Themes Flood Risk Area

GIS Program (GGPH036S6)

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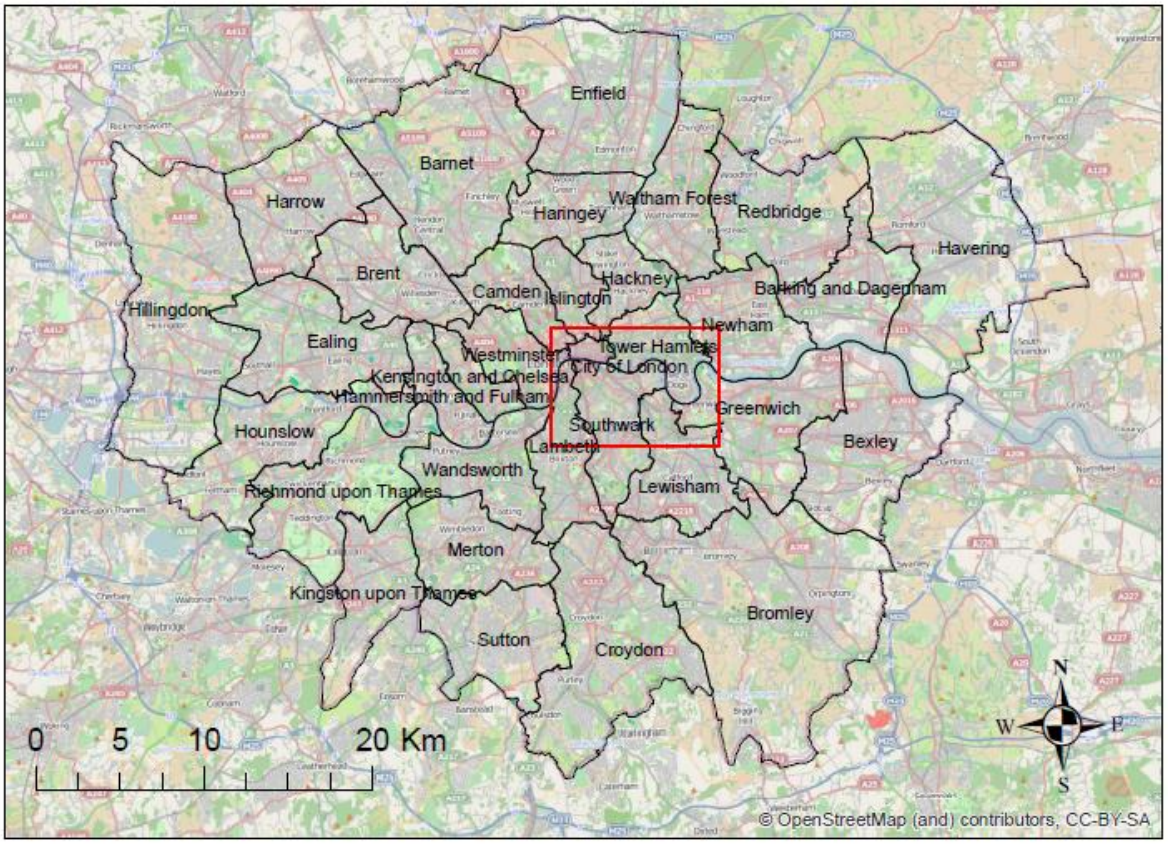


This report describes GIS analysis on a flood risk area, which is taken 300m from the Themes River bank. Data analysis is concentrating on the population, residential houses and cars or vans in the flood risk area as well as on a study area and whole London.

Table of Contents

Introduction

The aim of the report is to describe what would be the effect of flooding on population, properties and cars or vans 300m from the bank of the river Thames in London.

The report is broken into three parts of GIS analysis. First part includes whole London. Second part includes central London, which is called a study area and the last part is a flood risk area.

Data

The data is come from the web site: Casweb UK data Services 2001 Aggregate Statistic Dataset (2001). For creating maps was selected geographic output: District, CAS Ward, OA and following data information was downloaded; usual resident population, age structure, ethnic group, religion, cars and vans and household spaces and accommodation type also called properties.

Images of the streets were downloaded from the web site: Ordnance Survey (OS) Street view - national grid, reference square TQ, data type raster. For creating maps were used tq38sw, tq38se, tq37nw and tq37ne.tif file that represent the streets and building images on the maps of the study area.

The insurance company provides a polygon vector file of the study area and the Themes River with georeferences figure.01.

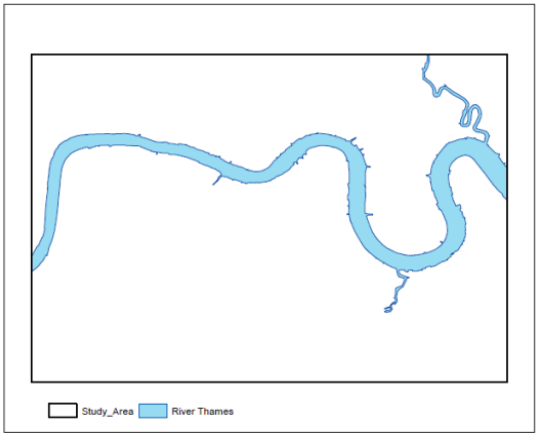


Figure.01

Methodology

The files of the study area and the Themes River were uploaded into Arc Map as well as the data files that were uploaded from Casweb (see Data chapter above). Then a flood risk area that is 300m on both sides from the Themes River was created via buffer tools.

The flood risk area overlaps outside of the study area on right, left and top side figure.02. Therefore created the flood risk area was clipped with the study area to insure that the flood risk area is just inside of the study area figure.03.

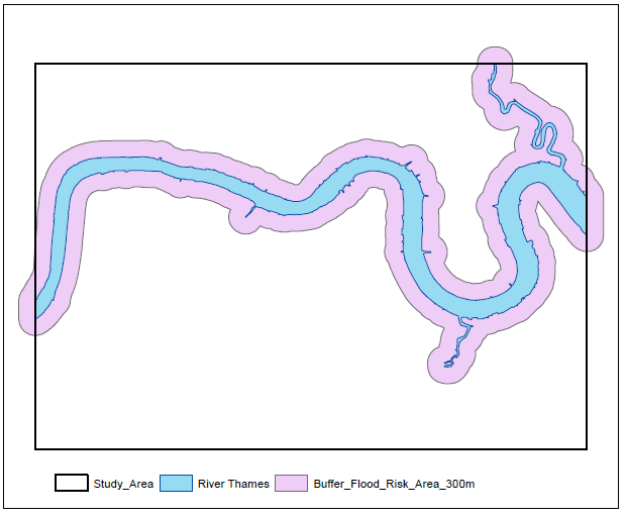


Figure.02

Afterword downloaded data was clipped with the study area and with the flood risk area to get layers with attributes tables of study or flood risk area. Only OA files were clipped because if the district file had been clip then the layer with data of the study or risk areas would have been inaccurate as the attribute table would have provided information for the whole borough.

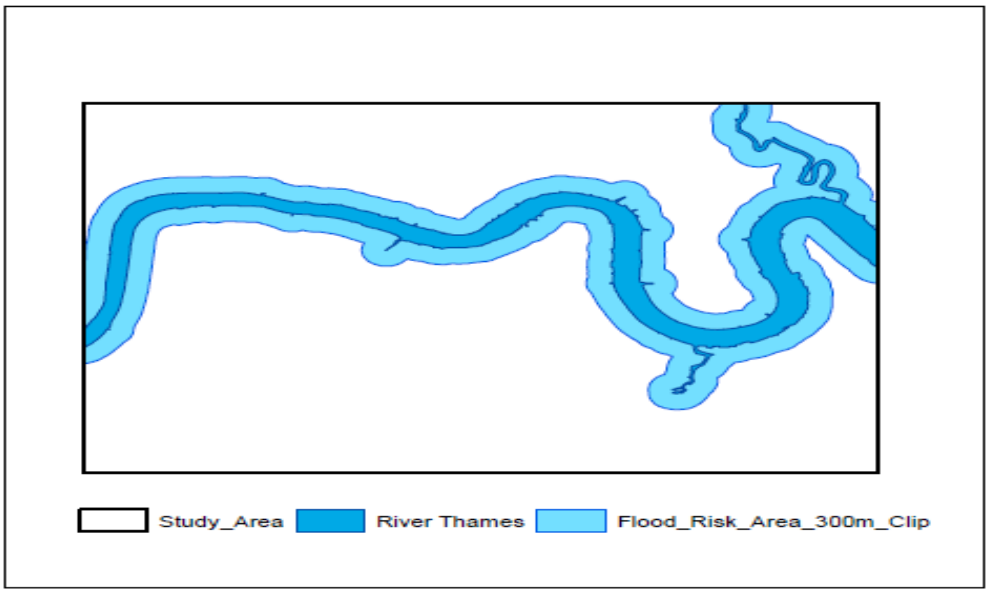


Figure.03

Inside attribute tables was creating a new column called Area_Km_Sq and via a calculate geometry was calculated an area per km^2. Then by the left click on each column and select statistics, it was found out a total of a particular column, for instance the sum of the London's area, for more information see the appendix; methodology support. Afterwards maps were created such as a thematic map on the page 9, figure.09.

Some of the attribute tables (table's values) were coped and pasted into the Excel to analyse additional information such as to create pie or column charts.

Analysis of London

London has area on 1594.72km^2 and London is divided into 32 boroughs plus the City of London. The largest borough is Bromley with 150.145km^2, which takes 9% of London's area and the smallest borough is City of London with 3.1514km^2, which takes 0.2%.

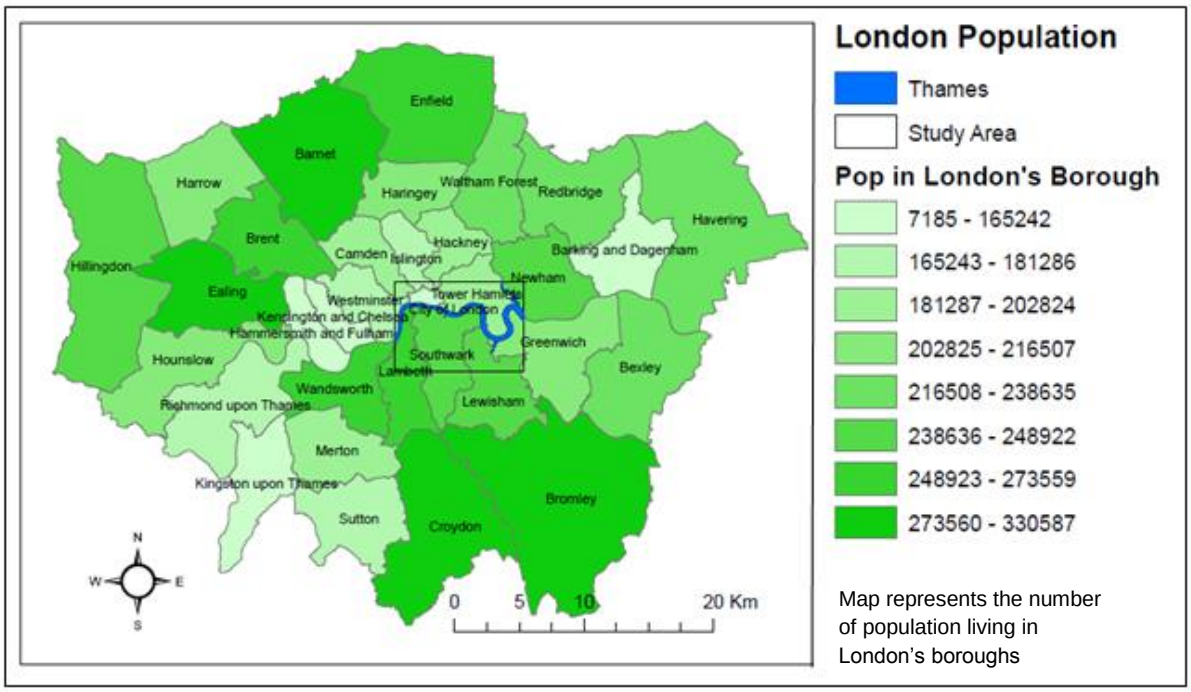


Figure.04

Population

London population is 7,172,091million. The most populated borough is Croydon, which takes 5%. The less populated borough is City of London with 7,185 people. A thematic map above represents population for each London's borough figure.04. In addition density map of the London's population could be seen on the page 14, figure.18 and 19.

London is multicultural city where majority of the population covers white British 60%. Other ethnic group living in London could be seen on the column chart figure.05 or table representation, in appendix on the page 29, figureA60.

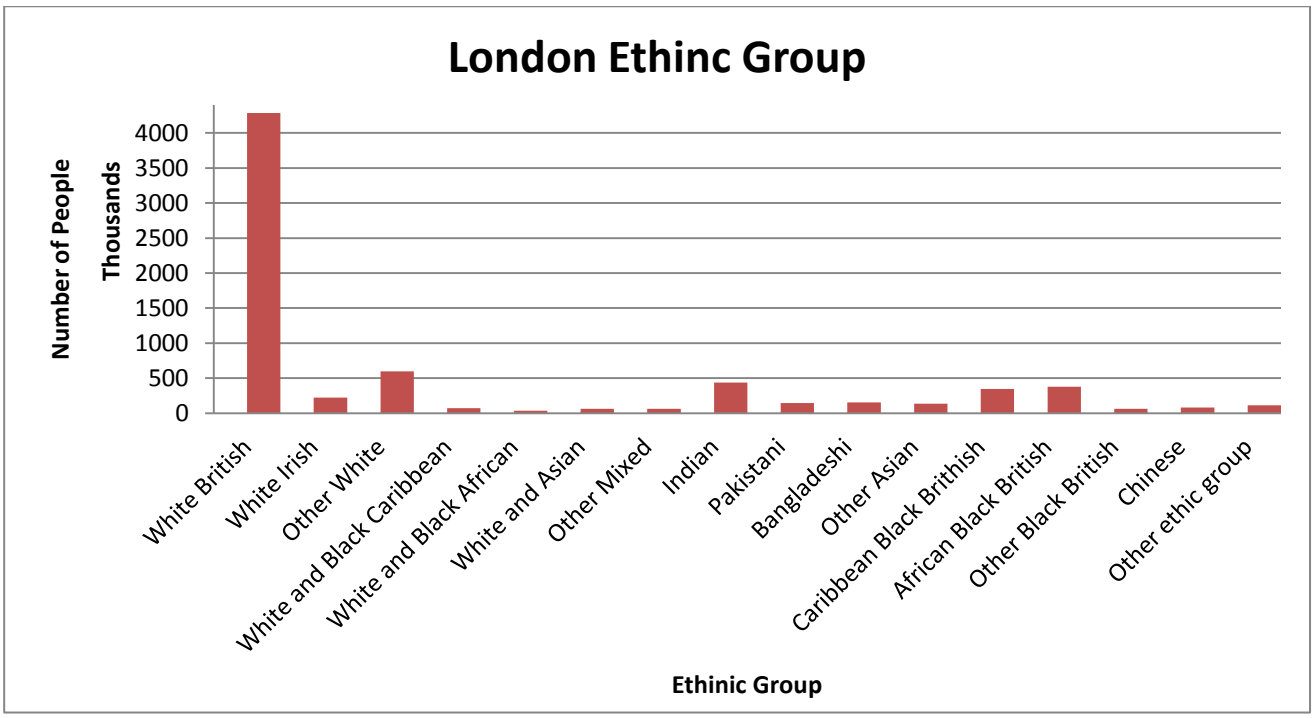


Figure.05

London has six main religions; Christian, Buddhist Hindu Jewish Muslim and Sikh. The Majority of the population is Christianity with 58%. The column chart below represent religion group in London or the table representation is available in appendix on the page30, figureA61.

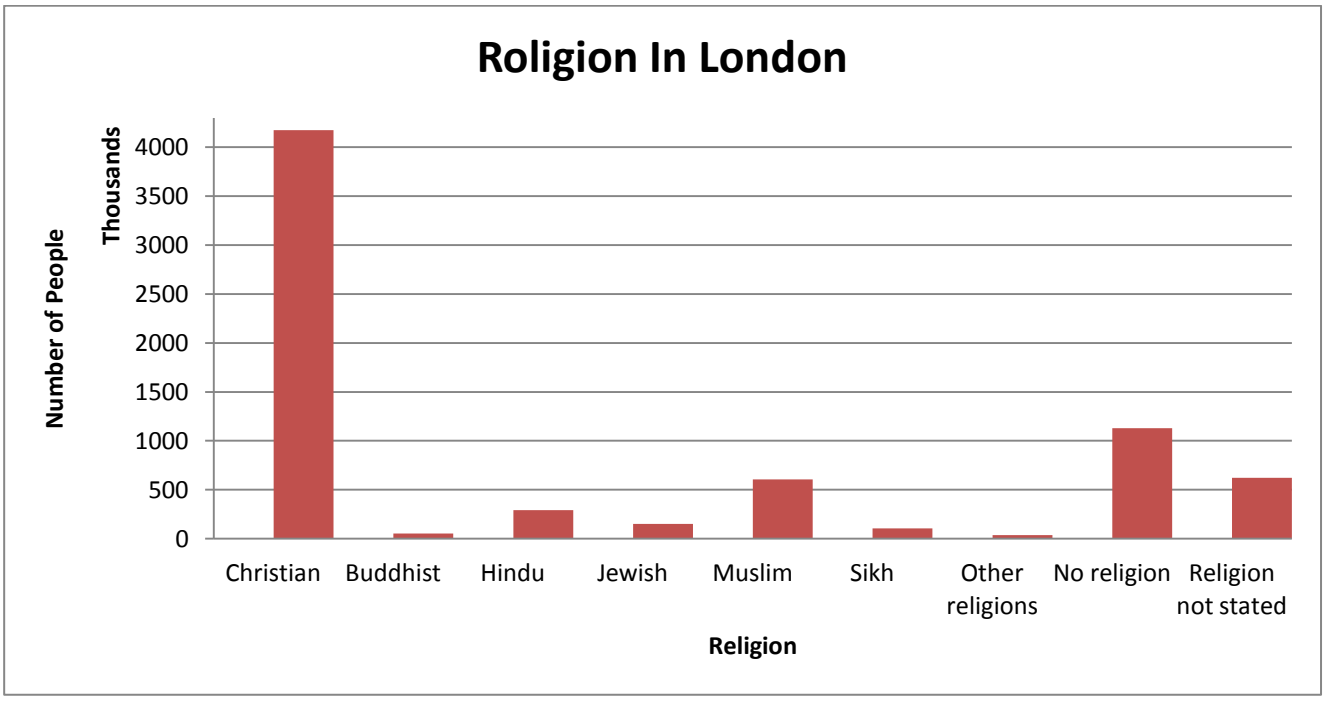


Figure.06

Property and Cars or Vans

In London are 6,219,316 properties, which 48% covers residential houses 3,015,997. Table representation of the London's properties is available in appendix on the page 31, figure.A62.

From 3,015,997 residential houses 37% do not have cars or van and 43% have one car or van. In London are 2,616,328 million cars or cans. A pie chart below represents all residential houses and their percentage of holding the cars or vans. Table representation of the London's cars and vans is available in appendix on the page 33, figure.A65.

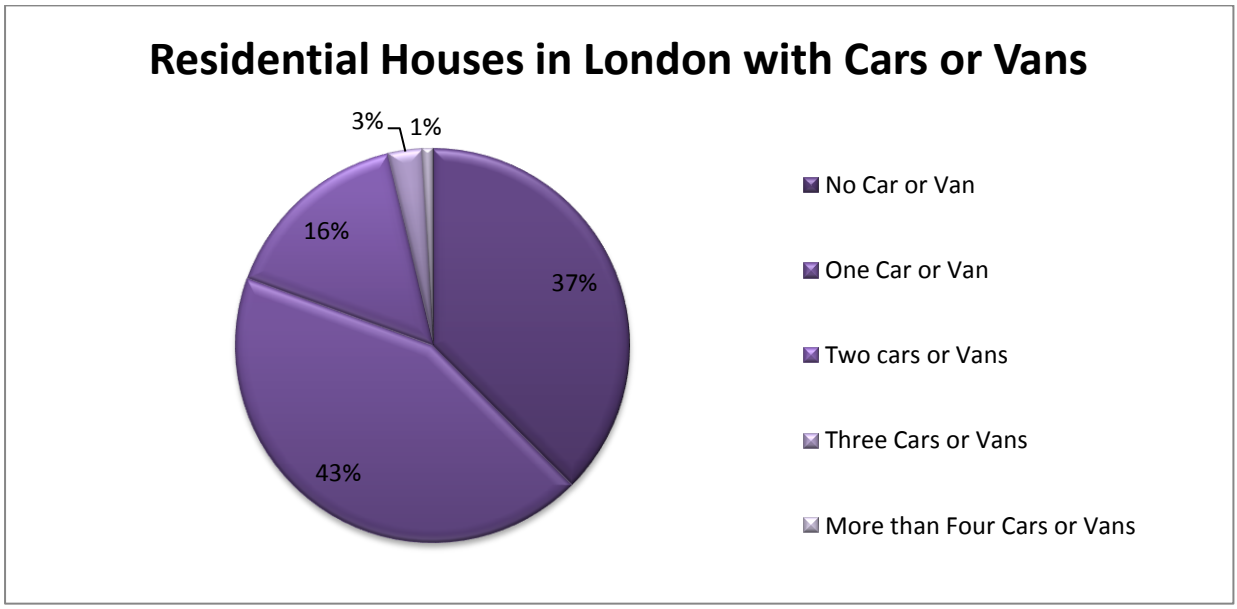


Figure.07

Analysis of the Study Area

The area that insurance company is interesting has 72.72km^2, which takes 4.56% of London's area and it covers 12 London's boroughs. The largest borough is Southwark with 20.15km^2, which takes 28% of the study area. Figure.08 compares' areas in km^2 of each borough in the study area.

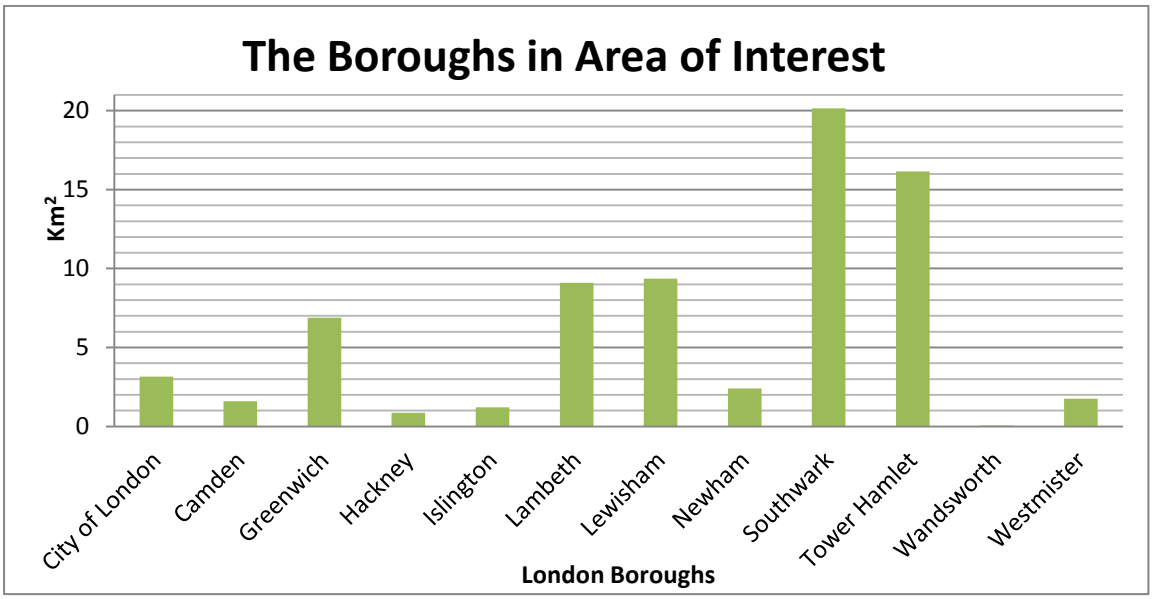


Figure.08

Population

In the study area lives 592,571 people, which is 8% of the London's population. Southwark has the highest population in the study area with 201,315 people. Figure.09 is a thematic map that represents a number of populations living in the study area per local area. Table representation of the population living in the study area is available in appendix on the page 34, figure.A66.

Majority of the population in the study area are Christians 54% and majority of the ethnic group is white British 47%. Table representation of the ethnic group and religion are available in appendix on the pages 29 and 30, figure.A60 and figure.A61.

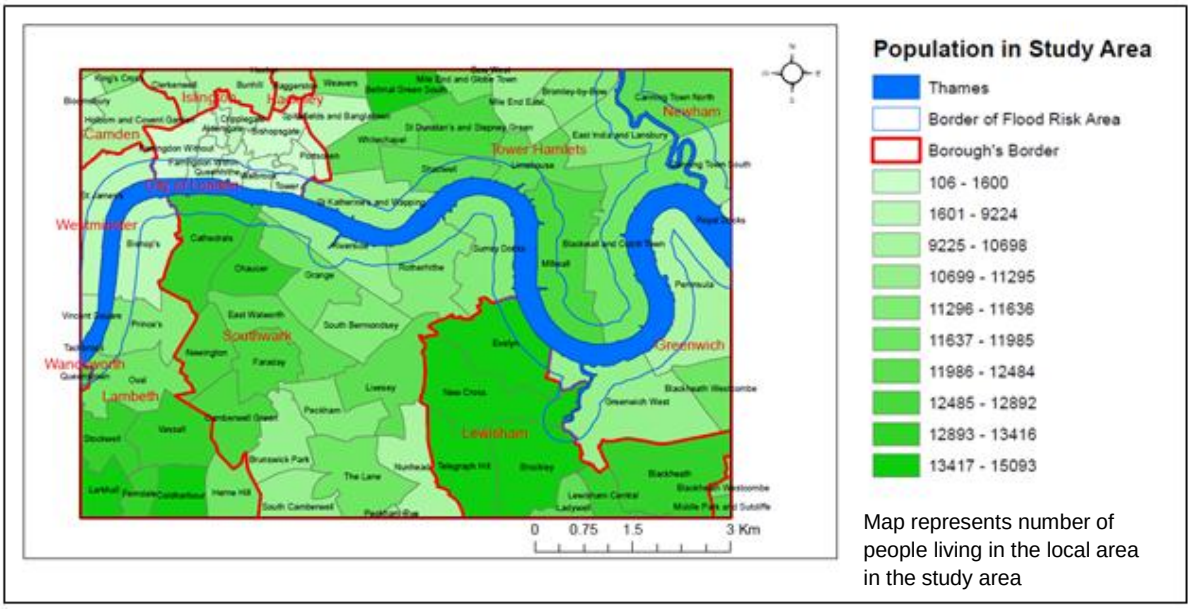


Figure.09

Property and Cars or Vans

The study area has 528,914 properties, which is 9% of the all London's properties. There are 256,618 residential houses, which is 49% of the whole properties in the study area and it is 8.51% of all residential houses in London. Table representation of the properties for the study area is available in appendix, page 31, figure.A63. Thematic map figure.10 represents the numbers of the residential houses in the study area.

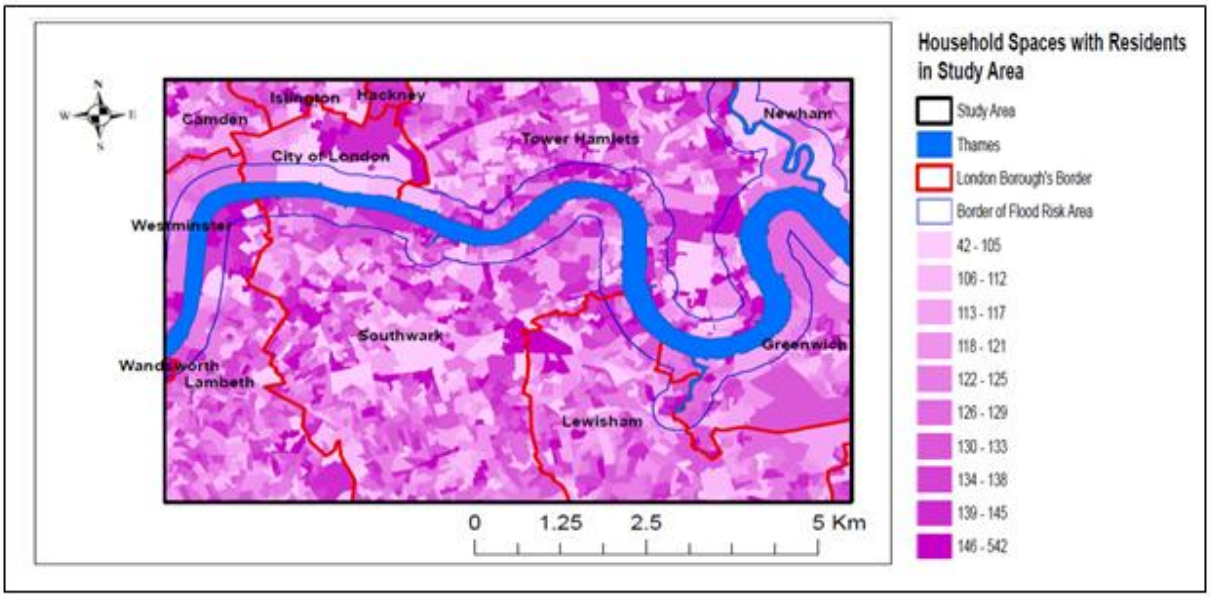


Figure.10

From 256,618 residential houses 55% do not have car or van and 37% have one car or van. In the study area is 137,445 cars or vans which is 5% of all cars and vans in London. Figure.11, on the following page represents residential houses and their percentage of holding cars or vans in study area. Table representation of the cars and vans is available in appendix on the page 33, Figure.A65.

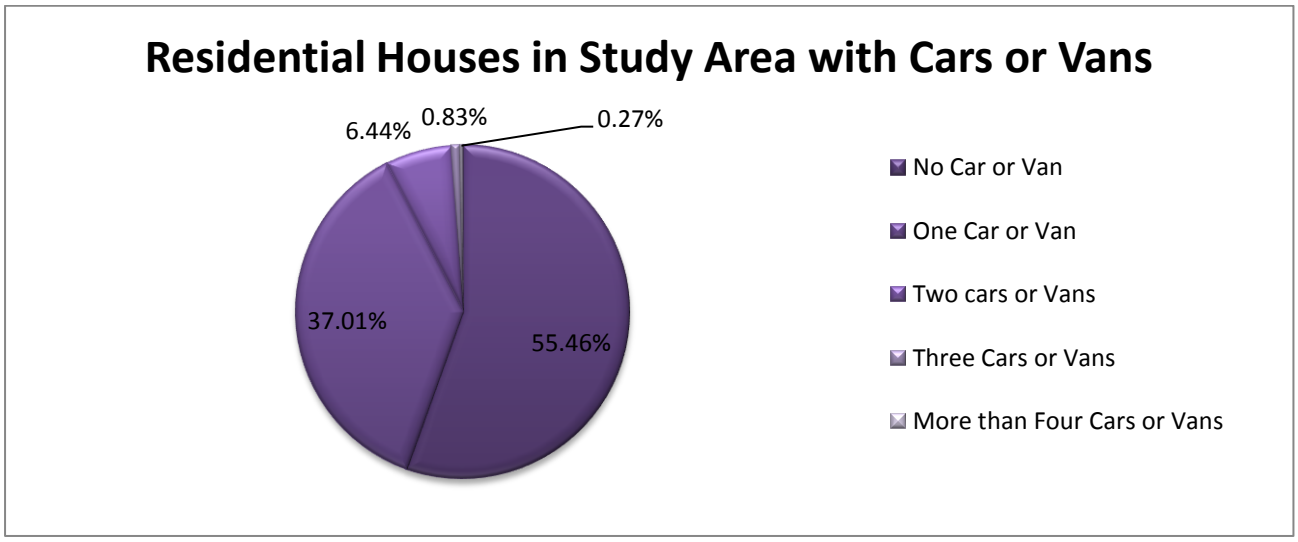

Residential Houses in Study Area with Cars or Vans
6.44%
0.83%
0.27%
37.01%
55.46%
No Car or Van
One Car or Van
Two cars or Vans
Three Cars or Vans
More than Four Cars or Vans

Figure.11

Analysis of the Flood Risk Area

The flood risk area has 19.35km^2, it takes 27% of the study area or 1.21% of the London's area and it covers nine boroughs. The largest borough is Tower Hamlet with 6.28km^2 and the smallest borough is Wandsworth with 0.05km^2.

Population

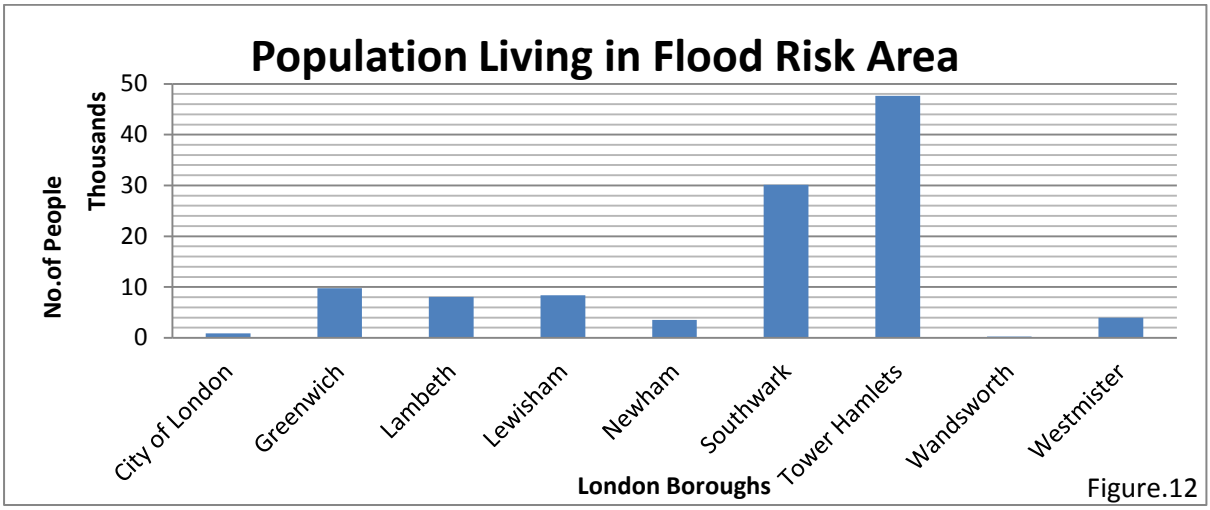


Figure.12

In the flood risk area lives 112,409 people, which is 1.6% of the London's population or it is 19% of the population in the study area. Figure.09 above represents the population in the flood risk area per each borough. Table representation of the population for the flood risk area is available in appendix on the page 35, figure.A67. Three maps below figure13, 14, and 15 represent density of the population in flood risk area.

Religion in the flood risk area is mostly Christianity with 55% and ethnic group is mostly white British with 54%. Table representation of the ethnic group and religion is available in appendix on the pages 29 and 30, figureA60 and figure.A61.

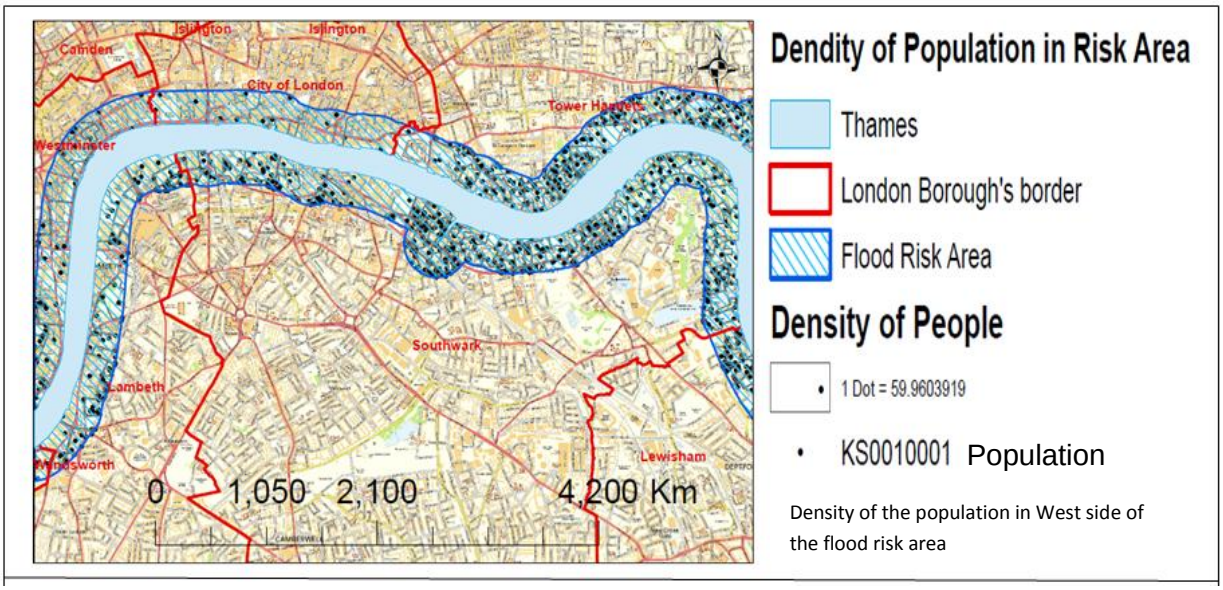
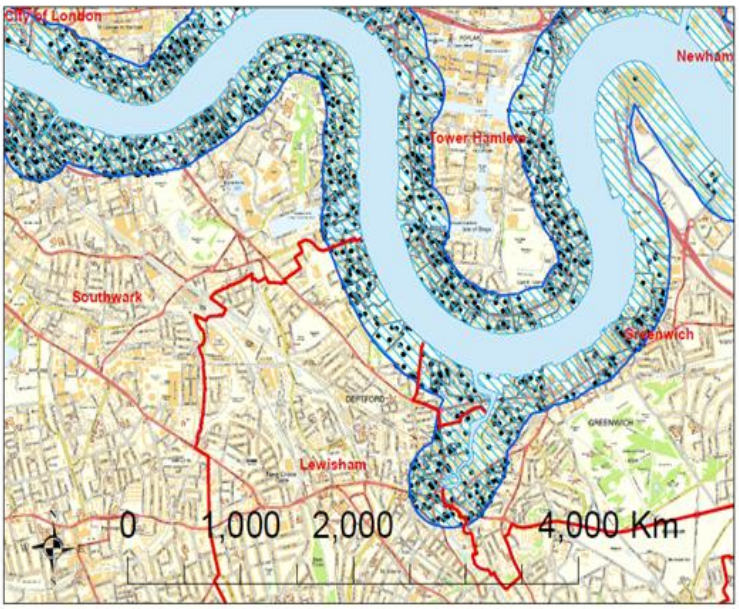


Figure.13



Dendity of Population in Risk Area

Thames

London Borough's border

Flood Risk Area

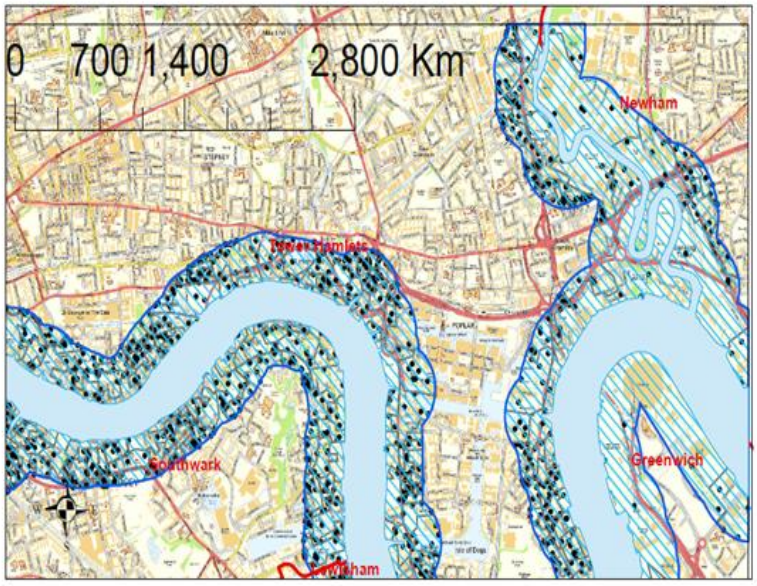
Density of People

1 Dot = 56.9623723

KS0010001 Population

Density of the population in South East side of the flood risk area

Figure.14



Dendity of Population in Risk Area

Thames

London Borough's border

Flood Risk Area

Density of People

1 Dot = 54.1142537

KS0010001 Population

Density of the population in North East side of the flood risk area

Figure.15

Properties and Cars or Vans

The flood risk area has 109,375 properties, which is 1.76% of all London's properties or 20.68% of the all properties in the study area. Table representation of the properties for the flood risk area is available in appendix on the page 32, figure.A64. From 109,375 properties 48% are residential houses 52,022. Figure.16 on the following page represents density map of the residential houses in the flood risk area.

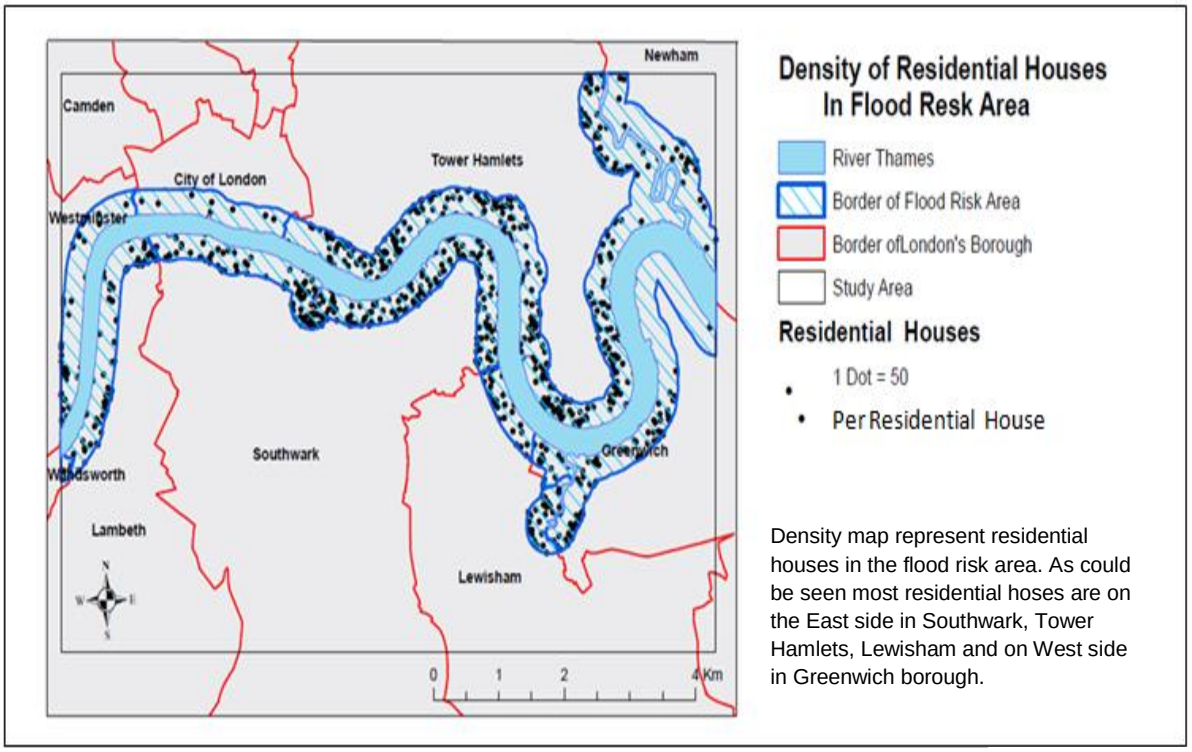


Figure.16

From 52,022 residential houses 50% do not have car or van and 41%have one car or van. There are 31,181 cars or vans in the flood risk area, which is 1% of all cars and vans in London or 23% of all cars and vans in the study area. Figure.17 below represents density map of the cars and vans in the flood risk area.

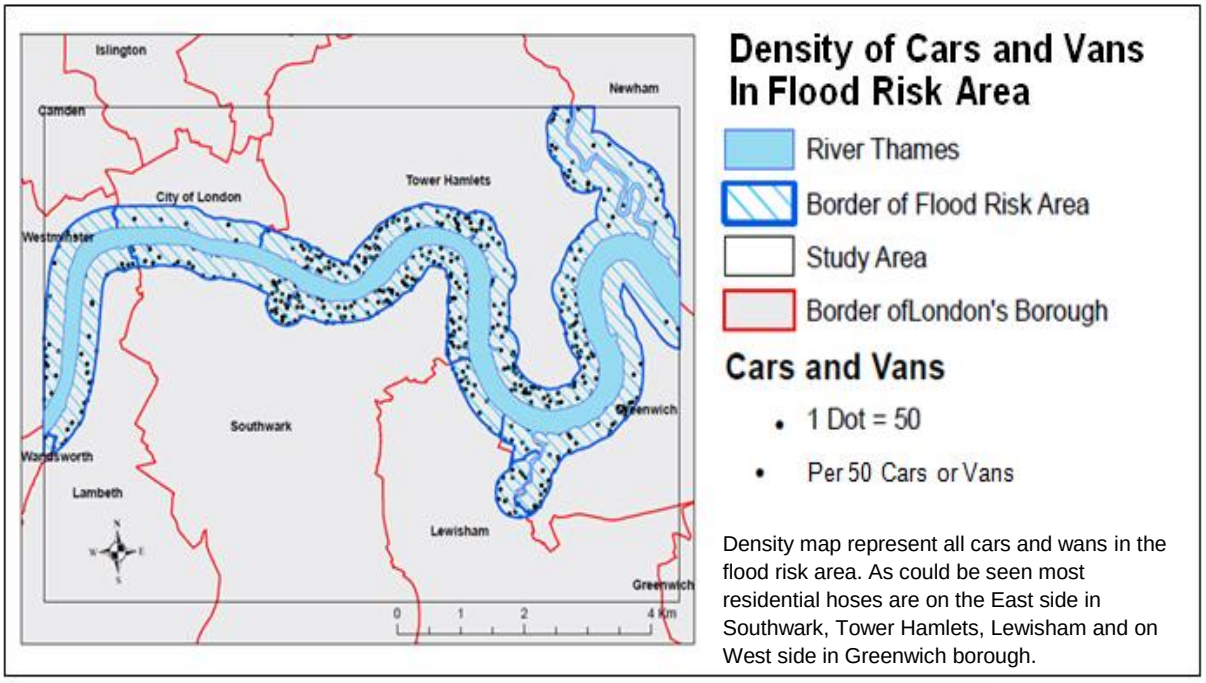
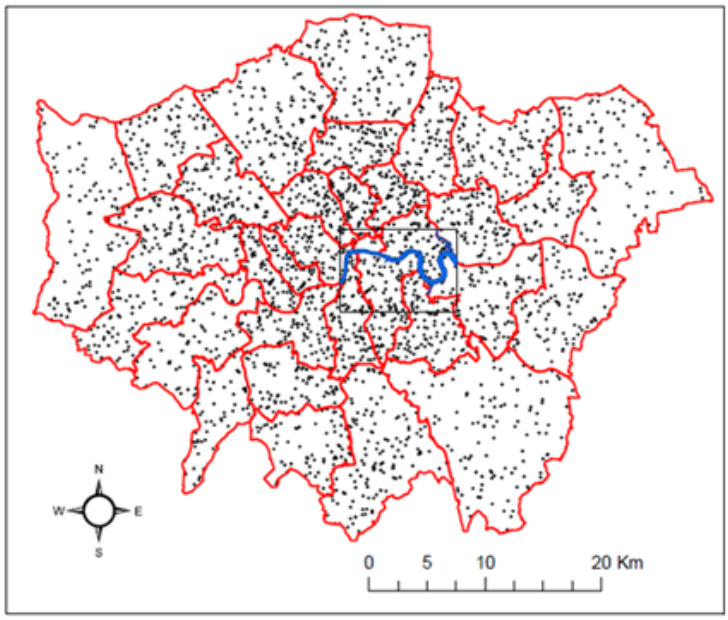


Figure.17

Additional Maps



Population Density in London

River Thames

Study Area

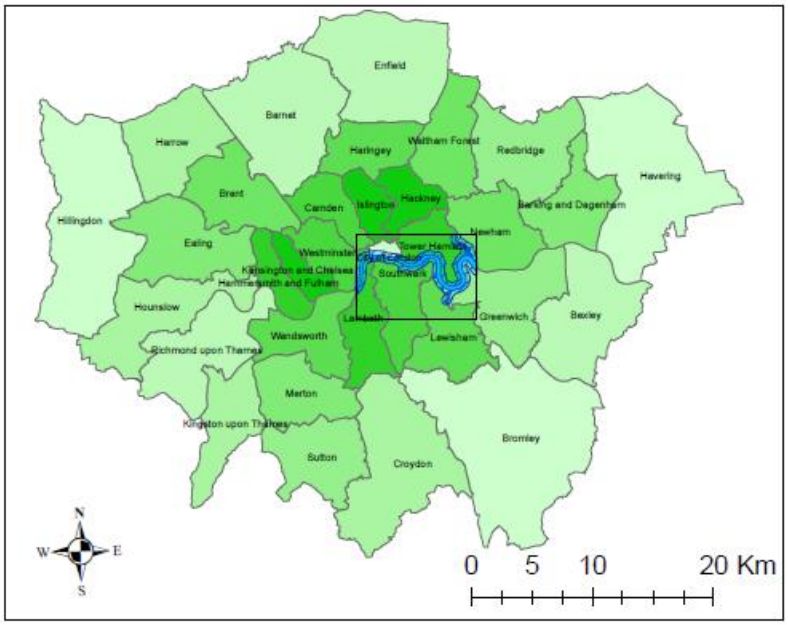
Boundary of London's Boroughs

1 Dot = 2,500

Population

The map represents density of the population in London. As could be seen on the map the highest density of the population is outside of the border of the study area on South and West side.

Figure.18



Dencity of the Population in London's boroughs

River Thames

Flood Risk Area

Study Area

Dencity of Population

Population /Area per km2

1959 - 2280

2281 - 3627

3628 - 4098

4099 - 4256

4257 - 5420

5421 - 6306

6307 - 7393

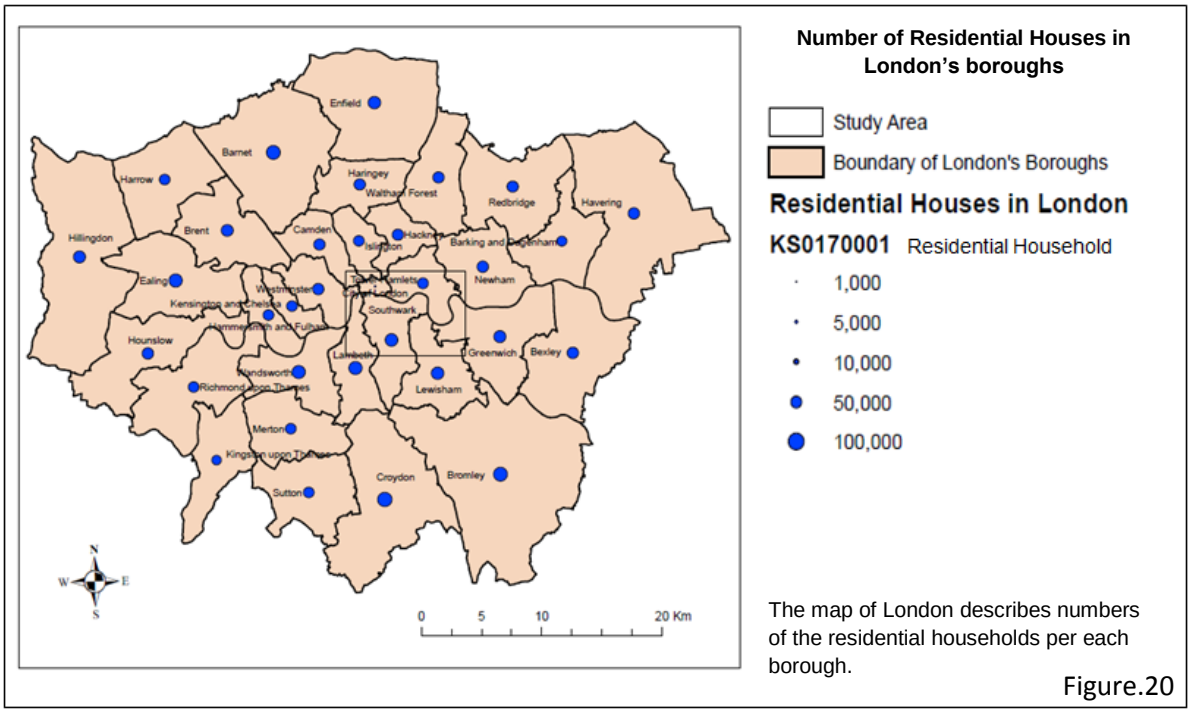
7394 - 9085

9086 - 9767

9768 - 12830

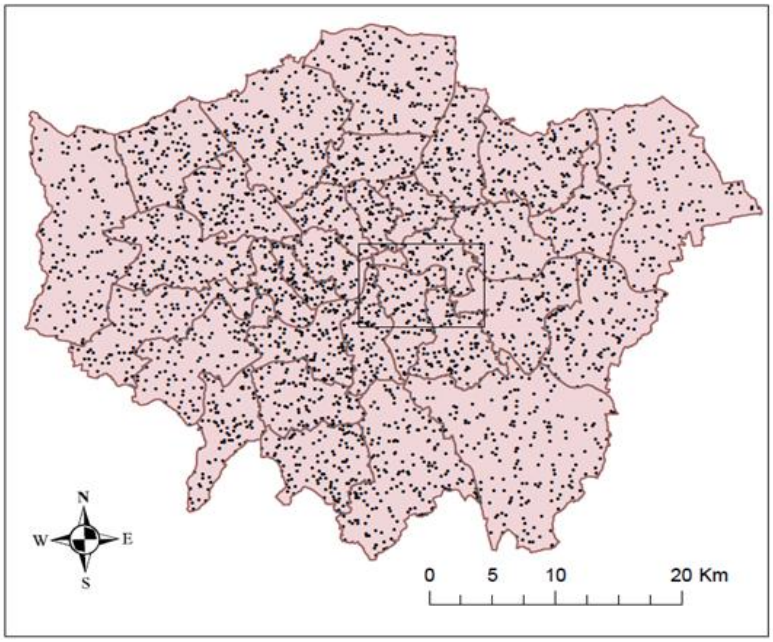
The map represents density of the population in London's borough. As could be seen the most populated boroughs are around the study area and City of London has the less populated.

Figure.19



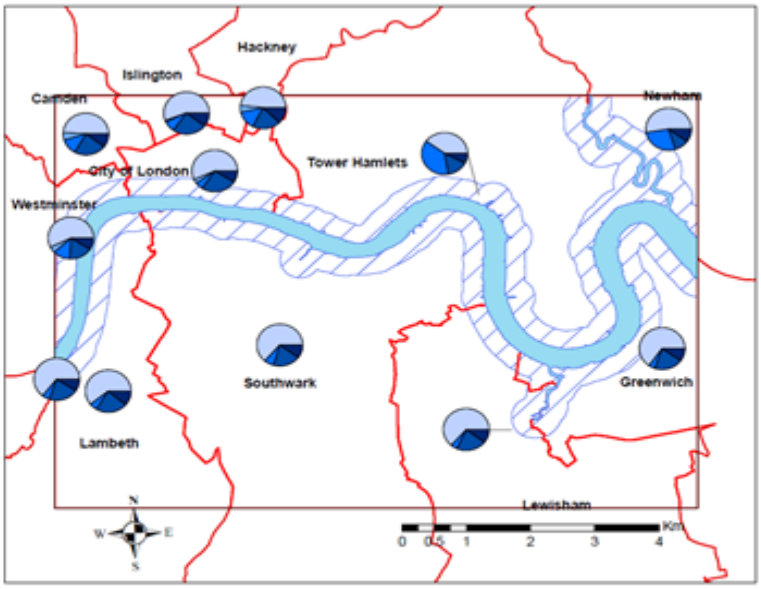
The map of London describes numbers of the residential households per each borough.

Figure.20



The map represents density of the all cars and vans in London

Figure.21



Religion Group In Study Area

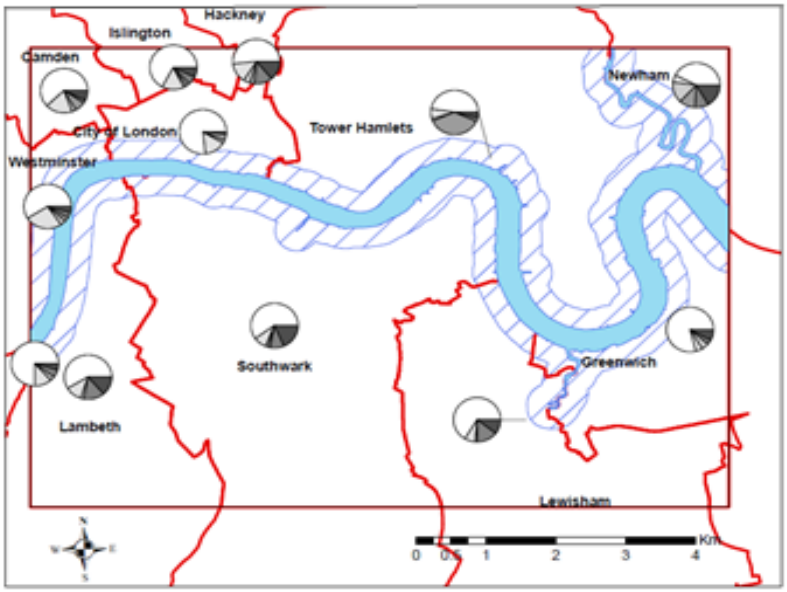
- River Thames
- Flood Risk Area
- Study Area
- London's Borough Borders

Religion Group

- Christian
- Jewish
- Muslim
- No Religion
- Religion not stated

The map represent religion group in the London's boroughs inside the study area. Each pie chart takes a proportion of the 3 main religion plus atheist and religion with not stated in the London's boroughs. (The pie chart represent whole borough, which include areas of the borough that are outside of the study area.)

Figure.22



Ethinc Group in Study Area

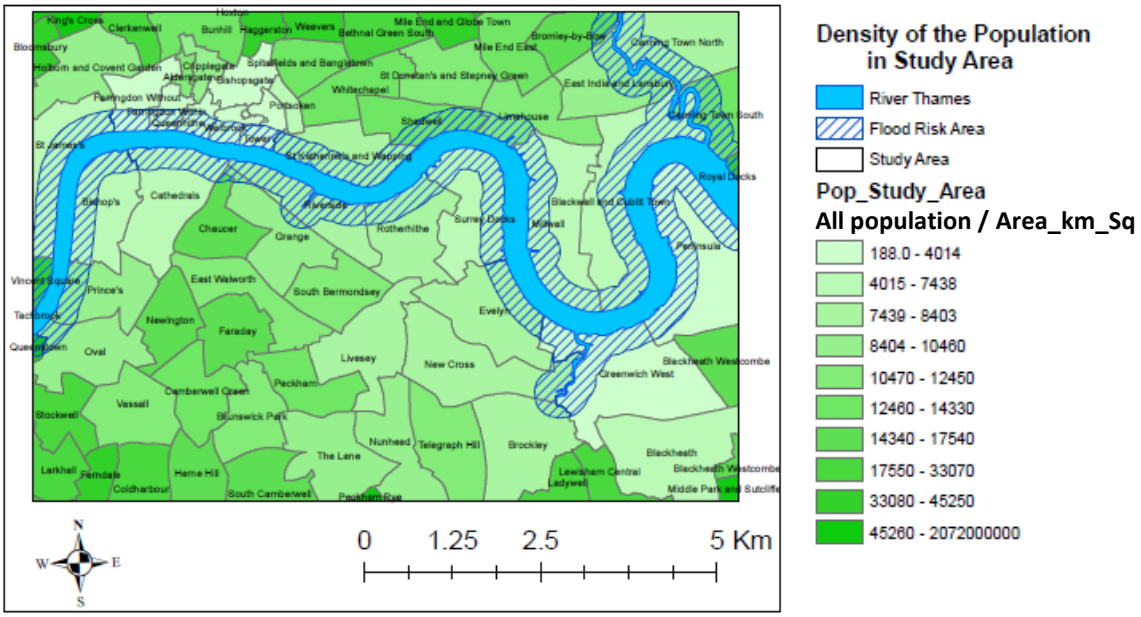
- River Thames
- Flood Risk Area
- Study Area
- London's Borough Borders

Ethnic Group

- White British
- Other White
- Indian
- Bangladesh
- Caribbean Black British
- African Black British

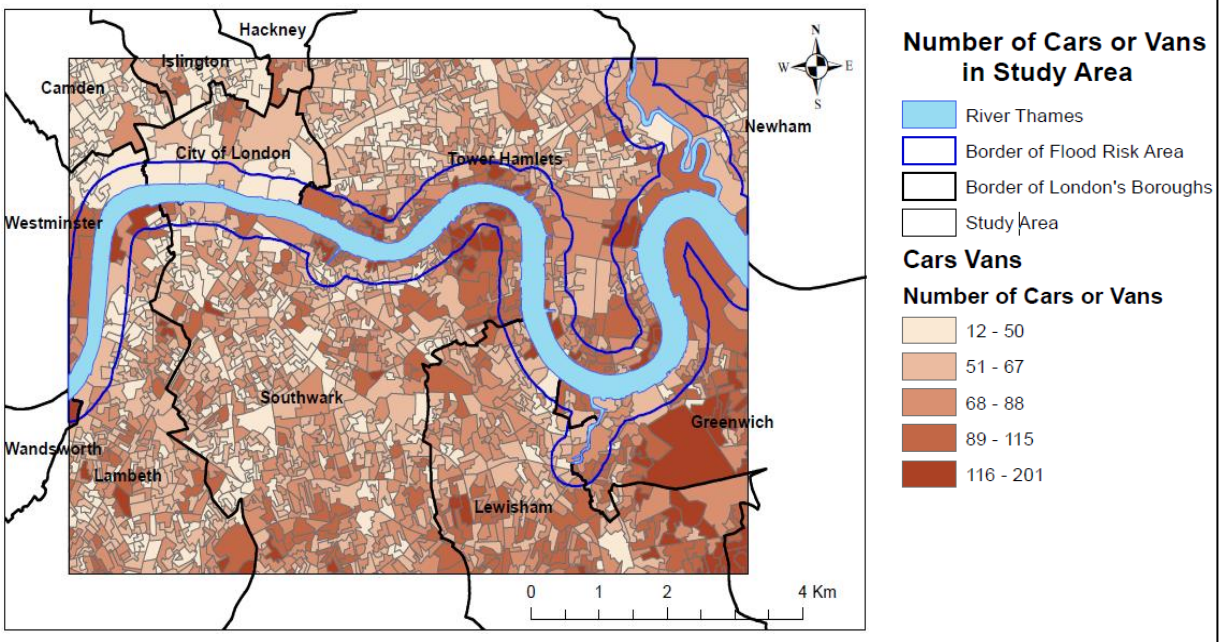
The map represent ethnic group living in the London's boroughs, inside the study area. Each pie chart takes a proportion of the 6 highest ethnic groups in London. (The pie chart represent whole borough, which include areas of the borough that are outside of the study area.)

Figure.23



Thematic map represent density population in the study area. On the map could be seen that Canning Town South, Shadwell, Limehouse and Vincent Square are locals' area that are in the flood risk area with the highest density of the population.

Figure.24



Thematic map shows numbers of all cars and vans in the study area. As could be seen most of the cars or vans are in the Southeast side in Greenwich borough and around the Thames River in Tower Hamlet, Southwark and Westminster boroughs.

Figure.25

Discussion

Data

Completeness of data is made by the Casweb who provide census of the London's population. Precision of the data that analyse the report is from the year 2001 therefore most on the information are not accurate to the current date. Additionally the data may not be entirely accurate as some of the people are not willing to input their data correctly or some of the people may not complete the census form at all.

Thematic Maps

A problem might occur with a thematic map if one local area is greater than other area. The greatest areas usually have the highest population than the smallest areas. Therefore some of the smallest area may be more populated per meter square then the largest areas. The thematic maps such as on the page 9, figure.09 represents number of people living in the local areas. On the other hand, the thematic map on the page 17 figure.24 represents density of the population living in the local areas.

The Flood Risk Area

The flood risk area that is presented in this report might misleading GIS analysis as it is calculated within 300m from the river bank. Accordingly all data providing for the flood risk area is accurate to this measurement. Nevertheless the evaluation was not included in the GIS data analyses, therefore some of the information may not be precisely truthful as the flooding may go further than 300m in one location and in other location might not even reach 200m from the river bank.

Conclusion

If the water will overflow 300m from the river bank in the study area would be affected 9 London's boroughs and it would cover area on 19.35km^2. In 2001 in the flood risk area lived 112,663 people and had 52,022 residential houses and had 31,181 cars and vans.

The area that the insurance company is interested takes 12 London's boroughs and it has 72.72km^2. In 2001 in the study area lived 592,525 people, had 256,649 residential houses and had 137,445 cars or vans.

In 2001 were registered in London 7,172,091 million peoples, had 3,015,997milion residential houses and had 2,616,328 million cars or cans. Additionally, from 7.2million of the population 8.3% lived in the study area and 1.2% lived in the flood risk area. From 3milion of the residential houses 8.51% is in the study area and 1.72% is in the flood risk area and from 2.6million cars or vans 5.25% is in study area and 1.19% is in the flood risk area.

Bibliography

OS Ordnance Survey (2014) OS OpenData Supply – Download or order Ordnance Survey OpenData Available from < https://www.ordnancesurvey.co.uk/opendatadownload/products.html > [Accessed on 29th of March 2014]

OS Ordnance Survey (2014) Great Britain's national mapping authority |Ordnance Survey Available from < http://www.ordnancesurvey.co.uk/ > [Accessed on 29th March 2014]

UK Data Service Census Support (2014) cs1 – Casweb | UK Data Service Census Support Available from < http://casweb.mimas.ac.uk/ > [Accessed on 29th of March 2014]

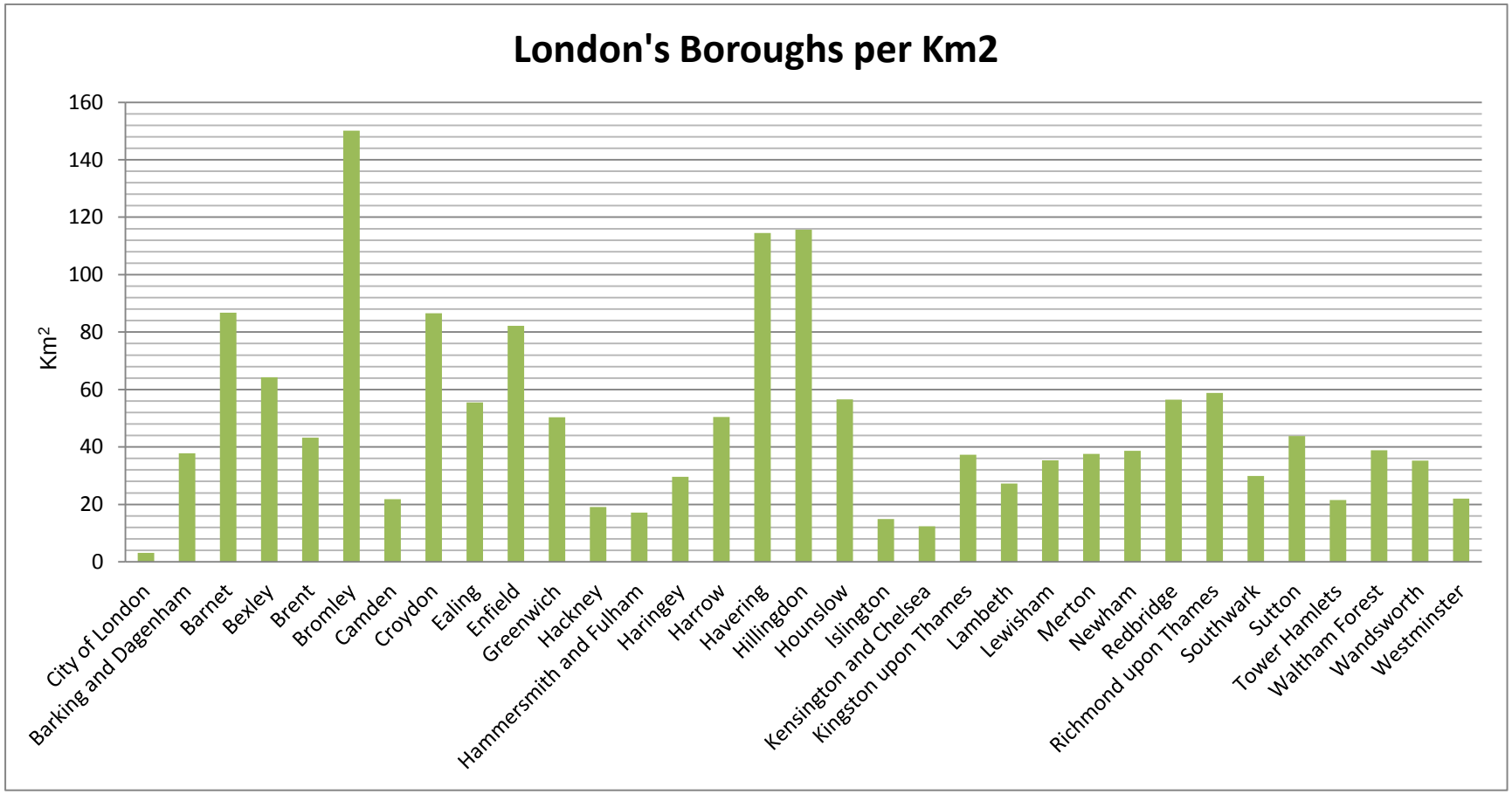
Appendix

Data Support

Borough	All Population	Male	Female	Live in Household	Live Communal	Students	Area km^2
City of London	7185	3832	3353	6861	324	67	3.1515
Barking and Dagenham	163944	78068	85876	162717	1227	528	37.779
Barnet	314564	149781	164783	310255	4309	4844	86.736
Bexley	218307	105148	113159	217262	1045	1505	64.264
Brent	263464	127806	135658	261232	2232	2640	43.235
Bromley	295532	141785	153747	292729	2803	3314	150.15
Camden	198020	95398	102622	188724	9296	1654	21.796
Croydon	330587	159111	171476	327472	3115	3384	86.519
Ealing	300948	147563	153385	298269	2679	2951	55.528
Enfield	273559	130706	142853	270314	3245	2424	82.201
Greenwich	214403	102777	111626	211792	2611	1417	50.38
Hackney	202824	97003	105821	201215	1609	1366	19.064
Hammersmith and Fulham	165242	78993	86249	163184	2058	1558	17.161
Haringey	216507	103666	112841	214377	2130	1931	29.587
Harrow	206814	99953	106861	205099	1715	3183	50.469
Havering	224248	107957	116291	222568	1680	1480	114.47
Hillingdon	243006	117461	125545	238777	4229	2166	115.7
Hounslow	212341	104239	108102	210519	1822	2120	56.593
Islington	175797	84229	91568	172262	3535	1122	14.86
Kensington and Chelsea	158919	75959	82960	155435	3484	2237	12.39
Kingston upon Thames	147273	71987	75286	143969	3304	1857	37.247
Lambeth	266169	131152	135017	263098	3071	1828	27.253
Lewisham	248922	119979	128943	246555	2367	1463	35.323
Merton	187908	91514	96394	186860	1048	1927	37.609
Newham	243891	119872	124019	242196	1695	1336	38.676
Redbridge	238635	115849	122786	236171	2464	2443	56.436
Richmond upon Thames	172335	83338	88997	169642	2693	2832	58.768
Southwark	244866	119817	125049	239512	5354	1465	29.897
Sutton	179768	86878	92890	178004	1764	1863	43.851
Tower Hamlets	196106	98178	97928	193987	2119	755	21.567
Waltham Forest	218341	106245	112096	216589	1752	1217	38.815
Wandsworth	260380	123742	136638	255973	4407	2707	35.22
Westminster	181286	88807	92479	175013	6273	1893	22.03

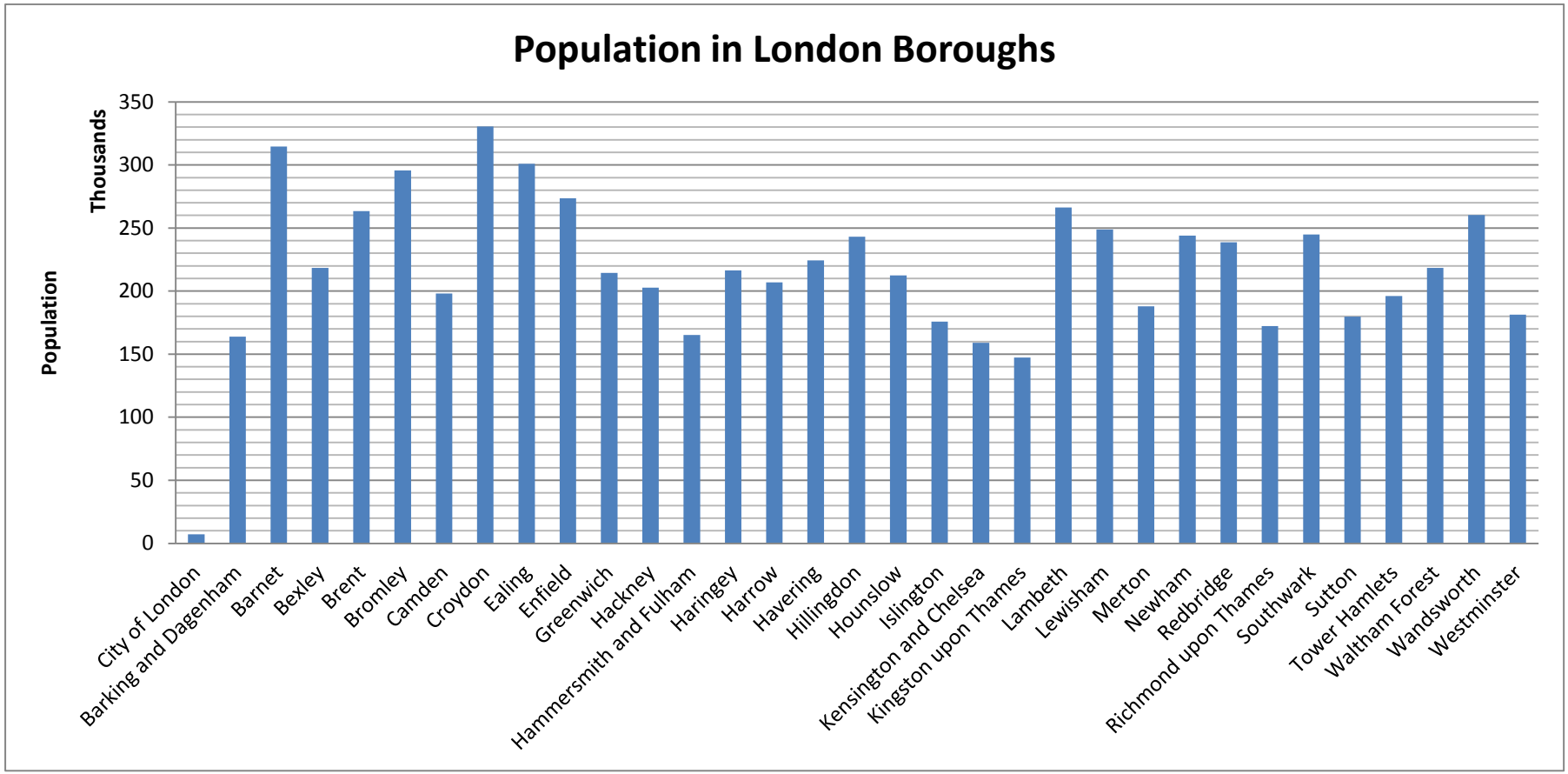
Table represents population and their living situation in each borough in London. Table also represents area of the km^2 of each borough in London.

Figure.A50



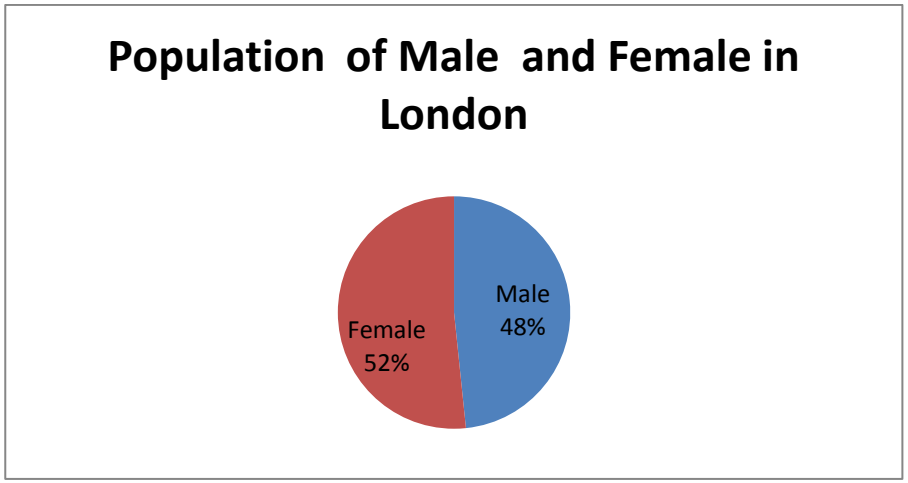
The column chart represents London's boroughs and their area per kilometre square.

Figure.A51



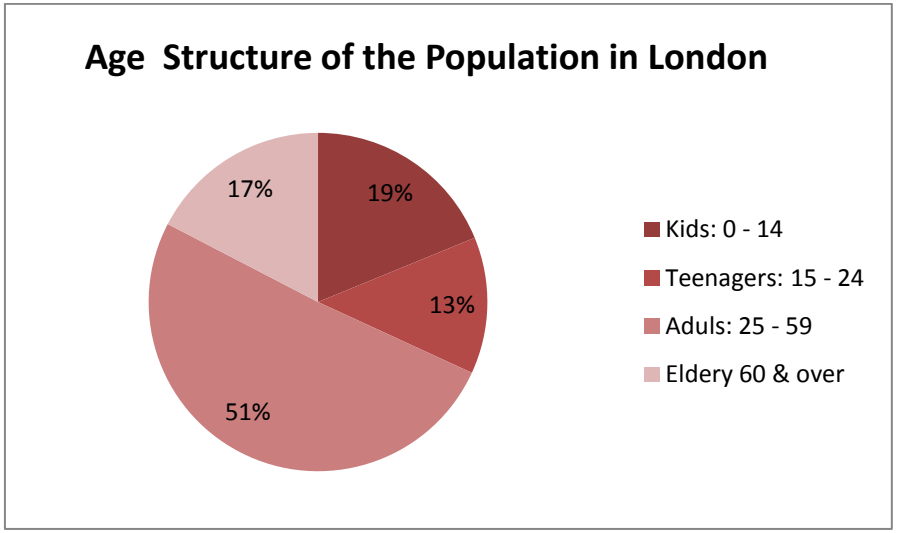
The column chart represents a population in London's boroughs.

Figure.A52



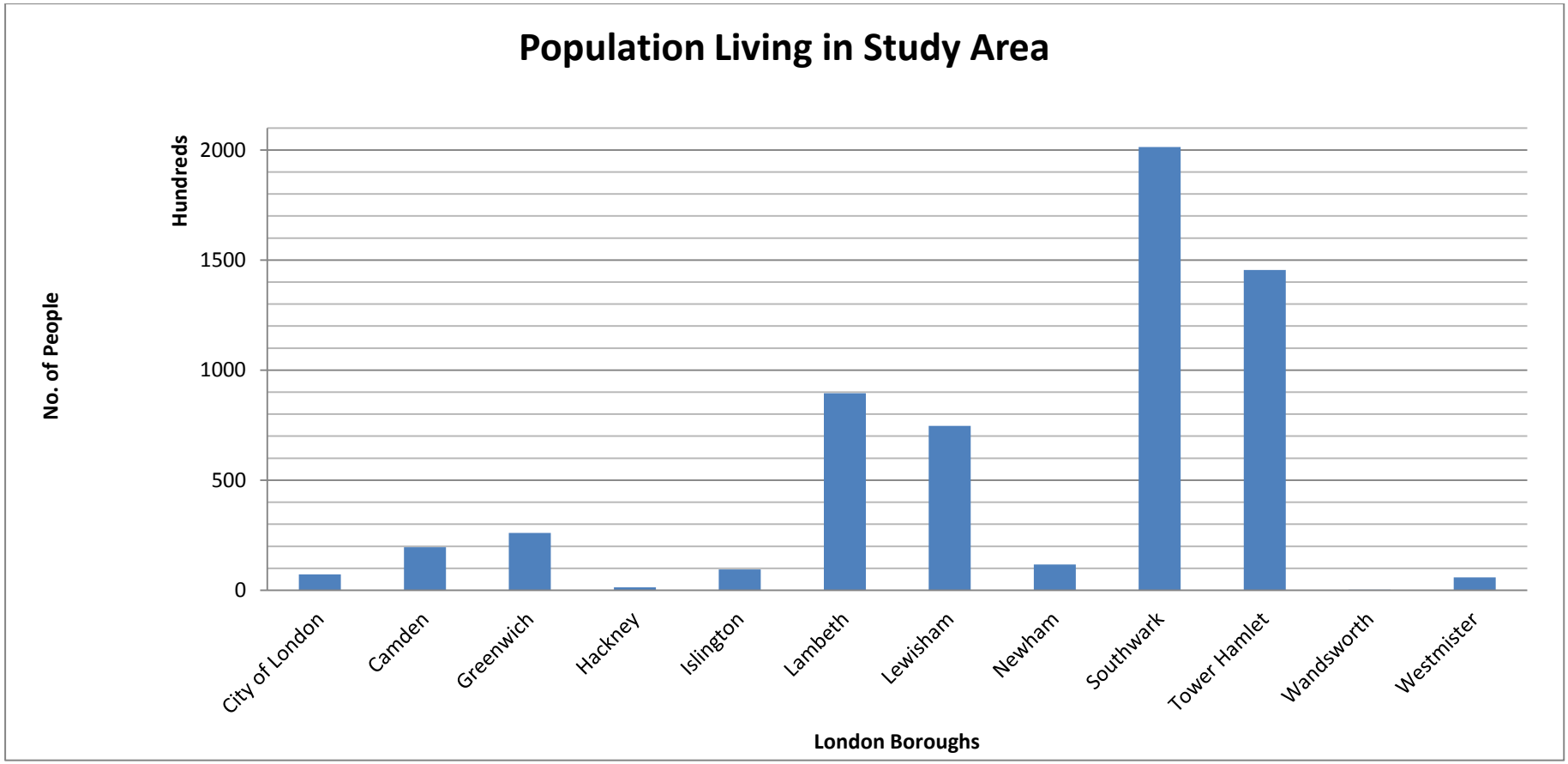
The pie chart represents percentage of male and female living in London.

Figure.A53



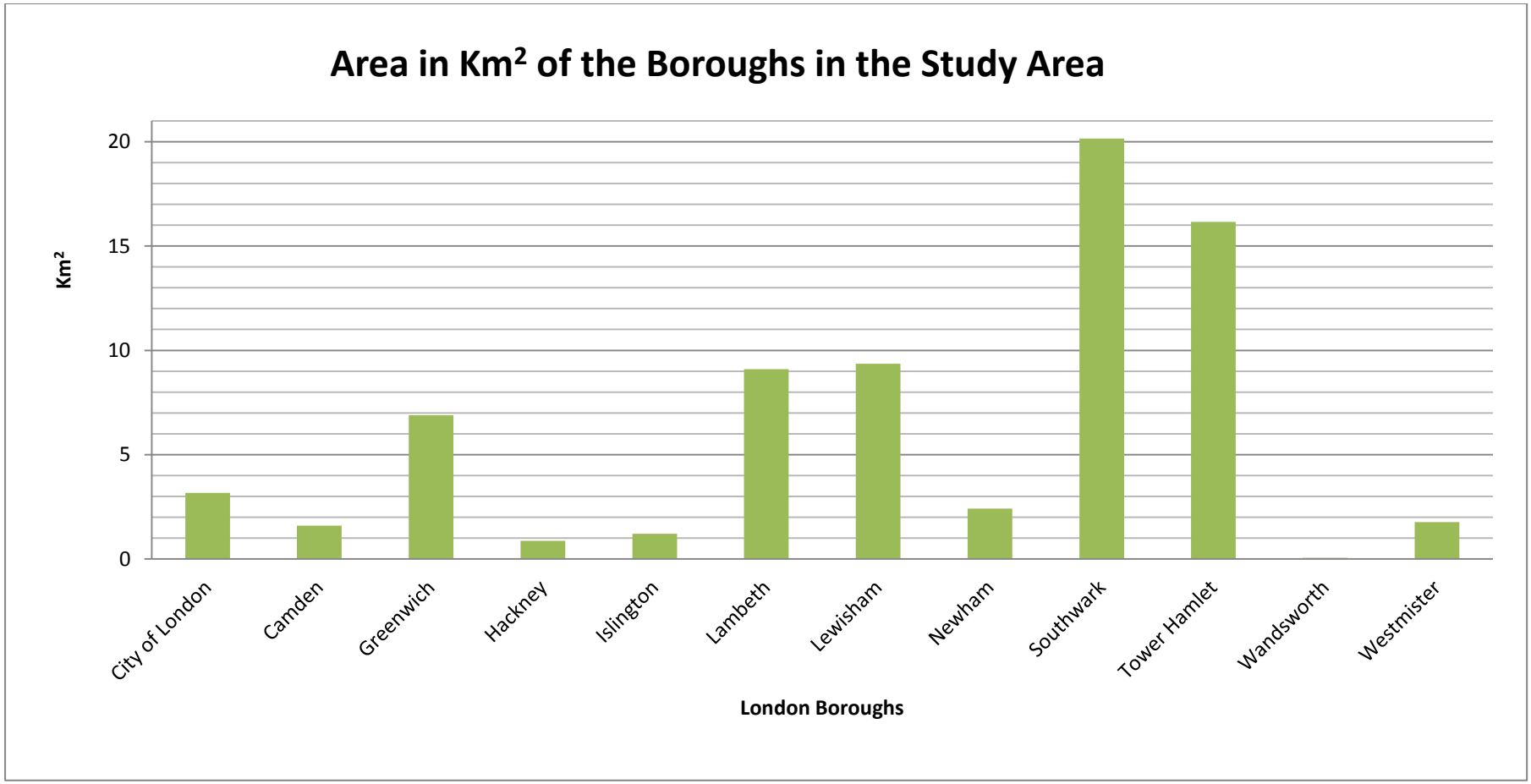
The pie chart represents London population age that is divided into 4 age groups;
kids (0-14 years), teenagers (15 - 24), adults (25 - 59) and elderly (60 and over). The highest percentage takes adults with 51% with 3,664,458 people.

Figure.A54



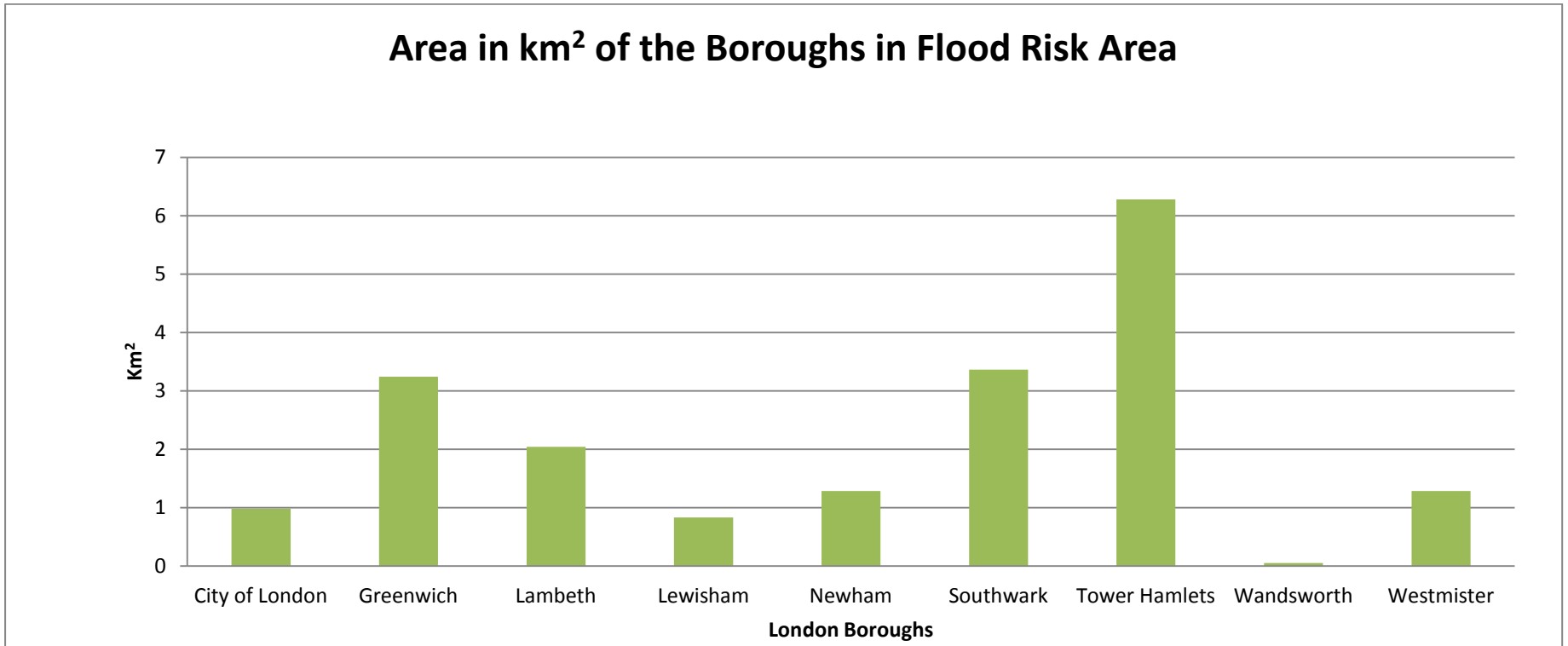
The column chart represents the population in the study area per each London's borough.

Figure.A55



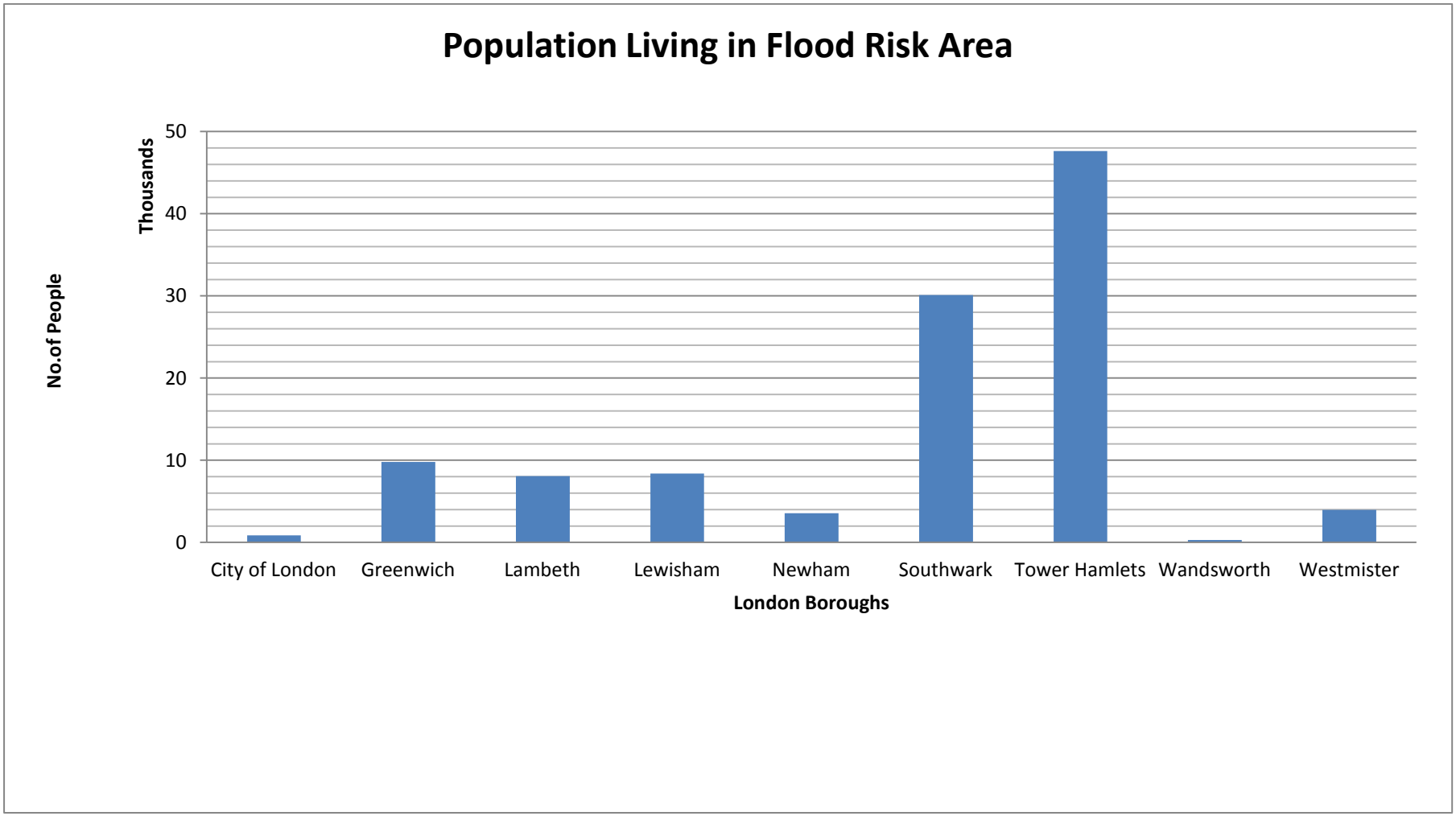
The column charts represents area per km^2 for each London's borough in the study area.

Figure.A56



The column chart represents area in km^2 per each London's borough in the flood risk area.

Figure.A57



The column chart represents population in the flood risk area per each London's borough.

Figure.A58

Age Structure Living in London, Study Area and Flood risk Area

	All Population	0 - 4	5 - 7	8 - 9	10 - 14	15	16 - 17	18 - 19	20 - 24	25 - 29
All London	7172091	478187	270885	180903	435402	82859	170346	163601	531004	692153
Study Area	592571	42095	22875	14985	35462	6651	13642	15355	58317	71612
Flood Risk Area	112409	6907	3660	2406	5840	1139	2324	2691	11845	17052
Percentage of Study Area	8.3%	8.8%	8.4%	8.3%	8.1%	8.0%	8.0%	9.4%	11.0%	10.3%
Percentage of Flood Risk Area	1.6%	1.4%	1.4%	1.3%	1.3%	1.4%	1.4%	1.6%	2.2%	2.5%

	30 - 44	45 - 59	60 - 64	65 - 74	75 - 84	85 - 89	90 & over
All London	1840936	1151369	282856	468067	310553	75703	124596
Study Area	160637	75061	19627	31114	19356	4010	1772
Flood Risk Area	31894	14274	3329	5104	3131	547	266
Percentage of Study Area	8.7%	6.5%	6.9%	6.6%	6.2%	5.3%	1.4%
Percentage of Flood Risk Area	1.7%	1.2%	1.2%	1.1%	1.0%	0.7%	0.2%

The table represents the age population living in London, in the study area and in the flood risk area. The table also represents the percentage of the age population living in the study area to whole London and living in the flood risk area to the study area and to London.

Figure.A59

Ethnic Group living in London, Study Area and Flood Risk Area

Ethnic Group	All people	White British	White Irish	Other White	White & Black Caribbean	White & Black African	White & Asian	Other Mixed	Indian	Pakistani	Bangladeshi
London	7172091	4287861	220488	594854	70928	34182	59944	61057	436993	142749	153893
Study Area	592462	280211	16249	50008	7632	4131	3620	5722	8987	3402	61238
Flood Risk Area	112620	60833	2978	11667	1028	598	805	924	2147	690	10992
Percentage of Study Area to London	8%	7%	7%	8%	11%	12%	6%	9%	2%	2%	40%
Percentage of Risk Area to London	1.6%	1.4%	1.4%	2.0%	1.4%	1.7%	1.3%	1.5%	0.5%	0.5%	7.1%
Percentage of Risk Area to Study Area	19%	22%	18%	23%	13%	14%	22%	16%	24%	20%	18%

Ethnic Group	Bangladeshi	Other Asian	Caribbean Black British	African Black British	Other Black British	Chinese	Other Ethic Group
London	153893	133058	343567	378933	60349	80201	113034
Study Area	61238	4666	42641	72710	9152	12249	9844
Flood Risk Area	10992	967	4196	8878	878	3131	1908
Percentage of Study Area to London	40%	4%	12%	19%	15%	15%	9%
Percentage of Risk Area to London	7.1%	0.7%	1.2%	2.3%	1.5%	3.9%	1.7%
Percentage of Risk Area to Study Area	18%	21%	10%	12%	10%	26%	19%

The table represents ethnic group of the population living in London, in the study area and in the flood risk area. The table also represents the percentage of the ethnic group living in the study area and in the flood risk area.

Figure.A60

Religion in London, Study Area and Flood Risk Area

Religion	All People	Christian	Buddhist	Hindu	Jewish	Muslim	Sikh	Other religions	No religion	Religion not stated
London	7172091	4176175	54297	291977	149789	607083	104230	36558	1130616	621366
Study Area	592381	320463	7209	5909	3533	88116	1726	2187	107136	56102
Flood Risk Area	112267	61882	1426	1429	662	15045	461	333	21944	9085
Percentage of Study Area to London	8%	8%	13%	2%	2%	15%	2%	6%	9%	9%
Percentage of Risk Area to London	2%	1%	3%	0%	0%	2%	0%	1%	2%	1%
Percentage of Risk Area to Study Area	19%	19%	20%	24%	19%	17%	27%	15%	20%	16%

The table represents the religion in London, in the study area and in the flood risk area. The table also represents the percentage of the religion living in the study area and in the flood risk area.

Figure.A61

Household's spaces and accommodation type (Properties) in London

Whole London		
Type of Building		No. Building
All Household Spaces	with residents	3015997
	with no residents vacant	77845
	with no residents holiday accommodation	15815
House or Bungalow	whole hose or bungalow detached	187764
	whole hose or bungalow Simi-detached	594849
	whole house or bungalow terraced (including end - terrace)	806309
Flat maisonette or apartment	purpose built block of flat or tenement	1027386
	part of a converted or share house	433361
	in a commercial building	56627
	Caravan or other mobile temporary structure	3363
Total of households spaces and accommodation type		6219316

The table describes households' spaces and accommodation type in London

Figure.A62

Household's spaces and accommodation type (Properties) in Study Area

Study Area			
Type of Building		No. Building	Percentage to London
All Household Spaces	with residents	256618	8.51%
	with no residents vacant	5320	6.83%
	with no residents holiday accommodation	2476	15.66%
House or Bungalow	whole hose or bungalow detached	3783	2.01%
	whole hose or bungalow Simi-detached	9924	1.67%
	whole house or bungalow terraced (including end - terrace)	40516	5.02%
Flat maisonette or apartment	purpose built block of flat or tenement	171457	16.69%
	part of a converted or share house	33033	7.62%
	in a commercial building	5513	9.74%
	Caravan or other mobile temporary structure	274	8.15%
Total of households spaces and accommodation type		528914	8.50%

The table describes households' spaces and accommodation type in the study area and percentage of households in the study area to London

Figure.A63

Household's spaces and accommodation type (Properties) in Flood Risk

Floor Risk Area				
Type of Building		No. Building	Percentage to London	Percentage to Study Area
All Household Spaces	with residents	52025	1.72%	20.27%
	with no residents vacant	1480	1.90%	27.82%
	with no residents holiday accommodation	1161	7.34%	46.89%
House or Bungalow	whole hose or bungalow detached	539	0.29%	14.25%
	whole hose or bungalow Simi-detached	1809	0.30%	18.23%
	whole house or bungalow terraced (including end - terrace)	8018	0.99%	19.79%
Flat maisonette or apartment	purpose built block of flat or tenement	39738	3.87%	23.18%
	part of a converted or share house	3323	0.77%	10.06%
	in a commercial building	1230	2.17%	22.31%
	Caravan or other mobile temporary structure	52	1.55%	18.98%
Total of households spaces and accommodation type		109375	1.76%	20.68%

The table describes households' spaces and accommodation type in the flood risk area and percentage of households in the flood risk area to London and to the study area.

Figure.A64

Cars and Vans in London, Study Area and Flood Risk Area

	All Houses	Houses Without Cars or Vans	Houses with One Car or Van	Houses with Two Cars or Vans	Houses with Three Cars or Vans	Houses with More Than 4 Cars or Vans	All Cars or Vans
All London	3015997	1130649	1298481	476185	86470	24212	2616328
Study Area	256618	142338	94971	16526	2124	690	137445
Flood Risk Area	52022	26085	21511	3846	459	121	31181
Percentage of Study Area to London	8.51%	12.59%	7.31%	3.47%	2.46%	2.85%	5.25%
Percentage of Risk Area to London	1.72%	2.31%	1.66%	0.81%	0.53%	0.50%	1.19%
Percentage of Risk Area to Study Area	20.27%	18.33%	22.65%	23.27%	21.61%	17.54%	22.69%

The table describes total and percentage of the residential houses and cars or vans in London, in the study area and in the flood risk area.

Figure.A65

Population in Study Area

Brought	Zone Code	All Pop	Male	Female	Live Household	Live Communal	Student	Area_km^2
City of London	00AA	7185	3832	3353	6861	321	66	3.1606
Camden	00AG	19538	9654	9884	17074	2465	78	1.5908
Greenwich	00AL	26041	12533	13508	25782	259	248	6.8918
Hackney	00AM	1411	733	678	1227	184	6	0.8668
Islington	00AU	9444	4749	4695	8982	463	57	1.2088
Lambeth	00AY	89462	44497	44965	88140	1321	552	9.0923
Lewisham	00AZ	74682	36407	38275	73623	1059	473	9.3598
Newham	00BB	11755	5536	6219	11634	121	58	2.4159
Southwark	00BE	201315	99024	102291	196190	5124	955	20.1544
Tower Hamlet	00BG	145507	73535	71972	143794	1712	598	16.1562
Wandsworth	00BJ	280	146	134	280	0	4	0.0567
Westminster	00BK	5905	3227	2678	5532	371	61	1.7649
Total	12	592525	293873	298652	579119	13400	3156	72.719

Table represents population and their living situation per each London's borough in the study area. Table also represents area of the km^2 per London's borough in the study area.

Figure.A66

Boroughs and Population in the Flood Risk Area

BOROUGTH	ZONE CODE	All POP.	MALE	FEMALE	LIVE HOUSEHOLD	LIVE COMMUNNAL	STUDENTS	AREA_KM^2
City of London	00AA	871	521	350	803	67	14	0.9799
Greenwich	00AL	9798	4736	5062	9575	223	65	3.2426
Lambeth	00AY	8054	4063	3991	7602	452	27	2.0431
Lewisham	00AZ	8391	4056	4335	8340	51	46	0.8299
Newham	00BB	3564	1753	1811	3468	96	17	1.2825
Southwark	00BE	30096	15585	14511	28847	1249	104	3.362
Tower Hamlets	00BG	47628	24753	22875	47323	305	234	6.2795
Wandsworth	00BJ	280	146	134	280	0	4	0.0485
Westminster	00BK	3957	2177	1780	3634	322	40	1.2825
Total in Flood Risk Area	9	112639	57790	54849	109872	2765	551	19.3505

Table represents population and their living situation per each London's borough in the flood risk area. Table also represents area of the km^2 per each London's borough in the flood risk area.

Figure.A67

Methodology Support

Table

Population

FID	Shape	ZONE_CODE	ZONE_LABEL	KS0010001	KS0010002	KS0010003	KS0010004	KS0010005	KS0010006
0	Polygon	00AA	City of London	7185	3832	3353	6861	324	67
1	Polygon	00AB	Barking and Dagenham	163944	78068	85876	162717	1227	528

Figure.M100

When district - usual resident population file was uploaded into ArcMap, it was opened an attribute table. The attribute table contain information such as all population (KS001001),male population (KS0010002), female population (KS0010003), people living in household (KS0010004), people living in communal (KS0010005) and Students (KS0010006). However to represent thematic map that describe density of the population per km^2 it need to have a column area per km^2 and attribute table was without area per kilometre square figure.M100. Therefore in the attribute table via table option was selected add field. It opens the Add Field dialog box figure.M101 where the name was given Area_Km_Sq and type double. After pressing OK button a new column Area_Km_Sq was created in the attribute table figure.M102.

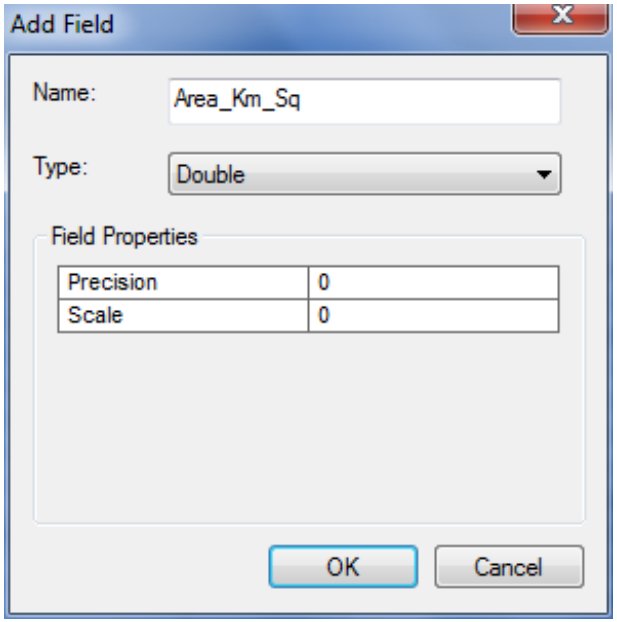


Figure.M101

KS0010006	Area_Km_Sq
1558	0
1931	0
3183	0
1480	0

Figure.M102

Then by the right click on the on the column Area_Km_Sq figure.M103 and selecting Calculate Geometry, it appears a dialog box Calculate Geometry figure.M104 where units was set to Square Kilometres. After pressing ok bottom, area per km^2 for each borough was calculated such as City of London 3.1515 figure.M105.

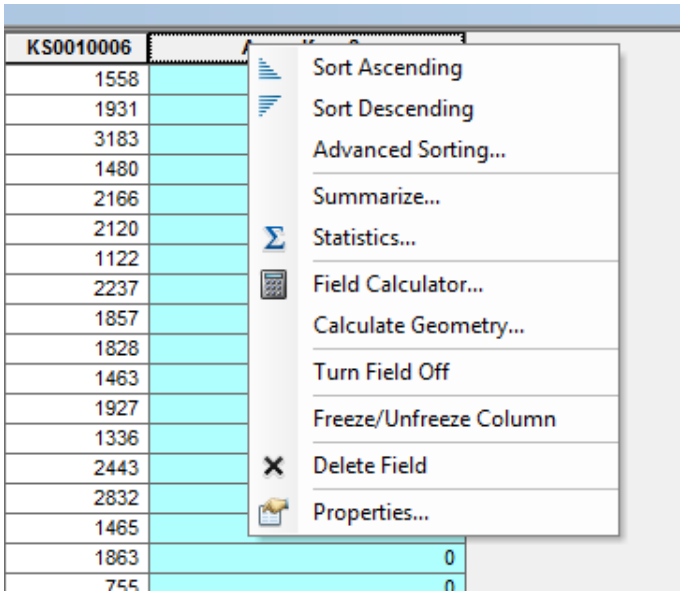


Figure.M103

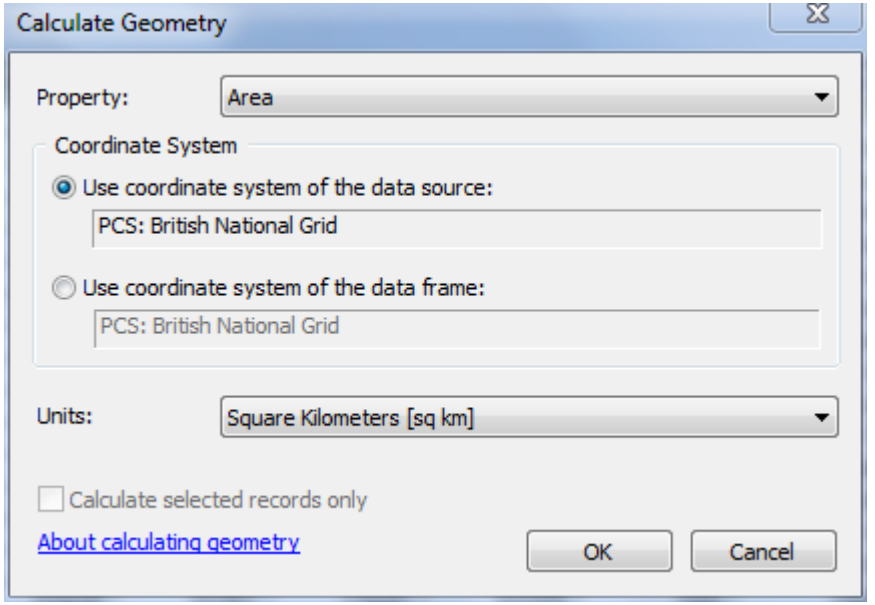
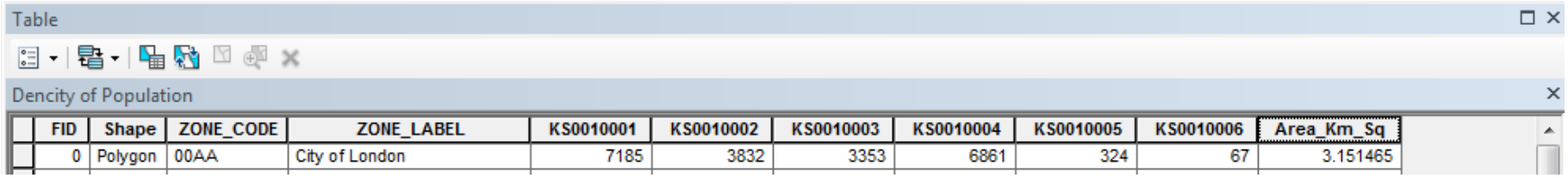


Figure.M104



FID	Shape	ZONE_CODE	ZONE_LABEL	KS0010001	KS0010002	KS0010003	KS0010004	KS0010005	KS0010006	Area_Km_Sq
0	Polygon	00AA	City of London	7185	3832	3353	6861	324	67	3.151465

Figure.M105

To find out a total of the London area it was done by the right click on the Area_Km_Sq column and selecting Statistic. It appears a dialog box Statistic of Population figure.M106 where is the statistic calculation such as sum, mean, etc. With a similar way was find out other calculation such as a total of population living in London.

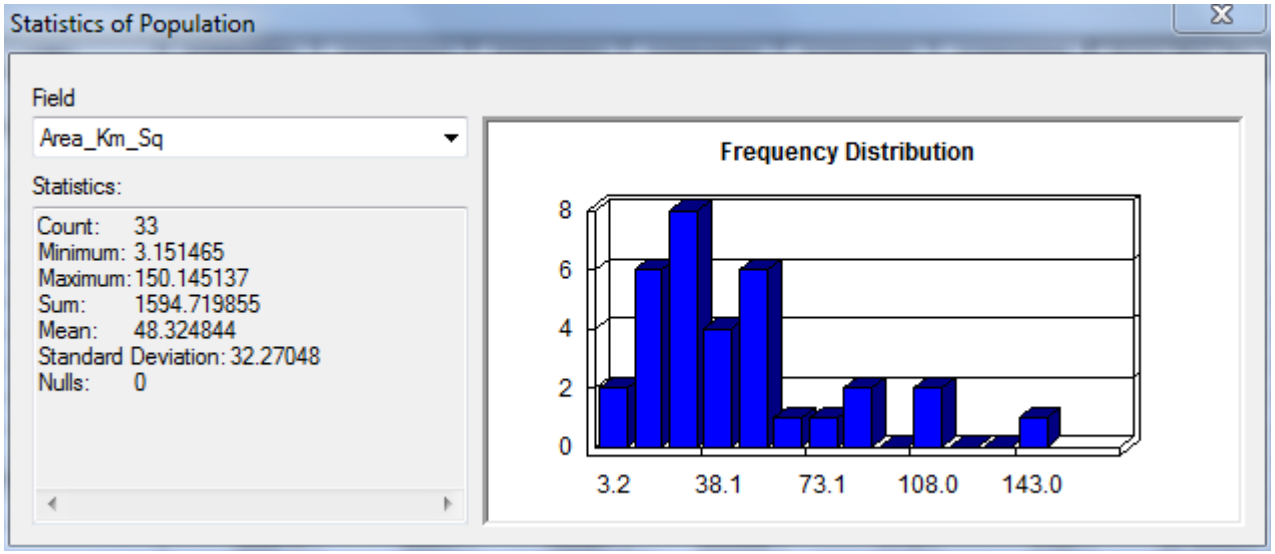


Figure.M106

When the attribute table contain area per km^2, the maps could be created such as thematic map on the page 14 figure.19. Firstly it was opened layer properties. On the top menu bar was selected symbology and then quantities – graduate colour. In the field; value was selected all population (KS0010001) and normalization was selected Area_Km_Sq. The reason why normalization was selected is because a thematic map needs to represent density of the population per km^2 and it needs a proportion of population to area (population divided by the area). Next in classification; class was selected to 10 and method to quantile. Afterward a colour ramp was selected to green bright as it shows on figure.M107 on the following page. Finally a data view was switched into a layout view and it was inserted legend, north arrow and scale bar via Insert menu as it shows on figure.M108 and then exporting the map.

With a similar way was creating other maps, such as the density map on page 14 figure.18, but instead of quantities – graduated colour was selected dot density or the thematic map with the highest to smaller number of population living London's borough on the page 4 figure.05, where normalization was not selected.

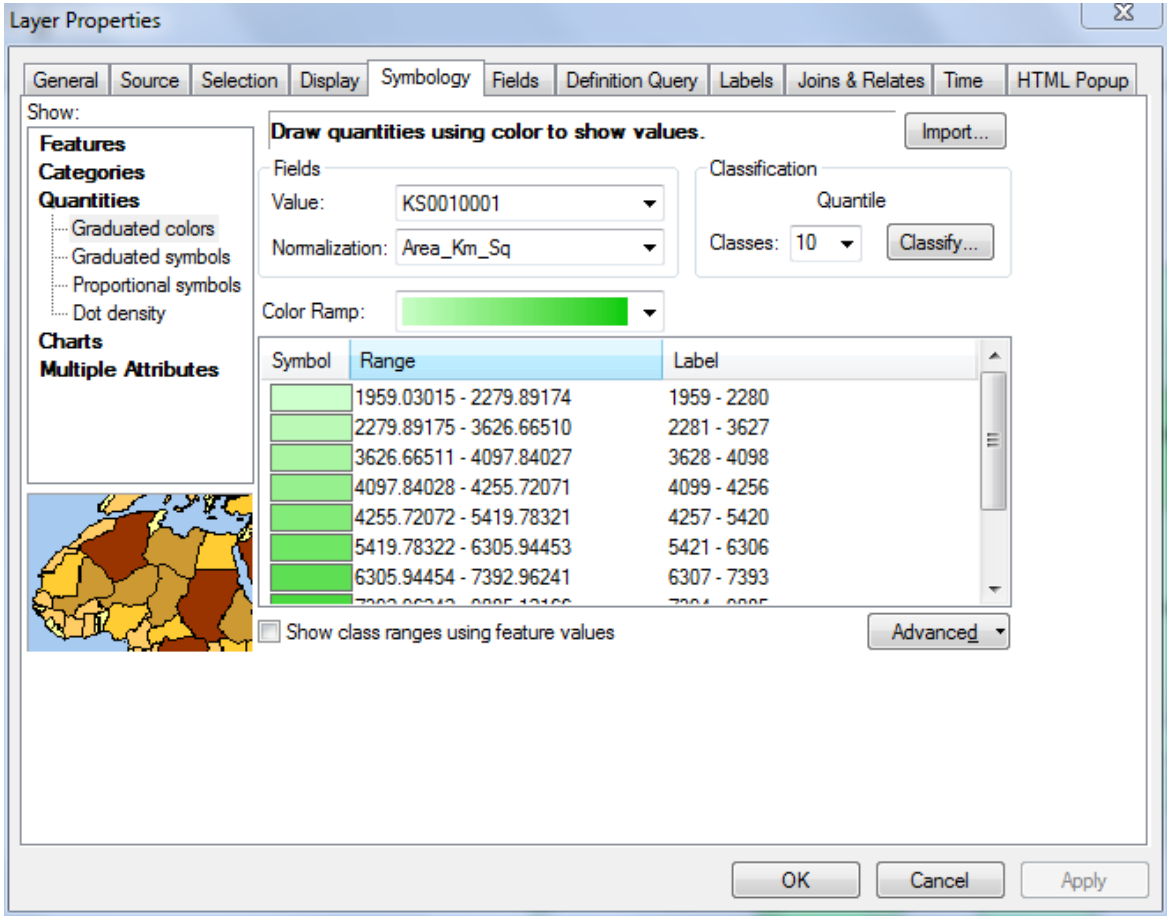


Figure.M107

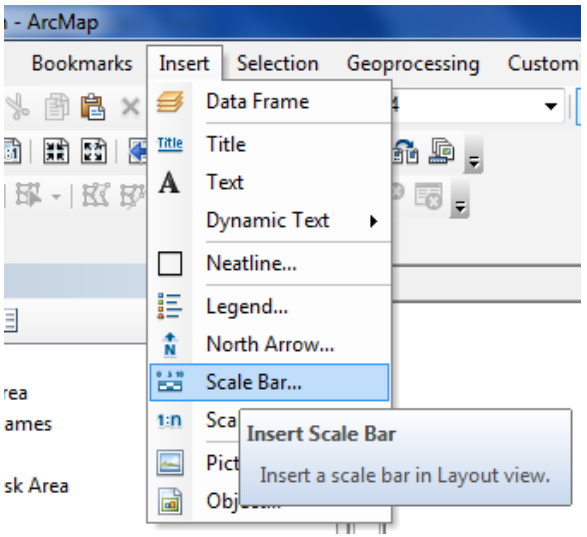


Figure.M108