

CHAPTER FOUR

DATA ANALYSIS

In this research, the Arc map program was used to answer queries about the main obstacles and causes of traffic congestion and to identify and study the most crowded road in order to find solutions for traffic congestion in the study area. All measurement units in meters.

4.1 Analysis Processes:

. The following chart illustrates the main causes of traffic congestion :

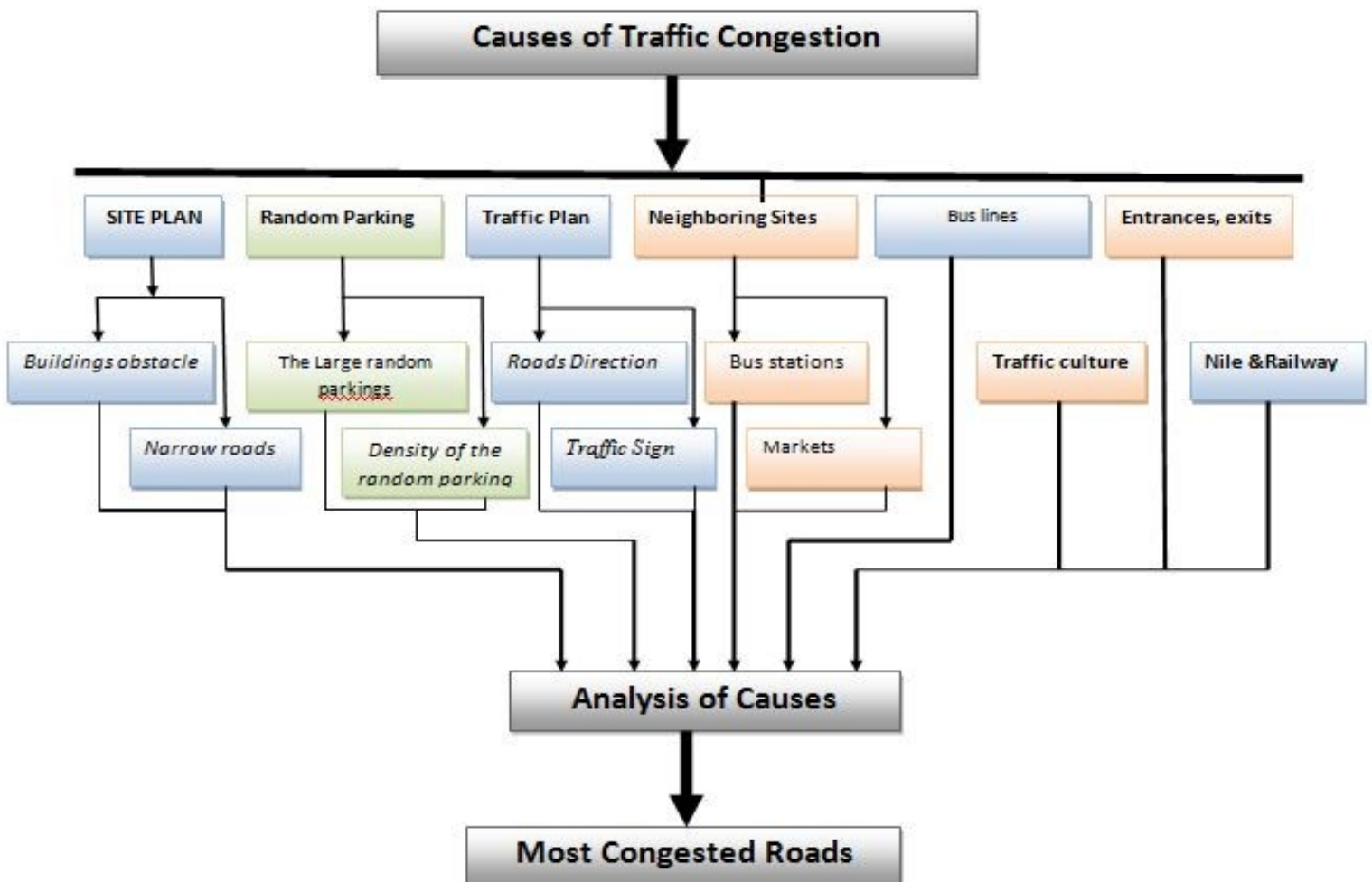


Figure (4, 1): Chart shows the main causes of traffic congestion

4.1.1 Impact of Site Plan on traffic:

Here we look for buildings that close or cause narrowing to roads.

4.1.1.1 Roads closed by buildings: In the study area there are many buildings that block some important roads. Analysis tools were used to detect these buildings, the software was asked to show the shortest roads in the study area, which does not exceed 1500m and greater than 200m using road layer as following:

Select by Attribute

Target layer: Road.

Field: length.

Condition: $\text{length} < 1300$ and $\text{length} > 500$

the blocked roads were displayed, after omitting the short roads that not effect in traffic and not closed by buildings see the Figure (4,2).



Figure (4, 2): shows roads closed by buildings

Table (4, 1): Report shows roads closed by buildings

NAME	ROAD_WIDTH	LENGTH	Direction
AL QASER ST.	40	1224.968412	two way
ABD ALLA ANNI	15	1043.198004	two way
ALI DEINAR ST.	15	1000.327819	two way
ATBARA ST.	20	688.753654	one way
BABEKER BADR	15	916.337088	two way
SALIH PASHA AL	15	1195.779243	two way
CAP. EL JAMEL :	15	1221.271489	two way
TERHAGA ST.	15	506.442417	one way
AL JAMI AL KBH	25	601.605232	one way
SENKAT ST.	15	641.705112	one way
SELIMAN KASHI	15	782.809592	one way
CAP. MARAD ST.	20	663.943021	one way
CAP. AEZ AL DIE	15	729.131974	two way
M. C. ST.	15	941.796406	one way
ABIDHAJ ALAM	15	604.245087	two way
Abogarja ST	15	880.072132	two way
A. AL NAGOMI S	25	1000.665516	one way
Altajiarzulfé	15	979.57215	one way
CONT MOKHLES	15	1003.803547	one way
HISHAM BIA ST.	15	943.80104	one way
MOHD ABD ALRA	25	578.836762	one way

All units in meters

4.1.1.2 Narrow roads: As a result of the old planning of the study area, there are many narrow roads and some of them have become a cause of congestion so we will look for these roads. Software asked to show the roads that its widths less than 25 meters and its lengths greater than one kilometer

Select by Attribute:

Target layer: Road

Fields: Road width & length

Condition: ROAD_WIDTH <25 AND LENGTH >1000

All roads with a width less 25m and length greater than one kilometer were displayed.

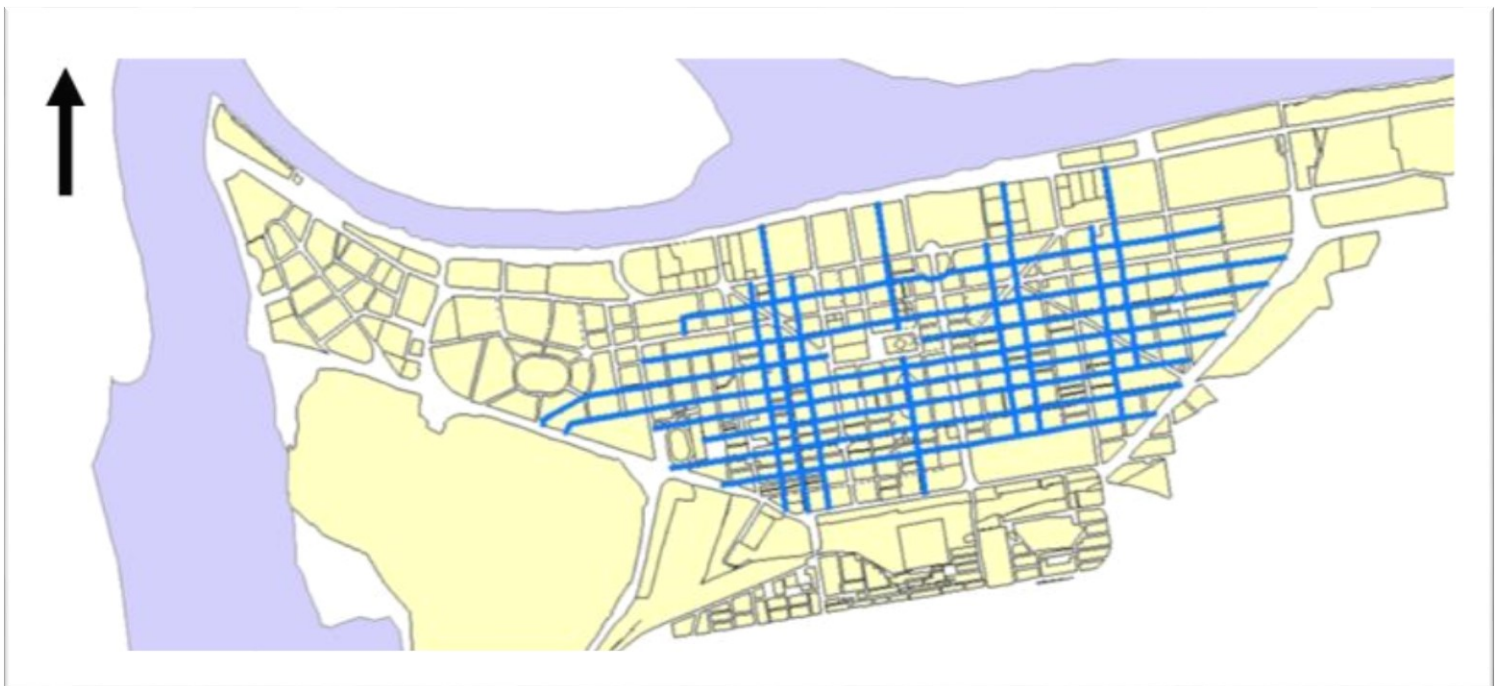


Figure (4, 3): shows the narrow roads

Table (4, 2): Report shows the narrow roads

NAME	LENGTH	ROAD_WIDTH	Dirction
AL SAYED ABD AL RAHM	2642.729883	20	one way
AL HURIYA ST.	1500.450271	20	one way
ABDALLA ANNUR ST.	1043.198004	15	two way
ALI DEINAR ST.	1000.327819	15	two way
AT TIGANI AL MAHI ST	3493.633645	15	two way
SALIH PASHA AL MUK S	1195.779243	15	two way
CAP. EL JAMEL ST.	1221.271489	15	two way
ASH SHERIEF AL HINDI	2960.741994	15	one way
ABU SIN ST.	1305.268063	15	one way
CONT MOKHLES ST.	1003.803547	15	one way
AL KHALIFA ST.	1392.519496	20	one way
AL BALADIYA ST.	3338.092593	20	one way
AL ISBITAIYA ST.	2246.233609	15	two way
AL ZUBAIR PASHA ST.	3332.118527	15	one way
21st OCTOBER ST.	2517.451995	15	one way
AL BRLMAN ST.	2886.308247	15	one way

All units in meters

4.1.2 Road congested by the random parking: In the study area there are many institutions that do not have internal parking's and all workers and customers stops their cars on the roads side near to these institutions. The impact of this random stand depends on the institutions size and services it provides. In this section we look for the following:

4.1.2.1 Congestion due to large parking: This type of traffic congestion often is in some parts of the road and most other parts of the road without any congestion, the solution in this case by building the internal parking of the institution that cause congestion or change its gate direction to another road if possible.

--First, ask the program to determine the largest area parkings , in the study area by:

Select by attribute

Target layer: Parking layer

Field: area

Condition: shape_Area > 500m



Figure (4,4): shows large random parking locations

--Second, the roads adjacent to the large car parking were identified as follows:

Select by Location:

Target layer: Road layer

Source layer: Parking layer

Active selected: large parking

Condition: distance 10m

Roads adjacent to the large random parking area were displayed

Table (4, 3): Report show Roads adjutant to the large random parking

NAME	LENGTH	ROAD_WIDTH	Direction
ALI ABDAL LTEIF	1366.174444	25	one way
AL GAMHURIYA ST	4474.211169	30	one way
AL SAYED ABD AL	2642.729883	20	one way
AL QASER ST.	1224.968412	40	two way
AL GAMA'A ST.	5055.185784	25	one way
ATBARA ST.	688.753654	20	one way
BABEKER BADRI S	916.337088	15	two way
AT TIGANI AL MAI	3493.633645	15	two way
AL JAMI AL KBIR S	601.605232	25	one way
SENKAT ST.	641.705112	15	one way
SELIMAN KASHIA	782.809592	15	one way
AL BRIR ST.	373.558376	25	two way
CAP. MARAD ST.	663.943021	20	one way
CAP. AEZ AL DIEN	729.131974	15	two way
ASH SHERIEF ALI	2960.741994	15	one way
Altayiar zulf	979.57215	15	one way
CONT MOKHLES S	1003.803547	15	one way
AL KHALIFA ST.	1392.519496	20	one way
AL BALADIYA ST.	3338.092393	20	one way
AL ZUBAIR PASHA	3332.118527	15	one way
HISHAM BIA ST.	943.80104	15	one way
WED HABBOBA ST	320.899307	15	one way
MEHIRRA ST.	441.042964	15	one way
21st OCTOBER ST.	2517.451995	15	one way
AL BRLMAN ST.	2886.308247	15	one way

All units in meters

4.1.2.2 Congestion due to random parking density: In this type, a large number of random parking lots are distributed along the road. The density of these random parking depends on the spaces beside each road. The solution in this case is the construction of public or commercial car parking in parts of the road.

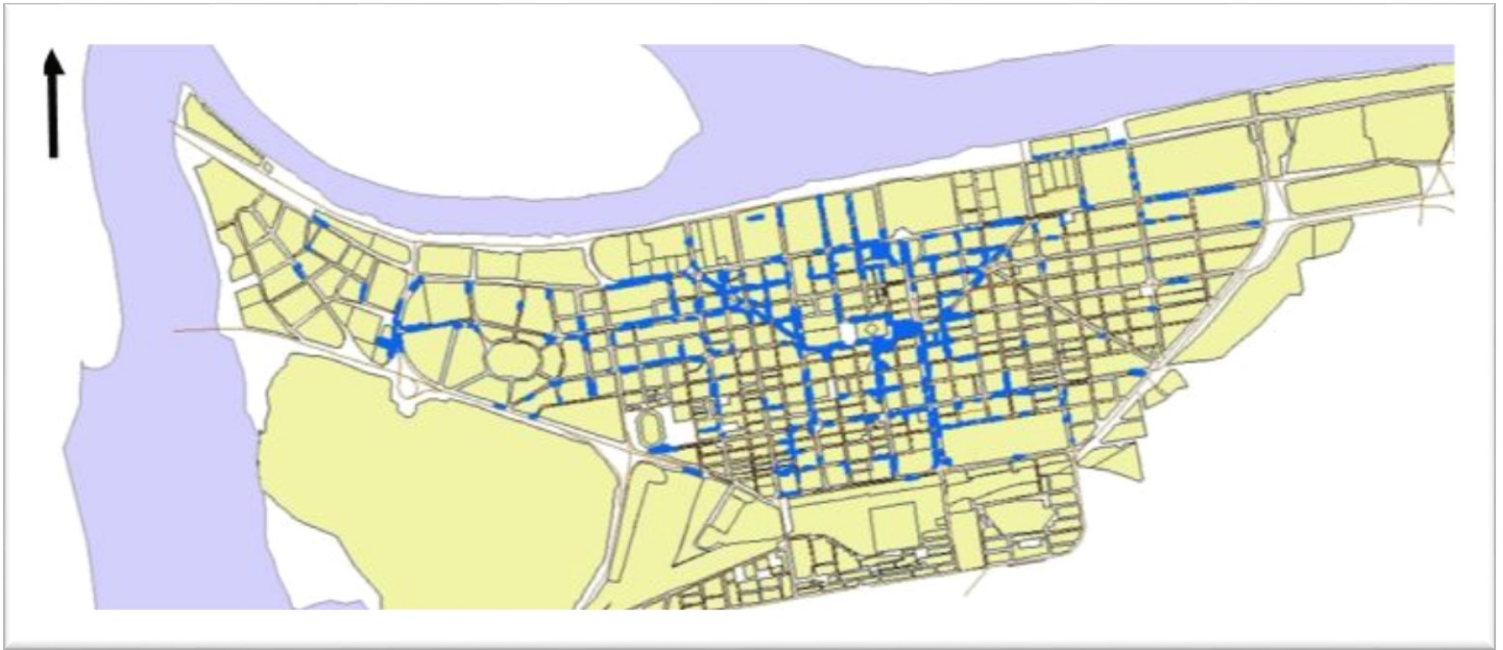


Figure (4, 5): shows random parking locations

After examining the random parking layer, the most affected roads were chosen, where random parking appear more than other roads. Total parking's area in each road was calculated and the density was found from equation:

$$\text{Density} = (\text{Total area of random parking}) / (\text{Space beside the road})$$

Here is example for calculation of random parking density in al-gamaa road

○ **Calculate the total area of random parking:**

After selecting the Al-gamaa road, the(select by location command) were used

Select by Location:

Target layer: Parking → Source layer: road → Active selection: Al- gamaa.

Condition: distance within 10m

All random parking's were selected on the Al gamaa Street.



Figure (4,6): shows random parking in Algamaa street.

Then report is created to give the statistical value about parking in Algamaa street.

Table (4, 4.1): Report shows Area of random parking in Algamaa street

1	1228.058328
20	380.484931
79	118.745617
81	72.647843
85	462.868534
86	138.031015
87	63.236935
88	36.053201
89	80.167474
112	185.887266
124	269.327074
217	343.419776
221	391.075174
244	110.691022
289	140.085256
293	323.548701
296	968.499595
297	656.326378
298	125.377685
299	38.270943
301	264.737909
302	63.649593
304	135.068362
305	68.039183
306	285.035698
...	...

All units in meters

Table (4, 4.2): Report shows roads random parking in Algamaa street

308	422.629868
309	31.172911
310	293.159253
311	3989.807668
312	342.179088
314	76.842506
323	37.288087
324	55.889442
325	55.793183
326	85.691166
327	76.105728
330	365.537278
424	38.841283
425	53.479824
426	65.188781

All units in meters

As shown in report: Total area =13293.493997 m²

- Calculation space beside the road :

Two buffers around Al-gamaa Street are created the first one for total area of road and the second for asphalt area, the different between the two buffers area will give the Space beside the road.



Figure (4, 7): shows buffers in Algamaa Street.

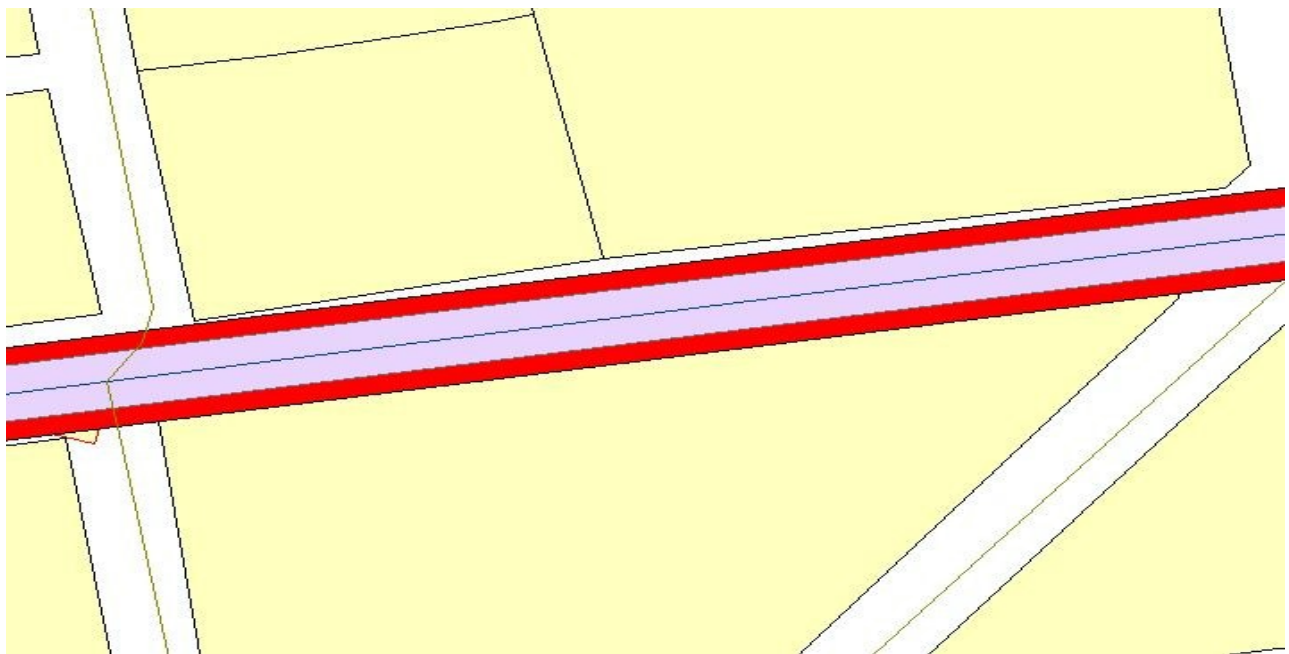


Figure (4, 8): shows the magnification of buffers in Al-gamaa street.

Space beside the road= total area of road - asphalt area

$$= 126373.628183 - 75825.409053$$

$$= 50548.21913 \text{ m}^2$$

- **Calculation of Density:**
- Density= (Total area of random parking)/Space beside the road
= 13293.493997/50548.21913
= **0.262986 m²**

In the same way, the steps have been repeated for the rest of the major main roads

4.1.3 Congested roads due to neighboring sites:

There is no doubt that the sites adjacent to the roads are the main factor that affects the traffic congestion. Markets, commercial centers, bus stations and service institutions, whether health or educational or ministries, attract many citizens with their cars to those sites, causing a lot of traffic congestion. Traffic congestion is different depends on the types of locations neighboring to the roads, the solutions are also different, so we will look for congested roads according to neighboring sites type.

4.1.3.1 Road congestion due to markets and shops:

In the study area there are many large markets and malls that contribute to increasing traffic congestion through the density of customers who attend their cars along with roads, in addition to the vendors whom cause the congestion.

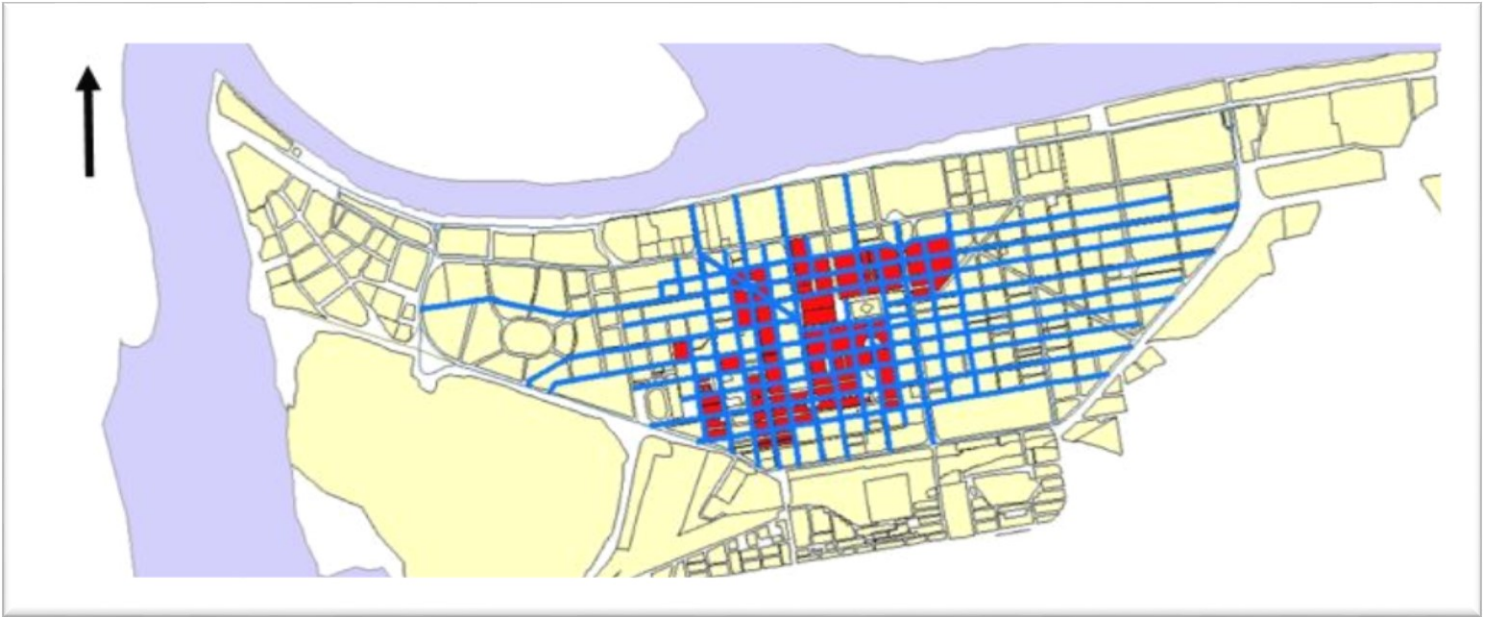


Figure (4,9): shows the Roads passing through the Markets and commercial centers

Table (4,5): Report shows the Roads passing through the Markets and commercial centers

NAME	ROAD_WIDTH	Direction
ALI ABDAL LTEIF ST.	25	one way
AL GAMHURIYA ST.	30	one way
AL SAYED ABD AL RAHM	20	one way
AL QASER ST.	40	two way
AL HURIYA ST.	20	one way
ABD AL MUNAEM MOHD S	25	two way
BABEKER BADRI ST.	15	two way
AT TIOANI AL MAHI ST	15	two way
SALIH PASHA AL MUK S	15	two way
CAP EL JAMEL ST.	15	two way
AL JAMI AL KBIR ST.	25	one way
SENKAT ST.	15	one way
SELIMAN KASHIA ST.	15	one way
CAP AEZ AL DIEN ST.	15	two way
ASH SHERIEF AL HINDI	15	one way
Altayiar zulfa	15	one way
CONT MOKHLES ST.	15	one way
AL KHALIFA ST.	20	one way
AL BALADIYA ST.	20	one way
AL ISBITAIYA ST.	15	two way
AL ZUBAIR PASHA ST.	15	one way
HISHAM BIA ST.	15	one way
21st OCTOBER ST.	15	one way
AL BRLMAN ST.	15	one way

All units in meters

4.1.3.2 Roads congestion due to bus stations:

Bus stations are one of the biggest causes of traffic congestion, Because of the confluence of a large number of public and private cars. In addition, it is usually surrounded by shops and peddler. There are also a large number of traffic attendants, causing congestion in nearby roads, as well as in the entrances and exits of these stations. The following are the main bus stations and roads affected by it.



Figure (4,10): shows the roads pass adjacent to the bus stations

Table (4,6): Report shows the roads pass adjacent to the bus stations

NAME	LENGTH	ROAD_WIDTH	Direction
ALI ABDAL LTEIF ST.	1366.1744	25	one way
AL GAMHURIYA ST.	4474.2111	30	one way
AL SAYED ABD AL RAHM	2642.7298	20	one way
AL QASER ST.	1224.9684	40	two way
AL HURIYA ST.	1500.4502	20	one way
SALIH PASHA AL FUK S	1195.7792	15	two way
SELIMAN KASHIA ST.	782.8095	15	one way
VED HABBOBA ST.	320.8998	15	one way
1st OCTOBER ST.	2517.4519	15	one way
Al-Tabia st	6777.8763	30	two way

All units in meters

4.1.4 Road congestion due to traffic plans:

The traffic plans affects traffic congestion. Traffic directions and traffic signs are the most important factors, so we look for the congested roads due to these factors.

4.1.4.1_Congestion of two-way roads:

According to the current traffic plan in the study area, the roads are divided into two types: one-way roads and two-way roads as the shown on map:

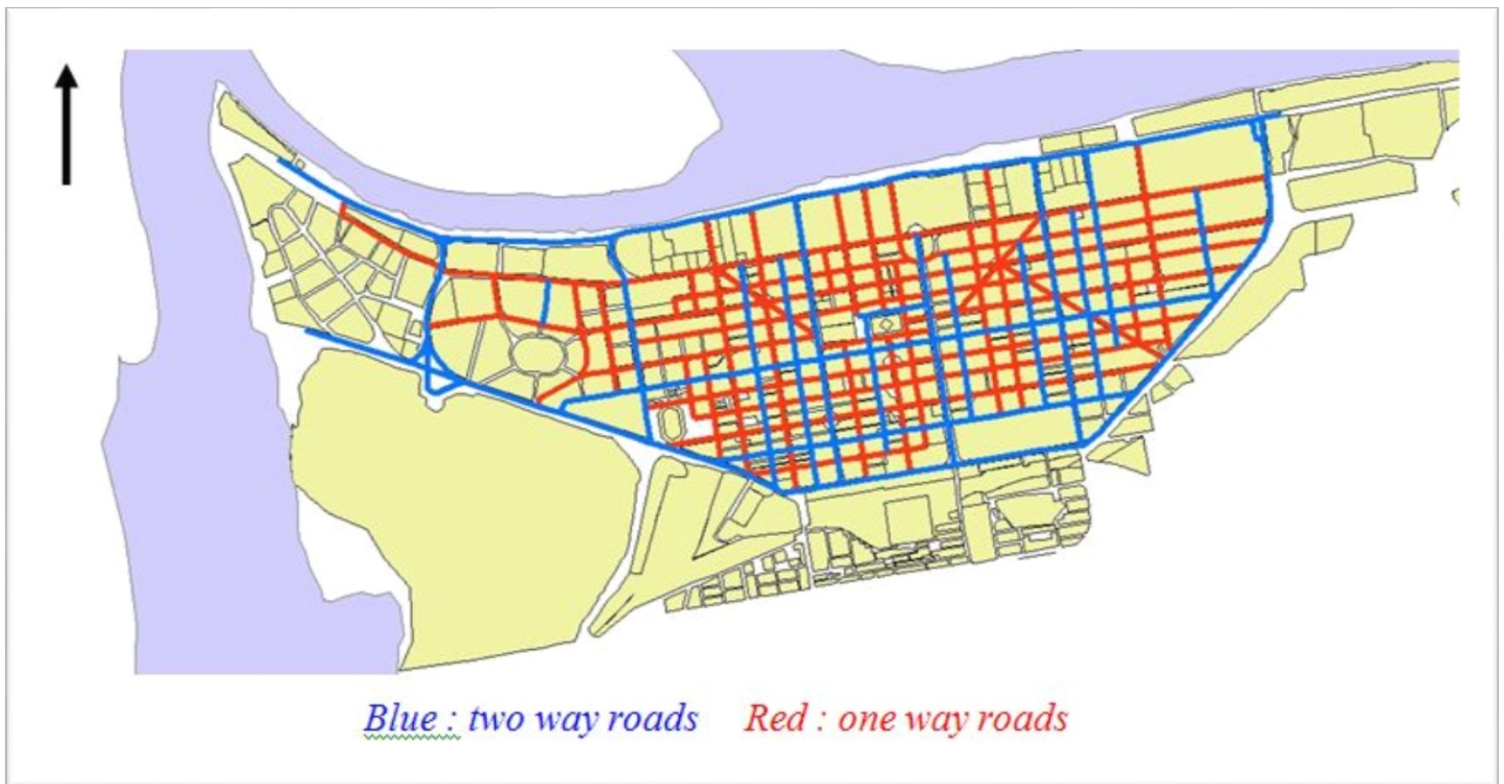


Figure (4, 11): shows the two way roads

Two-way roads, in study area especially narrow roads, are more congested than roads of one-way direction so we asked the database to view the two-way important roads, which asphalt width less than 18 m and length greater than 200m.

Table (4, 7): Report shows the most congested two way road.

NAME	LENGTH	ROAD_WIDT
AL QASER ST.	1224.968412	40
ABD ALLA ANNUR ST.	1043.198004	15
ALIDEINAR ST.	1000.327819	15
ABD ALMUNAEIM MOI	1515.827377	25
BABEKER BADRI ST.	916.337088	15
AT TIGANI AL MAHI ST.	3493.633645	15
SALIH PASHA AL MUK	1195.779243	15
CAP. EL JAMEL ST.	1221.271489	15
CAP. AEZ AL DIEN ST.	729.131974	15
ABIDHAJ AL AMIEN S	604.245087	15
Abogarja ST	880.072132	15
ARBAB AL AQCID ST.	1104.159269	25
AL MUK NIMIR ST.	1518.734973	25
AL ISBITAIYA ST.	2246.233609	15
Al-Tabia st	6777.876355	30

All units in meters

4.1.4.2 Road congestion due to traffic signs:

The light signals are one of the most important traffic sign in the study area, it organize traffic at road intersections as discussed above, but suffers from many problems such as power outages especially in the summer and unfair distribution of time between intersecting roads and un-synchronization with each other. Causing long or frequent stop that contribute to increased traffic congestion.



Figure (4, 12): shows traffic lights sign

The delay time for roads that contain a large number of traffic sign is calculated ,in order to find the roads that have a maximum values of delay time , Here we calculated the delay time in Al-Gamaa street as example:

Select by Location:

Target layer: signal layer

Source layer: Roads layer

Active selected: Algamaa street

Condition: distance 20m

All light signals in Algamaa Street are selected



Figure (4, 13): shows light signals in Al-Gamaa Street

Using the same steps delay time for the other roads are calculated..

4.1.5 Congestion at the entrances and the intersection of roads

Due to the small number of inputs and exits in the study area, most of the roads entering and exit the area is crowded especially in the morning and afternoon time. Using aerial imagery and field survey of the study area, the congested entrance and roads intersections were identified on the map, and the roads passing through these sites were identified.



Figure (4, 14): shows the roads passing through the most congested locations

Table (4, 8): Report shows the roads passing through the most congested locations

NAME	LENGTH	ROAD_WIDTH	Direction
AL GAMHURIYA ST.	4474.21	30	one way
AL SAYED ABD AL LAHM	2642.72	20	one way
Al Tabia Street	7055.33	20	two way
AL GAMA'A ST.	5055.18	25	one way
SALIH PASHA AL MUK S	1195.77	15	two way
SELIMAN KASHLA ST.	782.80	15	one way
Al tayyar ralf	979.57	15	one way
AL BALADIYA ST.	3338.09	20	one way
AL ISBITAIYA ST.	2246.23	15	two way
AL ZUBAIR PASHA ST.	3332.11	15	one way
VED HABBOBA ST.	320.89	15	one way

All units in meters

4.1.6 Roads congested due to bus lines:

There is no doubt that the road used by a large number of bus lines are always slower and busier than others due to the frequent stop of these buses, especially those used in Khartoum City, many of which are old. The map shows the most commonly used roads by bus lines in the study area.



Figure (4, 15): shows most commonly roads used by bus lines

Table (4,9): Report shows the most common used roads by bus lines

NAME	LENGTH	ROAD_WIDTH	Direction
AL GAMHU	4474.21	30	one way
AL SAYED/ RAHDI	2642.71	20	one way
AL GAMA A	5055.11	25	one way
ATBARAST	688.71	20	one way
SELDIAN K	782.81	15	one way
A AL NAGC	1000.61	25	one way
ARBAB AL :	1104.11	25	two way
AL BALADT	3338.01	20	one way
Al-Taba st	6777.51	30	two way

All units in meters

4.1.7 Congestion due to Railway and Nile:

Most roads in the study area are closes, either by rail or river Nile, so we chose the most important roads, which have no bridges.

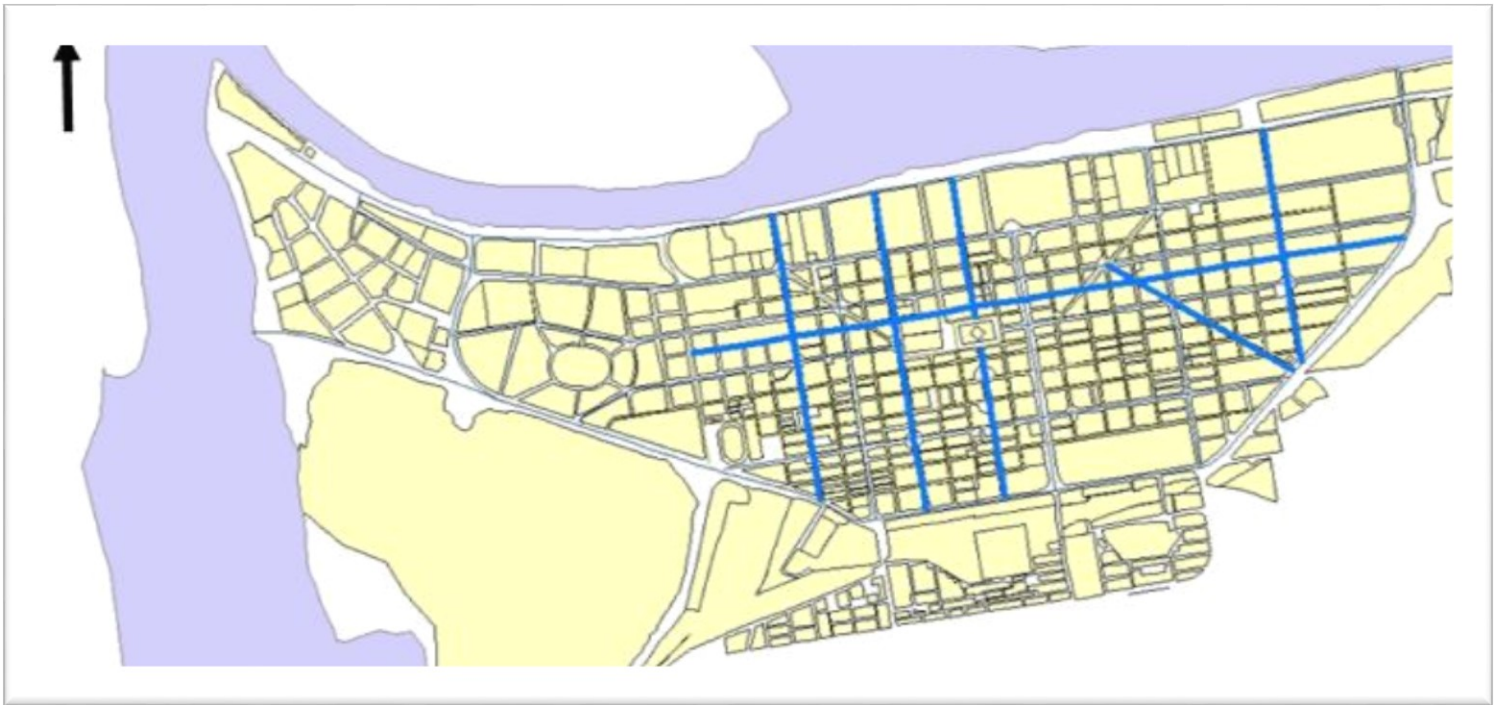


Figure (4, 15): shows important roads enclosed by Railway and Nile

Table (4,10): chows Important roads closed by Railway and Nile

NAME	LENGTH	ROAD_WIDTH	Dirction
ALI ABDAL LTEIF ST.	1366.1744	25	one way
ABDALMUNAEM MOHD S	1515.8273	25	two way
A. AL NAGOMI ST.	1000.6655	25	one way
AL KHALIFA ST.	1392.5194	20	one way
OSMAN DIGNA ST.	1114.9835	25	one way
AL ZUBAIR PASHA ST.	3332.1185	15	one way

All units in meters

4.1.8 Congestion due to road location

The geographical location of Tabiah Street and its extension is one of the factors causing it to suffer from traffic congestion. Most cars entering the study area pass through it. There are many traffic jams, especially at the intersection with Alamek Nimer, Quaser Street And Alhoria street .

4.2 Analysis Results

After conducting the analysis the congested roads are scheduled as the following:

4.2.1 Most congested roads:

We conclude from the above reports that the most congested roads in the study area are:

Table(4,11)The Most Congested Roads in Study Area :

No.	Roads
1	AL SAYED ABD AL RAHMAN
2	AL BALADIYA .
3	AL GAMHURIYA
4	AL QASER
5	SALIH PASHA AL MUK
6	AL GAMA'A .
7	AL ISBITAIYA
8	AL ZUBAIR PASHA
9	AI TAYAR ZULFE
10	AL KHALIF
11	ABD ALMUNAEIM MOHD
12	SELIMAN KASHA
13	AI BRLMAN
14	AI TABIA

4.2.2 The most influential institutions in traffic congestion :

Here is the Sketch and reports that shows the institutions cause traffic congestion due to random parking beside this location.

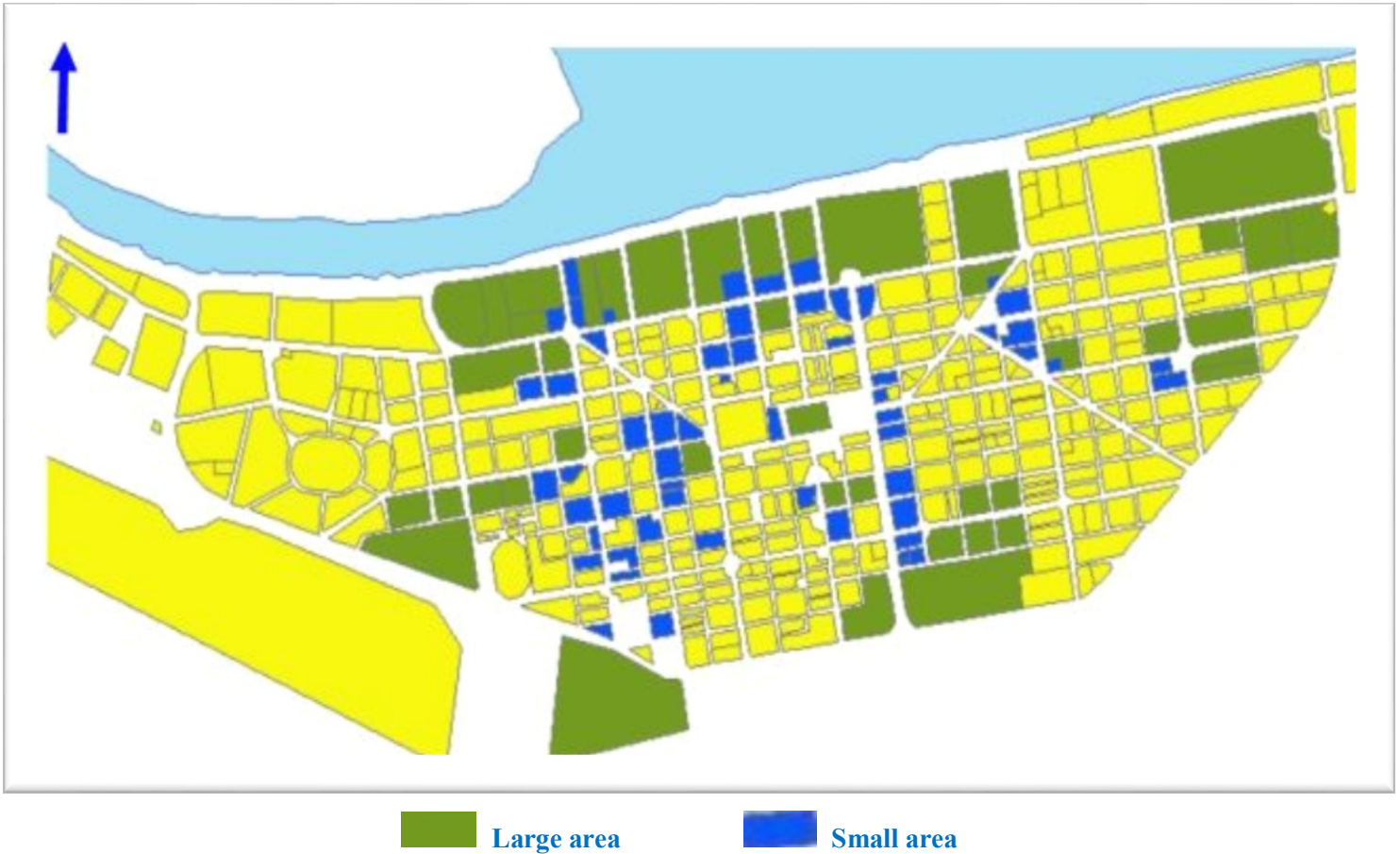


Figure (4.16): shows the most influential institutions in traffic congestion

Table (4.12.1): The most influential institutions in traffic congestion

NAME	Shape_Area
Center for Future Studies	10525.762922
Bank of Sudan Khartoum branch	12022.874285
Sudan Academy for Finance and Banking Sciences	14809.402629
Embassy of The United Kingdom	12918.340316
almawada hospital	10326.838928
Zein Medical Center	11147.516173
Al Shamal Islamic bank	13514.436348
Alsharega Conferances Hall	14626.594707
ALZAYTUONA SPESIALIZWED HOSPITAL	10148.653124
Shaheeda Dr. Salma Pharmacy	10448.925972
Ministry of culture	12189.418192
Grand Mosque	13146.067043
Teacher's Tower	11236.603388
University of Neeline Students Union	11206.549594
Student Barracks Cairo	11374.622202
University Khartoum Branch	
University of Khartoum	30588.139702
Al. Kmbonia School	15017.096307

All units in meters

Table (4.12.2): The most influential institutions in traffic congestion

National Electricity Company	39187.121269
Khartoum Hospital	91587.336304
Administration of University Requirements (AUR)	32720.794566
Jackson 's Position	147633.864629
Palace of The Republic	102911.788246
University of Khartoum	171351.750876
Ministry of Finance and National Economy	20335.584338
Ministry of Interior	25533.674654
Sudan Judiciary	44784.653976
Ministry of the Presidency of the Council of Ministers	54918.538164
Sudan University For Science And Tech	60529.734893
Faculty of Science, Economics and New Political Science	10530.095527
Sudan university of Science and Technology POP	16417.55907

All units in meters