

Spring 2016



[PROJECT REPORT: LEARN TO USE SPATIAL DATABASE]

CSE 6331.001 - Advance Topics in Database Systems

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Contents

High-level Description	4
Overview	4
Software Specification	5
QGIS:.....	5
Spatialite:	7
Spatialite plugin for QGIS - QSpatialite :.....	7
Simple SQL:.....	9
Q1: Select name from nyc_neighborhoods	9
Q2: Select all the neighborhood names which are under 'Manhattan' borough.....	11
Q3: Find number of letters in all the neighborhood names in Brooklyn.	12
Q4: What is the population of the city of New York?	15
Q5: Find the total population of the borough The Bronx.	15
Q6: Find the percentage of white people for each borough.	16
Geometry:	17
Q7: Compute the area of the 'West Village' neighborhood.	17
Q8: Compute the area of 'Manhattan' in acres.	19
Q9: Compute the number of the census blocks with hole in New York City	20
Q10: Find the length of the street 'Columbus Cir'.	21
Q11: Find the total length of all the streets in New York City in Kilometers.	22
Q12: What is the JSON representation of the boundary of 'West Village'?	22
Q13: Grouped by the type calculate the number of streets of each type	23
Q14: Summarized by the type, calculate the length of the streets of each type in New York.....	24
Spatial Relationship:.....	27
Q15: What is the neighborhood of the 'Broad St Subway Station'?	27
Q16: For the street named 'W Lake Dr' find the geometry value.....	30
Q17: Find the neighborhood and borough of 'W Lake Dr'	31
Q18: Find the street which joins 'intersects' 'W Lake Dr'	32
Q19: Find the total number of people who live within 50 meters of 'W LakeDr'	33
Q20: Find the distance between 'Columbus Cir' and 'Fulton Ave'.	35
Q21: Find the neighborhood of 'South Ferry' subway station.....	36
Q22: What is the population and racial make-up of the neighborhoods of	37
Manhattan?.....	37

Q23: What subway station is in 'Bensonhurst'?	46
Q24: What is the closest street to 'Cortlandt' subway station?	47
<i>References</i>	49

Project 1 (CSE-6331.001)

High-level Description

Overview

We have a dataset which consists of a New York State data. The dataset has many shape files in .shp format. We used SpatialLite software to create the database and load the shape files into it in order to perform the queries to it. Once the data has been uploaded to a SDBMS then we used QGIS software to visualize and for graphical interface for this project. Using the graphical interface we were able to show the different objects and locations, find distance from one point to another or compute the area of an object and various other tasks.

The dataset we are using consists of the following files:

- > nyc_census_blocks.dbf
- > nyc_census_blocks.prj
- > nyc_census_blocks.shp
- > nyc_census_blocks.shx
- > nyc_homicides.dbf
- > nyc_homicides.prj
- > nyc_homicides.shp
- > nyc_homicides.shx
- > nyc_neighborhoods.dbf
- > nyc_neighborhoods.prj
- > nyc_neighborhoods.shp
- > nyc_neighborhoods.shx
- > nyc_streets.dbf
- > nyc_streets.prj
- > nyc_streets.shp
- > nyc_streets.shx
- > nyc_subway_stations.dbf
- > nyc_subway_stations.prj
- > nyc_subway_stations.shp
- > nyc_subway_stations.shx
- > pagila.backup

We considered the data present in the NYC dataset folder. We used QSpatialLite plugin to execute the queries and get the output in tabular format as well as in spatial view or spatial table to represent the output

on map i.e., on QGIS Desktop, we select “Create Spatial View & Load in QGIS” to display the polygons objects and "Create Spatial Table and Load in QGIS" to display line and point objects.

Responsibilities:

Team Member	Tasks
Anuj Rakheja	Spatial View + Queries + Documentation
Shyam Gopal Rajanna	Spatial View + Queries + Documentation
Mudassir Ahmed	Spatial View + Queries + Documentation

Software Specification

QGIS:

- We used QGIS software because of the tools and GUI(Graphical User Interface) it provides is very easy to understand, manipulate data and shape files.

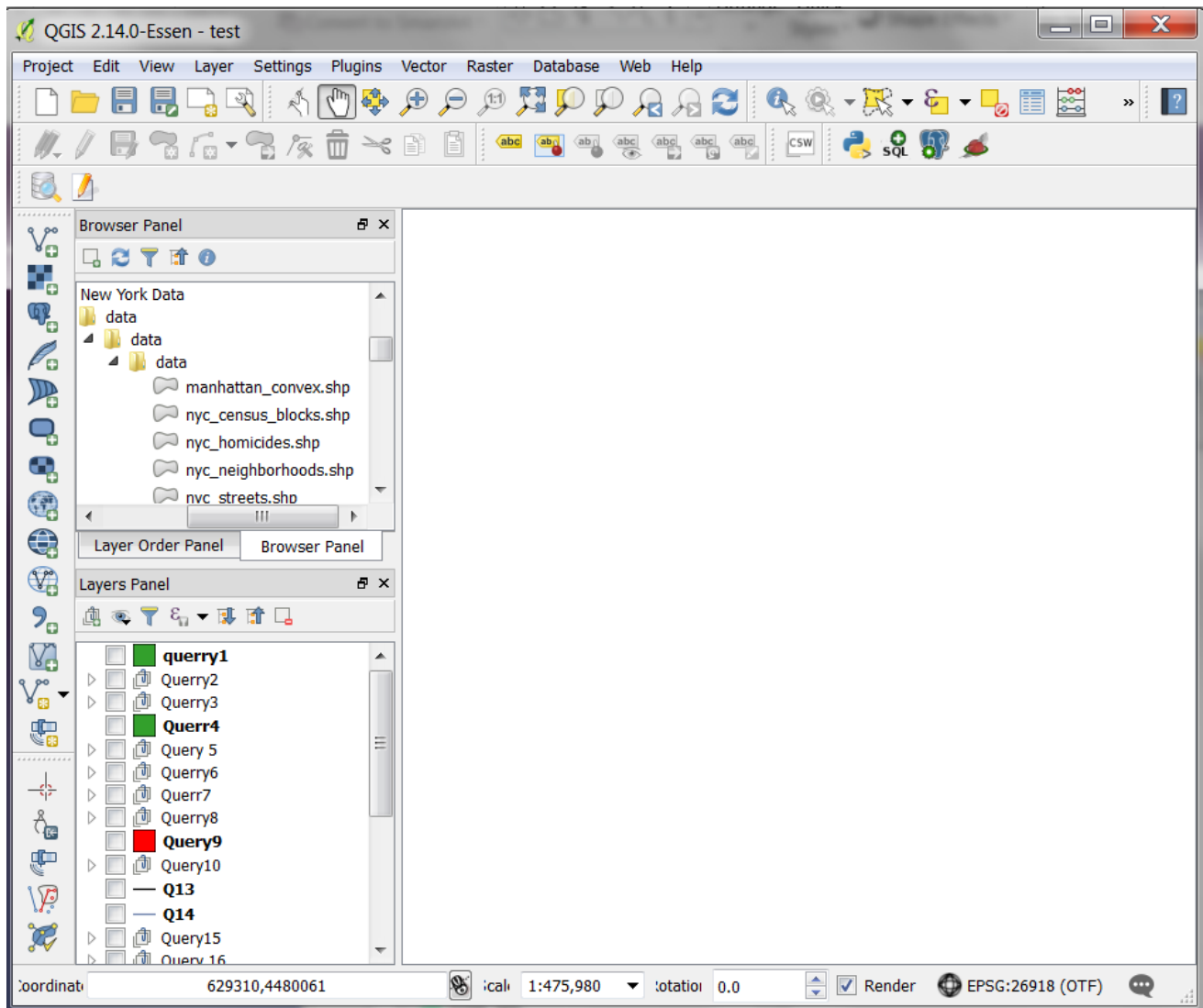


Fig 1: Screenshot of QGIS Desktop

- Also, QGIS (previously known as Quantum GIS) is a cross-platform free and open-source desktop geographic information system (GIS) application that provides data viewing, editing, and analysis. It is an open source geographical information system which is compatible on windows, mac, linux and bsd operating system (OS). We are using the OSGeo4W-2.14.0-1-Setup-x86_64 version of QGIS.

The following types of variant of QGIS software were installed

1. **QGIS Browser 2.14.0** – To view the attributes of the tables
2. **QGIS Desktop 2.14.0** - To view the shape files and for presenting the view for the queries required

Spatialite:

We used Spatialite to create the database. SpatiaLite is a spatial extension to SQLite, providing vector geo database functionality. It is similar to PostGIS, Oracle Spatial, and SQL Server with spatial extensions, although SQLite/Spatialite aren't based on client-server architecture: they adopt a simpler personal architecture. i.e. the whole SQL engine is directly embedded within the application itself.

For this project, We created spatial database named as NYC.sqlite and then imported all the given shape files to it:

- > nyc_census_blocks.shp
- > nyc_homicides.shp
- > nyc_neighborhoods.shp
- > nyc_streets.shp
- > nyc_subway_stations.shp

In this project we mainly used 4 out of 5 listed shape file i.e. No queries were performed on nyc_homicides.shp

Spatialite plugin for QGIS - QSpatialite :

QGIS supports the use of a file format called *spatialite* that is a lightweight, portable way to store an entire spatial database in a single file. One of the easiest ways of dealing with Spatialite files is to use the Qspatialite plugin in Quantum GIS. We can check if we have it installed using the QGIS Plugins Manager. Qspatialite will be found in the Plugins or Database menus.

Another big advantage of using QSpatialite plugin is because it is very efficient, provides nice editor and various other operations needed to create spatial views and spatial tables:

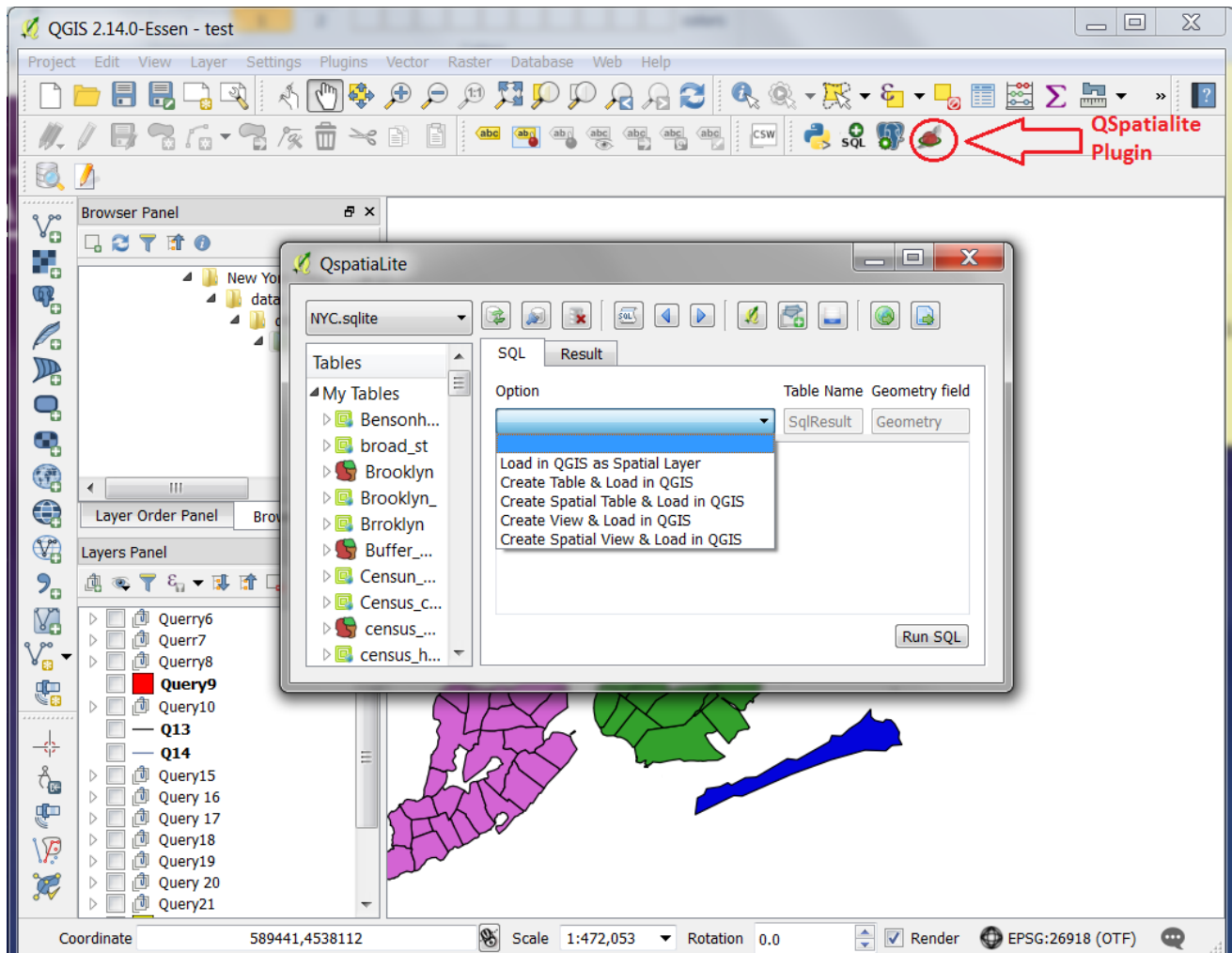


Fig 2. Various functions available in QSpatialite Plug-in

Simple SQL:

Q1: Select name from nyc_neighborhoods

➤ *SELECT NAME FROM nyc_neighborhoods;*



Fig 3: Spatial View of NYC neighborhoods

➤ **RESULT:**

NAME
Bensonhurst
East Village
West Village
Throggs Neck
Wakefield-Williamsbridge
Auburndale
Battery Park
Carnegie Hill
Mariners Harbor
Rossville
Harlem
Gramercy
Queens Village
Middle Village
Ettingville
Morris Park
Baychester
Great Kills
New Brighton
Fordham
Nkew Gardens
Soho
Spuyten Duyvil
Woodside
Bay Ridge
Mott Haven
Rosedale
Boerum Hill
Cobble Hill
Morningside Heights
Murray Hill
Port Richmond
Williams Bridge
Downtown
Woodrow
Union Port
Woodhaven-Richmond Hill
Soundview

Jamaica
Laurelton
Sunset Park
Borough Park
East Brooklyn
Midland Beach
Jackson Heights
Maspeth
Flatbush
Central Park
Charlestown-Richmond Valley
Glendale
Morris Heights
Kings Bridge
Country Club
Park Slope
Greenwich Village
Midtown
Bloomfield-Chelsea-Travis
Richmondtown
Williamsburg
Flushing
Canarsie
Greenwood
Annandale
City Island
Saintalbans
University Heights
Gravesend-Sheepshead Bay
Tribeca
North Sutton Area
Queensboro Hill
Springfield Gardens
Dyker Heights
Upper East Side
Financial District
Inwood
Bedford Park
Sunny Side

Lower East Side
Chelsea
Oakwood
South Beach
Tottensville
Hunts Point
Ridgewood
Forest Hills
Clearview
Brownsville
Bushwick
Washington Heights
Upper West Side
The Rockaways
Howland Hook
Ardon Heights
Fort Green
Clinton
Prince's Bay
Fresh Kills
High Bridge
Eastchester
Riverdale
Woodlawn-Nordwood
Huguenot
Clifton
Howard Beach
Tremont
Utopia
Garment District
East Harlem
Todt Hill
Parkchester
South Bronx
Westerleigh-Castleton
College Point
Mapleton-Flatlands
Little Italy
Bedford-Stuyvesant

Hamilton Heights
Carroll Gardens
Astoria-Long Island City
Yorkville
Chinatown

Bayside
Coney Island
Corona
Red Hook
Douglastown-Little Neck

Whitestone
Steinway
Rosebank

Q2: Select all the neighborhood names which are under 'Manhattan' borough.

```
➤ SELECT NAME
FROM nyc_neighborhoods
WHERE BORONAME = 'Manhattan';
```

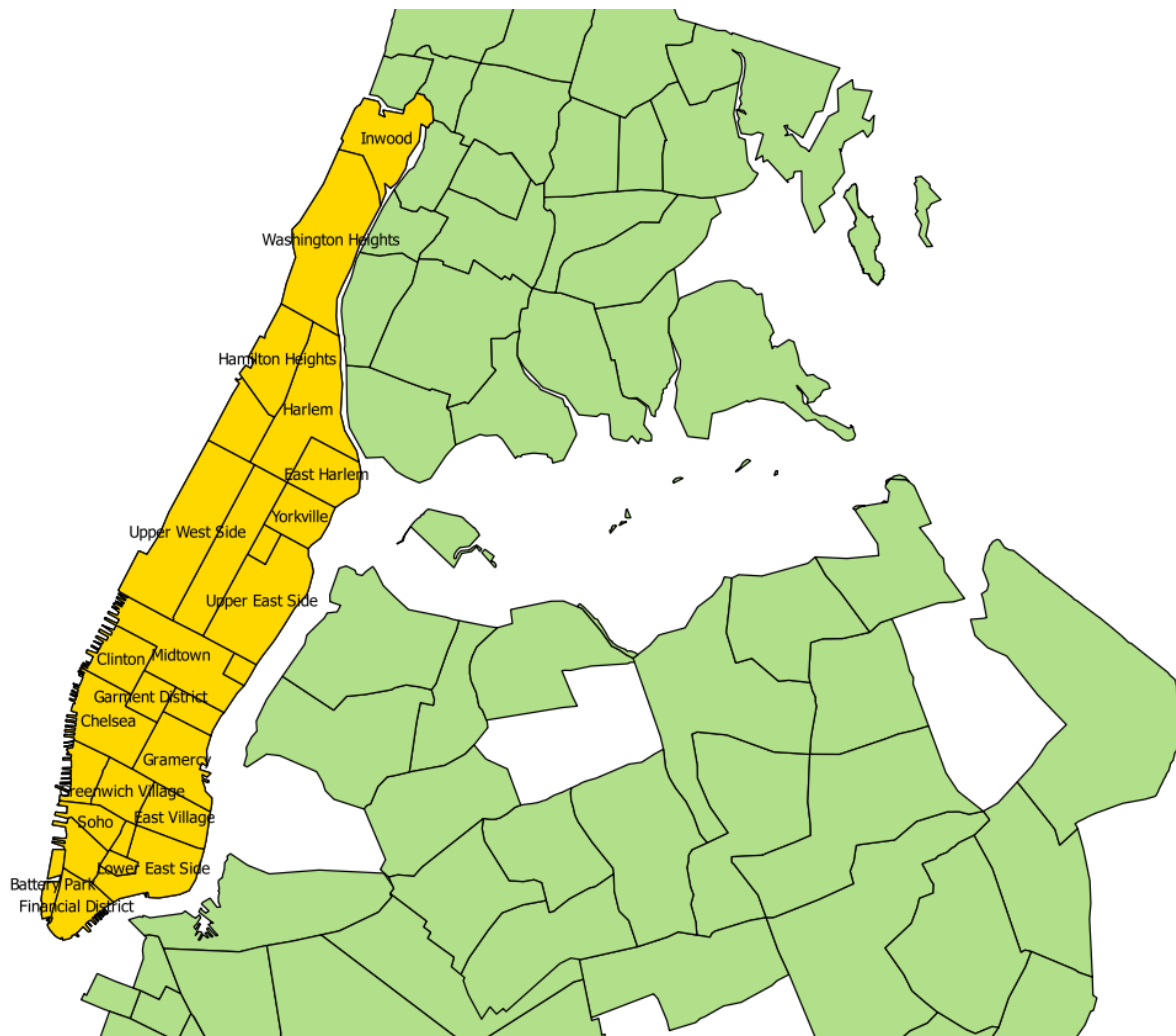


Fig 4: Spatial View of Neighborhoods under Manhattan Borough

➤ **RESULT:**

NAME
East Village
West Village
Battery Park
Carnegie Hill
Harlem
Gramercy
Soho
Morningside Heights
Murray Hill

Central Park
Greenwich Village
Midtown
Tribeca
North Sutton Area
Upper East Side
Financial District
Inwood
Lower East Side
Chelsea
Washington

Heights
Upper West Side
Clinton
Garment District
East Harlem
Little Italy
Hamilton Heights
Yorkville
Chinatown

Q3: Find number of letters in all the neighborhood names in Brooklyn.

➤ *SELECT LENGTH(NAME)*
FROM nyc_neighborhoods
WHERE BORONAME = 'Brooklyn';

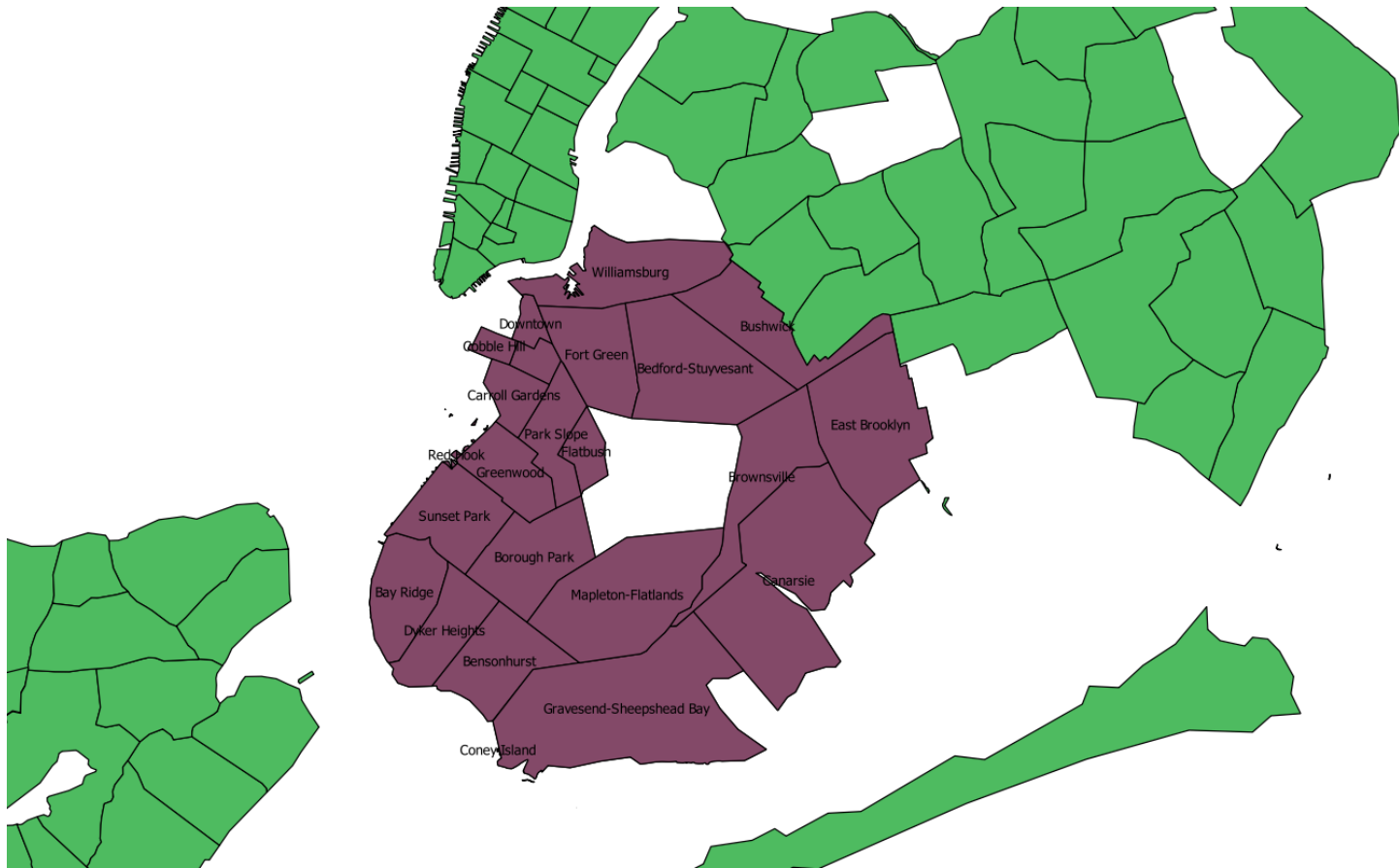


Fig 5: Spatial View of Neighborhoods of Brooklyn

➤ **RESULT:**

LENGTH(NAME)
11
12
12
12
24
10
12
13
15
9
6
8
14
14
11

11
10
11
12
7
12
4
14
8
9
10
8
11
11
19
11

13
15
8
7
10
23
9
7
9
11
12
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13
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7
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12
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11
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18
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24
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23
10
8
8

Q4: What is the population of the city of New York?

➤ `SELECT SUM(POPN_TOTAL) FROM nyc_census_blocks;`

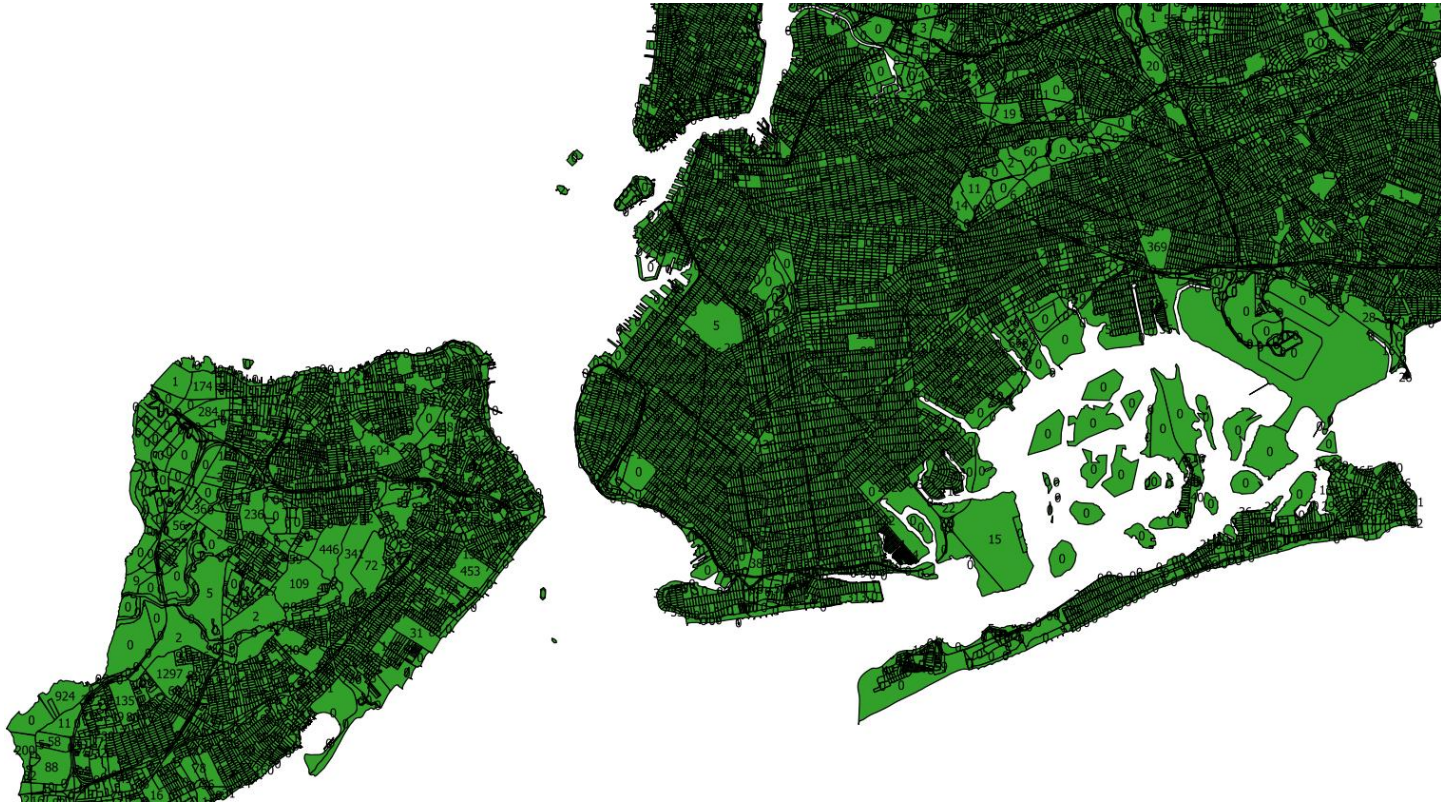


Fig 6: Spatial View of Population of New York City

➤ **Result: 8175032**

Q5: Find the total population of the borough The Bronx.

➤ `SELECT SUM(POPN_TOTAL)`
`FROM nyc_census_blocks`
`WHERE BORONAME = 'The Bronx';`

➤ **RESULT: 1385108**

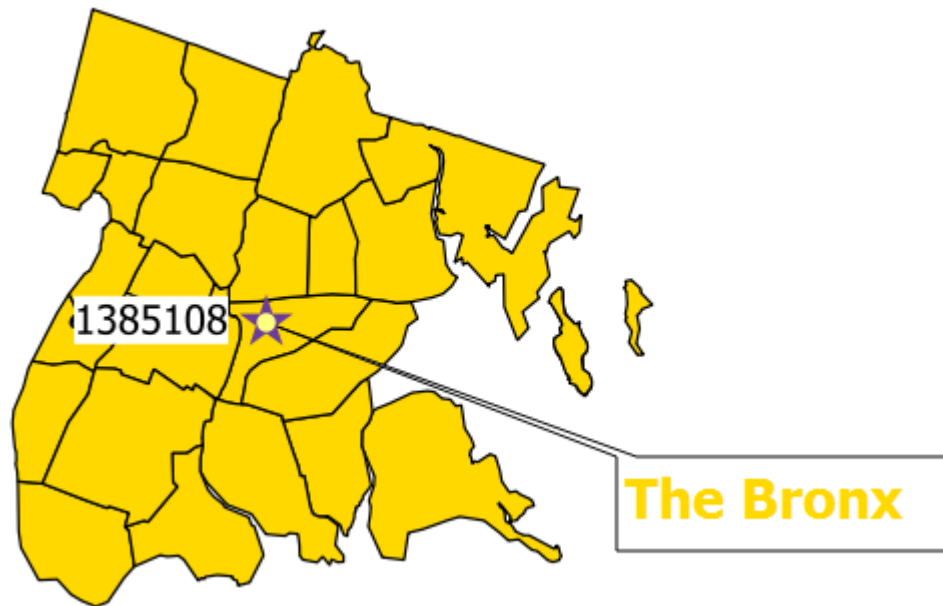


Fig 7: Spatial View of Total Population of 'The Bronx' Borough

Q6: Find the percentage of white people for each borough.

```
➤ SELECT BORONAME, SUM(POPN_TOTAL), SUM(POPN_WHITE),
    ROUND (CAST (SUM(POPN_WHITE) AS REAL)/SUM(POPN_TOTAL)*100,2) AS WHITE_PERCENTAGE
    FROM nyc_census_blocks
    GROUP BY BORONAME;
```

➤ **RESULT:**

BORONAME	SUM(POPN_TOTAL)	SUM(POPN_WHITE)	WHITE_PERCENTAGE
Brooklyn	2504700	1072041	42.8
Manhattan	1585873	911073	57.45
Queens	2230621	886049	39.72
Staten Island	468730	341677	72.89
The Bronx	1385108	386497	27.9

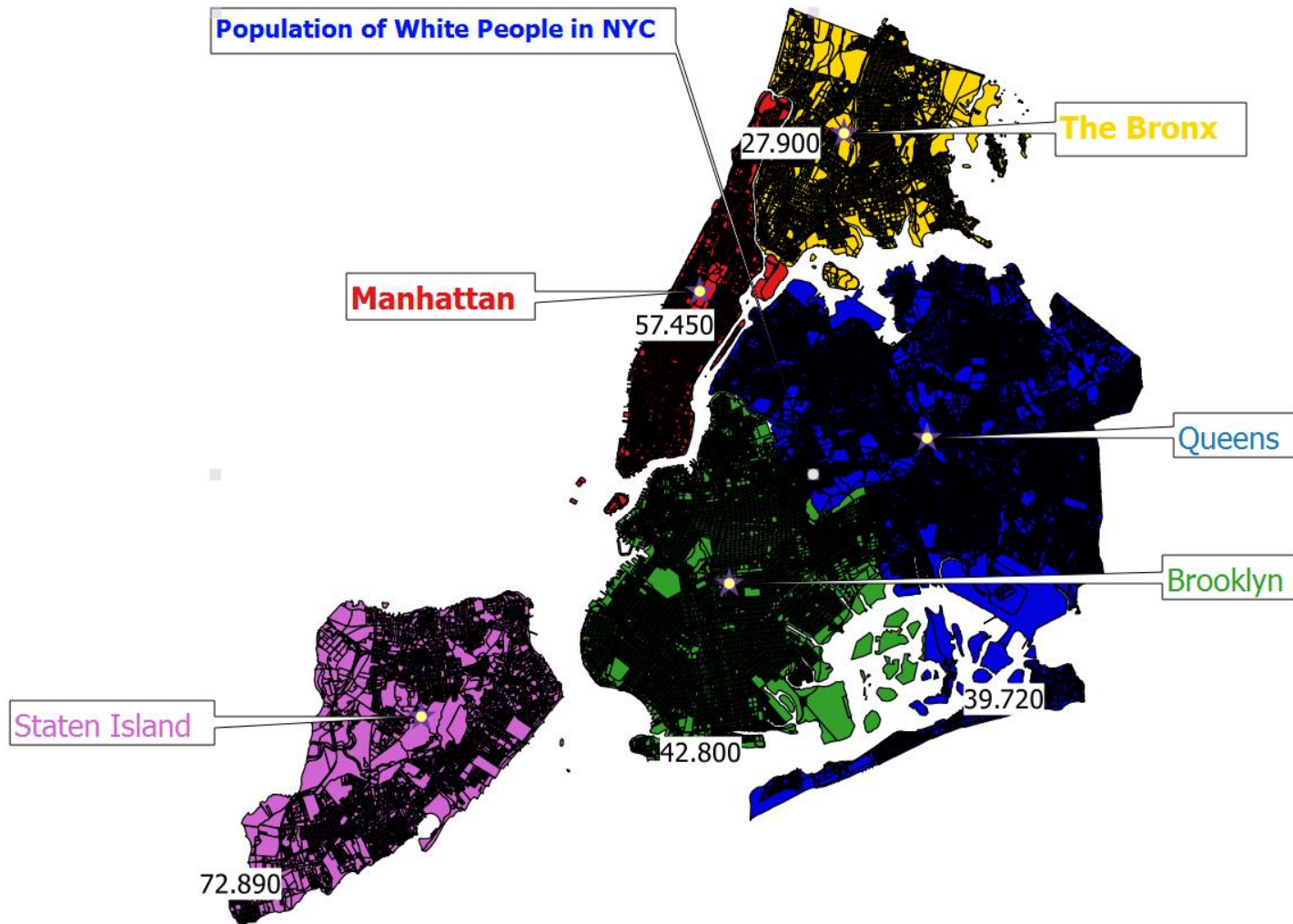


Fig 8: Spatial View of Percentage of white people for each borough

Geometry:

Q7: Compute the area of the 'West Village' neighborhood.

- `SELECT NAME, ST_AREA (Geometry)`
- `FROM nyc_neighborhoods`
- `WHERE NAME = 'West Village';`
- **RESULT(in m²):** 1.04461e+06

NAME	ST_AREA(Geometry)
West Village	1.04461e+06

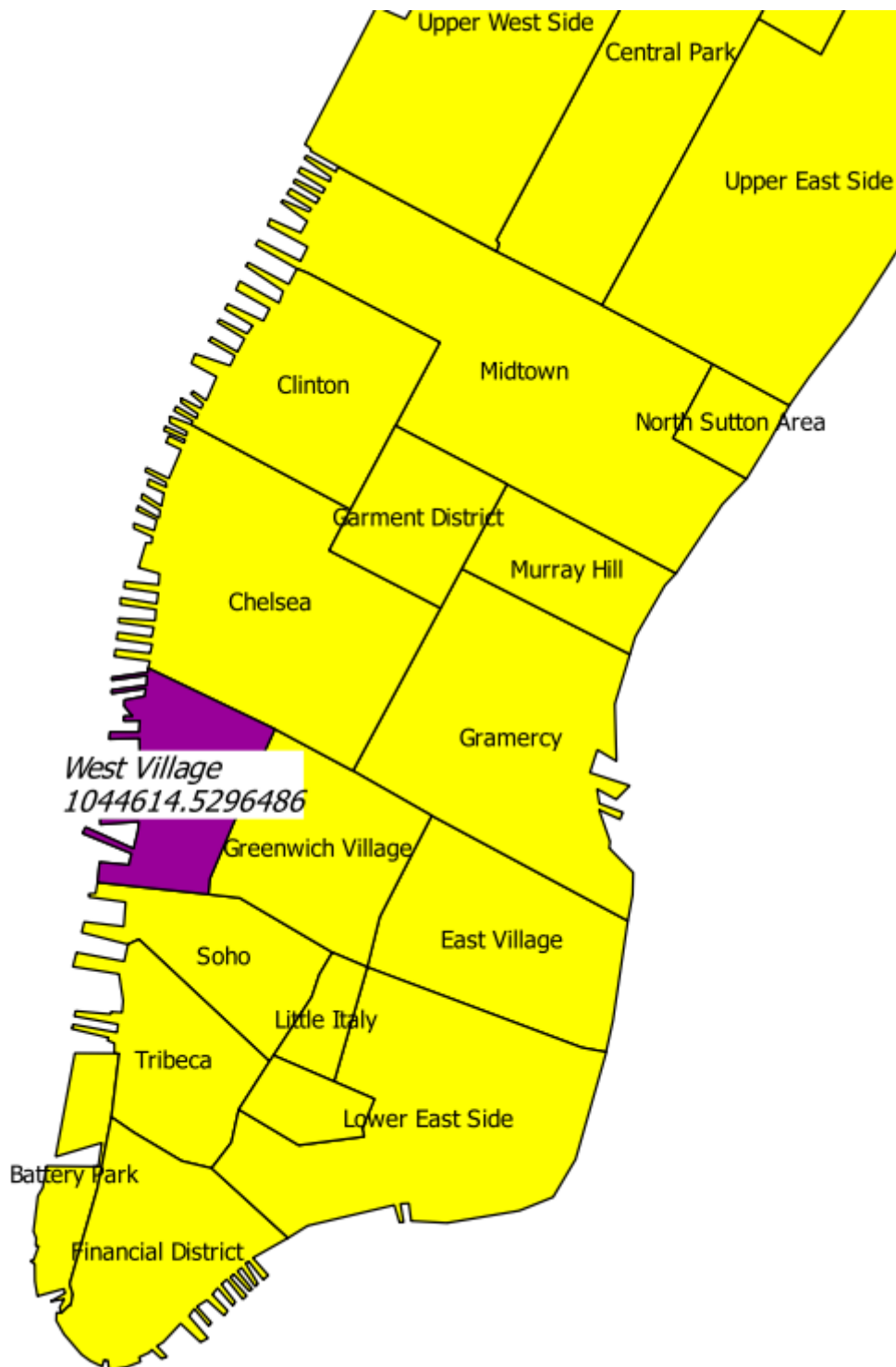


Fig 9: Spatial view of Area of West Village

Q8: Compute the area of 'Manhattan' in acres.

- ```
SELECT BORONAME, SUM(AREA (Geometry))/4046.85642
FROM nyc_neighborhoods
WHERE BORONAME = 'Manhattan';
```
- **RESULT(in acres):** 13965.8

| BORONAME  | SUM(AREA(GEOMETRY))/4046.85642 |
|-----------|--------------------------------|
| Manhattan | 13965.8                        |

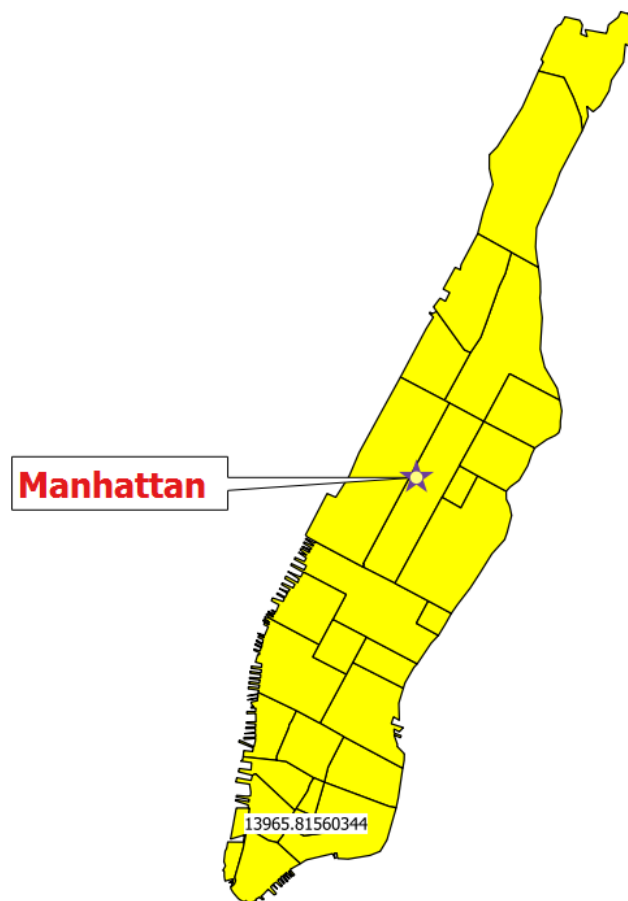


Fig 10: Spatial representation of Area of Manhattan

### Q9: Compute the number of the census blocks with hole in New York City

- `SELECT COUNT(*)`  
`FROM nyc_census_blocks`  
`WHERE NUMINTERIORRINGS(ST_GEOMETRYN(Geometry,1)) > 0;`
- **Result:** 43

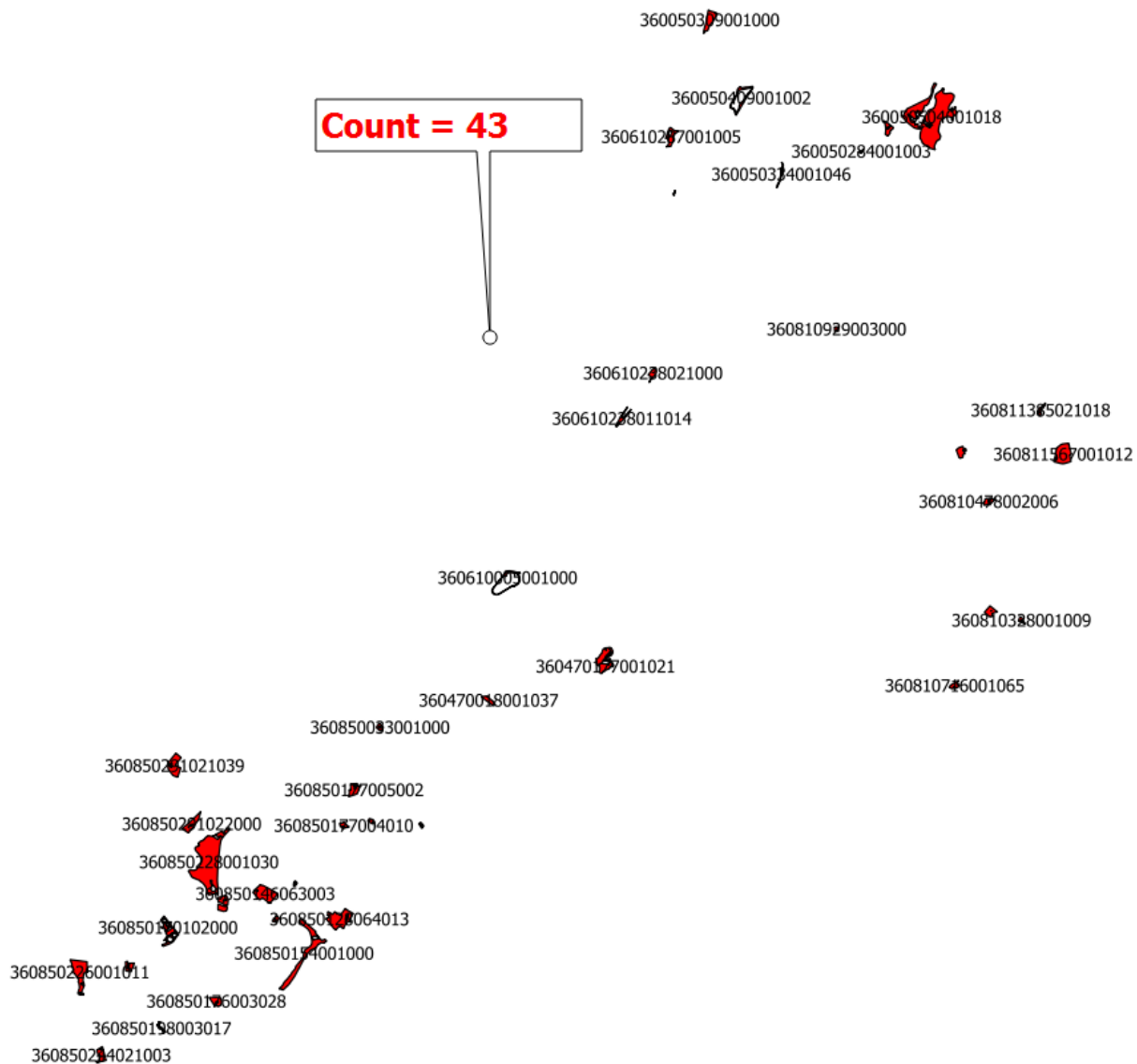


Fig 11: Spatial View of Count of Census Blocks with hole in New York City

Q10: Find the length of the street 'Columbus Cir'.

```
➤ SELECT NAME, CAST(LENGTH(Geometry) AS REAL)AS COLUMBUS_CIR_STREET_LENGTH
FROM nyc_streets
WHERE NAME = 'Columbus Cir';
```

➤ **RESULT(in meters):**

| NAME         | COLUMBUS_CIR_STREET_LENGTH |
|--------------|----------------------------|
| Columbus Cir | 713                        |

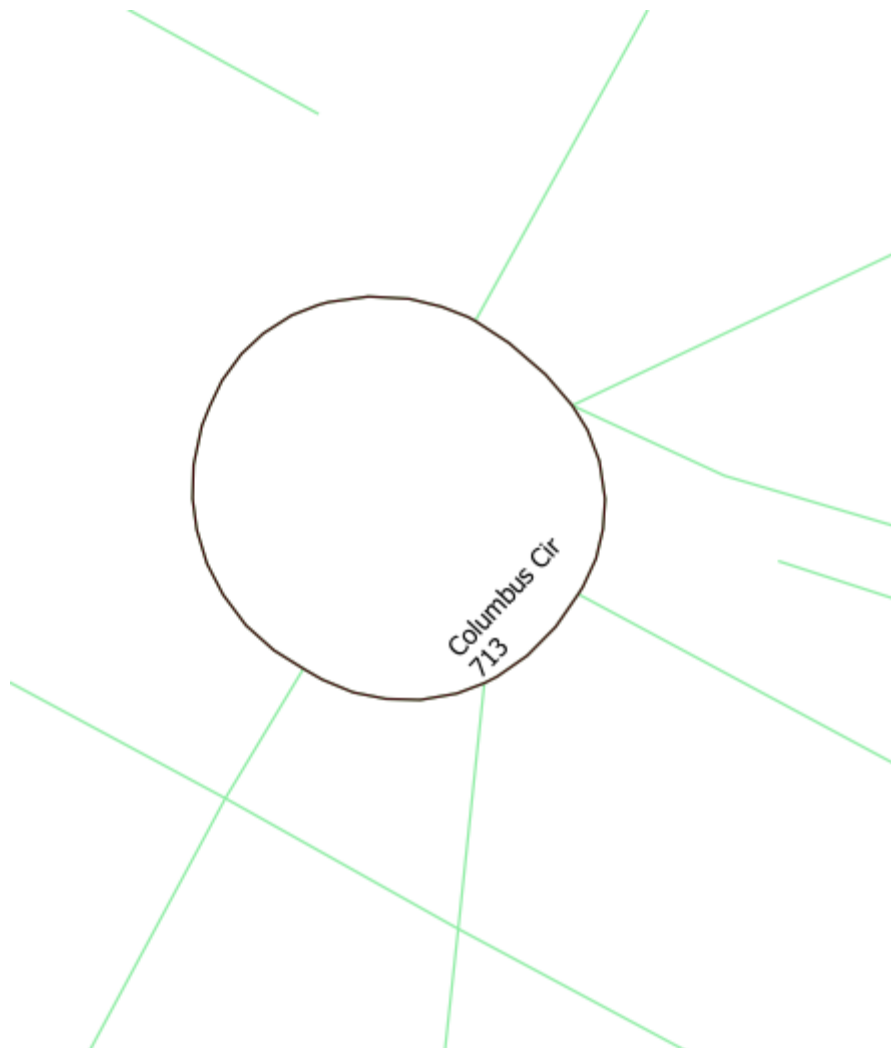


Fig 12: Spatial View of Columbus Circle with its Length in meter

## Q11: Find the total length of all the streets in New York City in Kilometers.

```
➤ SELECT CAST(SUM (LENGTH (Geometry)) AS REAL)/1000 AS
TOTAL_STREET_LENGTH_NYC_STREETS_IN_KM

FROM nyc_streets;
```

➤ **RESULT(in km): 3233.95**

## Q12: What is the JSON representation of the boundary of 'West Village'?

```
➤ SELECT NAME, ASGEOJSON(Geometry)

FROM nyc_neighborhoods

WHERE NAME= 'West Village';
```

➤ **RESULT:**

```
{ "type": "MultiPolygon", "coordinates": [[[[[583263.2776595835, 4509242.626023987], [583276.8199068634, 4509378.825446926], [583473.9709606677, 4509359.908944456], [583491.1922605945, 4509436.712101899], [583162.1055733619, 4509573.023287381], [583183.7629211798, 4509612.89170184], [583504.9003739061, 4509468.566869253], [583533.7302729085, 4509585.126406943], [583541.0231970509, 4509651.251073343], [583282.0086540785, 4509632.486606753], [583281.5338872193, 4509674.748429337], [583540.6957782047, 4509680.306080814], [583544.2379807131, 4509722.613197348], [583535.7248487498, 4509764.784463079], [583294.6488446214, 4509759.43009883], [583300.3796810756, 4509785.911472392], [583535.4272034232, 4509791.19811068], [583538.5228633031, 4509873.125708335], [583317.5125486899, 4509870.638359524], [583329.1816586801, 4509905.111607114], [583542.1244806301, 4509910.150107042], [583543.3894299654, 4509976.206886579], [583338.3069588535, 4509987.106862172], [583335.9414585796, 4510018.780658739], [583548.8810140223, 4510023.819403051], [583544.7581002651, 4510211.333753768], [583341.8694029976, 4510206.407989681], [583347.3620505599, 4510254.020356838], [583542.2845745855, 4510252.516427663], [583547.4483807002, 4510329.184002983], [583438.959078394, 4510327.961884844], [583440.6113059511, 4510359.680905152], [583498.8738294676, 4510360.337047187], [583441.84719336, 4510428.379068073], [583443.410155272, 4510468.02219667], [583579.7556511704, 4510493.333849789], [583587.1959170152, 4510546.251834388], [583358.5261442101, 4510511.975929037], [583358.2587679623, 4510535.748236739], [583592.9845851837, 4510567.450755248], [583596.2577262815, 4510633.530279972], [583359.5250365569, 4510601.80502573], [583359.3170689036, 4510620.294600859], [583602.0462911118, 4510654.729212195], [583601.7185282242, 4510683.78426505], [584454.9210194235, 4510273.151246953], [584352.745014016, 4510049.939239384], [584296.2888293361, 4509964.920445204], [584278.6717916562, 4509880.343595843], [584017.0762156184, 4509266.760846778], [584008.1256703735, 4509162.296346836], [583263.2776595835, 4509242.626023987]]]]]] }
```

## Q13: Grouped by the type calculate the number of streets of each type

➤ *SELECT TYPE, COUNT(\*) AS COUNT\_OF\_EACH\_STREET\_TYPE*  
*FROM nyc\_streets*  
*GROUP BY TYPE;*

**RESULT:**

| TYPE                                                | COUNT_OF_EACH_STREET_TYPE |
|-----------------------------------------------------|---------------------------|
| Construction                                        | 8                         |
| Cycleway                                            | 2                         |
| Footway                                             | 345                       |
| living_street                                       | 2                         |
| Motorway                                            | 227                       |
| motorway_link                                       | 953                       |
| motorway_link; residential                          | 1                         |
| Pedestrian                                          | 20                        |
| Primary                                             | 98                        |
| primary; residential; motorway_link;<br>residential | 2                         |
| primary_link                                        | 12                        |
| Residential                                         | 16560                     |
| residential; motorway_link                          | 2                         |
| Secondary                                           | 137                       |
| Service                                             | 90                        |
| Steps                                               | 7                         |
| Tertiary                                            | 257                       |
| Trunk                                               | 14                        |
| trunk_link                                          | 15                        |
| Unclassified                                        | 337                       |
| Undefined                                           | 2                         |





Fig 13: Spatial View of streets of each type

Q14: Summarized by the type, calculate the length of the streets of each type in New York.

```
SELECT TYPE, CAST (SUM (LENGTH (Geometry)) AS REAL) AS
TOTAL_LENGTH_OF_EACH_STREET_TYPE_IN_METERS

FROM nyc_streets

GROUP BY TYPE;
```



**➤ RESULT:**

| TYPE                                                | TOTAL_LENGTH_OF_EACH_STREET_TYPE_IN_METER<br>S |
|-----------------------------------------------------|------------------------------------------------|
| Construction                                        | 2056                                           |
| Cycleway                                            | 3074                                           |
| Footway                                             | 64977                                          |
| living_street                                       | 818                                            |
| Motorway                                            | 95339                                          |
| motorway_link                                       | 172513                                         |
| motorway_link; residential                          | 121                                            |
| Pedestrian                                          | 2932                                           |
| Primary                                             | 31250                                          |
| primary; residential; motorway_link;<br>residential | 434                                            |
| primary_link                                        | 2140                                           |
| Residential                                         | 2613232                                        |
| residential; motorway_link                          | 642                                            |
| Secondary                                           | 65297                                          |
| Service                                             | 17018                                          |
| Steps                                               | 783                                            |
| Tertiary                                            | 96649                                          |
| Trunk                                               | 3662                                           |
| trunk_link                                          | 2231                                           |
| Unclassified                                        | 58489                                          |
| Undefined                                           | 290                                            |



Fig 14: Spatial View of Length of Streets of each type

## Spatial Relationship:

### Q15: What is the neighborhood of the 'Broad St Subway Station'?

#### ➤ Query Part 1

```
SELECT LONG_NAME, NAME, ST_ASTEXT (Geometry)
FROM nyc_subway_stations
WHERE NAME = 'Broad St';
```

#### ➤ Result:

| LONG_NAME                  | NAME     | ST_AsText(Geometry )                     |
|----------------------------|----------|------------------------------------------|
| Broad St (J,M,Z) Manhattan | Broad St | MULTIPOINT(583571.905921 4506714.341192) |

#### ➤ Query Part 2

```
SELECT NAME, BORONAME
FROM nyc_neighborhoods
WHERE ST_INTERSECTS (Geometry, ST_GEOFROMTEXT ('POINT (583571.905921
4506714.341192)'));
```

#### ➤ Result:

| NAME               | BORONAME  |
|--------------------|-----------|
| Financial District | Manhattan |

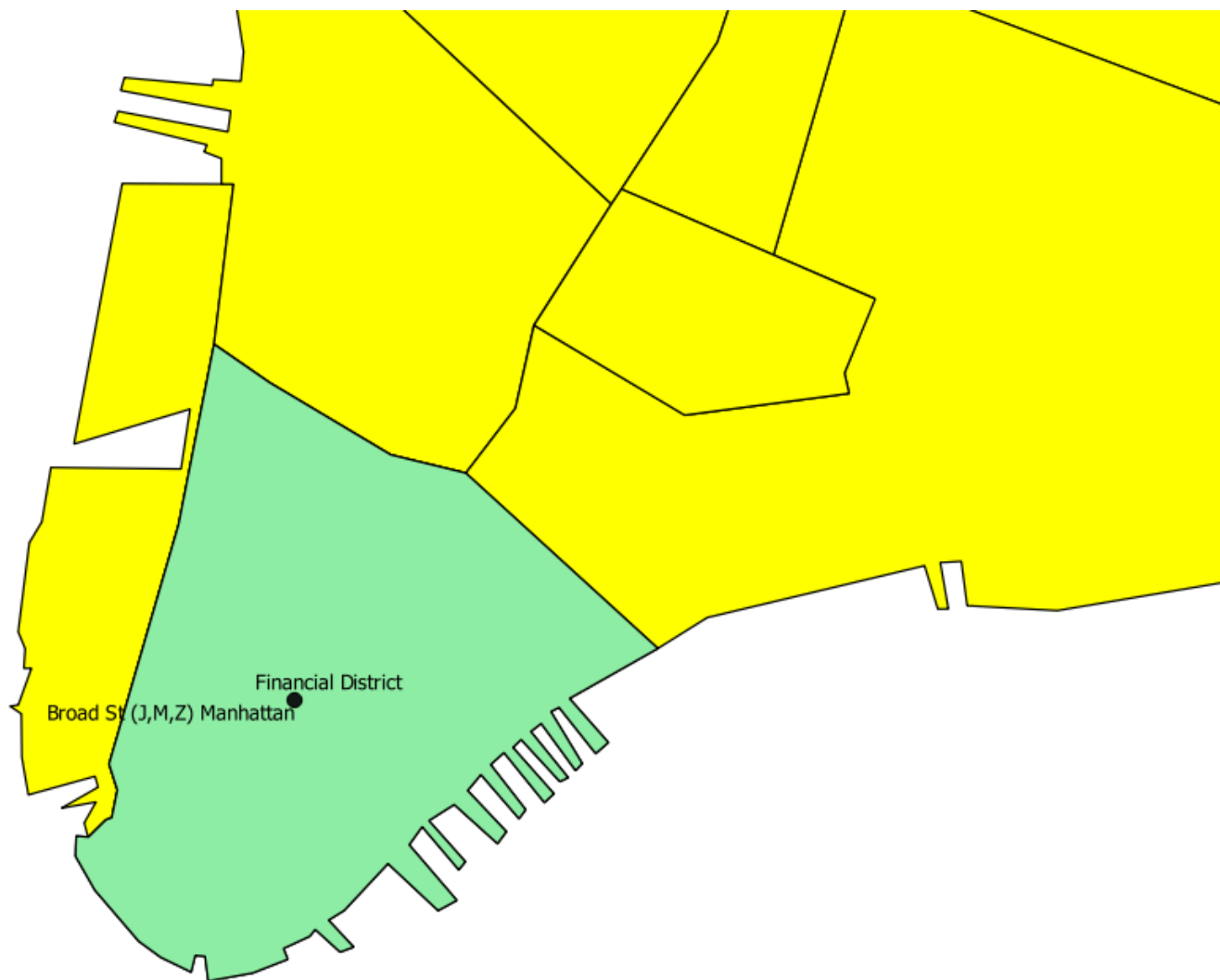


Fig 15: Spatial View of neighborhood of Broadway St Subway Station

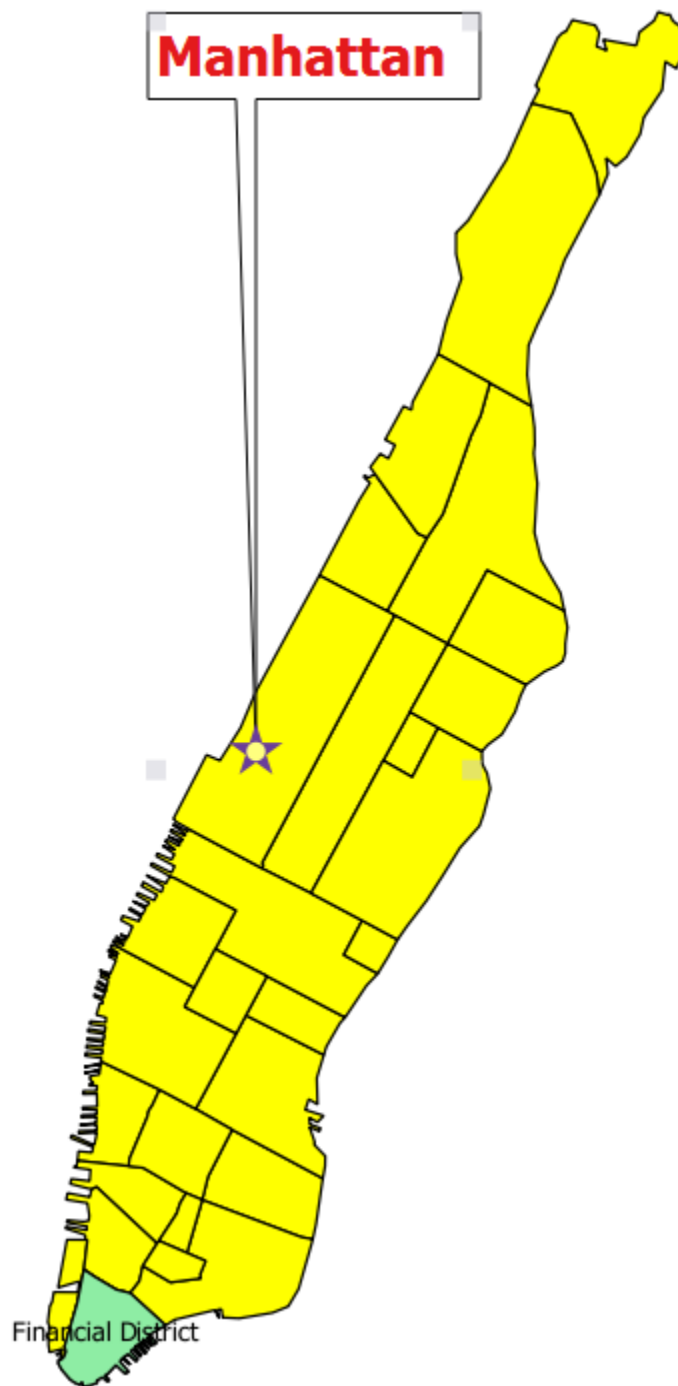


Fig 16: Spatial View of Financial District and Manhattan Borough

Q16: For the street named 'W Lake Dr' find the geometry value.

```
➤ SELECT ASTEXT (Geometry)
 FROM nyc_streets
 WHERE NAME = 'W Lake Dr';
```

➤ **RESULT:**

```
MULTILINESTRING((586812.15456 4501262.550553, 586811.714986 4501142.365469, 586815.620164
4501118.563824, 586824.623152 4501093.367351, 586835.815745 4501067.474831, 586899.084642
4500993.752556, 586916.144738 4500962.14456, 586924.387456 4500940.547484, 586927.583027
4500915.283224, 586923.744695 4500871.140909, 586920.396769 4500847.243411, 586913.455697
4500820.41737, 586908.078597 4500783.484532, 586908.450376 4500751.681447, 586915.112327
4500740.190971, 586921.182477 4500717.84686, 586929.399995 4500697.703867, 586958.855034
4500661.178356, 586981.521313 4500646.988608, 587024.907383 4500639.003242))
```

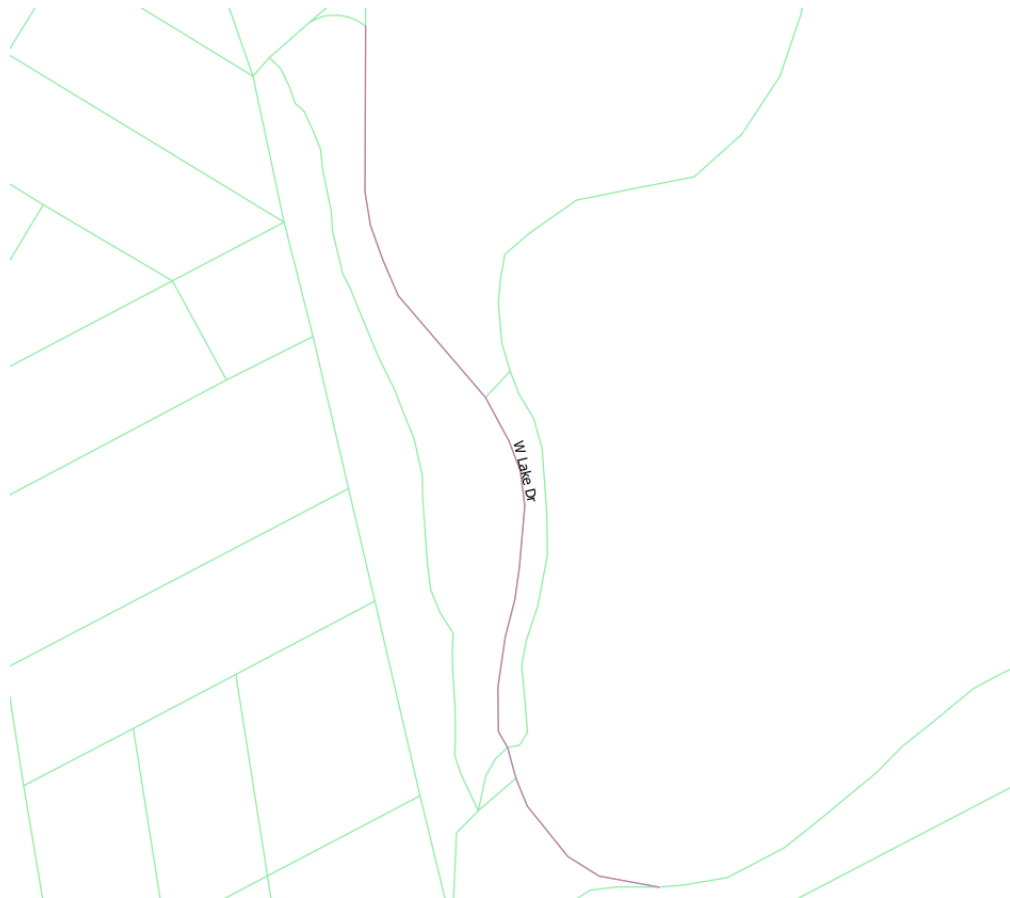


Fig 17: Spatial View of 'West Lake Dr'

Q17: Find the neighborhood and borough of 'W Lake Dr'.

- *SELECT n.NAME, n.BORONAME*  
*FROM nyc\_neighborhoods as n,nyc\_streets as s*  
*WHERE s.NAME = 'W Lake Dr' and ST\_INTERSECTS (n.Geometry,s.Geometry);*
- **RESULT:**

| Name       | BORONAME |
|------------|----------|
| Flatbush   | Brooklyn |
| Park Slope | Brooklyn |



Fig 18: Spatial View of neighborhood and borough of 'West Lake Dr'

Q18: Find the street which joins 'intersects' 'W Lake Dr' .

```
SELECT DISTINCT s2.NAME
FROM nyc_streets AS s1, nyc_streets AS s2
WHERE s1.NAME = 'W Lake Dr' AND s2.NAME IS NOT 'W Lake Dr'
AND INTERSECTS(s1.Geometry, s2. Geometry);
```

| NAME          |
|---------------|
| Center Dr     |
| Central Dr    |
| NULL          |
| Well House Dr |
| S Lake Dr     |

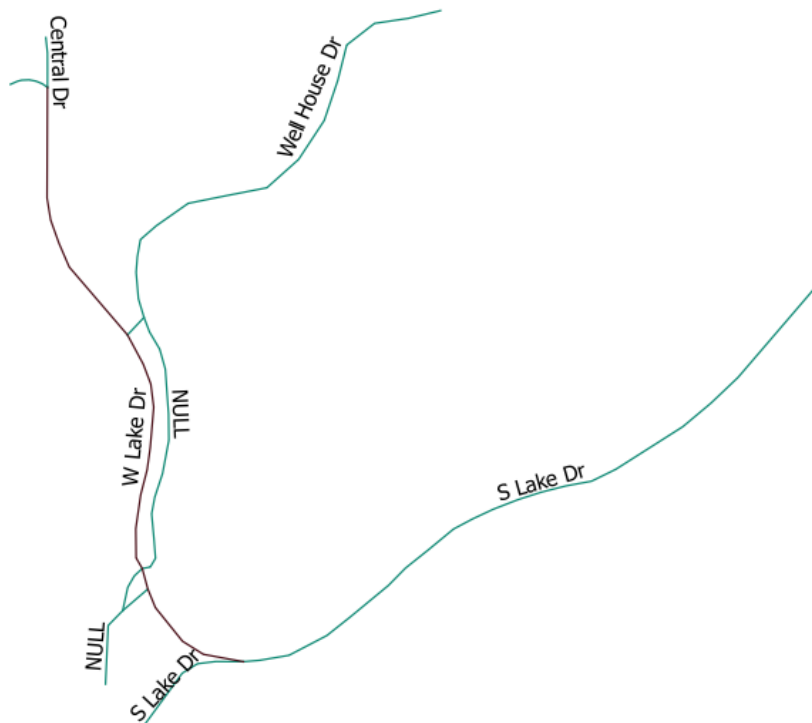


Fig 19: Spatial View of Street joining 'West Lake Dr'



Q19: Find the total number of people who live within 50 meters of 'W Lake Dr'

➤ **Step 1:** (Create Spatial Table)

```
SELECT Geometry, Name
FROM nyc_streets
Where Name = 'W Lake Dr'
```

➤ **Output (Step 1):**



|   | PKUID | NAME      |
|---|-------|-----------|
| 0 | 1     | W Lake Dr |

Fig 20: Geometry for W Lake Dr

Table 1: Spatial Table of WLake Dr.

➤ **Step 2:** (Create Buffer)

Used QGIS Tool present in -> Menu>Vector>Geoprocessing Tools>Buffer(s)...

Select the Table and enter the distance to make buffer(here it is 50 m)



Fig 21: Spatial View of Buffer created around W Lake Dr.

| SQL |       | Result     |            |
|-----|-------|------------|------------|
|     | PKUID | Geometry   | Buffer(Geo |
| 1   | 1     | GeomObject | NULL       |

Table 2: Attributes for Buffer Created

➤ **Step 3:** (Check Within)

```
SELECT SUM(c.POPN_TOTAL)
FROM nyc_census_blocks AS c, Buffer_W_Lake_Drive as b
WHERE WITHIN (c.Geometry, b.Geometry);
```

➤ **Result: 0**

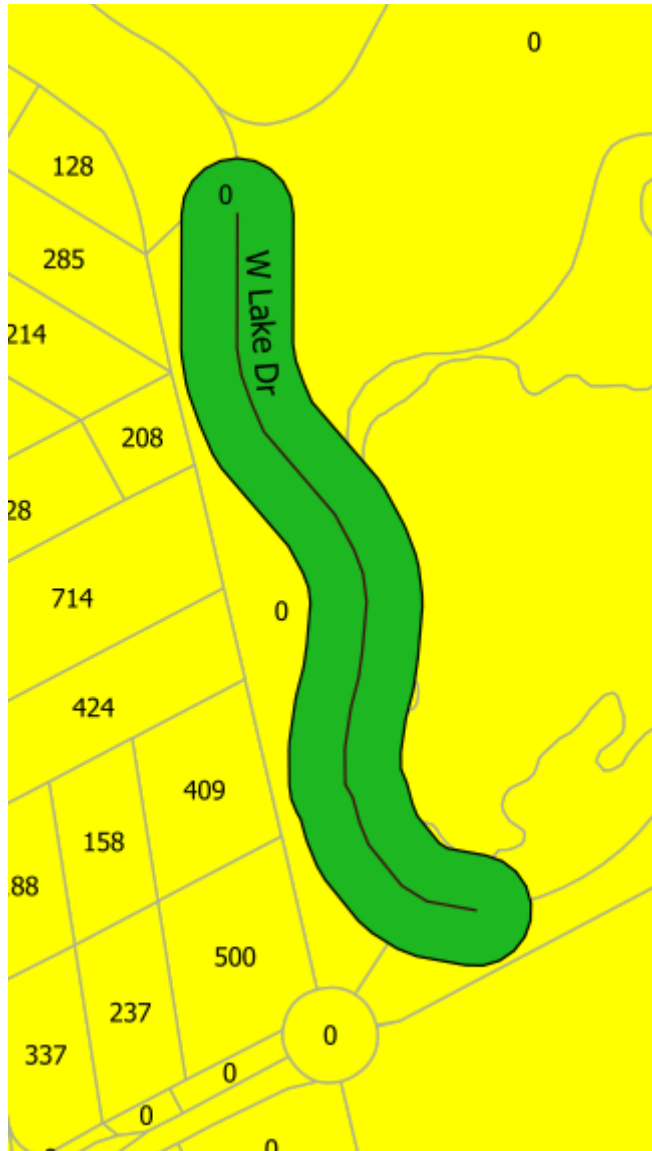


Fig 22: Spatial View of people living 50 meters within 'West Lake Dr'

Q20: Find the distance between 'Columbus Cir' and 'Fulton Ave'.

➤ `SELECT ST_DISTANCE`  
`((SELECT Geometry FROM nyc_streets WHERE NAME = 'Columbus Cir'),`  
`(SELECT Geometry FROM nyc_streets WHERE NAME = 'Fulton Ave'))`  
`AS distance_between_Columbus_Cir_and_Fulton_Ave;`

➤ **Result in meters: 9184.786**

Q21: Find the neighborhood of 'South Ferry' subway station.

➤ *SELECT n.NAME*  
  
*FROM nyc\_neighborhoods AS n, nyc\_subway\_stations AS s ON ST\_CONTAINS(n.Geometry, s.Geometry)*  
  
*WHERE s.NAME = 'South Ferry'*

➤ **Result: Financial District**

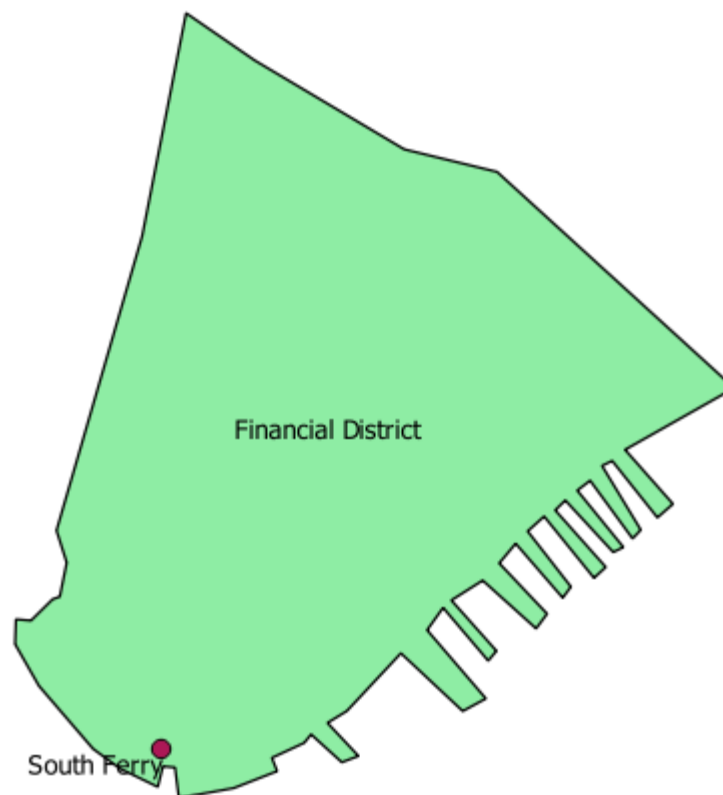


Fig 23: Spatial View of neighborhood of 'South Ferry' Subway Station

Q22: What is the population and racial make-up of the neighborhoods of Manhattan?

➤ *SELECT n.NAME, n.Geometry,  
SUM(POPN\_TOTAL) AS TOTAL\_POPULATION\_COUNT,  
ROUND(SUM(POPN\_WHITE)\*100.0/SUM(POPN\_TOTAL)) AS  
TOTAL\_POPULATION\_WHITE ,  
ROUND(SUM(POPN\_BLACK)\*100.0/SUM(POPN\_TOTAL)) AS  
TOTAL\_POPULATION\_BLACK,  
ROUND(SUM(POPN\_NATIV)\*100.0/SUM(POPN\_TOTAL)) AS  
TOTAL\_POPULATION\_NATIVE,  
ROUND(SUM(POPN\_ASIAN)\*100.0/SUM(POPN\_TOTAL)) AS  
TOTAL\_POPULATION ASIANS,  
ROUND(SUM(POPN\_OTHER)\*100.0/SUM(POPN\_TOTAL)) AS  
TOTAL\_POPULATION\_OTHERS  
FROM nyc\_census\_blocks AS c JOIN nyc\_neighborhoods AS n ON  
ST\_INTERSECTS(c.Geometry, n.Geometry)  
WHERE n.BORONAME = 'Manhattan'  
GROUP BY n.NAME;*

➤ Result:

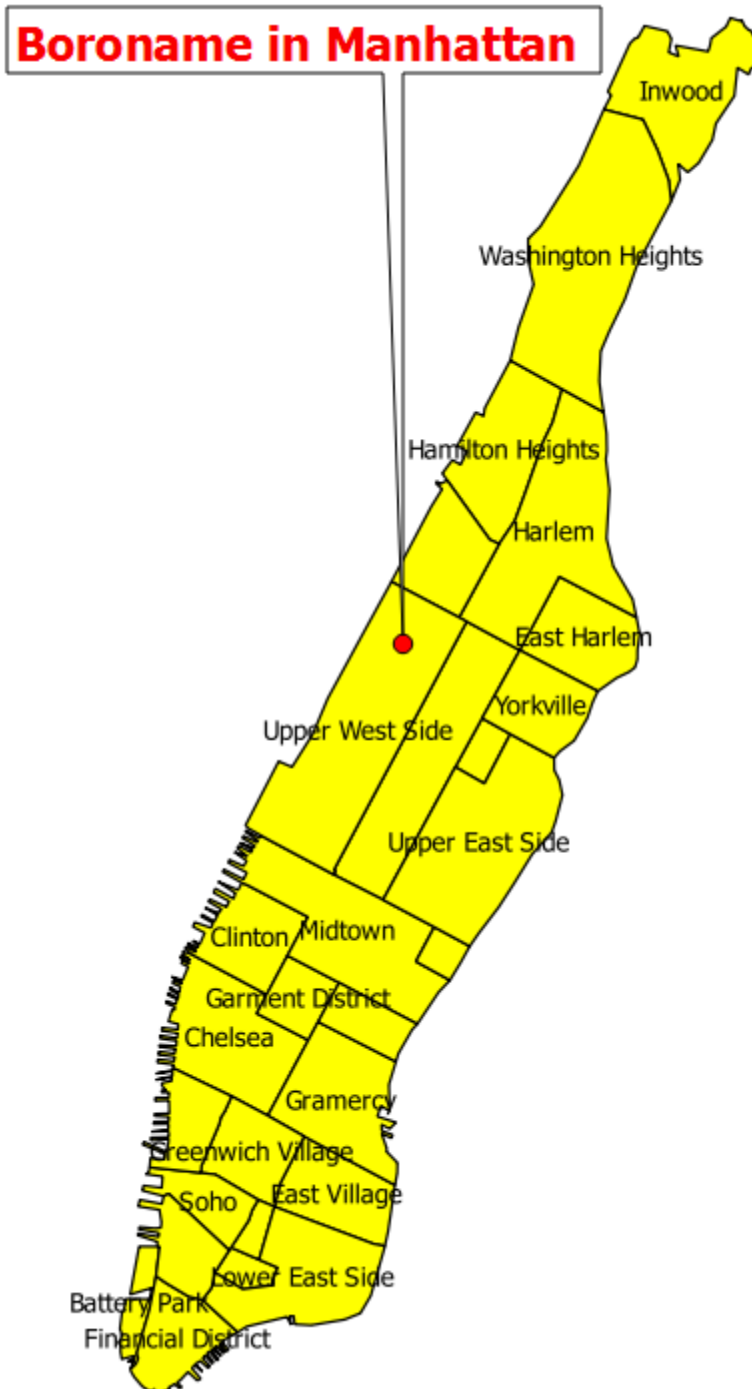


Fig 24: Spatial View of Boroughs of Manhattan

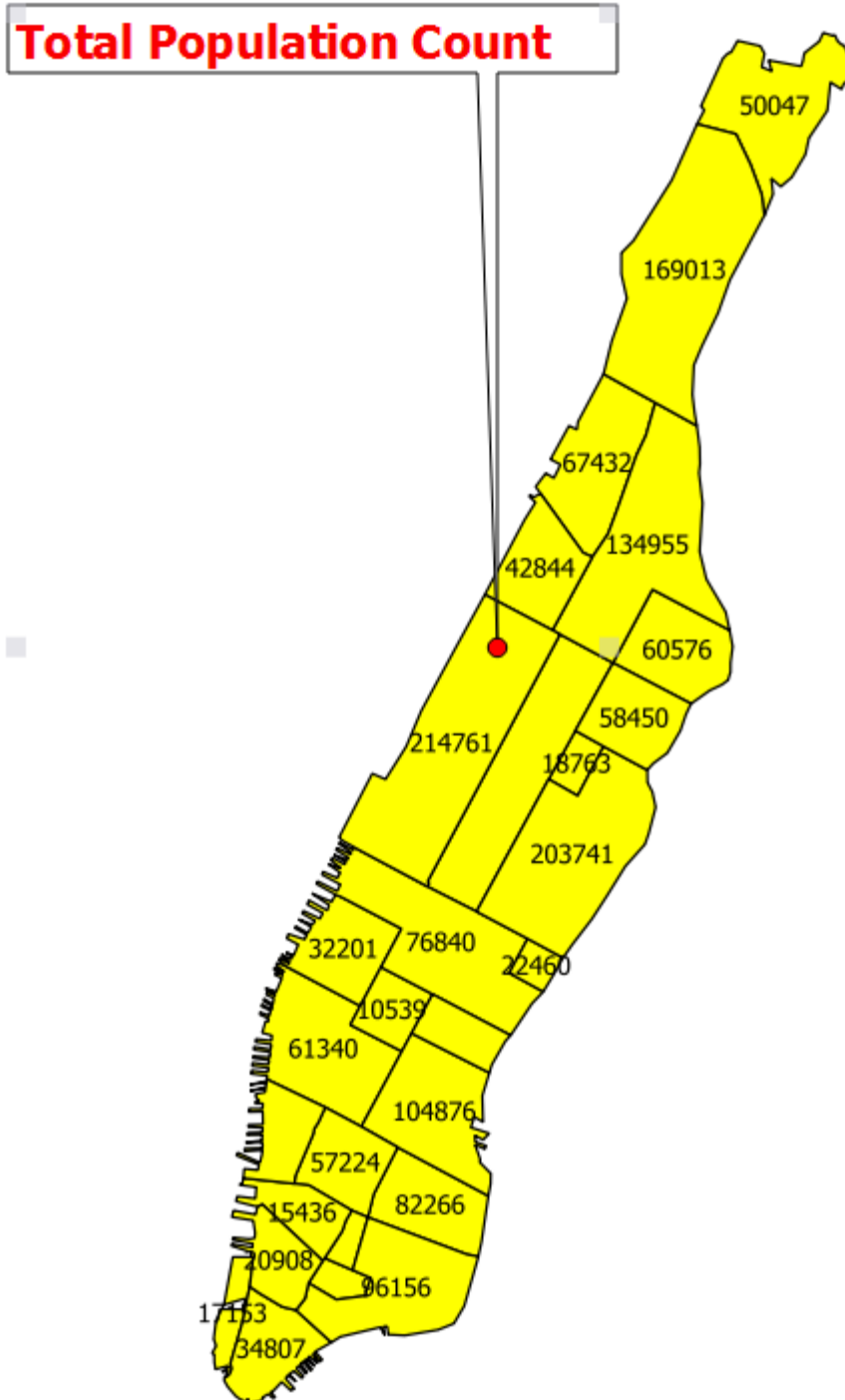


Fig 25: Spatial View of population count of Boroughs of Manhattan

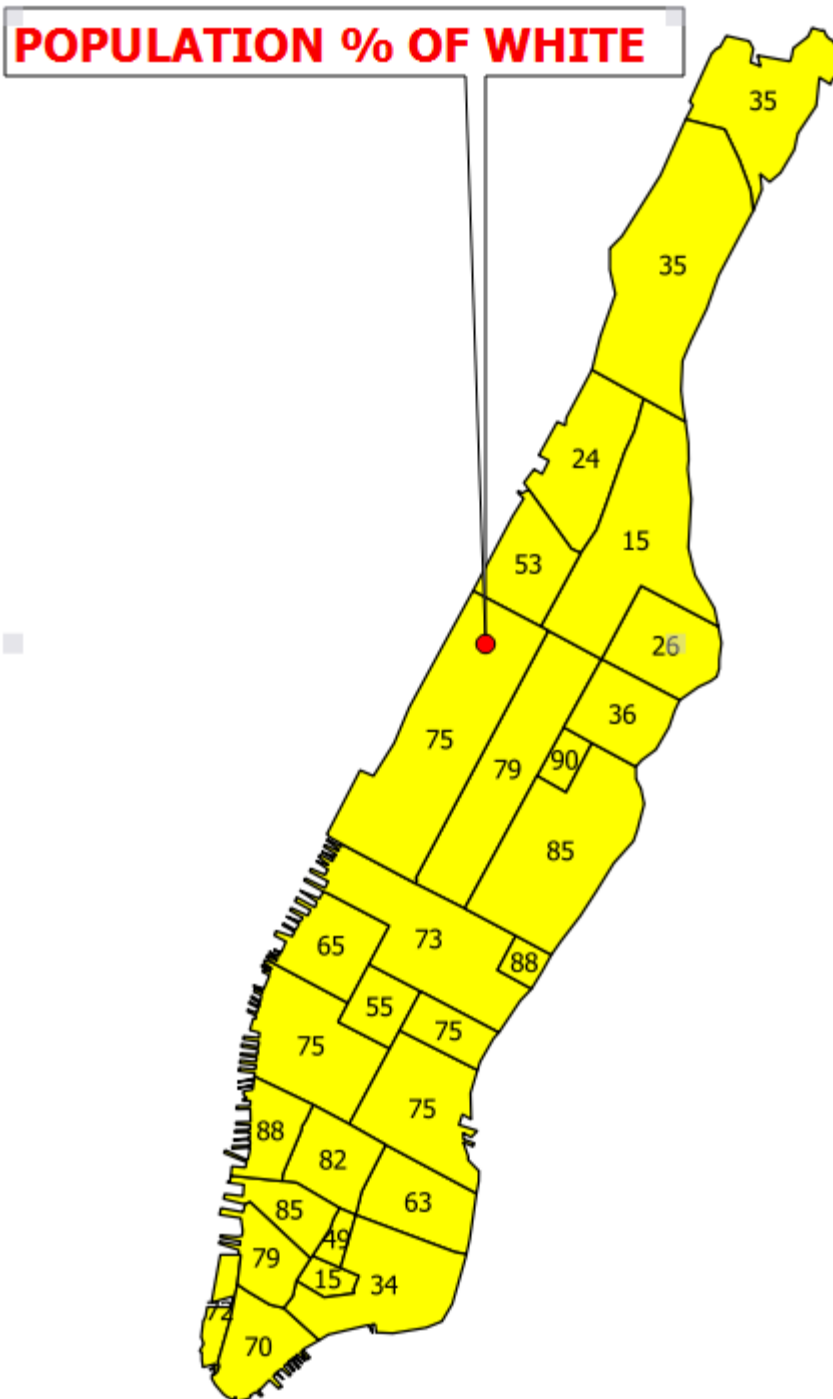


Fig 26: Spatial View of percentage of White Population in Boroughs of Manhattan



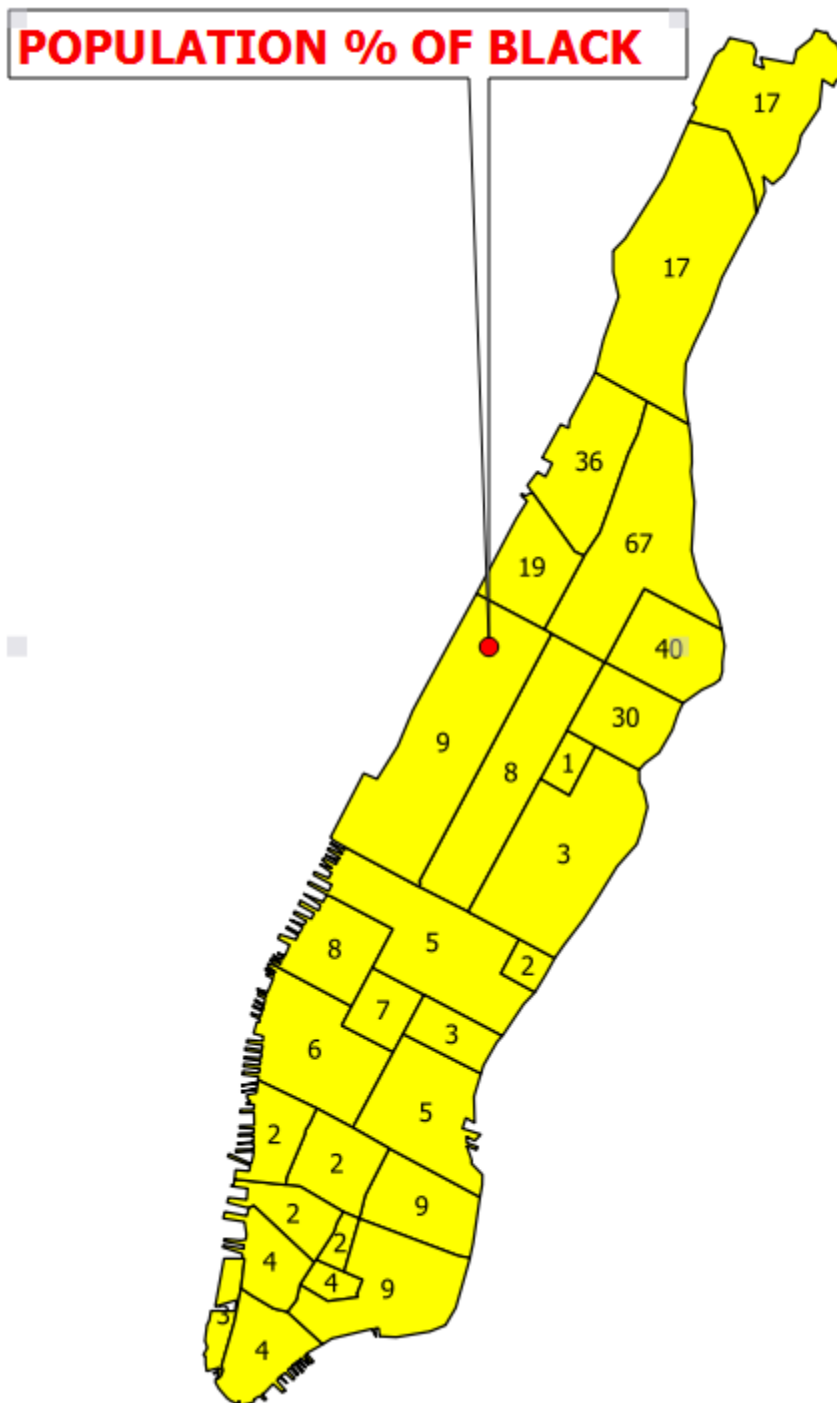


Fig 27: Spatial View of Percentage of Black Population in Boroughs of Manhattan



Fig 28: Spatial View of percentage of Native population in the Boroughs of Manhattan

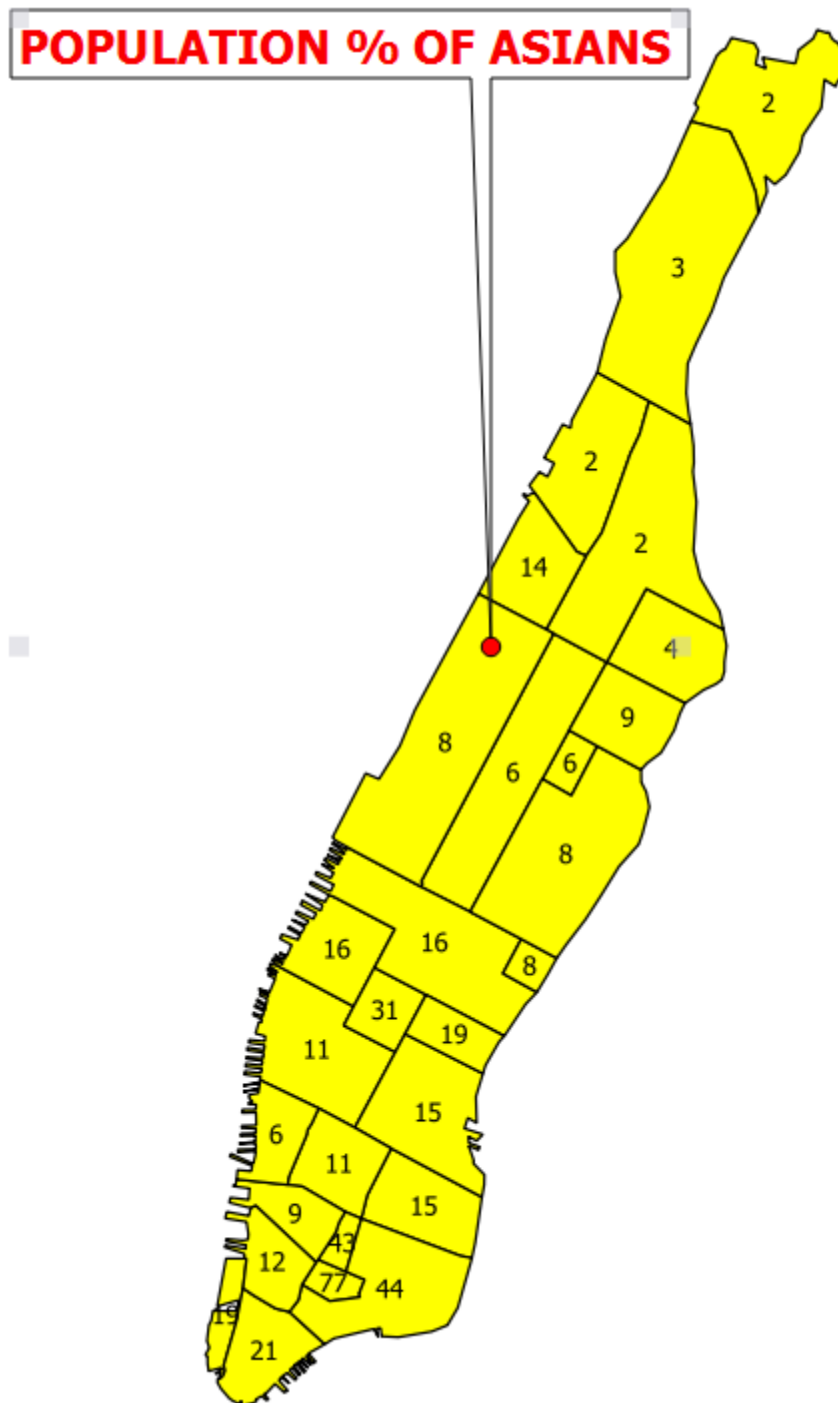


Fig 29: Spatial View of Percentage of Asians in the Boroughs of Manhattan

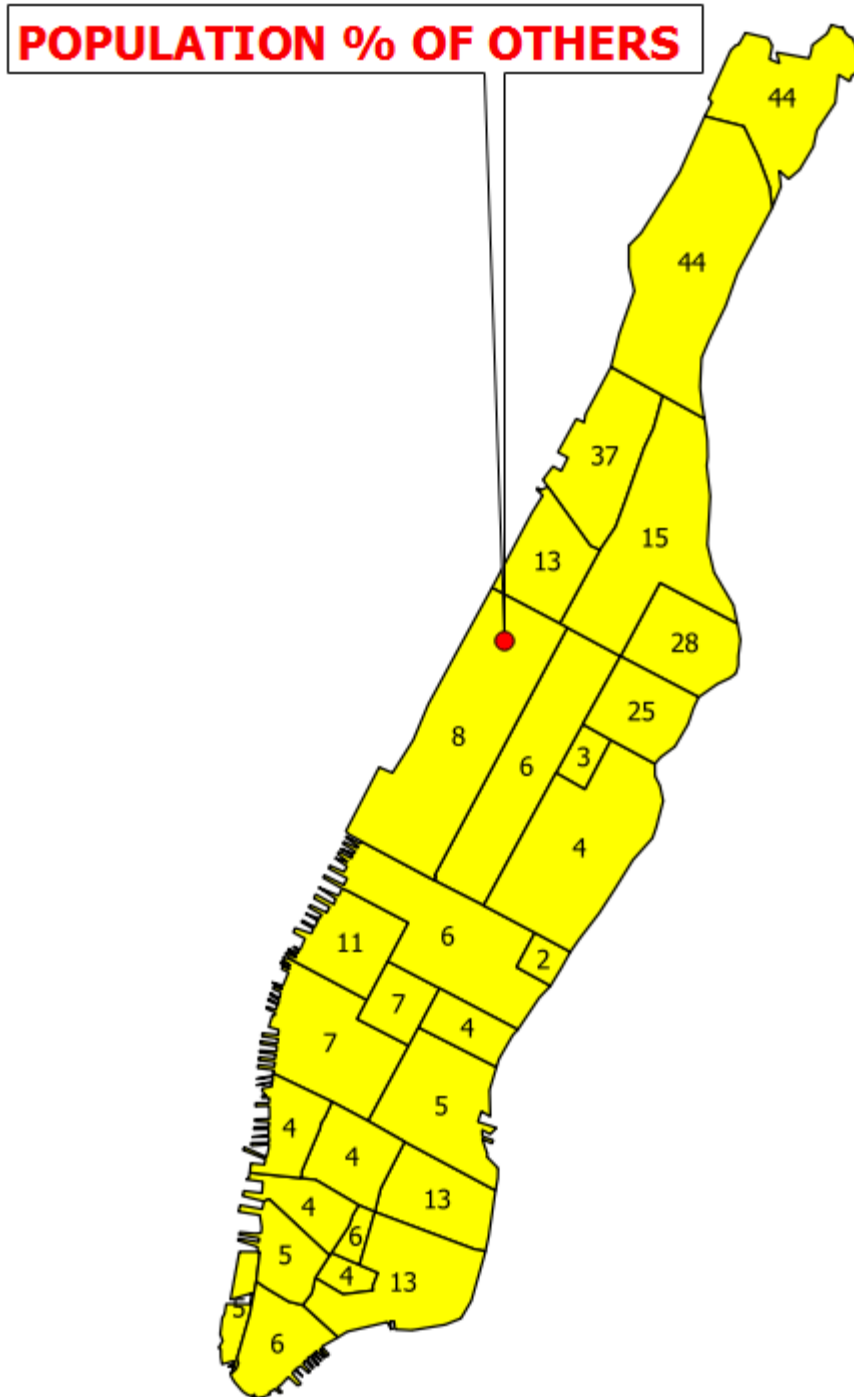


Fig 30: Spatial View of Percentage of Others in the Boroughs of Manhattan

➤ **Result:**

| NAME                | TOTAL_POPULATION_COUNT | TOTAL_POPULATION_WHITE | TOTAL_POPULATION_BLACK | TOTAL_POPULATION_NATIVE | TOTAL_POPULATION_ASIAN | TOTAL_POPULATION_OTHERS |
|---------------------|------------------------|------------------------|------------------------|-------------------------|------------------------|-------------------------|
| Battery Park        | 17153                  | 72                     | 3                      | 0                       | 19                     | 5                       |
| Carnegie Hill       | 18763                  | 90                     | 1                      | 0                       | 6                      | 3                       |
| Central Park        | 46600                  | 79                     | 8                      | 0                       | 6                      | 6                       |
| Chelsea             | 61340                  | 75                     | 6                      | 0                       | 11                     | 7                       |
| Chinatown           | 16209                  | 15                     | 4                      | 0                       | 77                     | 4                       |
| Clinton             | 32201                  | 65                     | 8                      | 0                       | 16                     | 11                      |
| East Harlem         | 60576                  | 26                     | 40                     | 1                       | 4                      | 28                      |
| East Village        | 82266                  | 63                     | 9                      | 0                       | 15                     | 13                      |
| Financial District  | 34807                  | 70                     | 4                      | 0                       | 21                     | 6                       |
| Garment District    | 10539                  | 55                     | 7                      | 0                       | 31                     | 7                       |
| Gramercy            | 104876                 | 75                     | 5                      | 0                       | 15                     | 5                       |
| Greenwich Village   | 57224                  | 82                     | 2                      | 0                       | 11                     | 4                       |
| Hamilton Heights    | 67432                  | 24                     | 36                     | 1                       | 2                      | 37                      |
| Harlem              | 134955                 | 15                     | 67                     | 1                       | 2                      | 15                      |
| Inwood              | 50047                  | 35                     | 17                     | 1                       | 2                      | 44                      |
| Little Italy        | 12568                  | 49                     | 2                      | 0                       | 43                     | 6                       |
| Lower East Side     | 96156                  | 34                     | 9                      | 0                       | 44                     | 13                      |
| Midtown             | 76840                  | 73                     | 5                      | 0                       | 16                     | 6                       |
| Morningside Heights | 42844                  | 53                     | 19                     | 1                       | 14                     | 13                      |
| Murray Hill         | 29655                  | 75                     | 3                      | 0                       | 19                     | 4                       |
| North Sutton Area   | 22460                  | 88                     | 2                      | 0                       | 8                      | 2                       |
| Soho                | 15436                  | 85                     | 2                      | 0                       | 9                      | 4                       |
| Tribeca             | 20908                  | 79                     | 4                      | 0                       | 12                     | 5                       |
| Upper               | 203741                 | 85                     | 3                      | 0                       | 8                      | 4                       |

|                    |        |    |    |   |   |    |
|--------------------|--------|----|----|---|---|----|
| East Side          |        |    |    |   |   |    |
| Upper West Side    | 214761 | 75 | 9  | 0 | 8 | 8  |
| Washington Heights | 169013 | 35 | 17 | 1 | 3 | 44 |
| West Village       | 26718  | 88 | 2  | 0 | 6 | 4  |
| Yorkville          | 58450  | 36 | 30 | 1 | 9 | 25 |

### Q23: What subway station is in 'Bensonhurst'?

➤ *Select s.LONG\_NAME*

*FROM nyc\_subway\_stations AS s, nyc\_neighborhoods AS n*

*WHERE N.NAME = 'Bensonhurst' and CONTAINS(n.Geometry, s.Geometry )*

➤ **Result:**

| <b>LONG_NAME</b>        |
|-------------------------|
| 18th Ave (D,M) Brooklyn |
| 20th Ave (D,M) Brooklyn |
| 71st St (D,M) Brooklyn  |
| 79th St (D,M) Brooklyn  |
| Bay Pky (D,M) Brooklyn  |
| Bay Pky (N) Brooklyn    |

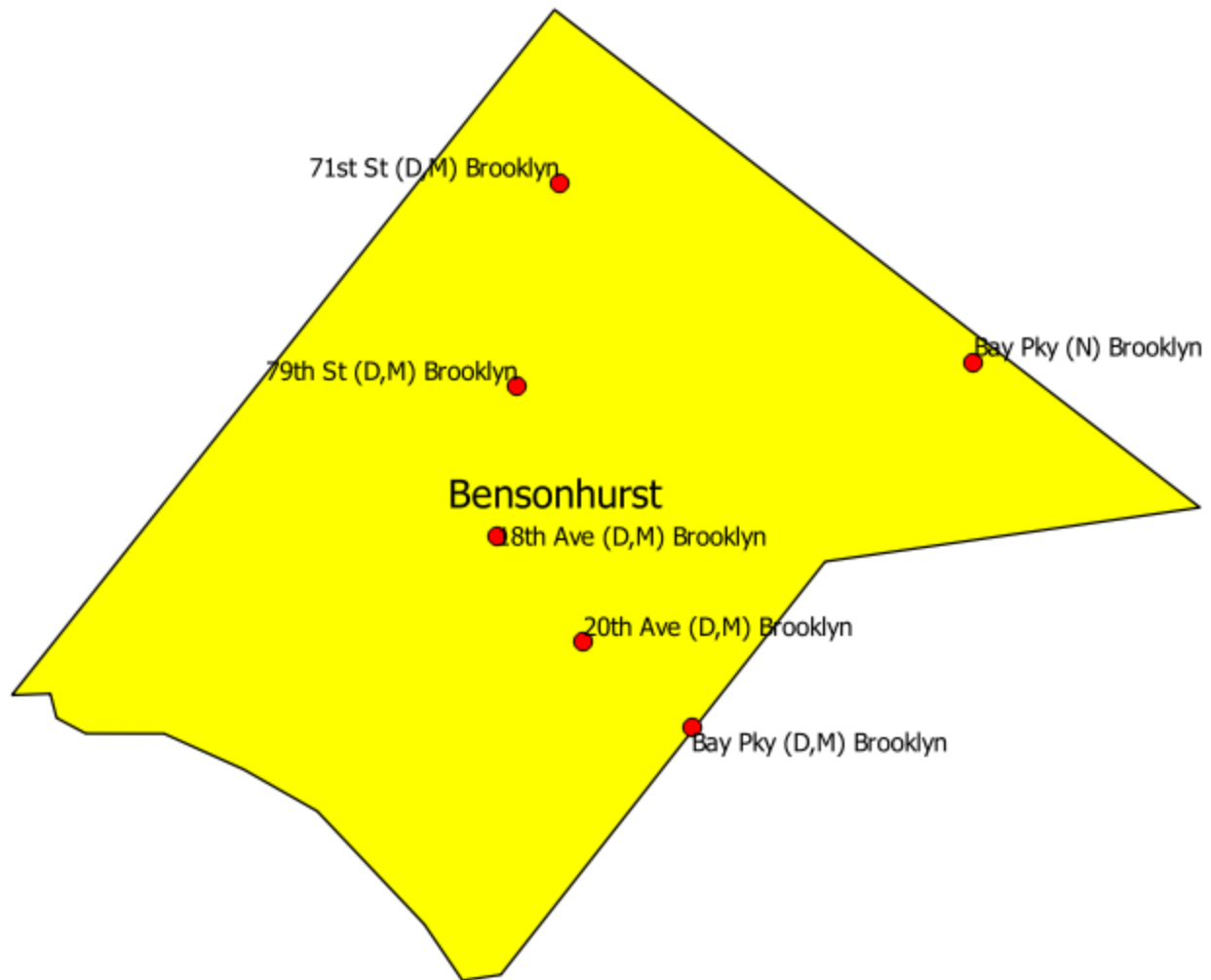


Fig 31: Spatial View of Subway stations in 'Bensonhurst'

Q24: What is the closest street to 'Cortlandt' subway station?

```
➤ SELECT s.NAME,ST_DISTANCE(s.Geometry,sub.Geometry) as Distance_Cortlandt
FROM nyc_streets as s,nyc_subway_stations as sub
WHERE sub.NAME = 'Cortlandt St'
ORDER BY Distance_Cortlandt asc
LIMIT 1;
```

➤ **RESULT:**

| NAME      | Distance_Cortlandt |
|-----------|--------------------|
| Church St | 0.384313           |

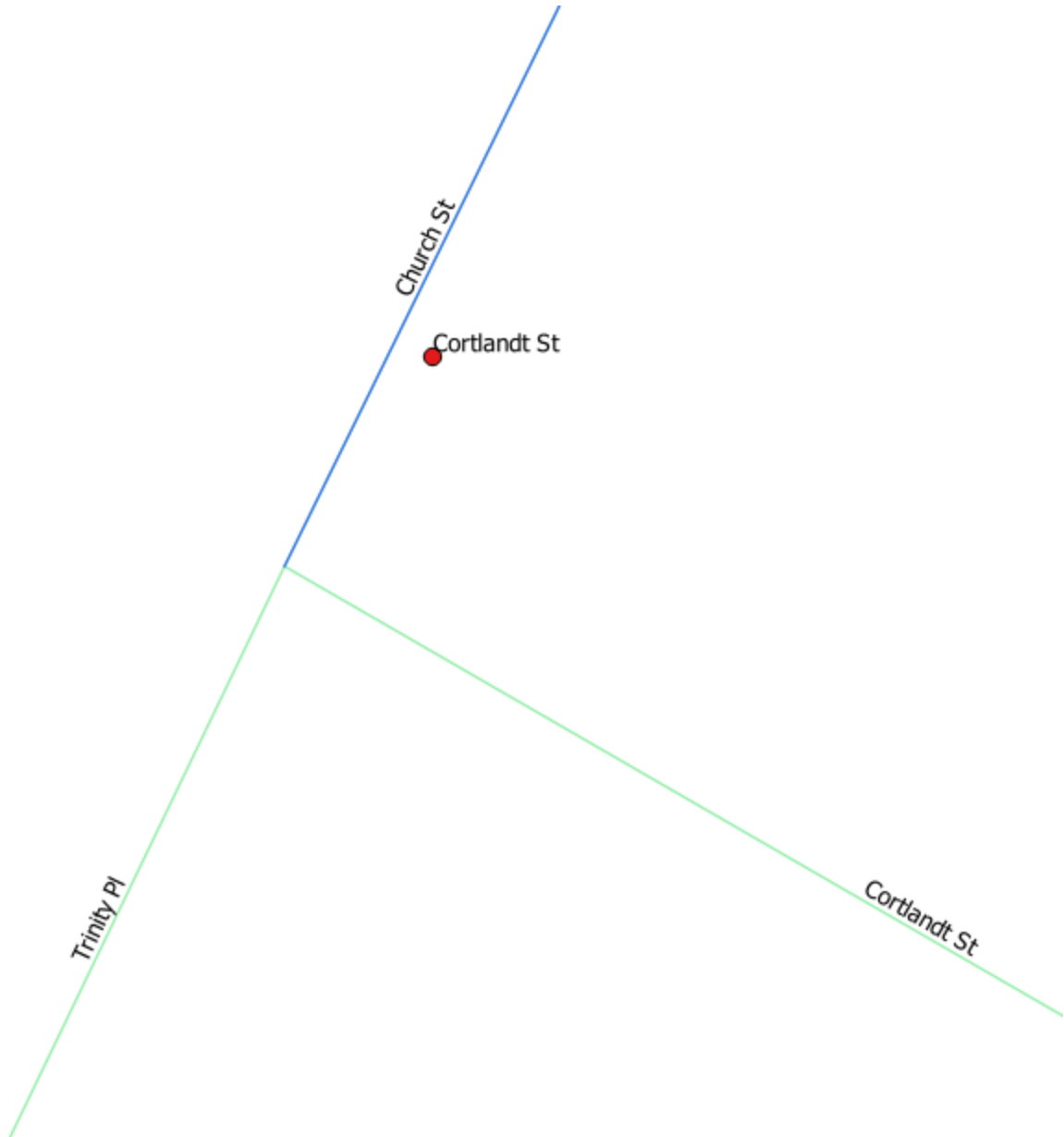


Fig 32: Spatial View of Street closest to 'Cortlandt' Subway Station



### *References*

<http://www.gaia-gis.it/spatialite-2.4.0-4/spatialite-sql-2.4-4.html>  
[http://www.qgistutorials.com/en/docs/performing\\_spatial\\_queries.html](http://www.qgistutorials.com/en/docs/performing_spatial_queries.html)  
[http://docs.qgis.org/2.0/en/docs/training\\_manual/databases/spatialite.html](http://docs.qgis.org/2.0/en/docs/training_manual/databases/spatialite.html)  
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<http://www.gaia-gis.it/gaia-sins/spatialite-sql-4.2.0.html#p4>  
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