

# Population Projection for Community Board 2

Report Prepared by Ontodia, Inc.

For Manhattan Community Board 2

**June 6, 2014**

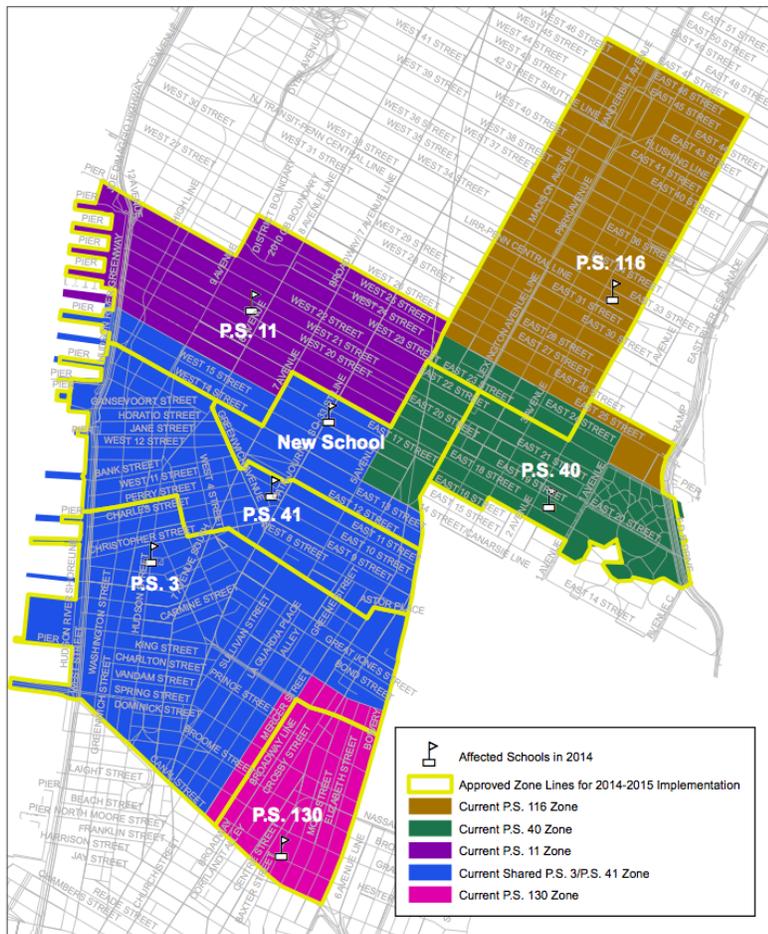
*With data as of June 1, 2014*

## Population Projection for Community Board 2

Ontodia conducted a population projection for Manhattan Community Board 2 (CB2). Specifically, CB2 was interested in a projected population of 5-year-olds in the year 2019 that would be likely to attend schools in CB2 or near CB2.

The Study Area consists of the all Elementary School Zones for the 2014-2015 school year for P.S. 3, P.S. 11, P.S. 41, P.S. 130, and the new P.S. 340.

A list of 2010 Census Blocks that make up this Study Area was used to construct a 5-year population projection of elementary-aged children for the combined area shown in the map below.



Several methods were used to generate population projections for the Study Area. Each method is explained in detail with the projections. All methods focus on generating a 2019 population projection for the number of children aged approximately 5-years old, the population that will be eligible to enroll in New York City elementary schools. At the end of the report we will discuss the differences between the methods.

## Executive Summary

Population projections of under 5-year-olds in the Study Area were conducted using three trend analyses and one cohort analysis. **These methods produced population projections for the number of 5-year-olds in 2019 that ranged from 974 to 1,286. The difference in the number of 5-year-olds from 2014 to 2019 ranged from 10 to 198.** To help determine which population projection to use we conducted two further analyses. First, we compared the increase in residential units in Manhattan to the Study Area. This analysis indicated that the increase in residential units remained relatively constant. Second, we compared birth rates in Manhattan and in the Study Area. This analysis indicated that **while the birth rate in Manhattan has been falling for the past decade it has been increasing in the Study Area.** The primary factor differentiating the population projections is the use of data from years 2002 and 2009, when the population of Manhattan shrank due to major unforeseen events. Absent any major events in the next five years that could cause population decrease the upper estimates may be appropriate.

## Summary of Methodology

Due to different availability of data, trend analysis was conducted in three ways. First, we used only data for the Study Area, available for 2000 and 2010, to conduct a trend analysis. Second, we used additional data for Manhattan in 2000 to 2012 to generate another trend analysis for the study area. Because there was a reverse in the direction in population growth in 2010 we also conducted a third trend analysis that only used Manhattan data from 2010 to 2012. To conduct the cohort survival analysis we used the birth rate data from Manhattan since birth rate, death rate, and net migration data for the Study Area was not available at the census block level. We did compare the birth rate of Manhattan to the birth rate of an area similar to the Study Area. Lastly, we analyzed change in residential units in Manhattan and the Study Area.

### Method 1A - Trend Analysis of Study Area

For this method we used 2000 and 2010 population numbers for the Study Area from the decennial census. A trend line was used to extrapolate a 2014 population estimate and 2019 population projection.

The trend analysis of the study area represents a status quo scenario where population growth in the study area follows long term trends.

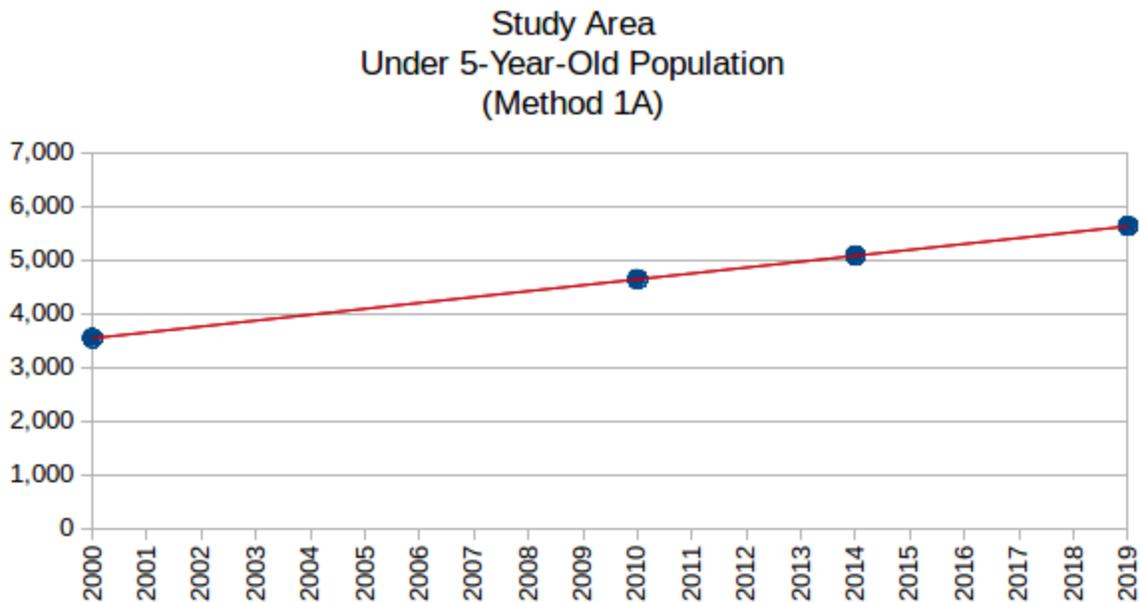
The equation for a simple trend line is  $y = mx + b$  where  $x$  is an independent variable (year),  $y$  is the dependent variable (population),  $m$  is the slope of the line, and  $b$  is a constant whose value is equal to  $y$  when  $x$  is zero. The function for the trend line used is  $f(x) = 109.9x - 216255$  where  $x$  is the input year. Full description of the equation in Appendix 3.

#### Method 1A Data

Year	Study Area Population Under 5
2000*	3,545
2010*	4,644
2014**	5,084
2019**	5,633

\* 2000 and 2010 data from decennial Census block group aggregations

\*\* 2014 and 2019 data generated by using simple trend analysis



Method 1A generates a 2019 population projection of 5,633 for under 5-year-olds. Dividing this cohort into 5 parts we can estimate that there will be 1,127 children living in the Study Area eligible to enroll in elementary school in 2019, an increase of 110 children from 2014.

#### **Method 1B - Trend Analysis based on added Manhattan Data**

Since age breakdown data is available at the block level only in 2000 and 2010 we used Manhattan data to augment the analysis. This method increases the number of data points used, but makes the assumption that Manhattan and the Study Area were experiencing similar rates of change.

Population estimates (2011 and 2012) and intercensal population estimates (2001 to 2009) are available with age breakdown for the Borough of Manhattan (New York County). This data was used in a trend analysis to generate a Manhattan 2014 population estimate and 2019 population projection.

The function for the trend line is  $f(x) = 153.4113x - 228011.2578$ , where  $x$  is the input year.

Method 1B Manhattan Data

Year	Manhattan Population Under 5
2000*	76,048
2001**	78,126
2002**	79,278
2003**	80,241
2004**	81,968
2005**	82,244
2006**	81,015
2007**	80,528
2008**	79,457
2009**	77,586
2010*	76,579
2011***	80,323
2012***	83,121
2013****	N/A
2014*****	80,959
2019*****	81,726

\* 2000 and 2010 data from Decennial Census

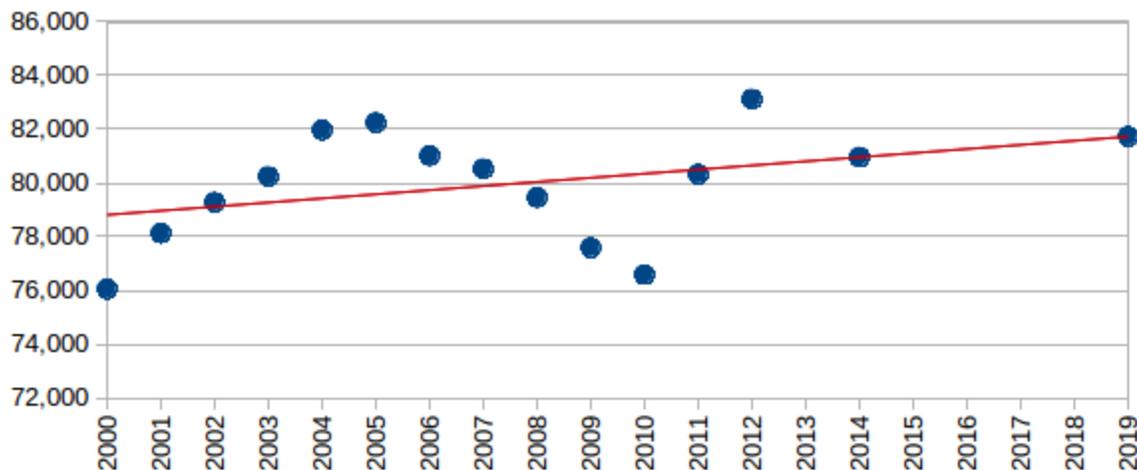
\*\* 2001 through 2009 data from Intercensal Estimates

\*\*\* 2011 and 2012 data from Census Population Estimates

\*\*\*\* Age Group data from 2013 Census Population Estimates not available at publication time

\*\*\*\*\* 2014 and 2019 data were generated using trend analysis

### Manhattan Under 5-Year-Old Population (Method 1B)



The Manhattan 2014 estimate and 2019 projection was then used to generate a new population estimate and projection for the Study Area. This was done assuming that the Study Area's under 5-year-old population's proportion to the under 5-year-old population of Manhattan will remain constant from 2014 to 2019.

In 2010 the Study Area's population of under 5-year-olds, 4,644, was 6.06% of Manhattan's 76,579 under 5-year-olds.

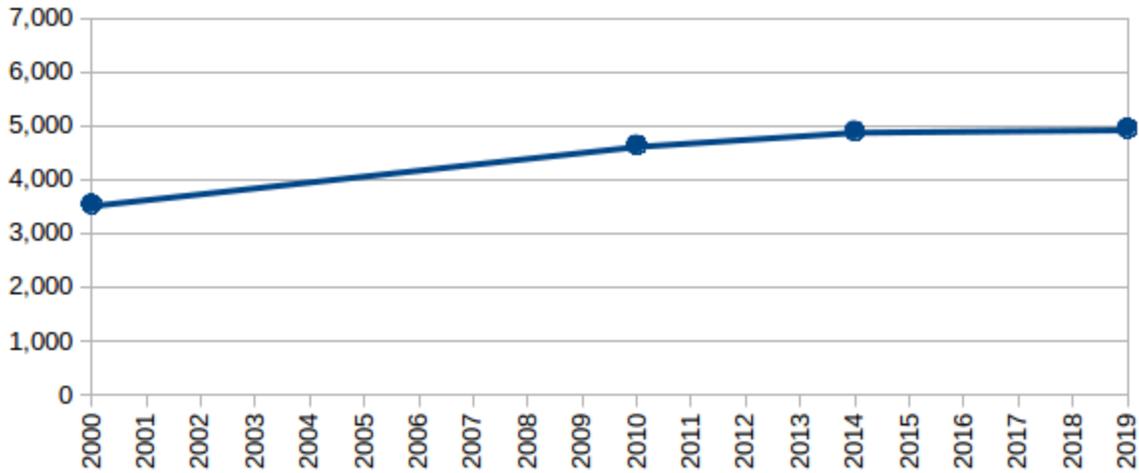
#### Method 1B Study Area Data

Year	Manhattan Population Under 5	Study Area Population Under 5
2000	76,048	3,545*
2010	76,579	4,644*
2014	80,959	4,906**
2019	81,726	4,953**

\* 2000 and 2010 data from decennial Census block group aggregations

\*\* 2014 and 2019 data based on proportions of Manhattan population in 2010

**Study Area  
Under 5-Year-Old Population  
(Method 1B)**



Assuming the proportion remains the same in 2019 we can project 4,953 under 5-year-olds in the Study Area. Dividing this cohort into 5 parts we can estimate that there will be 991 children living in the Study Area eligible to enroll in elementary school in 2019.

**Method 1C - Trend Analysis based on added Manhattan Data since 2010**

This method also attempts to graph the recent trend of the increasing under 5-years-old population in Manhattan since 2010.

This method attempts to discount the downturn in population due to the great recession and the September 11, 2001 terrorist attack. By using data points since 2010 we are forecasting a scenario without any future adverse events that would affect population growth. This is the high growth scenario.

Population estimates (2011 and 2012) are available with age breakdown for the Borough of Manhattan (New York County). This data was used in a trend analysis to generate a Manhattan 2014 population estimate and 2019 population projection.

The function for the trend line is  $f(x) = 3271.0433x - 6498060.3858$ , where  $x$  is the input year.

Method 1C Manhattan Data

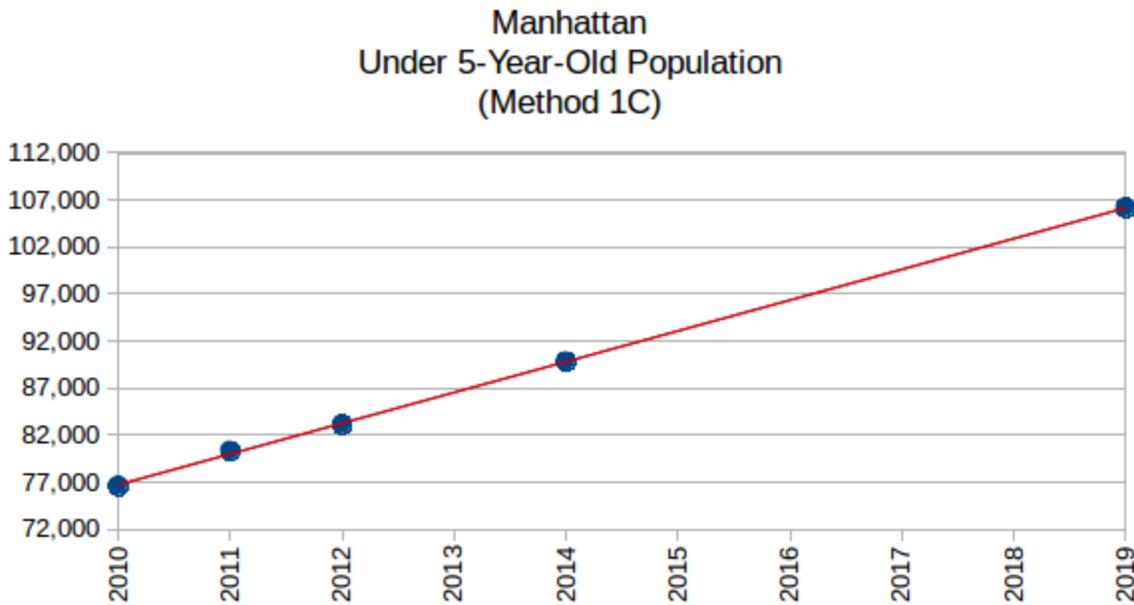
Year	Manhattan Population Under 5
2010*	76,579
2011**	80,323
2012**	83,121
2013***	N/A
2014****	89,821
2019*****	106,176

\* 2010 data from Decennial Census

\*\* 2011 and 2012 data from Census Population Estimates

\*\*\* Age Group data from 2013 Census Population Estimates not available at publication time

\*\*\*\* 2014 and 2019 data were generated using trend analysis



The Manhattan 2014 estimate and 2019 projection was then used to generate a new population estimate and projection for the Study Area. This was done assuming that the Study Area's under 5-year-old population's proportion to the under 5-year-old population of Manhattan will remain constant from 2014 to 2019.

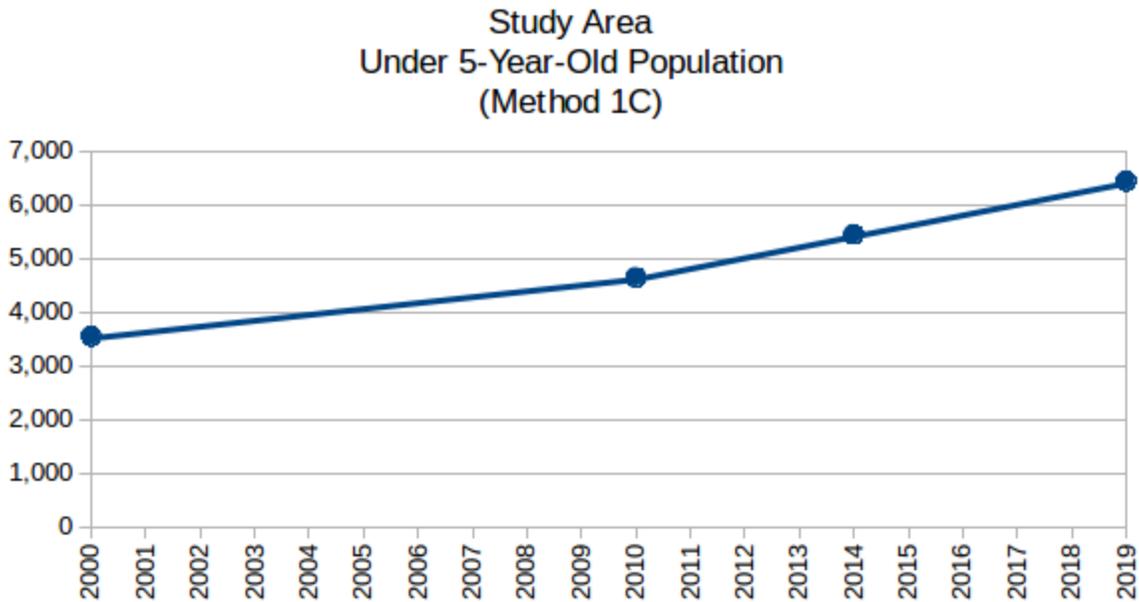
In 2010 the Study Area's population of under 5-year-olds, 4,644, was 6.06% of Manhattan's 76,579 under 5-year-olds.

Method 1C Study Area Data

Year	Manhattan Population Under 5	Study Area Population Under 5
2010	76,579	4,644*
2014	89,821	5,443**
2019	106,176	6,434**

\* 2010 data from decennial Census block group aggregations

\*\* 2014 and 2019 data based on proportions of Manhattan population in 2010



Assuming the proportion remains the same in 2019 we can project 6,434 under 5-year-olds in the Study Area. Dividing this cohort into 5 parts we can estimate that there will be 1,286 children living in the Study Area eligible to enroll in elementary school in 2019.

Method 2 - Cohort Survival

The second method we used was the Cohort Survival method. Population estimates and projections are calculated using the following equation:

$$\text{Population Estimate or Projection} = \text{Previous Population} + \text{Births} - \text{Deaths} + \text{Net Migration}$$

The cohort survival method accounts for changes in component trends in births, deaths, and net migration that affect population growth.

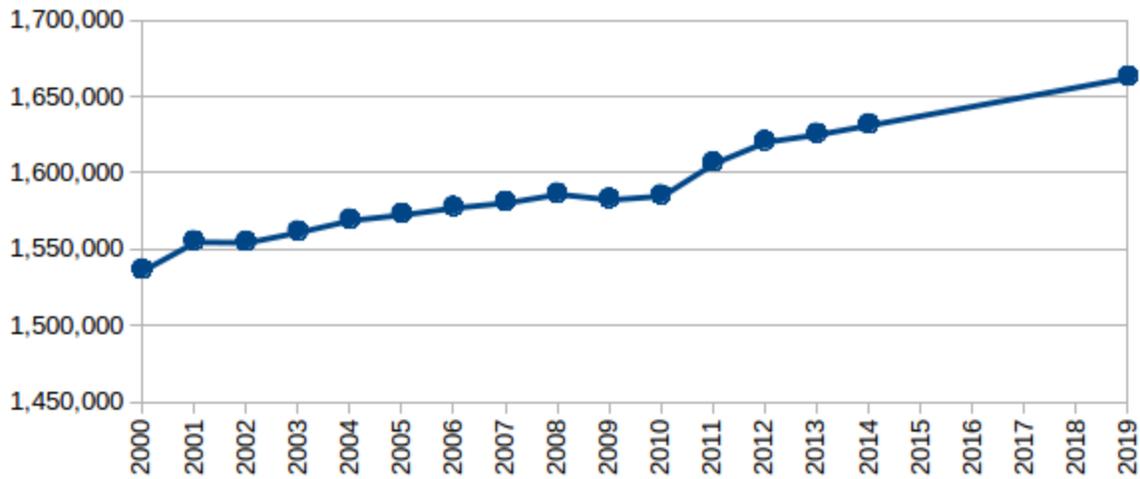
Birth, death, and net migration statistics are not available at the block level, so a population estimate for Manhattan in 2014 was generated using the cohort survival method. To produce the population projection for Manhattan in 2019 we averaged the birth and death rates from 2011 to 2013 because these years had consistent rates that appear to be a break from previous rates. For net migration we averaged data from 2001 to 2013 because we wanted to capture the fluctuation in migration in the years immediately after the September 11th, 2001 terrorist attack and the 2008 financial collapse.

#### Method 2 Manhattan Data

Year	Total Population	Births	Deaths	Birth Rate	Death Rate	Net Migration
2000*	1,537,195					
2001	1,555,729	20,164	12,289	0.0130	0.0079	-5,050
2002	1,555,382	20,584	11,729	0.0132	0.0075	-11,279
2003	1,562,154	20,470	12,242	0.0131	0.0078	1,175
2004	1,569,947	20,395	10,948	0.0130	0.0070	-3,779
2005	1,573,573	20,871	10,807	0.0133	0.0069	-7,603
2006	1,578,171	20,528	11,380	0.0130	0.0072	-3,852
2007	1,581,402	20,979	11,201	0.0133	0.0071	-1,239
2008	1,587,022	21,296	11,174	0.0134	0.0070	252
2009	1,583,431	20,634	11,043	0.0130	0.0070	-12,723
2010*	1,585,873					
2011	1,607,316	19,820	10,152	0.0123	0.0063	4,942
2012	1,621,323	19,713	10,477	0.0122	0.0065	3,936
2013	1,626,159	19,911	10,768	0.0122	0.0066	-2,474
2014	1,632,287	19,839	10,570	0.0122	0.0065	-3,141
2019	1,663,456	20,217	10,771	0.0122	0.0065	-3,141

\*Birth, death, and migration data not available for 2000 and 2010.

**Manhattan Population  
(Method 2)**



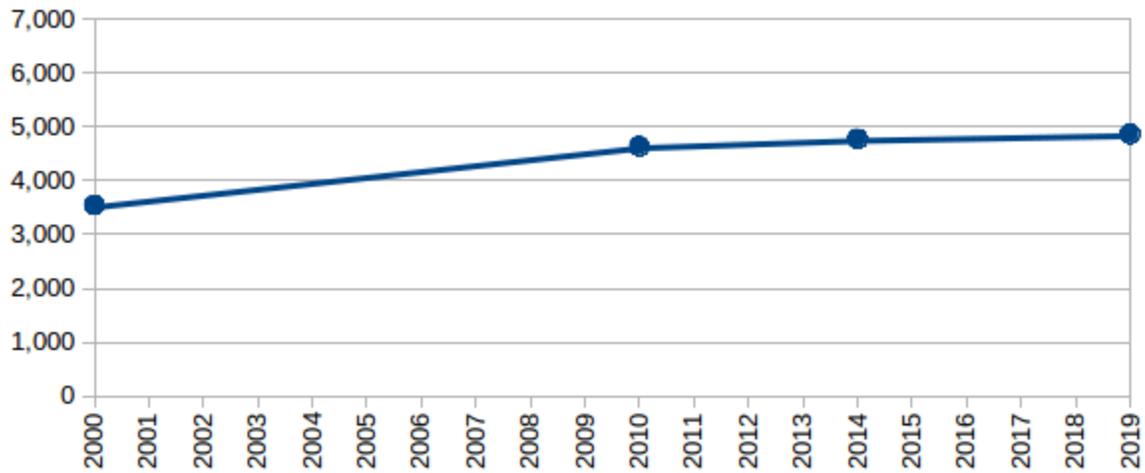
To generate a population estimate for 2014 and a population projection for 2019 of the Study Area based on the cohort survival method we made two assumptions. First, we assumed that the ratio of the total Study Area population to Manhattan would also remain the same from 2010 to 2019. Second, we assumed that the ratio of under 5-year-olds would remain the same from 2010 to 2019.

Method 2 Study Area Data

Year	Manhattan Total Population	Manhattan Under 5-year-olds	Study Area Total Population	Study Area Under 5-year-olds
2000	1,537,195	76,048	127,437	3,545
2010	1,585,873	76,579	132,054	4,644
2014	1,632,287	78,820	135,919	4,780
2019	1,663,456	80,325	138,514	4,871

Applying the cohort survival method to the Study Area using ratios we generated the population estimate and projection presented in the table above. The data for the Study Area under 5-year-olds is graphed below.

### Study Area Under 5-Year-Old Population (Method 2)



The cohort survival method gives us a population projection of 4,871 under 5-year-olds in the Study Area. Dividing this cohort into 5 parts we can estimate that there will be 974 children living in the Study Area eligible to enroll in elementary school in 2019.

## Comparing the Results

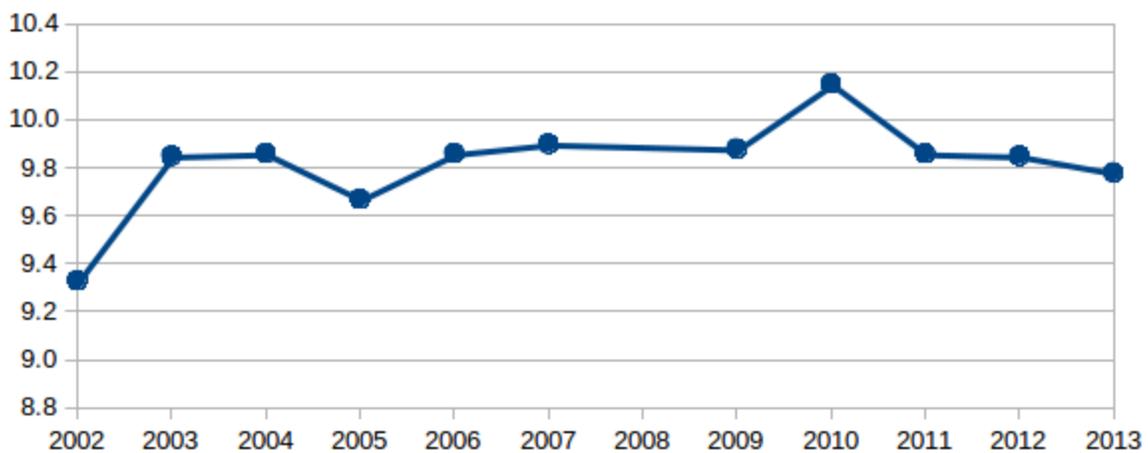
	Method 1A - Simple Trend	Method 1B - Trend Analysis with Manhattan Data	Method 1C - Trend Analysis with Manhattan Data since 2010	Method 2 - Cohort Survival
Study Area Under 5-year-olds in 2014	5,084	4,906	5,443	4,780
Study Area Under 5-year-olds in 2019	5,633	4,956	6,434	4,871
New Students Eligible to Enroll in Study Area Schools in 2014	1,017	981	1,089	956
New Students Eligible to Enroll in Study Area Schools in 2019	1,127	991	1,287	974
Change in New Students from 2014 to 2019	110	10	198	18

Methods 1B, 1C and 2 assume that the ratio of the population of the Study Area compared to the population of Manhattan will be the same in 2019 as it was in 2010. To examine this assumption we looked at residential unit data from PLUTO and housing unit and vacancy data from the American Community Survey. In the table below we show the number of residential units in the Study Area compared to Manhattan.

### Residential Unit Analysis Using PLUTO Data

Year	Manhattan Residential Units	Study Area Residential Units	Proportion of units in Study Area relative to all units in Manhattan
2002	910,307	84,942	9.33%
2003	861,790	84,924	9.85%
2004	873,650	86,115	9.86%
2005	901,980	87,180	9.67%
2006	898,253	88,553	9.86%
2007	910,821	90,173	9.90%
2009	893,134	88,234	9.88%
2010	851,104	86,429	10.15%
2011	889,785	87,736	9.86%
2012	886,123	87,288	9.85%
2013	901,781	88,236	9.78%

Percentage of Study Area Residential Units to Manhattan Residential Units



From 2003 to 2013 the proportion of residential units in the Study Area relative to the residential units in Manhattan has remained relatively steady.

Next we looked at the change in the number of housing units and vacant units in the Study Area compared to Manhattan, using data from the American Community Survey (2010 5-year; 2011 5-year; and 2012 5-year).

Analysis using ACS data on housing units

Year	Housing Units - Study Area	Housing Units - Manhattan	Proportion of units in Study Area relative to all units in Manhattan
2010	86,515	839,013	10.31%
2011	87,713	842,807	10.41%
2012	88,127	846,819	10.41%

Analysis using ACS data on vacancy rates

Year	Vacant Units - Study Area	Vacant Units - Manhattan	Proportion of vacant units in Study Area relative to all vacant units in Manhattan
2010	10,983	106,809	10.28%
2011	10,864	109,414	9.93%
2012	11,074	108,688	10.19%

The analysis of the housing unit and vacant unit data also do not show a significant change in the proportion of units in the Study Area relative to all units in Manhattan.

## Birth rates in the Study Area compared to Manhattan

Birth data was not available on the block or block group level, so we did not use it for the study area cohort analysis in Method 2. However, birth data was available on the census tract level, so we calculated the population for the census tract area that most closely coincides with the study area, resulting in a census tract area that is slightly larger than the study area.

Year	Study Area Population*	Study Area Births*	Study Area Birth Rate*	Manhattan Birth Rate
2000	132,937	1053	0.0079	0.0130**
2010	139,278	1330	0.0095	0.0124**
Percent Change			20%	-4.6%

\* Birth rate data is only available on the Census Tract level, so population of Study Area in this analysis is slightly larger than in other analysis.

\*\* Manhattan birth rates were not available for 2000 and 2010, so trends from 2001-2009 and 2011-2012 data were used to estimate the 2000 and 2010 birth rates.

We used 2000 and 2010 for comparison because those are the years that the most accurate population figures are available for at the tract level. In 2011, the latest year we had birth data for, the Study Area had an estimate birth rate of 0.0094. For comparison in 2011 Manhattan had a birth rate of 0.0123. This roughly continues the trend of the birth rate increasing in the study area as it declines in Manhattan.

## Household size in the Study Area compared to Manhattan

We also looked at average household size in the Study Area compared to Manhattan, using decennial Census data from 2000 and 2010 and ACS 5-year data from 2010, 2011, and 2012. No significant change was found. Since no significant change in housing units or family size was found to occur we do not recommend using them as factors to using either the higher or lower population projections for the Study Area.

## Conclusion

We project that the Study Area will have **974 to 1,286 new students** eligible for elementary school in 2019. **The difference in the number of 5-year-olds from 2014 to 2019 ranged from 10 to 198.**

The difference in the change of birth rates in the Study Area compared to Manhattan could be used to justify using the higher population projection, although it is unclear how much this should be taken into account.

## Appendix 1 - Data Sources Used

1. 2000 Census aggregated for Manhattan
2. 2010 Census aggregated for Manhattan
3. 2001 to 2009 Intercensal Estimates for Manhattan
4. 2011 Census Population Estimates for Manhattan
  - a. Estimates of the Components of Resident Population Change (Births, Deaths, Net-Migration)
  - b. Annual Estimates of the Resident Population for Selected Age Groups by Sex
5. 2012 Census Population Estimates for Manhattan
  - a. Estimates of the Components of Resident Population Change (Births, Deaths, Net-Migration)
  - b. Annual Estimates of the Resident Population for Selected Age Groups by Sex
6. 2013 Census Population Estimates for Manhattan
  - a. Estimates of the Components of Resident Population Change (Births, Deaths, Net-Migration)
7. 2000 Census aggregated for Study Area at Census Block and Census Tract levels
8. 2010 Census aggregated for Study Area at Census Block and Census Tract levels
9. Total residential units aggregated for Manhattan (from PLUTO 2002 through 2013)
10. Total residential units aggregated for Study Area (from PLUTO 2002 through 2013)
11. Housing Units and Vacancy Status for Manhattan were aggregated at County level (from ACS 5-years ending in 2010, 2011, and 2012)
12. Housing Units and Vacancy Status for Study Area were aggregated at Census Tract level (from ACS 5-years ending in 2010, 2011, 2012)

## Appendix 2 - Census Blocks and Census Tracts used in Analysis

The Study Area was defined by the following Census Blocks and Census Tracts. Tracts were used for analysis of 2010, 2011, and 2012 ACS data. Blocks were used for everything else.

### Census Blocks 2000

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*Census Blocks 2000 (Continued)*

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**Census Tracts 2010**

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### Appendix 3 - Trend Equation

The equation for a trend line is  $y = mx + b$

Where:

$x$  is an independent variable

$y$  is the dependent variable,

$m$  is the slope of the trend line

$b$  is a constant whose value is equal to  $y$  when  $x$  is zero

The equation for the slope of a trend line is  $m = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$

Where:

$\bar{x}$  is the average of the sample  $x$  variables

$\bar{y}$  is the average of the sample  $y$  variables