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Project:	**Bangladesh Air Pollution Studies (BAPS)**
ID #	**PO98151, DoE-S13**
Task 1:	**Emission Inventory**
Report:	**Draft Report**

Emissions Inventory for Dhaka and Chittagong of Pollutants PM_{10}, $PM_{2.5}$, NO_X, SO_X, and CO

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Executive Summary

The Bangladesh Air Pollution Studies (BAPS) project is being prepared for the Clean Air and Sustainability project at the Bangladesh Department of Environment (CASE/DoE). The project has been funded by the World Bank (International Development Association) for obtaining a better understanding of air pollution sources in Bangladesh.

The project included the development of emissions inventories, air pollution dispersion modeling as well as field studies/surveys in order to collect air samples and relevant input data. Task 1 of the project sets the basis for understanding the air pollution problems in Bangladesh (for Dhaka and Chittagong), and is a critical task for the entire project. No complete emissions inventory has previously been conducted for these two cities in Bangladesh. The emissions inventory include mapping the various sources (point, area, and line) in the two cities The emissions inventory will further represent the basis for air pollution dispersion modeling undertaken as part of Task 2 of the project.

A combined methodology of using bottom-up and top-down scaled input data has been used to populate the emission inventory for Dhaka and Chittagong. Sources of emissions of PM_{10}, $PM_{2.5}$, NO_X, SO_X, and CO have been investigated for the sectors Industry (including brick kilns separately), Road Traffic, non-road Traffic, Agriculture, Urban, and Fossil Fuel (energy and gas processing). The emissions inventory has been compiled in the NILU model AirQUIS, which can then process the dispersion modelling of the emissions as needed for Task 2 of this project.

Results for the inventory indicate that PM_{10}, $PM_{2.5}$ and SO_2 emissions are dominated by the brick kiln sector in Dhaka. In addition, the traffic sector is the dominating emission source for NOx and CO in Dhaka. In Chittagong, the dominating source sectors are more mixed, where PM_{10} emissions are primarily from the industrial sector, and SOx emissions from the brick kiln sector exclusively. Also in Chittagong, $PM_{2.5}$ and CO emissions are primarily from the urban sector, while NOx emissions are primarily from the traffic sector. Annual emission totals for Dhaka are 2-10 times those found in Chittagong, depending on the pollutant of interest.

This emission inventory for Dhaka and Chittagong was used for the dispersion modelling (Task 2) to assess the air quality for each city based on the resulting concentrations from the model. When examining and assessing these concentration values from Task 2, it will be important for policy makers to refer back to the resulting emissions generated from this inventory to understand what necessary limits need to be placed, and on what specific sectors.

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1 Introduction

Dhaka can be considered one of the world's most polluted mega-cities when it comes to air pollution (Gurjar et al., 2008), where air quality during the winter months is a severe problem (Randall et al., 2011a). In addition, future projections of emissions are not promising (Randall, 2011b). There are also large regional issues contributing to local air pollution in both Dhaka and Chittagong. Urgent government action is required to mitigate the pollution at both local and regional scale in order to protect the health of the Bangladeshi population (Begum et al., 2011; Randall et al., 2011a).

The Bangladesh Air Pollution Studies (BAPS) project is being prepared for the Clean Air and Sustainability project at the Bangladesh Department of Environment (CASE/DoE). The project has been funded by the World Bank (International Development Association) for obtaining a better understanding of air pollution sources in Bangladesh.

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The background for this Task 1 report has been the previously submitted Inception Reports for Task 1 (Randall et al., 2012). A team of local and foreign experts have been contracted to conduct the work under the direction of the Norwegian Institute for Air Research (NILU).

A major part of the methodology including the use of the AirQUIS models and planning tools have been introduced to CASE/DoE during the NORAD financed BAPMAN programme (Randall et. al 2015).

2 Purpose and goals

The purpose of this Task 1 report is to provide an inventory of air pollution sources for air pollutants (PM_{10}, $PM_{2.5}$, NO_X, and CO) for both Dhaka and

Chittagong. The emissions inventories are divided into source sectors and are specified for locations and other physical parameters.

One specific goal has been to identify and map the emission sources so that the results can be used directly as input to the dispersion model (Task 2) for each city. The sources have thus been characterized as point, line, and area sources. This has made it possible to estimate and evaluate the impact of present emissions as well as future emissions, taking into account mitigation possibilities. This report will provide CASE/DoE with an understanding of the total emissions, as well as the sectors responsible for pollutants investigated.

3 Study area

The study area for this project is defined by the domains in both Dhaka and Chittagong as discussed in the succeeding chapters.

3.1 Bangladesh Map

Bangladesh is a land of 147,570 sq km. Shown in Figure 3.1 are the location of the two grids of interest with respect to the whole country. The 24 x 50 sq km grid for Dhaka is located in Dhaka Division and the 20 x 32 sq km grid for Chittagong is located in Chittagong Division.

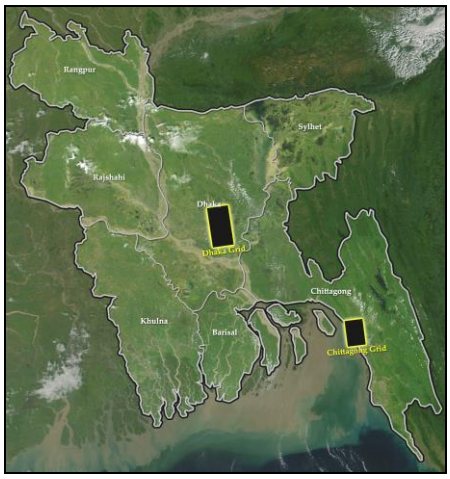


Figure 3.1: Bangladesh Map.

3.2 Dhaka Grid

For the study in Dhaka, a 24 x 50 sq km domain centered at 235472.00 m E and 2637401.00 m N (Zone 46Q in UTM coordinates system) was used (see Figure 3.2). Each cell of the grid has a resolution of 1x1 km^2. This grid domain covers the whole of Dhaka City Corporation (DCC) area. Additionally, it covers a portion of Gazipur district in the north, part of Savar Upazila in the West, Part of Keraniganj Thana in the South and part of Narayanganj district in the south and southeast.

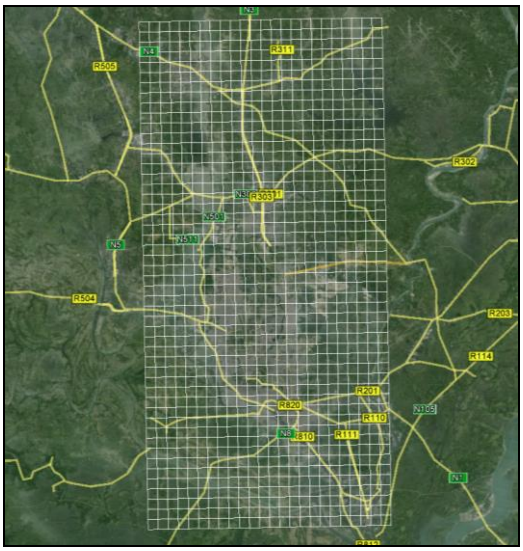


Figure 3.2: Dhaka Grid (50 x 24 sq km).

3.3 Chittagong Grid

The grid dimension for Chittagong City emission inventory is 20 X 32 km^2 with center point at 377374.00 mE and 2472510.00 mN (Zone 46Q in UTM coordinates system) and cell resolution is 1x1 km^2 (see Figure 3.3). This grid domain covers the whole of Chittagong City Corporation area along with part of Sitakunda, Hathhazari, Raozan, BoalKhali, Patiya and Anowara Upazila.

Figure 3.3: Chittagong Grid (20 x 32 sq km).

4 Methods and Data Sources

All major pollutant sectors were investigated for the emission inventory. Table 1 shows an overview of the sources used for this emission inventory, organized by each sector and corresponding pollutant. A description of each sector used in this inventory is in Table 2.

This emissions inventory uses two types of approaches: bottom-up and top-down. Bottom-up is defined as collection of data (location, production, volume, etc.) from field work and/or research at the finest resolution (mainly industry and traffic sectors for this inventory). Top-down is defined as data collection from existing compiled sources, normally with less resolution. This inventory uses a scaled methodology to the top-down data (mainly area sources) to reduce the resolution and give greater accuracy to this top-down input data, mostly also by filling gaps in the bottom-up approach.

Table 1: Source overview for each sector and corresponding pollutant.

	Pollutant Sector						
	Industry	Brick Kilns	Traffic	Agriculture	Urban	Non-road	Fossil Fuel
PM_{10}	Bottom-up scaled*	Bottom-up	Bottom-up	Top-down scaled	Top-down scaled	Top-down scaled	Top-down scaled
$PM_{2.5}$	Bottom-up scaled*	Bottom-up	Bottom-up	Top-down scaled	Top-down scaled	Top-down scaled	Top-down scaled
SOx	Bottom-up scaled*	Bottom-up	Bottom-up	Top-down scaled	Top-down scaled	Top-down scaled	Top-down scaled
NOx	Top-down scaled	N/A	Bottom-up	Top-down scaled	Top-down scaled	Top-down scaled	Top-down scaled
CO	Top-down scaled	N/A	Bottom-up	Top-down scaled	Top-down scaled	Top-down scaled	Top-down scaled

*not including brick kilns

Table 2: Explanation of Pollutant sectors.

Source Sector	Sector description
Industrial	Energy industries (Power plants), Manufacturing industries, etc. (not including brick kilns)
Brick kilns	All brick kilns with stack, all designated as Fixed chimney kiln (FCK)
Traffic	Road sources (cars, taxis, motorcycles, baby taxis, busses, trucks)
Agricultural	Agricultural activities
Urban	Residential combustion
Non-road	Non-road Transport, shipping and aviation
Fossil Fuel	Extraction and distribution of fossil fuels (refineries)

4.1 Industrial Emissions (bottom-up scaled)

We have identified the position of major pollutant industries in combination with local knowledge, existing GIS files, and Google Earth. We collected monthly industrial production data from Bangladesh Bureau of Statistics (BBS) and compiled the emission factors for corresponding industries from AP42, EMEP/EEA emission inventory guidebook 2013 and measurement from BAPS Task 5 (for steel mills and ceramic industries). The production data and emissions factors were then calculated to produce resultant emissions from industries per grid cell for each city. This was treated as area sources for the

emission and dispersion modeling of the entire domain for each city. We have converted point source emission into grid cell emission for Brick Kilns stacks and Non-Brick-kilns stacks separately as we employed time variation factors for Brick Kiln stack emissions (assuming standard operating time of brick kilns during December-April in Bangladesh).

4.1.1 Location of Industry stacks

The position of Brick-kiln stacks and Non-brick kiln stacks are presented in Figure 4 and 5 for Dhaka and Chittagong city respectively. The coordinates of the industrial sources used for the inventory can be found in Appendix A for Chittagong and Appendix B for Dhaka.

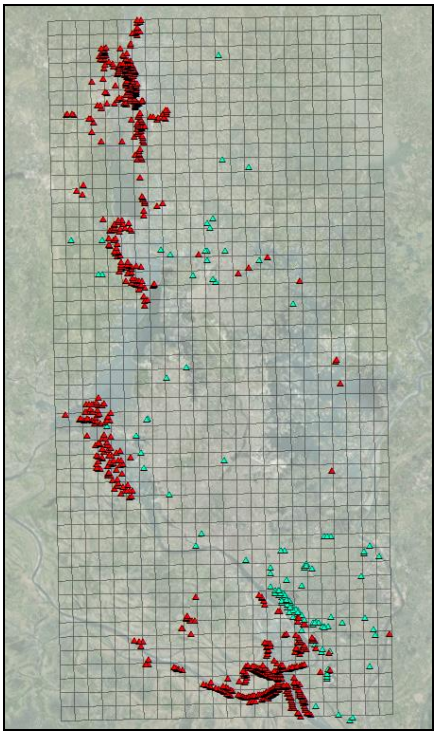


Figure 4.1: Location of Brick Kiln Stacks (Red) and Non-Brick Kiln Industry Stacks (Blue) for Dhaka.

The major sources for identification of the stack positions were by local knowledge and Google Earth. The smaller sources were based on an old GIS file shared with us by CASE/DoE during the BAPMAN project (Scott et. al 2015).
The emissions from ship salvage industries in Chittagong was included as part of the industrial sources, point and area (top down data used from Edgar)

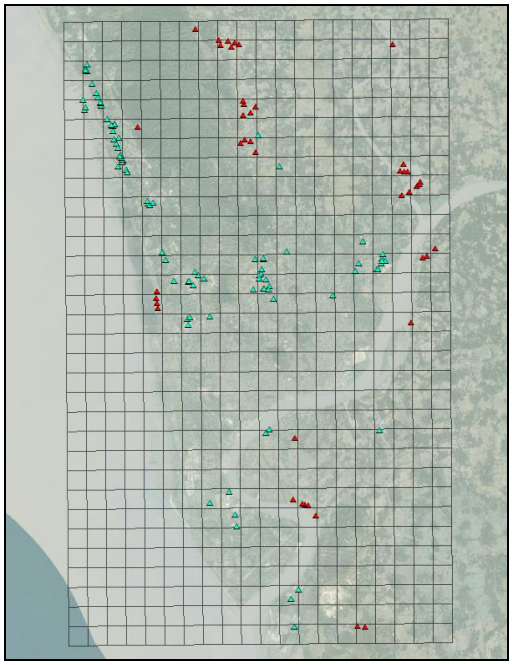


Figure 4.2: *Location of Brick Kiln Stacks (Red) and Non-Brick Kiln Industry Stacks (Blue) for Chittagong.*

4.1.2 Emission Factors

Emission factors used for the industrial sector (in addition to the number of industries found in Dhaka and Chittagong for each sector) can be seen in Table 3. The emission factors in tons per year were obtained by collecting information from BBS for the production data, and from AP42, and EMEP/EEA for the basic emission factors. The detailed production data and basic factors are shown in Appendix C.

Table 3: *Number of Industrial Stacks and Emission Factors Used in the model.*

Source Sector Name	# of Industries in Chittagong Grid	# of Industries in Dhaka Grid	Average Emission per industry (tons per year)		
			PM_{10}	$PM_{2.5}$	SO_x
Bricks	43	639	83.4	27.4	92.6
Metal Processing	75	83	16.7	14.6	0.4
Paper Processing	0	18	0.04	0.03	0.05
Polyester	0	10	3.4	0	0
Polyvynil Chloride	9	5	0.5	0.2	0
Glass Manufacturing	2	3	0.9	0.7	0
Cement Production	7	3	129.9	43.3	0
Clay Ceramics	0	2	19.6	5.7	49.1
Battery Production	0	2	0.0007	0.0004	0
Urea	2	0	94.7	68.1	0
Ammonia	2	0	0	0	12.5
DAP	1	0	665.8	235.0	0
TSP	1	0	1326	390	0

4.1.3 Industrial Point Sources to Grid Sources

The industries (point sources) were converted to grid sources due to the numerous number of stacks involved in the study. Converting these sources into grid sources allow the emission to be calculated as an area source. The conversion of point sources to grid sources requires the location of the industries and the amount of emission per pollutant per industry. The location of the industries are shown in Figure 4.1 for Dhaka and Figure 4.2 for Chittagong in the earlier chapters. The emissions factors used are shown in Table 3 above. These values are then inputted in ArcGIS to be able to create a spatial joining wherein all industries contained in each grid cell will be summed up respectively. Separate processing is done for brick kilns due to its dominance in terms of emissions and seasonality of production. The result for PM_{10}, $PM_{2.5}$ and SOx are shown in Figure 4.3 for Dhaka and Figure 4.4 for Chittagong.

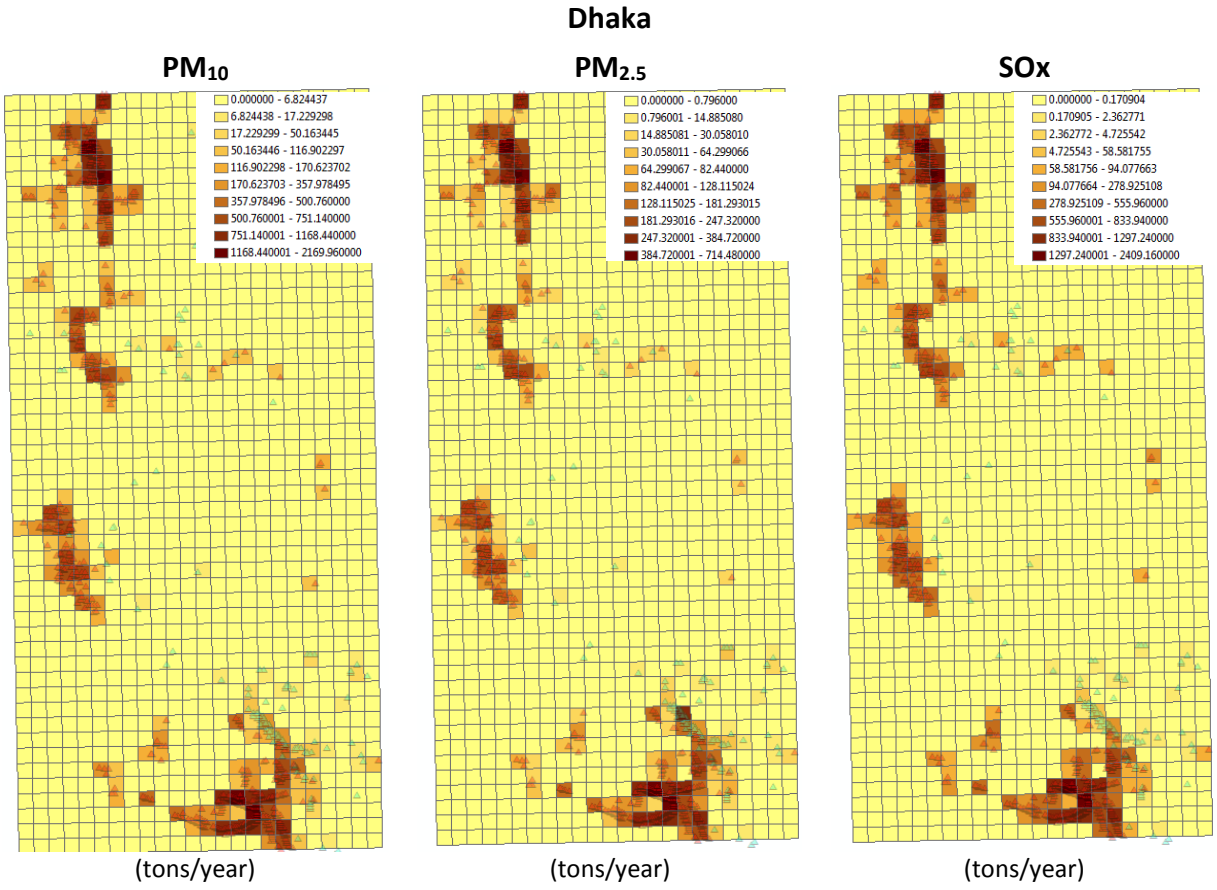


Figure 4.3: Point Sources to Grid Sources for PM_{10}, $PM_{2.5}$ and SO_x Emission in Dhaka.

The results from the investigations undertaken in Task 5 (measured emissions from selected industries) were used in order to estimate air pollution concentrations in the vicinity of these industries (Rahman et. al 2015a). The emission factors for these industries were evaluated with reference to the results from Task 5.

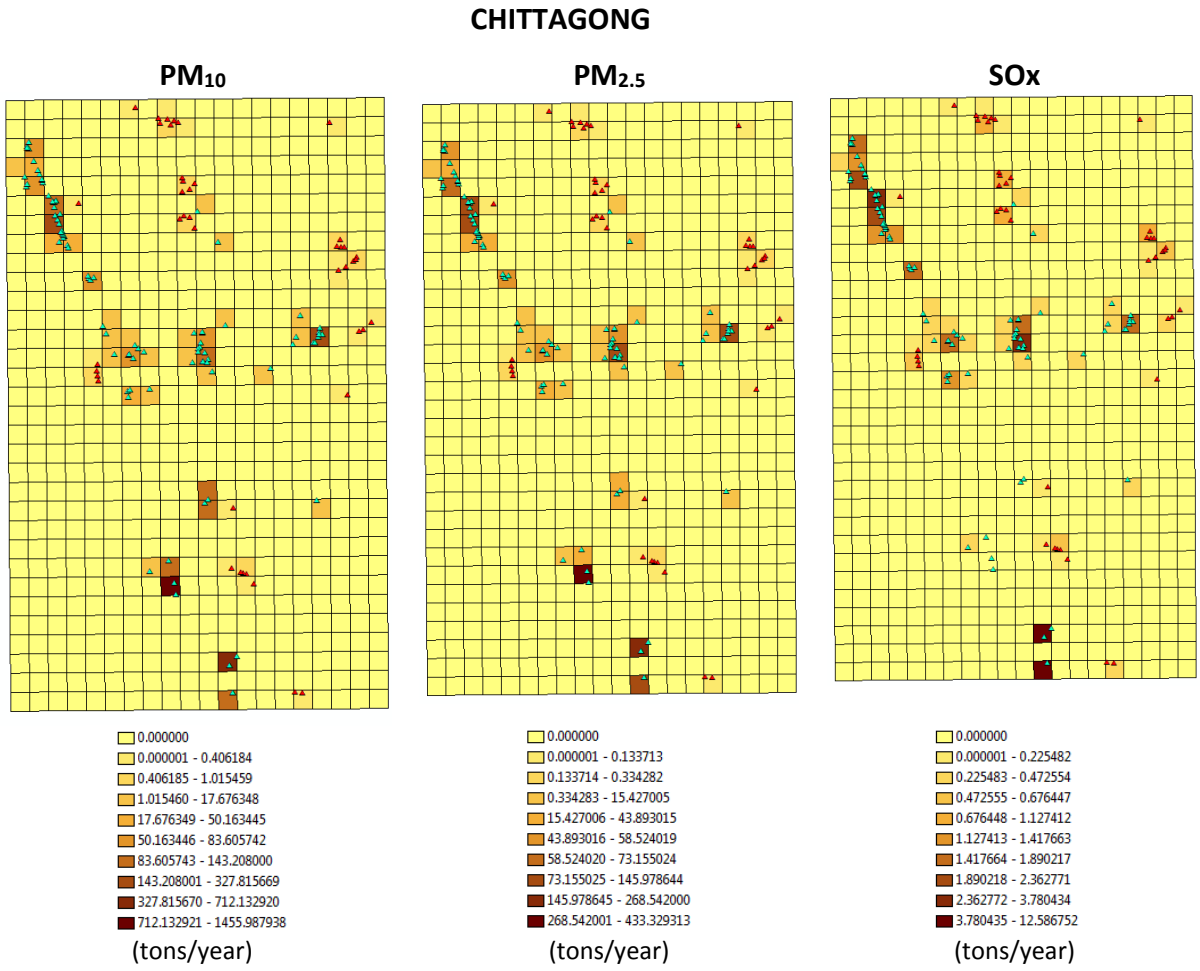


Figure 4.4: Point Sources to Grid Sources for PM10, PM2.5 and SOx Emission in Chittagong.

4.1.4 Brick Kiln Sources (bottom-up)

The bottom-up approach to brick kiln source processing is done separately for other industrial soruces which used the bottom-up scalled approach outlined above. This is because the brick kilns have such a high amount of emissions and have a different seasonality of production. The seasonality of the brick kiln production for this study means that the operation is ongoing during the months of December to April and not in operation on the other months. The brick kiln locations and emission factors where obtained from Randall et al., 2014.

4.2 Traffic Emissions (bottom-up)

The number of vehicles per specific vehicle type in a road class for a particular hour will be determined by collecting data from traffic survey conducted on selected representative sites in Dhaka and Chittagong. After the traffic survey, data was quality checked and data was flagged based on expected trends. From this data processing, 24-hour time variation factors and vehicle distributions were established. This is inputted into AirQUIS together with the average daily traffic to be able to determine the number of a specific type of vehicle for a

particular hour in a road class, for each city. The traffic survey is needed to generate a first estimate of traffic flows and vehicle class distributions for the different road types for different time categories. AirQUIS takes the results from the traffic survey and multiplies this data by the traffic emission factors to subsequently determine the total emissions inventory from mobile sources.

4.2.1 Data Collection, Road Class and Vehicle Type

Data collection was done with the assistance from Bangladesh University of Engineering and Technology (BUET) for the traffic survey in Dhaka, and Chittagong University (CU) for the traffic survey in Chittagong. The data collection is categorized by the road class, vehicle type and day that survey was collected. The three road classes are described in Table 4 and the six vehicle types are described in Table 5 below.

Table 4: Description of Road Classes

Road Class (type)	Description
Primary	Main roads and highways, with at least 2 lanes traffic in each direction
Secondary	Medium sized roads with 1-2 lanes traffic in each direction
Diffuse	Small roads with less than 1 lane of traffic in each direction

Table 5: Description of Vehicle Types.

Vehicle Class (type)	Description
Cars	All passenger vehicles and small trucks with 4 wheels and room for 3-12 passengers.
Taxi	Small taxis with room for 3-4 passengers.
Bus	Large busses with more than 4 wheels and room for up to 50+ passengers.
Truck	Large heavy duty trucks with more than 4 wheels.
Motorcycle (MC)	2 wheeled vehicles for 1-2 passengers.
Baby taxi	3 wheeled vehicles for 1-4 passengers.

4.2.2 Data Collection Methods

The methods for the traffic survey include counting the number of vehicles which cross each sampling site during set time variations, as well as indicating the type of vehicle (according to the vehicle class) for each vehicle crossing the site. The survey sites and location information for Dhaka can be seen in Figure 4.5 and Table 6, and for Chittagong in Figure 4.4 and Table 9.

The data collection is completed for one day entire day (24 hours) for every site, and was broken down into hourly sampling segments. This was done for both a weekend (Friday-Saturday) and weekday (Sunday-Thursday). Each hourly sampling occurred two times lasting for 20 minutes each with 10-minute breaks in between. The obtained sampling with a total of 40 minutes was multiplied to be able to obtain the hourly number of vehicles.

The emissions from the airport are mostly assumed to be included in the road traffic as well as in the non-road emission estimates.

Table 6: List of Traffic Survey Sites.

Site#	Road Name	Lat	Long	Road type	Traffic flow	Est. Speed
1	Begum Roykeya Ave	23.7967	90.3731	Secondary	Medium	50-65 kph
2	Mirpur Road (Near Grameen Bank)	23.8022	90.3589	Secondary	Low	40-50 kph
3	Kakrail (Bir Uttam Shamsul Alam Shorok)	23.7250	90.4077	Diffuse	Low	30-50 kph
4	Shahabagh (Shahabagh- Katabon)	23.7377	90.3943	Primary	Low	50-55 kph
5	Airport (Bangla motor)	23.7461	90.3947	Primary	Low	30-50 kph
6	Khilgaon Flyover	23.7437	90.4241	Diffuse	High	40 kph
7	Progoti Soroni (Middle Badda)	23.7824	90.4266	Primary	High	40 kph
8	Kamal Ataturk Avenue	23.7941	90.4122	Secondary	Medium	45 kph
9	Mirpur Road (Priminister House)	23.7670	90.3696	Primary	Slow	40-50 kph
10	Dhaka Highway	23.7106	90.4322	Primary	High way	25 kph
11	Abdul Gani Road	23.7278	90.3928	Diffuse	Medium	45 kph

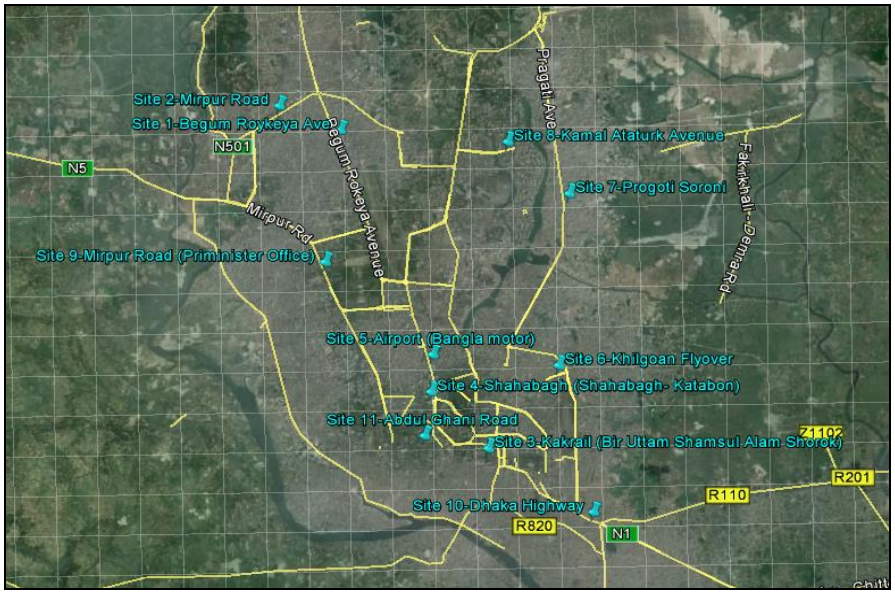


Figure 4.5: Map of Dhaka Traffic Survey Sites.

Table 7: List of Traffic Survey Sites in Chittagong.

Site#	Site Name	Road Name	Lat	Long	Road type	Traffic flow	Est. Speed
1	Naval Head Quarter	M A Aziz Road	22.2804	91.7850	**Secondary**	**Medium**	**20-25 kph**
2	Boro Pole	Port Connecting Road	22.3295	91.7891	**Primary**	**High**	**25-30 kph**
3	Tiger Pass	Dewanhat Overbridge	22.3417	91.8156	**Primary**	**High**	**40-45 kph**
4	City Gate	Chittagong	22.3736	91.7734	**Primary**	**High**	**25-30 kph**
5	GPO	H S Sarwardy Road	22.3335	91.8340	**Secondary**	**Medium**	**15-20 kph**
6	BAWA School	CDA Avenue	22.3541	91.8220	**Primary**	**High**	**30-35 kph**
7	Rahattar Pole	K. B. Aman Ali Road	22.3593	91.8516	**Diffuse**	**Low**	**5-10 kph**
8	Shah Amanat Bridge	Dhaka-Chittagong Highway	22.3307	91.8517	**Primary**	**High**	**40-45 kph**
9	Kalurghat Bridge	Cox'sBazar Road	22.3975	91.8862	**Secondary**	**Medium**	**15-20 kph**
10	CMC Gate	K. B. Fazlul Kader Road	22.3607	91.8302	**Secondary**	**Medium**	**10-15 kph**
11	BSRM, Bayezid Bostami	Bayazid Bostami Road	22.3786	91.8117	**Diffuse Industrial**	**Low**	**15-20 kph**
12	Kulgaon- Oxygen More	Hathazari Rd	22.3972	91.8201	**Secondary**	**High**	**20-25 kph**

Figure 4.6: Map of Chittagong Traffic Survey Sites.

4.2.3 Data Reporting

Table 8 shows the specific details regarding the data sheets used during the traffic survey. Data collected includes the site number; description of the road; site name; latitude and longitude of the survey site; road type; traffic flow; estimated speed; name of the observer; date and day of data collection; and the start and stop time of counting. It is was also vital that the direction of the traffic flow was indicated.

Table 8: Sample Traffic Survey Sheet for Data Reporting.

Site#	1			Site#	1	
Description	Main road			Description	Main road	
Road	Begum Rockeya Ave			Road	Begum Rockeya Ave	
Lat	23.79668			Lat	23.79668	
Long	90.3731			Long	90.3731	
Road type	Primary			Road type	Primary	
Traffic flow	high			Traffic flow	high	
Est. Speed	60 km/h			Est. Speed	60 hm/h	
Observer	SR			Observer	SR	
Date	19 feb 2012			Date	19 feb 2012	
Day	Sunday			Day	Sunday	
Period ID	A			Period ID	A	
Time ID	1			Time ID	1	
start time	00:00			start time	00:30	
stop time	00:20			stop time	00:50	
direction	North-bound	Total		direction	North-bound	Total
Cars		242		Cars		289
Taxi		2		Taxi		4
Bus		50		Bus		45
Truck		11		Truck		14
MC		17		MC		18
Baby Taxi		60		Baby Taxi		72
	Total veh	382			Total veh	442
		GRAND TOTAL veh/dir/hour:*	1236			
		*(total veh1 + total veh2)(1.5)				

4.2.4 Data Analysis

The collected data from the traffic survey was then processed and analyzed. A quality check of the expected trend and the normality of data points was then analyzed to be able to determine the data to be flagged.

4.2.5 Data Statistical Analysis

A statistical analysis of the data was performed by completing the time variation factor per vehicle type for each road class. The total vehicles per hour for both directions is tabulated in a row from hour 0 to hour 23 for each vehicle class and each site as seen in Table 9. This same tabulation is done for each vehicle type for every road class. The average number of vehicles per hour for all the sites in that road class is computed as shown in the table as example.

Table 9: Sample Data Statistical Analysis.

Vehicle type	SITE	0	1	2	3	…	20	21	22	23	TOTAL
Cars	Site#4	167	153	141	117	…	604	471	350	203	12831
Cars	Site#5	605	161	125	127	…	1243	1215	961	691	25631
Cars	Site#7	226	104	63	57	…	703	506	372	304	10957
Cars	Site#9	293	189	108	120	…	983	730	479	258	15679
Cars	Site#10	65	60	35	50	…	92	89	87	65	2047
Cars	**Sum**	**1357**	**667**	**471**	**470**	**…**	**3624**	**3011**	**2249**	**1521**	**67144**
Cars	**Average**	**271**	**133**	**94**	**94**	**….**	**725**	**602**	**450**	**304**	**13429**
Cars	**TIME FACTOR**	**0.0202**	**0.0099**	**0.0070**	**0.0070**	**….**	**0.0539**	**0.0448**	**0.0335**	**0.0226**	**1.0000**

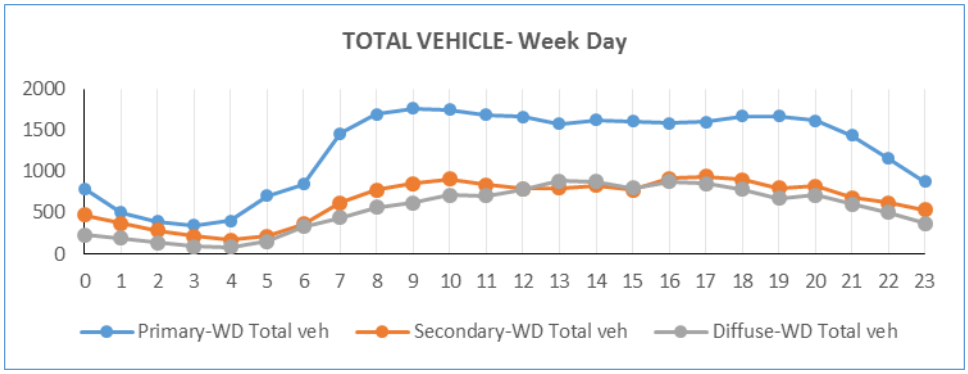
4.2.6 Data Flagging

Based on the average number of cars per hour obtained in the data analysis, data flagging has to be performed by generating a time-based graph. A graph of the total vehicles per hour for weekday and weekend is shown in Figure 4.7 for Dhaka and Figure 4.8 for Chittagong. This was also performed for each of the vehicle classes. The final graphs can be seen in Appendix E for Dhaka and Appendix F for Chittagong.

The purpose of these graphs is to be able to visualize the various trends. A normal trend for cars, taxis, buses and motorcycles would have two peaks representing rush hours in the morning and in the afternoon. The normal trend for trucks would have low count during truck bans, which is usually in the middle of the day. Moreover, sudden out of trend peaks can easily be seen in these graphs.

The day of the week variations in traffic is automatically taken into account in the traffic flow numbers used as input to the AirQUIS modelling tool.

(a)



(b)

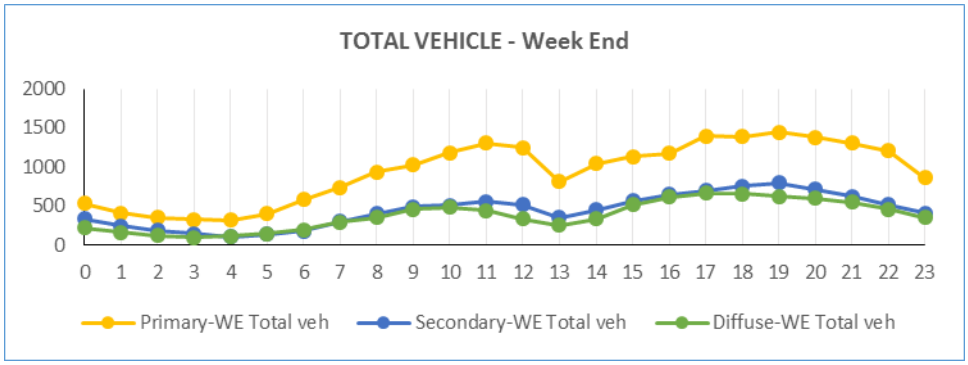
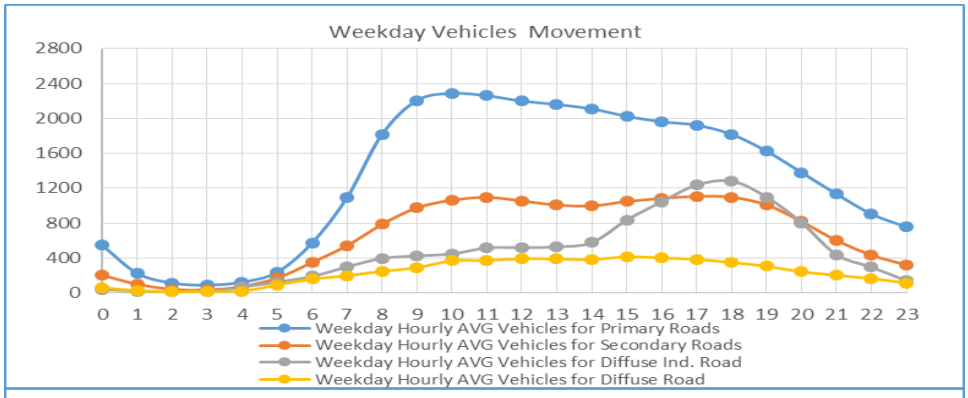


Figure 4.7: Average Number of Total Vehicle per Hour for (a) Weekday and (b) Weekend at Dhaka.

a)



b)

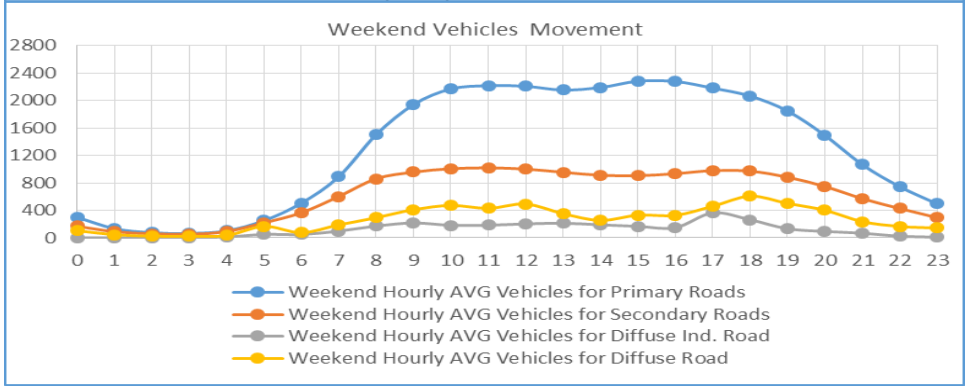


Figure 4.8: Average Number of Total Vehicle per Hour for (a) Weekday and (b) Weekend at Chittagong.

The data that were flagged for Dhaka are shown as an example in Appendix D; for Chittagong, a similar procedure was followed. The initial flagging is the truck ban and heavy-duty vehicles ban on some secondary and diffuse roads. There are five data points flagged based on sudden peaks and troughs in the graph. When this out of trend data is detected in the graphs, the raw traffic data is backtracked and crosschecked for abnormality.

4.2.7 Quality control of the traffic inventory data

After the data flagging, a final inspection of the trend of the hourly number of vehicles per vehicle type in each road class on a weekday and weekend has been performed. Based from the observation, the data flagging has normalized the trends and the final graphs are shown in Appendix D.

4.2.8 Traffic Time Variation Factors

Time variation factors are the values to be multiplied in the average daily traffic (see Appendix E and F). Thus, it should be representative of the actual number of vehicles in each road class and day. It is important to note that each road class and day has different time variation factors. Therefore, the steps to obtain the time factor are to be performed separately for each road class and for weekday and weekend.

The time factor is obtained by getting the percentage of vehicles for that particular hour over the total 24 hours. The sum of the time factor for each class should be equal 1.0 for the whole 24 hours.

The weekday effect of total traffic flows were also taken into account in the emission inventory. The time variation for weekday (Sunday through Thursday) and weekend (Friday and Saturday) was applied to the mobile sources based on the calculations done on the traffic survey results.

4.2.9 Vehicle Distribution Factors

The 24 hours traffic counting results gave not only the traffic time variation but also the vehicle distribution on different road classes. The distribution will be built base on the average distribution at different counting sites within the same road class. These factors will be used to obtain traffic volume of different vehicles classes. It means that these factors represent how the vehicles are most likely distributed in such road class and day. The vehicle distribution is obtained by getting the average number of vehicles for the whole 24 hours in all sites with the same road class.

The final vehicle distribution for Dhaka is seen below in figure:

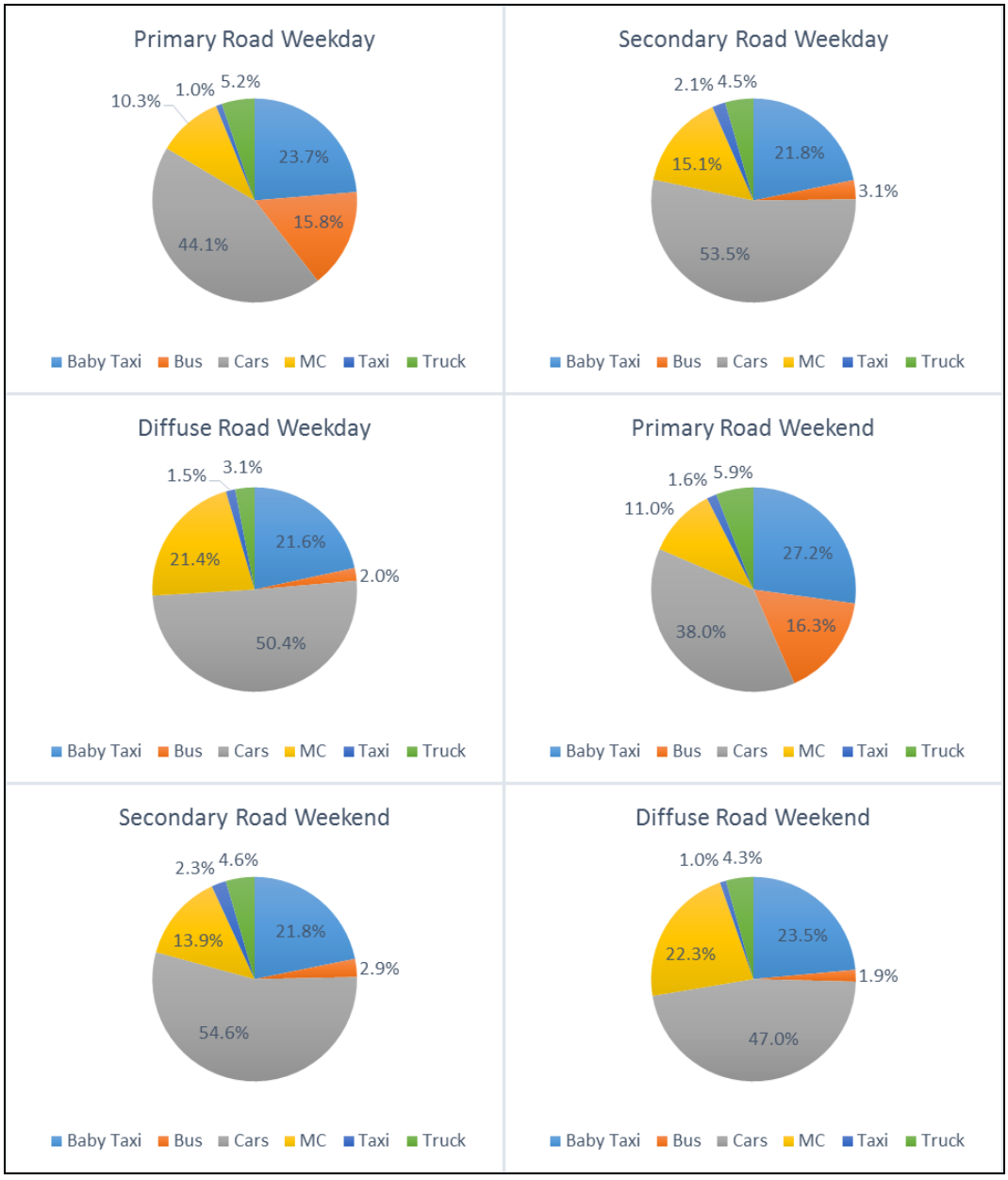


Figure 4.9: Distributions of vehicle types on different roads in Dhaka

The final vehicle distribution for Chittagong is seen below in figure:

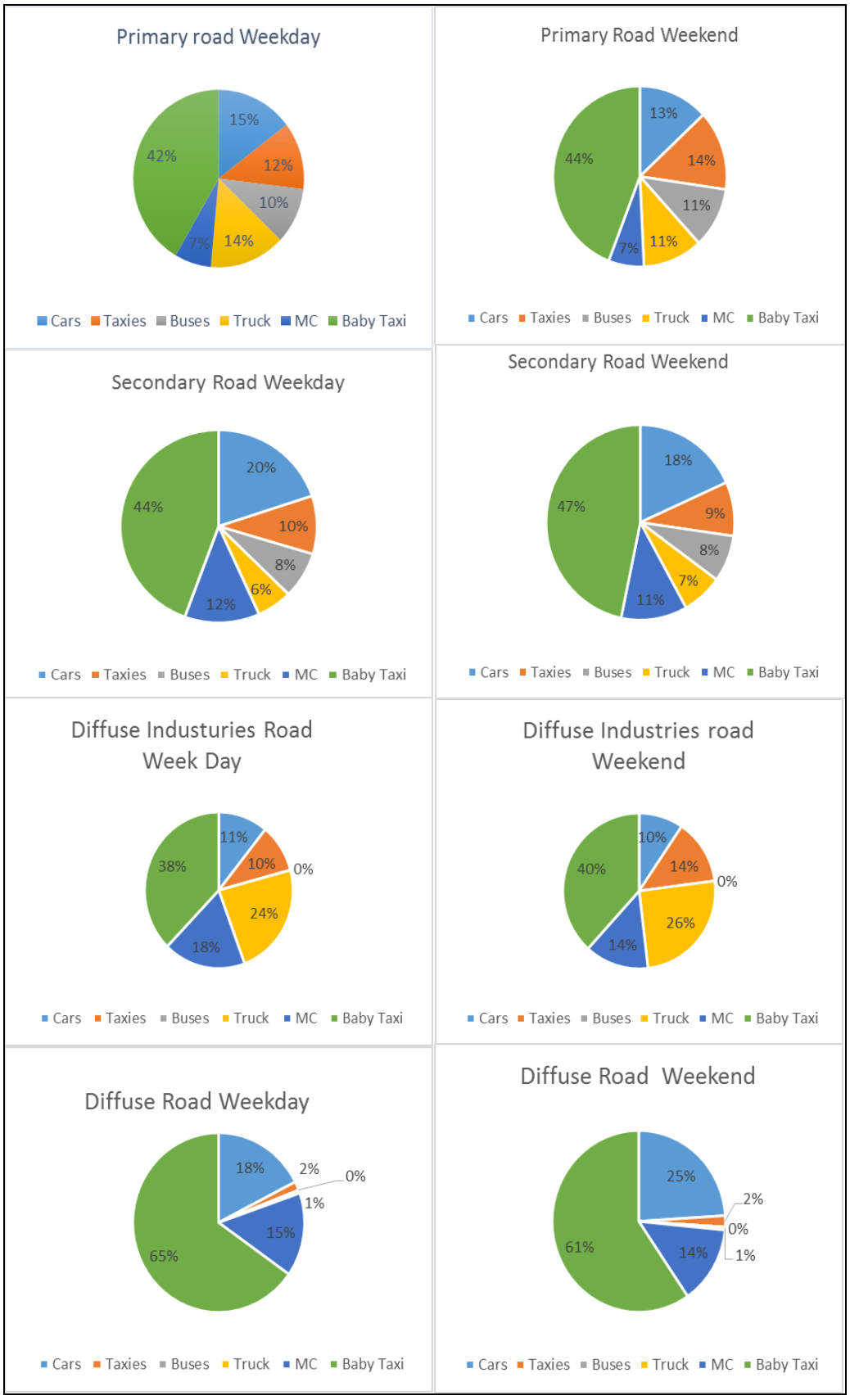


Figure 4.10: Distributions of vehicle types on different roads in Chittagong.

4.2.10 Average Daily Traffic (ADT)

To be able to get the number of certain vehicles in a particular hour, the time variation factor and vehicle distribution factor will be multiplied to the average daily traffic. Thus, only the ADT has to be obtained for the other sites that were included in the traffic survey. For this study, the ADT is obtained per road class. The ADT of all the survey sites in each road class are averaged and this value is used as ADT for all other sites under the same road class (Table 10).

Table 10: Average Daily Traffic for each Road Class in Dhaka and Chittagong

ROAD CLASS	ADT for Dhaka	ADT for Chittagong
Primary	14,090	15,720
Secondary	7,062	7,871
Diffuse	5,935	2,934
Diffuse Industries		1,844

4.2.11 Emission factors and vehicle class distributions

Emission factors used for mobile sources in this inventory are found in Appendix G. The emission calculated vehicle classes and registered vehicle class (ECVC-RVC) distribution used in the inventory are found in Appendix H.

4.3 Area Sources and gap filling (top-down scaling)

Since the necessary area source information for a detailed bottom-up inventory is not presently available, these emissions were estimated using a top-down approach. Utilizing this technique, emissions from area sources over the Dhaka and Chittagong modelling areas will be produced by spatially downscaling data from an existing global emissions inventory.

The anthropogenic emissions for the AirQUIS emission model runs for Dhaka and Chittagong are based on the Emission Database for Global Atmospheric Research (EDGAR) version 4.2 (EC/JRC, 2009), produced collaboratively by the Joint Research Centre (JRC) and the Netherlands Environment Assessment Agency (PBL). The original emission data has been acquired from the EDGAR website in NetCDF format (Rew & Davis, 1990).

The EDGAR database provides global data at 0.1º x 0.1º spatial resolution annually for the period from 1970 to 2008. So far, only data for 2008 have been used in the project. Emission data for four individual species have been downloaded, namely CO, NOx, PM_{10}, and SOx. The EDGAR emission data are provided in sectors according to the IPCC/NFR sector classification scheme, however some of these sectors are not available individually but rather lumped together in one file.

As the AirQUIS emission model uses sectors based on the SNAP classification (Selected Nomenclature for reporting of Air Pollutants), the EDGAR data provided in the highly detailed IPCC/NFR sectors had to be converted to the

more broad SNAP sectors. While there are existing conversion tables providing sector-to-sector mapping between the two classification systems, the actual conversion between the two classification systems is complicated by the fact that the EDGAR data are provided in individual files which in some cases lumps several sectors together.

After a sector mapping taking into account the limitations due to the lumped EDGAR files, the SNAP-based EDGAR emissions have been created by summing all the applicable emissions of the various IPCC/NFR sectors for each SNAP sector. This was done individually for each species and SNAP sector at a global scale.

However, creating emission data for $PM_{2.5}$ has been a challenge as EDGAR v4.2 does not provide such emissions. One possible solution would have been to obtain the $PM_{2.5}$ emission data from a different data source such as the INTEX-B emission inventory (Zhang & Streets, 2009) for Asia. These data are given on a 0.5º x 0.5º resolution, and a downscaling to our domain/resolution would increase the already high uncertainty to an unacceptable level. Furthermore this approach would not guarantee internal consistency between the PM_{10} and $PM_{2.5}$ emissions. For maintaining this consistency, we decided to estimate the $PM_{2.5}$ emissions from the given PM_{10} emissions by applying a sector-dependent scaling factor, which is estimated from published total emissions of PM_{10} and $PM_{2.5}$ for Bangladesh for each SNAP sector. The data on total emissions of PM_{10} and $PM_{2.5}$ for Dhaka and Chittagong was acquired from work done as part of the EDGAR-HTAP inventory (Janssens-Maenhout, G. et al., 2012).

In order to downscale the SNAP-based EDGAR emissions from the 0.1º x 0.1º spatial resolution, the data has been preprocessed to produce separate shapefiles for each species for each of the sectors. ArcGIS geoprocessing tools have been developed to further disaggregate the emissions from different sectors down to the 1 km x 1 km urban model grid based on spatially detailed land cover information explored from local investigations and Google Earth mapping data.

4.3.1 Pre-processing of study area (land use)

The main input for the downscaling of the EDGAR data is the land use map for both Dhaka (Figure 4.11 and Chittagong (Figure 4.12). The land use map, as shown in the figures, were generated manually from Google Earth imagery by scanning the aerial images within the grid area. The domain was divided into 4 different categories namely agricultural/forest, industrial, residential and water areas. The agricultural/forest area were identified based from the wide green or vegetation-related colors in the Google Earth image. The water area were easily identified based on the blue or water-related colors. The industrial and urban areas then constitute the rest of the areas. Further information from industrial point sources were then used to distinguish industrial form urban areas.

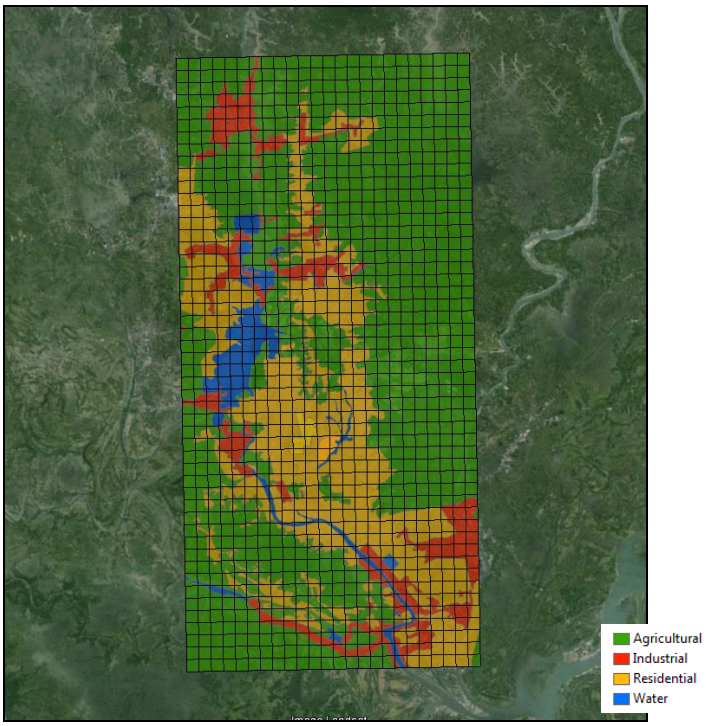


Figure 4.11: *Dhaka Land Use Map generated manually in ArcGIS from Google Earth imagery.*

It can be observed in the Dhaka Land Use Map as presented in Figure 4.11 that the agricultural land are mainly located in the northeast and southwest part of the grid. The major water areas (during the dry season) are located in the west side, which shows a part of the Buriganga River. The river stretches from the west to the southeast part of the grid. The residential areas are mainly found in the center of the grid, which represents the Dhaka City Center. Further residential area stretches along the side of the river from west to southeast. The northern portion of the residential areas are accompanied by the Dhaka-Mymensingh Highway that serves as the connection of northern provinces into Dhaka City. The industrial areas are scattered around the grid, mainly near the river where there are many brick kiln clusters. The patches of industrial areas surrounded by residential areas are composed of different industries such as textile production, metal processing and chemical industries.

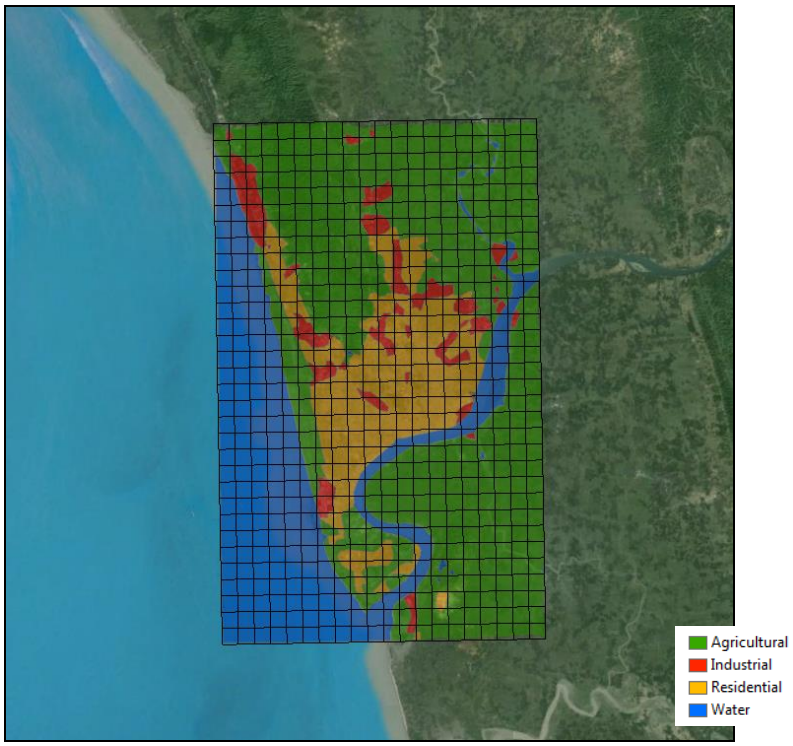


Figure 4.12: Chittagong Land Use Map.

The Chittagong land use map presented in Figure 4.12 shows the distribution of the different land categories for the EDGAR data. It can be observed that the west and southwest part of the grid is a water area, which is the Bay of Bengal. Additionally, Karnaphuli River is a major part of the city of Chittagong as seen in the figure. The agricultural areas are in the north and southeast part of the grid. The urban area is located in the center part of the grid in the city center. The industrial areas are distinguished by the brick kilns majorly located in the north part of the grid and near the river. The other industrial areas that are located within the residential areas are mostly textile and metal processing.

Aside from the land use maps, the EDGAR data is another major input used for the downscaling. Figure 4.13 and Figure 4.14 show an example of the gridded values used from EDGAR Data for Dhaka and Chittagong, respectively. It can be observed in Figure 4.13 that ten grids from EDGAR data where utilized as reference for the Dhaka downscaling. Consequently, Figure 4.14 shows that six EDGAR data grids where used as basis for the Chittagong downscaling. The EDGAR data contains a uniform concentration value within the grid. The components that are used for this downscaling are PM_{10}, $PM_{2.5}$, CO, SOx, and NOx. These data are then correlated with the land use maps that were generated.

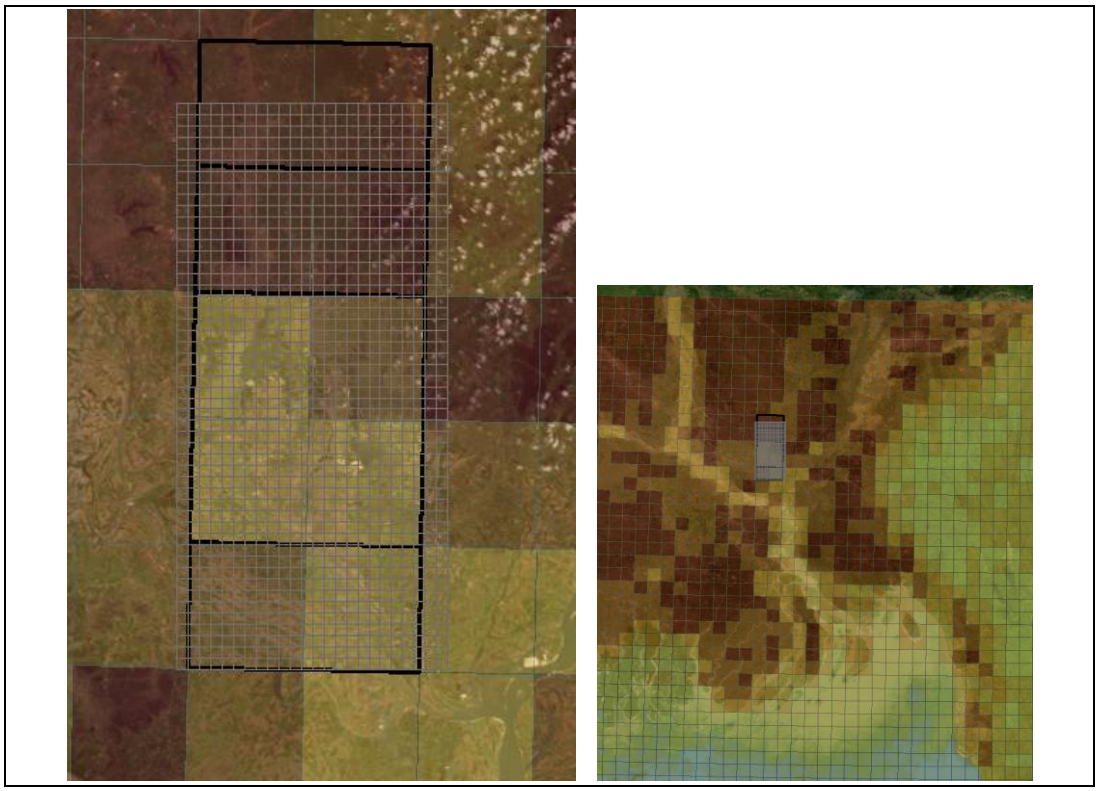


Figure 4.13: Sample EDGAR Gridded Data used for Downscaling (Dhaka).

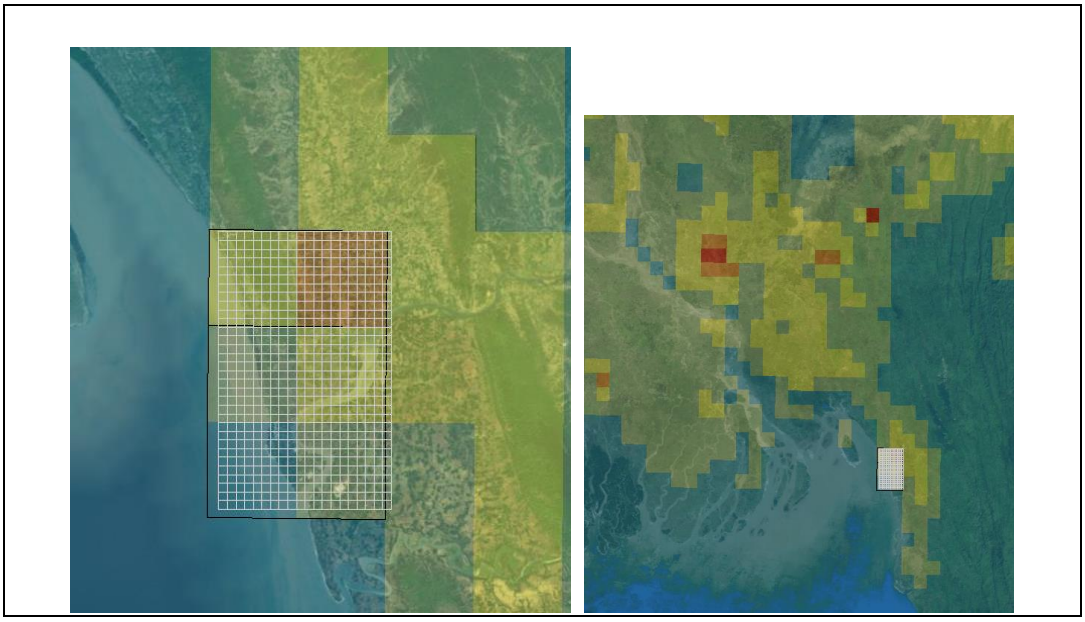


Figure 4.14: Sample EDGAR Gridded Data used for Downscaling (Chittagong).

4.3.2 Scaling of Edgar data from 2008 to 2013

The output data from Edgar has been updated from year 2008 to 2013 based on GDP growth rate. The GDP growth rate used was 6.3 % for Dhaka and Chittagong.

4.4 The AirQUIS Model

The AirQUIS model (v 14.0.0.82) is a compact tool for Air Quality Management (AQM) with functionalities of emission inventory, numerical modeling, air quality and meteorological data with statistical assessment methods, within an operable and functional GIS platform. AirQUIS was used to store all data from all sectors, and to compile the calculations necessary for the total emission values. This data within AirQUIS was then essential to the dispersion modelling conducted in Task 2 using the built-in EPISODE model in AirQUIS. Results from the studies undertaken in Task 4 (Rahman et. al 2015a) and task 5 (Rahman et. al 2015b) was added to the PM emission rates before models were run in AirQUIS as part of Task 2.

5 Emission Results

Emission results are presented below by pollutant for Dhaka and Chittagong in separate sections.

5.1 Dhaka

The emissions results for Dhaka for 2013 are presented for the criteria components in Bangladesh (PM_{10}, $PM_{2.5}$, SOx, NOx, and CO). These results are categorized into different sectors and graphed to be able to identify the highest contributor of pollutants. After which, the gridded values for the emissions are presented, and the gridded dispersion is presented in the Task 2 report.

Table 11 shows a summary of the total annual emissions in Dhaka for each of the five components in tons/year (2013). This table gives a synopsis of the results, which are further discussed in the succeeding chapters. This table also compares the results from this inventory to a results generated from the GAINS top-down global emission inventory (Randall, 2011b). Differences between this emission inventory and emissions reported in GAINS were expected and most likely due to the difference in domain, year and method of data collection, in addition to the sectors incorporated.

Table 11: Dhaka Annual Emissions per Component for all source sectors, with comparison to GAINS global emission inventory.

	Dhaka Annual Emissions (tons/year)		
Component	This Inventory (2013)	GAINS (2010)	% Difference
PM_{10}	58,524	44,950	+23%
$PM_{2.5}$	20,819	35,300	-70%
SOx	60,216	34,300	+75%
NOx	14,862	32,800	-121%
CO	45,581	27,100	+68%

5.1.1 PM_{10}

The distribution of PM_{10} emissions as categorized into different sources in Dhaka is presented in Figure 5.1. It is evident from these results that the brick kiln industry is the main contributor of PM_{10} in Dhaka. This brick kilns emit an average of 53,333 tons of PM_{10} per year, which is 91.1% of the total annual PM_{10} emissions in Dhaka. The PM_{10} emission from brick kiln industries is followed by the mobile sources emissions that contributes 1,952 tons per year, which equivalent to 3.3% of the total annual PM_{10} emissions.

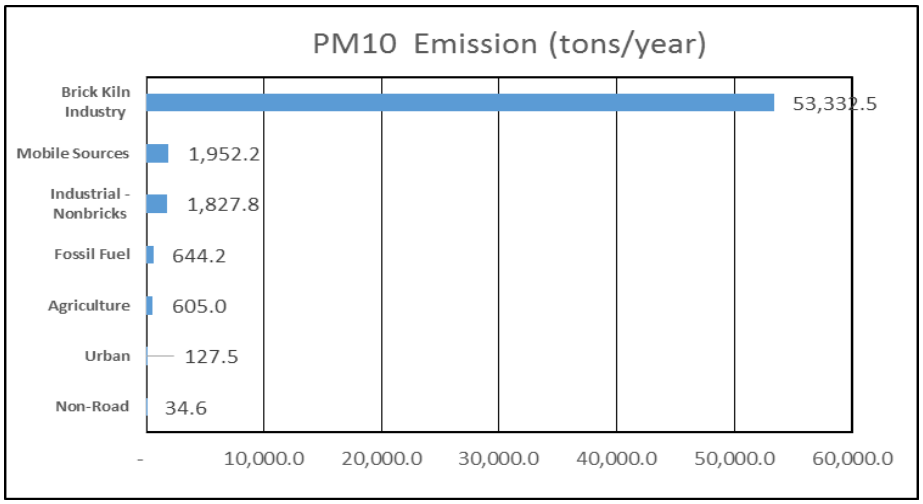


Figure 5.1: PM_{10} Emissions from Different Sectors in Dhaka.

The brick industry is a major energy consuming industry in the country. In Dhaka alone, there are approximately 1000 brick kilns within its vicinity, and this inventory is based on over 600 kilns in the modelling grid. The map of the PM_{10} emissions within the grid for the year 2013 is presented in Figure 5.2. The PM_{10} emission values for Dhaka ranges from 0 to 2,885 tons per year per grid cell (1x1 km^2). Looking at the PM_{10} Dhaka emission map in Figure 5.2 and correlating it with the location of brick kiln stacks in Figure 4.1, it is noticeable that the high PM_{10} emission areas in the same areas as where brick kilns clusters are located, particularly in the north-west portion of the grid.

Emissions from biomass burning seem to be under estimated. The Task 3 report by Begum et. al (2015a) indicated that about 7% of PM originated from biomass burning in Dhaka. The underestimation as shown in Figure 16 is a result of the data base used for estimating top/down emission rates. The EDGAR (Rew, R. & Davis, G., 1990), which was based on anthropogenic sources only, did not include biomass burning. Biomass burning was not also included in the input data for bottom-up estimates.

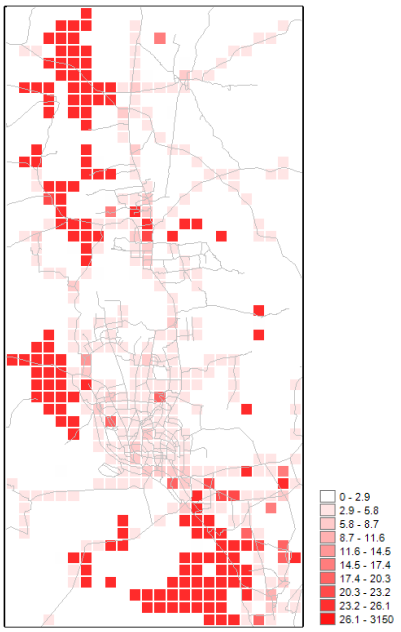


Figure 5.2: Plot of PM_{10} annual gridded emissions (tons/year) for Dhaka, 2013.

5.1.2 PM2.5

The $PM_{2.5}$ emissions from different sources in Dhaka is presented in Figure 5.3. Based from these results, the brick kiln industry is the main contributor of $PM_{2.5}$ emissions in Dhaka. The brick kiln sources emitted an average of 17,557 tons of $PM_{2.5}$ for 2013, which is 84.3% of the total annual $PM_{2.5}$ emissions in Dhaka. The $PM_{2.5}$ emission from brick kiln industries is followed by the non-brick kiln industries that contributes 1,405 tons per year equivalent to 6.7% of the total annual $PM_{2.5}$ emissions.

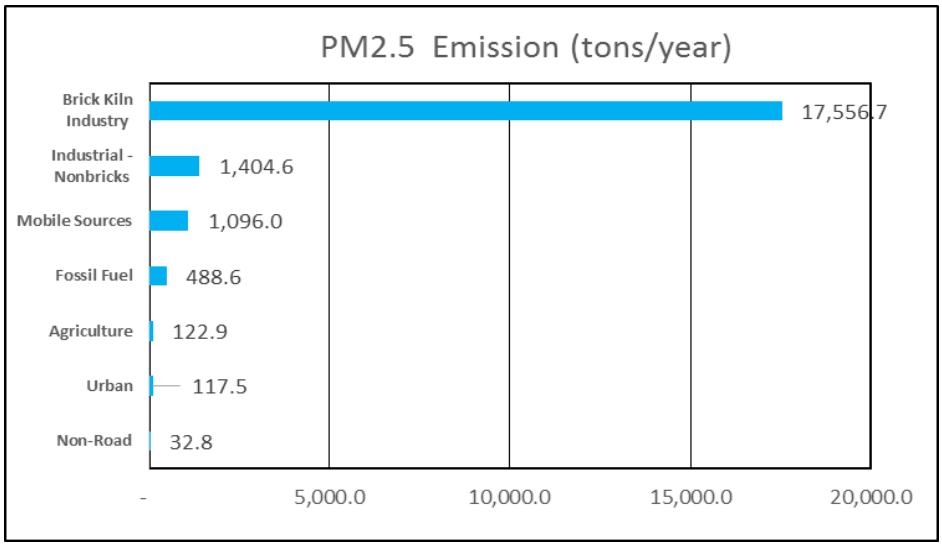


Figure 5.3: $PM_{2.5}$ Emissions from Different Sectors in Dhaka

Figure 5.4 below shows the $PM_{2.5}$ emission map which illustrates the grid cells where the sources of high $PM_{2.5}$ emissions are located. The $PM_{2.5}$ emissions for each grid cell (1 x 1 km sq.) ranges 0.0 to 2,171 tons per year. Same as PM_{10}, the high $PM_{2.5}$ emissions areas are affected by the location where the brick kiln clusters are located.

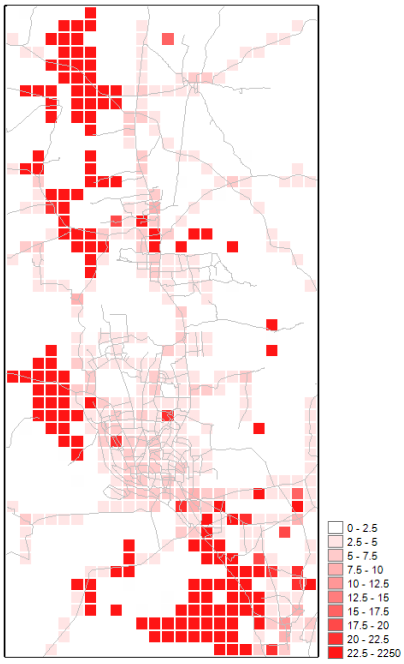


Figure 5.4: Plot of $PM_{2.5}$ annual gridded emissions (tons/year) for Dhaka, 2013.

5.1.3 SO_2

The SO_2 emissions from different sources in Dhaka is presented in Figure 5.5; we assume for this entire inventory that a majority of the SOx emissions are as SO_2. Based from these results, the brick kiln industry is the main contributor of SO_2 emissions in Dhaka. The brick kiln sources emitted an average of 59,221 tons of SO_2 for 2013, which is 98.3% of the total annual SO_2 emissions in Dhaka. In each brick kiln stack (Fixed Chimney Kiln - FCK) approximately 92 tons of SOx is released per year. This is multiplied by more than 600 of these stacks inside the grid.

It can also be observed that there is zero emission of SOx from fossil fuel activities in Dhaka (primarily gas/oil processing), this can be that there are no such activities recorded within the Dhaka grid. In addition, the combustion of coal and high sulfur fuels are categorized under industrial sector, as well as brick kiln industries

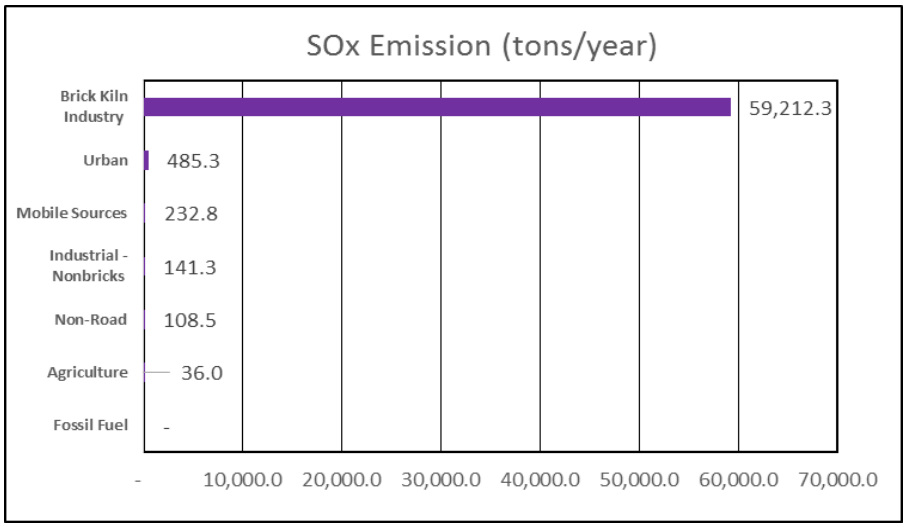


Figure 5.5: SOx Emissions from Different Sectors in Dhaka.

Also SOx emissions from mobile sources seem to be very low. The emission factor from diesel trucks are 0.4 g/km. However, even if there are few diesel trucks on the roads this issue may have to investigated further in the next phase of this project.

To have a clearer understanding of the spatial distribution of SO_2 emission sources, the emissions map is shown in Figure 5.6. This map shows that the emissions per square kilometer (grid cell) ranges from 0.0 to 2.409 tons per year. Knowing that brick kiln contributes a great majority of the SO_2 emissions, it can be inferred that high SO_2 emission grids contain the most number of brick kiln stacks. This is located in the west and north-west portion of the grid.

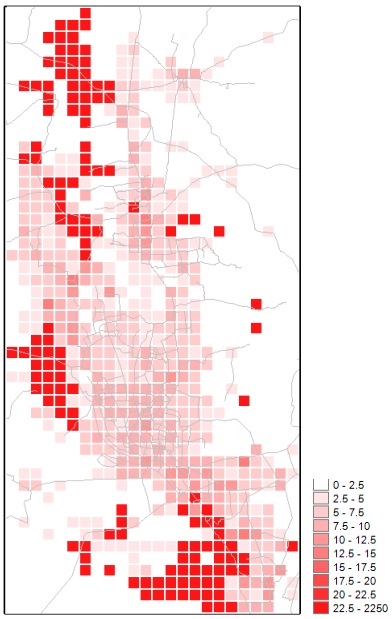


Figure 5.6: Plot of SO_2 annual gridded emissions (tons/year) for Dhaka, 2013.

5.1.4 NO_X

The NO_x emissions from different sources in Dhaka is presented in Figure 5.7. Based from these results, mobile sources are the main contributor of NO_x emissions in Dhaka. This sector contributes as much as 7,620 tons per year for 2013 in the Dhaka grid, which is 58.6% of the total annual NO_x emissions. The industrial sources emit the second highest NO_x amounting to 15.7% of the total annual NO_x. Part of the industrial emissions are from the brick industry. NO_x is a byproduct of fuel combustion in mobile sources; there is high NO_x emission from diesel-powered vehicles, as well as emissions from CNG and gasoline-powered vehicles. Again we see that SO_x emissions from traffic (diesel trucks) might be underestimated as mentioned before.

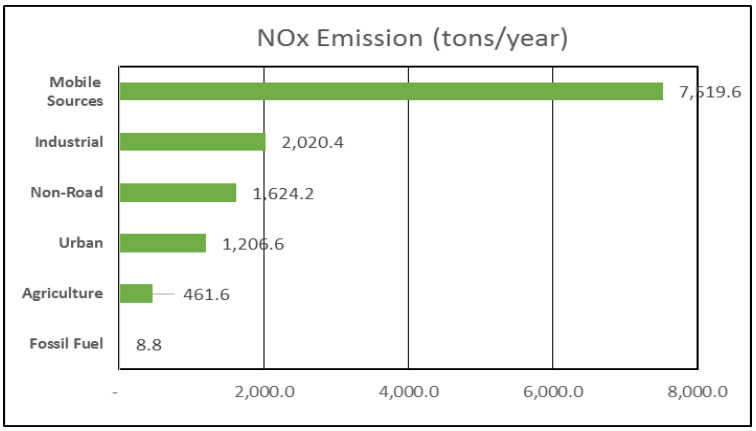


Figure 5.7: NO_x Emissions from Different Sectors in Dhaka.

Figure 5.8 shows the map of the NO_x emissions for Dhaka. The range of NO_x emissions is from 0 to 76 tons per year per 1x1 km^2 grid cell. For NO_x, since the mobile sources are contributing the highest amount of emissions it can be observed that the NO_x emissions are concentrated around the road network.

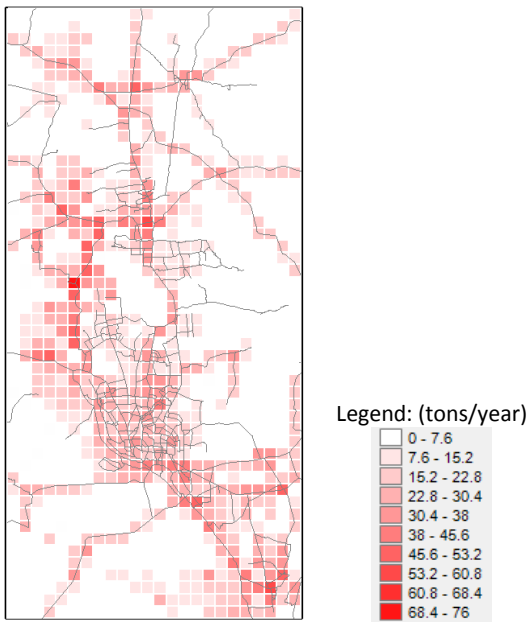


Figure 5.8: Plot of NO_x Annual Emissions (tons/year) for Dhaka 2013.

5.1.5 CO

Figure 5.9 shows the CO emissions in Dhaka, which are dominated by mobile sources amounting to 18,451 tons per year for 2013. The mobile source sector constitutes 40.5% of the total CO emissions, higher than fossil fuel and industrial emissions (which include brick kilns) constituting only 27.1% and 16.4% of the total CO emissions, respectively. The brick-kiln contribution to the CO emissions might be significant during the winter season. However, during the rainy season this part will be zero.

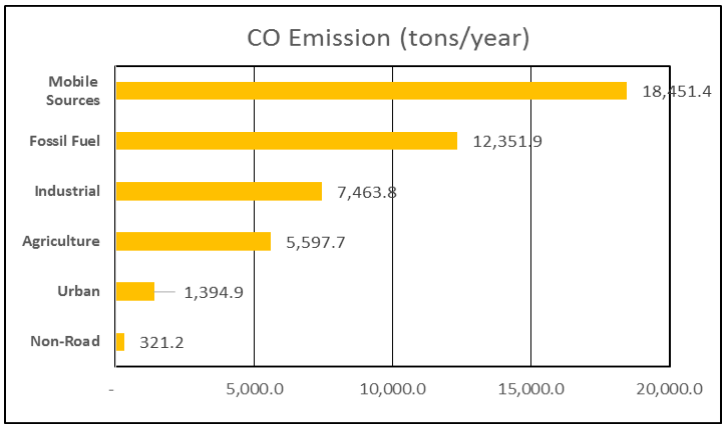


Figure 5.9: Annual CO Emissions from Different Sectors in Dhaka.

The emissions of CO within the Dhaka grid ranges from 0.0 to 174 tons per year per grid cell as shown in Figure 5.10 below. It has already been established that mobile sources dominate the CO emissions. Thus, it can be seen similar to NOx emissions that the CO emissions follow the road network. It should also be noted that for CO, brick kilns were included in the industrial sources sector.

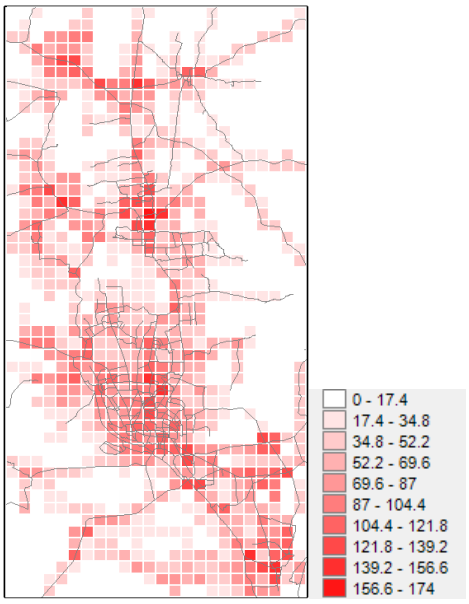


Figure 5.10: Plot of CO Annual Emissions (tons/year) for Dhaka 2013.

5.2 Chittagong

The emissions results for Chittagong for 2013 are presented for the criteria components in Bangladesh (PM_{10}, $PM_{2.5}$, SOx, NOx, and CO) and are categorized into different sectors and graphed to be able to identify the highest contributor of pollutants. After which, the gridded values for the emissions are presented, and the gridded concentrations thereof are presented in the Task 2 report.

Table 12 shows the total annual emissions in Chittagong for each of the five criteria components. This table gives a synopsis of the results, which are further discussed in the succeeding chapters. These results show the tons per year of emissions for each component for the year 2013.

Table 12: Total Emissions in Chittagong (2013) for all components for all source sectors.

Component	Annual Emissions (tons/year)
PM_{10}	10,282
$PM_{2.5}$	5,686
SOx	6,200
NOx	4,082
CO	29,926

Details of each component source sectors are described in the subsequent subsection.

5.2.1 PM_{10}

The distribution of PM_{10} emissions categorized into different sources in Chittagong is presented in Figure 5.11. The PM_{10} emission from industries (including brick kilns) makes up approximately 70% of the total PM_{10} emissions in Chittagong, followed by the urban sources emission that contributes 2412 tons per year equivalent to 23% of the total annual PM_{10} emissions.

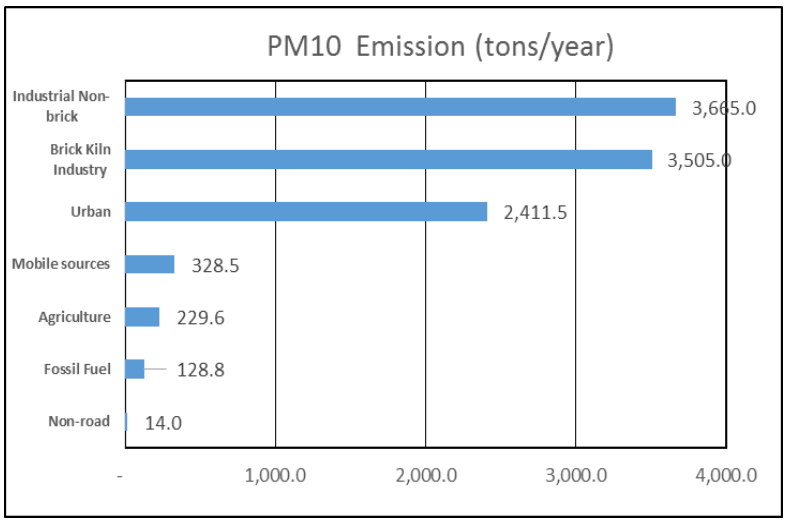


Figure 5.11: PM_{10} Emissions from Different Sectors in Chittagong.

In comparison to Dhaka, Chittagong has much higher PM_{10} emissions from the industrial and urban source sectors, but less from the brick kiln sector (due to that Chittagong only has 10% of the number of brick kilns that Dhaka has).

The re-suspension of PM from roads as identified in Task 4 (Rahman et. al 2015a) (10.89 g/VKT), was added to the PM emission rates for traffic in the AirQUIS modelling for Task 2.

Figure 5.12 shows yearly emissions for all sources/sectors per grid cell (1km^2) for Chittagong. The maximum grid cell has 1577 tons/year PM_{10}.

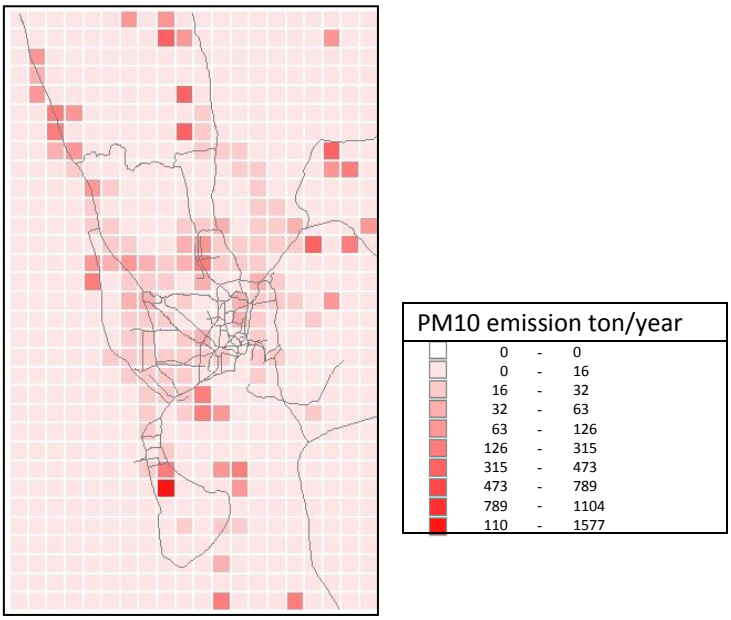


Figure 5.12: Map of PM_{10} Annual Emissions (tons/year) for Chittagong 2013.

5.2.2 $PM_{2.5}$

The distribution of $PM_{2.5}$ emissions as categorized into different source sectors in Chittagong is presented in Figure 5.13. The $PM_{2.5}$ emission from the urban sector makes up approximately 54% of the total $PM_{2.5}$ emissions in Chittagong, followed by the industrial sector emissions equivalent to 39% of the total annual $PM_{2.5}$ emissions.

The urban sector $PM_{2.5}$ emissions in Chittagong are much higher than the same emission sector source for Dhaka. A reason for this difference may be that Dhaka has more modern infrastructure which limits urban/residential combustion in comparison to Chittagong.

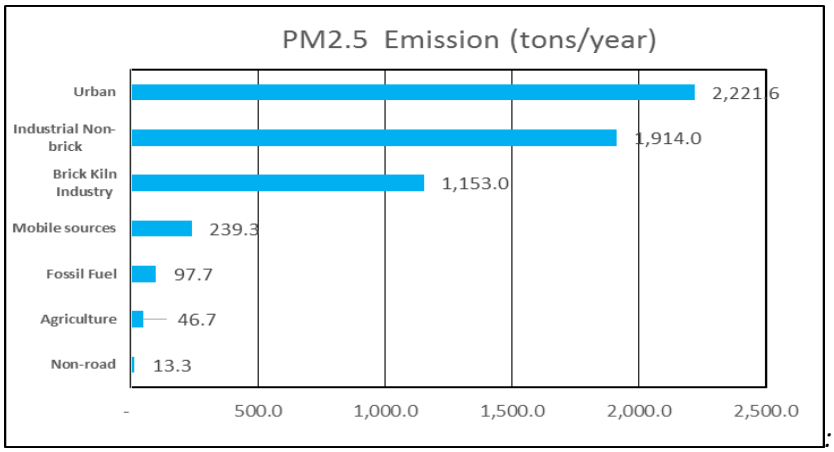


Figure 5.13: *$PM_{2.5}$ Emissions from Different Sectors in Chittagong*

The relatively high emission rate of fine particles from urban areas in Chittagong may be due to the location of the many squatters. These could be residents that are not counted for in the official population, and they will burn anything they can for cooking and heating. Some of this may be biomass fires and smoke plumes around the city producing $PM_{2.5}$ and CO. The magnitude of this source may be difficult to estimate.

$PM_{2.5}$ source sector emission distribution across the grid for Chittagong is the similar as shown for PM_{10}, see Figure 5.14. The maximum grid cell has 442 tons/year $PM_{2.5}$.

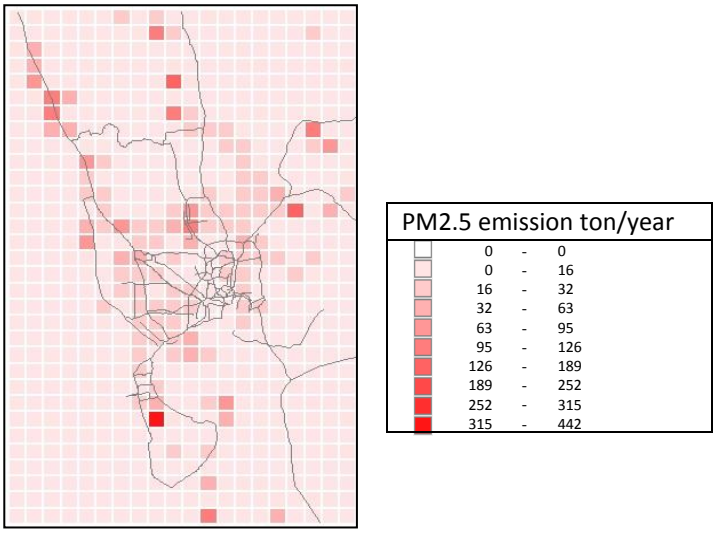


Figure 5.14: *Map of $PM_{2.5}$ Annual Emissions (tons/year) for Chittagong 2013.*

5.2.3 SO_2

The distribution of SO_2 emissions categorized into different sources in Chittagong is presented in Figure 5.15. The SO_2 emission from the brick kiln sector makes up

approximately 64% of the total SO_2 emissions in Chittagong, followed by fossil fuel sector emissions equivalent to 29% of the total annual SO_2 emissions.

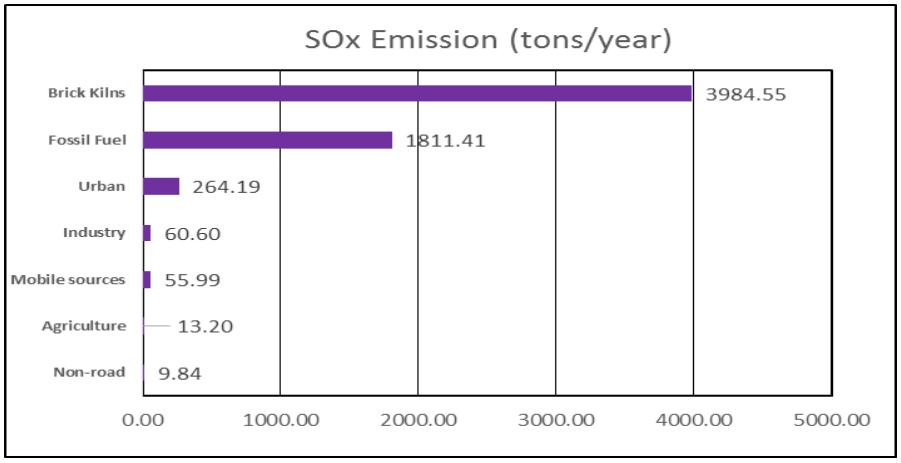


Figure 5.15: SO_2 Emissions from Different Sectors in Chittagong.

It is understandable that the numerous brick kilns in Chittagong are contributing as the major sector to the SO_2 emissions, in addition to the fossil fuel sector (from the large gas processing industries in the grid), however, the low emission totals for the remaining industries ("Industry" sector) appears to be underestimated in the inventory for Chittagong. An explanation for this underestimation is that the brick kiln sector is accounting for some of the other industrial emissions.

Figure 5.16 shows the annual SOx emissions across the grid domain for Chittagong. The maximum grid cell has 473 tons/year SOx.

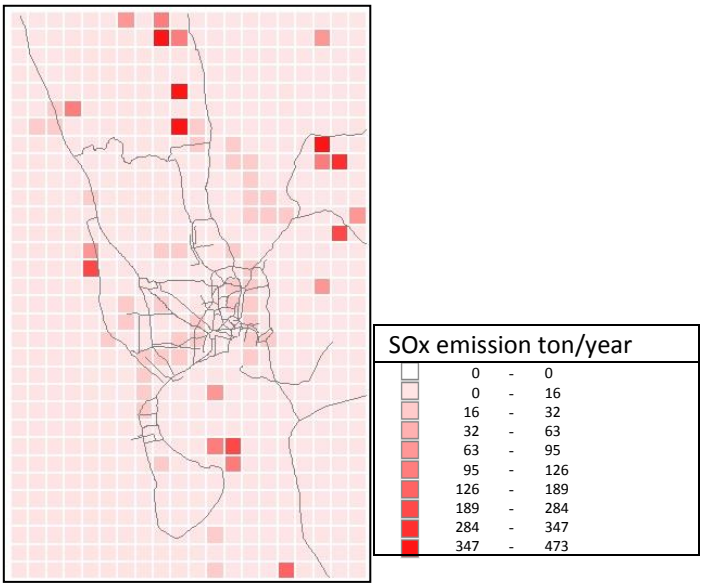


Figure 5.16: Map of SO_2 Annual Emissions (tons/year) for Chittagong 2013.

5.2.4 NOx

The distribution of NOx emissions categorized into different sources in Chittagong is presented in Figure 5.17. The NOx emission from the mobile source sector makes up approximately 42% of the total NOx emissions in Chittagong, followed by fossil fuel sector emissions equivalent to 22% of the total annual NOx emissions. These results for NOx are consistent with the understanding of the sources, where the vehicles should be the major contributor for this component.

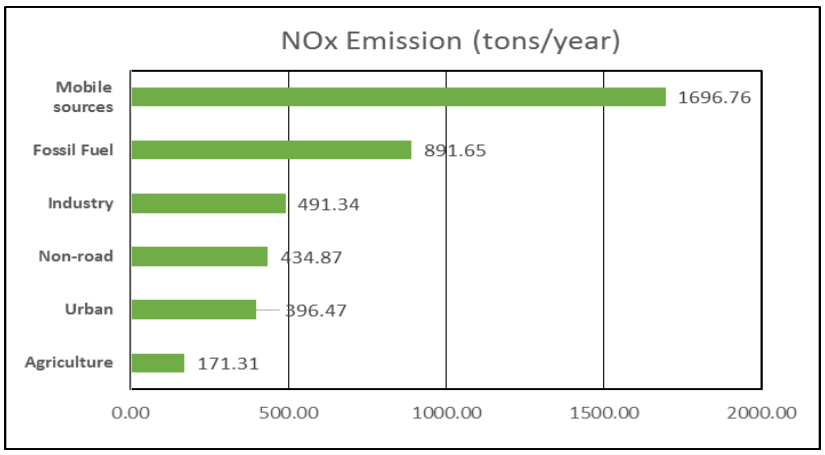


Figure 5.17: NOx Emissions from Different Sectors in Chittagong.

Figure 5.18 shows the annual NOx emissions across the grid domain for Chittagong, where it is evident that these emissions follow the mobile sources along the road network. The maximum grid cell has 54 tons/year NOx.

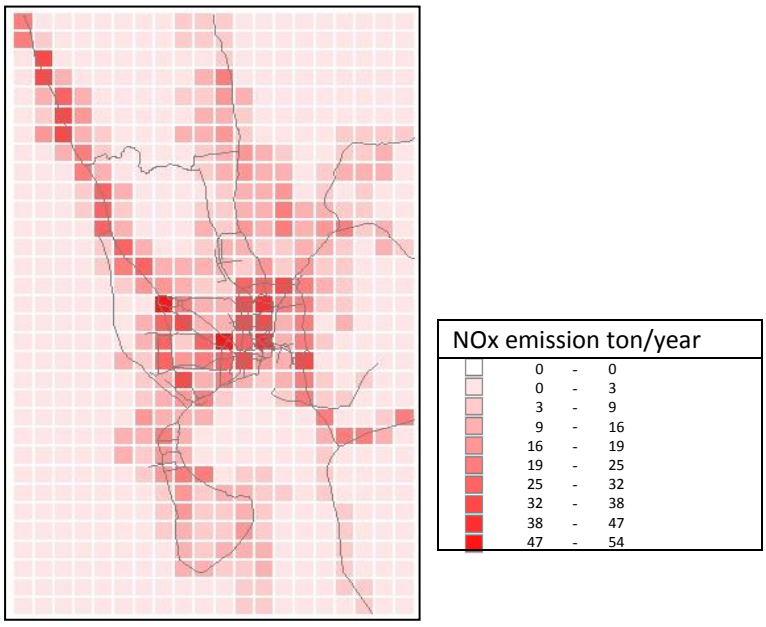


Figure 5.18: Map of NOx Annual Emissions (tons/year) for Chittagong 2013.

5.2.5 CO

The distribution of CO emissions categorized into different sources in Chittagong is presented in Figure 5.19. The CO emissions from the urban source sector makes up approximately 60% of the total CO emissions in Chittagong, followed by the mobile source sector emissions equivalent to 18% of the total annual CO emissions.

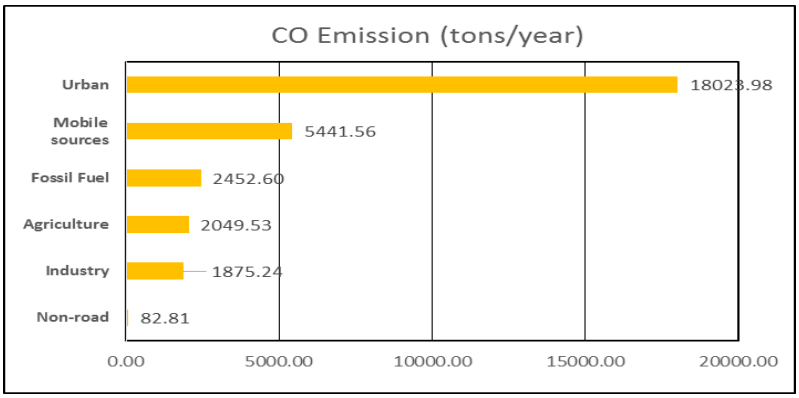


Figure 5.19: Sector wise CO emission.

As commented for $PM_{2.5}$ emissions, it is not completely certain why the urban source sector is the dominating sector for these emissions in Chittagong, including CO. As mentioned for $PM_{2.5}$, a possible reasoning is there are many squatters spread around the city. The type of residential combustion being performed in Chittagong includes burning of biomass for cooking and heating.

Figure 5.20 shows the annual CO emissions across the grid domain for Chittagong, where it is evident that these emissions are in the urban areas, in addition to following the mobile sources along the road network. The maximum grid cell has 331 tons/year CO.

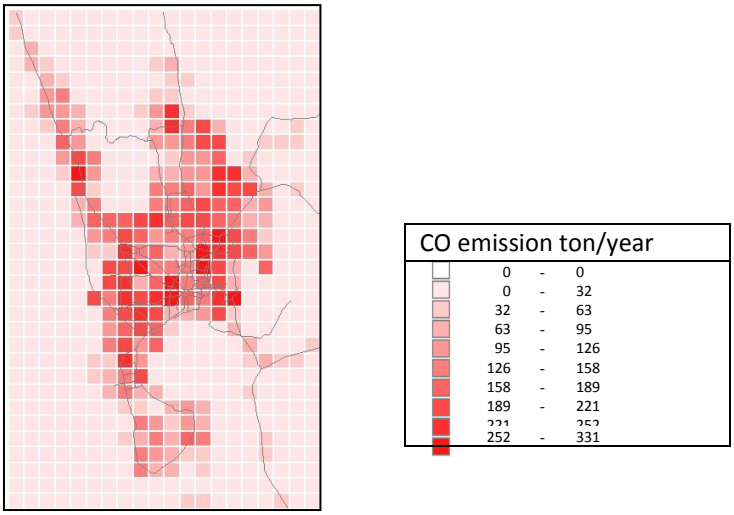


Figure 5.20: Map of CO Annual Emissions (tons/year) for Chittagong 2013.

6 Summary

This report has documented the annual emissions and source sectors for Dhaka and Chittagong for the year 2013. In addition, the methodology used for producing the emission inventories has been thoroughly presented.

A summary of the annual emissions for both Dhaka and Chittagong can be seen in Table 13. The total annual emissions for Dhaka are much greater for each pollutant in comparison to Chittagong, but this is as expected due to the difference in size and sources between each city.

Table 13: Summary of annual emissions (tons/year) for both Dhaka and Chittagong.

	PM_{10}	$PM_{2.5}$	SOx	NOx	CO
Dhaka	58,524	20,819	60,216	14,862	45,581
Chittagong	10,282	5,686	6,200	4,082	29,926

A summary of main emission source sectors for each pollutant in Dhaka and Chittagong can be seen in Table 14.

Table 14: Summary of main emission source sectors for each pollutant in Dhaka and Chittagong.

	PM_{10}	$PM_{2.5}$	SOx	NOx	CO
Dhaka	Brick Kilns	Brick Kilns	Brick Kilns	Traffic	Traffic
Chittagong	Industry	Urban	Brick Kilns	Urban	Traffic

These emission inventories for both Dhaka and Chittagong have been critical for completion of the dispersion of the emissions in Task 2 of this project. Task 2 gives a much clearer picture of the air quality impacts in the form of concentrations found from the various sources investigated.

For some of the air pollutants as well as for selected source categories there seem to be a need for looking closer into some of the problems, as the basic input data is not always complete.

7 Policy Implications

This emission inventory for Dhaka and Chittagong was used for the dispersion modelling (Task 2) to assess the air quality for each city based on the resulting concentrations from the model. When examining and assessing these concentration values from Task 2, it will be important for policy makers to refer back to the resulting emissions generated from this inventory to understand what necessary limits need to be placed, and on what specific sectors.

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Appendix A

Industrial Sources (Chittagong)

Stack ID	Stack name	EW Co-ordinate	NS Co-ordinate
10101	Brick Kiln 10101	385076.83	2480697.63
10102	Brick Kiln 10102	380320.1	2463124.94
10103	Brick Kiln 10103	379920.57	2463611.56
10104	Brick Kiln 10104	379739.75	2463668.57
10105	Brick Kiln 10105	379625.24	2463704.5
10106	Brick Kiln 10106	379165.72	2463932.18
10107	Brick Kiln 10107	384908.3	2479508.97
10108	Brick Kiln 10108	385323	2479658
10109	Brick Kiln 10109	385709.42	2479958.81
10110	Brick Kiln 10110	385868.92	2480209.14
10111	Brick Kiln 10111	385232.7	2480716.5
10112	Brick Kiln 10112	384852.59	2480742.72
10113	Brick Kiln 10113	385034.88	2481092.39
10114	Brick Kiln 10114	384478.67	2487252.62
10115	Brick Kiln 10115	377343.52	2481787.18
10116	Brick Kiln 10116	377090.44	2482324.37
10117	Brick Kiln 10117	376779	2482405
10118	Brick Kiln 10118	376559.67	2482269.28
10119	Brick Kiln 10119	376671.03	2483655.07
10120	Brick Kiln 10120	377075.92	2483782.66
10121	Brick Kiln 10121	375471.19	2487545.27
10122	Brick Kiln 10122	375556.38	2487289.4
10123	Brick Kiln 10123	375948.89	2487494.76
10124	Brick Kiln 10124	376102.75	2487187.88
10125	Brick Kiln 10125	376276.49	2487409.74
10126	Brick Kiln 10126	376519.77	2487284.72
10127	Brick Kiln 10127	386190.73	2476386.55
10128	Brick Kiln 10128	386639.48	2476774.3
10129	Brick Kiln 10129	385995.76	2476303.48
10130	Brick Kiln 10130	385360.05	2472985.57
10131	Brick Kiln 10131	372172.42	2473797.92
10132	Brick Kiln 10132	372094.12	2474338.26
10133	Brick Kiln 10133	372121	2474697.84
10134	Brick Kiln 10134	382841.08	2457359.58
10135	Brick Kiln 10135	382455.86	2457437.33
10136	Brick Kiln 10136	371193.56	2483128.17
10137	Brick Kiln 10137	374251.15	2488106.38
10138	Brick Kiln 10138	379250.07	2467080.93
10139	Brick Kiln 10139	377341	2484085
10140	Brick Kiln 10140	385819.71	2480056.27
10141	Brick Kiln 10141	376720	2484250
10142	Brick Kiln 10142	376701	2484428
10143	Brick Kiln 10143	372134.92	2474059.29
20201	Ruby Cement	375806.626	2464337.097
20202	T.K. Bangal Corporation	383817.813	2476032.866
20203	NGS Cement Industries Ltd,	376194.374	2462562.582
20204	Confidence Cement	370083.411	2482242.601
20205	Aramit Group Of Companies	383557.85	2475691.608
20206	DIMOND CEMENT	377734.031	2467372.005
20207	National Cement Insustires Ltd.	377911.92	2467526.271

Stack ID	Stack name	EW Co-ordinate	NS Co-ordinate
40401	Chittagong Steel Mills Ltd.	374792.536	2463802.718
40402	Van Gard Steel Mill Ltd.	373674.107	2473255.809
40403	Jilani Steel Mills	381262.134	2474391.547
40404	M.R. Steel Pvt. Ltd.	373771.998	2475159.334
40405	Kabir Steel Ind. Ltd.	383850.526	2476276.188
40406	Sima Steel mills Ltd.	370566.276	2480909.921
40407	Khawaja Azmir Steel I Rolling Ltd.	370164.068	2482042.628
40408	Ambia Steel & Re-rolling Mills Ltd.	370305.178	2481687.142
40409	Star Metals	384044.973	2476119.733
40410	Balaka Steel Indus. Ltd.	374258.435	2475465.384
40411	Nation Iron & Steel Ind. Ltd.	383609.577	2475724.433
40412	LS Steel & Re-rolling	371704.607	2479162.155
40413	BR Steel mills	370415.789	2481376.201
40414	Khalil Steel Mills	369914.237	2482930.483
40415	Peninsula Steel Mills	369885.229	2483152.166
40416	Brothers Ispat Ltd.	369916.102	2483151.906
40417	Imtiaz Rolling Mills	370009.654	2483261.837
40418	H. Steel Re-Rolling Mills	370009.654	2483261.837
40419	Sico Steel Ltd.	368373.773	2484526.835
40420	SARM Steel mills	371776.203	2479106.202
40421	Sima Authority	371962.314	2479204.306
40422	Mirza Ampole Steel & Re-rolling	371675.013	2479317.405
40423	M/S. Golden Steel	370616.534	2480765.566
40424	QS Steel	370155.972	2481079.442
40425	Kabir Steel Re-rolling Mills	370363.864	2481321.278
40426	Re-rolling Industries	370354.5	2481432.075
40427	M/S. S.S. International	370334.845	2481542.959
40428	Guri Steel Ltd.	370232.483	2481610.25
40429	Abul Khair Steel Mills	369961.963	2482487.205
40430	N.G Steel Inds.	374027.872	2474969.034
40431	Khairunnassa Corporation	373723.07	2472945.404
40432	Karim Pipe Ind.	373839.317	2473309.821
40433	Universal Steel	377145.978	2474733.635
40434	Bangladesh Steel Mills Ltd.	377681.564	2474751.541
40435	Map Corporation Ind. Ltd.	377778.162	2475248.996
40436	Mobarak Rolling Mills	372435.322	2476642.823
40437	Bangaldesh Steel Maghna Mills	377554.1	2475560.767
40438	G.K. Steel Ltd.	382445.509	2475644.655
40439	BM Iron Industries	378534.055	2481033.449
40440	Multi Steel Castings Ltd.	377460.649	2475461.863
40441	Green Mark Iron Steel Ltd.	377459.248	2475284.73
40442	Golden Iron Wax Ltd.	368490.081	2486098.068
40443	Mujib Steel	368594.954	2486329.686
40444	Modern Steel Mills Ltd.	377693.541	2476268.243
40445	Saleh Steel Ind. Ltd.	377712.453	2474751.297
40446	Javed Steel Mills Ltd.	373000.054	2475198.859
40447	Unity Brakers Ltd.	374576.356	2475307.804
40448	BSKM	374115.731	2475643.69
40449	BM Steel	372607.335	2476276.04
40450	Al-Saba Steel Mills	369813.659	2483208.129
40451	Harun Rolling	369599.981	2483497.803
40452	Aslam Steel	368451.563	2483994.716
40453	SMS Steel	368483.472	2484116.236

Stack ID	Stack name	EW Co-ordinate	NS Co-ordinate
40454	SL Steel Mills	369328.223	2484219.778
40455	Vatiali Steel Mills	369277.709	2484330.926
40456	Golden Steel Mills Ltd.	369257.598	2484386.456
40457	Sitalpur Steel Mills Ltd.	369146.66	2484653.124
40458	Master Rolling Mills	369055.929	2484875.333
40459	Nazia (Pvt.) Ltd.	368853.897	2485319.929
40460	Sonali Steels	368602.318	2485986.391
40461	Rini Subader Steel Re- Rolling Mills	368499.709	2486020.482
40462	Ali Steel Industries	374869.595	2473367.902
40463	Banj Bangladesh Ltd.	377971.083	2474904.258
40464	Hill Vew Steel Ltd.	373803.157	2475192.296
40465	Malik Re-rolling Mills Ltd.	377673.388	2476323.759
40466	Gawchha Pack Steel	382837.924	2477158.452
40467	Bangladesh Re-Rolling Steel Mills	377576.354	2475770.95
40468	S.S Re-rolling	378890.917	2476657.404
40469	Islam Steel Mills Ltd.	378171.959	2474260.532
40470	Bayejid Steel Ind. Ltd.	377918.206	2474727.531
40471	YunusSteel Engineering & Technolozy ltd.	383903.579	2476486.145
40472	Chowdhury Safu Ind.	377476.23	2482625.039
40473	Abul Khair Steel Industries Ltd	370191.299	2482563.886
40474	Asif Steel Mill	377226.763	2476299.505
40475	S. ALAM Re-rolling Mill	383662.028	2467434.012
70701	Rahman Glass Procesing Ind.	383849.363	2476121.199
70702	Usmania Glass Sheet Fac. Ltd.	382613.259	2476041.95
111101	Chittagong Urea Fertilizer Factory(CUFL)	379120.042	2457397.008
111102	Karnaphuli Fertilizer Comp (KAFCO)	378963.227	2458842.909
121201	Chittagong Urea Fertilizer Factory(CUFL)	379120.042	2457397.008
121202	Karnaphuli Fertilizer Comp (KAFCO)	378963.227	2458842.909
131301	DAP Fertilizer Industry	379366.033	2459295.039
141401	T.S.P. Fertilizer Factory	376075.652	2463183.525

Appendix B

Industrial Sources (Dhaka)

Count	Stack Name	Source Sectors Name	X_Coor	Y_Coor
1	Matuail Board Mill_stack	Paper Processing	241408.7505	2623314.306
2	S.R. Power Factory_stack	Paper Processing	241302.7911	2623094.556
3	S. R. Packaging_stack	Paper Processing	241304.764	2623205.339
4	Janit Packaging Ltd._stack	Paper Processing	239896.3998	2624338.689
5	Shanta Enterprise_stack	Paper Processing	241408.7505	2623314.306
6	Pack Saas BD Ltd_stack	Paper Processing	231555.6641	2636792.433
7	Millener Level_stack	Paper Processing	224914.8319	2646781.769
8	Jago Carparation_stack	Paper Processing	227109.4949	2644301.605
9	Shahin Packaging Ltd._stack	Paper Processing	226803.8694	2644307.401
10	Tetreams Board_stack	Paper Processing	235129.0298	2648141.616
11	Beg Group_stack	Paper Processing	237790.3427	2651746.406
12	Shyaper Packaging Ltd_stack	Paper Processing	235919.3581	2652338.508
13	Samrat Packaning Ind._stack	Paper Processing	235249.1377	2643595.489
14	Wega Packaging & Accessories Ltd_stack	Paper Processing	234715.5254	2647816.758
15	Zinni Packaging_stack	Paper Processing	234913.0867	2647480.631
16	Unique Paper Products Ltd._stack	Paper Processing	234678.7359	2645822.537
17	Fahima Box INds. Ltd_stack	Paper Processing	244374.7864	2612069.454
18	RIB Paper Mills_stack	Paper Processing	244582.8447	2612287.441
19	Mart Paper_stack	Paper Processing	245871.6225	2615921.791
20	Bangladesh Paper Mills Ltd._stack	Paper Processing	246723.0425	2623774.742
21	Three Star Plastic Factory_stack	Polyester	233900.2145	2625666.425
22	Jofarsons Ltd._stack	Polyester	230176.8549	2633936.545
23	A.M. Flaxco Poly Print_stack	Polyester	230072.8406	2633827.656
24	Egal Gol Company_stack	Polyester	232996.9506	2637541.511
25	Taj Plastic Company_stack	Polyester	238787.7287	2621750.646
26	Pokha Plastc Ind._stack	Polyester	240233.145	2620343.158
27	Gazi Taxis Ltd._stack	Polyester	239536.7578	2621352.992
28	Masud Meral_stack	Polyester	241075.0733	2621768.787
29	Sowan Metal Industry_stack	Polyester	239960.728	2622231.959
30	National Polymer Ind. Ltd._stack	Polyester	234576.8767	2645824.416
31	Polymar Indestry_stack	Polyvynil Chloride	227209.9415	2633438.048
32	International Dakuan Pvt. Ltd._stack	Polyvynil Chloride	239624.8998	2620575.674
33	Bangal Fine Plastic Ltd._stack	Polyvynil Chloride	240824.2544	2641942.566
34	B.K. PVC Pipe_stack	Polyvynil Chloride	233627.3358	2644068.71
35	Said Plastic Pipe House_stack	Polyvynil Chloride	245625.4377	2619361.331
36	Sunbard Sanitation Ltd_stack	Clay Ceramics Manufacturing	239436.7149	2621465.604
37	Keya Malamain Ind._stack	Clay Ceramics Manufacturing	240133.0893	2620455.765
38	Juyal Enterprise_stack	Glass Manufacturing	239128.6432	2621360.309
39	NA_stack	Glass Manufacturing	231319.4222	2645995.711
40	National Glass_stack	Glass Manufacturing	238435.4055	2645088.803
41	Monir & Co._stack	Cement Production	229804.8292	2630396.934
42	Abdul Moname Ltd._stack	Cement Production	229621.5762	2631508.653
43	Rajdhani Construction Eng. Ltd._stack	Cement Production	241017.8756	2618556.069
44	Polly Metal Factory_stack	Metal Processing	233475.9312	2624787.606
45	Pasific Furniture_stack	Metal Processing	227155.7167	2646739.082
46	Rahmot Metal_stack	Metal Processing	239836.896	2621015.158
47	Kashim Metal Ind. Ltd_stack	Metal Processing	240031.0548	2620457.588
48	Kamal Karigori_stack	Metal Processing	235750.8884	2659767.101
49	Nowjam Battery_stack	Battery Production	229338.479	2632733.077
50	Haque Brothers Ltd._stack	Battery Production	236002.9006	2645798.178
51	Eyar Ali Re-Rolling & Steel Mills_stack	Metal Processing	246022.5576	2624562.68
52	S.B. Steel_stack	Metal Processing	241810.8973	2622974.698

Count	Stack Name	Source Sectors Name	X_Coor	Y_Coor
53	Sarder Steel & Re-Rolling Mills_stack	Metal Processing	243280.246	2625275.819
54	Khadem Steel Ind._stack	Metal Processing	242770.2526	2625284.85
55	Mohona Steel & Ind._stack	Metal Processing	242974.2502	2625281.235
56	Al Aksa Steel Mills Ltd._stack	Metal Processing	245604.845	2624015.918
57	Kajla Steel & Eng, Rolling Mill_stack	Metal Processing	239590.3776	2624344.174
58	Five Star Steel Ind._stack	Metal Processing	240135.0689	2620566.549
59	Orient Re-Rolling Mills_stack	Metal Processing	240027.0943	2620236.02
60	Forman Steel Mills_stack	Metal Processing	240237.1025	2620564.726
61	Raibow Re-Rolling Mills_stack	Metal Processing	240233.145	2620343.158
62	NF_stack	Metal Processing	238832.2815	2622667.995
63	Taj Industries Ltd._stack	Metal Processing	239130.6312	2621471.094
64	Dyamond Steel Products Co. Ltd._stack	Metal Processing	239130.6312	2621471.094
65	Al-Raji Re-Rolling_stack	Metal Processing	239734.8653	2621016.984
66	Asia Re-Rolling Mills_stack	Metal Processing	239636.8023	2621240.38
67	Rahman Steel Mills_stack	Metal Processing	240035.0156	2620679.156
68	Samia Re-rolling_stack	Metal Processing	240433.2612	2620117.947
69	Famous Steel Mills_stack	Metal Processing	240329.2468	2620008.985
70	Salam Steel Mills_stack	Metal Processing	240036.9961	2620789.94
71	Sun Steel Re- Rolling Mills Ltd._stack	Metal Processing	240031.0548	2620457.588
72	Al Nur Steel Re- Rolling Mills_stack	Metal Processing	240227.2093	2620010.806
73	Radoyan Steel & Re-rolling Mills LTd_stack	Metal Processing	240227.2093	2620010.806
74	Nabi Steel Ind. Ltd._stack	Metal Processing	240423.3773	2619564.029
75	Binimoy Steel Re-rolling Mills_stack	Metal Processing	240737.3962	2620001.704
76	Golden Rolling Mills_stack	Metal Processing	241842.1121	2618984.697
77	Sharmen Re-Rolling_stack	Metal Processing	246318.4665	2618130.278
78	Pratasa Weading Industries_stack	Metal Processing	245371.7062	2622357.774
79	Best Steel Rolling Mills_stack	Metal Processing	240835.4861	2619778.319
80	Hamid Re-rolling Mills_stack	Metal Processing	241131.7467	2619218.952
81	Prime Re-Rolling Mills_stack	Metal Processing	242050.1269	2619202.643
82	Satata Re-Rolling mills_stack	Metal Processing	243178.452	2619515.134
83	Excel Steel Mills_stack	Metal Processing	242962.6325	2618854.045
84	ASR Rolling Mills_stack	Metal Processing	242656.5007	2618859.455
85	RS Tarders_stack	Metal Processing	242554.4566	2618861.26
86	Shah Fataullah Re-Rolling Mills_stack	Metal Processing	242252.2485	2619088.244
87	Suma Metal Re-Rolling Mills_stack	Metal Processing	241844.0774	2619095.479
88	Shajahan Steel Re-rolling Mill_stack	Metal Processing	243033.3926	2617079.731
89	R.R. Steel Complex Ltd._stack	Metal Processing	241824.4277	2617987.652
90	Aliganj Iron_stack	Metal Processing	241918.6238	2617542.712
91	Fatullah Steel Re-rolling Mills_stack	Metal Processing	242419.0949	2616979.766
92	The Sun Rising Steel Mills Ltd_stack	Metal Processing	242794.0817	2615089.259
93	Mosuling Nagar Re-Rolling Ltd._stack	Metal Processing	241942.2322	2613109.611
94	Minan Steel_stack	Metal Processing	242796.0365	2615200.041
95	Sikder Re Rolling_stack	Metal Processing	243565.8471	2612526.906
96	Al- Ahmmed Re-Rolling Mills Ltd._stack	Metal Processing	246224.1454	2618575.178
97	Chakda steel & Re-rolling Mills_stack	Metal Processing	240637.3343	2620114.307
98	Al Hadis Re-rolling Mills_stack	Metal Processing	241037.5915	2619663.901
99	Provati Steel Mills Ltd._stack	Metal Processing	245606.7858	2624126.699
100	B.M.T. Rolling Mills_stack	Metal Processing	239736.8484	2621127.769
101	Asar Steel Mills Ltd._stack	Metal Processing	239632.8345	2621018.811
102	Alijan Steel Ind._stack	Metal Processing	239934.9639	2620791.765
103	Takno Sun Steel Mills_stack	Metal Processing	240431.2842	2620007.163
104	Kadamtali Steel Mills_stack	Metal Processing	239836.896	2621015.158
105	Hasan steel_stack	Metal Processing	239430.7581	2621133.251

Count	Stack Name	Source Sectors Name	X_Coor	Y_Coor
106	H. Ali Steel Mills Ltd_stack	Metal Processing	239738.8316	2621238.553
107	R.B. Steel Mills_stack	Metal Processing	239838.8784	2621125.943
108	Rahima Steel Ltd._stack	Metal Processing	240035.0156	2620679.156
109	Kamal Steel Ind._stack	Metal Processing	240137.0485	2620677.333
110	Hazi Tahar Ali Steel Ind._stack	Metal Processing	240123.1926	2619901.845
111	S. Cutting Mills_stack	Metal Processing	239534.773	2621242.207
112	Bangladesh Balade Factory Ltd_stack	Metal Processing	235049.4654	2643820.815
113	M/S, Saika Steel indestry Ltd._stack	Metal Processing	232026.2517	2645650.038
114	S.S. Steel Mills Ltd._stack	Metal Processing	234666.4785	2645157.797
115	Jamuna Steel Ltd._stack	Metal Processing	242905.9229	2615641.368
116	New Dhaka Modilong_stack	Metal Processing	241822.4632	2617876.869
117	DHL Steel Tubes Mills_stack	Metal Processing	240735.4217	2619890.921
118	Chitagong Steel Works_stack	Metal Processing	242907.8773	2615752.149
119	Nasir Steel Mills_stack	Metal Processing	243986.9663	2619057.621
120	M/s. Al Baraka Steel & Co._stack	Metal Processing	242654.5418	2618748.673
121	Haque Steel Complex Ltd_stack	Metal Processing	242525.0692	2617199.526
122	Minal Steel Ind. Ltd._stack	Metal Processing	242799.9463	2615421.605
123	Dhalashari Iron & Eng. Works_stack	Metal Processing	239626.8833	2620686.458
124	Rahim Aloy Steel Mills Ltd._stack	Metal Processing	239126.6552	2621249.525
125	Agrani Molding_stack	Metal Processing	240231.1664	2620232.374
126	S.S. Metal_stack	Metal Processing	239334.687	2621467.434
127	Mohammadia Metal_stack	Metal Processing	241235.7593	2619327.921
128	Sagar Steel Mills_stack	Metal Processing	241946.1203	2619093.669
129	Shofiq Metal_stack	Metal Processing	231605.4178	2628479.377
130	Sun Enterprise_stack	Metal Processing	241406.7783	2623203.523
131	Usuf Metal_stack	Metal Processing	239934.9639	2620791.765
132	Wahid Ali Metal_stack	Metal Processing	238821.8205	2623085.201
133	Kadaria Matel Industries_stack	Metal Processing	239436.7149	2621465.604
134	NF_stack	Metal Processing	237098.5505	2623714.283
135	Gigabite_stack	Metal Processing	235627.2245	2630843.601

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
1	Brick_Stack_592	Brick kilns	240815.21	2612392
2	Brick_Stack_589	Brick kilns	241572.58	2612508
3	Brick_Stack_593	Brick kilns	240676.78	2612606
4	Brick_Stack_590	Brick kilns	241457.78	2612606
5	Brick_Stack_591	Brick kilns	241292.43	2612695
6	Brick_Stack_595	Brick kilns	240618.97	2612714
7	Brick_Stack_594	Brick kilns	241202.84	2612847
8	Brick_Stack_598	Brick kilns	240185	2612999
9	Brick_Stack_596	Brick kilns	241159.35	2613025
10	Brick_Stack_599	Brick kilns	240382.29	2613045
11	Brick_Stack_600	Brick kilns	240318.17	2613156
12	Brick_Stack_597	Brick kilns	241115.03	2613177
13	Brick_Stack_601	Brick kilns	240247.87	2613307
14	Brick_Stack_612	Brick kilns	241075.65	2613383
15	Brick_Stack_602	Brick kilns	240208.8	2613425
16	Brick_Stack_611	Brick kilns	241212.07	2613440
17	Brick_Stack_533	Brick kilns	237173.9	2613473
18	Brick_Stack_610	Brick kilns	241040.71	2613501
19	Brick_Stack_603	Brick kilns	240143.9	2613549
20	Brick_Stack_640	Brick kilns	237393.06	2613559
21	Brick_Stack_638	Brick kilns	237585.69	2613583
22	Brick_Stack_609	Brick kilns	241004.35	2613590
23	Brick_Stack_608	Brick kilns	241123.24	2613663
24	Brick_Stack_607	Brick kilns	240972.86	2613678
25	Brick_Stack_639	Brick kilns	238076.91	2613689
26	Brick_Stack_637	Brick kilns	238210.88	2613715
27	Brick_Stack_636	Brick kilns	238320.85	2613728
28	Brick_Stack_634	Brick kilns	238526.33	2613753
29	Brick_Stack_614	Brick kilns	240044.99	2613768
30	Brick_Stack_635	Brick kilns	238404.01	2613772
31	Brick_Stack_613	Brick kilns	240176.93	2613789
32	Brick_Stack_606	Brick kilns	240928.01	2613801
33	Brick_Stack_670	Brick kilns	236947.35	2613818
34	Brick_Stack_633	Brick kilns	238547.89	2613858
35	Brick_Stack_671	Brick kilns	236828.66	2613867
36	Brick_Stack_605	Brick kilns	240975.45	2613876
37	Brick_Stack_615	Brick kilns	240017.97	2613879
38	Brick_Stack_669	Brick kilns	237097.82	2613882
39	Brick_Stack_672	Brick kilns	236710.61	2613891
40	Brick_Stack_604	Brick kilns	240823.55	2613904
41	Brick_Stack_665	Brick kilns	237633	2613909
42	Brick_Stack_632	Brick kilns	238702.05	2613925
43	Brick_Stack_668	Brick kilns	237230.91	2613925
44	Brick_Stack_673	Brick kilns	236596.53	2613941
45	Brick_Stack_667	Brick kilns	237377.35	2613947
46	Brick_Stack_666	Brick kilns	237519.18	2613962
47	Brick_Stack_694	Brick kilns	235776.3	2613986
48	Brick_Stack_631	Brick kilns	238791.06	2613988
49	Brick_Stack_674	Brick kilns	236483.47	2613990
50	Brick_Stack_664	Brick kilns	237796.34	2613998
51	Brick_Stack_663	Brick kilns	237913.4	2614012
52	Brick_Stack_662	Brick kilns	238039.4	2614032

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
53	Brick_Stack_618	Brick kilns	239931.1	2614039
54	Brick_Stack_641	Brick kilns	240798.56	2614053
55	Brick_Stack_630	Brick kilns	238896.16	2614059
56	Brick_Stack_693	Brick kilns	235643.15	2614064
57	Brick_Stack_675	Brick kilns	236346	2614075
58	Brick_Stack_661	Brick kilns	238186.3	2614093
59	Brick_Stack_692	Brick kilns	235531.62	2614122
60	Brick_Stack_616	Brick kilns	240070.04	2614125
61	Brick_Stack_629	Brick kilns	238999.06	2614138
62	Brick_Stack_660	Brick kilns	238335.39	2614145
63	Brick_Stack_642	Brick kilns	240766.97	2614181
64	Brick_Stack_659	Brick kilns	238430.95	2614199
65	Brick_Stack_628	Brick kilns	239118.98	2614239
66	Brick_Stack_617	Brick kilns	239845.3	2614246
67	Brick_Stack_696	Brick kilns	235366.6	2614279
68	Brick_Stack_658	Brick kilns	238588.88	2614285
69	Brick_Stack_644	Brick kilns	240811.14	2614296
70	Brick_Stack_643	Brick kilns	240702.95	2614296
71	Brick_Stack_657	Brick kilns	238709.84	2614322
72	Brick_Stack_688	Brick kilns	235251.6	2614332
73	Brick_Stack_695	Brick kilns	235942.57	2614336
74	Brick_Stack_627	Brick kilns	239219.1	2614340
75	Brick_Stack_656	Brick kilns	238801.06	2614389
76	Brick_Stack_687	Brick kilns	235086.28	2614394
77	Brick_Stack_626	Brick kilns	239311.76	2614419
78	Brick_Stack_697	Brick kilns	235808.14	2614421
79	Brick_Stack_619	Brick kilns	240007.27	2614424
80	Brick_Stack_655	Brick kilns	238917.17	2614473
81	Brick_Stack_686	Brick kilns	234902.12	2614487
82	Brick_Stack_645	Brick kilns	240553.54	2614498
83	Brick_Stack_625	Brick kilns	239410.3	2614526
84	Brick_Stack_691	Brick kilns	235627.38	2614543
85	Brick_Stack_685	Brick kilns	234708.1	2614552
86	Brick_Stack_622	Brick kilns	239778.57	2614564
87	Brick_Stack_654	Brick kilns	239034.39	2614578
88	Brick_Stack_620	Brick kilns	239957.16	2614581
89	Brick_Stack_624	Brick kilns	239512.47	2614594
90	Brick_Stack_690	Brick kilns	235465.05	2614631
91	Brick_Stack_653	Brick kilns	239136.67	2614642
92	Brick_Stack_684	Brick kilns	234415.51	2614648
93	Brick_Stack_621	Brick kilns	239830.79	2614682
94	Brick_Stack_689	Brick kilns	235300.6	2614684
95	Brick_Stack_623	Brick kilns	239651.57	2614685
96	Brick_Stack_646	Brick kilns	240543.99	2614690
97	Brick_Stack_683	Brick kilns	234296.96	2614690
98	Brick_Stack_652	Brick kilns	239221.15	2614722
99	Brick_Stack_647	Brick kilns	240817.57	2614734
100	Brick_Stack_681	Brick kilns	234071.91	2614754
101	Brick_Stack_648	Brick kilns	240464.66	2614789
102	Brick_Stack_649	Brick kilns	240577.58	2614829
103	Brick_Stack_538	Brick kilns	233872.46	2614830
104	Brick_Stack_650	Brick kilns	240429.44	2614881
105	Brick_Stack_751	Brick kilns	239246.42	2614899

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
106	Brick_Stack_700	Brick kilns	236826.77	2614913
107	Brick_Stack_682	Brick kilns	234422.19	2615003
108	Brick_Stack_699	Brick kilns	236456.67	2615010
109	Brick_Stack_701	Brick kilns	236930.9	2615059
110	Brick_Stack_745	Brick kilns	239258.23	2615068
111	Brick_Stack_746	Brick kilns	239340.51	2615136
112	Brick_Stack_747	Brick kilns	239483.68	2615157
113	Brick_Stack_743	Brick kilns	239171.3	2615171
114	Brick_Stack_698	Brick kilns	235591.88	2615195
115	Brick_Stack_739	Brick kilns	238784.11	2615211
116	Brick_Stack_651	Brick kilns	240426.34	2615212
117	Brick_Stack_744	Brick kilns	239272.4	2615221
118	Brick_Stack_736	Brick kilns	238702.64	2615224
119	Brick_Stack_741	Brick kilns	239041.18	2615237
120	Brick_Stack_738	Brick kilns	238896.06	2615256
121	Brick_Stack_702	Brick kilns	236999.83	2615284
122	Brick_Stack_733	Brick kilns	238617.29	2615312
123	Brick_Stack_734	Brick kilns	238420.44	2615352
124	Brick_Stack_703	Brick kilns	236789.25	2615371
125	Brick_Stack_750	Brick kilns	239433.27	2615393
126	Brick_Stack_749	Brick kilns	239309.87	2615394
127	Brick_Stack_748	Brick kilns	239191.06	2615422
128	Brick_Stack_728	Brick kilns	238275.13	2615435
129	Brick_Stack_742	Brick kilns	239084.69	2615451
130	Brick_Stack_726	Brick kilns	238161.94	2615474
131	Brick_Stack_704	Brick kilns	236987.98	2615492
132	Brick_Stack_752	Brick kilns	239353.57	2615500
133	Brick_Stack_740	Brick kilns	238945.34	2615502
134	Brick_Stack_737	Brick kilns	238830.47	2615506
135	Brick_Stack_735	Brick kilns	238701.48	2615515
136	Brick_Stack_722	Brick kilns	238042.16	2615538
137	Brick_Stack_705	Brick kilns	236776.62	2615541
138	Brick_Stack_720	Brick kilns	237935.97	2615573
139	Brick_Stack_880	Brick kilns	242327.03	2615581
140	Brick_Stack_706	Brick kilns	236960.35	2615600
141	Brick_Stack_732	Brick kilns	238520.6	2615638
142	Brick_Stack_753	Brick kilns	239238.4	2615645
143	Brick_Stack_721	Brick kilns	237826.98	2615650
144	Brick_Stack_719	Brick kilns	237715.81	2615715
145	Brick_Stack_755	Brick kilns	239139.59	2615720
146	Brick_Stack_881	Brick kilns	243036.99	2615720
147	Brick_Stack_707	Brick kilns	236748.62	2615736
148	Brick_Stack_756	Brick kilns	238969.51	2615738
149	Brick_Stack_754	Brick kilns	239386.74	2615739
150	Brick_Stack_729	Brick kilns	238405.71	2615788
151	Brick_Stack_725	Brick kilns	238211.34	2615794
152	Brick_Stack_717	Brick kilns	237561.91	2615809
153	Brick_Stack_731	Brick kilns	238483.2	2615810
154	Brick_Stack_757	Brick kilns	239516.35	2615811
155	Brick_Stack_724	Brick kilns	238150.24	2615815
156	Brick_Stack_759	Brick kilns	239710.91	2615827
157	Brick_Stack_758	Brick kilns	239609.16	2615832
158	Brick_Stack_516	Brick kilns	240096.13	2615836

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
159	Brick_Stack_723	Brick kilns	238065.6	2615857
160	Brick_Stack_510	Brick kilns	240214.34	2615881
161	Brick_Stack_718	Brick kilns	237407.32	2615884
162	Brick_Stack_727	Brick kilns	238180.32	2615897
163	Brick_Stack_680	Brick kilns	232341.61	2615897
164	Brick_Stack_715	Brick kilns	237841.61	2615902
165	Brick_Stack_716	Brick kilns	237977.76	2615908
166	Brick_Stack_730	Brick kilns	238288.81	2615911
167	Brick_Stack_517	Brick kilns	240064.26	2615919
168	Brick_Stack_710	Brick kilns	237106.28	2615930
169	Brick_Stack_711	Brick kilns	237269.4	2615942
170	Brick_Stack_760	Brick kilns	239417.24	2615963
171	Brick_Stack_513	Brick kilns	240514.06	2615964
172	Brick_Stack_714	Brick kilns	237705.53	2615964
173	Brick_Stack_512	Brick kilns	240378.84	2615971
174	Brick_Stack_679	Brick kilns	232111.31	2615973
175	Brick_Stack_511	Brick kilns	240305.21	2615979
176	Brick_Stack_678	Brick kilns	231982.53	2615989
177	Brick_Stack_515	Brick kilns	240799.95	2616007
178	Brick_Stack_514	Brick kilns	240634.7	2616015
179	Brick_Stack_677	Brick kilns	231864.56	2616031
180	Brick_Stack_713	Brick kilns	237531.52	2616060
181	Brick_Stack_761	Brick kilns	239535.06	2616061
182	Brick_Stack_676	Brick kilns	231712.86	2616076
183	Brick_Stack_708	Brick kilns	236955.65	2616082
184	Brick_Stack_518	Brick kilns	240952.95	2616086
185	Brick_Stack_712	Brick kilns	237390.7	2616089
186	Brick_Stack_762	Brick kilns	239466.59	2616091
187	Brick_Stack_763	Brick kilns	239634.14	2616100
188	Brick_Stack_519	Brick kilns	241041.22	2616104
189	Brick_Stack_766	Brick kilns	238182.27	2616113
190	Brick_Stack_520	Brick kilns	241181.19	2616129
191	Brick_Stack_709	Brick kilns	237109.48	2616145
192	Brick_Stack_764	Brick kilns	239212.83	2616272
193	Brick_Stack_535	Brick kilns	229922.69	2616320
194	Brick_Stack_537	Brick kilns	229680.03	2616362
195	Brick_Stack_765	Brick kilns	239013.33	2616459
196	Brick_Stack_875	Brick kilns	229901.73	2616704
197	Brick_Stack_767	Brick kilns	238447.11	2616816
198	Brick_Stack_521	Brick kilns	240877.83	2616904
199	Brick_Stack_570	Brick kilns	242938.73	2616919
200	Brick_Stack_768	Brick kilns	238495.11	2616942
201	Brick_Stack_526	Brick kilns	240520.75	2617051
202	Brick_Stack_522	Brick kilns	240887.62	2617097
203	Brick_Stack_769	Brick kilns	238522.17	2617135
204	Brick_Stack_770	Brick kilns	238590.81	2617183
205	Brick_Stack_523	Brick kilns	240889.23	2617186
206	Brick_Stack_527	Brick kilns	241329.54	2617230
207	Brick_Stack_524	Brick kilns	240692.42	2617232
208	Brick_Stack_569	Brick kilns	242036.61	2617305
209	Brick_Stack_525	Brick kilns	240553.7	2617313
210	Brick_Stack_528	Brick kilns	241111.67	2617340
211	Brick_Stack_771	Brick kilns	238477.42	2617445

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
212	Brick_Stack_772	Brick kilns	238556.84	2617448
213	Brick_Stack_773	Brick kilns	238733.27	2617462
214	Brick_Stack_530	Brick kilns	241134.47	2617475
215	Brick_Stack_532	Brick kilns	241194.12	2617512
216	Brick_Stack_774	Brick kilns	238714.23	2617656
217	Brick_Stack_775	Brick kilns	238611.19	2617657
218	Brick_Stack_536	Brick kilns	229388.94	2617673
219	Brick_Stack_776	Brick kilns	238452.88	2617693
220	Brick_Stack_529	Brick kilns	240730.47	2617709
221	Brick_Stack_777	Brick kilns	238305.09	2617771
222	Brick_Stack_534	Brick kilns	240898.24	2617778
223	Brick_Stack_568	Brick kilns	241980.67	2617817
224	Brick_Stack_567	Brick kilns	241844.71	2617834
225	Brick_Stack_566	Brick kilns	241727.41	2617853
226	Brick_Stack_531	Brick kilns	240834.56	2617884
227	Brick_Stack_540	Brick kilns	229499.45	2617965
228	Brick_Stack_564	Brick kilns	241819.76	2617994
229	Brick_Stack_549	Brick kilns	229267.64	2617996
230	Brick_Stack_559	Brick kilns	241770.54	2618010
231	Brick_Stack_560	Brick kilns	240768.74	2618026
232	Brick_Stack_542	Brick kilns	228918.96	2618074
233	Brick_Stack_807	Brick kilns	247347.6	2618196
234	Brick_Stack_548	Brick kilns	240601.86	2618246
235	Brick_Stack_779	Brick kilns	239811.06	2618291
236	Brick_Stack_778	Brick kilns	239917.28	2618311
237	Brick_Stack_543	Brick kilns	232989.78	2618427
238	Brick_Stack_544	Brick kilns	232424.98	2618892
239	Brick_Stack_541	Brick kilns	232351.33	2618895
240	Brick_Stack_557	Brick kilns	241292.29	2618976
241	Brick_Stack_558	Brick kilns	241185.41	2618976
242	Brick_Stack_556	Brick kilns	240765.77	2619194
243	Brick_Stack_546	Brick kilns	233130.54	2619378
244	Brick_Stack_547	Brick kilns	232949.02	2619391
245	Brick_Stack_565	Brick kilns	233281.03	2619430
246	Brick_Stack_571	Brick kilns	240738.46	2619494
247	Brick_Stack_572	Brick kilns	240816.96	2619501
248	Brick_Stack_545	Brick kilns	232676.61	2619522
249	Brick_Stack_562	Brick kilns	232722.3	2619636
250	Brick_Stack_553	Brick kilns	232801.26	2619783
251	Brick_Stack_561	Brick kilns	239469.65	2619950
252	Brick_Stack_563	Brick kilns	239349.93	2619985
253	Brick_Stack_552	Brick kilns	238384.38	2620475
254	Brick_Stack_551	Brick kilns	238323.98	2620764
255	Brick_Stack_550	Brick kilns	238207.35	2620913
256	Brick_Stack_554	Brick kilns	238169.13	2621024
257	Brick_Stack_879	Brick kilns	233406.66	2621071
258	Brick_Stack_555	Brick kilns	238009.36	2621166
259	Brick_Stack_409	Brick kilns	228765.08	2628333
260	Brick_Stack_1	Brick kilns	228888.32	2628360
261	Brick_Stack_415	Brick kilns	228184.73	2628596
262	Brick_Stack_413	Brick kilns	228445.95	2628782
263	Brick_Stack_977	Brick kilns	228973.28	2628789
264	Brick_Stack_410	Brick kilns	228781.28	2628814

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
265	Brick_Stack_412	Brick kilns	228597.88	2628820
266	Brick_Stack_418	Brick kilns	227690.96	2628944
267	Brick_Stack_414	Brick kilns	228272.35	2629042
268	Brick_Stack_416	Brick kilns	227917.22	2629170
269	Brick_Stack_411	Brick kilns	228676.66	2629203
270	Brick_Stack_417	Brick kilns	227998.24	2629326
271	Brick_Stack_420	Brick kilns	227563.14	2629567
272	Brick_Stack_419	Brick kilns	227888.59	2629636
273	Brick_Stack_421	Brick kilns	227197.76	2629880
274	Brick_Stack_422	Brick kilns	227420.84	2629934
275	Brick_Stack_856	Brick kilns	243386.31	2629966
276	Brick_Stack_423	Brick kilns	227196.65	2630019
277	Brick_Stack_425	Brick kilns	228259.05	2630053
278	Brick_Stack_424	Brick kilns	227298.47	2630091
279	Brick_Stack_426	Brick kilns	227868.2	2630280
280	Brick_Stack_64	Brick kilns	226579.62	2630393
281	Brick_Stack_68	Brick kilns	226676.6	2630408
282	Brick_Stack_66	Brick kilns	226419.72	2630460
283	Brick_Stack_61	Brick kilns	227223.56	2630605
284	Brick_Stack_57	Brick kilns	228155.88	2630651
285	Brick_Stack_54	Brick kilns	228363.39	2630697
286	Brick_Stack_63	Brick kilns	227496.17	2630699
287	Brick_Stack_65	Brick kilns	226446.58	2630753
288	Brick_Stack_60	Brick kilns	227667.06	2630793
289	Brick_Stack_62	Brick kilns	227372.69	2630843
290	Brick_Stack_58	Brick kilns	228011.81	2630952
291	Brick_Stack_71	Brick kilns	226583.71	2630959
292	Brick_Stack_59	Brick kilns	228221.51	2630993
293	Brick_Stack_56	Brick kilns	227637.36	2631006
294	Brick_Stack_70	Brick kilns	226866.43	2631101
295	Brick_Stack_51	Brick kilns	228877.72	2631197
296	Brick_Stack_69	Brick kilns	226853.27	2631225
297	Brick_Stack_67	Brick kilns	226595.27	2631246
298	Brick_Stack_55	Brick kilns	227542.73	2631324
299	Brick_Stack_77	Brick kilns	227347.48	2631338
300	Brick_Stack_427	Brick kilns	226399.93	2631347
301	Brick_Stack_53	Brick kilns	227877.6	2631532
302	Brick_Stack_428	Brick kilns	227008.37	2631588
303	Brick_Stack_52	Brick kilns	228113.16	2631664
304	Brick_Stack_429	Brick kilns	227287.24	2631754
305	Brick_Stack_430	Brick kilns	226869.01	2631803
306	Brick_Stack_431	Brick kilns	227495.55	2631868
307	Brick_Stack_432	Brick kilns	227174.41	2632049
308	Brick_Stack_436	Brick kilns	226352.03	2632078
309	Brick_Stack_433	Brick kilns	226726.41	2632131
310	Brick_Stack_435	Brick kilns	226556.48	2632245
311	Brick_Stack_434	Brick kilns	227232.39	2632304
312	Brick_Stack_438	Brick kilns	226885.06	2632553
313	Brick_Stack_437	Brick kilns	227077.52	2632581
314	Brick_Stack_439	Brick kilns	227496.79	2632700
315	Brick_Stack_899	Brick kilns	225747.61	2632774
316	Brick_Stack_440	Brick kilns	227031.75	2632860
317	Brick_Stack_451	Brick kilns	226334.12	2633656

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
318	Brick_Stack_446	Brick kilns	226723.63	2633664
319	Brick_Stack_445	Brick kilns	227067.23	2633735
320	Brick_Stack_447	Brick kilns	226500.28	2633819
321	Brick_Stack_444	Brick kilns	227436.42	2633819
322	Brick_Stack_443	Brick kilns	227261.68	2633832
323	Brick_Stack_452	Brick kilns	226116.31	2633848
324	Brick_Stack_455	Brick kilns	225594.89	2633901
325	Brick_Stack_453	Brick kilns	225941.21	2633930
326	Brick_Stack_456	Brick kilns	225374.11	2633939
327	Brick_Stack_458	Brick kilns	225225.7	2633977
328	Brick_Stack_457	Brick kilns	225295.85	2633982
329	Brick_Stack_454	Brick kilns	225803.23	2634016
330	Brick_Stack_450	Brick kilns	226395.76	2634045
331	Brick_Stack_442	Brick kilns	227323.82	2634141
332	Brick_Stack_449	Brick kilns	226589.9	2634256
333	Brick_Stack_838	Brick kilns	224240.22	2634285
334	Brick_Stack_448	Brick kilns	226717.98	2634344
335	Brick_Stack_441	Brick kilns	227533.28	2634383
336	Brick_Stack_103	Brick kilns	226152.49	2634446
337	Brick_Stack_105	Brick kilns	225777.48	2634447
338	Brick_Stack_106	Brick kilns	226237.87	2634453
339	Brick_Stack_108	Brick kilns	225650.33	2634502
340	Brick_Stack_99	Brick kilns	226541.19	2634615
341	Brick_Stack_102	Brick kilns	225991.98	2634659
342	Brick_Stack_107	Brick kilns	226665.56	2634912
343	Brick_Stack_97	Brick kilns	226899.85	2634923
344	Brick_Stack_459	Brick kilns	225759.43	2635002
345	Brick_Stack_100	Brick kilns	226315.98	2635016
346	Brick_Stack_98	Brick kilns	226508.61	2635016
347	Brick_Stack_101	Brick kilns	226148.61	2635032
348	Brick_Stack_96	Brick kilns	227048.85	2635043
349	Brick_Stack_104	Brick kilns	225952.13	2635050
350	Brick_Stack_109	Brick kilns	226526.21	2635117
351	Brick_Stack_110	Brick kilns	226617.89	2635468
352	Brick_Stack_833	Brick kilns	244093.86	2636165
353	Brick_Stack_834	Brick kilns	243838.17	2637741
354	Brick_Stack_835	Brick kilns	243900.8	2637870
355	Brick_Stack_111	Brick kilns	230102.63	2641978
356	Brick_Stack_113	Brick kilns	230112.12	2642333
357	Brick_Stack_112	Brick kilns	230303.81	2642410
358	Brick_Stack_114	Brick kilns	230043.59	2642681
359	Brick_Stack_117	Brick kilns	229726.92	2643135
360	Brick_Stack_115	Brick kilns	230103.74	2643265
361	Brick_Stack_116	Brick kilns	230768.68	2643415
362	Brick_Stack_121	Brick kilns	229811.85	2643440
363	Brick_Stack_120	Brick kilns	229891.58	2643484
364	Brick_Stack_119	Brick kilns	230849.46	2643490
365	Brick_Stack_122	Brick kilns	229836.32	2643519
366	Brick_Stack_125	Brick kilns	229537.7	2643525
367	Brick_Stack_836	Brick kilns	241338.61	2643548
368	Brick_Stack_118	Brick kilns	230830.2	2643560
369	Brick_Stack_130	Brick kilns	229366.85	2643580
370	Brick_Stack_129	Brick kilns	229164.55	2643653

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
371	Brick_Stack_124	Brick kilns	229629.78	2643758
372	Brick_Stack_126	Brick kilns	229720.79	2643762
373	Brick_Stack_123	Brick kilns	229966.05	2643774
374	Brick_Stack_131	Brick kilns	228749.65	2643806
375	Brick_Stack_127	Brick kilns	229469.03	2643812
376	Brick_Stack_128	Brick kilns	229301.83	2643871
377	Brick_Stack_134	Brick kilns	229275.63	2643986
378	Brick_Stack_979	Brick kilns	236870.36	2644165
379	Brick_Stack_132	Brick kilns	228898.07	2644346
380	Brick_Stack_133	Brick kilns	229216.71	2644357
381	Brick_Stack_905	Brick kilns	228287.46	2644492
382	Brick_Stack_978	Brick kilns	237635.15	2644586
383	Brick_Stack_136	Brick kilns	229236.1	2644647
384	Brick_Stack_141	Brick kilns	228469.46	2644686
385	Brick_Stack_156	Brick kilns	228795.25	2644737
386	Brick_Stack_878	Brick kilns	229891.23	2644765
387	Brick_Stack_138	Brick kilns	228469.88	2644781
388	Brick_Stack_137	Brick kilns	229234.49	2644792
389	Brick_Stack_906	Brick kilns	229568.86	2644821
390	Brick_Stack_135	Brick kilns	228992.99	2644844
391	Brick_Stack_140	Brick kilns	228430.29	2644915
392	Brick_Stack_139	Brick kilns	228863.79	2644952
393	Brick_Stack_145	Brick kilns	228476.97	2645144
394	Brick_Stack_142	Brick kilns	228926.12	2645145
395	Brick_Stack_837	Brick kilns	239063.93	2645317
396	Brick_Stack_238	Brick kilns	228210.69	2645561
397	Brick_Stack_845	Brick kilns	234038.46	2645566
398	Brick_Stack_239	Brick kilns	228413.82	2645618
399	Brick_Stack_240	Brick kilns	228045.39	2645783
400	Brick_Stack_241	Brick kilns	228263.01	2645802
401	Brick_Stack_242	Brick kilns	228236.7	2645905
402	Brick_Stack_243	Brick kilns	227974.48	2645916
403	Brick_Stack_244	Brick kilns	228120.48	2646191
404	Brick_Stack_271	Brick kilns	227668.21	2646322
405	Brick_Stack_266	Brick kilns	227619.38	2646399
406	Brick_Stack_245	Brick kilns	228207	2646437
407	Brick_Stack_246	Brick kilns	227941.78	2646686
408	Brick_Stack_265	Brick kilns	227606.83	2646826
409	Brick_Stack_247	Brick kilns	228071.54	2646866
410	Brick_Stack_248	Brick kilns	228401.74	2647344
411	Brick_Stack_250	Brick kilns	227693.91	2647398
412	Brick_Stack_262	Brick kilns	229243.12	2647401
413	Brick_Stack_252	Brick kilns	227794.47	2647416
414	Brick_Stack_251	Brick kilns	227856.75	2647460
415	Brick_Stack_249	Brick kilns	227977.47	2647475
416	Brick_Stack_263	Brick kilns	229128.41	2647514
417	Brick_Stack_260	Brick kilns	228432.2	2647514
418	Brick_Stack_261	Brick kilns	228810.13	2647587
419	Brick_Stack_253	Brick kilns	228005.55	2647615
420	Brick_Stack_254	Brick kilns	228021.23	2647782
421	Brick_Stack_255	Brick kilns	228027.01	2647861
422	Brick_Stack_259	Brick kilns	228674.18	2647874
423	Brick_Stack_264	Brick kilns	229091.79	2647892

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
424	Brick_Stack_256	Brick kilns	228344.96	2647998
425	Brick_Stack_258	Brick kilns	228575.56	2648115
426	Brick_Stack_257	Brick kilns	228334.07	2648155
427	Brick_Stack_904	Brick kilns	227206.17	2648246
428	Brick_Stack_268	Brick kilns	230134.33	2648455
429	Brick_Stack_267	Brick kilns	230164.69	2648742
430	Brick_Stack_278	Brick kilns	231151.2	2649088
431	Brick_Stack_283	Brick kilns	230267.31	2649292
432	Brick_Stack_275	Brick kilns	231520.49	2649325
433	Brick_Stack_269	Brick kilns	230217.69	2649431
434	Brick_Stack_291	Brick kilns	230105.45	2649573
435	Brick_Stack_270	Brick kilns	230105.47	2649730
436	Brick_Stack_273	Brick kilns	230081.99	2649807
437	Brick_Stack_907	Brick kilns	225763.72	2650001
438	Brick_Stack_909	Brick kilns	225336.13	2650266
439	Brick_Stack_908	Brick kilns	225841.56	2650699
440	Brick_Stack_272	Brick kilns	229950	2651153
441	Brick_Stack_276	Brick kilns	230087.41	2652401
442	Brick_Stack_284	Brick kilns	229760	2652436
443	Brick_Stack_277	Brick kilns	230056.52	2652594
444	Brick_Stack_287	Brick kilns	229873.05	2652775
445	Brick_Stack_286	Brick kilns	229643.71	2652785
446	Brick_Stack_281	Brick kilns	229922.2	2652864
447	Brick_Stack_279	Brick kilns	229917.4	2653062
448	Brick_Stack_280	Brick kilns	230002.97	2653189
449	Brick_Stack_282	Brick kilns	230262.44	2653629
450	Brick_Stack_793	Brick kilns	228705.89	2653736
451	Brick_Stack_789	Brick kilns	227168.32	2653747
452	Brick_Stack_294	Brick kilns	230207.57	2653815
453	Brick_Stack_293	Brick kilns	230213.19	2653985
454	Brick_Stack_859	Brick kilns	229570.65	2654073
455	Brick_Stack_292	Brick kilns	230101.2	2654095
456	Brick_Stack_289	Brick kilns	229798	2654256
457	Brick_Stack_285	Brick kilns	229838.23	2654400
458	Brick_Stack_860	Brick kilns	226563.53	2654464
459	Brick_Stack_288	Brick kilns	230054.98	2654471
460	Brick_Stack_290	Brick kilns	229969.13	2654583
461	Brick_Stack_301	Brick kilns	229835.18	2654613
462	Brick_Stack_298	Brick kilns	230127.99	2654649
463	Brick_Stack_307	Brick kilns	230050.27	2654764
464	Brick_Stack_300	Brick kilns	229879.58	2654787
465	Brick_Stack_325	Brick kilns	230346.61	2654820
466	Brick_Stack_296	Brick kilns	229814.6	2654925
467	Brick_Stack_295	Brick kilns	230095.8	2655046
468	Brick_Stack_297	Brick kilns	229905.59	2655087
469	Brick_Stack_299	Brick kilns	230162.83	2655138
470	Brick_Stack_861	Brick kilns	226680.67	2655154
471	Brick_Stack_303	Brick kilns	230069.85	2655269
472	Brick_Stack_313	Brick kilns	231260	2655270
473	Brick_Stack_901	Brick kilns	229387.92	2655305
474	Brick_Stack_321	Brick kilns	231837.52	2655314
475	Brick_Stack_310	Brick kilns	231708.91	2655358
476	Brick_Stack_308	Brick kilns	231330.15	2655386

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
477	Brick_Stack_862	Brick kilns	226492.39	2655423
478	Brick_Stack_863	Brick kilns	226331.54	2655447
479	Brick_Stack_306	Brick kilns	230756.58	2655463
480	Brick_Stack_304	Brick kilns	229892.02	2655491
481	Brick_Stack_305	Brick kilns	230974.55	2655498
482	Brick_Stack_302	Brick kilns	229982.59	2655619
483	Brick_Stack_316	Brick kilns	231630.58	2655635
484	Brick_Stack_312	Brick kilns	231950.54	2655661
485	Brick_Stack_919	Brick kilns	225274.59	2655679
486	Brick_Stack_922	Brick kilns	224707.78	2655715
487	Brick_Stack_309	Brick kilns	230060.81	2655726
488	Brick_Stack_920	Brick kilns	225142.25	2655768
489	Brick_Stack_921	Brick kilns	224796.01	2655816
490	Brick_Stack_315	Brick kilns	231906.96	2655822
491	Brick_Stack_314	Brick kilns	232020.33	2655929
492	Brick_Stack_311	Brick kilns	231906.1	2655939
493	Brick_Stack_163	Brick kilns	229726.06	2656160
494	Brick_Stack_864	Brick kilns	227247.39	2656176
495	Brick_Stack_162	Brick kilns	229702.72	2656223
496	Brick_Stack_164	Brick kilns	229704.43	2656328
497	Brick_Stack_165	Brick kilns	229858.46	2656355
498	Brick_Stack_870	Brick kilns	226996.25	2656370
499	Brick_Stack_865	Brick kilns	227157.91	2656381
500	Brick_Stack_147	Brick kilns	229034.44	2656382
501	Brick_Stack_152	Brick kilns	229117.64	2656416
502	Brick_Stack_166	Brick kilns	229984.9	2656466
503	Brick_Stack_159	Brick kilns	229684.52	2656471
504	Brick_Stack_857	Brick kilns	227641.31	2656473
505	Brick_Stack_148	Brick kilns	228903	2656482
506	Brick_Stack_158	Brick kilns	229821.15	2656491
507	Brick_Stack_872	Brick kilns	228193.09	2656495
508	Brick_Stack_149	Brick kilns	228991.56	2656518
509	Brick_Stack_161	Brick kilns	229751.63	2656558
510	Brick_Stack_167	Brick kilns	230175.72	2656559
511	Brick_Stack_160	Brick kilns	229655.67	2656589
512	Brick_Stack_169	Brick kilns	230275.86	2656623
513	Brick_Stack_168	Brick kilns	230158.97	2656630
514	Brick_Stack_157	Brick kilns	229624.67	2656653
515	Brick_Stack_150	Brick kilns	229291.28	2656666
516	Brick_Stack_155	Brick kilns	228406.87	2656761
517	Brick_Stack_153	Brick kilns	229628.63	2656762
518	Brick_Stack_151	Brick kilns	229280.25	2656811
519	Brick_Stack_154	Brick kilns	228780.04	2656816
520	Brick_Stack_144	Brick kilns	228520.01	2656892
521	Brick_Stack_172	Brick kilns	229509.64	2656954
522	Brick_Stack_173	Brick kilns	229423	2657045
523	Brick_Stack_322	Brick kilns	229045.53	2657050
524	Brick_Stack_171	Brick kilns	229598.94	2657056
525	Brick_Stack_170	Brick kilns	229753.57	2657084
526	Brick_Stack_146	Brick kilns	227695.06	2657204
527	Brick_Stack_174	Brick kilns	229735.52	2657215
528	Brick_Stack_175	Brick kilns	229782.94	2657224
529	Brick_Stack_317	Brick kilns	229174.58	2657246

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
530	Brick_Stack_143	Brick kilns	227561.14	2657306
531	Brick_Stack_176	Brick kilns	229750.89	2657320
532	Brick_Stack_327	Brick kilns	229294.07	2657401
533	Brick_Stack_903	Brick kilns	229474.6	2657408
534	Brick_Stack_177	Brick kilns	229768.54	2657412
535	Brick_Stack_319	Brick kilns	229325.98	2657439
536	Brick_Stack_179	Brick kilns	229792.2	2657540
537	Brick_Stack_318	Brick kilns	229151.52	2657543
538	Brick_Stack_178	Brick kilns	229800.35	2657611
539	Brick_Stack_183	Brick kilns	229576.89	2657637
540	Brick_Stack_320	Brick kilns	229294.42	2657644
541	Brick_Stack_180	Brick kilns	229746.76	2657698
542	Brick_Stack_338	Brick kilns	229013.03	2657727
543	Brick_Stack_877	Brick kilns	228263.46	2657755
544	Brick_Stack_181	Brick kilns	229785.84	2657757
545	Brick_Stack_323	Brick kilns	229362.23	2657814
546	Brick_Stack_182	Brick kilns	229662.04	2657844
547	Brick_Stack_185	Brick kilns	229743.07	2657845
548	Brick_Stack_184	Brick kilns	229853.65	2657857
549	Brick_Stack_331	Brick kilns	229021.09	2657887
550	Brick_Stack_983	Brick kilns	229062.77	2657959
551	Brick_Stack_324	Brick kilns	229506.77	2658033
552	Brick_Stack_329	Brick kilns	229210.4	2658058
553	Brick_Stack_873	Brick kilns	226632.37	2658077
554	Brick_Stack_326	Brick kilns	229108.08	2658089
555	Brick_Stack_866	Brick kilns	229499.23	2658191
556	Brick_Stack_874	Brick kilns	227389.42	2658234
557	Brick_Stack_867	Brick kilns	229279.23	2658259
558	Brick_Stack_336	Brick kilns	229341.26	2658317
559	Brick_Stack_339	Brick kilns	229143.91	2658353
560	Brick_Stack_335	Brick kilns	229343.2	2658400
561	Brick_Stack_328	Brick kilns	229608.84	2658408
562	Brick_Stack_342	Brick kilns	229168.82	2658432
563	Brick_Stack_868	Brick kilns	229515.24	2658441
564	Brick_Stack_359	Brick kilns	228982.29	2658478
565	Brick_Stack_869	Brick kilns	229662.23	2658549
566	Brick_Stack_348	Brick kilns	228458.62	2658565
567	Brick_Stack_341	Brick kilns	228997.47	2658571
568	Brick_Stack_346	Brick kilns	229123.88	2658584
569	Brick_Stack_352	Brick kilns	228507.86	2658638
570	Brick_Stack_330	Brick kilns	229751.97	2658655
571	Brick_Stack_337	Brick kilns	229293.31	2658736
572	Brick_Stack_349	Brick kilns	229086.74	2658744
573	Brick_Stack_343	Brick kilns	228974	2658748
574	Brick_Stack_351	Brick kilns	228494.44	2658751
575	Brick_Stack_334	Brick kilns	229767.54	2658764
576	Brick_Stack_333	Brick kilns	229694.43	2658790
577	Brick_Stack_345	Brick kilns	229077.15	2658822
578	Brick_Stack_344	Brick kilns	229223.42	2658828
579	Brick_Stack_332	Brick kilns	229579.15	2658834
580	Brick_Stack_350	Brick kilns	228596.02	2658867
581	Brick_Stack_354	Brick kilns	228876.96	2658902
582	Brick_Stack_360	Brick kilns	229013.83	2658908

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
583	Brick_Stack_340	Brick kilns	229430.33	2658922
584	Brick_Stack_371	Brick kilns	227468.06	2658959
585	Brick_Stack_355	Brick kilns	229018.72	2658993
586	Brick_Stack_237	Brick kilns	229542.85	2658995
587	Brick_Stack_353	Brick kilns	228556.98	2659013
588	Brick_Stack_347	Brick kilns	229159.92	2659073
589	Brick_Stack_367	Brick kilns	228159.35	2659105
590	Brick_Stack_356	Brick kilns	228605.32	2659139
591	Brick_Stack_361	Brick kilns	229544.15	2659152
592	Brick_Stack_236	Brick kilns	229201.91	2659176
593	Brick_Stack_362	Brick kilns	229433.64	2659193
594	Brick_Stack_363	Brick kilns	229389.41	2659194
595	Brick_Stack_358	Brick kilns	228664.96	2659240
596	Brick_Stack_365	Brick kilns	229238.52	2659268
597	Brick_Stack_357	Brick kilns	228983.1	2659272
598	Brick_Stack_370	Brick kilns	227566.9	2659275
599	Brick_Stack_368	Brick kilns	228145.43	2659291
600	Brick_Stack_274	Brick kilns	228854.94	2659309
601	Brick_Stack_369	Brick kilns	227876.82	2659438
602	Brick_Stack_235	Brick kilns	229209.77	2659467
603	Brick_Stack_871	Brick kilns	229183.71	2659472
604	Brick_Stack_364	Brick kilns	229398.46	2659487
605	Brick_Stack_234	Brick kilns	229211.9	2659564
606	Brick_Stack_373	Brick kilns	227349.93	2659594
607	Brick_Stack_233	Brick kilns	229077.18	2659645
608	Brick_Stack_372	Brick kilns	227543.94	2659666
609	Brick_Stack_374	Brick kilns	227224.5	2659698
610	Brick_Stack_232	Brick kilns	228941	2659822
611	Brick_Stack_378	Brick kilns	227543.15	2659871
612	Brick_Stack_376	Brick kilns	227362.88	2659872
613	Brick_Stack_375	Brick kilns	227161.19	2659903
614	Brick_Stack_379	Brick kilns	227649.86	2659911
615	Brick_Stack_231	Brick kilns	228907.17	2659926
616	Brick_Stack_377	Brick kilns	227372.22	2659957
617	Brick_Stack_230	Brick kilns	229165.09	2660052
618	Brick_Stack_380	Brick kilns	227615.28	2660086
619	Brick_Stack_381	Brick kilns	227415.22	2660095
620	Brick_Stack_382	Brick kilns	227520.4	2660145
621	Brick_Stack_383	Brick kilns	227573.99	2660218
622	Brick_Stack_384	Brick kilns	227473.08	2660241
623	Brick_Stack_386	Brick kilns	227543.75	2660385
624	Brick_Stack_385	Brick kilns	227348.67	2660396
625	Brick_Stack_229	Brick kilns	228693.83	2660409
626	Brick_Stack_387	Brick kilns	227667.17	2660467
627	Brick_Stack_366	Brick kilns	229462.99	2660605
628	Brick_Stack_858	Brick kilns	229420.15	2660712
629	Brick_Stack_509	Brick kilns	229941.8	2661290
630	Brick_Stack_507	Brick kilns	229717.34	2661443
631	Brick_Stack_508	Brick kilns	229585.65	2661479
632	Brick_Stack_506	Brick kilns	229859.39	2661533
633	Brick_Stack_505	Brick kilns	229970.62	2661582
634	Brick_Stack_504	Brick kilns	230160.48	2661605
635	Brick_Stack_503	Brick kilns	229959.51	2661821

Count	Stack_Name	Source_sec	EW_Co_	NS_Co_
636	Brick_Stack_502	Brick kilns	229944.71	2662213
637	Brick_Stack_501	Brick kilns	230122.69	2662227
638	Brick_Stack_499	Brick kilns	230243.35	2662369
639	Brick_Stack_500	Brick kilns	229973.74	2662379

Appendix C

Industrial Production Values and Emission Factors

Source Sector	Emission Factors				Source	COMMENT
	PM10	PM2.5	SO2	UNIT		
Brick Kiln	6.44	2.12	7.15	g/s	BAPMAN, CASE Project	
Metal Processing	1.84	1.61	0.052	Kg/MT	BAPS Task5 and EMEP/EEA emission inventory guidebook 2013	80%PM10, 70%PM2.5
Paper Processing	0.8	0.6	1	kg/Mg air dried pulp	EMEP/EEA emission inventory guidebook 2013	
Polyester	33.3			lbs/tons produced	EPA - Emission Inventory Improvement Program (EIIP) 2001	
PVC	0.1	0.05	0	Kg/MT	EMEP/EEA emission inventory guidebook 2013	
Glass factory	0.12	0.1	0	Kg/MT	EMEP/EEA emission inventory guidebook 2013	Assume average glass thickness 4mm and glass density 2500 Kg/M3
Cement	0.3	0.1	ND	Kg/MT	AP 42, Uncontrolled	In Bangladesh only 2 cement industry produce Clinker from raw materials. 85%PM10, 30%PM2.5 , Conversion of emission factor from 99% controlled emission factor
Clay Ceramics	702.9	206.74	1758.8	(g/ton ceramic ware)	BAPS Task5 and EMEP/EEA emission inventory guidebook 2013	50%PM10, 15%PM2.5
Battery Production	1300	650		g/Mg lead	EMEP/EEA emission inventory guidebook 2013	
Urea - CUFL	0.234	0.1677	0	Kg/MT	AP42, 60%PM10, 43%PM2.5	
Urea - KAFCO	0.069	0.05	0	Kg/MT	AP42	
Ammonia	ND	ND	0.0288	Kg/MT	AP42	
DAP	1.156	0.408	0.04	Kg/MT	AP42, 85% PM10, 30%PM2.5	Conversion of emission factor from 75% controlled emission factor
TSP	13.26	3.9	0	Kg/MT	AP42, Assuming uncontrolled. 51%PM10, 15%PM2.5	Conversion of emission factor from 99% controlled emission factor

Source sectors that are not mentioned are not included in this bottom-up emissions inventory study due to lack of data.

Source Sector	Average Annual Production/Plant	Units	Comments
Brick Kiln	1,290,500.00	Nos	
Metal Processing	9,087.58	MT	all steel pipes, rods, sheets, steel foundries
Paper Processing	56,968.00	(mt)	all paper processing
Polyester	1,328.86	'000' metre	all other plastic processing (except urea, pvc)
Polyvinyl Chloride	5,081.50	MT	
Glass factory	796,000.00	Sq. m	both glass sheet and glass products
Cement	433,293.13	MT	stone breaking and cement processing
Clay Ceramics	5,173.00	('000' doz)	
Battery Production	139,416.00	'000' No.	
Urea - CUFL	612,000.00	MT	
Urea - KAFCO	670,680.00	MT	
Ammonia	437,040.00	MT	
DAP	576,000.00	MT	
TSP	100,000.00	MT	

Source: Bangladesh Bureau of Statistics 2013

Assumptions:

All production are assumed to be equal to the average production for Bangladesh

Appendix D

Traffic Data Flagging for Dhaka

- Primary Road – Weekday – Motorcycle – Hour 16 – Site 9

SITE #9 (Weekday-Southbound)								
TIME:	**0**	**…**	**15**	**16**	**17**	**…**	**23**	**Total**
Number of Motorcycle:	27	…	89	**6**	86	…	39	1345

Vehicle type	SITE	0	…	15	16	17	…	23	TOTAL
MC	Site#4	41	…	167	181	170	…	62	2738
MC	Site#5	71	…	293	301	227	…	206	4797
MC	Site#7	71	…	177	181	244	…	123	3619
MC	Site#9	75	…	226	179	235	…	98	3713
MC	Site#10	3	…	28	30	41	…	24	756
MC	**Sum**	**260**	**…**	**891**	**871**	**916**	**…**	**513**	**15623**
MC	**Average**	**52**	**…**	**178**	**174**	**183**	**…**	**103**	**3125**
MC	**TIME FACTOR**	**0.01664**	**…**	**0.05701**	**0.05577**	**0.05863**	**…**	**0.03281**	**1.00000**

It can be seen in the table above that there are only six motorcycles for hour 16 based from traffic counting. This value is too low compared to the adjacent hours, 89 motorcycles for hour 15 and 86 motorcycles for hour 17. Thus, the average for hour 15 and 17, which is 87.5, will be used to replace the original value. Doing so, the data analysis table as shown above will also be updated. The original value 179 will be replaced by 233, which is the result after adding both directions and multiplying by 40/60.

- Primary Road – Weekend – Cars – Hour 12 – Site 5

SITE #5 (Weekend-Northbound)								
TIME:	**0**	**…**	**11**	**12**	**13**	**…**	**23**	**Total**
Number of Cars:	120	…	180	**289**	103	…	145	3207

SITE #5 (Weekend-Southbound)								
TIME:	**0**	**…**	**11**	**12**	**13**	**…**	**23**	**Total**
Number of Cars:	65	…	156	**200**	88	…	160	2932

Vehicle type	SITE	0	…	11	12	13	…	23	TOTAL
Cars	Site#4	133	…	749	716	675	…	723	12613
Cars	Site#5	245	…	465	561	251	…	391	8111
Cars	Site#7	246	…	563	563	332	…	295	9463
Cars	Site#9	224	…	603	616	383	…	226	10657
Cars	Site#10	63	…	105	102	80	…	65	2078
Cars	**Sum**	**910**	**…**	**2485**	**2559**	**1721**	**…**	**1700**	**42921**
Cars	**Average**	**182**	**…**	**497**	**512**	**344**	**…**	**340**	**8584**
Cars	**TIME FACTOR**	**0.02120**	**…**	**0.05789**	**0.05961**	**0.04009**	**…**	**0.03961**	**1.00000**

Based from the graph of primary road for weekend, the number of cars for hour 12 is at an unusual peak. The traffic counting data supports this observation. Site 5 has an exceptionally high number of cars for hour 12. The average of the adjacent hours is used to replace the original value. 142 cars will be used instead of 289 and 122 cars will be used instead of 200. Furthermore, the data analysis table will be updated by changing 561 with 411, which is the result of the sum of both direction and multiplied by 40/60.

- Primary Road – Weekend – Motorcycle – Hour 11 – Site 5 and Site 10

SITE #5 (Weekend-Southbound)								
TIME:	**0**	**…**	**10**	**11**	**12**	**…**	**23**	**Total**
Number of Motorcycle:	8	…	54	**93**	60	…	9	1244

SITE #10 (Weekend-Southbound)								
TIME:	**0**	**…**	**10**	**11**	**12**	**…**	**23**	**Total**
Number of Motorcycle:	1	…	23	**40**	17	…	4	251

Vehicle type	SITE	0	…	10	11	12	…	23	TOTAL
MC	Site#4	29	…	143	137	149	…	169	2638
MC	Site#5	23	…	189	234	196	…	37	3354
MC	Site#7	31	…	207	200	175	…	79	2753
MC	Site#9	69	…	213	215	93	…	84	2867
MC	Site#10	5	…	62	79	37	…	20	818
MC	**Sum**	**157**	**…**	**815**	**865**	**649**	**…**	**389**	**12429**
MC	**Average**	**31**	**…**	**163**	**173**	**130**	**…**	**78**	**2486**
MC	**TIME FACTOR**	**0.01260**	**…**	**0.06554**	**0.06962**	**0.05224**	**…**	**0.03132**	**1.00000**

The number of motorcycles for primary road on the weekend on hour 11 is on a sudden peak. The traffic counting suggests that site 5 and site 10 has an unusual data on the southbound direction. Thus, the value 93 for site 5 will be replaced by 57, which is the average of the number of motorcycles for the adjacent hours. The value 40 for site 10 will be adjusted to 20. Accordingly, the data analysis table will be updated by adjusting 234 to 210 and 79 to 65. This is the result after summing both direction and multiplying them by 40/60 for each site.

- Secondary Road – Weekend – Motorcycle – Hour 22 – Site 2

SITE #2 (Weekend-Northbound)						
TIME:	**0**	**…**	**21**	**22**	**23**	**Total**
Number of Motorcycle:	6	…	7	**39**	5	435
Number of Motorcycle:	5	…	3	**40**	2	422

Vehicle Type	SITE	0	…	20	21	22	23	TOTAL
MC	Site#1	26	…	119	91	85	51	1569
MC	Site#2	25	…	30	17	63	14	1039
MC	Site#8	34	…	160	133	108	48	1874
MC	**Sum**	**85**	**…**	**309**	**241**	**255**	**113**	**4481**
MC	**Average**	**28**	**…**	**103**	**80**	**85**	**38**	**1494**
MC	**TIME FACTOR**	**0.01889**	**…**	**0.06903**	**0.05370**	**0.05698**	**0.02529**	**1.00000**

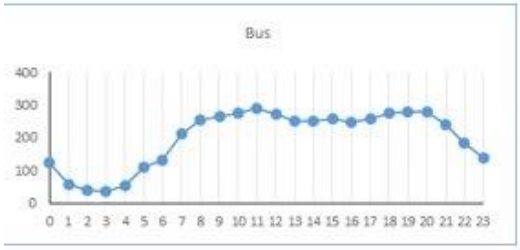
As observed in the first table, the number of motorcycles for both of the 20-minute sampling in the 22nd hour has extremely high value compared to its adjacent hours. Thus, the average of the adjacent shall replace the values obtained. 39 will be replaced by 6 and 40 will be replaced by 3. Subsequently, 63 in the data analysis table will be replaced by 16.

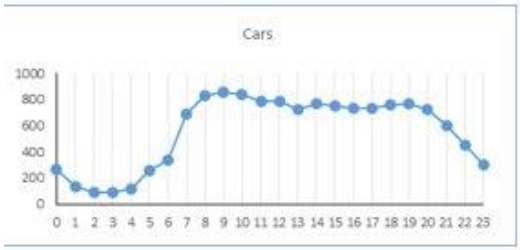
Appendix E

Traffic Time Variation Factors: Dhaka

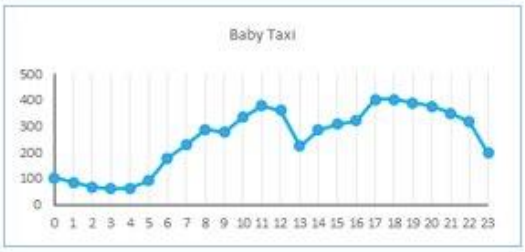
Dhaka

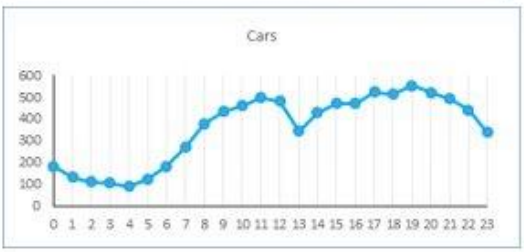
PRIMARY ROAD (WEEKDAY)

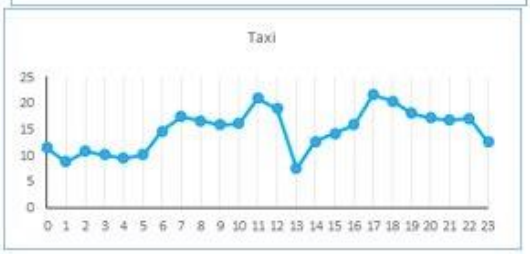




PRIMARY ROAD (WEEKEND)

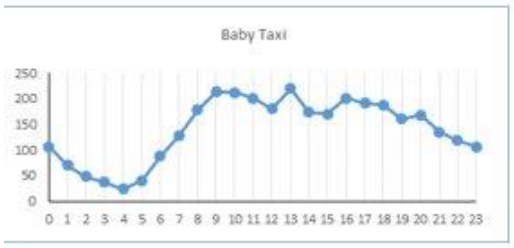


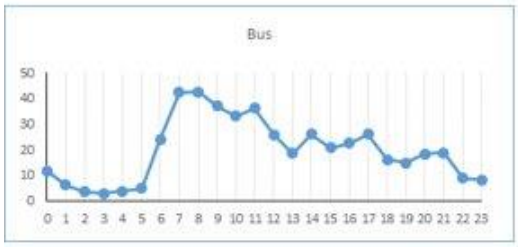


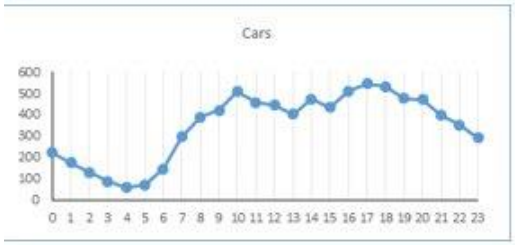


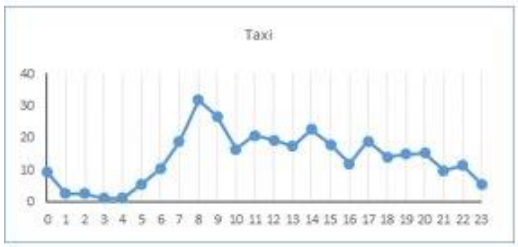
Dhaka

SECONDARY ROAD (WEEKDAY)

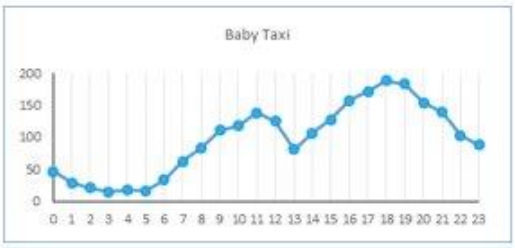


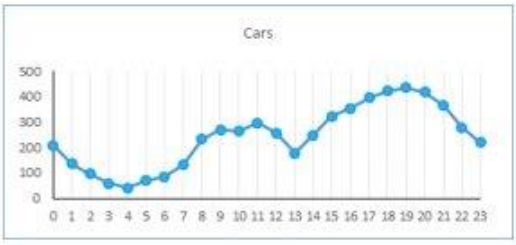


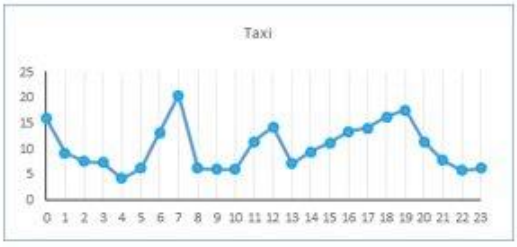




SECONDARY ROAD (WEEKEND)

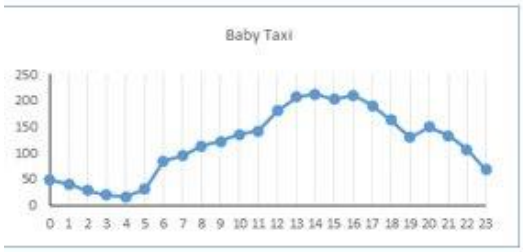


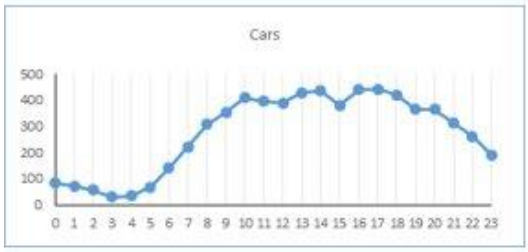


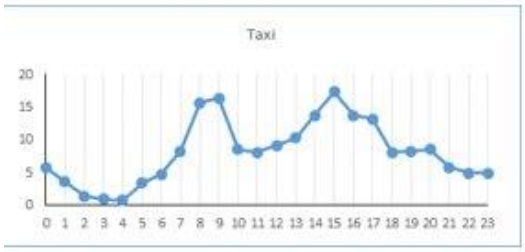


Dhaka

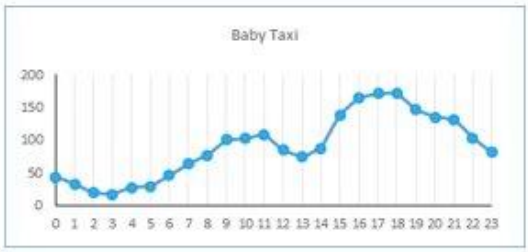
DIFFUSE ROAD (WEEKDAY)

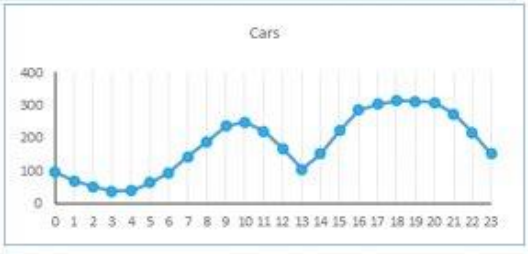


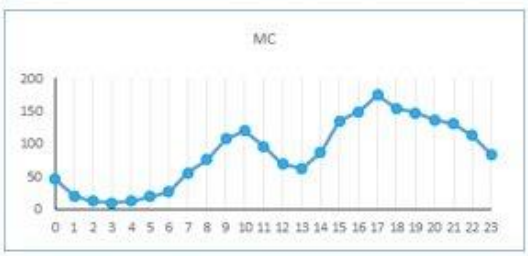


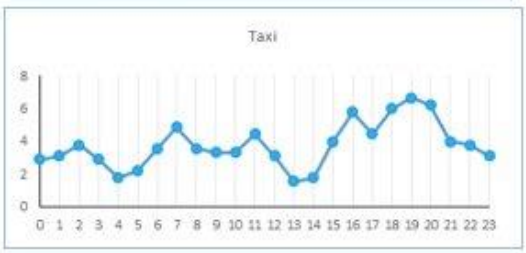


DIFFUSE ROAD (WEEKEND)







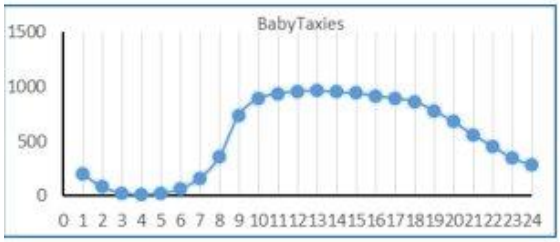


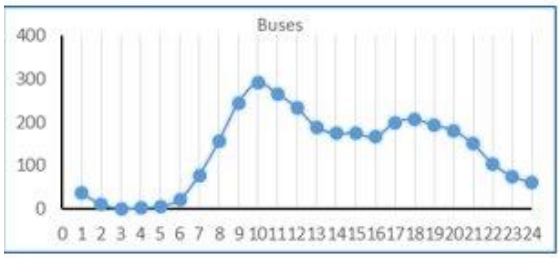
Appendix F

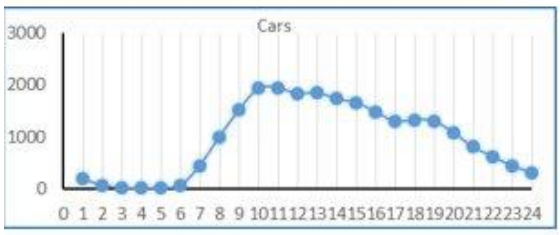
Traffic Time Variation Factors: Chittagong

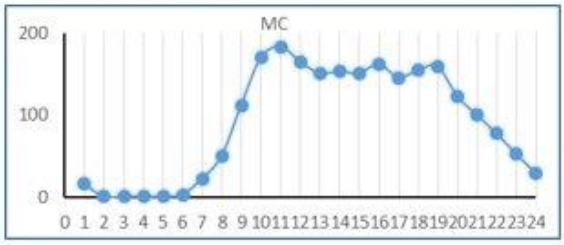
Chittagong

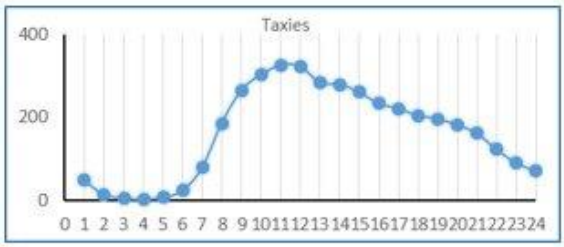
PRIMARY ROAD (WEEKDAY)

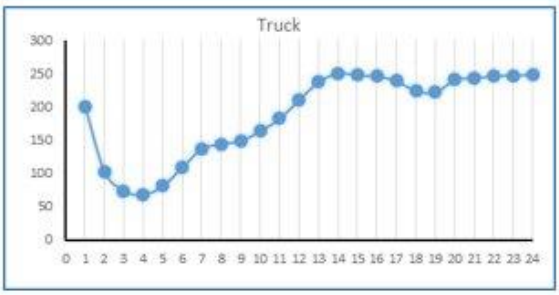




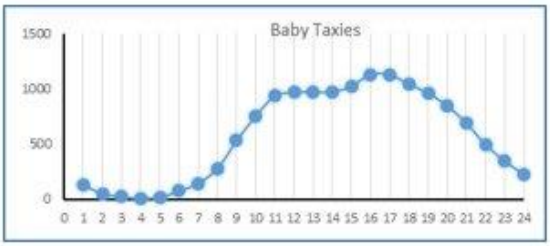


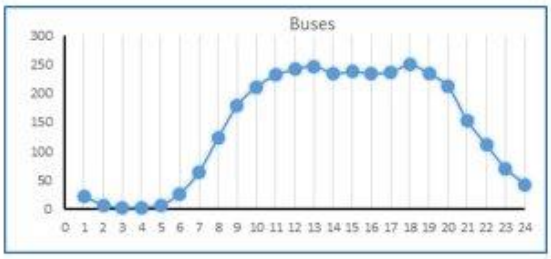


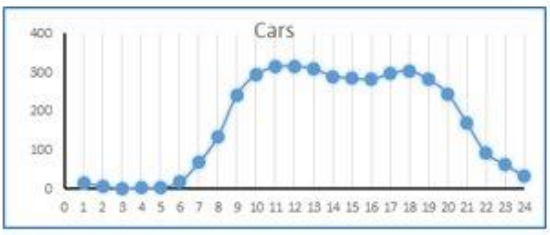


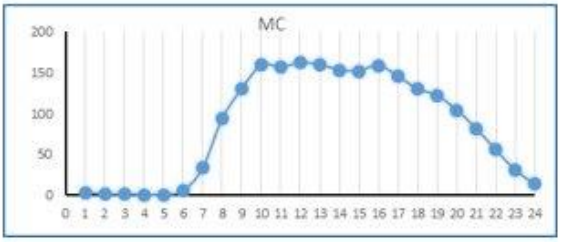


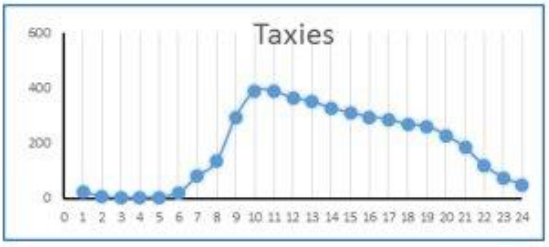
PRIMARY ROAD (WEEKEND)

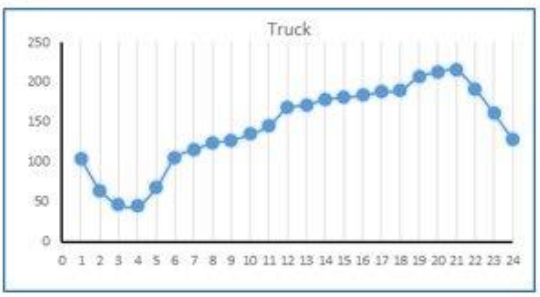






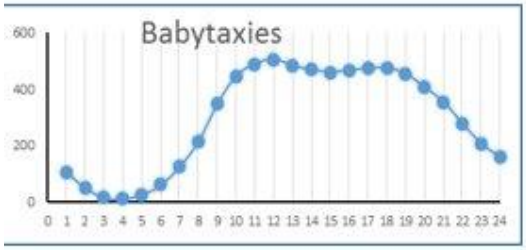


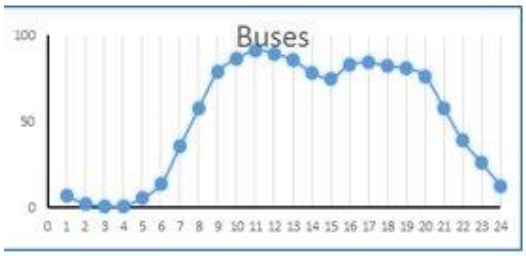


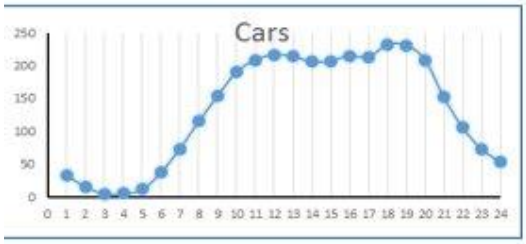


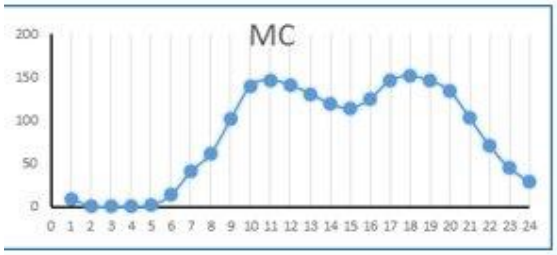
Chittagong

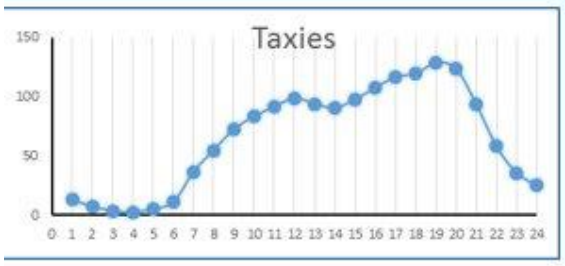
SECONDARY ROAD (WEEKDAY)

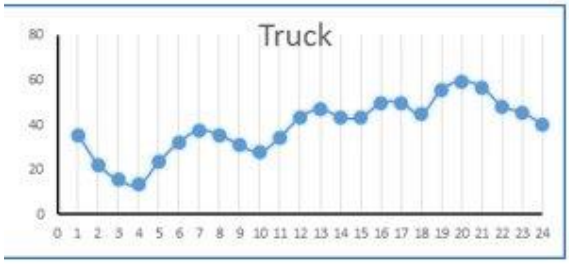




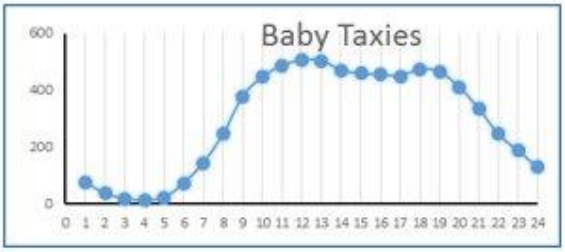


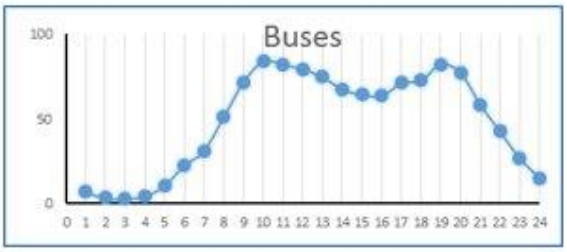


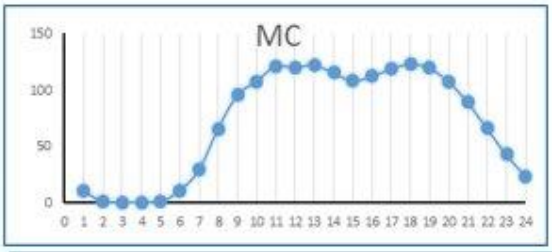


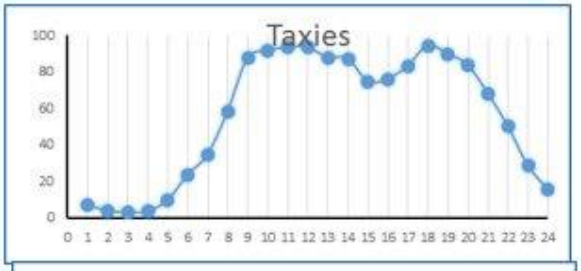


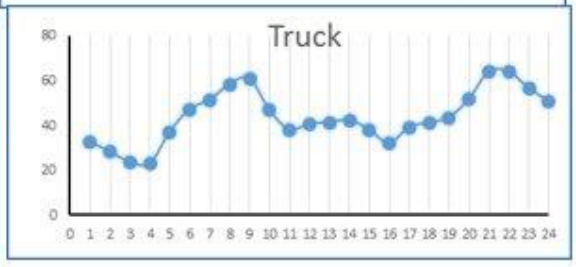
SECONDARY ROAD (WEEKEND)











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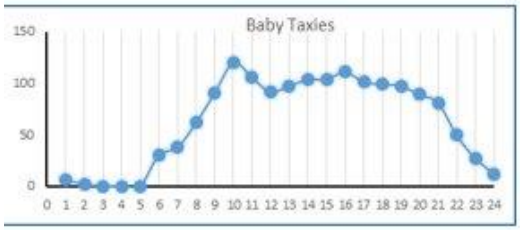
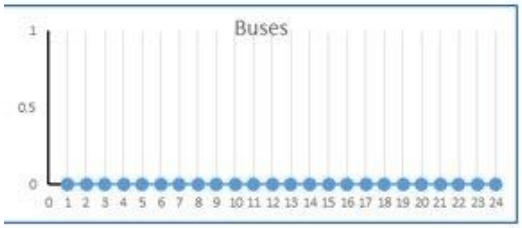
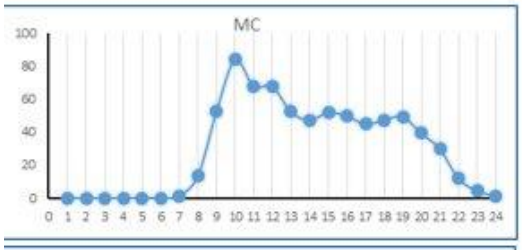
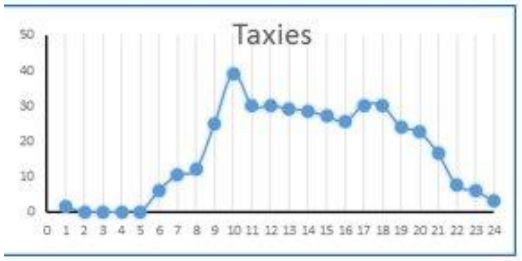
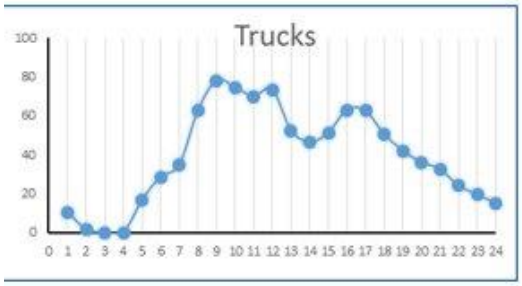
DIFFUSE IND ROAD (WEEKDAY)



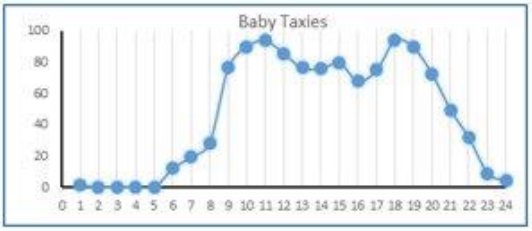


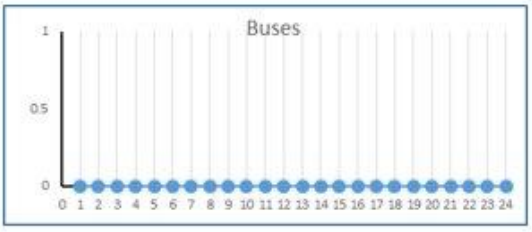


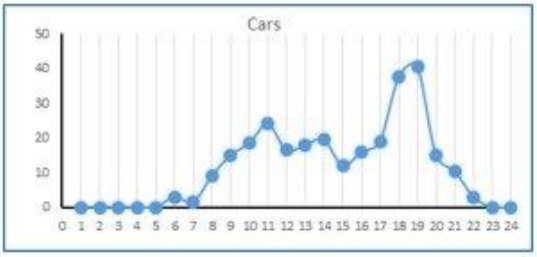


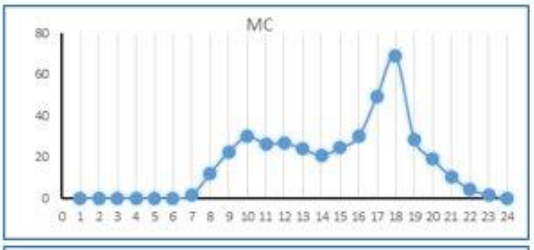


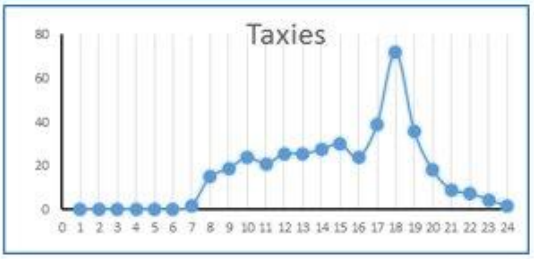
DIFFUSE IND ROAD (WEEKEND)

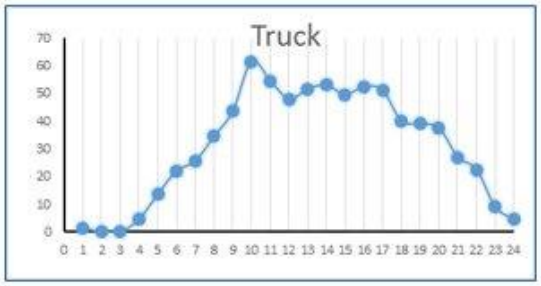












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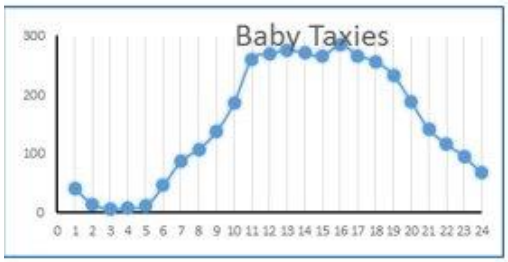
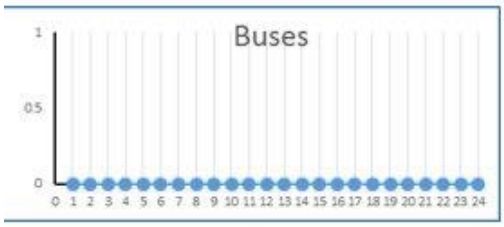
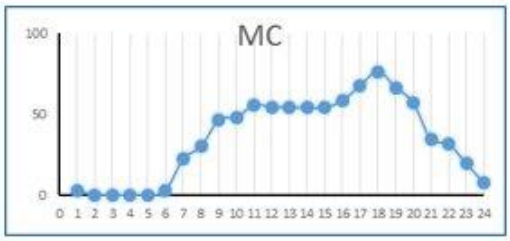
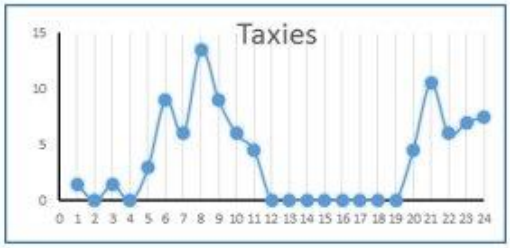
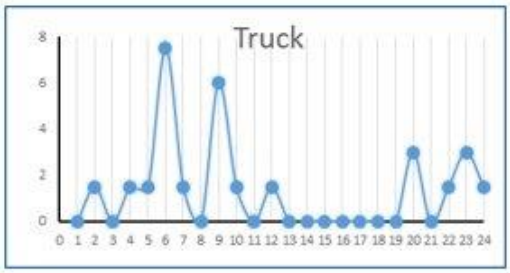
DIFFUSE ROAD (WEEKDAY)



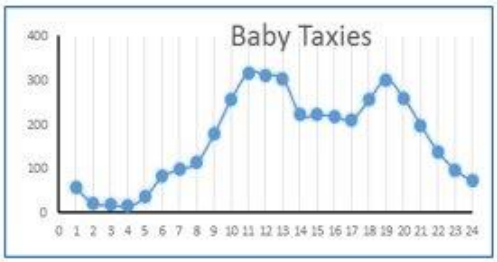


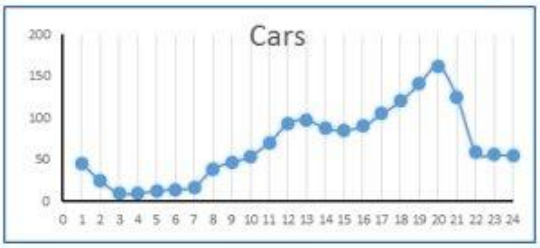


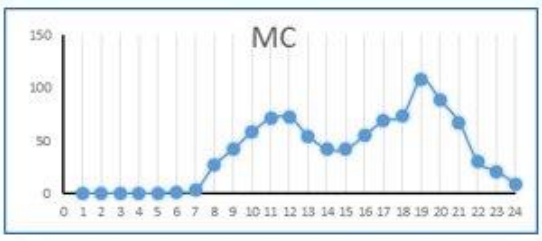


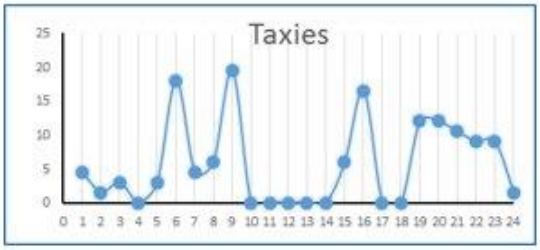


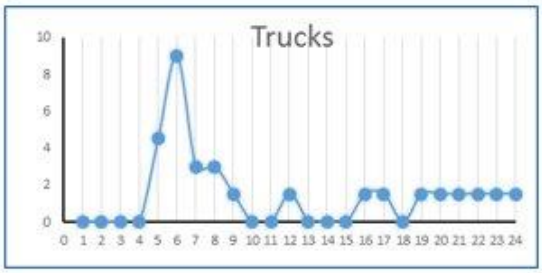
DIFFUSE ROAD (WEEKEND)











Appendix G

Traffic Source Emission Factors

ECVC Basic and Ageing Factors

Calculation Type	Component ID	ECVC ID	Basic Factor	Ageing Factor	Fuel ID	Unit	ECVC Name	Fuel	Component	Unit	Source	Group
1	6	26	5.09	0	3	32	CNG Auto-rickshaw		CO	g/km	Baidya, 2009	M3W-CNG
1	113	26	52	0	3	32	CNG Auto-rickshaw		CO2	g/km	Baidya, 2009	M3W-CNG
1	115	26	0.01	0	3	32	CNG Auto-rickshaw		EP	g/km	Baidya, 2009	M3W-CNG
1	3	26	0.2	0	3	32	CNG Auto-rickshaw		NOx	g/km	Baidya, 2009	M3W-CNG
1	4	26	0	0	3	32	CNG Auto-rickshaw		SO2	g/km	Baidya, 2009	M3W-CNG
1	6	21	3.6	0	3	32	CNG bus 01-05		CO	g/km	Baidya, 2009	Bus CNG-A
1	113	21	557	0	3	32	CNG bus 01-05		CO2	g/km	Baidya, 2009	Bus CNG-A
1	115	21	0.19	0	3	32	CNG bus 01-05		EP	g/km	Baidya, 2009	Bus CNG-A
1	3	21	1	0	3	32	CNG bus 01-05		NOx	g/km	Baidya, 2009	Bus CNG-A
1	4	21	0	0	3	32	CNG bus 01-05		SO2	g/km	Baidya, 2009	Bus CNG-A
1	6	18	5.94	0	3	32	CNG bus 91		CO	g/km	Baidya, 2009	Bus CNG-D
1	113	18	557	0	3	32	CNG bus 91		CO2	g/km	Baidya, 2009	Bus CNG-D
1	115	18	0.19	0	3	32	CNG bus 91		EP	g/km	Baidya, 2009	Bus CNG-D
1	3	18	0.19	0	3	32	CNG bus 91		NOx	g/km	Baidya, 2009	Bus CNG-D
1	4	18	0	0	3	32	CNG bus 91		SO2	g/km	Baidya, 2009	Bus CNG-D
1	6	19	5.94	0	3	32	CNG bus 91-95		CO	g/km	Baidya, 2009	Bus CNG-C
1	113	19	557	0	3	32	CNG bus 91-95		CO2	g/km	Baidya, 2009	Bus CNG-C
1	115	19	0.19	0	3	32	CNG bus 91-95		EP	g/km	Baidya, 2009	Bus CNG-C
1	3	19	1	0	3	32	CNG bus 91-95		NOx	g/km	Baidya, 2009	Bus CNG-C
1	4	19	0	0	3	32	CNG bus 91-95		SO2	g/km	Baidya, 2009	Bus CNG-C
1	6	20	4.4	0	3	32	CNG bus 96-2000		CO	g/km	Baidya, 2009	Bus CNG-B
1	113	20	557	0	3	32	CNG bus 96-2000		CO2	g/km	Baidya, 2009	Bus CNG-B
1	115	20	0.19	0	3	32	CNG bus 96-2000		EP	g/km	Baidya, 2009	Bus CNG-B
1	3	20	1	0	3	32	CNG bus 96-2000		NOx	g/km	Baidya, 2009	Bus CNG-B
1	4	20	0	0	3	32	CNG bus 96-2000		SO2	g/km	Baidya, 2009	Bus CNG-B
1	6	11	0.06	0	3	32	CNG car		CO	g/km	ICAP, 2007	Pass Car CNG
1	113	11	143.54	0	3	32	CNG car		CO2	g/km	ICAP, 2007	Pass Car CNG
1	115	11	0.006	0	3	32	CNG car		EP	g/km	ICAP, 2007	Pass Car CNG
1	3	11	0.74	0	3	32	CNG car		NOx	g/km	ICAP, 2007	Pass Car CNG
1	4	11	0	0	3	32	CNG car		SO2	g/km	ICAP, 2007	Pass Car CNG
1	6	13	3.14	0	3	32	CNG taxi		CO	g/km	Baidya, 2009	Taxi CNG
1	113	13	196	0	3	32	CNG taxi		CO2	g/km	Baidya, 2009	Taxi CNG
1	115	13	0.01	0	3	32	CNG taxi		EP	g/km	Baidya, 2009	Taxi CNG
1	3	13	0.3	0	3	32	CNG taxi		NOx	g/km	Baidya, 2009	Taxi CNG
1	4	13	0	0	3	32	CNG taxi		SO2	g/km	Baidya, 2009	Taxi CNG
1	6	23	4.4	0	3	32	CNG truck		CO	g/km	Baidya, 2009	Bus CNG
1	113	23	557	0	3	32	CNG truck		CO2	g/km	Baidya, 2009	Bus CNG
1	115	23	0.19	0	3	32	CNG truck		EP	g/km	Baidya, 2009	Bus CNG
1	3	23	1	0	3	32	CNG truck		NOx	g/km	Baidya, 2009	Bus CNG
1	4	23	0	0	3	32	CNG truck		SO2	g/km	Baidya, 2009	Bus CNG
1	6	17	4.5	0	2	32	Diesel bus 01-05		CO	g/km	Baidya, 2009	Bus D-A
1	113	17	757	0	2	32	Diesel bus 01-05		CO2	g/km	Baidya, 2009	Bus D-A
1	115	17	0.59	0	2	32	Diesel bus 01-05		EP	g/km	Baidya, 2009	Bus D-A
1	3	17	12	0	2	32	Diesel bus 01-05		NOx	g/km	Baidya, 2009	Bus D-A
1	4	17	0.476	0	2	32	Diesel bus 01-05		SO2	g/km	Baidya, 2009	Bus D-A
1	6	14	12.7	0	2	32	Diesel bus 91		CO	g/km	Baidya, 2009	Bus D-D
1	113	14	757	0	2	32	Diesel bus 91		CO2	g/km	Baidya, 2009	Bus D-D
1	115	14	3.3	0	2	32	Diesel bus 91		EP	g/km	Baidya, 2009	Bus D-D
1	3	14	19	0	2	32	Diesel bus 91		NOx	g/km	Baidya, 2009	Bus D-D
1	4	14	0.476	0	2	32	Diesel bus 91		SO2	g/km	Baidya, 2009	Bus D-D
1	6	15	7.43	0	2	32	Diesel bus 91-95		CO	g/km	Baidya, 2009	Bus D-C
1	113	15	757	0	2	32	Diesel bus 91-95		CO2	g/km	Baidya, 2009	Bus D-C
1	115	15	2.48	0	2	32	Diesel bus 91-95		EP	g/km	Baidya, 2009	Bus D-C
1	3	15	13.49	0	2	32	Diesel bus 91-95		NOx	g/km	Baidya, 2009	Bus D-C
1	4	15	0.476	0	2	32	Diesel bus 91-95		SO2	g/km	Baidya, 2009	Bus D-C
1	6	16	5.5	0	2	32	Diesel bus 96-2000		CO	g/km	Baidya, 2009	Bus D-B
1	113	16	757	0	2	32	Diesel bus 96-2000		CO2	g/km	Baidya, 2009	Bus D-B
1	115	16	1.49	0	2	32	Diesel bus 96-2000		EP	g/km	Baidya, 2009	Bus D-B
1	3	16	13.49	0	2	32	Diesel bus 96-2000		NOx	g/km	Baidya, 2009	Bus D-B
1	4	16	0.476	0	2	32	Diesel bus 96-2000		SO2	g/km	Baidya, 2009	Bus D-B
1	6	22	4.5	0	2	32	Diesel truck		CO	g/km	Baidya, 2009	HDT D
1	113	22	706	0	2	32	Diesel truck		CO2	g/km	Baidya, 2009	HDT D
1	115	22	1.22	0	2	32	Diesel truck		EP	g/km	Baidya, 2009	HDT D
1	3	22	8.86	0	2	32	Diesel truck		NOx	g/km	Baidya, 2009	HDT D
1	4	22	0.444	0	2	32	Diesel truck		SO2	g/km	Baidya, 2009	HDT D
1	6	4	3	0	2	32	EURO 1 D		CO	g/km	Baidya, 2009	Car D-B1
1	113	4	237	0	2	32	EURO 1 D		CO2	g/km	Baidya, 2009	Car D-B1
1	115	4	0.46	0	2	32	EURO 1 D		EP	g/km	Baidya, 2009	Car D-B1
1	3	4	1.1	0	2	32	EURO 1 D		NOx	g/km	Baidya, 2009	Car D-B1
1	4	4	0.149	0	2	32	EURO 1 D		SO2	g/km	Baidya, 2009	Car D-B1
1	6	3	14.3	0	1	32	EURO 1 G		CO	g/km	Baidya, 2009	Car G-B1
1	113	3	242	0	1	32	EURO 1 G		CO2	g/km	Baidya, 2009	Car G-B1
1	115	3	0.07	0	1	32	EURO 1 G		EP	g/km	Baidya, 2009	Car G-B1
1	3	3	0.98	0	1	32	EURO 1 G		NOx	g/km	Baidya, 2009	Car G-B1
1	4	3	0.08	0	1	32	EURO 1 G		SO2	g/km	Baidya, 2009	Car G-B1
1	6	6	3	0	2	32	EURO 2 D		CO	g/km	Baidya, 2009	Car D-B2
1	113	6	237	0	2	32	EURO 2 D		CO2	g/km	Baidya, 2009	Car D-B2
1	115	6	0.46	0	2	32	EURO 2 D		EP	g/km	Baidya, 2009	Car D-B2
1	3	6	1.1	0	2	32	EURO 2 D		NOx	g/km	Baidya, 2009	Car D-B2
1	4	6	0.149	0	2	32	EURO 2 D		SO2	g/km	Baidya, 2009	Car D-B2
1	6	5	14.3	0	1	32	EURO 2 G		CO	g/km	Baidya, 2009	Car G-B2
1	113	5	242	0	1	32	EURO 2 G		CO2	g/km	Baidya, 2009	Car G-B2
1	115	5	0.07	0	1	32	EURO 2 G		EP	g/km	Baidya, 2009	Car G-B2
1	3	5	0.98	0	1	32	EURO 2 G		NOx	g/km	Baidya, 2009	Car G-B2
1	4	5	0.08	0	1	32	EURO 2 G		SO2	g/km	Baidya, 2009	Car G-B2
1	6	8	2.72	0	2	32	EURO 3 D		CO	g/km	Baidya, 2009	Car D-A
1	113	8	237	0	2	32	EURO 3 D		CO2	g/km	Baidya, 2009	Car D-A
1	115	8	0.19	0	2	32	EURO 3 D		EP	g/km	Baidya, 2009	Car D-A
1	3	8	1	0	2	32	EURO 3 D		NOx	g/km	Baidya, 2009	Car D-A
1	4	8	0.149	0	2	32	EURO 3 D		SO2	g/km	Baidya, 2009	Car D-A
1	6	7	2.72	0	1	32	EURO 3 G		CO	g/km	Baidya, 2009	Car G-A
1	113	7	242	0	1	32	EURO 3 G		CO2	g/km	Baidya, 2009	Car G-A
1	115	7	0.06	0	1	32	EURO 3 G		EP	g/km	Baidya, 2009	Car G-A
1	3	7	0.69	0	1	32	EURO 3 G		NOx	g/km	Baidya, 2009	Car G-A
1	4	7	0.08	0	1	32	EURO 3 G		SO2	g/km	Baidya, 2009	Car G-A
1	6	10	0.06	0	2	32	EURO 4 D		CO	g/km	ICAP, 2007	Pass Car D
1	113	10	148.76	0	2	32	EURO 4 D		CO2	g/km	ICAP, 2007	Pass Car D
1	115	10	0.015	0	2	32	EURO 4 D		EP	g/km	ICAP, 2007	Pass Car D
1	3	10	0.28	0	2	32	EURO 4 D		NOx	g/km	ICAP, 2007	Pass Car D
1	4	10	0.06	0	2	32	EURO 4 D		SO2	g/km	hcmc	
1	6	9	0.84	0	1	32	EURO 4 G		CO	g/km	ICAP, 2007	Pass Car G
1	113	9	172.95	0	1	32	EURO 4 G		CO2	g/km	ICAP, 2007	Pass Car G
1	115	9	0.002	0	1	32	EURO 4 G		EP	g/km	ICAP, 2007	Pass Car G
1	3	9	0.09	0	1	32	EURO 4 G		NOx	g/km	ICAP, 2007	Pass Car G
1	4	9	0.05	0	1	32	EURO 4 G		SO2	g/km	hcmc	
1	6	24	2	0	1	32	MC-2 strokes		CO	g/km	Baidya, 2009	M2W-2S
1	113	24	44	0	1	32	MC-2 strokes		CO2	g/km	Baidya, 2009	M2W-2S
1	115	24	0.18	0	1	32	MC-2 strokes		EP	g/km	Baidya, 2009	M2W-2S
1	3	24	0.08	0	1	32	MC-2 strokes		NOx	g/km	Baidya, 2009	M2W-2S
1	4	24	0.014	0	1	32	MC-2 strokes		SO2	g/km	Baidya, 2009	M2W-2S
1	6	25	2	0	1	32	MC-4 strokes		CO	g/km	Baidya, 2009	M2W-4S
1	113	25	33	0	1	32	MC-4 strokes		CO2	g/km	Baidya, 2009	M2W-4S
1	115	25	0.06	0	1	32	MC-4 strokes		EP	g/km	Baidya, 2009	M2W-4S
1	3	25	0.29	0	1	32	MC-4 strokes		NOx	g/km	Baidya, 2009	M2W-4S
1	4	25	0.011	0	1	32	MC-4 strokes		SO2	g/km	Baidya, 2009	M2W-4S
1	6	12	11.48	0	3	32	Minibus		CO	g/km	Baidya, 2009	LDT D
1	113	12	306	0	3	32	Minibus		CO2	g/km	Baidya, 2009	LDT D
1	115	12	1.33	0	3	32	Minibus		EP	g/km	Baidya, 2009	LDT D
1	3	12	4.8	0	3	32	Minibus		NOx	g/km	Baidya, 2009	LDT D
1	4	12	0.192	0	3	32	Minibus		SO2	g/km	Baidya, 2009	LDT D
1	6	1	42	0	1	32	PreCat		CO	g/km	Baidya, 2009	Car G-D
1	113	1	242	0	1	32	PreCat		CO2	g/km	Baidya, 2009	Car G-D
1	115	1	0.1	0	1	32	PreCat		EP	g/km	Baidya, 2009	Car G-D
1	3	1	1.93	0	1	32	PreCat		NOx	g/km	Baidya, 2009	Car G-D
1	4	1	0.08	0	1	32	PreCat		SO2	g/km	Baidya, 2009	Car G-D
1	6	2	19.31	0	1	32	US 83/87/90		CO	g/km	Baidya, 2009	Car G-C
1	113	2	242	0	1	32	US 83/87/90		CO2	g/km	Baidya, 2009	Car G-C

Appendix H

Traffic Source ECVC-RVC Distribution

ECVC - RVC Distribution - **VALIDITY PERIOD 2013**

ECVC ID	Road Class ID	Percentage (%)	Vehicle Class (RVC)	Road Class	ECVC Name	Vehicle Class (RVC)
1	1	0.0	1	Primary	PreCat	car
2	1	0.0	1	Primary	US 83/87/90	car
3	1	5.0	1	Primary	EURO 1 G	car
4	1	0.0	1	Primary	EURO 1 D	car
5	1	5.0	1	Primary	EURO 2 G	car
6	1	0.0	1	Primary	EURO 2 D	car
7	1	5.0	1	Primary	EURO 3 G	car
8	1	0.0	1	Primary	EURO 3 D	car
9	1	5.0	1	Primary	EURO 4 G	car
10	1	0.0	1	Primary	EURO 4 D	car
11	1	70.0	1	Primary	CNG car	car
12	1	10.0	1	Primary	Minibus	car
13	1	100.0	2	Primary	CNG taxi	taxi
14	1	10.0	3	Primary	Diesel bus 91	bus
15	1	10.0	3	Primary	Diesel bus 91-95	bus
16	1	10.0	3	Primary	Diesel bus 96-2000	bus
17	1	0.0	3	Primary	Diesel bus 01-05	bus
18	1	0.0	3	Primary	CNG bus 91	bus
19	1	0.0	3	Primary	CNG bus 91-95	bus
20	1	0.0	3	Primary	CNG bus 96-2000	bus
21	1	70.0	3	Primary	CNG bus 01-05	bus
22	1	60.0	4	Primary	Diesel truck	truck
23	1	40.0	4	Primary	CNG truck	truck
24	1	1.0	5	Primary	MC-2 strokes	MC
25	1	99.0	5	Primary	MC-4 strokes	MC
26	1	100.0	6	Primary	CNG Auto-rickshaw	Autorickshaw
1	2	0.0	1	Secondary	PreCat	car
2	2	0.0	1	Secondary	US 83/87/90	car
3	2	5.0	1	Secondary	EURO 1 G	car
4	2	0.0	1	Secondary	EURO 1 D	car
5	2	5.0	1	Secondary	EURO 2 G	car
6	2	0.0	1	Secondary	EURO 2 D	car
7	2	5.0	1	Secondary	EURO 3 G	car
8	2	0.0	1	Secondary	EURO 3 D	car
9	2	5.0	1	Secondary	EURO 4 G	car
10	2	0.0	1	Secondary	EURO 4 D	car
11	2	70.0	1	Secondary	CNG car	car
12	2	10.0	1	Secondary	Minibus	car
13	2	100.0	2	Secondary	CNG taxi	taxi
14	2	10.0	3	Secondary	Diesel bus 91	bus
15	2	10.0	3	Secondary	Diesel bus 91-95	bus
16	2	10.0	3	Secondary	Diesel bus 96-2000	bus
17	2	0.0	3	Secondary	Diesel bus 01-05	bus
18	2	0.0	3	Secondary	CNG bus 91	bus
19	2	0.0	3	Secondary	CNG bus 91-95	bus
20	2	0.0	3	Secondary	CNG bus 96-2000	bus
21	2	70.0	3	Secondary	CNG bus 01-05	bus
22	2	60.0	4	Secondary	Diesel truck	truck
23	2	40.0	4	Secondary	CNG truck	truck
24	2	1.0	5	Secondary	MC-2 strokes	MC
25	2	99.0	5	Secondary	MC-4 strokes	MC
26	2	100.0	6	Secondary	CNG Auto-rickshaw	Autorickshaw
1	3	0.0	1	Difuse	PreCat	car
2	3	0.0	1	Difuse	US 83/87/90	car
3	3	5.0	1	Difuse	EURO 1 G	car
4	3	0.0	1	Difuse	EURO 1 D	car
5	3	5.0	1	Difuse	EURO 2 G	car
6	3	0.0	1	Difuse	EURO 2 D	car
7	3	5.0	1	Difuse	EURO 3 G	car
8	3	0.0	1	Difuse	EURO 3 D	car
9	3	5.0	1	Difuse	EURO 4 G	car
10	3	0.0	1	Difuse	EURO 4 D	car
11	3	70.0	1	Difuse	CNG car	car
12	3	10.0	1	Difuse	Minibus	car
13	3	100.0	2	Difuse	CNG taxi	taxi
14	3	10.0	3	Difuse	Diesel bus 91	bus
15	3	10.0	3	Difuse	Diesel bus 91-95	bus
16	3	10.0	3	Difuse	Diesel bus 96-2000	bus
17	3	0.0	3	Difuse	Diesel bus 01-05	bus
18	3	0.0	3	Difuse	CNG bus 91	bus
19	3	0.0	3	Difuse	CNG bus 91-95	bus
20	3	0.0	3	Difuse	CNG bus 96-2000	bus
21	3	70.0	3	Difuse	CNG bus 01-05	bus
22	3	60.0	4	Difuse	Diesel truck	truck
23	3	40.0	4	Difuse	CNG truck	truck
24	3	1.0	5	Difuse	MC-2 strokes	MC
25	3	99.0	5	Difuse	MC-4 strokes	MC
26	3	100.0	6	Difuse	CNG Auto-rickshaw	Autorickshaw
1	4	0.0	1	Difuse (industry)	PreCat	car
2	4	0.0	1	Difuse (industry)	US 83/87/90	car
3	4	5.0	1	Difuse (industry)	EURO 1 G	car
4	4	0.0	1	Difuse (industry)	EURO 1 D	car
5	4	5.0	1	Difuse (industry)	EURO 2 G	car
6	4	0.0	1	Difuse (industry)	EURO 2 D	car
7	4	5.0	1	Difuse (industry)	EURO 3 G	car
8	4	0.0	1	Difuse (industry)	EURO 3 D	car
9	4	5.0	1	Difuse (industry)	EURO 4 G	car
10	4	0.0	1	Difuse (industry)	EURO 4 D	car
11	4	70.0	1	Difuse (industry)	CNG car	car
12	4	10.0	1	Difuse (industry)	Minibus	car
13	4	100.0	2	Difuse (industry)	CNG taxi	taxi
14	4	10.0	3	Difuse (industry)	Diesel bus 91	bus
15	4	10.0	3	Difuse (industry)	Diesel bus 91-95	bus
16	4	10.0	3	Difuse (industry)	Diesel bus 96-2000	bus
17	4	0.0	3	Difuse (industry)	Diesel bus 01-05	bus
18	4	0.0	3	Difuse (industry)	CNG bus 91	bus
19	4	0.0	3	Difuse (industry)	CNG bus 91-95	bus
20	4	0.0	3	Difuse (industry)	CNG bus 96-2000	bus
21	4	70.0	3	Difuse (industry)	CNG bus 01-05	bus
22	4	60.0	4	Difuse (industry)	Diesel truck	truck
23	4	40.0	4	Difuse (industry)	CNG truck	truck
24	4	1.0	5	Difuse (industry)	MC-2 strokes	MC
25	4	99.0	5	Difuse (industry)	MC-4 strokes	MC
26	4	100.0	6	Difuse (industry)	CNG Auto-rickshaw	Autorickshaw

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Emissions Inventory for Dhaka and Chittagong of Pollutants

PM10, PM2.5, NOX, SOX, and CO

PROJECT LEADER
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NILU PROJECT NO.
O-111091

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ABSTRACT
The Bangladesh Air Pollution Studies (BAPS) project is being prepared for the Clean Air and Sustainability project at the Bangladesh Department of Environment (CASE/DoE). This report summarizes the results from Task 1: Emission inventories. A combined methodology of using bottom-up and top-down scaled input data has been used to populate the emission inventory for Dhaka and Chittagong. Sources of emissions of PM_{10}, $PM_{2.5}$, NO_X, SO_X, and CO have been investigated for the sectors Industry (including brick kilns separately), Road Traffic, non-road Traffic, Agriculture, Urban, and Fossil Fuel (energy and gas processing). The emissions inventory has been compiled in the NILU model AirQUIS, which can then process the dispersion modelling of the emissions as needed for Task 2 of this project.

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