A Subway Analysis of New York City Charter Schools

Charisse Gulosino
James Crocker

Abstract

The study explores the accessibility of prospective charter school sites to at-risk and special-needs populations and connected high-need public schools. Current New York City Department of Education data is used to determine the spatial terrain of public elementary and middle school high-need areas. The spatial analysis is superimposed on the subway public transportation network to produce a subway map of stops and lines quantified by over a wide range of potential students attending high-need public schools. Following the need-based and market-based models of school provision, this unique aspect of charter schools has not been fully explored in terms of subway accessibility. The study suggests that charter schools may find market niches in pockets of needs, the vulnerable and high-risk student populations in particular. This has implications for the potential equity and competitive dimensions of charter schools.

Introduction

Almost without exception, the general expectation in the charter school literature is for students and their families to exercise schooling options from a much wider attendance catchment area beyond their immediate neighborhood (Henig, 1994; Cullen et al., 2005). Because of the chronic gap in the quality of educational options and academic outcomes, many see charter schools as the most promising route for freeing under-served students and minority communities trapped in failing inner-city schools. Given the inequities of the present public school system, choice-based policies such as charter schools may be necessary to increase the educational opportunities available to poor households who are trapped in failing schools. This is true in New York City (NYC), where the current fifty-eighth charter schools are designed to serve specific types of students, especially students with disabilities and students designated at-risk.

Charter schools receive the lion's share of their funding operations through voucher-like allocations that travel with students. Geographic location is a critical factor for serving different student populations for several reasons. First, the physical location of charter schools serving disadvantaged populations is critical as distance may affect their ability to "vote with their feet" and exercise different schooling options (Holmes et al., 2006). Second, since some states do not fund the transportation of charter school students, lack of transportation may inhibit low-income, single-parent families from trying to arrange choice options for their children. Third, a lack of available transportation options (due to shortages of public transportation in rural and suburban areas) and a lack of access to existing transportation services (due to little coordination between school district and charter operators) may affect choice opportunities for special-needs children and other vulnerable populations. Finally, an often-heard concern over charter schools is that competition for high-quality student outcomes may put pressure on them to avoid locating in neighborhoods in proximity to at-risk and special-needs population (Lacireno-Paquet et al., 2002).

Location is ever-present as a choice factor in the published studies; however, there is little research examining the spatial distribution of charter schools over a wide range of potential students attending high-need public schools (Henig and MacDonald, 2002; Bettinger, 1999; Lubienski, 2005). This paper analyzes the location of charter schools using the subway network in order to provide some preliminary insights into the relationship between charter school locations and accessibility of these choice options for noncharter, special student populations. A typical subway network consists of several stations distributed throughout NYC connected by a network of lines. In this study, the subway network provides the context for visually representing the accessibility of charter school locations to targeted student populations such as low-income, special needs, and limited English proficient students.

The focus on subway network and its importance for charter schools is based upon four assumptions. First, the interconnected subway lines along high-need public schools and the density of charter school locations from the subway stations represent the options or accessibility incentives provided by school choice (i.e., location and convenience). Access also implies that admission processes of charter schools are fair and open, and that specific student populations are not avoided. Second, the fact that the majority of NYC charter schools tend to cluster, those clustered schools have the potential to penetrate the market for student enrollments or particular types of students. Third, accessibility and clustering of charter schools to potential students may enhance the marketing strategies and management of schools competing for students (Lubienski, 2003a, 2003b). Finally, the charter schools' knowledge of spatial connectivity to potential students may increase the synergy of complementary services (i.e., potential spillover benefits or positive externalities from adjacent competitors) needed by students that they serve and bring resources into the high-need public schools where they operate. These underlying assumptions have not been fully explored in terms of transportation accessibility, a subway network analysis in particular.

The remainder of the paper is organized as follows. The second section describes the conceptual framework of the study. The third section examines the data and methodology. The fourth section analyzes the findings using a Geographic Information System (GIS). The final section concludes and discusses policy implications.

Conceptual Framework

The literature review focuses and analyzes what choice scholars such as Henig (2002) and Levin (2003), to mention a few, call the 'need-based' and 'market-based' models of charter school provision. Proponents of the 'need-based model' argue that charter schools tap a higher proportion of disadvantaged students as major potential market. Most studies assume that the number and distribution of organizations with a social mission orientation will be positively associated with the provision of services for particular categories of need (Henig et al., 2000). Other studies confirm that nearly all charter school target "at-risk" populations who are worst served by their surrounding district (Manno et al., 1998). Indeed, charter school founding teams may cite at-risk students as the primary reason for creating charter schools. Charter schools as newly created schools can specifically recruit and/or provide an alternative for at-risk, low-income, minority, and special-needs students by addressing their multiple needs in a coordinated manner. Although charter schools cannot limit enrollment to a particular area, the New York charter legislation gives preference to new schools that serve students who are minority or at-risk of academic failure.

Under a 'market-like' schooling arrangement, students and their parents are matched to the types of schooling that meet their needs because of the variety of charter schools that could emerge and the incentives of charter schools to be responsive to the needs of diverse student populations. According to Levin (1991, 1998), schools maximize their objective functions by choosing an input mix and an effort level. Thus, various combinations of inputs and effort will naturally attract different groups of applicants in charter schools. Although the regulatory environment of NYC charter schools involve the use of a lottery system to select potential students at random (for instance, state law forbid charter schools from discriminating in their enrollment practices), sufficient incentives are being created to attract disproportionate numbers of difficult-to-teach students.

Both need-based and market-based models lend themselves to a subway analysis. Following the market-like model, the interconnected subway stations represent the arrangement of available charter school options for diverse families that are competing with existing public schools. The key dynamics of the market are choice and competition, demonstrated by the pool of potential students and the clustering of charter school near buffered subway stations. The capacity of a school to be reached by potential student populations, clustered around an ordered connection of subway stations, may open up possibilities for students who are locked into public school high-need areas. Further, the connectivity between nearby subway stations and charter school locations represent the incentives to locate nearer public school high-need areas where potential difficult-to-serve populations are most likely to reside. Because of the transportation system of New York City (NYC) is highly extensive, moderate-to-high service areas are well served by the subway system, with most of the city's subway lines stopping across the entire service spectrum. The information about subway routes can be used to capture and cultivate the interest of charter schools to take advantage of the potential for developing schools in high need areas while also creating competitive advantage through competitive positioning.

Data and Methodology

The general descriptive measures used in this study fall under the framework of need and market. In order to measure need and market, a number of variables on public schools were collected for all New York City (NYC) in elementary and middle grade levels. One measure of need – a combination of poor performance and limited local resources – identifies schools as having high student needs relative to their capacity to raise revenues. New York City Department of Education (NYCDOE) designated schools as high-need, medium-need, and low-need. On the other hand, the education market is measured in terms of attracting potential students from low-income, English Language Learners (ELL), and special education population.

NYCDOE provided us with tabular data in the form of a MS Access database for the 2003- 2004 school year. The database contained the data, queries and reports for the Department's annual report. The five DOE tables and their attributes used in our analysis are:
1. School addresses (street address, ZIP)
2. Need Groups (High, Medium, Low)
3. English Language Learners (percent)
4. Special Ed (percent full time)
5. Free/Reduced Lunch (percent free lunch)

The data analysis of the above variables is superimposed on the public transportation subway network to produce a subway map of stops and lines. Shapefiles for NYC subway lines and stations is provided through Columbia University's Electronic Data Service (EDS) archive. Borough and Instructional Region shapefiles are available for download from NYC Department of City Planning's Bytes of the Big Apple website. The table of school addresses is geocoded to 1,211 point features of primary and middle school locations. Using the attribute school ID, bds (combined ID's for boro, school district and school) as the join field, the point features are joined to the four data tables with their respective educational need attributes. Using the Spatial Analyst extension, density rasters of school point features are created using the following attributes for each school:
1. Need Groups - High Need selected point features
2. English Language Learners - Percent
3. Special Ed - Percent Full Time
4. Free/Reduced Lunch - Percent Free Lunch

Each of the resulting four rasters is then reclassed in into ranks 1 to 10. Using the Raster Calculator the four reclassed rasters are added, resulting in an overall raster of Educational Service Need Areas (ESNAs) in nine equal interval ranks with values from 4 to 40. From the geocoded charter school addresses, the resulting charter school point features are used to produce a density raster of charter locations areas by school capacity. This raster is reclassed in ranks 1-10.

Using the Raster Calculator again, the ranked densities raster for Charter Locations areas are subtracted from the ranked ESNA raster to get a raster of Educational Service Need Areas Without the Charter Schools (ESNAWOCS). The raster of ESNAWOCS is converted into polygon features and displayed in ten ranks. The highest three ranks- values greater than 28 are selected and saved as a new layer defining the ESNAWOCS. That feature is then dissolved to define the targeted need area. Primary and Middle Schools that fall within the need areas are selected and displayed by each of the four levels of need.

The new fields for x and y coordinates are added to the attribute table for the subway station shapefile and values are calculated for them. The table is exported and added to the map. The station points are remapped with their x and y values for all subway stations.

A spatial join is then created between charter school points and all subway stations with the output for each charter the attributes of the nearest station (station name, connecting subway lines, xy coordinates, etc.) and the distance to it. That table is exported and added to the map. The charters are added to the map using their xy coordinates and displayed by their distance to subway stations. The nearest subway stations are mapped by their xy coordinates. A histogram of the count of the nearest stations within ten ranges of distances from charters is created and added to the map.

Subway station point features within the need area (ESNSWOCS) are selected with the need area buffered to .25 miles and saved as a new layer of ESNAWOCS subway stations. ESNAWOCS schools are similarly spatially joined to the ESNAWOCS subway stations to determine their distances to the nearest subway stations, and a histogram of their distribution created. A matrix of charter schools ranked by level of station proximity to high need public schools in the ESNAWOCS ranked by their station proximity is created.

Results

Map 1 displays the location of all public primary and middle schools within NYC's five Boros this paper analyzes by education service needs spatially.
Map 2 shows the ranked spatial densities of public school locations by classification as belonging to NYC DOE's high need grouping, the percent of full time special education pupils, the percent of pupils English language learners, and the percent of pupils qualified for free lunch. It is readily seen that the

four need rasters show areas of the highest need in the Bronx with areas of lower concentrations in Brooklyn.

Map 3 distills the four need spatial distributions of Map 2 into a single NYC map of Education Service Need Areas (ESNA) of ranked need. This map reflects the combined effect of the four need types by defining an area of the very highest need for NYC in one area in the Bronx.

Map 4 overlaying the location of charter schools on the NYC ESNA shows that most charters are located in the proximity to high need areas and also tend to cluster. It also shows that the highest need areas are without charter school locations.

Map 5 attempts to more precisely gauge the potential impact of charters (by their student population) on the NYC ESNA by a ranked spatial density analysis.

Map 6 shows the result of removing the areas impacted by existing charter schools from the ESNA. This is the map of Education Service Need Areas Without Charter Schools or ESNAWOCS. This map clearly reveals one major area of extreme need for NYC. This area needs to be further defined by determining its boundaries.

Map 7 is the polygon version of Map 6 converted from its raster form allowing the continued analysis of the ESNAWOCS.

Map 8 is the selection of the top three ranks of ESNAWOCS ten need levels shown in Map 7 (28 through 39).

Map 9 combines by dissolving the interior boundaries into the two bounded areas of the highest need levels for Education Service Need Areas without Charter Schools for NYC. The larger is in the Bronx and the smaller in northern Manhattan.

Map 10 shows the “connectedness” of charter schools to the NYC subway network by their proximity to their nearest subway station. It also shows the distance relationships between charters and the two highest need ESNAWOCS in the Bronx and Northern Manhattan. The histogram reveals that the majority of charters are well connected to the subway system. Of the 52 charter schools 39 are located less than .313 miles from a subway station.

Map 11 examines the “connectedness” of the 40 public schools within the ESNAWOCS to the subway system by their proximity to the nearest subway station. The histogram shows that 29 public schools are located less than .472 miles. The public schools in the highest education service need areas appear to be less well connected to the subway system than charter schools citywide.

Map 12 separates out the least well “connected” public schools in the ESNAWOCS. The eight schools symbolized as yellow circles are more than a half mile from a subway station. Potential charter school pupils in this high need area would probably find attending charter schools via a subway commute unattractive. As an alternative to delivering education services by subway, a charter school could choose to locate in this area. The red circle in the midst of the public schools is the most central location for a new charter school. All eight public schools fall within .3 mile of that potential site.

Conclusions and Implications

This paper proposes a GIS methodology (a subway network analysis) to identify connected potential student markets outside the tightly clustered set of charter schools. Following the need-based and market-based models of school provision, charter schools may offer new opportunities in public school high-need areas where existing schools are performing badly and they may cluster in areas to serve disadvantaged student populations. The mapping of the public school high-need landscape vis-à-vis public transportation linkages reveals that existing charter schools may expand in connected areas (near subway stations) with dense proportions of vulnerable students as free public schools. Increasing charter school enrollments of such students indicates accessibility of this choice for disadvantaged populations, thus helping to address issues of equity. This suggests that charter schools may find market niches in pockets of needs, the vulnerable and high-risk student populations in particular.

Results from this study have implications for future research and policy. In New York City, the growth in numbers of charters has resulted in clustering in high-need areas. The GIS findings fit expectations that charter schools will locate in public school high-need areas that are favored by legislation and authorizers. How it will play out over time in terms of competition over student markets in these areas is yet to be seen. The findings reported here demonstrate that unlike the NYC public schools that are bound to their catchment areas, those clustered charter schools have the potential to serve a somewhat more difficult-to-teach students traditionally handled by existing public schools or to expand into public school high-need areas with transportation linkages but without charter schools.

For a policy perspective, the results of this study suggest the potential equity and competitive dimensions of charter schools. However, before concluding that charter schools have the potential to stretch available resources and find market niches in pockets of needs, more research needs to be conducted to determine the broad range of factors that could be influenced by charter school location. Our spatial analyses do not control for a third set of factors such as the availability of facilities, low rents, and locational preferences over and above the connection between charter schools and need areas. These confounding variables can be examined empirically in future research.

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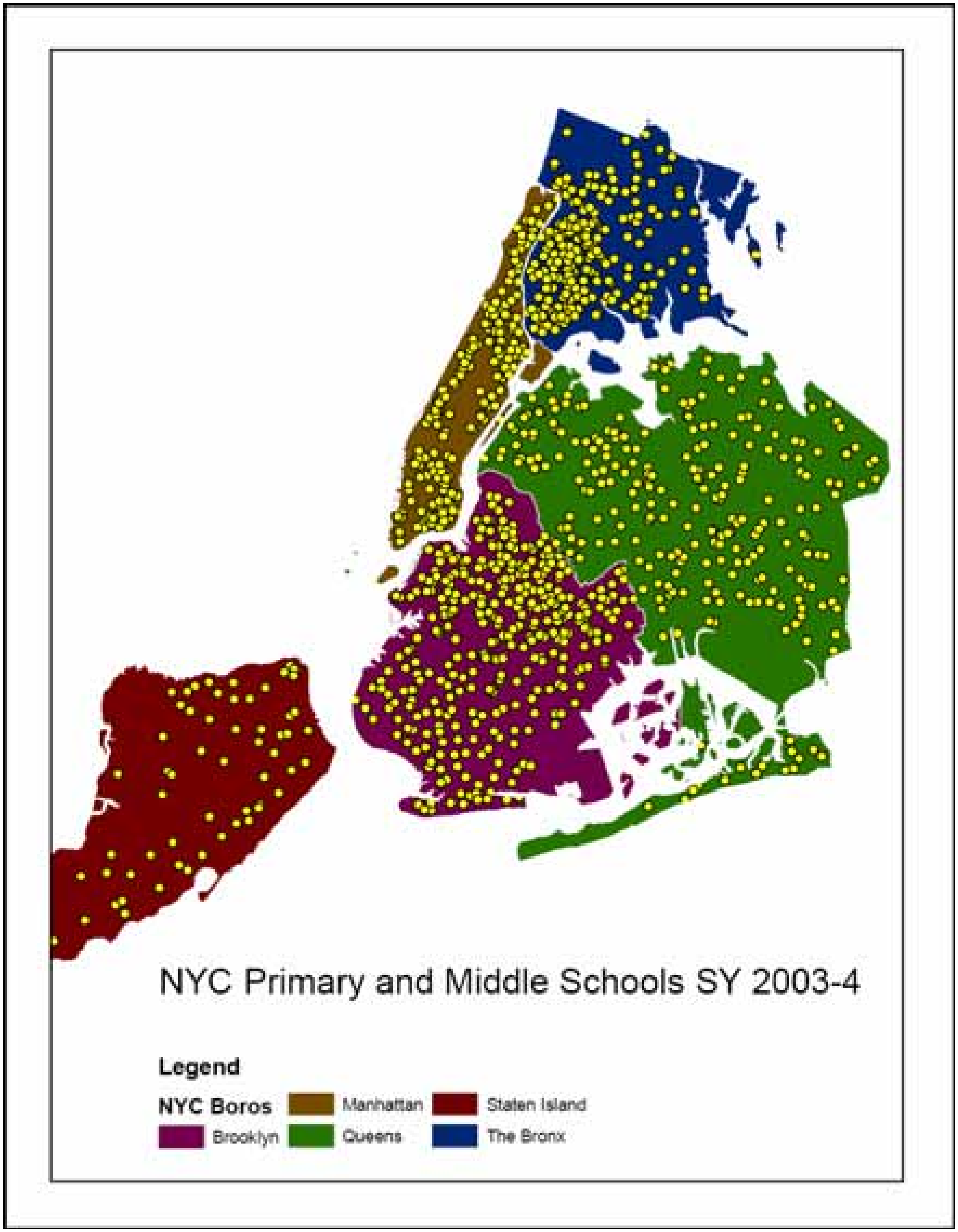
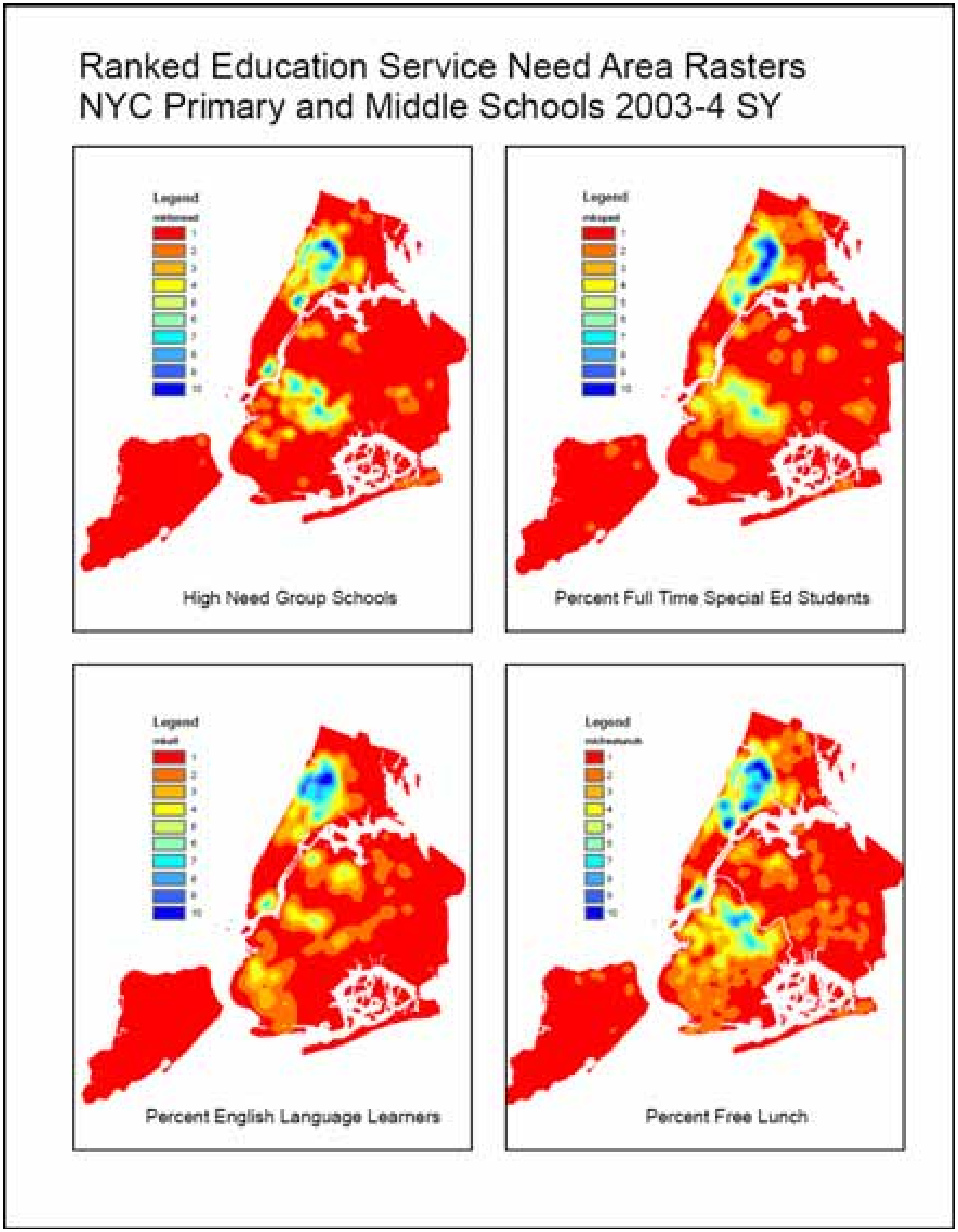
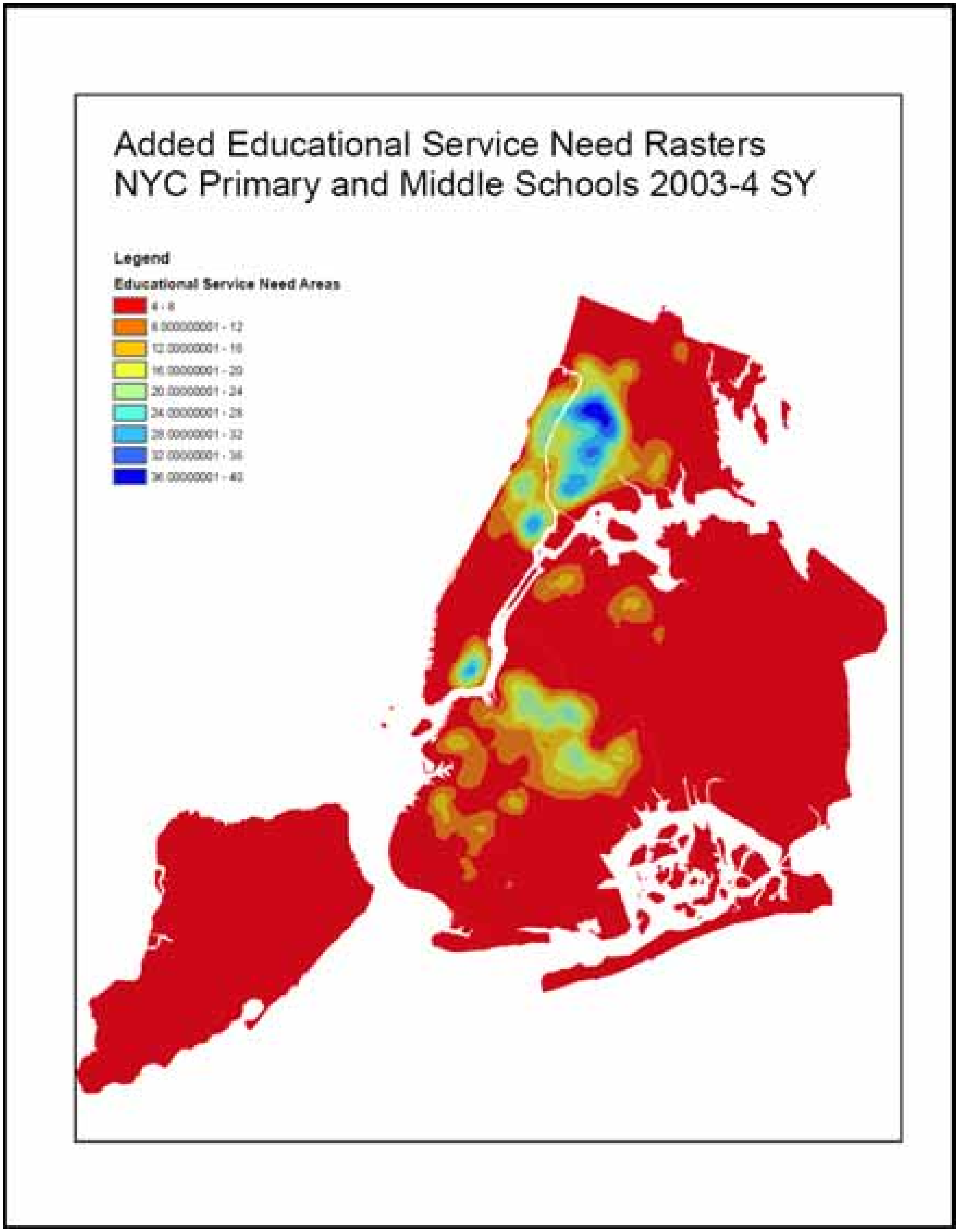

NYC Primary and Middle Schools SY 2003-4
Legend
NYC Boros
Manhattan
Staten Island
Brooklyn
Queens
The Bronx

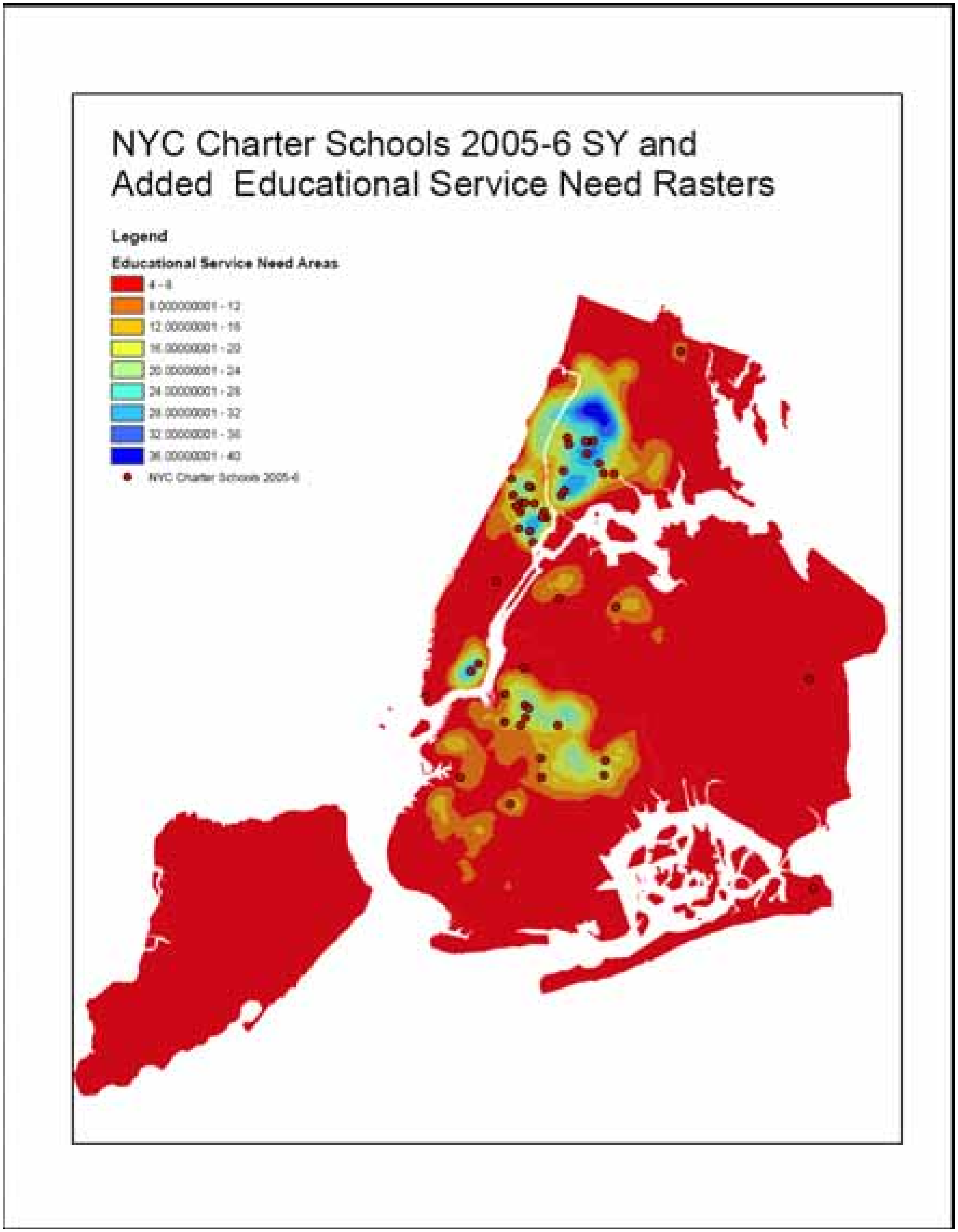
Map 1


Ranked Education Service Need Area Rasters
NYC Primary and Middle Schools 2003-4 SY
Legend
High Need Group Schools
Legend
Percent Full Time Special Ed Students
Legend
Percent English Language Learners
Legend
Percent Free Lunch

Map 2

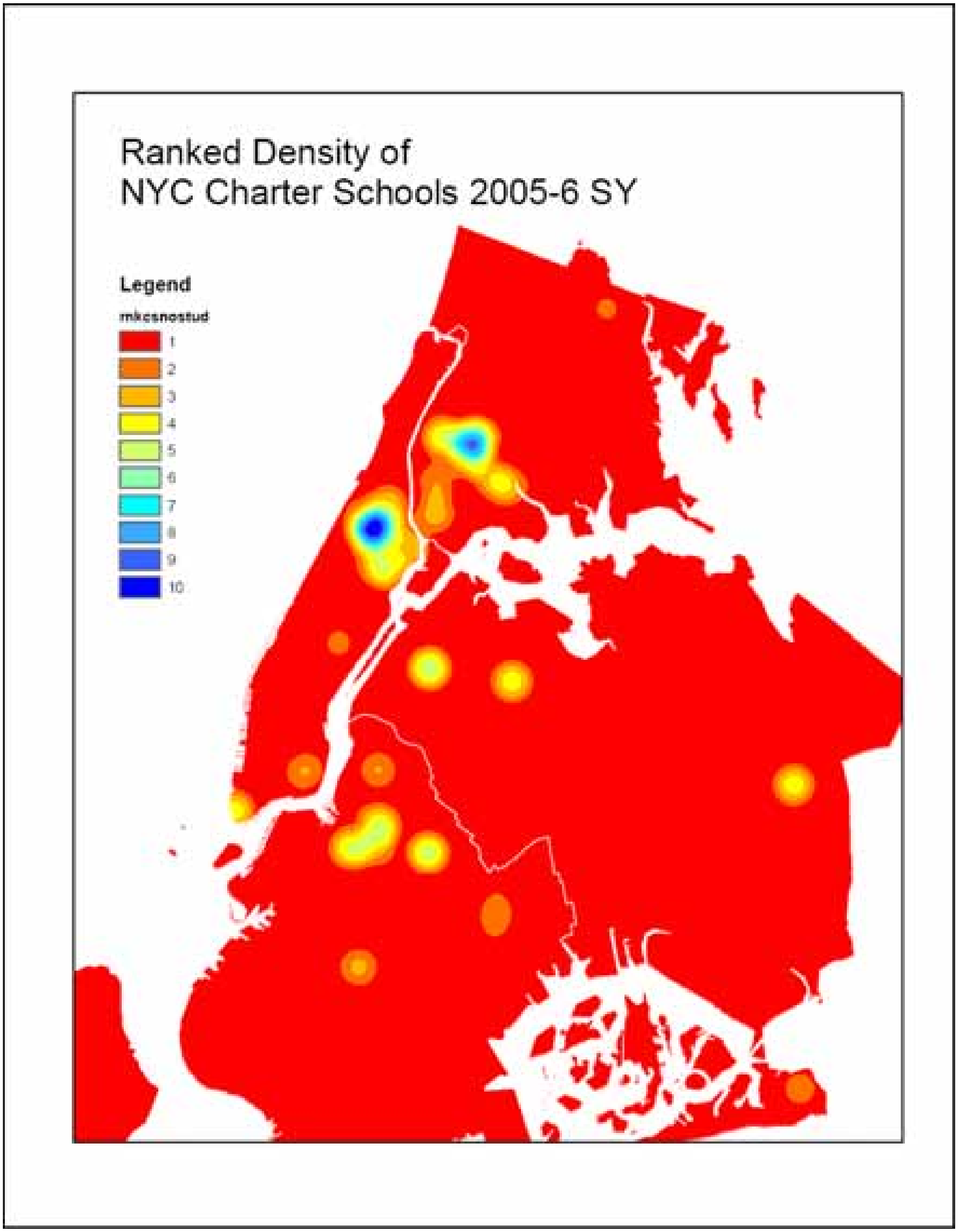

Added Educational Service Need Rasters
NYC Primary and Middle Schools 2003-4 SY
Legend
Educational Service Need Areas

Map 3

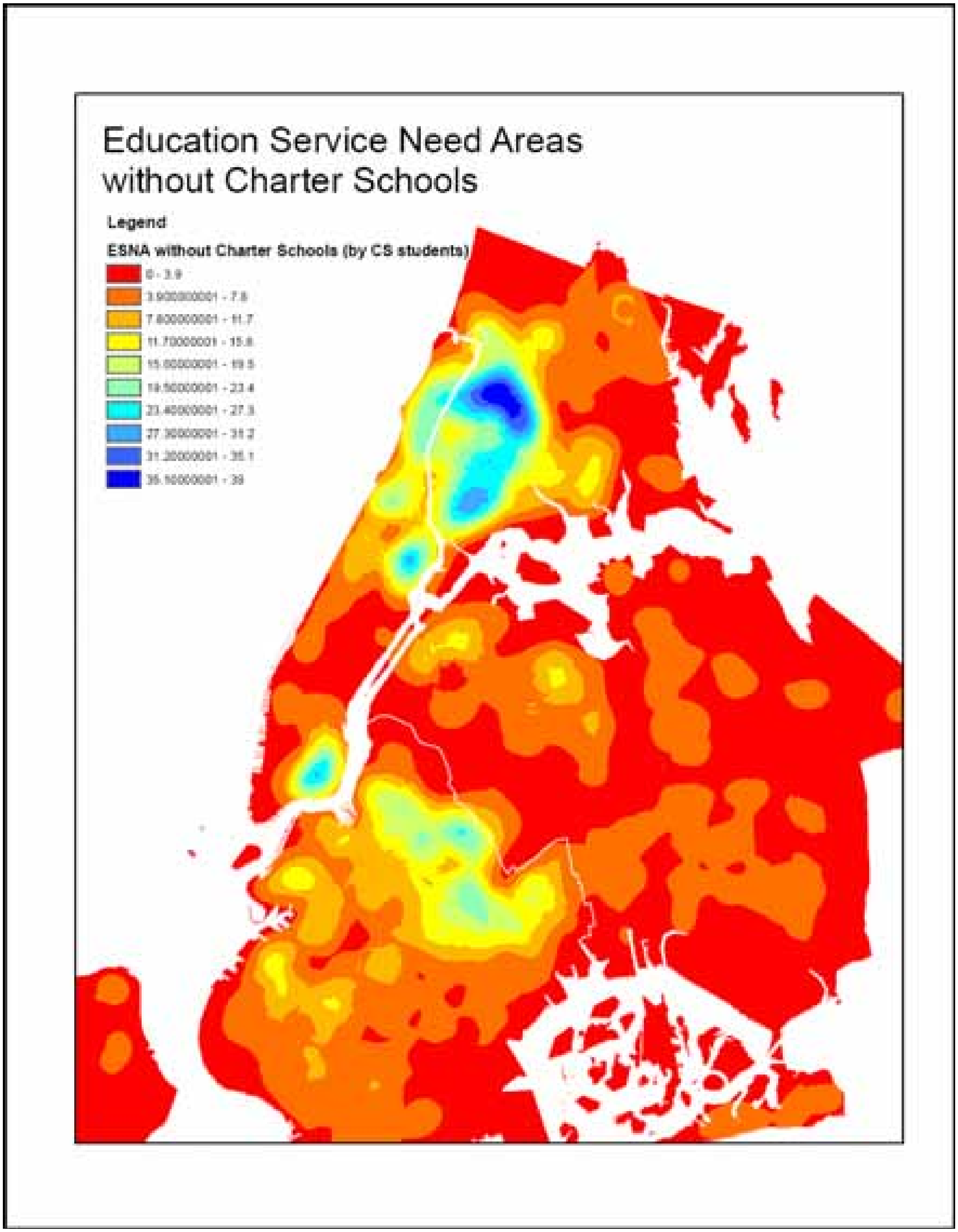


NYC Charter Schools 2005-6 SY and
Added Educational Service Need Rasters
Legend
Educational Service Need Areas
4 - 8
8.000000001 - 12
12.00000001 - 16
16.00000001 - 20
20.00000001 - 24
24.00000001 - 28
28.00000001 - 32
32.00000001 - 36
36.00000001 - 40
NYC Charter Schools 2005-6

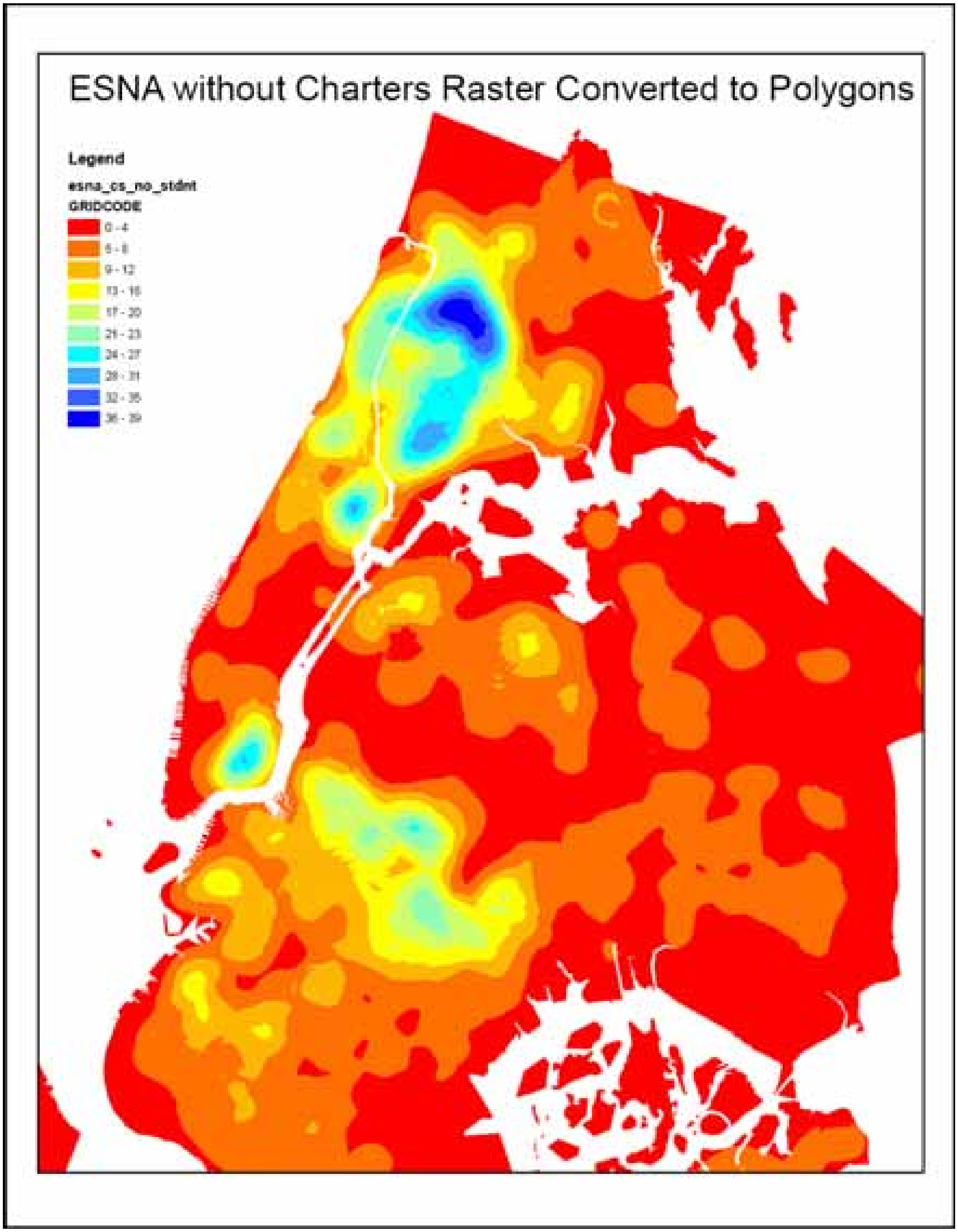
Map 4


Ranked Density of
NYC Charter Schools 2005-6 SY
Legend
mkcsnostud
1
2
3
4
5
6
7
8
9
10

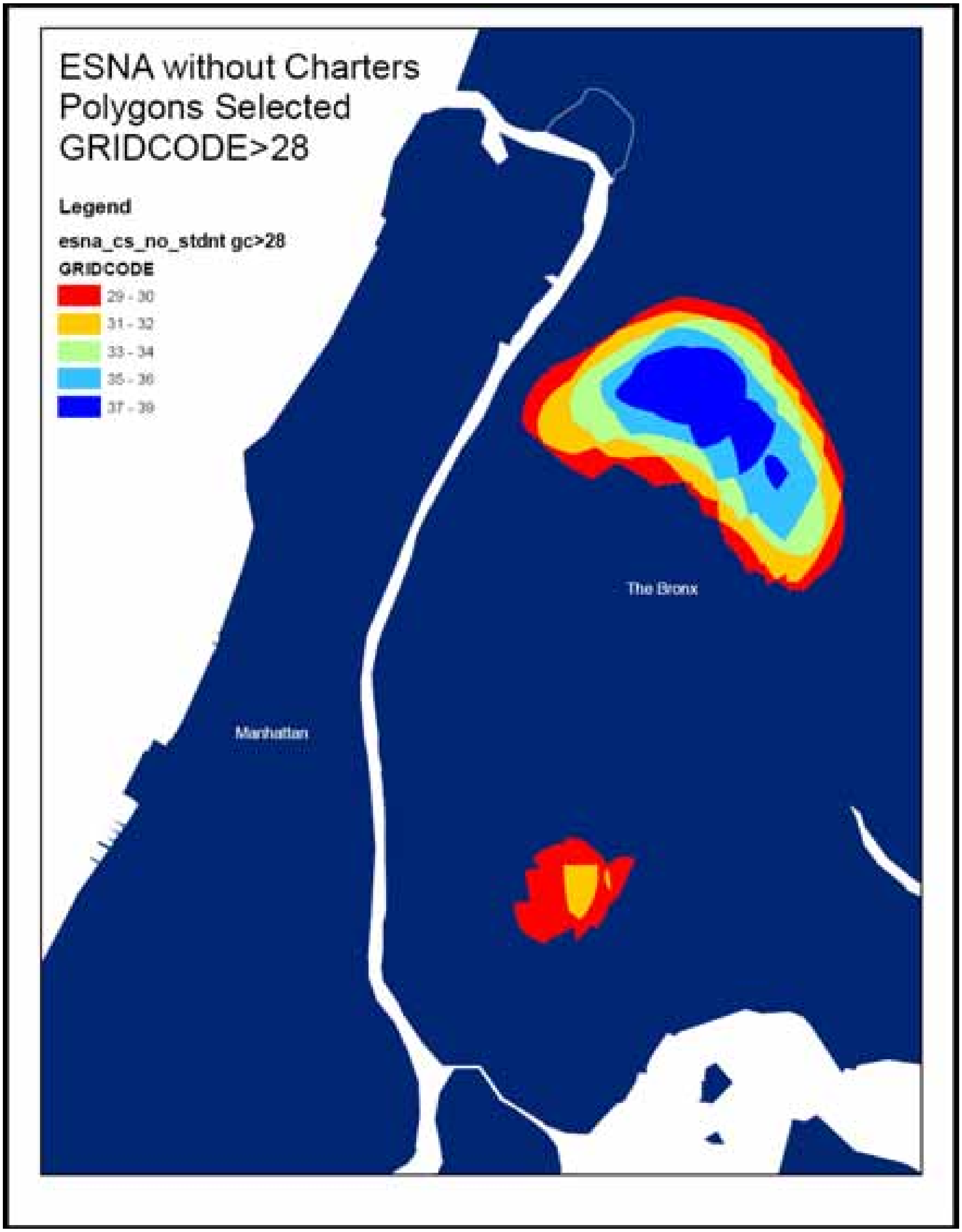
Map 5


Education Service Need Areas
without Charter Schools
Legend
ESNA without Charter Schools (by CS students)

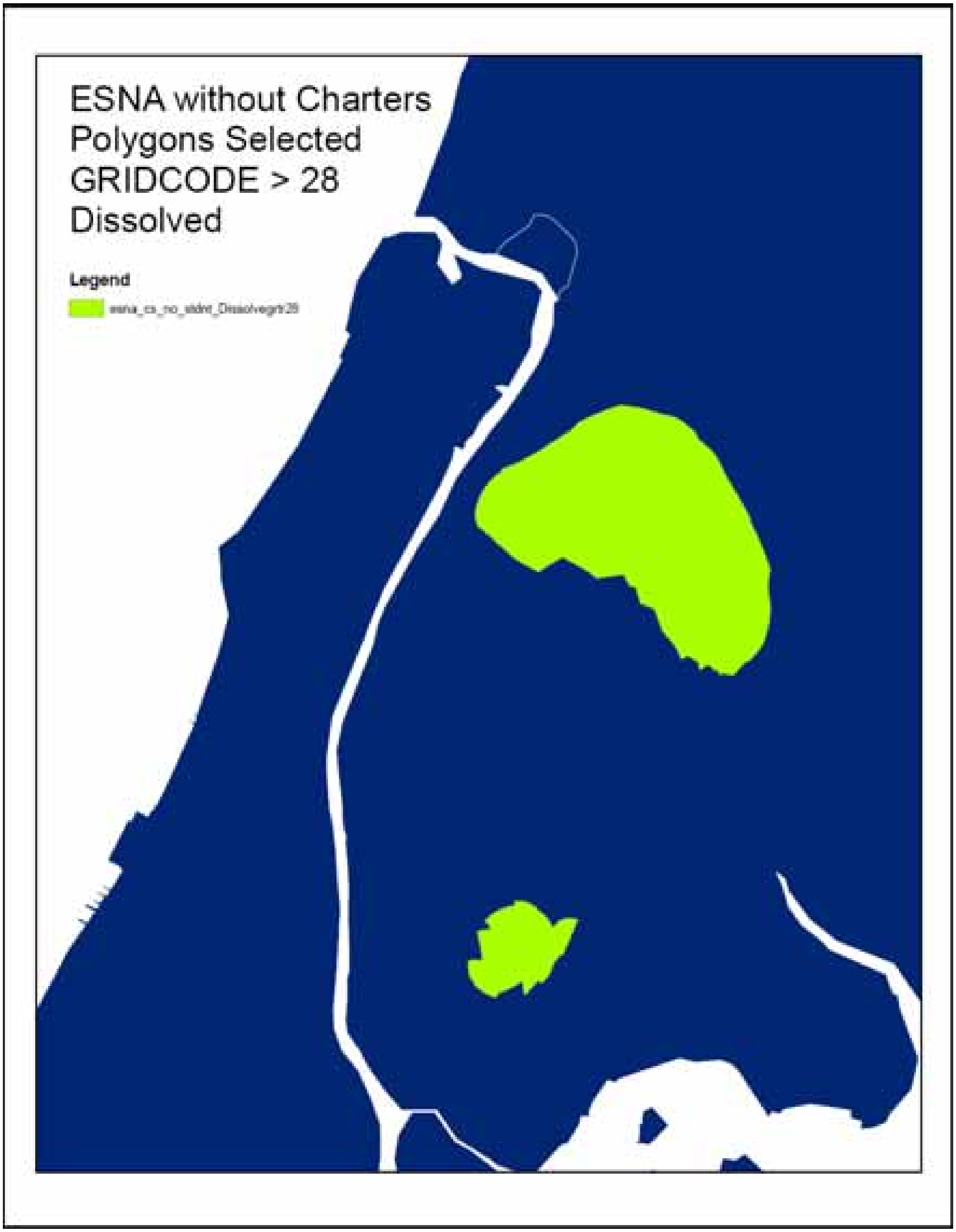
Map 6


ESNA without Charters Raster Converted to Polygons
Legend
esna_cs_no_stdnt
GRIDCODE
0 - 4
9 - 12

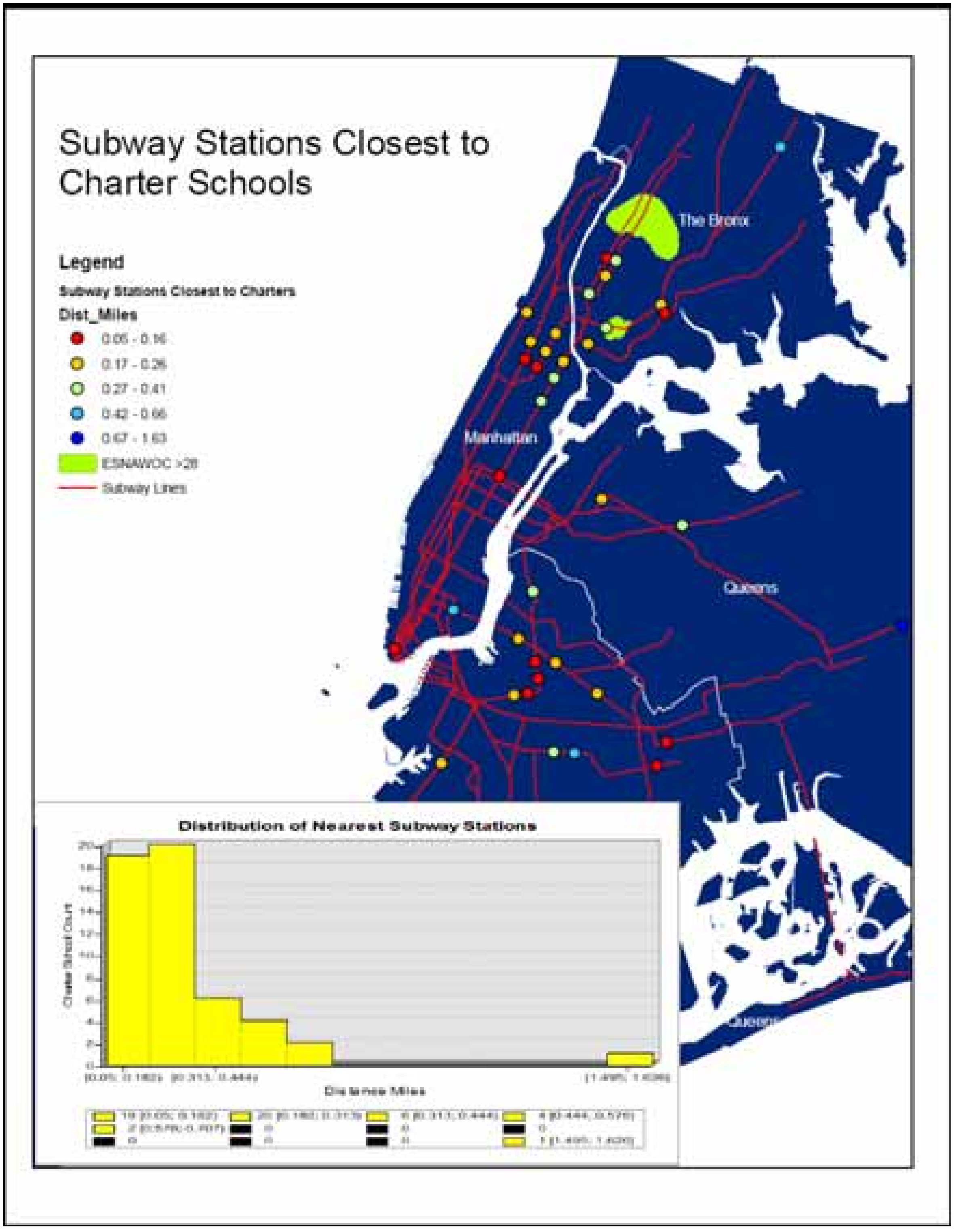
Map 7


ESNA without Charters
Polygons Selected
GRIDCODE>28
Legend
esna_cs_no_stdnt gc>28
GRIDCODE
29 - 30
31 - 32
33 - 34
35 - 36
37 - 39
The Bronx
Manhattan

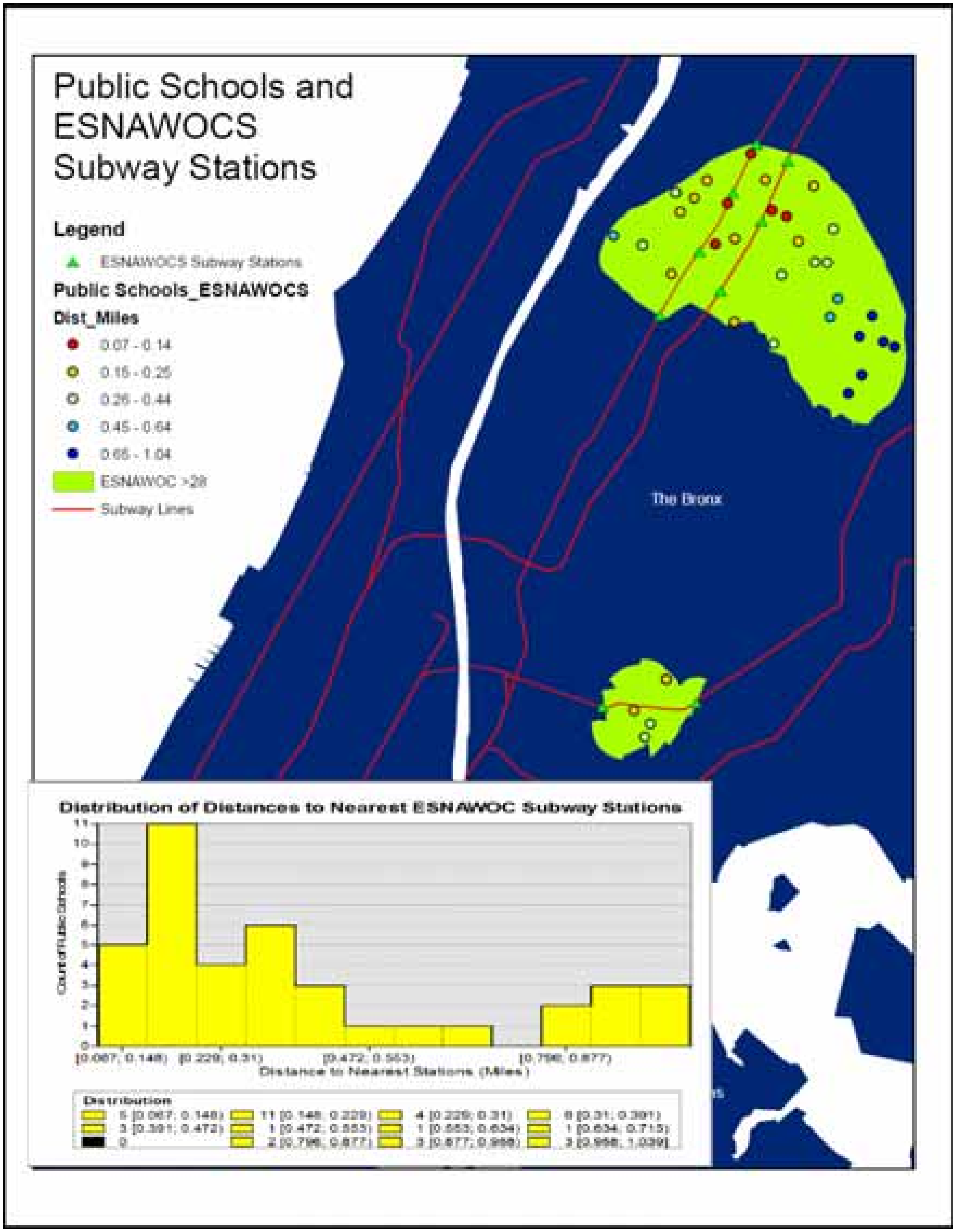
Map 8


ESNA without Charters
Polygons Selected
GRIDCODE > 28
Dissolved
Legend

Map 9

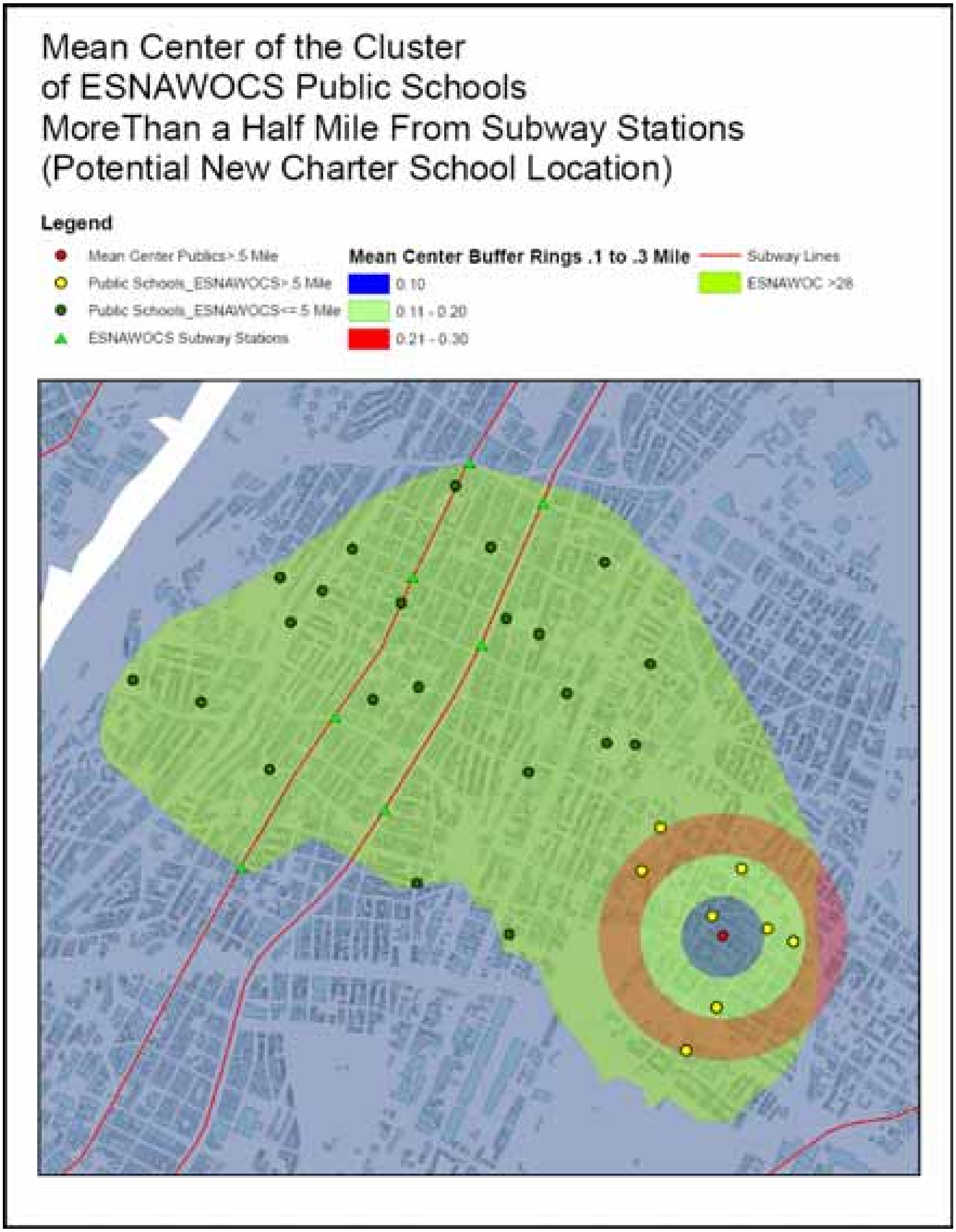

Subway Stations Closest to Charter Schools
Legend
Subway Stations Closest to Charters
Dist_Miles
0.05 - 0.16
0.17 - 0.26
0.27 - 0.41
0.42 - 0.66
0.67 - 1.63
ESNAWOC >28
Subway Lines
The Bronx
Manhattan
Queens
Distribution of Nearest Subway Stations
Distance Miles

Map 10



Public Schools and ESNAWOCS Subway Stations
Legend
ESNAWOCS Subway Stations
Public Schools_ESNAWOCS
Dist_Miles
0.07 - 0.14
0.15 - 0.25
0.26 - 0.44
0.45 - 0.64
0.65 - 1.04
ESNAWOC >28
Subway Lines
The Bronx
Distribution of Distances to Nearest ESNAWOC Subway Stations
Count of Public Schools
[0.067; 0.148) [0.229; 0.31) [0.472; 0.553) [0.796; 0.877)
Distance to Nearest Stations (Miles)
Distribution
5 [0.067; 0.148) 11 [0.148; 0.229) 4 [0.229; 0.31) 6 [0.31; 0.391)
3 [0.391; 0.472) 1 [0.472; 0.553) 1 [0.553; 0.634) 1 [0.634; 0.715)
0 2 [0.796; 0.877) 3 [0.877; 0.958) 3 [0.958; 1.039]

Map 11


Mean Center of the Cluster
of ESNAWOCS Public Schools
MoreThan a Half Mile From Subway Stations
(Potential New Charter School Location)
Legend
Mean Center Publics>.5 Mile
Public Schools_ESNAWOCS>.5 Mile
Public Schools_ESNAWOCS<=.5 Mile
ESNAWOCS Subway Stations
Mean Center Buffer Rings .1 to .3 Mile
0.10
0.11 - 0.20
0.21 - 0.30
Subway Lines
ESNAWOC >28

Map 12

Author Information:

Dr. Charisse Gulosino
Doctor of Education in Education Policy
Email: cag2022@columbia.edu
Phone: 646-251-8134
Webpage: http://cgulosino.googlepages.com/

Mr. James Crocker
Mid-Bronx Senior Citizens Council
Email: jamesacrocker@earthlink.net
Phone: 646-209-1098