MEASUREMENTS OF CARBON MONOXIDE CONCENTRATIONS AT MAJOR STALLING TRAFFIC POINTS IN MINNA, NIGER STATE, NIGERIA

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Abstract
This project was undertaken so that the levels of carbon monoxide concentrations at the major stalling traffic points in Minna could be determined. These stalling traffic points of Minna were initially georeferenced, the values archived on the Minna GIS, and then CO levels were measured at some of these stations during the morning, afternoon, and evening hours. The dataset acquired for this survey indicates that 22 stations (of the 33 stations occupied) had CO values greater than the 10ppm threshold for the morning hours, 15 stations (of the 16 occupied) had CO values greater than the 10ppm threshold for the afternoon hours, whilst 8 stations (of the 17 occupied) had CO values greater than the 10ppm threshold for the evening hours. Thus, for the time of day when traffic warden personnel are active in Minna (morning and afternoon hours) most of them would be continually exposed to hazardous levels of CO emissions; if they were to work into the evening hours, the exposure regime would be unchanged. The final result of this exercise is now a GIS CO level layer at stalling traffic points in Minna.

Keywords: Stalling traffic, GIS layer, georeference, noxious emission

Introduction
Carbon monoxide (CO) pollution is a constant menace facing the typical traffic warden at any of the major stalling traffic points in Minna. Knowing the levels of exposure to this kind of noxious emission should be of interest to the traffic warden personnel and the overseeing authority charged with public health issues, that is, the Niger State Environmental Protection Agency (NISEPA). This project was undertaken with such a target objective in mind. Furthermore, as a result of the current trend in handling georeferenced data, the dataset of this project was processed and displayed in conformance with the Geographic Information System (GIS) scheme.

Concept of Stalling Traffic Point: For this study, a “stalling traffic point” is defined to be a road junction or node where all practical motor-mobiles (i.e. cars, trucks, motor-tricycles, motor-cycles, etc.) necessarily decelerate upon approaching the junction, for practical safety purposes, and accelerate to change velocity as they exit that junction; the process of acceleration involves a revving of the engines of the motor-mobiles, with associated increase in the exhaust gaseous effluents. Thus, stalling traffic points are formed at intersections of road junctions and major stalling traffic points are formed at intersections of major road junctions (Jonah, 2013).

Concept of Parts Per Million (ppm): The parts per million (ppm) is commonly used as a measure of small levels of pollutants in air, water, body fluids, etc. Parts per million is the mass ratio between the pollutant component and the solution and ppm is defined as a way of expressing very dilute concentrations of substances. Just as per cent means out of a hundred, so parts per million or ppm means out of a million. One ppm is equivalent to 1 milligram of something per liter of water (mg/l) or 1 milligram of something per kilogram soil (mg/kg).

Carbon Monoxide Essentials: According to the Microsoft Encarta Premium (2009), carbon monoxide is a chemical compound of carbon and oxygen with the formula CO. Carbon monoxide is formed whenever carbon or substances containing carbon are burned with an insufficient air supply. Even when the amount of air is theoretically sufficient, the reaction is not always complete, so that the combustion gasses contain some free oxygen and some carbon monoxide. An incomplete reaction is especially probable when it takes place quickly, as in automobile engine; for this reason, automobile-exhausts gasses contain harmful qualities of carbon monoxide, sometimes several percent, although antipollution devices are intended to keep the level below 1 percent. As little as 1/1000 of 1 percent of carbon monoxide in air may produce symptoms of poisoning and as little as 1/5 of 1 percent may prove fatal in less than 30 minutes (being odourless means that carbon monoxide is an insidious poison that produces only mild symptoms of headache, nausea, or fatigue, followed by unconsciousness). Carbon monoxide is a major component of air pollution in urban areas. In addition to being present in automobile exhaust, carbon monoxide also occur in cigarette smoke. Carbon monoxide is an important industrial fuel because it contains more than two-thirds of the heating value of the carbon from which it was formed. It is a constituent of water gas, producer gas, blast furnace gas, and coal gas. In smelting iron ore, carbon monoxide formed from coke used in the process acts as a reducing agent, that is, it removes oxygen from the ore. Carbon monoxide combines actively with chlorine to form carbonyl chloride, or phosgene, and it combines with hydrogen, when heated in the presence of a catalyst to form methyl alcohol. The direct combination of carbon monoxide with certain metals, forming gaseous compounds, is used in refining those metals, particularly nickel. Carbon monoxide melts at -205^0 C (-337^0 F) and boils at -191.5^0 C (-312.7^o F).

According to Enger and Smith (2002), carbon monoxide (CO) is produced when organic materials, such as gasoline, coal, wood, and trash, are incompletely burned. The single largest source of carbon monoxide is the automobile. Although increased fuel efficiency and the use of catalytic converters have reduced carbon monoxide emissions per kilometer driven, carbon monoxide remains a problem because the number of automobiles and the number of kilometre driven have increased. In many part of the world, automobiles are poorly maintained and many have inoperable pollution control equipment, resulting in even greater amount of carbon monoxide. The next largest source of carbon monoxide is smoking cigarettes and other tobacco products. Currently in the United States and some other countries, there is a great deal of pressure to restrict areas where smoking is permitted to minimize exposure to second-hand cigarette smoke. Restaurants designate nonsmoking sections (some even advertise themselves as smoke-free), public buildings have designated nonsmoking areas, and corporations and colleges are designating their buildings as smoke free. Smoking is decreasing in the industrialized world today, but in the developing nations, smoking retains its image of glamour and sophistication as a result of extensive marketing campaigns by cigarette companies. Several hours of exposure to air containing 0.001 percent of carbon monoxide can cause death. Because carbon monoxide remains attached to hemoglobin for a long time, even small amounts tends to accumulate and reduce the blood’s oxygen-carrying capacity. The amount of carbon monoxide produced in heavy traffic can cause headaches, drowsiness, and blurred vision. A heavy smoker in congested traffic is doubly exposed and may experience several impaired reaction time compared to nonsmoking drivers. Fortunately, carbon monoxide is not a persistent pollutant. Natural processes convert carbon monoxide to other compounds that are not harmful. Therefore, the air can be cleared of its carbon monoxide if no new carbon monoxide is introduced into the atmosphere. At the present, there exist no specific studies targeted at understanding the factors that contribute negatively to impact the health of traffic warden personnel at Minna. These traffic warden personnel spend almost all their active working hours at the stalling traffic points of Minna town.

The objectives of this study are the following, namely:

(i) To measure carbon monoxide emission levels at stalling traffic points at Minna.

(ii) To create a Geographic Information System (GIS) layer of carbon monoxide emission levels at these stalling traffic points for Minna town. Naturally, such a carbon monoxide emission level GIS layer is substrated upon the existence of a GIS database for Minna.

The creation of a carbon monoxide emission level GIS layer at stalling traffic points for Minna town would contribute immensely to the public health repository database of the Niger State Government. Such a database would form a critical component of the public health policy formulations of the Niger State Government. Also, Jonah *et al.* (2009; 2010; 2011) have built frameworks for carbon monoxide pollution studies and the authors have always recommended continuous carbon monoxide monitoring studies and mitigation schemes.

Malakootian and Yaghmaeian (2004) investigated the levels of carbon monoxide in heavy traffic intersections of Kerman municipal districts in 2003-2004. Kerman City is located at the southeastern part of Iran. Carbon monoxide is highly toxic for human health and natural ecosystems in metropolitan districts especially due to high traffic and industrial activities. For this reason, the authors decided to investigate and the high of CO pollutants in heavy traffic intersections of Kerman City. In this regards, 21 heavy traffic squares and intersections were selected and the concentration of CO were measured. In the middle of each month during the year, sampling and measurement were scheduled three times at daily times according 7-12 a.m.; 12-16 and 16-20 p.m. In each period, 12 samples of 5 minutes were collected and CO concentration for 1-hr was calculated. The results obtained indicate that the hourly mean concentrations were lower than WHO guidelines and also lower than measurements of 1989, which was already done. In spite of more cases and higher populations, natural gas distribution was the cause of decline in CO concentrations.

In a study of vehicular emissions and air quality standards in Nigeria, Abam *et al.* (2009) investigated vehicular emissions in selected areas in Calabar Nigeria. These areas, MP1, MP2 , and MP3 were considered with nine sampling points (SP1 – SP9) in each area placed 8.0m away from the edge of the road in downwind direction. Priority parameters: carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter-10 (PM_{10}) and noise level were monitored. Other relevant parameters monitored includes ambient temperature, wind direction, wind velocity and traffic count. The results of CO, NO_2, SO_2, PM_{10} and noise level were in the range of 3.3-8.7 ppm, 0.02 – 0.09 ppm, 0.04 – 0.15 ppm, 170 – 260 $\mu g/m^3$ and 58.5 -72.4 dB respectively. The highest level obtained for the air pollution indicators for CO was: 8.7 ppm, 7.6 pm and 7.4 ppm at SP1 for day 1, 2 and 3. The concentration of SO_2 was highest at SP2 with values 0.10ppm and 0.12ppm. Emission concentration for NO_2, PM_{10} and noise level was found to be highest at SP2 where traffic intersections and traffic count is high. All the five monitored air pollutants when compared with AQI level (Air Quality Index) were in the range of: CO – poor to moderate and moderate to poor in different locations, SO_2 – was from very poor to poor, NO_2- from very poor to poor, PM_{10} and noise level was poor at all locations. The overall comparison of data for different sections show that concentration of pollutants is highest at (SP1 – 3) and (SP8

– 9) in the three areas MP1, MP2 , and MP3 due to volume of traffic and pollution. The study concludes that transport-related pollution in Calabar is indeed significant with possible severe health consequences.

During the 2008 Olympics, the Chinese government made a significant effort to improve air quality in Beijing, including restrictions on traffic. They estimated the reductions in carbon monoxide (CO) and carbon dioxide (CO_2) emissions resulting from the control measures on Beijing transportation. Using MOPITT (Measurements of Pollution in the Troposphere) multispectral satellite observations of near-surface CO along with WRFChem (Weather Research and Forecasting model with Chemistry) simulations for Beijing during August, 2007 and 2008, they estimated changes in CO due to meteorology and transportation sector emissions. Applying a reported CO/CO_2 emission ratio for fossil fuels, they found the corresponding reduction in CO_2, 60 ± 36 Gg[CO_2]/day. As compared to emission scenarios being considered for the IPCC AR5 (Intergovernmental Panel on Climate Change, 5th Assessment Report), this result suggests that urban traffic controls on the Beijing Olympics scale could play a significant role in meeting target reductions for global CO_2 emissions (Worden, et al, 2012).

In a study to estimate air pollution in Béjaia city in Algeria, Alkama et al (2006) used an enclosure of 0.80 m^3 for the collection of gases directly on the outlet side of the tailpipe of the vehicles. A three-gas detector (MX21 plus), introduced inside the enclosure, measures the rates of carbon monoxide CO, sulphur dioxide SO_2 and nitric monoxide NO. The authors studied the exhaust pollutants according to the age of the vehicles (1980 – 2004) and the acceleration of the engine; measurements related to a sample of 204 vehicles using gasoline or diesel oil fuel. The authors counted the number of vehicles passing through the Daouadji square during one month (March 2004) and calculated the total pollution rejected. The comparison with the air pollution measured *in situ* confirmed that urban pollution is primarily from automobile sources. On the curve of the weekly evolution of the air pollution the days and peak hours of the automobile traffic appear clearly. The correlation with the number of vehicles is very significant (0.78). By taking account of the annual rate of increase in the number of vehicles and keeping the current park without adequate maintenance, a statistical model envisages an unbearable urban pollution near 2010. The authors were encouraged to challenge the authorities on the urgency of the introduction of the vehicle inspection and technical control by comparison between the rejections and the standard European, American and Japanese norms. Except the new vehicles (less than 5 years old), where the results are comparable, the others exceeded by far those standards.

The Study Area: This study is centred on Minna town, the stations of interest being the major stalling traffic points: forty (40) such locations have been identified. These are listed in the Appendix 1. These major stalling traffic points are, for practical purposes, not evenly-spaced but are easily identified within the Minna built-up town centre. As expected of a typical traffic node, motor-mobiles are the primary sources of CO at these locations. The Minna built-up town centre (from the Maryam Babangida Girls Science Secondary School in the north to the Abdulkareem Lafene State Secretariat in the south, and the southwest-northeast Kpakungu-Maitumbi axis), was covered for this study.

Survey Procedures

Site Selection: The areal extent of Minna town was earmarked for this survey, initially to cover all of Maikunkele to Chanchaga and all of the outlying neighbourhoods of Kpakungu to the outlying neighbourhoods of Maitumbi. However, because of the need to create a Geographic Information System (GIS) layer of carbon monioxide signature substrated on an existing Minna GIS, and because the existing Minna GIS was substrated on the acquired analogue map of Fig. 1 the areal extent selected for this study covered the Maryam Babangida Girls Science Secondary School in the north to the Abdulkareem Lafene State Secretariat in the south, and the southwest-northeast Kpakungu-Maitumbi axis.

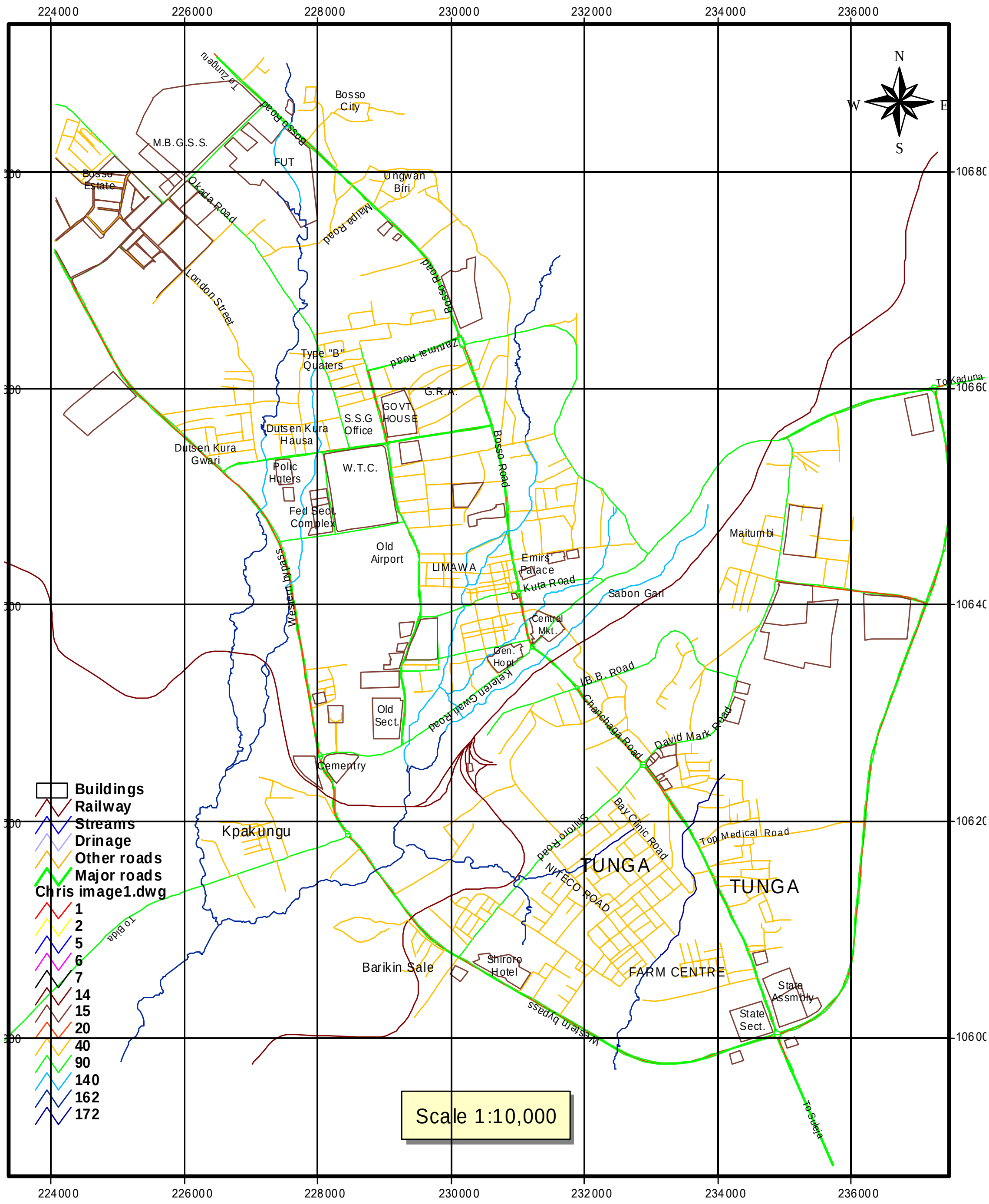

Fig. 1: Analogue map of Minna (Source: Datanet Services, 2012)

Survey Tools: Field Compass: The common field compass was used extensively during the course of this survey as a key direction-finder. Since the map of Fig.1 has a directional icon indicating the four cardinal points, the compass enabled the survey party to confirm that the vicinity of Maryam Babangida Girls Science Secondary School (the most northern of the stations of interest) is truly northward of the staging or muster point for this survey, i.e. the Federal University of Technology, Minna's Bosso Campus. The compass was also used in tandem with the hand-held Global Positioning System (GPS) unit to eliminate any doubt whatsoever as to whether the study group members were on an exact straight course, when this information was desired.

Hand-held Global Positioning System (GPS) Unit: The Garmin *etrex* hand-held Global Positioning System (GPS) unit was employed chiefly for georeferencing of stations of interest during the course of this survey; it was also used in tandem with the field compass, for a minor role sort of, to confirm a defined "rectilinear" direction. Actually, the aforementioned existing Minna GIS, specific to this study, was created by reliance on georeferencing information acquired by means of the Garmin *etrex* hand-held (GPS) unit, thus ensuring a modicum of fidelity.

Carbon Monoxide Meter: The carbon monoxide meter employed for this survey was the CROWCON GASMAN CO meter. The CO meter is a personal gas detector which is designed to be worn by individuals working in hazardous environments, such as confined spaces and will give a loud audible and bright visual alarm warning when pre-set concentrations of gas are exceeded. It has a typical measuring range of 0-500 ppm, typical alarm levels of 30 and 100ppm, and typical response time (T_{90}) of about 10 seconds.

Carbon Monoxide Measurements at Stalling Traffic Points: A measurement using the CO meter proceeded by occupying the first georeferenced road stalling traffic point for this survey, i.e. the road junction opposite the Ja'afaru Mairiga Motel. Initially, the CO meter was turned on (i.e. by pressing down the large power button) whence the device went through some self-test routines like alarm test, LCD test, and battery level test. After the entire test, the CO reading for that particular place was displayed numerically on the LCD screen. At each of the stalling traffic point of interest, three different values of the CO level at that instant were measured and recorded.

Dataset of Study: The body of acquired data for this study is presented as Appendix 2.

Data Analysis and Creation of a Geographic Information System (GIS) Layer of Carbon Monoxide Emissions

Carbon Monoxide Emission Analysis: For this study, a carbon monoxide (CO) level threshold of 10 parts per million (ppm) was selected: According to the European Commission, air quality standard CO safe threshold is 10 ppm; values less than this amount are within tolerable levels, whilst values greater than this amount are considered hazardous, although time of exposures is an important factor to be considered. Average CO levels for the set of three readings at each of the stalling point were computed and tabulated, see Appendix 2.

Creation of a Carbon Monoxide Emission Geographic Information System (GIS) Layer for Major Stalling Traffic Points at Minna: The carbon monoxide level GIS layer for this study was substrated on the existing Minna Geographic Information System (MGIS). The composite GIS CO level maps for the morning, afternoon, and evening hours at the stalling traffic points are as shown in Figs 2-4.

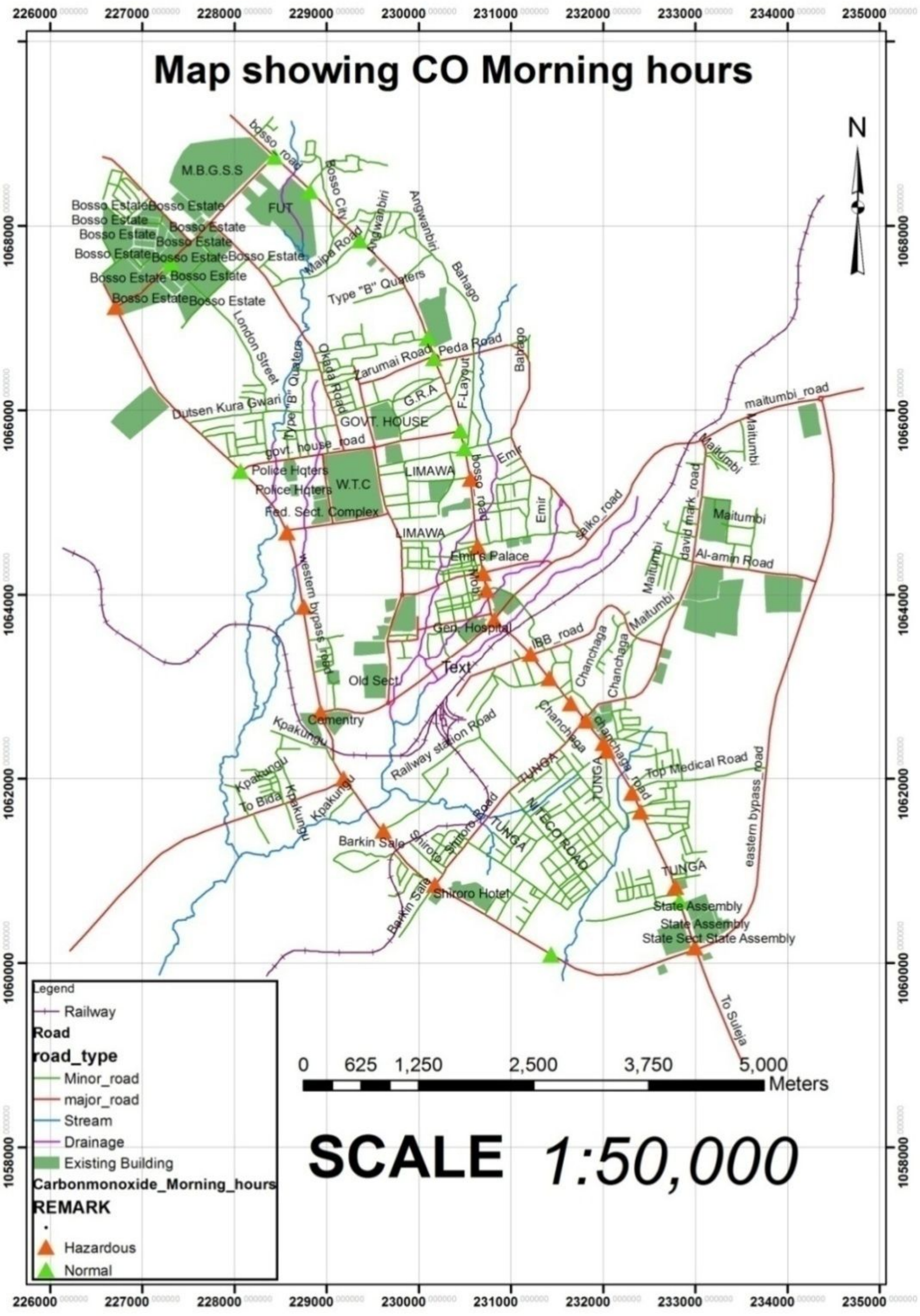

Fig. 2: Composite GIS CO level map for the morning hours

Note: The red and green triangles at the identified major stalling traffic points visited during the morning hours indicate "hazardous" and "normal" levels, above and below the 10ppm threshold.

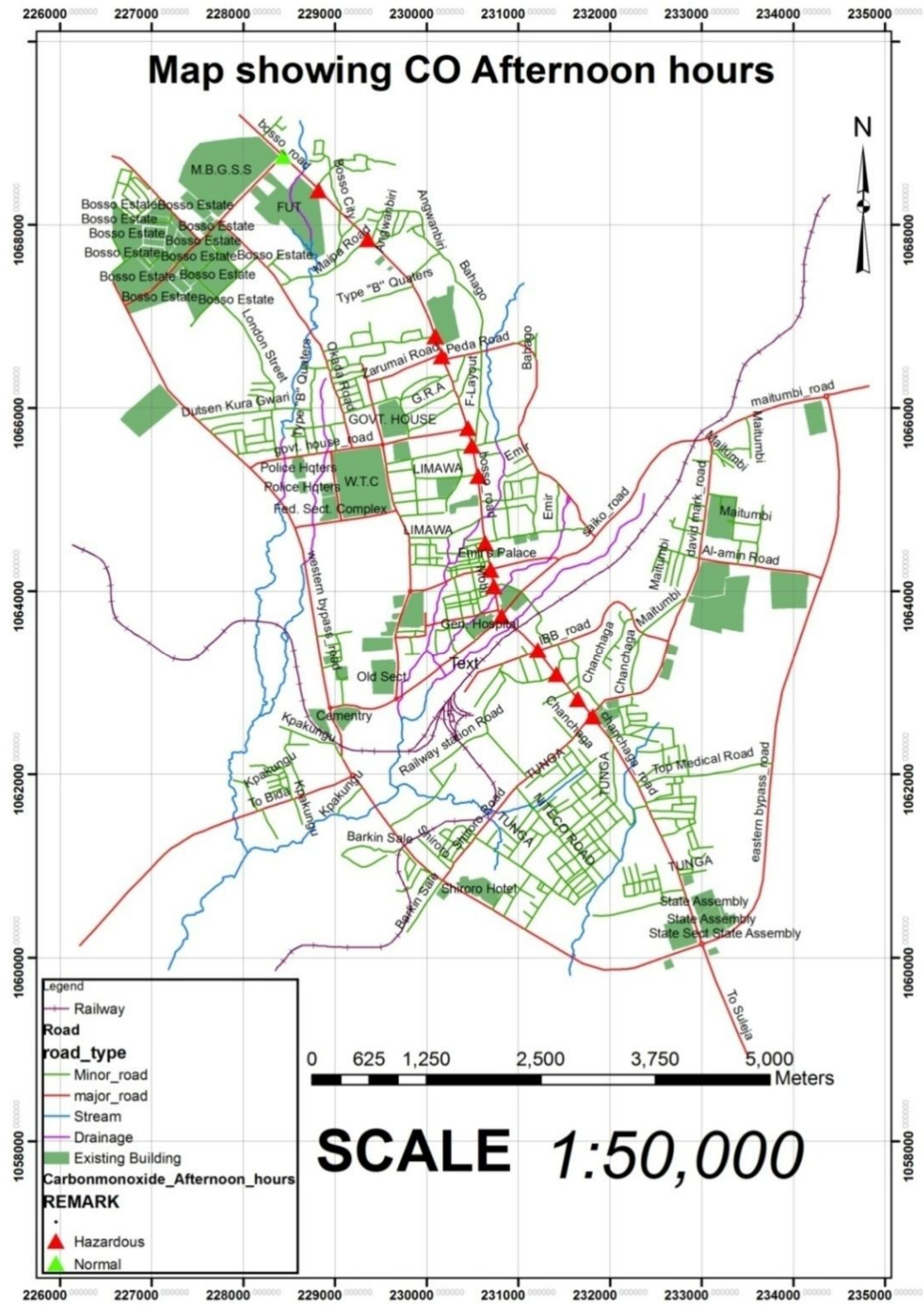

Fig.3: Composite GIS CO level map for the afternoon hours.

Note: The red triangles and the green triangle at the identified major stalling traffic points visited during the afternoon hours indicate “hazardous” and “normal” levels, above and below the 10ppm threshold; only a single “normal” station was encountered here.)

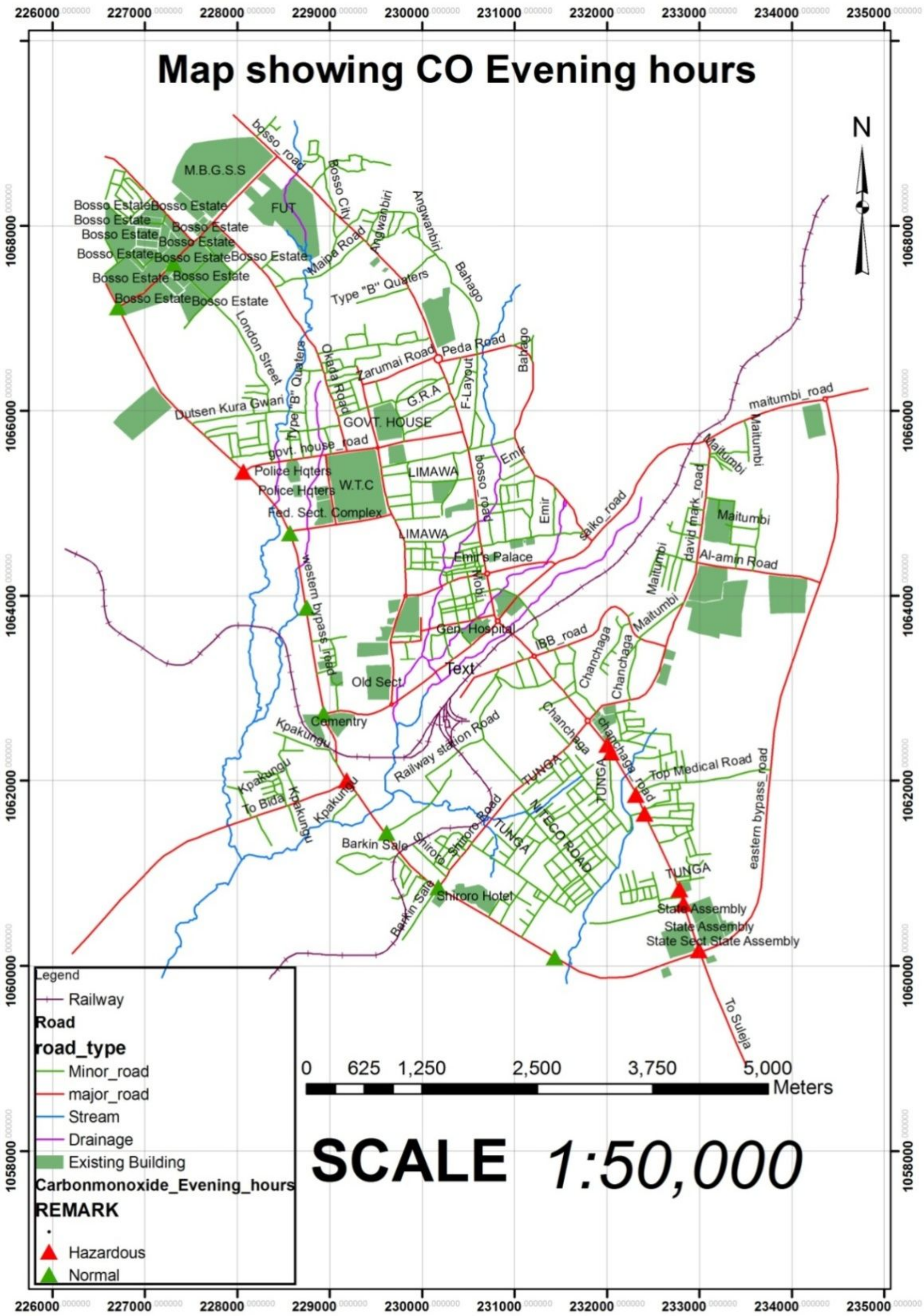

Fig.4: Composite GIS CO level map for the evening hours.

Note: The red and green triangles at the identified major stalling traffic points visited during the evening hours indicate "hazardous" and "normal" levels, above and below the 10ppm threshold.

Discussion

For this study, "morning hours" surveys were those carried out between the 00:01a.m.-11:59a.m interval, "afternoon hours" surveys were carried out between the 12:01p.m.-06:59p.m interval and "evening hours" surveys were carried out between the 07:01p.m.-11:59p.m interval. The dataset acquired for this survey indicates that 22 stations (of the 33 stations occupied) had CO values greater than the 10ppm threshold at the instant of measurement for the swath of measurement interval corresponding to the morning hours, 15 stations (of the 16 stations occupied) had CO values greater than the 10ppm threshold at the instant of measurement for the swath of measurement interval corresponding to the afternoon hours, whilst 8 stations (of the 17 stations occupied) had CO values greater than the 10ppm threshold at the instant of measurement for the swath of measurement interval corresponding to the evening hours. Based on the MGIS, CO-level GIS layers for the morning, afternoon, and evening hours were created for the stalling traffic points of Minna that were visited at those times; these are the composite maps, see Figs 2-4: light green colour code was assigned to stations with CO levels below the threshold of 10ppm whilst red colour code was assigned to stations with CO levels above the threshold of 10ppm.

Conclusion

The result of this survey shows that for the time of day when traffic warden personnel are active in Minna (morning and afternoon hours) most of them would be continually exposed to hazardous levels of CO emissions; if they were to work into the evening hours, the exposure regime would be unchanged. Carbon monoxide exposure at the major stalling traffic points in Minna is high overall, albeit over disparate intervals (i.e. not a continuous stream or a continuum); this still calls for concern because of the risk of the gradual build-up of carboxy-haemoglobin in the bloodstream. The final result of this exercise is now a GIS CO level layer at stalling traffic points in Minna. This GIS CO level layer is now a veritable audit mechanism tool for stalling traffic points at Minna.

Recommendation

What could be done for now is the archival of the result of this survey for future reference purpose and the continual monitoring of these carbon monoxide levels. Furthermore, for the stalling traffic points where they may found traffic warden personnel should be enlightened (by agents of government who are stakeholders of this study) to the fact of the presence of another kind of risk situation to them (there are several risk situations like hit-and-run, dust storms, heat spells, etc.). However, for the CO pollution (unlike that for noise pollution) proactive measures may be taken to limit the CO intake into the body system even over these disparate intervals; one approach is the issuance of surgical masks to the traffic warden personnel on active duty.

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APPENDIX 1

LIST OF THE STALLING TRAFFIC POINTS OCCUPIED IN THE COURSE OF THIS STUDY

Jafar Mairiga Junction, F.U.T. Minna Junction, Mypa Junction, Bahago Junction, Zarumai Roundabout, Government House Junction, Mustapha Junction, Government Day Junction, Emir's Palace Junction, Kuta Road/Obasanjo Complex Roundabout, Unity Bank Junction, Mobil Roundabout, I.B.B. Road Roundabout, Central Bank Junction, F.R.S.C. Junction, David Mark Road Roundabout, N.S.T.A. Junction, MTN Junction, Top Medical Junction, Muazu Babangida Junction, Abdulsalam Motor Park Junction, Royal Wood/Conoil Junction, City Gate Roundabout, Mandela Road/Talba Farm Junction, Shiroro Hotel Junction, Morris Fertilizer Junction, Kpakungu Roundabout, Cemetery Roundabout, Kure Modern Market Junction, Federal Secretariat Junction, Dutsen Kura Junction, Arayan Junction, London Street Junction, Okada Road Junction, General Hospital Junction, Sabon Gari Junction, Peda Junction, Kuta Motor Park Junction, Flamingo Junction, and Dana Pharmaceutical Roundabout.

APPENDIX 2
BODY OF ACQUIRED DATA FOR THIS STUDY

App. 2-1: Dataset for morning hours (i.e. interval of 0001-1159 hours)

Station No.	Conventional Location	X-value (UTM)	Y-value (UTM)	Average CO Value (ppm)	Internationally-Acceptable CO Level Threshold (ppm)
1	Jafar Mairiga Junction	0228437	1068754	6.20	10.00
2	F.U.T. Junction	0228819	1068379	8.36	10.00
3	Maipa Junction	0229357	1067847	5.56	10.00
4	Bahago Junction	0230096	1066785	9.16	10.00
5	Zarumai Roundabout	0230163	1066569	6.76	10.00
6	Government House Junction	0230450	1065782	8.26	10.00
7	Mustapha Junction	0230495	1065592	9.06	10.00
8	Government Day Junction	0230563	1065262	10.70	10.00
9	Emir's Junction	0230640	1064527	15.36	10.00
10	Kuta/Obasanjo Complex Roundabout	0230697	1064238	14.86	10.00
11	Unity Bank Junction	0230733	1064057	17.03	10.00
12	Mobil Roundabout	0230818	1063729	19.26	10.00
13	IBB Roundabout	0231211	1063359	17.83	10.00
14	Central Bank Junction	0231416	1063093	17.86	10.00
15	F.R.S.C. Junction	0231649	1062823	18.60	10.00
16	David Mark roundabout	0231810	1062633	19.06	10.00
17	NSTA Junction	0232004	1062388	14.96	10.00
18	MTN Junction	0232045	1062306	19.26	10.00
19	TOP Medical Junction	0232312	1061850	17.50	10.00
20	Muazu Babangida Junction	0232408	1061644	16.26	10.00
21	Abdulsalam Park Junction	0232786	1060830	14.33	10.00
22	Royal	0232828	1060673	8.76	10.00

	Wood/Conoil Junction				
23	Tall gate Round about	0232995	1060170	10.73	10.00
24	Mandela/Farm Junction	0231434	1060097	7.93	10.00
25	Shiroro Hotel Junction	0230174	1060852	14.43	10.00
26	Morris Junction	0229616	1061440	12.86	10.00
27	Kpakungu Roundabout	0229184	1062006	16.63	10.00
28	Cemetery Roundabout	0228933	1062725	15.66	10.00
29	Main Market Junction	0228751	1063873	12.50	10.00
30	Federal Secretariat Junction	0228570	1064679	11.36	10.00
31	Dutsen Kura Junction	0228065	1065344	9.93	10.00
32	Arayan Junction	0226707	1067122	14.56	10.00
33	London Street Junction	0227312	1067596	5.80	10.00

App. 2-2: Dataset for Afternoon Hours (i.e. interval of 1201-1859 hours)

Station No.	Conventional Location	X-value (UTM)	Y-value (UTM)	Average CO Value (ppm)	Internationally-Acceptable CO Level Threshold (ppm)
1	Jafar Mairiga Junction	0228437	1068754	6.99	10.00
2	F.U.T. Junction	0228819	1068379	11.76	10.00
3	Maipa Junction	0229357	1067847	11.50	10.00
4	Bahago Junction	0230096	1066785	17.26	10.00
5	Zarumai Roundabout	0230163	1066569	11.70	10.00
6	Government House Junction	0230450	1065782	14.13	10.00
7	Mustapha Junction	0230495	1065592	13.10	10.00
8	Government Day Junction	0230563	1065262	13.70	10.00
9	Emir's	0230640	1064527	12.36	10.00

	Junction				
10	Kuta/Obasanjo Complex Roundabout	0230697	1064238	13.70	10.00
11	Unity Bank Junction	0230733	1064057	11.30	10.00
12	Mobil Roundabout	0230818	1063729	13.43	10.00
13	IBB Round about	0231211	1063359	17.00	10.00
14	Central Bank Junction	0231416	1063093	15.10	10.00
15	FRSC Junction	0231649	1062823	18.06	10.00
16	David Mark roundabout	0231810	1062633	17.06	10.00

App. 2-3: Dataset for Evening Hours (i.e. interval of 1901-2359 hours)

Station No.	Conventional Location	X-value (UTM)	Y-value (UTM)	Average CO Value (ppm)	Internationally-Acceptable CO Level Threshold (ppm)
1	N.S.T.A. Junction	0232004	1062388	11.30	10.00
2	MTN Junction	0232045	1062306	10.43	10.00
3	TOP Medical Junction	0232312	1061850	12.60	10.00
4	Muazu Babangida Junction	0232408	1061644	11.73	10.00
5	Abdulsalam Park Junction	0232786	1060830	10.53	10.00
6	Royal Wood/Conoil Junction	0232828	1060673	19.70	10.00
7	Tall gate Round about	0232995	1060170	18.56	10.00
8	Mandela/Farm Junction	0231434	1060097	9.16	10.00
9	Shiroro Hotel Junction	0230174	1060852	9.16	10.00
10	Morris Junction	0229616	1061440	9.66	10.00
11	Kpakungu Roundabout	0229184	1062006	11.40	10.00
12	Cemetery Roundabout	0228933	1062725	9.46	10.00
13	Main Market Junction	0228751	1063873	9.66	10.00

14	Federal Secretariat Junction	0228570	1064679	6.93	10.00
15	Dutsen Kura Junction	0228065	1065344	10.36	10.00
16	Arayan Junction	0226707	1067122	7.00	10.00
17	London Street Junction	0227312	1067596	6.36	10.00