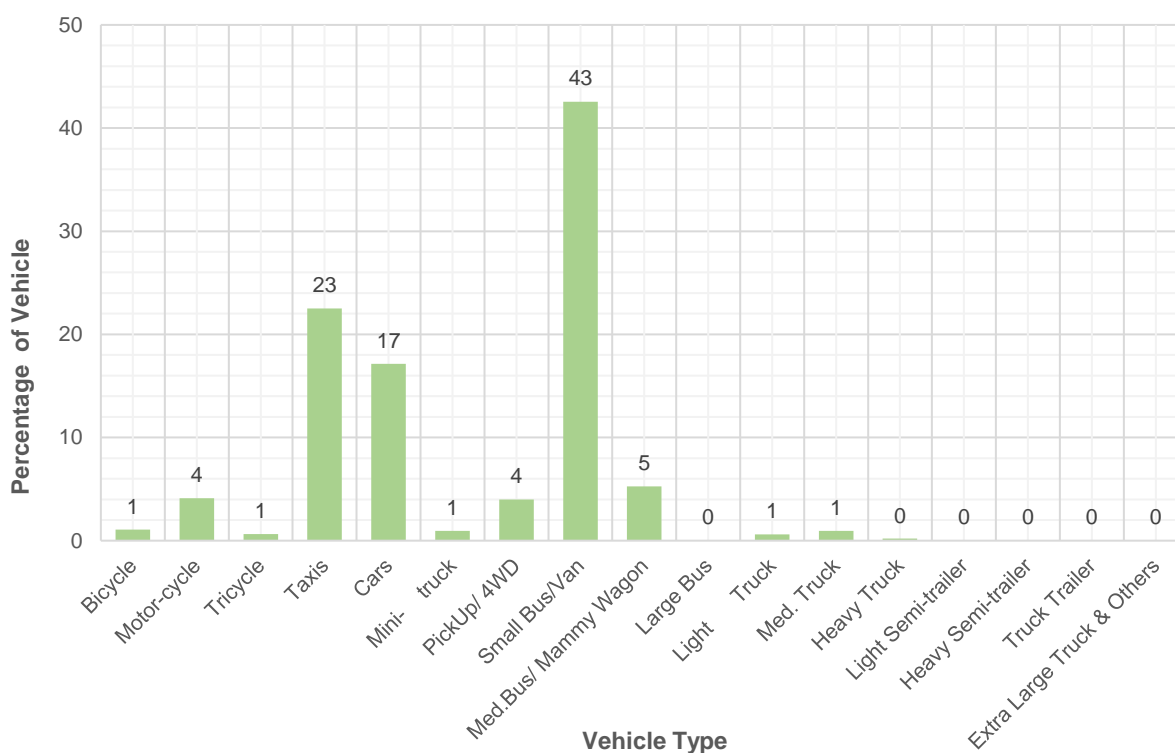
- Both morning and evening peak hour periods vary widely from one station to the other and across the days.
- With an annual vehicle increment of 5%, the highest trafficked road, that is, Post Office should reach its capacity in about 13 years' time.

*Table 5-3: Summary of Screen Line Count*

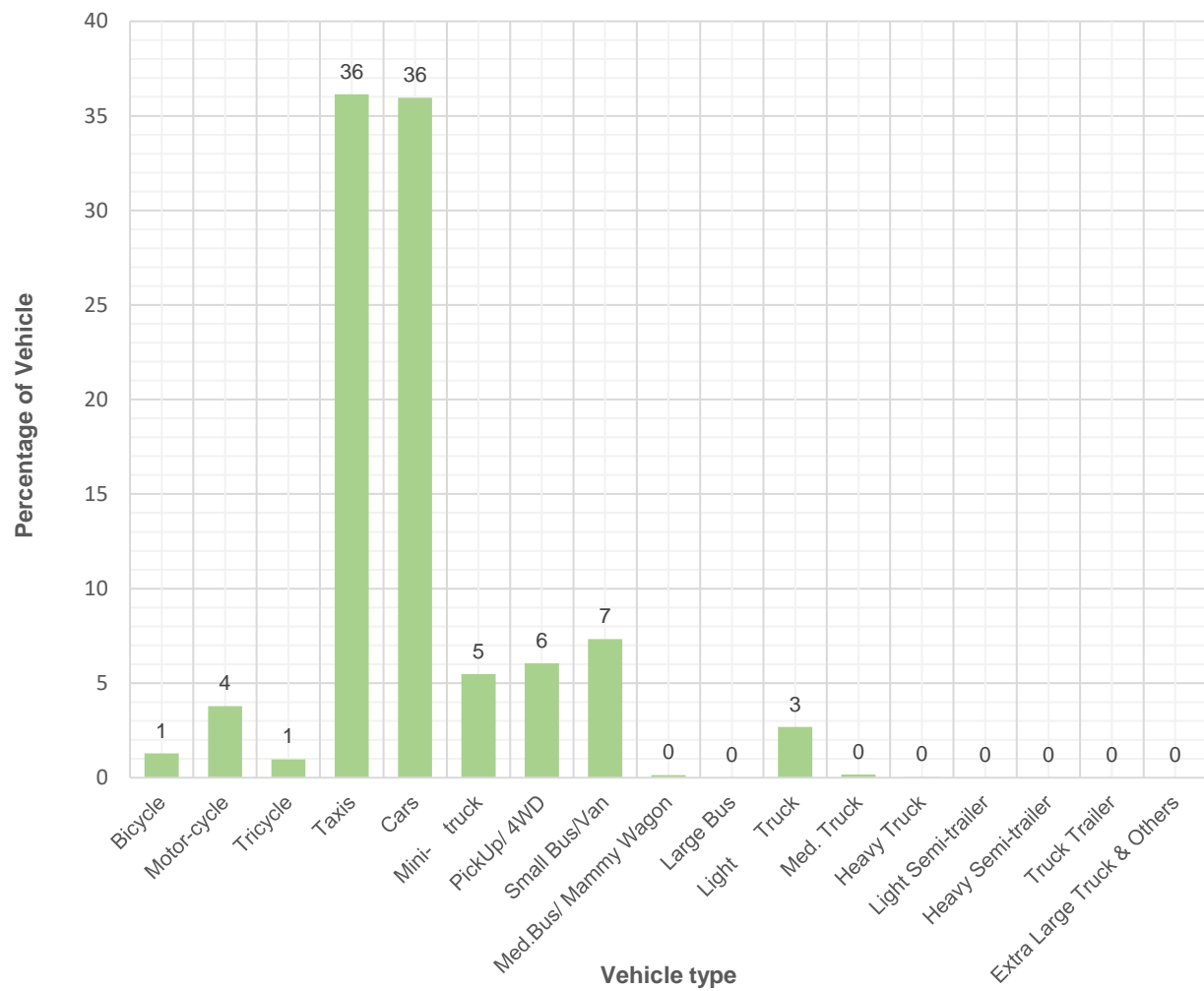
Location	AM Peak Volume (PCU)		PM Traffic Volume (PCU)		Peak Periods			
	In	Out	In	Out	AM In	AM Out	PM In	PM Out
<b><u>Day 1 (Monday)</u></b>								
Post Office	709	661	496	502	7:00-8:00	7:00-8:00	5:00-6:00	4:15-5:15
Anglican Church	589	423	580	570	6:45-7:45	8:00-9:00	3:45-4:45	4:45-5:45
Customs Boundary	745	312	451	364	6:45-7:45	7:00-8:00	5:00-6:00	4:30-5:30
Goil Fuel Station	726	360	442	830	7:00-8:00	7:45-8:45	5:00-6:00	5:00-6:00
Presec Cluster of Schools	293	415	342	434	7:00-8:00	7:45-8:45	3:00-4:00	4:00-5:00
Total Health Pharmacy	592	396	640	470	7:15-8:15	8:00-9:00	4:45-5:45	3:15-4:15
Ashaley Botwe Road	775	491	-	-	6:15-7:15	7:30-8:30	-	-
	694	371	-	-	6:30-7:30	8:15-9:15	-	-
<b><u>Day 2 (Wednesday)</u></b>								
Post Office	763	566	461	577	7:00-8:00	7:00-8:00	5:00-6:00	4:30-5:30
Anglican Church	518	617	645	609	8:00-9:00	7:45-8:45	4:45-5:45	4:00-5:00
Customs Bonded	917	366	408	418	6:30-7:30	6:45-7:45	3:00-4:00	5:15-5:15
Goil Fuel Station	684	363	447	719	7:00-8:00	7:45-8:45	3:00-4:00	5:00-6:00
Presec Cluster of Schools	279	259	420	352	8:00-9:00	7:30-8:30	3:45-4:45	4:45-5:45
Total Health Pharmacy	558	436	648	442	7:45-8:45	7:15-8:15	4:30-5:30	3:15-4:15
<b><u>Day 3 (Sunday)</u></b>								
Post Office	406	436	572	647	8:00-9:00	8:00-9:00	3:30-4:30	3:15-4:15
Anglican Church	363	433	352	447	8:00-9:00	8:00-9:00	4:45-5:45	5:00-6:00
Customs Bonded	418	226	348	323	7:45-8:45	6:45-7:45	3:00-4:00	3:15-4:15

Goil Fuel Station	517	369	455	455	8:00-9:00	8:00-9:00	5:00-6:00	3:00-4:00
Presec Cluster of Schools	386	285	430	308	8:00-9:00	7:00-8:00	3:15-4:15	3:15-4:15
Total Health Pharmacy	581	467	536	463	7:45-8:45	6:15-7:15	3:00-4:00	4:15-5:15

A typical weekday composition of the various vehicle types observed for the eight locations are presented in *Figure 5-7 - Figure 5-14* for each of the screen line stations. It is evident that, with the exception of the Post Office station where small buses were the most used vehicle type, cars and taxis were the most dominant modes of transport at all the screenline stations studied.



*Figure 5-7: Composition of various vehicle types – Post Office*



*Figure 5-8: Composition of various vehicle types – Anglican Church*

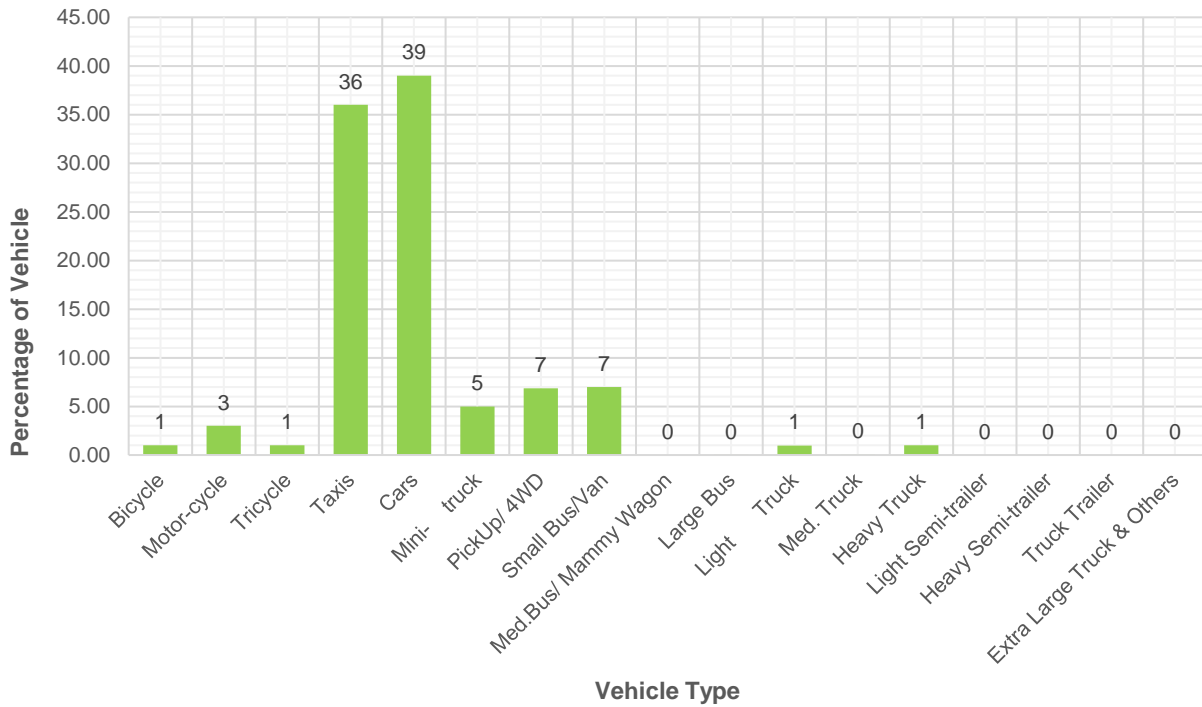


Figure 5-9: Composition of various vehicle types – Custom Boundary

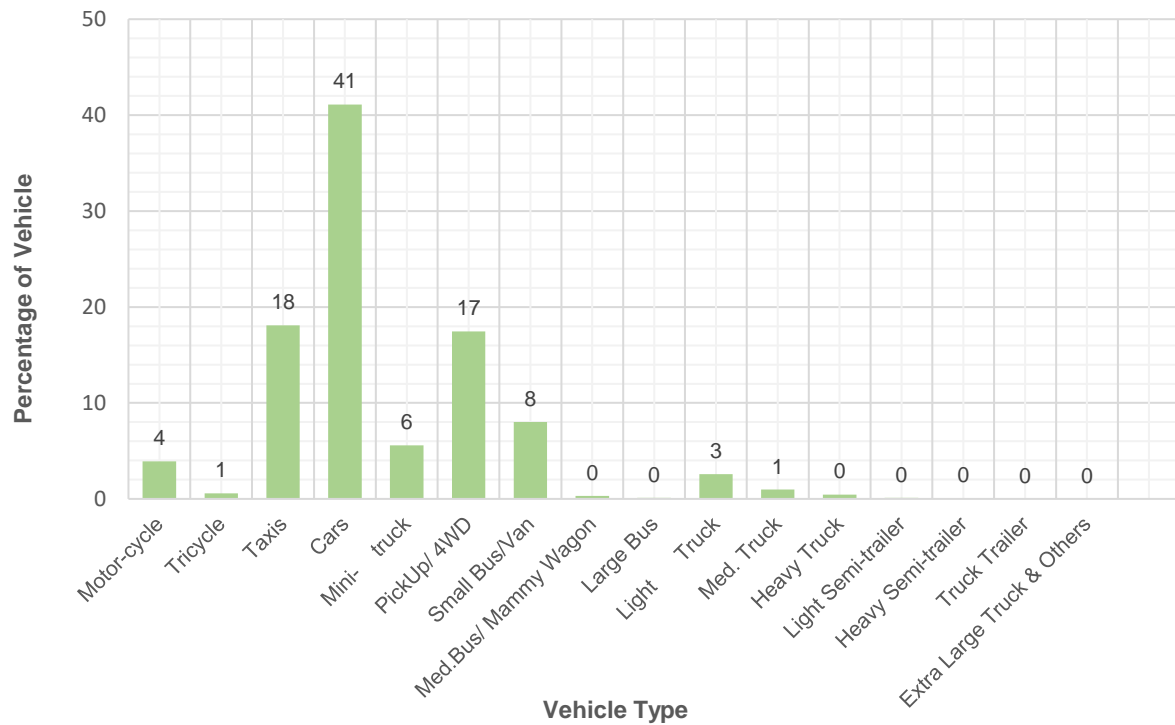


Figure 5-10: Composition of various vehicle types - Goil Fuel Station



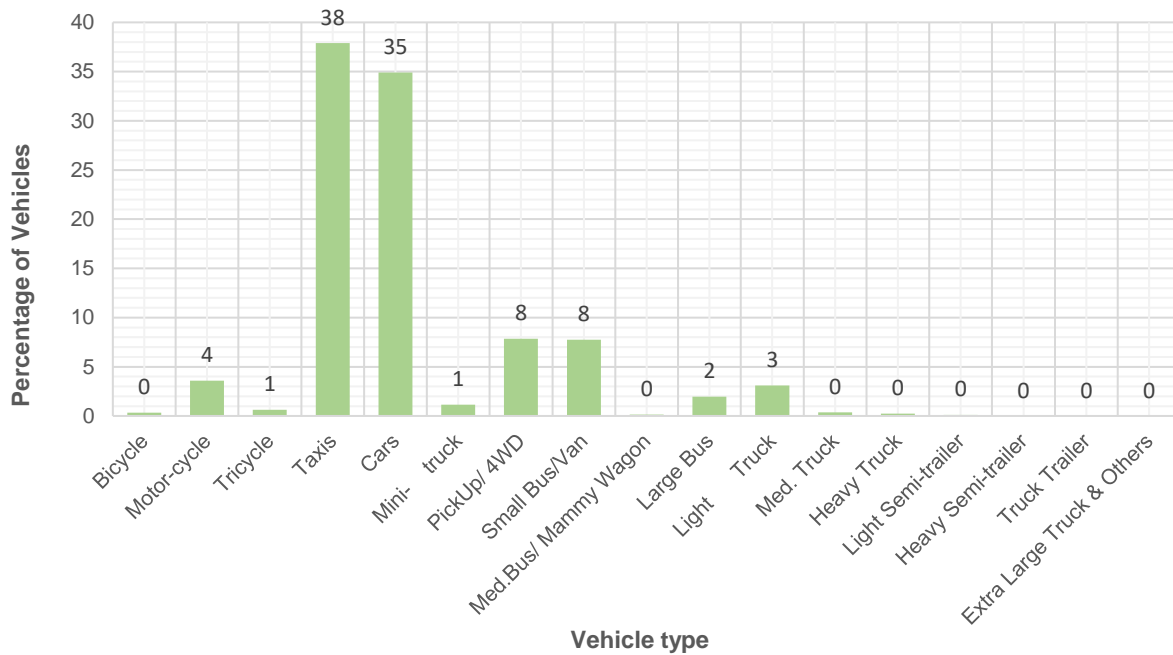


Figure 5-11: Composition of various vehicle types - Presec Cluster of Schools

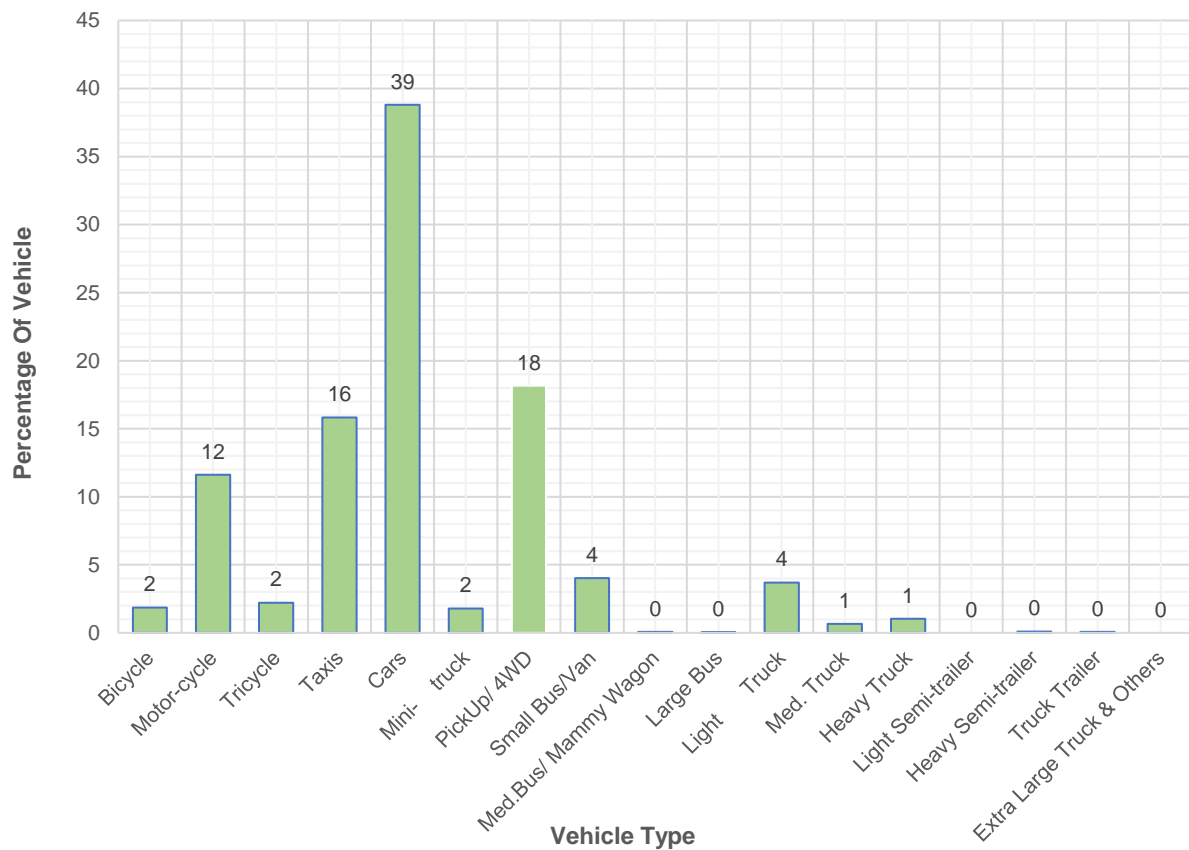


Figure 5-12: Composition of various vehicle types - Total Health Pharmacy

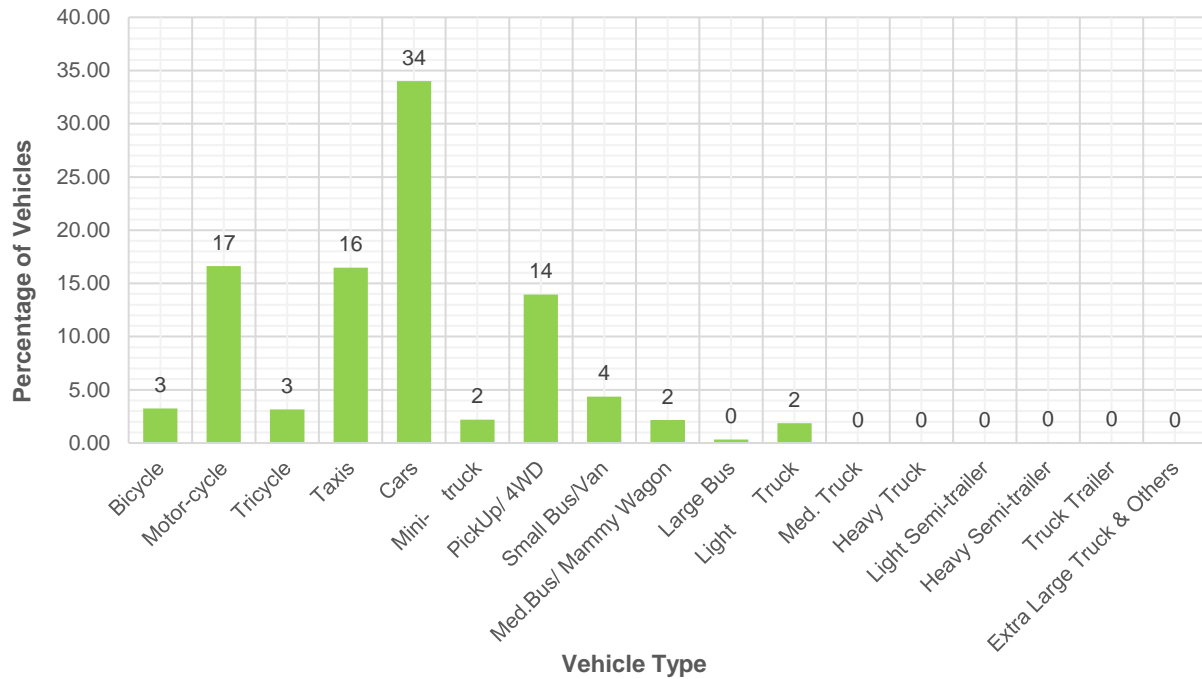


Figure 5-13: Composition of various vehicle types - Ashaley Botwe Road

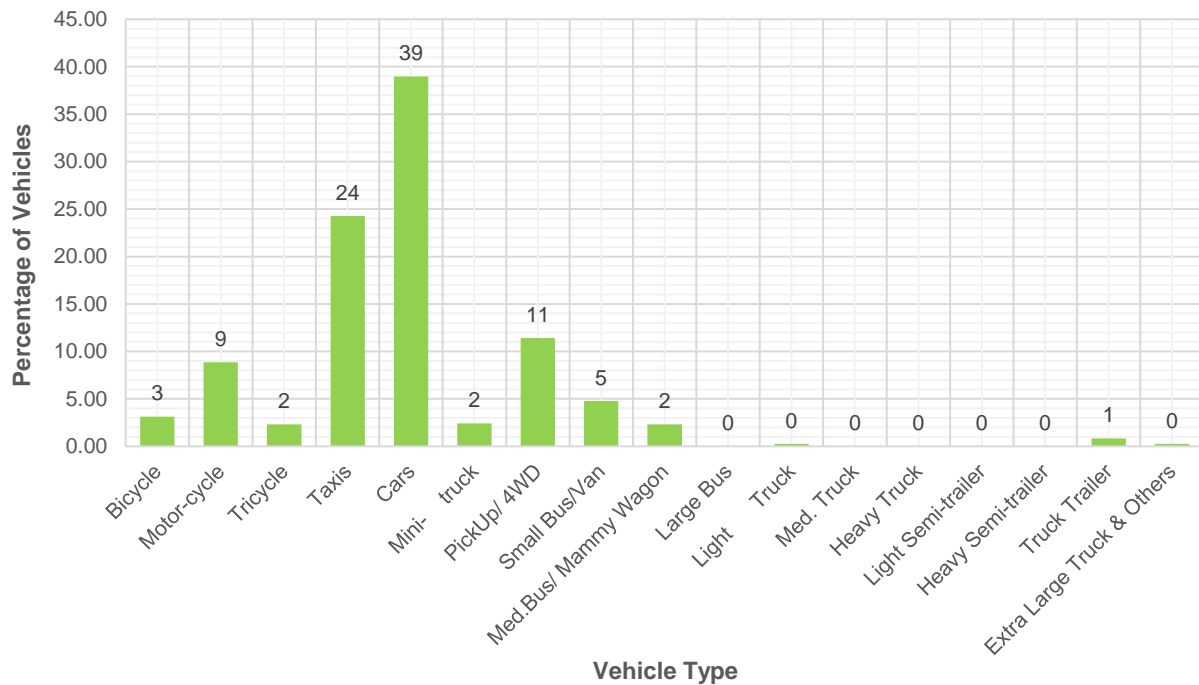


Figure 5-14: Composition of various vehicle types - Agbotui Road

### 5.2.6 Junction Turning Movement Counts

The detailed data on the junction turning movements are attached as part of *Appendix 4*. However, *Table 5-4* below provides the summary data on throughput and proportion of left-turning and right-turning vehicles, where applicable, at all the locations studied.

Close examination of the table would reveal two types of pattern, first, that the overall levels of traffic handled by the intersection would go with the significance of the road and its connection with trip generators. The second pattern that is apparent from the table, as expected, is that the traffic throughput registered was closely related to the proportion of turning vehicles at the intersection. The larger the number of left-turning vehicles, the more the conflicting/crossing movements and therefore, generally, the lesser the traffic flows.

*Table 5-4: Summary of turning movement counts*

Intersection	Leg	Left Turners		Through Movement		Right Turners	
		Am	Pm	Am	Pm	Am	Pm
Zongo Junction	From Market	148	147	123	125	50	57
	From Libya Couters	296	300	345	245	131	98
	From Legon	378	214	1160	1122	176	304
	From Adenta	303	245	1270	1144	92	62
Hajia Hawa / Asharley Botwe Road Junction	From Customs	674	611	763	998	-	-
	From West Legon	-	-	346	464	247	272
	From Zongo Jnt	1400	1373	-	-	1319	1529
Action SHS	From Atomic	342	274	-	-	276	272
	From Madina Estates	329	409	217	447	-	-
	From Municipal	-	-	735	648	403	320
Hajia Hawa / Old Road Junction	From Customs	143	181	570	541	-	-
	From West Legon	-	-	406	416	126	280
	From Zongo Jnt	339	173	-	-	324	162
	From New Road	293	246	-	-	104	110

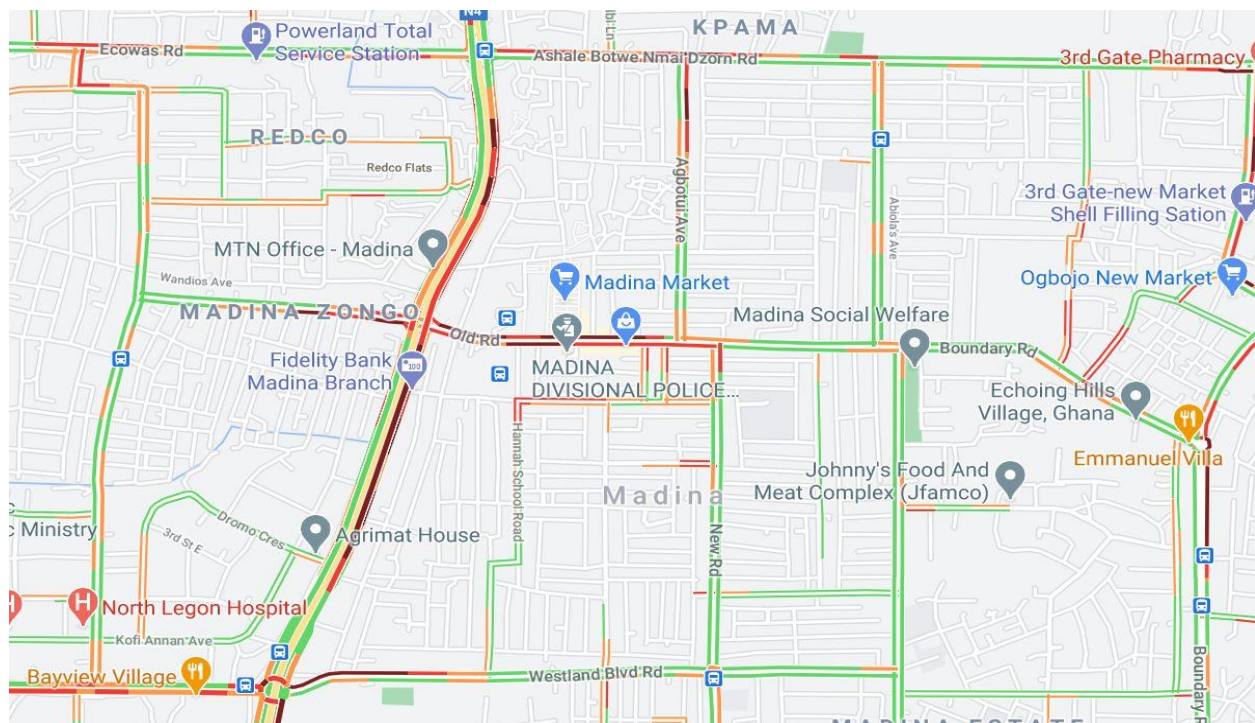
Intersection	Leg	Left Turners		Through Movement		Right Turners	
		Am	Pm	Am	Pm	Am	Pm
Eco- Bank	From Zongo Jnt	-	-	451	340	333	202
	From Municipla	124	190	533	241	-	-
Our Lady of Apostles Junction	From Customs	253	192	421	260	-	-
	From West Legon	-	-	126	335	231	347
	From Zongo Jnt	292	386	-	-	226	275
Rawling Circle	From UPS	-	-	205	385	55	103
	From Anglican CH	-	-	502	342	138	130
	From Action SHS	-	-	311	278	335	144
	From Atomic Jnt	-	-	568	628	270	182
Ritz Junction	From Legon	258	255	1325	1578	211	221
	From Adenta	268	245	1538	1416	221	225
	From Aya lo-lo	195	189	52	58	172	208
	From Abgobga	165	233	198	207	49	44
Social Welfare	From Post office	-	-	498	396	202	155
	From Madina Estates	141	264	-	-	369	408
	From Municipla	345	163	389	402	-	-

The data has been processed and analysed and will be used as the basis for junction modelling. The data for the key times (AM peak and PM peak) have been represented to show the turning movements visually.

### 5.3 Traffic Condition on Roads

Firstly, nodes and links which experience recurrent congestion on the road networks within the study area were identified. This was made possible by using advanced traveller information system (ATIS) and confirmed on the ground through site visits. ATIS broadcast traveller information to commuters to help them in planning their trips and also

offer directions/guidance on the road. The ATIS media receives traffic information from the control and concurrently transmits information from its current position to the control. Companies such as Google with more data input because of the widespread use of their applications are able to predict traffic congestion with a high degree of accuracy in cities, including Madina. For a first step, Google Live Traffic was observed for several days to identify locations which experience recurrent congestion before detailed investigation was carried out to identify the causes of the congestion. A typical weekday traffic situation during the peak period is as shown in *Figure 5-15*.



*Figure 5-15: Identification of locations with recurrent congestion*

The traffic information is presented in a form of a colour-coded map with red indicating locations which are congested and green representing free flow traffic conditions. After observing the traffic conditions for several days, the following road corridors were identified as almost always congested during the peak travel times and require further investigation:

- Old Road;
- Ashaley Botwe Nmai Dzorn Road;

- Agbotui Road;
- Westland Boulevard; and
- Legon Road

## 5.4 Travel Time and Queue Length

Delay studies were carried out at locations which were identified to be problematic. The My Track app provides the speed and time stamp and distance data of the test vehicle as it travels along the study route. The maximum queue length was estimated from the speed time profiles of the travel time runs and verified with the odometer reading from a vehicle. The time stamps of the start and end of queue were identified on the speed time profiles and the difference between their corresponding distances from a reference point was taken as the queue length.

### 5.4.1 Old Road

A typical speed profile for the Old Road, specifically from the new Assembly building to Zongo Junction is as shown in *Figure 5-16*.

It was observed that speeds at certain segments were relatively low. Using a speed limit of 30 km/h permitted in market areas (since Madina main market is located in the area), it could be observed that the delay experienced by motorist as a result of the congestion was estimated to be 1040 seconds on the approximately 2.0 km stretch of road. At about 50% of the road length, vehicles moved at crawling speeds, slower than 5 km/h.

From the analyses of the master station and screen line counts data, the congestion on the Old Road is not a capacity problem. It can be attributed to the following:

- Traders taking over the sides of the road reducing the effective carriageway width and creating side friction to vehicular movements thereby significantly reducing the efficiency of the road.
- Jaywalking of pedestrians causing vehicles to slow down many times along the road. Aside safety concerns, pedestrians also impede the smooth flow of traffic. This has come about because street hawkers have encroached on the sidewalks leaving no space for pedestrians.

- Access points to stations (on the VRA park) creating conflict between the vehicles on the main road and those joining.
- On street parking by the Assembly, though the road width does not support that.

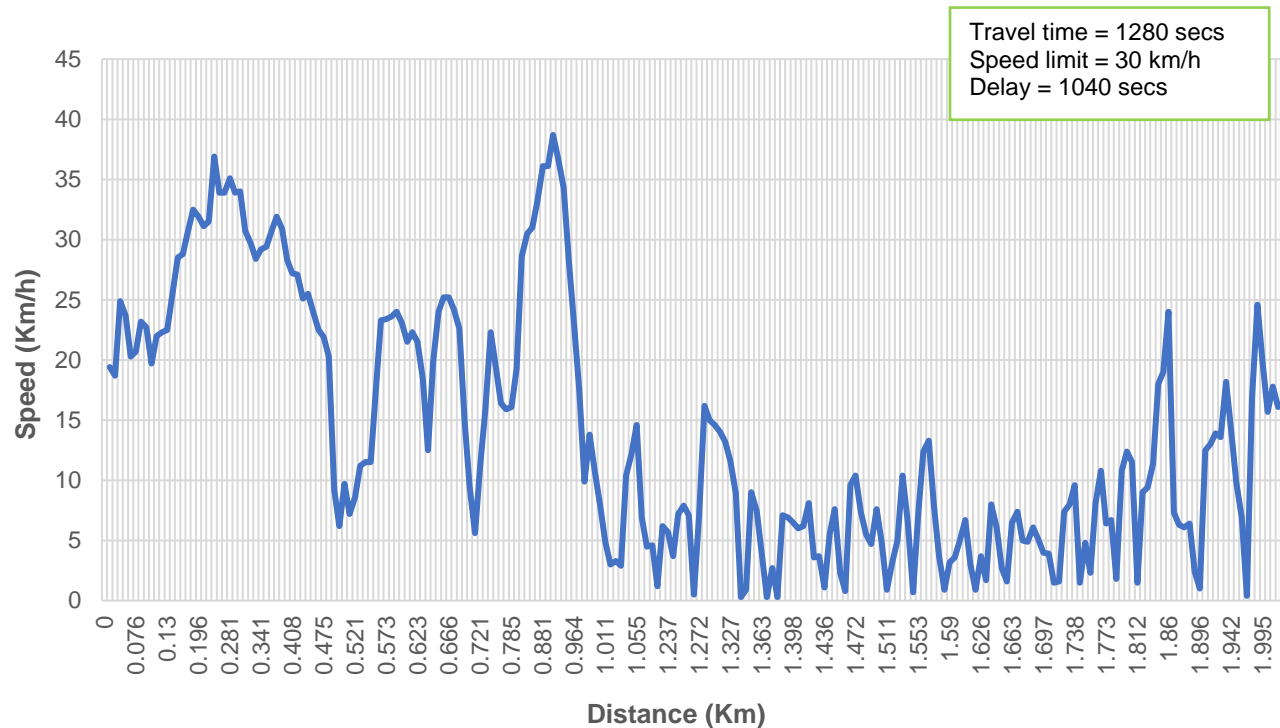


Figure 5-16: Speed profiles along Old Road

#### 5.4.2 Ashaley Botwe Nmai Dzorn Road

Figure 5-17 indicates a typical speed profile along the Ashaley Botwe Nmai Dzorn Road, specifically from Metal Masters Junction to Ritz Junction.

Using a speed limit of 50 km/h permitted in settlement areas, the delay experienced by motorist as a result of the congestion was estimated to be 1340 seconds on the approximately 1.8 km stretch of road.

From the analyses of the screen line count, the congestion on the Ashaley Botwe Nmai Dzorn Road is not a capacity problem. It can be attributed to the following:

- Control delay as a result of the traffic light at Ritz junction. Ritz junction has a long cycle length of 5 minutes, 30 seconds. Priority is given to vehicles on the main



Madina – Adenta highway (N4) leaving a limited green time for traffic from the minor roads (i.e., Ashaley Botwe and Ecowas). Therefore, a long queue is created when these roads are on the red phase.

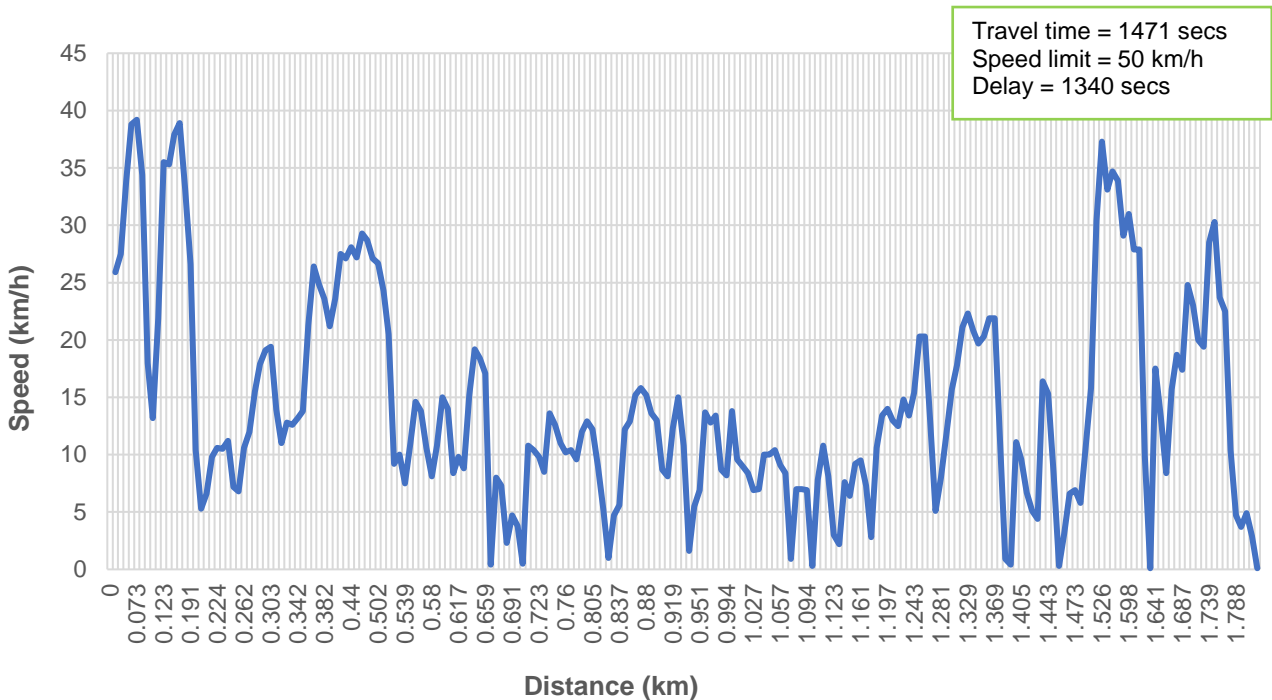


Figure 5-17: Speed profile along Ashaley Botwe Nmai Dzorn Road

### 5.4.3 Agbotui Road

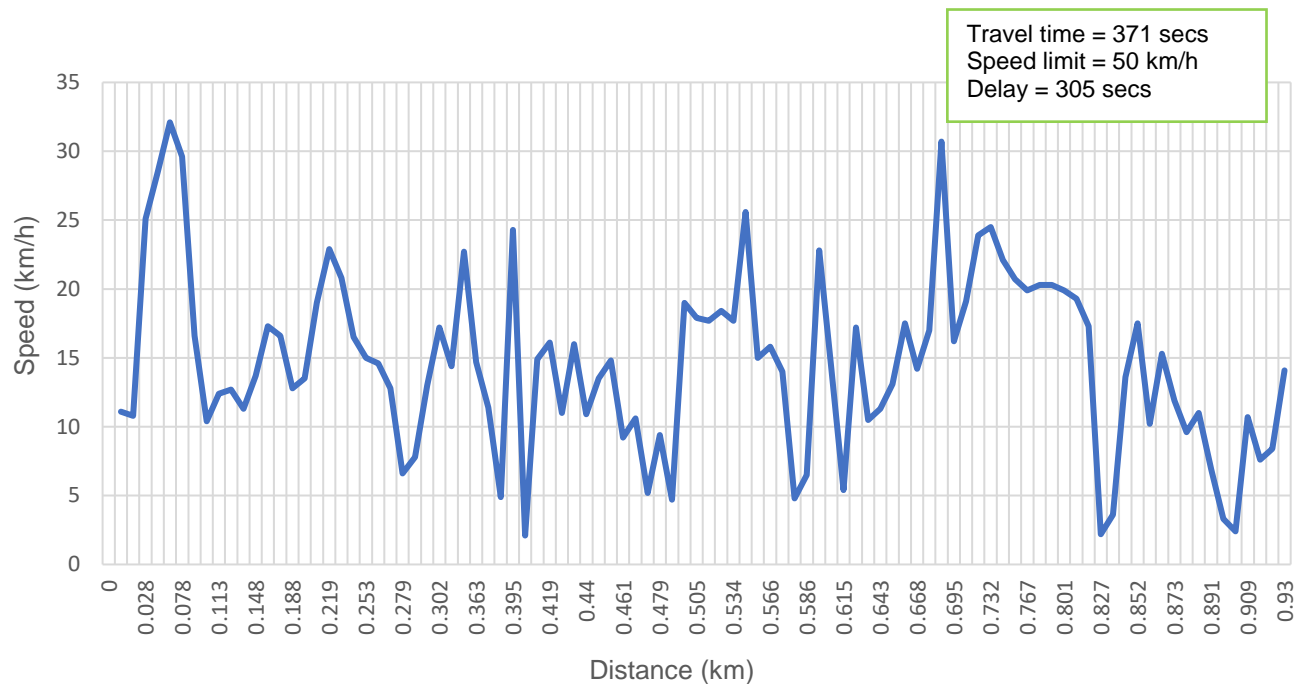
Figure 5-18 indicates a typical speed profile along the Agbotui road, specifically from Old Road to Asharley Botwe Road.

Using a speed limit of 50 km/h permitted in settlement areas, the delay experienced by motorist as a result of the congestion was estimated to be 305 seconds on the approximately 0.93 km stretch of road.

From the analysis of the master station count data, the congestion on the Agbotui road is as a result of the following:

- control delay as a result of the junctions with the Old Road and Asharley Botwe Road.

- reducing the congestion on the Old Road and Asharley Botwe Road will result in reducing the congestion on the Agbotui Road.



*Figure 5-18: Speed profile along Agbotui road*

#### 5.4.4 Westland Boulevard Legon Hatson Junction to Action School Junction

Figure 5-18 indicates a typical speed profile along the Westland Boulevard, specifically from Legon/ Atomic Road Junction to Action School Junction.

Using a speed limit of 50 km/h permitted in settlement areas, the delay experienced by motorist as a result of the congestion was estimated to be 1062 seconds on the approximately 2.5 km stretch of road.

From the analysis of the master station count data, the congestion on the Westland Boulevard is attributable to the following:

- control delay as a result of the Atomic Roundabout.

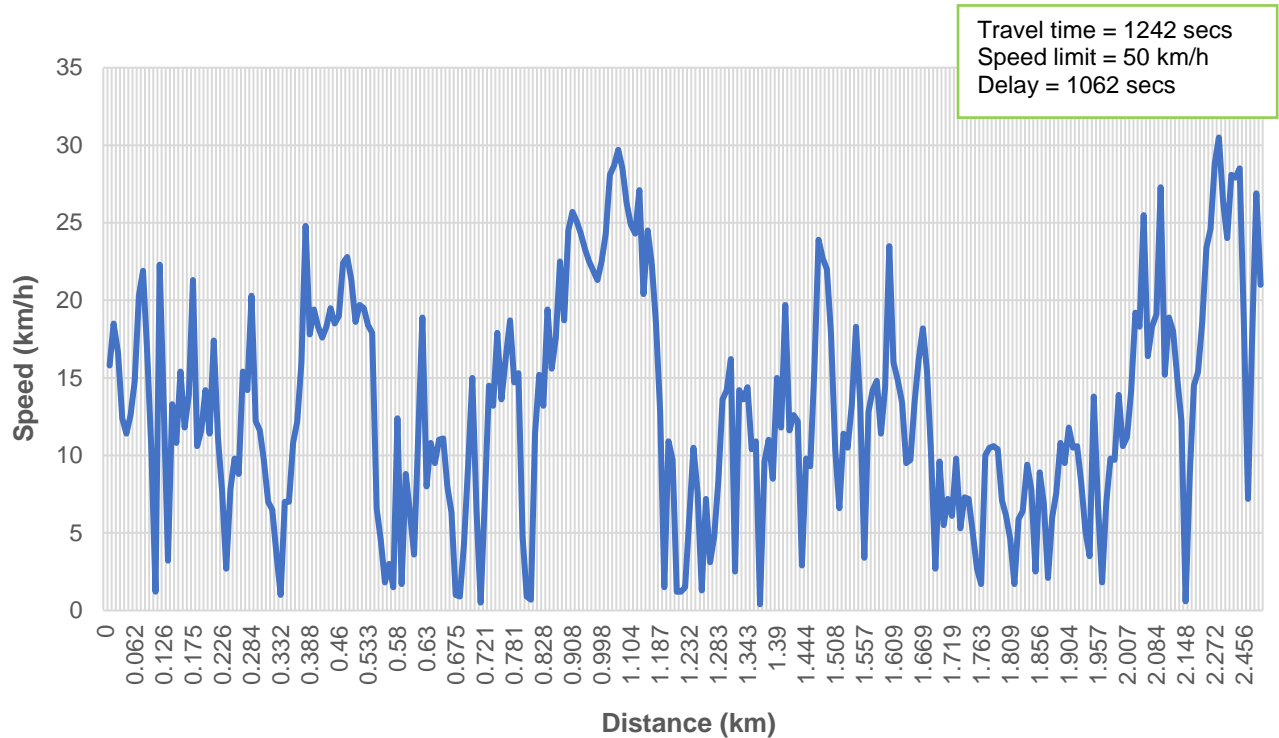


Figure 5-19: Speed profile along Westland Boulevard

#### 5.4.5 Madina - Adenta Highway (N4)

Figure 5-18 indicates a typical speed profile along the Madina Adenta Highway, specifically from Ritz Junction to Zongo Junction.

Using a speed limit of 50 km/h permitted in settlement areas, the delay experienced by motorist as a result of the congestion was estimated to be 869 seconds on the approximately 1.3 km stretch of road.

From the analysis of the master station count data, the congestion on the N4 highway is as a result of the following

- control delay as a result of the traffic lights at Ritz and Zongo Junctions.

The highway carries a high volume of traffic and was recently expanded to six-lanes. The delay, is as a result of the high cycle length of the traffic lights. Though drivers will have

to spend a lot of time in traffic when they encounter the red phase, longer cycle length also ensures a high throughput as lost times are reduced.

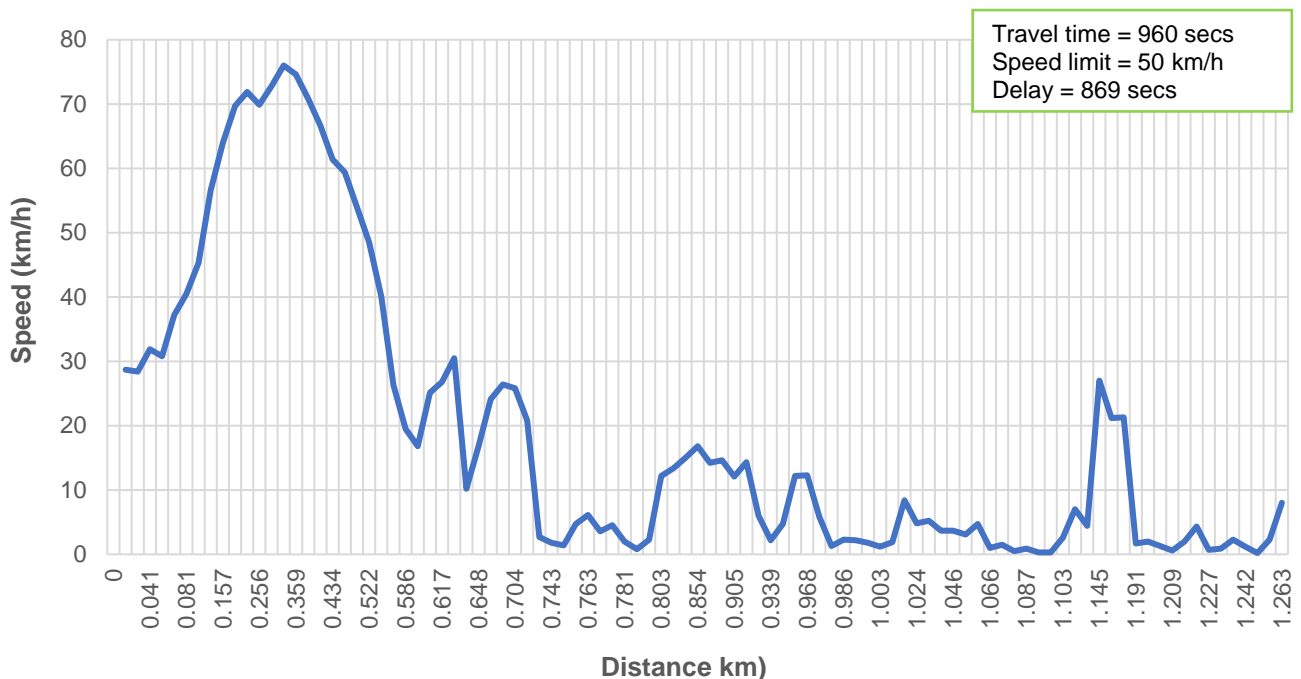


Figure 5-20: Speed profile along Madina – Adenta Highway (N4)

## 5.5 Pedestrian Counts

Pedestrian counts were conducted at selected places of significant conflict with vehicular traffic in the city for two days. The morning and evening peak volumes for the two sites where the counts were carried out are as shown in *Table 5-5* and the summary 15-minutes volume presented in *Appendix 5*. From the results, the following inferences could be made:

- High volumes of pedestrians were observed walking along the road at both locations studied.
- The number of pedestrians crossing were also observed to be high.

The high pedestrian volumes at the sites support the need to provide for all categories of road users, including pedestrians.

Table 5-5: Peak period pedestrian volumes

Census Point	Location	Peak Hour Volume (AM)	Peak Hour Volume (PM)
	<b><u>Day 1</u></b>		
<b>P1</b>	<b>Police Station</b>		
	<i>Crossing</i>	141	158
	<i>Walking along</i>	1700	1713
<b>P2</b>	<b>Delcom Ltd</b>		
	<i>Crossing</i>	618	372
	<i>Walking along</i>	1112	827
	<b><u>Day 2</u></b>		
<b>P1</b>	<b>Police Station</b>		
	<i>Crossing</i>	262	225
	<i>Walking along</i>	1712	1617
<b>P2</b>	<b>Delcom Ltd</b>		
	<i>Crossing</i>	767	367
	<i>Walking along</i>	1587	1331

## 5.6 Classified Occupancy Count

Classified occupancy counts were also collected at the same locations as the master station counts (i.e., Westland Boulevard Avenue (Near Seed House)) and Old Road (Madina Police Station). The average persons per vehicle (fill factor) is as shown in *Table 5-6*. It can be deduced from the table that:

- The average number of persons occupying a vehicle (2.9 persons per vehicle) was generally low at the study area.
- This was also true for buses (which were mostly mini-buses used for commercial purposes) as they recorded an average fill factor of 7 persons per vehicle out of the expected 12 – 15 passengers
- Taxis registered a fill factor of 1.8 persons per vehicle whilst cars, sports utility vehicles (SUVs) and pickups recorded an average passenger capacity of 1.9 persons per vehicle.

Table 5-6: Fill factor for different categories of vehicles

Vehicle Type	Fill Factor
Bicycle	1
Motor cycle/tricycle	1.3
Taxi	1.8
Cars/SUV	1.9
Bus	7
Trucks	1.8
<b>All vehicles</b>	<b>2.9</b>

The occupancy survey was carried out in February, 2021 when Ghana was experiencing the second wave of the COVID-19 pandemic. There is evidence, however, to suggest that mobility patterns have changed as result of the pandemic (Dzisia, et al., 2021). The study found statistically significant differences in mode preferences prior to, and during the outbreak of COVID-19 in urban Ghana. This, might have affected the result.

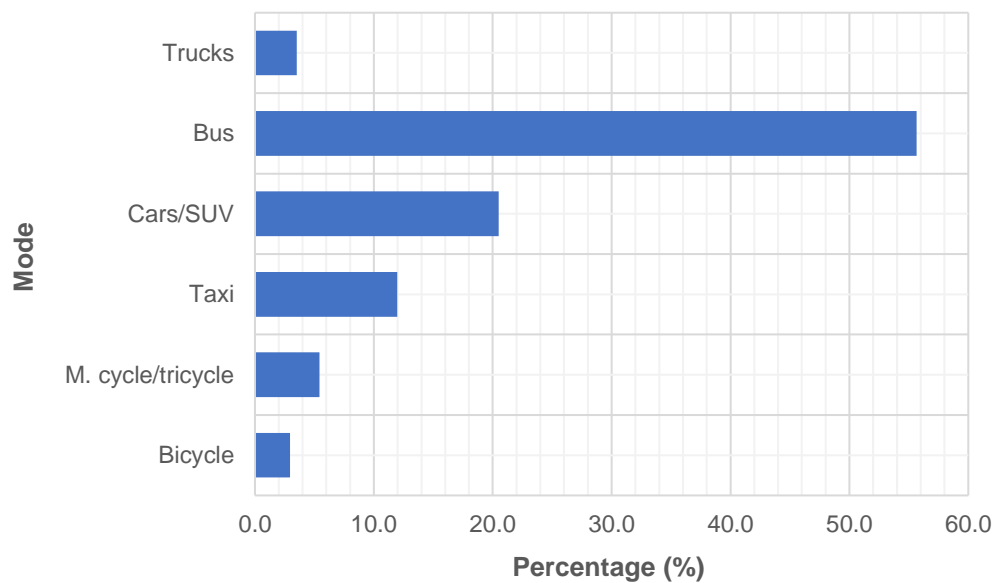
## 5.7 Passenger Mode Split

Figure 5-21 shows the passenger mode split at the two master stations from 7:00 – 12:00.

The following deductions are made:

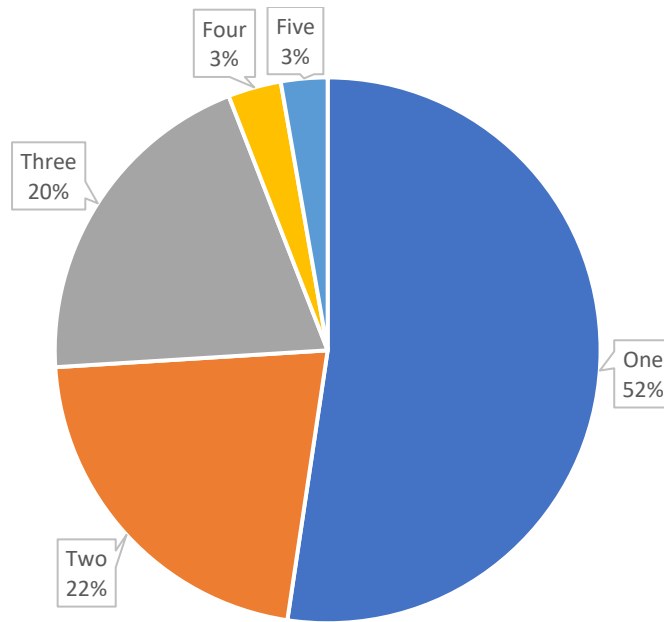
- The majority of passengers were those using mini-buses (trotro), constituting 55.6% of total passenger volumes. This was followed by cars (sedan), sports utility vehicles (SUVs) and pickups, (20.5%) and taxis (12.0%).
- The buses, which were carrying most passengers were mostly mini-buses with an average of 7 passengers per vehicle. Taxis and cars alone were carrying almost one-third (32.5%) of all passengers within the study area. This is worrying considering the fact that all these vehicles are low occupancy vehicles. Therefore, introduction of high occupancy vehicles (HOVs) will be a proactive solution for future traffic congestion management.
- More worrying is the fact that slightly more than one-half (52%) of cars/SUVs/taxis, including taxis, were single occupancy vehicles and 22% and 20% were carrying two and three persons, respectively (see Figure 5-22).

- The use of bicycle as a mode of transport is relatively higher within the study area compared to Tema. From the survey, cyclists constituted 3.0 of all passengers.
- The use of high occupancy public transport should be promoted to reduce the reliance on mini-buses and private vehicles as this is not sustainable.



*Figure 5-21: Passenger mode split*



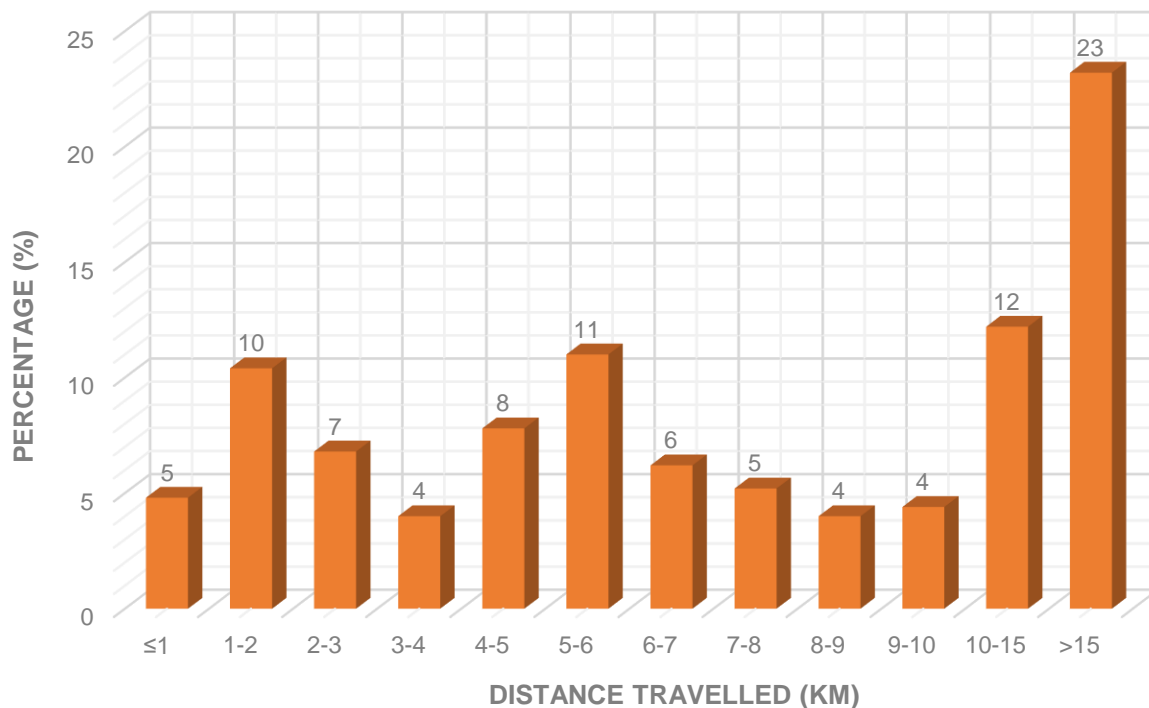


*Figure 5-22: Number of occupants in cars/SUVs*

## 5.8 Travelling Distances

Active transport, such as walking and cycling, is being encouraged in communities throughout the world. Motorized transport affects our health, safety and that of the environment.

From the origin – destination survey, it was established that the journeys of about 5% of respondents were within walking distance (1 kilometre or less) and the commuters could have made the travel without the need of a motorized vehicle. Also, about 34% of respondents were within cycling distances (5 kilometres or less). These results are presented in *Figure 5-23*. Pedestrian walkways and cycle lanes will therefore be useful looking at the travel pattern of the respondents.

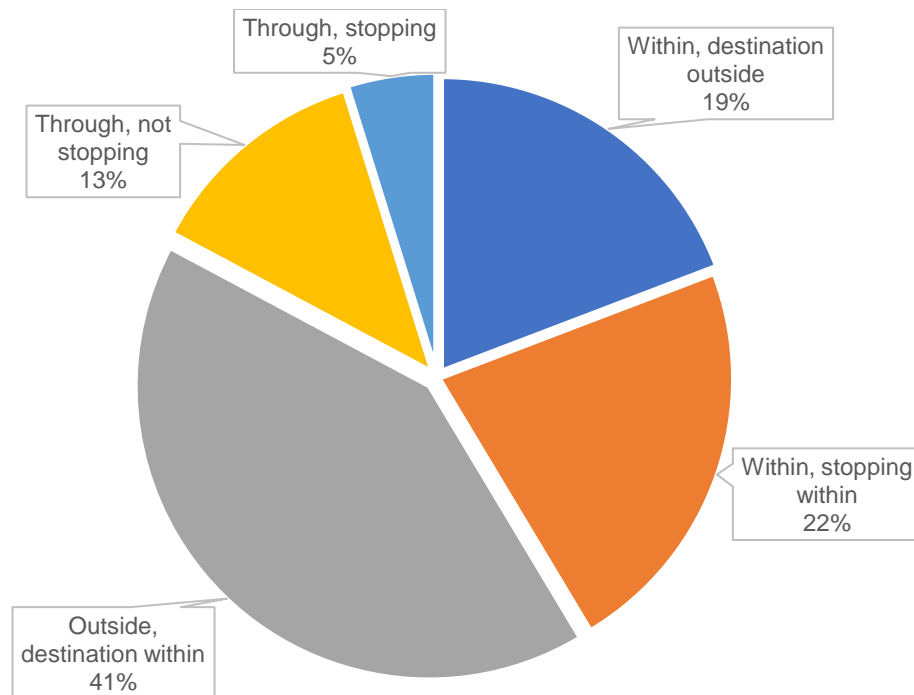


*Figure 5-23: Travelling distances of respondents*

## 5.9 Origin – Destination and Demand for Parking

Figure 5-24 shows the distribution of the start and end points of the journeys and whether the motorist transacted any business within the study area which required that they stopped, waited or parked. From the pie chart (Figure 5-24), 13% of drivers said they had no business doing within the study area and were just travelling through. Approximately 19% of drivers started their journeys from within but traveling outside the study area whilst 22% started within the area and will terminate their journeys within. About 41% were coming from outside but had their destination within the area which require them to wait or park. Again, about 5% of vehicles were through traffic but had business doing in the study area which require them to stop or wait.

From the ensuing, the demand for lay-bys, particularly, for commercial vehicles and parking places for private vehicles within the study area is very high.



*Figure 5-24: Start and end points of journeys of respondents*

## 5.10 Road Traffic Safety

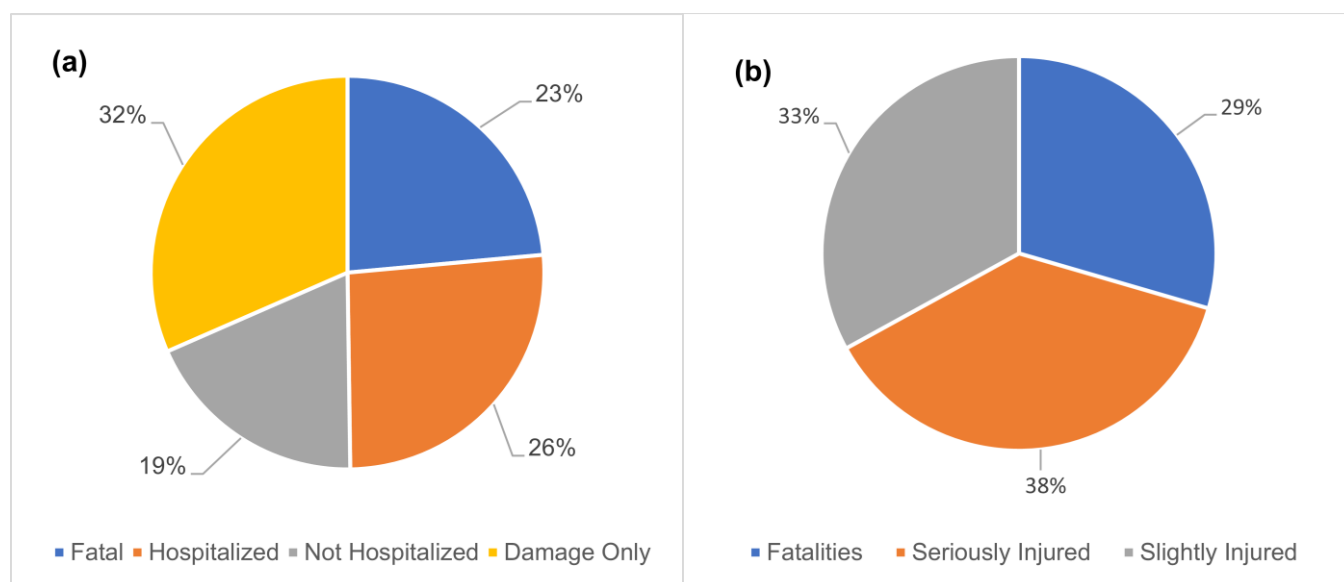
### 5.10.1 General Pattern in Crashes

During the period 2014–2018, a total of 225 road traffic crashes occurred within the study area resulting in 200 casualties. In all the crashes, 23% involved one or more persons being killed in the crash (fatal), 26% involved at least one person being hospitalized for more than 24-hours and 19% involved at least a person being treated and discharged. In 32% of the crashes, no person was killed or injured but property was damaged during the crash (see *Table 5-7*). Fatalities, serious and slight injuries constituted 29%, 38% and 33%, respectively as shown in *Figure 5-25* and *Table 5-7*. The number of crashes and their resulting casualties could have been higher if under-reporting was accounted for.

Generally, road traffic crashes were on the increase over the study period.

*Table 5-7: Distribution of crashes and casualties by year, 2014-2018*

Year	Crashes					Casualties			
	Fatal	Hospitalized	Not Hospitalized	Damage Only	Total	Fatalities	Seriously Injured	Slightly Injured	Total
2014	8	11	9	9	37	10	11	14	35
2015	8	7	6	16	37	8	10	9	27
2016	13	15	7	4	39	13	20	11	44
2017	9	11	3	3	26	10	15	9	34
2018	15	15	17	39	86	18	19	23	60
Total	53	59	42	71	225	59	75	66	200



*Figure 5-25: Proportion of severity of a) crashes b) casualties*

### 5.10.2 Road Users at Risk

From *Figure 5-26*, the pattern of fatalities reveals that the road user type with the highest share of casualties in traffic in the study area is pedestrians. Pedestrian alone, constituted one-half (50%) of all road traffic casualties in the area. Occupants of bus/mini-bus (20%), occupants of cars (13%) and motorcyclists (10%) follow in that order.

The current mixed traffic situation where there is inadequate infrastructure provision for pedestrians or pedestrian facilities are completely taken over by street hawkers thereby

compelling them to share the road space with motorized vehicles may be a contributory factor for the high incidents of pedestrian crashes.

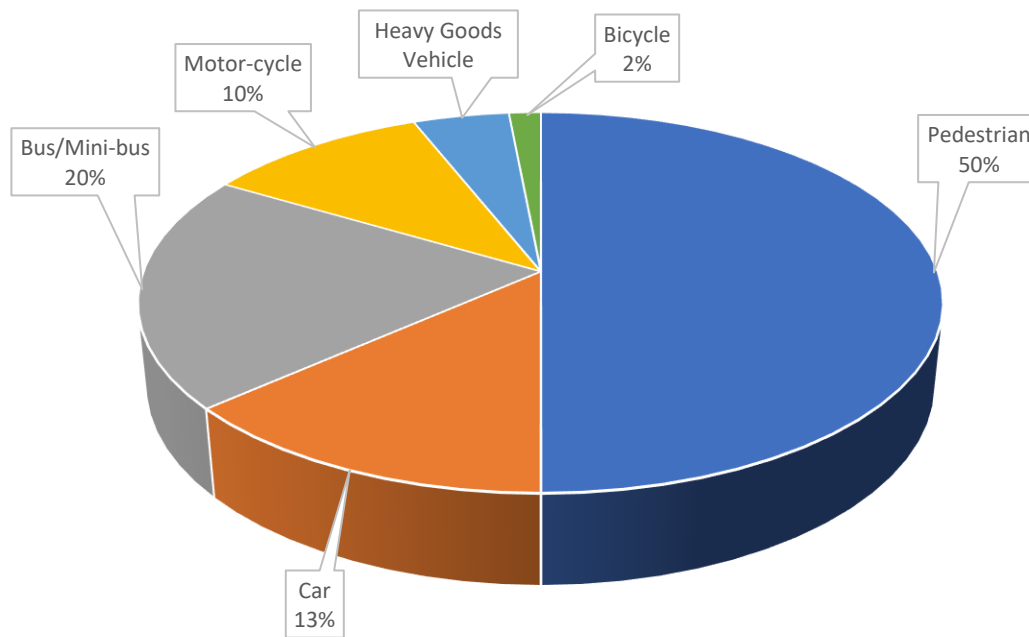


Figure 5-26: Proportion of fatalities by road user type

### 5.10.3 Time and Location of Crashes

From the data available, 88 of the crashes representing 39% occurred at night-time (between 18:00 – 06:00 hrs). However, for fatal crashes, approximately 57% occurred during the hours of the night. Considering fatal pedestrian crashes, approximately 59% occurred at night-time. Provision of functional street light throughout the night will reduce some of the crashes associated with night-time conspicuity problems.

Almost two-thirds (147; 65.3%) of crashes occurred on straight sections outside junctions and 78 (34.7%) occurred at junctions.

### 5.11 Investigation into Locations with High Frequency of Crashes.

The under-listed locations recorded high frequencies of crashes:

- 1) Ritz Junction
- 2) Zongo Junction
- 3) Firestone
- 4) Madina Cemetery
- 5) Atomic Overpass

A further investigation as shown in *Table 5-8* revealed the following:

- The Zongo Junction location requires attention as more fatal crashes occurred at this site (17no.). A further investigation at the site revealed that 53.7% of crashes were vehicular-pedestrian collisions.

This is not surprising as the Consultants observed that although there is an overhead footbridge at the location, many pedestrians cross the six-lane road using unauthorised paths as seen in the example of *Figure 5-27*.



*Figure 5-27: Crossing using unauthorized route*

- Same apply to the high incidents of pedestrian crashes at Ritz Junction.
- The high incidents of rear-end, right angle and side swipe collisions at the Ritz and Zongo junctions may be as a result of traffic conflicts when the signals are off or some drivers jumping red light.

Table 5-8: Investigation into locations with high frequency of crashes

Variable	Location				
	Ritz Junction	Zongo Junction	Firestone	Madina Cemetery	Atomic Overpass
<b>Crash Severity</b>					
Fatal	13	17	8	2	3
Hospitalized	18	15	4	2	3
Not Hospitalized	10	5	5	5	4
Damage Only	15	17	2	6	3
<b>Total</b>	<b>56</b>	<b>54</b>	<b>19</b>	<b>15</b>	<b>13</b>
<b>Year</b>					
2014	4	10	3	4	6
2015	4	11	1	4	2
2016	10	7	3	3	3
2017	13	10	1	0	0
2018	25	16	11	4	2
<b>Total</b>	<b>56</b>	<b>54</b>	<b>19</b>	<b>15</b>	<b>13</b>
<b>Collision Type</b>					
Head On	6	1	3	3	0
Rear End	11	13	0	5	6
Right Angle	14	1	0	0	0
Side Swipe	5	10	2	5	0
Ran off Road	1	0	2	1	3
Hit Object off Road	0	0	1	0	0
Hit Object on Road	1	0	0	0	0
Hit Parked Vehicle	0	0	2	0	2
Hit Pedestrian	18	29	9	1	2
Other	0	0	0	0	0
<b>Total</b>	<b>56</b>	<b>54</b>	<b>19</b>	<b>15</b>	<b>13</b>
<b>Time of Day</b>					
Day	31	28	10	10	11
Night	25	26	9	5	2
<b>Total</b>	<b>56</b>	<b>54</b>	<b>19</b>	<b>15</b>	<b>13</b>

## 5.12 Parking

An assessment of the existing parking scheme by the LaNMMA, on the Old Road was undertaken. A walk through the established on-street parking area indicated that a number of the parking lots have been taken over completely by traders and are not available for use by vehicles.

The parking accumulation curve, which shows the number of vehicles parked at any given instant of time, for the Old Road is shown in *Figure 5-28*. From the chart, the maximum accumulation was 87 and it occurred between 13:30 and 13:45 hours. It can also be deduced from the graph that parking accumulation remains high from midday to the late evenings when it begins to drop.

The parking volume at this site, which is the total number of vehicles parked from the 6:00 – 18:00 hours, was 1,120. On the average, the vehicles were parked for 25.89 minutes. Generally, as shown in *Figure 5-29*, majority of the vehicles park for a short duration of time. Approximately 70% of the vehicles were parked for less than 1 hour. However, significant proportion of the vehicle park for a long time.



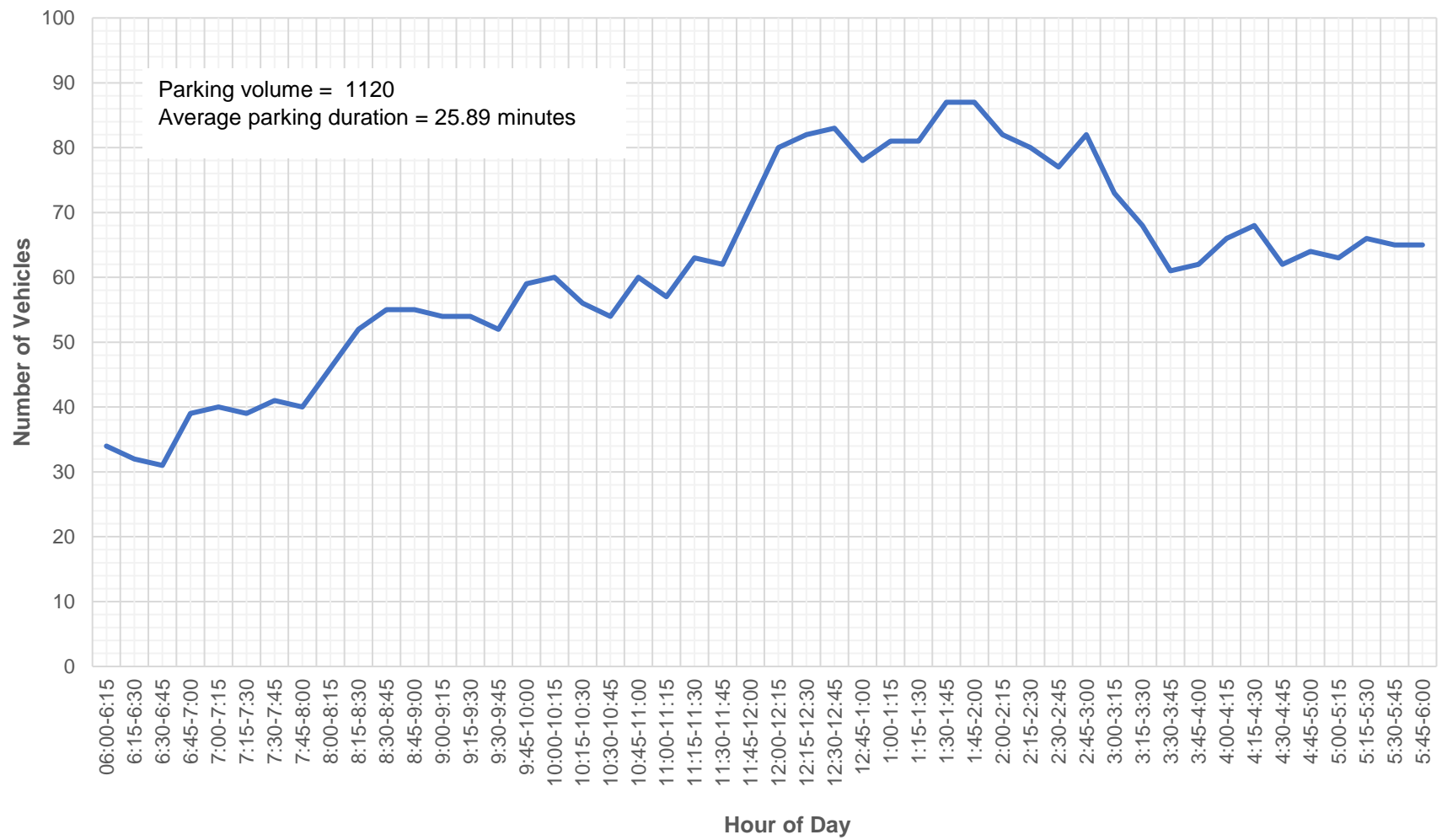
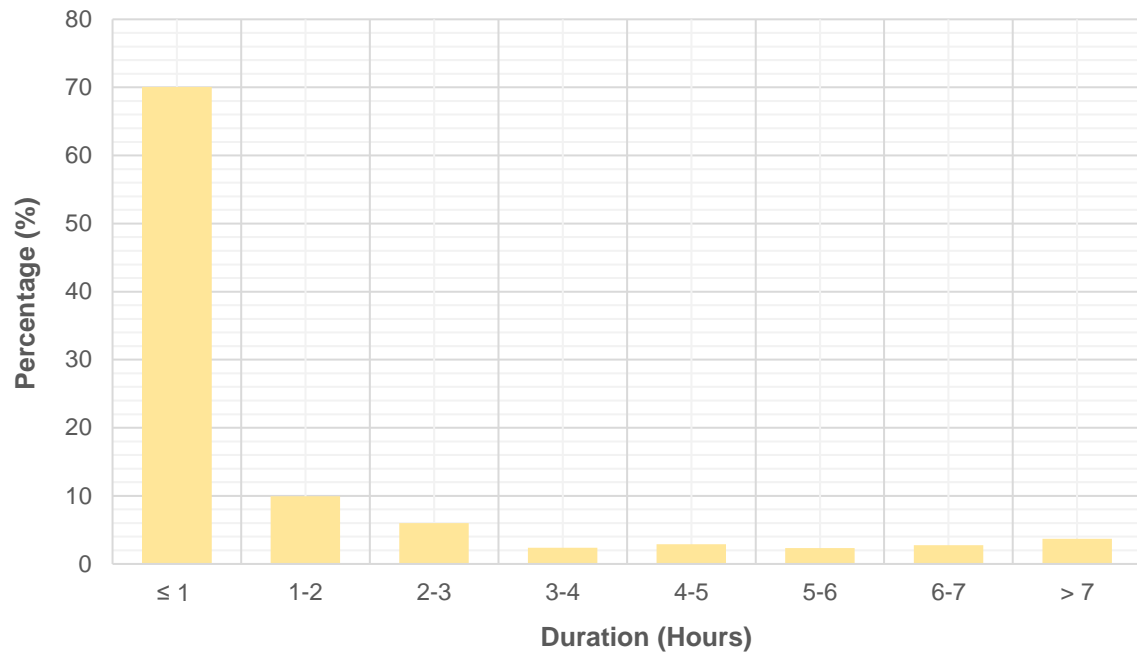


Figure 5-28: Parking accumulation curve



*Figure 5-29: Proportion of vehicles parked by duration*

## **6 COMMUNITY/ STAKEHOLDER CONSULTATION**

### **6.1 Economic Activities in the Madina Municipality**

Madina is the capital town of the La Nkwantanang-Madina Municipal Assembly. The city forms part of the great conurbation of suburbs which forms the Greater Accra Region. Madina is bordered to the north by Adenta, south by East Legon, West by North Legon and East by Asharley Botwe, all suburbs of the Greater Accra Region. The presence of important educational institutions like the University of Professional Studies Accra, (UPSA); and the proximity to Presbyterian Boys Senior High School and the University of Ghana has made the Municipality a very busy suburb in the Greater Accra Region.

### **6.2 The Main Central Market**

Economic activities are very brisk in the municipality. The major economic centre is the Madina Central Market. The Madina Central Market is gated and has about 14 entrances and exits. There are many aisles within the market which have been rendered impassable due to encroachment by unlawful hawkers. Therefore, shoppers prefer buying from the roadside to avoid the hustles and tussles which typify the densely congested market.

The gates open around 6:30 am and close at about 7:00 pm. The market has expanded beyond its perimeters by coalescing into adjoining houses and suburbs. Residential buildings near the market have been gentrified into shops and offices for commercial purposes.

Buying and selling are the two predominant economic activities with Madina Central market being the densest buying and selling point of the municipality. Street hawkers predominate in the study area. There are major financial institutions in the market including Manya Krobo Rural Bank, Fidelity Bank, Commercial Bank, BEIGE Bank, ABSA Bank and Consolidated Bank of Ghana. Some of these financial institutions also have branches along the National Road Number 4 (N4). There are also a couple of shopping malls like the Madina Shopping Mall, MELCOM Shopping Mall and Rosehill Shopping Mall distributed in the central business district of Madina. These commercial activities bring shoppers to the central business district on a daily basis.

### 6.3 Perspectives of Market Women

Interaction with the market women at the Madina Central Market revealed that they receive some financial assistance from the MICRO Finance and Banking Institutions located in Madina. They claim they are unable to service these loans because of low sales occurring within the Market. One of the market women stressed that *“street hawking is a main concern to Madina market women. The street hawkers compete with us for customers. They do not pay any rent but those of us in the market do. Unfortunately, buyers prefer to buy on the street to forestall the dense human traffic within the Market”*. Some of the market women also bemoaned that ‘squatter hawkers’ have established their merchandise in the customers’ car park. This has a negative repercussion on buying and selling in the main market. Consequently, *“Many times, we are unable to repay our loans”* one of the market women stressed.

The market women indicated view that there have not been many fire outbreaks in Madina Central Market. *“To the best of my knowledge, there has been only one major fire incidence in the market over the past 5 years, that is, in 2019. Many shops were destroyed”* one of the market women stated. She also indicated that, the worst fire outbreak in the market occurred 5 to 10 years ago. During this fire incidence, the *second-hand clothing* section was razed completely. This section had been rebuilt and all the victims have had their stalls restored. Regarding whether there was easy access for firefighters when there were the fire incidences, the market women indicated that the fire outbreaks usually occur at night. They usually hear about fire incidence in the news or when they arrive in the market the next morning to trade. However, they were of the opinions that the current haphazard arrangement of market structures is indicative of difficult movement for fire tenders in case of a fire outbreak.

The market women were of the view that there is little theft and burglary incidence in the market. *‘Sometimes, due to the dense human traffic we do hear of pick-pocketing and phone snatching. We do also hear once in a while that thieves have broken into shops to steal items, but it is not a common occurrence’*. The market women were also of the view that the *Municipal Assembly* is blameable for the proliferation of street hawking in the city because they allocate spaces to street traders. They were of the view that decongesting

the city of street hawkers will improve buying and selling activities in the main market, cycling, walking and traffic flow in Madina especially on the Old Road.

#### 6.4 The Satellite Markets

There are two (2) major satellite markets in Madina namely; the New Market and Bohye Market. Both satellite markets are prime lands on which modern market complexes could be built. The New Market which is located South-East of the Madina Central Market is some 300 metres away as the crow flies. The total distance around the New Market (perimeter) is about 335 m. This market which consists of temporary structures/sheds are completely deserted.

The second satellite market, the Bohye Market, West of Madina Central Market has a perimeter of about 400 m. Like the New Market, the Bohye Market has also been deserted. Only few bulk-breaking fruits sellers are trading there. The temporary structures at the Bohye Market (see *Figure 6-1*) have been turned into a haven for criminals.



*Figure 6-1: Deserted market structures in Bohye Market, Madina*

*Figure 6-1* shows temporary structures erected at the deserted Bohye Market. An interview with one of the Market leaders revealed that all kinds of criminals including robbers, thieves, prostitutes, alcoholics and wee smokers live there. “*They just use*

*polythene sheets to cover the structures and turn these sheds into their houses. In them they rape and beat their innocent victims'. Through the interviews, we ascertained whether the presence of these criminals affect traders' businesses. According to the market women at Bohye Market the activities of these criminals negatively affect trade in this market. "For, we see and hear of bad incidence like theft, assault and wee smoking occurring in the market. Those who do not have the heart to withstand these incidence will definitely leave and sadly to sell along the road. Patronage of the market is very low as all buyers' attention is on the Central Market".*

Another reason why traders do not want to sell at the Bohye Market is burglary. When asked, whether there has been any incidence of burglary and thievery recently in the Market, one of the market women said *"My brother, it is a regular routine. Just last week, thieves broke into one of our containers and made away with many items including bags of rice and gallons of oil. Another colleague who sells watermelon had all her goods worth over **three thousand Ghana Cedis (GH¢3,000.00)** stolen overnight. So, you see, we have a lot of challenges in the Market".*



*Figure 6-2: Grain sellers' section of the Bohye Market, Madina*

On the way forward to improve buying and selling at the Bohye Market, the market women requested that *"the criminals in the market should be removed immediately and the*

*market reconstructed. We do not request any sophisticated edifice; just a simple structure will suffice”* one of the market women said. *Figure 6-2* illustrates the grain sellers’ section devoid of any buyers.

## **6.5 Roadside hawking and developments**

While the vast majority of economic activities are concentrated at the Madina Central Market, substantial amount of business activities also take place along the N4. Many of the banks located at the Market Square also have their branches along the N4. Along the N4, there are considerable number of shops and street hawkers. The street hawkers have encroached on the sidewalks and cyclist facilities. Street hawking are also found along major arterial roads like the Ashale-Botwe Nmai Dzon Road, Agbotui Avenue and other residential streets though in reduced intensity.

Another development typical of Madina roads is the unauthorized expansion of shops as well as locating metal containers beyond the boundaries of houses. These developments sadly obstruct cyclists and pedestrian movements and will definitely hinder non-motorized transport infrastructural development in the future. An example of extension of structures and inadequate pedestrian facilities are shown in *Figure 6-3*. Shop owners in addition to their encroachment on the road reservation further lease out the small spaces fronting their shops to street hawkers thereby leaving no space for non-motorized transport users.





*Figure 6-3: Extension of buildings to road reservation and lack of pedestrians' facilities in Madina*

## **6.6 Parking and Accesses to the Madina Central Market**

The main access to the Madina Central Market off the N4 highway is through the Old Road (Zongo) Junction. The Old Road has the highest density of street hawkers. The street sellers do spread their retailing goods onto the limited road shoulders. This renders walking and cycling difficult. Hawking activities also obstruct free traffic flow and causes perennial gridlocks. Consequently, truckers use alternative accesses which are less congested such as the Ritz Junction on the Ashale-Botwe Nmai Dzorn Road and Agbotui Avenue in the North while in the South, through the Atomic Junction turning on Westland Boulevard and other streets to connect Hannah School Road to the Madina Central Market.

There are two parking areas for the Madina Central Market namely; the offloading bay, north of the market and the customers' car park south of the market which is opposite to the Madina Divisional Police Station. Trading activities have also spread to these facilities thereby negatively affecting the operation and functionality of the parking facilities as seen in *Figure 6-4*.





*Figure 6-4: Hawkers' encroachment of customers' car park at Madina Market*

The two main trotro terminals in the municipalities are the Madina-Abokobi lorry station, the bigger of the two; and Decorbuilt (VRA) lorry station. The Madina-Abokobi lorry station is managed by the Madina Municipal Assembly and is in a very deplorable state. During rainy seasons, the place becomes very muddy and authorities of the facility have to spread chippings over the place to make it useable for travellers. Illumination is also very poor at night-time at the Madina-Abokobi lorry station and many parts of the city.

## **6.7 Perspectives of residents and road users**

Perspectives of residents and road users were sought to find out about the adequacy and satisfaction of road infrastructural and facilities for road users' in the study area. Road users' perspectives were broadly categorized into three categories namely; *perspectives of residents, non-motorized transport and motorized transport users* and are expatiated below.

## **6.8 Residents**

Residents of the city were of the view that compared 10 years ago Madina to today's Madina, there is a contrasting difference. Residents were of the view that tall buildings and beautiful roads have been built in the recent past. Nonetheless, liveability in Madina

was better 10 years ago than Madina today. Residents were of the view that street hawking and wrong parking have steadily increased over the past ten years and gotten to its worst peak now than ever. This has also affected traffic congestion to a very large extent. Residents believe that partisan politics have had considerable influence on people's behaviour and for that matter the beauty of the city is lost. Residents were of the view that street hawkers and reckless drivers have persistently flouted the hawking and parking regulations because they have the backing of the Municipal Assembly, police and traffic wardens. People also attributed the current haphazard use of road space in Madina to partisan politics. *"Earlier on, there was nothing like whom you know and what have you in Madina. We insisted on the right thing to be done. But we lost control when partisan politics started to become serious in Ghana. They now see the good works we do [enforcement] as 'anti-government'. This has negatively affected the development of Madina. The traffic congestion from Zongo Junction to Madina Central is just too bad"*.

Street hawkers persistently defend their acts that the Municipal Assembly taxes them. Therefore, no one can eject them from the road. This has largely weakened enforcement.

People were of the opinion that speeding in Madina was low and that there were ample traffic calming devices in their neighbourhoods. Nonetheless, Madina residents were generally not satisfy with the current state of *inner-city* roads. They are of the view that the deplorable state of the *inner-city* roads compels motorists to overuse the few arterial roads which are in better conditions thereby worsening traffic congestions.

Residents also have the opinion that the on-street parking in front of the Madina police station was demarcated to supplement the off-street parking facility at the marketplace intended for shoppers. The idea was to provide short time parking for the buyers within thirty to sixty minutes. Unfortunately, these parking lots have been taken over by trotro and taxi drivers for loading. Loading on the driveway tend to compound traffic congestion on the Old Road. *'On a busy day it can take one hour or more to drive from Zongo junction to taxi rank. This is abnormal. Until recently one could see the road clearly from Zongo junction to Social Welfare with free flow of vehicles'* said one of the residents.

A question was asked about how the traffic congestion affects life in Madina. One of the residents said. *"Oh I think it affects me to a large extent. For instance, when I have an*

*appointment, I will either use alternative roads which will be far off or set off early enough say, forty minutes early if only I want to be on time. Again, students of the Social Welfare School always have to alight at Zongo Junction and walk for the remaining journey to school due to the perennial gridlocks on this road”.*

## **6.9 Non-motorized transport**

Cycle and pedestrians’ infrastructure were adequately present on the N4 section of Madina. However, street hawking and wrongful parking had rendered the cycle lanes and sidewalks impassable as shown in *Figure 6-5*.



*Figure 6-5: Pedestrian and cycling facilities occupied by street hawkers*

Pedestrians and cyclists cautiously meander their ways through these hawkers and are badly harassed when they step on or cause traders’ merchandise to spill.



*Figure 6-6: Few pedestrian patronizing footbridge at Zongo Junction*

Also, two out of six pedestrian bridges along the N4 from Legon to Adenta are located in Madina. As shown in *Figure 6-6*, the facilities are less patronized because pedestrians claim the bridge span is too long. Prior to the construction of these bridges, zebra crossings were designated for pedestrians. Upon completion, the zebra crossing signs and markings are still left at their positions. This looks tempting because some pedestrians might still think crossing at this location is still permitted.



*Figure 6-7: A stream of pedestrians crossing at grade 50 m away of a footbridge at Zongo Junction.*

Measuring the entire span (east to west) of the pedestrians' bridge at Zongo Junction gave a walking distance of approximately 314 meters. As shown in *Figure 6-7*, pedestrians still cross at grade of the high volume and speed road and often get knocked down by speeding vehicles. It is important to stress that residents demonstrated against the government in November 2018, when construction of the footbridges delayed. Residents were angry that their kinsmen were being knocked down by speeding motorists. It therefore comes as a surprise that after completion of the bridges, pedestrians do not patronize them. It is important to note that one of the pedestrians' bridges in Madina, located about 50 meters north of Ritz Junction is not completed. See *Figure 6-8* for details. Though this bridge is opened for use, the eastern side is yet to be completed. There were generally no other pedestrians and cyclists infrastructure in Madina. This situation has jeopardized pedestrians and cyclists movement and safety in the municipality.



*Figure 6-8: Uncompleted footbridge blocking pedestrians and cycle lanes near Ritz Junction.*

## **6.10 Motorized transport**

Drivers were of the perception that traffic congestion is badly affecting their operations. Troto drivers were of the opinion that street trading is the main cause of traffic congestions. *“I do not understand traders. They do sell their goods right on the road pavements. This has to stop because they [traders] have pushed pedestrians unto the*



roadways. *We [drivers] have to considerably reduce our speeds to a snail pace so as not to hit a street trader or a pedestrian*” one of the drivers said. Another motorists indicated that *“law and order has broken down completely [in the city]. There is no discipline regarding using of road space in Madina. This extends right in from of the Madina police station. I am surprised that not much is being done to ameliorate the traffic congestion problem in the city”*. It was noted that some drivers who do not belong to any driver unions load on the roadway which constricts the carriageways and compound the traffic congestions. It was indicated that the police and traffic wardens or their loved ones own the trotro and taxis. Drivers of these vehicles regularly flaunt the on-street loading with impunity because they think they have the backing of police and city authorities.

Again, due to the unauthorized expansion of buildings, heavy goods vehicles always encounter problems in negotiating curves at junctions in attempt to access the market. This causes unnecessary delays and inconveniences. Motorists therefore suggested that truckers should offload their goods during weekends or late evenings when market has closed. This will alleviate the stresses they undergo in an attempt to offload goods during the day.

### **6.11 Safety and security**

Residents of Madina are of the opinions that the city is generally peaceful and safe for living. According to the residents, there is limited incidence of crime like robberies and rapes in the city largely because of the *instant justice* system being practiced by some people in the area. The police corroborated the relative peace assertion and indicated that one of the *ring leaders* who led in a lot of burglaries and other petty crimes in Madina has been apprehended and jailed. Therefore, there is little incidence of criminal cases in the municipality. *“Occasionally, we do hear of phone and bag snatchings especially when the universities are in session”* a policeman reported. The police have therefore increased night patrols in the suburbs where these incidences happen. It is also recommended to improve night-time illumination of the municipality.

Over the past 10 years, fire incidence were infrequent in Madina including the market. The few domestic fire incidences normally occurred in the zongo area and usually involves unattended electrical fires. As fire officers are detailed in the market all the time,

they helped to put off fires before they get out of hands. The market women have also been educated on fire-prevention techniques. However, the fire service officers said that the incidence of fire outbreaks is on ascendency in recent years. For instance, there was a fire outbreak in the market in 2019 during which over 20 adjoining shops were razed down. It took the fire service a couple of hours to bring the fire under control. There was also a fire outbreak at the Madina Social Welfare area in February, 2021. This fire incident destroyed a carpenter's shop and a school building. The fire officers indicated that street hawking, unauthorized kiosks and structures along the street impede free movements of their oversized fire tenders. The fire officers also recommended two measures as fire prevention techniques; first installing smoke detectors alarms and second minimizing Class 'A' Combustible Materials such as wood in buildings.

Pedestrians' safety is a major challenge in the Madina municipality. The crashes are concentrated on the N4. One of the Assembly Members of the area said that, in the first quarter of 2021 for instance, seven pedestrian fatalities occurred in Madina. Therefore, the Regional Minister of the Greater Accra Region in conjunction of the Municipal Chief Executive of Madina Municipality deployed the police and military to enforce the use of the pedestrian bridges which were hitherto hardly used. Using of the footbridges in Madina has increased and no pedestrian accident has been reported since then. The community believes that erecting a barbwire fence over the median as in Kaneshie will bring about a permanent solution.

## **6.12 Summary of the Perspectives of Survey**

Firstly, development of the New Market and Bohye Market into modern market complexes is a Madina's top priority. Secondly, roadside hawking is negatively affecting Madina Market businesses to the extent that traders are unable to break even and repay their bank loans.

Thirdly, just like in Tema Community 1, lack of enforcement of building and trading regulations has led to the misuse of land spaces in Madina. Aisles in the market are occupied with squatter hawkers making movement in the Central Market difficult. Buildings fronting roads have been unjustly extended beyond their boundaries. Street hawking and on-street loading by trotro drivers block the carriageways, causes traffic

congestion and negatively affect cyclists and pedestrians' mobility. People's non-use of engineering countermeasures in Madina has exacerbated pedestrians' injuries and fatalities in the area. Therefore, enforcement of building, trading and traffic regulations is imperative.



## **7 PUBLIC OPINIONS FROM THE WORKSHOP**

The ToR requires BRRI to organize stakeholders' workshops to present results, recommendations and conceptual plans to participants and elicit their perspectives on the major themes presented. This is to enable stakeholders to make substantial inputs to the conceptual plans to enable the project achieve its goals. The Madina meeting was organized on November 26, 2020 at the conference room of the La Nkwantanang-Madina Municipal Assembly. There were forty-five (45) participants in attendance. Some of the participants were drawn from the Municipal Assembly, market women, police, residents, fire service, Department of Urban Roads; and road users such as motorists, pedestrians and cyclists.

Stakeholders' contributions are summarized below:

### **7.1 Traffic congestions**

Stakeholders were of the view that traffic congestions in the Madina Municipality is a major transportation problem. Participants were of the view that the main causes of the perennial gridlocks in the city especially, on the Old Road are street hawking, irresponsible parking and loading by drivers on the roadways. Landlords and shop owners also rent spaces fronting their facilities to hawkers. It was suggested that future meetings should invite street hawkers and landlords to participate in the discussions. Participants were of the view that decongesting the road of hawkers will promote free flow of vehicles. It was argued that there are some spaces still in the Central Market and that if properly planned, can still accommodate a lot more traders. More importantly, if the satellite markets are developed, many traders can be settled there.

### **7.2 Road Safety**

Road safety, particularly pedestrian safety is a serious health issue in the Madina municipality. The crashes are predominantly clustered around the N4. Despite the pedestrians' bridges constructed across the major road of this caliber, pedestrians do not

use these bridges and have been jaywalking by crossing everywhere at grade. Stakeholders argued that the police cannot be present all the time to ensure that pedestrians use this change. Attitudinal change was recommended as the remedial measure to prevent pedestrian crashes on the highway. People also expressed concern about the inadequacy of zebra crossings at school zones.

### **7.3 Street Hawking**

Street hawking was identified as one of the main challenges at Madina. Participants of the meeting argued that traders have left their market stalls and are trading on the road pavements. It is believed that this has become a canker because there are no punishments for this violation. This contributes to a large extent to the traffic congestions happening on the roads in Madina particularly, on the Old Road. Trading on the streets also make it difficult for pedestrians and cyclists to use the road safely and conveniently. Stakeholders pointed out that partisan politics in the city has been the main reason why street hawking has thrived in the municipality. They argued that people in political and administrative authority apportion the road space to their kinsmen and party faithful. Hence, these leaders do not have the moral right to support any decongesting and beautification plans which will affect street hawking in the municipality. Stern measures should be taken to crack down on street hawking/ trading.

### **7.4 Developing Madina Inner City Roads**

There are many inner streets in Madina Municipality which needs to be developed. Currently only few arterial roads are motorable and all vehicles are concentrated there. It was therefore recommended that other inner roads should be developed to form a good alternative road network for the city. This will redistribute traffic and alleviate the perennial traffic congestion of the city.

## **7.5 Development of Satellite Markets (Bohye market and New Market)**

Traders from Bohye Market present at the stakeholders' workshop indicated that their place is infested with criminals which is why many traders do not want to sell at that place. Fortunately, unlike Tema, where there appears to be no land readily available for the construction of alternative market, ample prime spaces are available for the construction of the proposed satellite markets in Madina. Developing both the New Market and Bohye Market into new market complexes will improve and redistribute trading activities in the municipality. Participants of the meeting indicated that donor funding may be needed to accomplish the goal of building new market complexes. They expressed apprehension that when these capital-intensive projects are left for the municipal assembly to fund, there may unduly delay or the project may not see the light of day. In the proposed arrangements of the new markets, stakeholders suggested that there is the need to develop the accesses and parking areas very well to make the places safe and attractive to traders and shoppers.

## **7.6 Aesthetics of the Madina city**

Participants who had lived in Madina since the Mid-1970s stressed that the beauty of Madina then was comparable to towns in the advanced countries. Streets were well laid out, buildings were in accordance with plan, and there were no kiosks and street hawking. Now, things have changed and everyone is not following any regulations and plan. Madina has therefore lost its beauty due to illegal extensions of buildings and street hawking. The city has to restore its beauty and the surest way is through self-discipline, decongestion of the roads and enforcement of building and traffic regulations.

## **7.7 Use of Parking Spaces and Plans**

Many of the establishments such as banks and shopping malls within the municipality have their private parking lots reserved for their customers. Participants expressed concerns about the inadequacy of parking spaces in Madina. The customer's car park has been turned into market. The on-street parking on Old Road has been taken over by street hawkers. Therefore, shoppers do not have adequate parking spaces when they

come to shop at the market square. Motorists sometimes park in adjacent schools like the Nkwatanang school and walk to shop in the market. This is not very conducive for academic purposes.

### **7.8 Converting roads to one-ways**

Apparently, the vast majority of participants wanted the Old Road and other roads surrounding the market to be converted into a one-way. They were of the view that a one-way traffic scheme will improve traffic flow due to reduced conflicts between vehicles moving in opposite directions. Stakeholders were also of the view that the on-street parking in front of the market should be relocated to ensure that the one way will work proficiently.

### **7.9 Attitudinal Change**

Stakeholders were of the view that for the Madina Municipal to regain its beauty and liveability, there is the need for an overall behavioural change. City authorities, political leaders and the general public should change their attitudes. For instance, the authorities should not allocate road reservations and road pavements to traders, traders should understand the risk involved in the street hawking and pedestrians should endeavour to use the footbridges and facilities provided for their use.

### **7.10 Lessons learnt from the stakeholders' meeting**

Developing of satellite markets, that is, Bohye and New Markets is an important request of the Madina Municipality. Participants reiterated that donor funding is imperative to get this capital-intensive project completed. Just like the Tema Community 1 meeting, the stakeholders at this meeting wanted the Madina inner roads to be improved upon so as to relieve the arterial roads of the perennial traffic congestions. Decongesting the streets of hawkers and deploying one-way traffic movements on selected road segments will also improve traffic flow. Enforcement of traffic and trading regulations was underscored as the major driver to bring about attitudinal change and improve liveability of the Madina Municipality.

## 8 CONCEPTUAL PLANS

Generally, causes of road traffic congestion may be grouped under two main broad areas. Congestion may occur when there are more vehicles than the road can accommodate (demand > supply). It may also be caused by a bottleneck (e.g., drivers turning one of a two-lane road into a station, construction works, etc.) on a section of the roadway.

Congestions caused by bottlenecks can be resolved by simply removing the bottleneck.

However, road traffic congestion resulting from capacity problem are more challenging to resolve. Attempts to deal with the issue have, in the past, focused on building new roads and expanding existing ones. Mostly, space and financial constraints make it difficult to expand the road infrastructure to accommodate the increasing traffic demand, particularly in the urban areas. The other solution for dealing with congestion resulting from capacity issue, that is, reducing traffic volume by encouraging commuters to leave their vehicles at home to join mass public transport is not popular in the country.

Proper traffic management may also help reduce the traffic situation. Efficiently managing and optimizing the use of the existing transport infrastructure may also help in a great deal. This conceptual plan looks at all the scenarios available for prescribing a solution to the problem.

This conceptual plan prepared culminates from the existing known characteristics of traffic, traffic operations, network and others as explained in the previous chapters. The investigations and results derived from analysis of the focal issues, in greater part, inform the content of the plans.

## 8.1 Improving Traffic Mobility

### 8.1.1 Removing Bottlenecks

#### 8.1.1.1 Old Road

As discussed, road traffic congestion on the Madina Old Road is primarily as a result of trading activities on both sides of the road. Side friction caused by trading activities by the road side, drivers stopping in the middle of the road for passengers to alight and board their vehicles and some motorists slowing or stopping in the middle of the roadway to buy from roadside hawkers are the main causes. Again, the road width is not adequate to accommodate a two-directional traffic flow plus an on-street parking alternating on the sides of the road.

- *Prevention of on-street trading and the relocation of the on-street parking on the Madina Old Road will greatly improve traffic flow.*
- *A one-way traffic on the Old Road as shown in Figure 8-1 is proposed.*

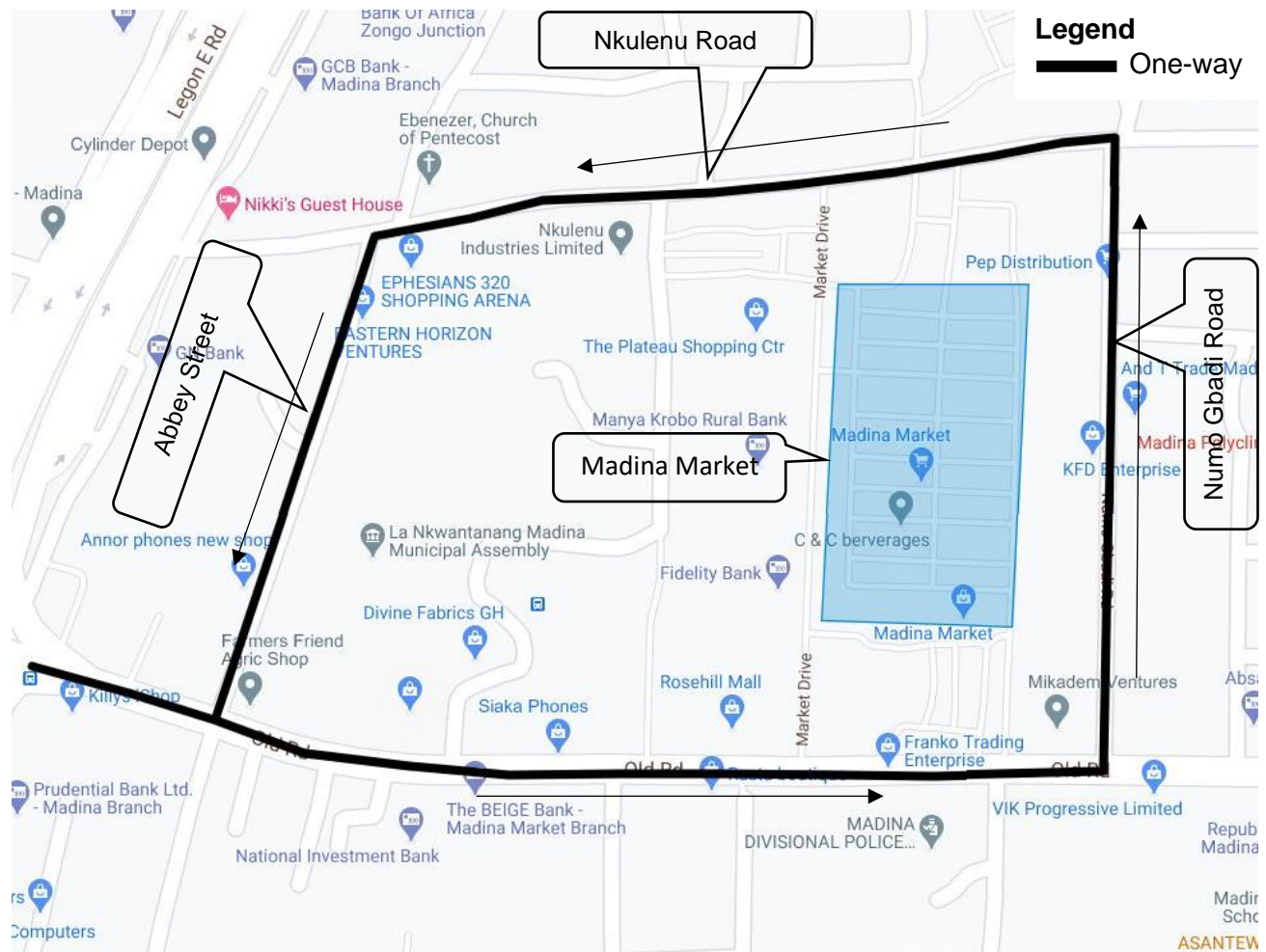


Figure 8-1: Proposed one-way circulatory lane around Madina main market

#### 8.1.1.2 Atomic Junction

Some commercial vehicles, particularly trotro drivers stop to offload and/or load passengers at the exit of the roundabouts impeding the smooth flow of traffic.

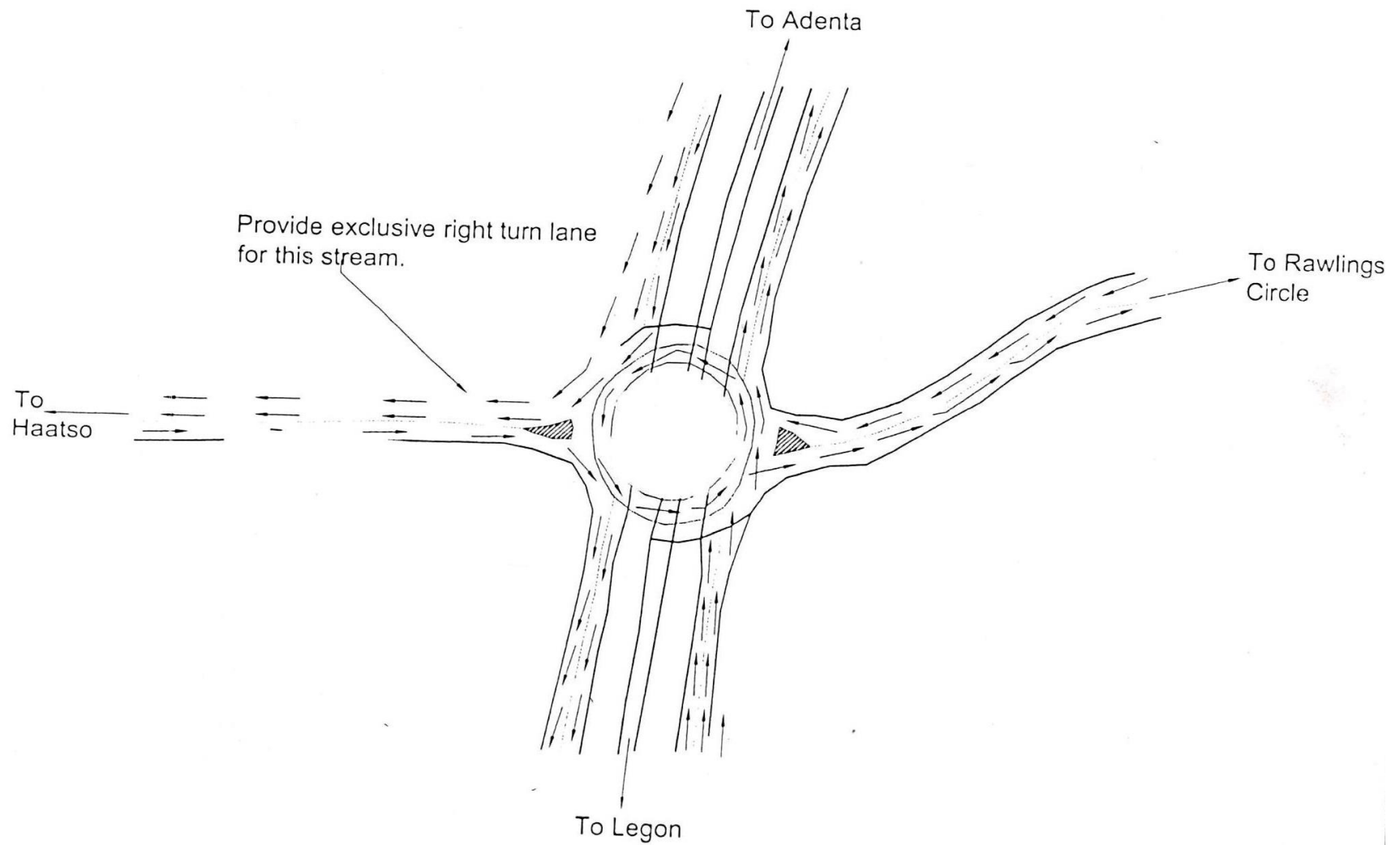
- *Putting a “No stopping”, “No waiting” signs, enforcing and making sure drivers stop at designated bus stops will reduce the congestion at the Atomic Junction.*

Providing an exclusive right-turn lane for vehicles traveling from Adenta to Haatso as seen in *Figure 8-2*.

There always seem to be a conflict between vehicles at the roundabout, impeding the smooth flow of traffic at peak periods. This has necessitated traffic wardens, directing traffic at the roundabout.

- The study will explore the possibility of improving traffic flow using signalization at the roundabout through simulation.





*Figure 8-2: Proposed configuration of Atomic roundabout*

### **8.1.2 Optimising the Use of the Available Road Space**

From the volume counts (including the turning movements), vehicles should be able to move freely, even during the peak periods, without experiencing any major delay aside control delays at the two traffic lights at Ritz and Zongo junctions and the Atomic roundabout.

#### **8.1.2.1 Introduction of an Efficient Public Transport System**

Cars, pickups, sports utility vehicles (SUVs), taxis and mini-buses (carrying an average of 7 passengers) are the most predominant transport modes in the study area. These “low occupancy” vehicles are a leading contributor to road congestion and air pollution and it is inefficient in terms of cost and operations. Considering the fact that population and economic activities are growing, the use of these low occupancy vehicles as the predominant transport mode is not sustainable.

A public mass transport system focusing on operational efficiency while providing improved accessibility and reliability to passengers should be the target. This can be operated on selected routes where travel demand is high. However, an implementation of this should look beyond the study area.

#### **8.1.2.2 Making Use of Advanced Traveller Information System**

Advanced Traveller Information System (ATIS) hold a huge potential to help deal with traffic congestion problem in cities. When traffic information is presented to drivers and commuters, it allows them to choose their departure time, route, mode of transport and even their destinations. Consequently, ATIS results in an optimal use of the existing road infrastructure. Fortunately, Google provides traffic information at the study location which commuters can access for free. City authorities can educate residents of the use and advantages of ATIS in helping them plan their journeys and to avoid congested areas when on the road. However, some requirement must be met to make the implementation of ATIS a success. There is the need to develop a network of roads instead of the continual expansion of major roads. In this way, drivers can utilize the traffic information

in deciding on other alternative good roads when the main road is congested to avoid delay.

## **8.2 Pedestrian Facilities**

Planning for transport should be sustainable. From the data, apart from the high pedestrian volumes which were recorded at some sections, a significant proportion of motorists' journeys were within walking distance. The team observed that some roadways could be redesigned, to take advantage of the wide right-of-way to accommodate pedestrian walkways. Some of these corridors are listed below:

- Asharley Botwe Road,
- Westland Boulevard, and
- Social Welfare Road.

In order to ensure the safety of the pedestrian, the sidewalks should be raised with kerbs to prevent conflict with vehicles.

Traders, who have taken over pedestrian walkways (e.g., on Old Road and Madina Adenta Highway N4), should be removed and the pavement maintained to ensure pedestrians have unrestricted access to the walkways.

On the Madina – Adenta highway, at locations where overhead footbridges have been constructed, pedestrians should be educated to use them instead of crossing at grade to help minimise the pedestrian fatalities.

## **8.3 Bicycle Facilities**

Bicycle infrastructure is also vital component of transport infrastructure. There is a bicycle infrastructure on the Madina – Adenta Highway (N4). The investigations revealed that the Ashaley Botwe Road could be redesigned to accommodate bicycle infrastructure.

The design could employ using one side of the road for pedestrian sidewalk and the other for the bicycle facility.

#### **8.4 Road and Pedestrian Crossing Markings**

The road inventory revealed absence of road markings on some of the roads surveyed and this needs immediate attention. This is also a safety issue since markings give motorists needed guidance and help to maintain lane discipline at all times.

Consideration should be given to reinstating existing pedestrian crossing markings which are defaced. From the surveys, some areas, indicated below, which exhibited high pedestrian volume requires pedestrian crossing facilities.

- Madina Market; and
- Police station

#### **8.5 Bus Stops or Lay-bys**

The Consultant found just a few bus stops within the study area. Considering the fact that drivers will at some point of their journeys, drop off and pick up passengers, bus stops have been proposed on the following roads. This is also informed by the proportion of commercial vehicles in the master station and screen line counts and the presence of schools.

- Old Road;
- Boundary Road;
- Ashaley Botwe;
- Presec Schools; and
- Lutheran School.

It is also proposed that “no waiting” sign should be placed at these bus stops and enforced to prohibit drivers from using them apart from dropping off and picking up passengers.

#### **8.6 Street Lights**

Driving at night is known to be one of the most daunting tasks commonly faced by the drivers. Poor night-time vision of some drivers, coupled with the poor road visual guidance result in the rather high night-time road traffic fatality rate. This is particularly high among

the vulnerable road user groups, that is, pedestrians and cyclists who also fail to make themselves visible by wearing retro-reflective material or light-coloured clothing.

From the study carried out, streetlights on a significant proportion of the roadways in the project enclave, particularly the local roads need to be fixed.

## **8.7 Parking**

An on-street parking facilities were identified at Madina–Adenta Highway (N4) and Old Road and an off-street parking facility was identified at the Madina main market. The capacity of both the on-street and off-street parking facilities has been reduced because some lots have been taken over by traders.

*Traders occupying parking lots should be removed to make the spaces available for use by vehicles.*

## **8.8 Parking Fee**

The daily permit of GHS 3.00, even for short parking duration (dwell time), must be reviewed. The Consultant is proposing an hourly parking pricing since dwell times of visitors to the parking facility may vary because of different needs. However, hourly parking pricing can actually increase demand and therefore congestion if imposed imprudently.

Our recommendation is that the hourly parking price should be highly elastic to dwell time with hefty fees being charged for longer parking of more than one hour.

## **8.9 The Madina Main Market**

Street hawkers were found along roads and some parking lots. It is proposed that a bigger modern market is built to accommodate all these traders. The Bohye market can be re-built for this purpose.

### **8.10 Three (3) Conceptual Plans to Address Traffic and Parking Issues.**

Per the ToR of the project, three conceptual plans to solve the identified problems in the previous chapters, concentrating on low cost but high return measures, paying attention to all transport modes should be proffered. From the foregoing, the conceptual plans are as presented below:

#### **Plan A: Removal of Bottlenecks and Efficient Traffic Management to Improve Mobility and Parking.**

The non-traffic factors (i.e., bottlenecks) resulting in congestions in the study area should be curtailed to improve mobility and parking.

Particularly, street traders plying their businesses on the sides of the Old Road should be relocated.

The on-street parking between Zongo Junction and the Old Road/ Agbotui Junction should be relocated.

An hourly parking pricing is proposed instead of the daily permit for all vehicles.

#### **Plan B: Redesigning and Improving Road Conditions in the Study Area**

Building and/or improving upon a network of roads is always good as it distributes the traffic instead of all motorists relaying on only a few good roads. The Madina inner-city roads must be re-constructed to improve internal traffic circulation.

Some roads could also be redesigned, to take advantage of the wide road shoulders to accommodate pedestrian walkways and cycle facilities. These roads are shown in *Figure 8-3*.

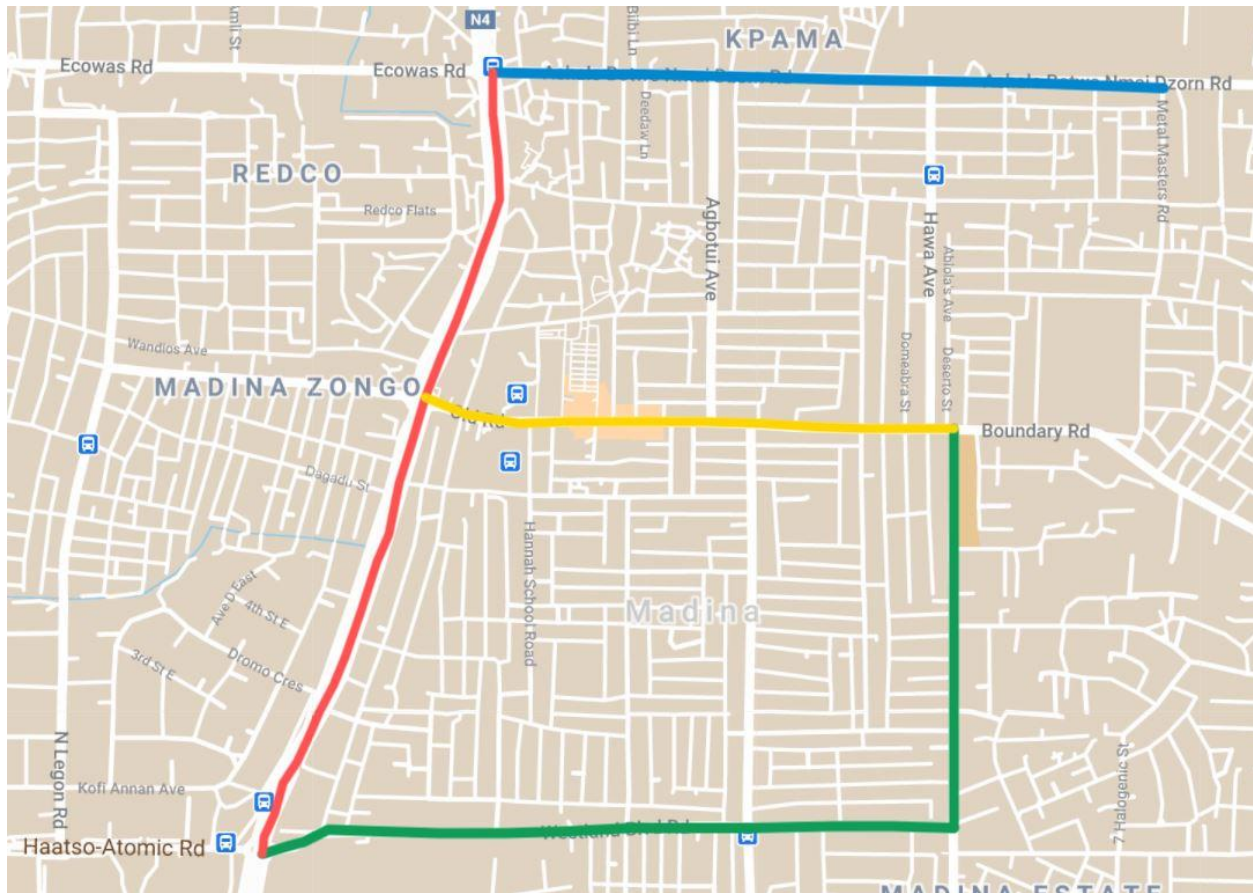
Generally, road improvement should tackle the following:

- Pedestrian facilities,
- Cycle facilities,
- Street lighting,
- Road markings and signs,

- Provision of bus stops,
- Covering up all open drains close to arterial and collector roads,
- One-way circulatory traffic scheme around the Madina main market,
- Improving parking facilities and management, and
- Clearing of squatter hawkers.

### **Plan C: Plan B and the Community One Market Redevelopment**

In addition to Plan B, Plan C proposes the development of the Bohye market into a modern, multi-storey building to accommodate more traders. The design of the market should have a well-designed car park to accommodate the vehicles of visitors.



*Figure 8-3: Proposed locations for pedestrian walkways and cycle lanes*

### Legend

- Pre-existing Pedestrian Walkway + Bicycle Lane
- Pre-existing Pedestrian Walkway
- Pedestrian Walkway + Bicycle Lane
- Pedestrian Walkway



## **9 CONCLUSIONS AND NEXT STEPS**

### **9.1 Conclusions**

This report described the specific tasks performed in identification of traffic and parking problems in Madina. The approach involved the following:

- Desktop study
- Reconnaissance Survey
- Traffic and Parking Data Collection and Analysis
- Community/ Stakeholder Consultation.

Problems that affect the efficiency of traffic flows in the study area have been identified and described. A discussion of the key results of the traffic and parking surveys as well as the network and safety conditions have been presented. In accordance with the ToR, three conceptual plans to solve the identified problems, taking into consideration all transport modes, have been provided. The conceptual plans, fall under the following work areas:

- Plan A: Removal of Bottlenecks and Efficient Traffic Management to Improve Mobility and Parking.
- Plan B: Redesigning and Improving Road Conditions in the Study Area.
- Plan C: Plan B and the Bohye Redevelopment.

### **9.2 Next Steps**

The following are the next immediate activities after approval of the Draft Final Report.

- Hold two public hearings with citizens and stakeholders for Tema; on this basis, assist local officials in selecting one option of the proposed three conceptual plans.
- Deepen the analysis of the selected options, taking all received comments into account, prepare a description of the measures to be taken and works to be carried out, including maps, plans, drawings and main technical specifications, and

revised cost estimates, all at a level of detail that corresponds to a pre-engineering study.

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## Appendix 1: Results of Road Inventory

Chainage	Carriage way Type (S/D)	Carriage way Width	Road Surface Type (G/B/C)	Road Surface Condition	Drain Type	Drain Shape	Drain Width	Sidewalk Presence (Y/N)	Street Light (Y/N)	Presence of Vendors (Y/N)	Presence of bus stop/lay-by (Y/N)
<b>Westland Boulevard</b>											
0.0-0.2											
LHS	S	8 m	B	G	C	V	0.7 m	N	Y	N	N
RHS	S	8 m	B	G	C	V	0.7 m	N	Y	N	N
0.2-0.5											
LHS	S	8 m	B	G	C	U	0.7 m	N	Y	N	N
RHS	S	8 m	B	G	C	U	0.7 m	N	Y	N	N
0.5-0.6											
LHS	S	8 m	B	G	C	U	0.7 m	N	N	N	N
RHS	S	8 m	B	G	C	U	0.7 m	N	N	N	N
0.6-0.7											
LHS	S	8 m	B	G	C	U	0.7 m	N	N	N	N
RHS	S	8 m	B	G	C	U	0.7 m	N	N	N	N
0.7-0.9											
LHS	S	8 m	B	G	C	U	0.5 m	N	N	N	N
RHS	S	8 m	B	G	C	U	1.2 m	N	N	N	N
0.9-1.3											
LHS	S	8 m	B	G	C	U	0.5 m	N	N	N	N
RHS	S	8 m	B	G	C	U	1.2 m	N	N	N	N
1.3-1.8											
LHS	S	8 m	B	G	C	U	0.5 m	N	N	N	N
RHS	S	8 m	B	G	C	U	0.5 m	N	N	N	N
Carriageway Type		Road Surface Type		Road Surface Condition		Median		Drain Type		Shoulder Type	Drain Shape
Single (S) Dual (D)		Gravel (G) Bituminous (B) Cement Concrete (CC)		Good (G) Poor (P) Bad (B)		None (N) Flat (F) Raised (R)		None (N) Earth (E) Stone pitched (SP) Concrete (C)		None (N) Gravel (G) Bituminous (B) Concrete (C)	U V Trapezoidal

Chainage	Carriage way Type (S/D)	Carriage way Width	Road Surface Type (G/B/C)	Road Surface Condition	Sidewalk Type	Sidewalk Condition	Drain Type	Drain Shape	Drain Width	Sidewalk Presence (Y/N)	Street Light (Y/N)	Presence of Vendors (Y/N)	Presence of bus stop/lay-by (Y/N)
<b>New Road</b>													
0.0-0.1													
LHS	S	12 m	B	G	PB	Fair	C	U	0.5	Y	Y	N	N
RHS	S	12 m	B	G	PB	Fair	C	U	0.5	Y	Y	N	N
0.1-0.3													
LHS	S	12 m	B	G	PB	Fair	C	U	0.5	Y	Y	N	N
RHS	S	12 m	B	G	PB	Fair	C	U	0.5	Y	Y	N	N
0.3-0.4													
LHS	S	12 m	B	G	PB	Fair	C	U	0.5	N	Y	N	N
RHS	S	12 m	B	G	PB	Fair	C	U	0.5	N	Y	N	N
0.4-0.6													
LHS	S	12 m	B	G	unpaved	P	C	U	0.5	N	Y	N	N
RHS	S	12 m	B	G	unpaved	P	C	U	0.5	N	Y	N	N
0.6-0.7													
LHS	S	12 m	B	G	unpaved	P	C	U	0.5	N	Y	N	N
RHS	S	12 m	B	G	unpaved	P	C	U	0.5	N	Y	N	N
0.7-0.8													
LHS	S	12 m	B	G	-	-	C	U	0.5	N	Y	N	N
RHS	S	12 m	B	G	-	-	C	U	0.5	N	Y	N	N
0.8-0.9													
LHS	S	12 m	B	G	-	-	C	U	0.5	N	Y	N	N
RHS	S	12 m	B	G	-	-	C	U	0.5	N	Y	N	N
0.9-1.0													
LHS	S	12 m	B	G	-	-	C	U	0.5	N	Y	N	N
RHS	S	12 m	B	G	-	-	C	U	0.5	N	Y	N	N
Carriageway Type		Road Surface Type		Condition		Median		Drain Type		Shoulder Type		Drain Shape	
Single (S) Dual (D)		Gravel (G) Bituminous (B) Cement Concrete (CC)		Good (G) Poor (P) Bad (B)		None (N) Flat (F) Raised (R)		None (N) Earth (E) Stone pitched (SP) Lined Concrete		None (N) Gravel (G) Bituminous (B) Concrete (C)		U V Trapezoidal (TRP)	

Chainage	Carriage way Type (S/D)	Carriage way Width	Road Surface Type (G/B/C)	Road Surface Condition	Drain Type	Drain Shape	Drain Width	Sidewalk Presence (Y/N)	Street Light (Y/N)	Presence of Vendors (Y/N)	Presence of bus stop/lay-by (Y/N)
<b>Agbotui Road</b>											
0.0-0.05											
LHS	S	12 m	B	G	C	U	0.5	N	N	N	N
RHS	S	12 m	B	G	C	U	0.5	N	N	N	N
0.05-0.2											
LHS	S	12 m	B	G	Not C	U	0.5	N	N	N	N
RHS	S	12 m	B	G	Not C	U	0.5	N	N	N	N
0.2-0.3											
LHS	S	12 m	B	G	C	U	0.5	N	N	N	N
RHS	S	12 m	B	G	C	U	0.5	N	N	N	N
0.3-0.6											
LHS	S	12 m	B	G	C	U	0.5	N	N	N	N
RHS	S	12 m	B	G	C	U	0.5	N	N	N	N
0.6-0.9											
LHS	S	12 m	B	G	C	U	0.5	N	N	N	N
RHS	S	12 m	B	G	C	U	0.5	N	N	N	N
Carriageway Type		Road Surface Type		Road Surface Condition		Median		Drain Type		Shoulder Type	Drain Shape
Single (S) Dual (D)		Gravel (G) Bituminous (B) Cement Concrete (CC)		Good (G) Poor (P) Bad (B)		None (N) Flat (F) Raised (R)		None (N) Earth (E) Stone pitched (SP) Concrete (C)		None (N) Gravel (G) Bituminous (B) Concrete (C)	U V Trapezoidal

Chainage	Carriage way Type	Carriage way Width	Road Surface Type	Road Surface Condition (G/B/C)	Drain Type	Drain Shape	Drain Width	Sidewalk Presence (Y/N)	Sidewalk Width	Street Light (Y/N)	Presence of Vendors (Y/N)	Presence of bus stop/lay-by (Y/N)
Nii Koi Atsen Avenue												
0.0-0.1												
LHS	S	10.0 m	B	Fair	Y	Y	0.7	N	-	N	N	N
RHS	S	10.0 m	B	Fair	Y	Y	0.7	N	-	N	N	N
0.1-0.5												
LHS	S	10.0 m	B	Fair	C	Y	0.7	N	-	N	N	N
RHS	S	10.0 m	B	Fair	-	Y	-	N	-	N	N	N
0.5-1.0												
LHS	S	12.0 m	B	G	C	U	0.70	Y	7.00	Y	N	N
RHS	S	12.0 m	B	G	C	U	0.70	Y	7.00	Y	N	N
Hawa Avenue (Botwe Road)												
0.0-0.15												
LHS	S	12.0m	B	G	C	U	0.5 m	N	N	N	N	N
RHS	S	12.0m	B	G	C	U	0.5 m	N	N	N	N	N
0.15-0.30												
LHS	S	12.0m	B	F	C	U	0.5 m	N	N	N	N	N
RHS	S	12.0m	B	F	C	U	0.5 m	N	N	N	N	N
0.3-0.9												
LHS	S	12.0m	G	F	C	U	0.5 m	N	N	N	N	N
RHS	S	12.0m	G	F	C	U	0.5 m	N	N	N	N	N

## Appendix 2: Summary of Master Station Count – Volume in PCU

<b>Route Name:</b> Westland Blvd								
<b>Census point:</b> Seed House								
<b>Traffic Direction:</b> Atomic Junction to Rawlings Circle (OUT)								
Time	Day of Week							ADT
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	
12:00-01:00	176	92	93	46	53	63	66	84
01:00-02:00	75	32	32	31	34	18	35	37
02:00-03:00	39	32	12	18	15	13	17	21
03:00-04:00	21	20	19	22	6	15	12	17
04:00-05:00	34	31	44	47	29	28	41	37
05:00-06:00	102	45	117	114	120	114	119	104
06:00-07:00	314	184	420	405	475	446	380	375
07:00-08:00	422	273	782	676	761	787	599	614
08:00-09:00	543	421	613	561	611	588	529	552
09:00-10:00	561	460	583	581	559	538	541	546
10:00-11:00	564	343	503	475	426	557	559	490
11:00-12:00	568	428	553	480	566	531	564	527
12:00-01:00	623	442	552	532	519	612	586	552
01:00-02:00	563	473	506	489	519	406	561	502
02:00-03:00	439	364	572	618	624	609	625	550
03:00-04:00	452	473	620	643	637	675	683	597
04:00-05:00	508	469	635	611	613	606	559	572
05:00-06:00	554	464	507	629	616	624	472	552
06:00-07:00	453	370	467	538	559	473	592	493
07:00-08:00	440	362	553	521	506	513	461	479
08:00-09:00	398	396	417	450	461	423	402	421
09:00-10:00	369	333	351	320	487	443	458	394
10:00-11:00	205	219	212	232	234	236	321	237
11:00-12:00	158	160	66	134	97	147	195	136



<b>Route Name:</b> Westland Blvd								
<b>Census point:</b> Seed House								
<b>Traffic Direction:</b> Rawlings Circle to Atomic Junction (IN)								
Time	Day of Week							ADT
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	
12:00-01:00	101	68	44	26	101	32	38	59
01:00-02:00	62	31	24	23	62	22	16	34
02:00-03:00	16	28	3	12	16	9	12	14
03:00-04:00	23	11	15	11	23	8	9	14
04:00-05:00	34	35	58	64	34	38	66	47
05:00-06:00	98	49	178	183	98	185	175	138
06:00-07:00	342	172	449	459	342	500	422	384
07:00-08:00	424	251	597	654	424	695	594	520
08:00-09:00	486	359	578	611	486	698	542	537
09:00-10:00	468	446	531	436	468	524	529	486
10:00-11:00	539	386	463	432	539	515	554	490
11:00-12:00	427	349	476	556	427	547	524	472
12:00-01:00	492	454	452	462	472	445	552	475
01:00-02:00	442	451	486	456	461	571	366	462
02:00-03:00	433	426	417	395	406	358	571	429
03:00-04:00	382	407	407	471	506	451	426	436
04:00-05:00	416	385	402	395	414	396	392	400
05:00-06:00	457	354	390	359	359	337	379	376
06:00-07:00	336	347	374	346	338	344	271	336
07:00-08:00	320	321	342	297	329	286	274	310
08:00-09:00	312	271	280	358	319	289	214	292
09:00-10:00	232	242	273	288	334	396	298	295
10:00-11:00	178	151	159	166	188	188	276	187
11:00-12:00	134	79	67	99	95	95	113	97

<b>Route Name:</b> Old Road								
<b>Census point:</b> Madina Police Station								
<b>Traffic Direction:</b> Market to Post Office (OUT)								
Time	Day of Week							ADT
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	
12:00-01:00	74	104	116	65	145	64	86	94
01:00-02:00	44	61	58	45	17	34	41	43
02:00-03:00	28	49	37	36	22	20	41	33
03:00-04:00	33	48	28	31	23	21	46	33
04:00-05:00	74	161	77	129	93	149	76	108
05:00-06:00	285	370	107	348	233	336	232	273
06:00-07:00	444	451	334	457	425	437	411	423
07:00-08:00	409	394	345	402	383	419	404	394
08:00-09:00	415	356	359	377	367	390	421	384
09:00-10:00	356	389	411	384	406	370	361	383
10:00-11:00	353	324	388	349	384	348	331	354
11:00-12:00	324	284	387	328	355	252	315	321
12:00-01:00	319	258	373	316	331	232	358	312
01:00-02:00	279	249	367	316	310	191	290	286
02:00-03:00	299	276	296	258	332	190	295	278
03:00-04:00	260	225	321	250	357	240	349	286
04:00-05:00	289	269	240	301	315	319	288	289
05:00-06:00	325	352	332	288	251	345	262	308
06:00-07:00	333	289	372	315	303	345	295	322
07:00-08:00	258	324	219	260	322	295	330	287
08:00-09:00	189	272	200	199	285	229	222	228
09:00-10:00	207	252	207	210	222	167	215	211
10:00-11:00	213	223	181	204	178	189	198	198
11:00-12:00	123	203	125	216	93	153	104	145

<b>Route Name:</b> Old Road								
<b>Census point:</b> Madina Police Station								
<b>Traffic Direction:</b> Post Office to Market (IN)								
Time	Day of Week							ADT
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	
12:00-01:00	86	118	88	69	52	64	92	81
01:00-02:00	40	72	38	53	27	26	23	40
02:00-03:00	38	35	26	48	25	31	28	33
03:00-04:00	39	64	43	47	31	44	50	46
04:00-05:00	133	139	74	172	133	169	133	136
05:00-06:00	371	427	181	371	301	338	243	319
06:00-07:00	593	640	418	656	582	653	589	590
07:00-08:00	725	635	521	669	771	693	726	677
08:00-09:00	456	384	525	559	563	542	551	511
09:00-10:00	422	285	522	422	444	319	469	412
10:00-11:00	343	219	490	403	387	296	379	360
11:00-12:00	244	235	482	259	342	264	311	305
12:00-01:00	270	240	495	261	367	237	326	314
01:00-02:00	280	233	465	234	356	225	287	297
02:00-03:00	276	301	507	343	282	278	356	335
03:00-04:00	256	278	470	318	291	206	392	316
04:00-05:00	233	196	479	375	245	327	272	304
05:00-06:00	264	239	420	337	283	358	357	322
06:00-07:00	340	214	431	348	367	465	417	369
07:00-08:00	400	401	367	390	305	460	384	387
08:00-09:00	397	330	312	324	227	386	349	332
09:00-10:00	296	278	234	230	170	294	243	249
10:00-11:00	235	207	217	179	167	205	200	201
11:00-12:00	175	133	125	102	96	140	118	127

### Appendix 3: Summary of Screen Line Count – Volume in PCU

#### Madina Post Office (Madina Market - Post Office)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	89		102		60	
06:15-06:30	110		126		41	
06:30-06:45	134		110		40	
06:45-07:00	120	453	109	446	48	189
07:00-07:15	171	535	159	503	44	173
07:15-07:30	167	591	146	523	50	182
07:30-07:45	134	592	116	529	80	221
07:45-08:00	171	643	131	551	87	260
08:00-08:15	168	640	138	530	104	321
08:15-08:30	120	593	121	506	110	381
08:30-08:45	117	576	158	548	106	408
08:45-09:00	98	504	123	540	105	426
<b>Pm</b>						
15:00-15:15	123		133		129	
15:15-15:30	107		86		151	
15:30-15:45	119		96		147	
15:45-16:00	131	480	79	394	168	595
16:00-16:15	139	495	110	371	168	634
16:15-16:30	89	477	129	414	117	599
16:30-16:45	108	466	157	476	137	589
16:45-17:00	120	455	138	534	159	580
17:00-17:15	84	400	114	539	114	526
17:15-17:30	109	420	159	568	115	524
17:30-17:45	136	449	115	527	134	521
17:45-18:00	144	473	135	523	102	465

Madina Post Office (Post Office - Madina Market)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	143		123		48	
06:15-06:30	178		176		40	
06:30-06:45	170		178		54	
06:45-07:00	168	659	174	650	50	192
07:00-07:15	168	683	172	700	55	199
07:15-07:30	180	685	168	692	63	222
07:30-07:45	172	687	209	724	68	236
07:45-08:00	173	692	203	753	84	270
08:00-08:15	164	689	154	735	97	311
08:15-08:30	174	683	176	742	105	354
08:30-08:45	170	681	142	675	72	358
08:45-09:00	162	670	178	649	123	397
<b>Pm</b>						
15:00-15:15	72		91		83	
15:15-15:30	104		60		86	
15:30-15:45	72		82		125	
15:45-16:00	61	309	63	296	138	431
16:00-16:15	66	302	79	284	170	519
16:15-16:30	84	283	94	317	128	561
16:30-16:45	95	306	103	339	101	538
16:45-17:00	98	344	118	394	132	532
17:00-17:15	106	384	108	423	93	455
17:15-17:30	118	417	102	432	117	444
17:30-17:45	108	429	115	443	104	446
17:45-18:00	156	487	130	455	121	435

Anglican Church (Rawlings Circle to Eco-bank)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	55		47		31	
06:15-06:30	66		63		69	
06:30-06:45	110		80		60	
06:45-07:00	133	364	75	265	64	224
07:00-07:15	153	461	91	309	75	268
07:15-07:30	127	522	97	343	76	275
07:30-07:45	167	579	126	388	31	246
07:45-08:00	80	527	120	433	67	249
08:00-08:15	136	510	113	455	96	271
08:15-08:30	117	500	154	513	103	298
08:30-08:45	93	426	109	496	66	333
08:45-09:00	150	496	138	514	79	345
<b>Pm</b>						
15:00-15:15	144		128		85	
15:15-15:30	150		158		90	
15:30-15:45	142		141		75	
15:45-16:00	130	566	161	589	71	321
16:00-16:15	148	570	144	605	50	286
16:15-16:30	154	575	153	600	49	244
16:30-16:45	159	592	144	603	78	248
16:45-17:00	109	571	157	598	93	270
17:00-17:15	94	517	167	621	80	299
17:15-17:30	109	471	174	642	84	335
17:30-17:45	108	421	144	642	92	348
17:45-18:00	100	411	131	616	85	341

Anglican Church (Eco-bank - Rawlings Circle)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	68		89		80	
06:15-06:30	65		87		80	
06:30-06:45	65		116		90	
06:45-07:00	78	276	145	437	31	282
07:00-07:15	65	274	80	428	55	257
07:15-07:30	112	321	106	447	62	238
07:30-07:45	84	340	115	446	97	244
07:45-08:00	81	343	163	463	74	287
08:00-08:15	86	364	150	533	78	310
08:15-08:30	121	372	136	564	119	367
08:30-08:45	124	412	157	606	111	382
08:45-09:00	103	434	119	562	125	433
<b>Pm</b>						
15:00-15:15	155		170		98	
15:15-15:30	136		119		90	
15:30-15:45	125		130		85	
15:45-16:00	144	560	105	524	102	375
16:00-16:15	50	455	150	504	85	361
16:15-16:30	50	369	120	506	106	378
16:30-16:45	94	338	180	556	85	378
16:45-17:00	163	357	142	592	96	372
17:00-17:15	127	433	104	545	119	406
17:15-17:30	156	540	125	551	104	404
17:30-17:45	142	588	82	453	104	423
17:45-18:00	111	535	94	405	119	445

Total Health (Ayalolo to Ritz Junction)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
Am						
06:00-07:00	66		77		83	
06:15-06:30	62		105		101	
06:30-06:45	79		98		79	
06:45-07:00	110	317	119	400	96	358
07:00-07:15	117	368	119	441	100	375
07:15-07:30	102	409	116	452	126	401
07:30-07:45	116	446	131	484	86	408
07:45-08:00	172	508	119	484	83	396
08:00-08:15	136	526	142	507	155	450
08:15-08:30	83	506	128	520	152	476
08:30-08:45	85	475	129	519	157	547
08:45-09:00	94	397	154	554	141	605
Pm						
15:00-15:15	146		143		162	
15:15-15:30	149		145		140	
15:30-15:45	153		119		131	
15:45-16:00	119	567	115	522	149	582
16:00-16:15	126	548	102	481	150	571
16:15-16:30	101	500	118	454	133	563
16:30-16:45	127	473	168	503	104	536
16:45-17:00	162	516	144	531	109	496
17:00-17:15	169	558	173	602	76	422
17:15-17:30	156	614	156	641	71	360
17:30-17:45	143	629	145	618	131	386
17:45-18:00	106	574	112	586	81	358



Total Health (Ritz Junction to Ayalolo)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
Am						
06:00-07:00	104		67		107	
06:15-06:30	92		75		112	
06:30-06:45	57		58		130	
06:45-07:00	77	331	92	292	149	498
07:00-07:15	73	299	69	294	113	504
07:15-07:30	81	288	111	330	92	484
07:30-07:45	79	311	111	383	103	458
07:45-08:00	74	308	85	376	107	416
08:00-08:15	123	358	125	432	113	416
08:15-08:30	71	347	104	426	138	462
08:30-08:45	75	343	90	405	109	467
08:45-09:00	121	390	93	413	100	460
Pm						
15:00-15:15	119		104		123	
15:15-15:30	107		92		110	
15:30-15:45	129		125		141	
15:45-16:00	101	455	92	413	110	485
16:00-16:15	130	466	128	437	118	479
16:15-16:30	91	450	86	431	86	455
16:30-16:45	118	439	116	422	125	439
16:45-17:00	98	436	102	432	129	458
17:00-17:15	109	416	110	413	150	490
17:15-17:30	104	429	95	422	79	483
17:30-17:45	100	411	116	422	119	477
17:45-18:00	76	389	97	417	77	425

Customs Boundary (Customs Bounded Warehouse to Madina Zongo)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	165		102		45	
06:15-06:30	123		143		26	
06:30-06:45	130		173		68	
06:45-07:00	219	637	212	631	49	188
07:00-07:15	187	659	269	798	87	231
07:15-07:30	184	720	238	893	65	269
07:30-07:45	153	743	193	913	93	294
07:45-08:00	198	722	163	863	119	364
08:00-08:15	189	724	196	789	105	382
08:15-08:30	99	639	165	716	82	399
08:30-08:45	153	639	168	691	111	417
08:45-09:00	79	520	131	659	75	372
<b>Pm</b>						
15:00-15:15	68		121		94	
15:15-15:30	73		92		79	
15:30-15:45	85		100		87	
15:45-16:00	88	314	82	395	86	347
16:00-16:15	132	379	81	355	92	344
16:15-16:30	87	392	101	364	77	342
16:30-16:45	74	382	112	377	82	336
16:45-17:00	58	351	59	355	54	304
17:00-17:15	104	323	72	345	84	297
17:15-17:30	116	351	82	325	103	323
17:30-17:45	134	411	66	279	70	311
17:45-18:00	90	443	57	276	81	338

Customs Boundary (Madina Zongo - Customs Bounded Warehouse)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	48		52		43	
06:15-06:30	47		53		38	
06:30-06:45	45		64		46	
06:45-07:00	67	207	77	245	60	187
07:00-07:15	64	223	76	269	44	189
07:15-07:30	99	275	99	315	52	203
07:30-07:45	66	296	107	358	60	217
07:45-08:00	74	303	70	351	55	211
08:00-08:15	59	298	73	348	46	213
08:15-08:30	98	297	81	331	39	200
08:30-08:45	68	299	78	302	53	193
08:45-09:00	58	282	80	312	62	200
<b>Pm</b>						
15:00-15:15	65		87		44	
15:15-15:30	85		82		71	
15:30-15:45	62		80		76	
15:45-16:00	50	263	80	329	99	290
16:00-16:15	74	272	88	330	71	318
16:15-16:30	54	241	94	342	51	297
16:30-16:45	87	266	122	384	84	305
16:45-17:00	82	297	107	410	77	283
17:00-17:15	109	332	73	396	80	291
17:15-17:30	80	357	105	407	56	297
17:30-17:45	71	342	108	393	73	286
17:45-18:00	81	341	103	390	68	277

Goil Filling Station (Social Welfare - Action SHS)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	95		67		27	
06:15-06:30	129		126		43	
06:30-06:45	136		132		70	
06:45-07:00	151	512	146	472	56	196
07:00-07:15	167	584	173	577	75	244
07:15-07:30	160	615	149	600	100	301
07:30-07:45	158	637	164	631	100	331
07:45-08:00	182	667	165	650	88	363
08:00-08:15	169	669	155	632	123	411
08:15-08:30	172	681	157	640	118	429
08:30-08:45	125	648	112	589	119	447
08:45-09:00	94	560	163	587	120	479
<b>Pm</b>						
15:00-15:15	105		121		99	
15:15-15:30	110		105		92	
15:30-15:45	111		113		99	
15:45-16:00	96	422	99	438	110	400
16:00-16:15	100	417	84	401	93	394
16:15-16:30	109	416	76	372	92	394
16:30-16:45	89	394	101	359	100	395
16:45-17:00	108	406	105	366	98	383
17:00-17:15	109	415	110	392	100	390
17:15-17:30	101	407	111	428	118	416
17:30-17:45	88	406	87	414	82	398
17:45-18:00	118	415	91	400	120	420

Customs Boundary (Action SHS - Social Welfare)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	31		29		31	
06:15-06:30	60		54		30	
06:30-06:45	61		64		39	
06:45-07:00	54	206	51	198	45	146
07:00-07:15	68	244	57	226	57	172
07:15-07:30	63	247	66	238	73	215
07:30-07:45	76	261	75	250	72	248
07:45-08:00	88	295	91	289	81	283
08:00-08:15	80	307	87	319	77	302
08:15-08:30	91	334	90	343	93	322
08:30-08:45	100	359	91	359	95	345
08:45-09:00	80	350	79	347	101	365
<b>Pm</b>						
15:00-15:15	118		147		110	
15:15-15:30	127		148		119	
15:30-15:45	142		149		98	
15:45-16:00	157	544	154	599	121	449
16:00-16:15	153	578	147	599	105	444
16:15-16:30	161	612	175	625	86	411
16:30-16:45	175	646	134	610	118	431
16:45-17:00	163	652	164	619	97	407
17:00-17:15	169	669	182	655	109	410
17:15-17:30	192	699	178	658	95	419
17:30-17:45	216	740	168	692	62	363
17:45-18:00	189	766	189	717	86	352

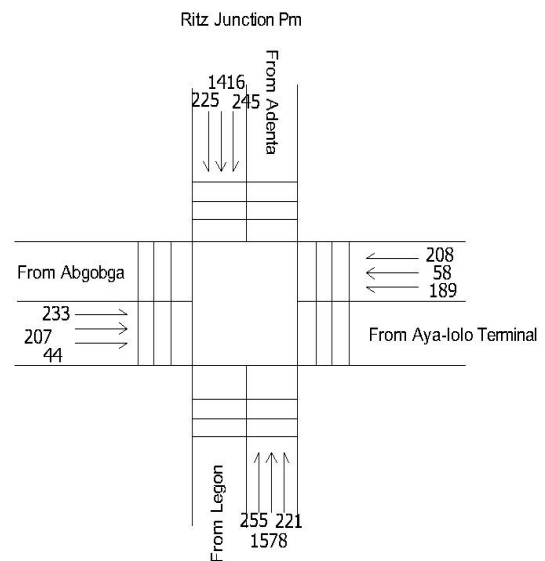
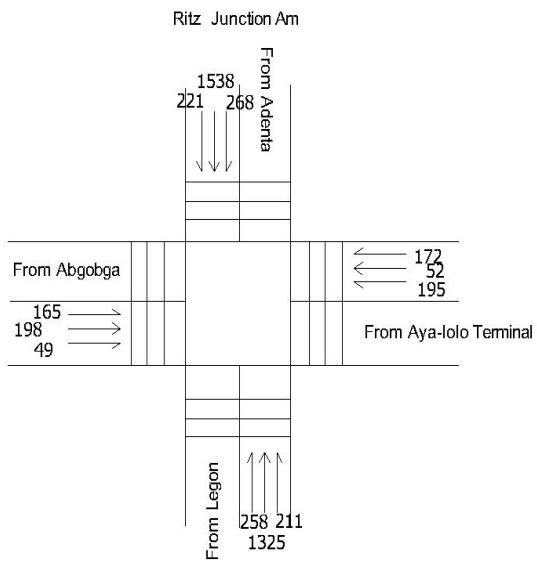
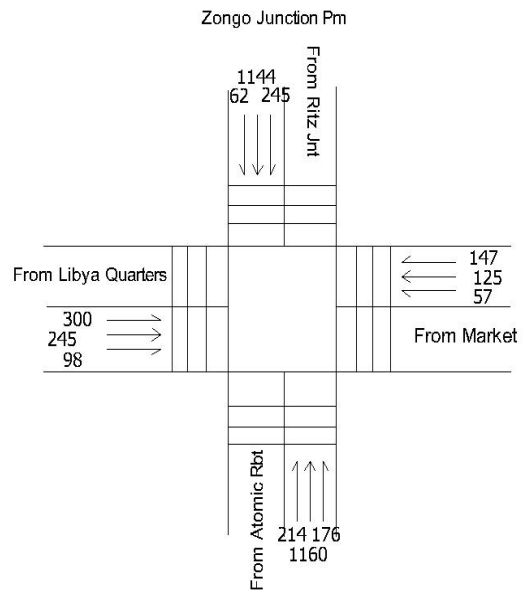
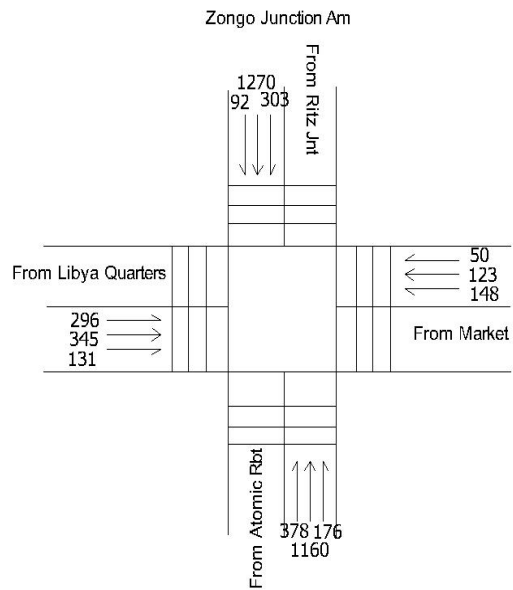
Presec Cluster of Schools (Rawlings Circle to Atomic Junction)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	79		24		28	
06:15-06:30	59		39		45	
06:30-06:45	62		62		34	
06:45-07:00	63	263	66	191	57	163
07:00-07:15	100	284	41	208	78	213
07:15-07:30	53	278	26	195	58	227
07:30-07:45	69	285	67	200	84	277
07:45-08:00	68	291	59	192	84	304
08:00-08:15	37	227	82	234	86	312
08:15-08:30	28	202	55	264	108	362
08:30-08:45	57	190	64	260	97	375
08:45-09:00	59	181	77	278	94	386
<b>Pm</b>						
15:00-15:15	102		71		110	
15:15-15:30	96		66		99	
15:30-15:45	74		64		103	
15:45-16:00	70	343	106	307	118	429
16:00-16:15	73	313	81	316	105	425
16:15-16:30	71	288	108	359	100	426
16:30-16:45	41	254	124	419	74	397
16:45-17:00	31	216	56	369	99	378
17:00-17:15	82	225	99	387	96	369
17:15-17:30	47	201	45	323	90	359
17:30-17:45	66	227	84	283	88	374
17:45-18:00	40	235	72	299	83	358

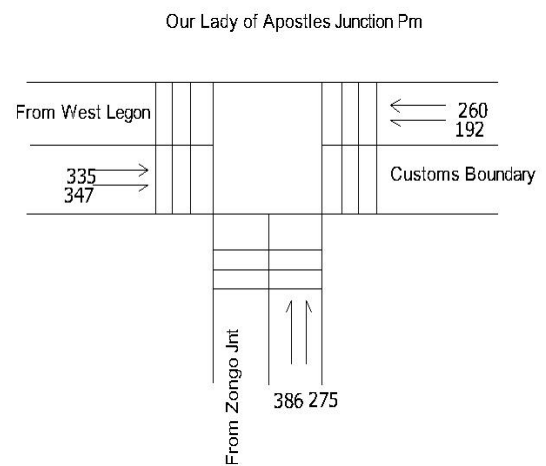
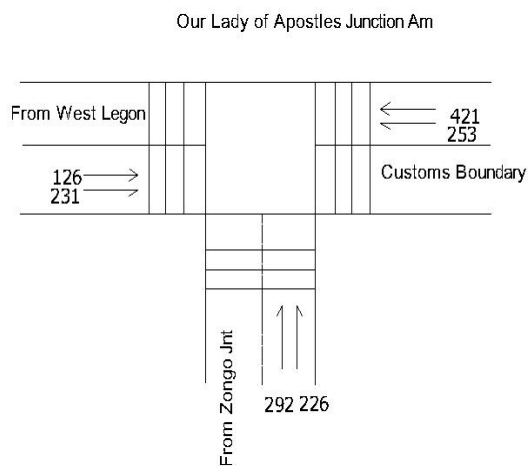
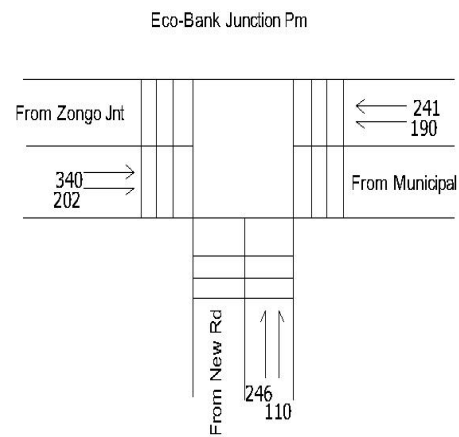
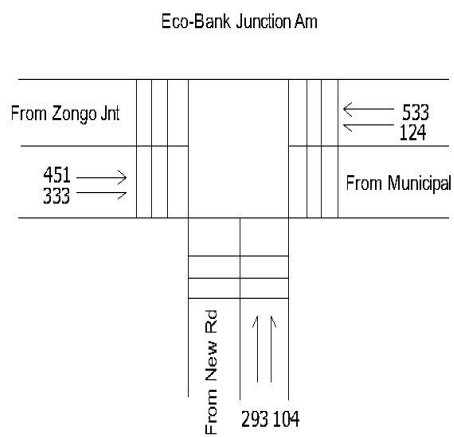
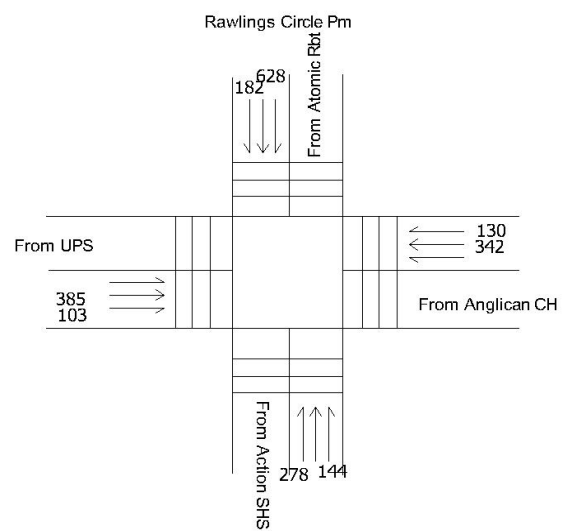
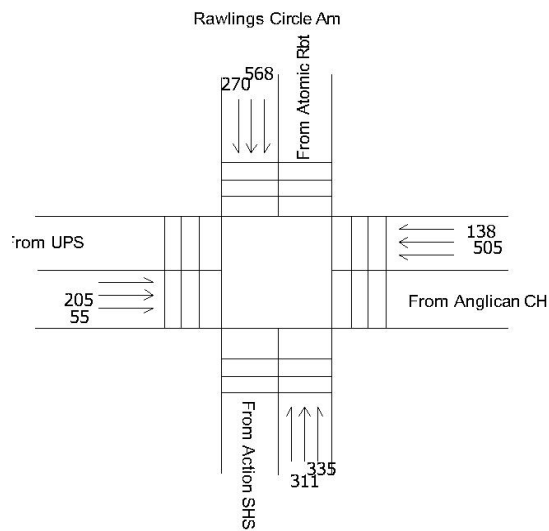
Presec Cluster of Schools (Atomic Junction to Rawlings Circle)

Time	Saturday	Hourly Volume	Tuesday	Hourly Volume	Friday	Hourly Volume
<b>Am</b>						
06:00-07:00	60		39		29	
06:15-06:30	54		57		31	
06:30-06:45	81		58		49	
06:45-07:00	75	270	50	204	16	125
07:00-07:15	75	286	69	235	68	164
07:15-07:30	84	315	53	231	75	208
07:30-07:45	97	331	69	242	56	215
07:45-08:00	108	364	58	249	84	284
08:00-08:15	95	384	61	240	49	264
08:15-08:30	110	410	69	256	49	238
08:30-08:45	97	410	62	249	39	221
08:45-09:00	84	386	56	248	43	180
<b>Pm</b>						
15:00-15:15	97		71		73	
15:15-15:30	69		85		94	
15:30-15:45	99		82		68	
15:45-16:00	101	366	96	333	73	307
16:00-16:15	110	379	74	337	69	303
16:15-16:30	90	400	82	334	67	277
16:30-16:45	110	411	94	346	48	256
16:45-17:00	115	425	69	319	73	257
17:00-17:15	74	389	91	336	77	265
17:15-17:30	72	371	90	344	77	275
17:30-17:45	60	321	85	336	70	297
17:45-18:00	54	260	82	349	64	288

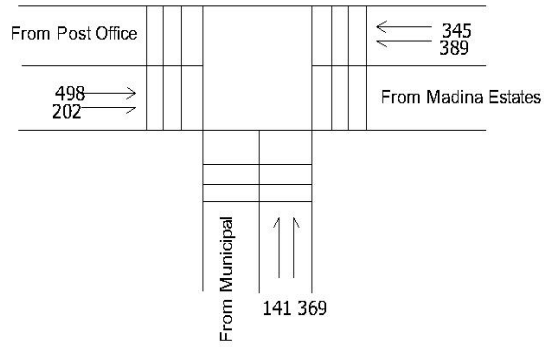
## Appendix 4: Junction Turning Movement - Volume in PCU



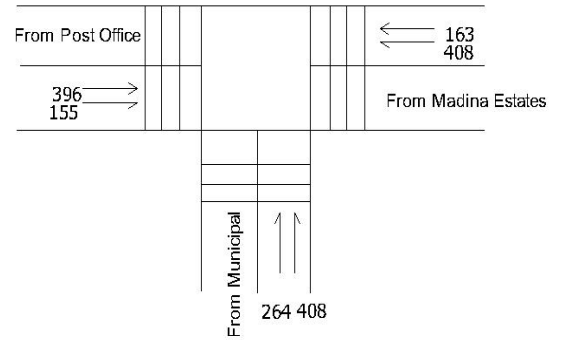




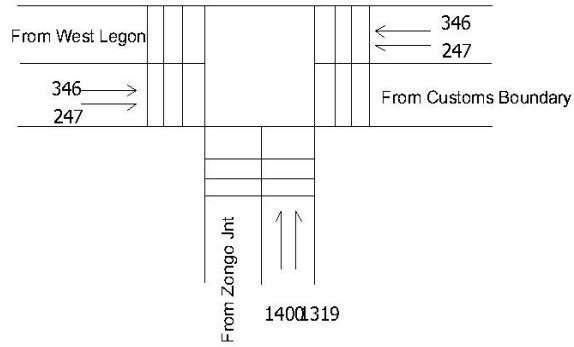
Social Welfare Junction Am



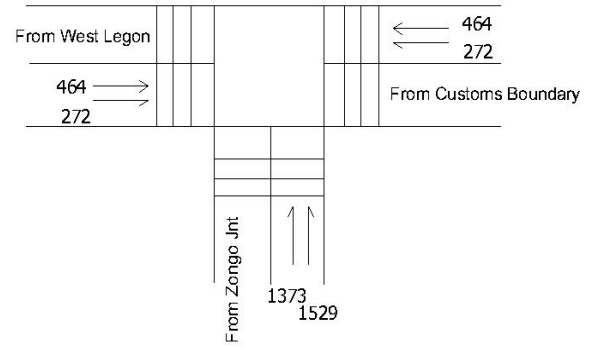
Social Welfare Junction Pm



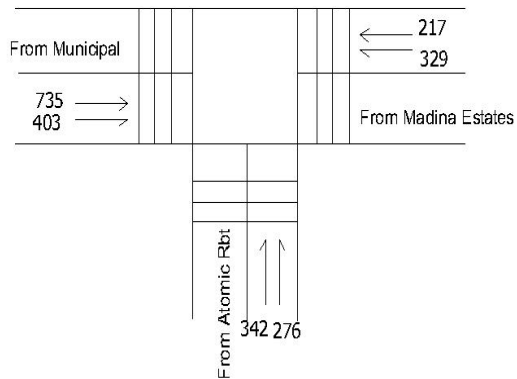
Hajia Hawa/Asharley Botwe Jnt Am



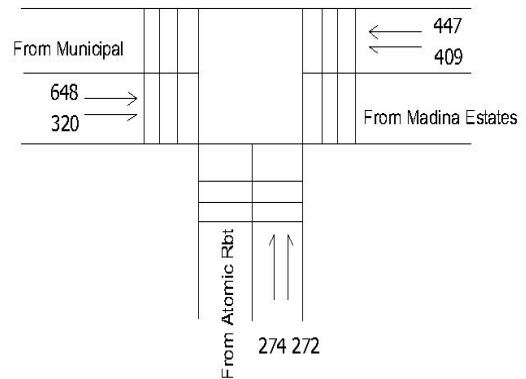
Hajia Hawa/Asharley Botwe Jnt Pm



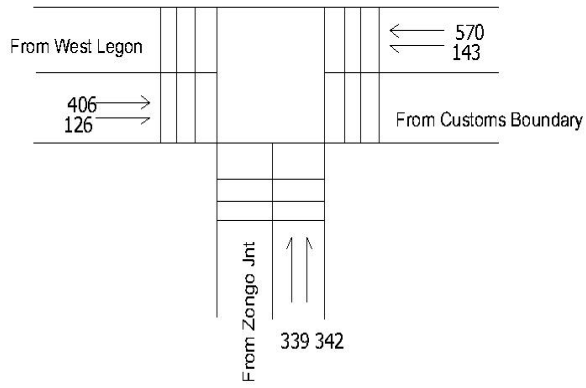
Action SHS Junction Am



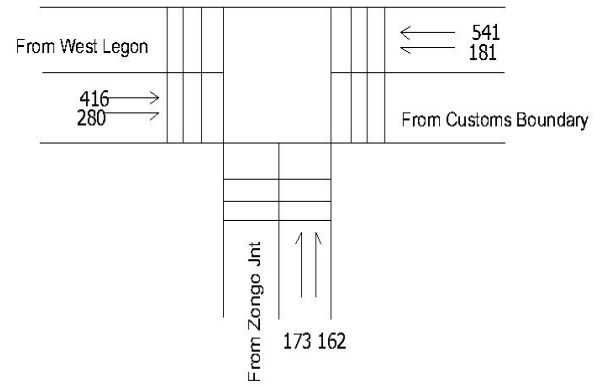
Action SHS Junction Pm



Hajia Hawa/Old Road Jnt Am



Hajia Hawa/Old Road Jnt Pm



## Appendix 5: Summary of Pedestrian Count Data

### Madina Police Station

Time	Sunday		Wednesday	
	Across	Along	Across	Along
<b>Am</b>				
07:30-07:45	54	375	45	335
07:45-08:00	34	377	49	390
08:00-08:15	27	480	68	475
08:15-08:30	26	383	74	400
08:30-08:45	31	417	57	416
08:45-09:00	33	420	60	421
09:00-09:15	32	374	71	352
09:15-09:30	29	313	63	385
<b>Pm</b>				
15:00-15:15	29	355	46	331
15:15-15:30	34	470	72	421
15:30-15:45	36	433	55	415
15:45-16:00	26	400	54	396
16:00-16:15	46	410	44	385
16:15-16:30	38	397	57	328
16:30-16:45	39	393	57	386
16:45-17:00	35	434	48	361

# Delcom Ltd Station

Time	Sunday		Wednesday	
	Across	Along	Across	Along
Am				
07:30-07:45	135	240	109	240
07:45-08:00	145	275	180	358
08:00-08:15	145	305	203	356
08:15-08:30	193	270	212	345
08:30-08:45	92	262	365	490
08:45-09:00	99	212	389	599
09:00-09:15	110	230	383	591
09:15-09:30	55	200	450	674
Pm				
15:00-15:15	75	225	286	388
15:15-15:30	90	205	316	437
15:30-15:45	127	200	308	394
15:45-16:00	75	242	317	406
16:00-16:15	80	180	278	349
16:15-16:30	72	197	407	474
16:30-16:45	50	195	329	461
16:45-17:00	70	160	288	377