The Public Schools of Brookline

Enrollment, Capacity, and Utilization Study

Draft Final Report

April 2,2012

MGT of America, Inc.

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SECTION ONE: DEMOGRAPHIC ANALYSIS AND ENROLLMENT PROJECTIONS

Introduction

This section is devoted to reviewing and evaluating the demographic data for The Public Schools of Brookline. MGT developed enrollment projections for the next ten-years, using several enrollment projection models to evaluate enrollment patterns for the district. Over the next ten years, enrollment is expected to increase across the district. The specific impact of future student enrollment on school building capacities is outlined in *Section Two* of this report.

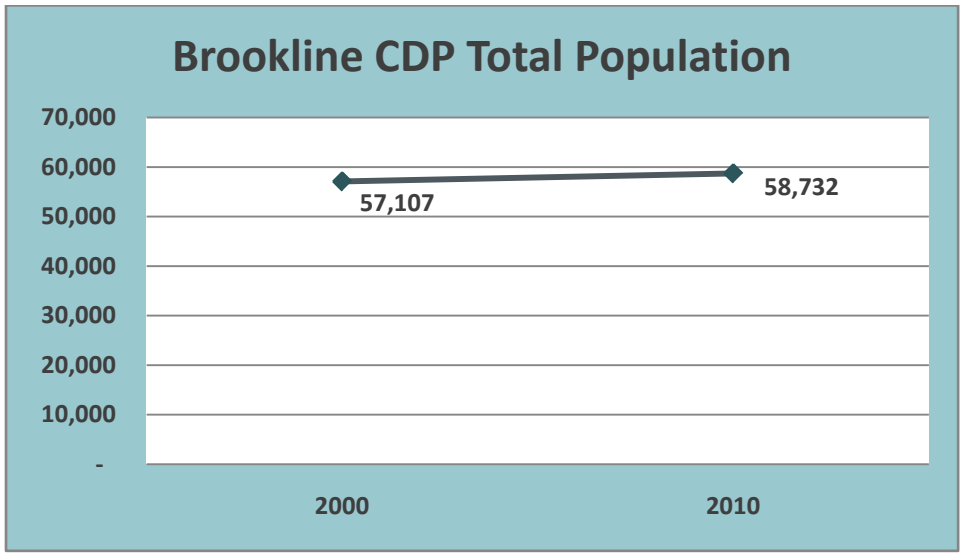
Historical Data

An analysis of both quantitative and qualitative data forms the basis for MGT's enrollment projections. Quantitative data comes from the district, the county, and the United States Census Bureau (Census). Quantitative data provides the basic understanding of trends "by the numbers." Qualitative data is gathered from conversations with district officials familiar with enrollment trends and city planners, and provides the "why" behind the numbers. Both forms of data are critical to the preparation of enrollment projections for this study.

BROOKLINE POPULATION TRENDS

It is important to understand the context in which the district's enrollment trends occur. That is why MGT studied the Brookline population for trends. The Brookline population is growing, though not very quickly. In fact, the total Brookline population has increased only 2.8 percent since the 2000 Census. *Exhibit 1-1* shows the increase in total population from 2000 to 2007.

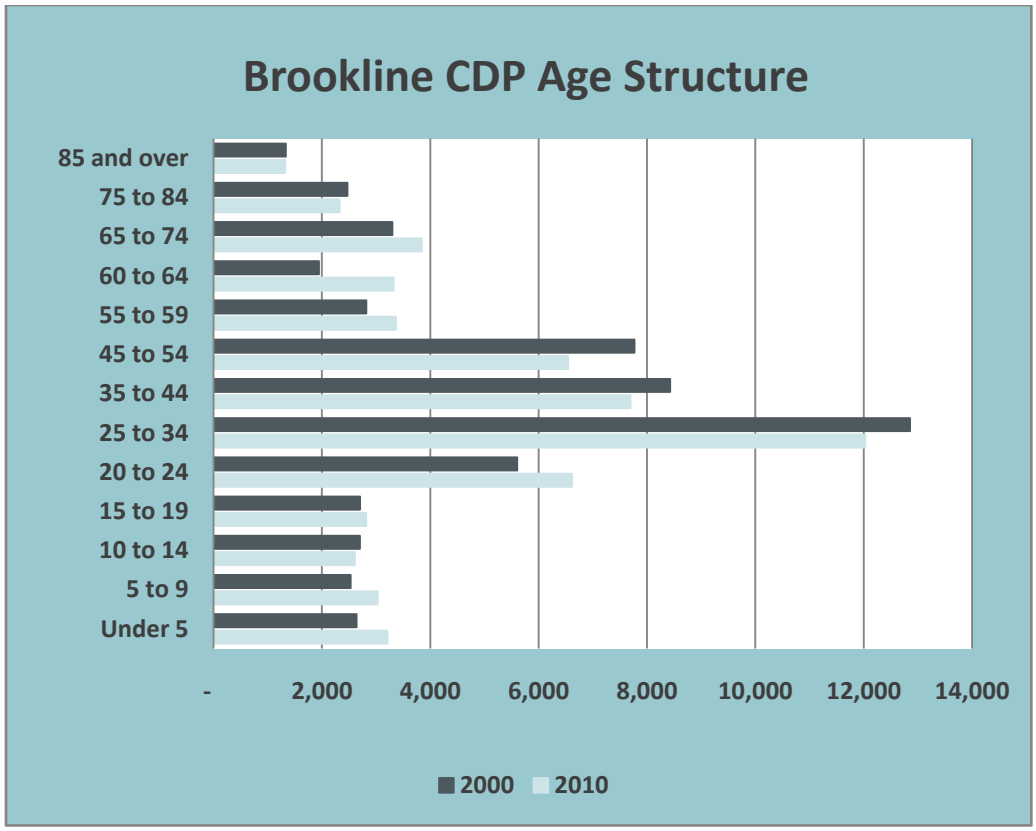
Exhibit 1-1
The Public Schools of Brookline
Brookline Total Population
2000 to 2010



Source: United States Census Bureau.

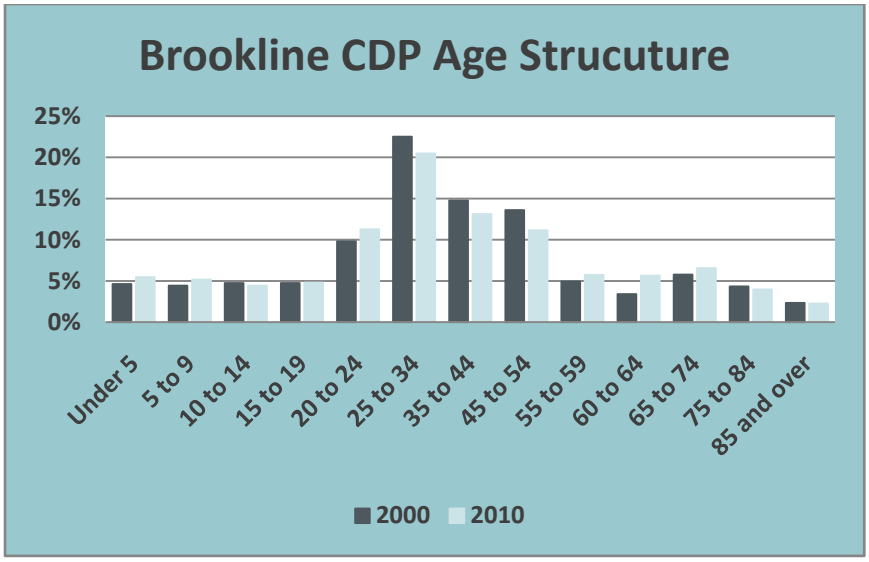
A look at the age structure of Brookline reveals that the largest segment of the population is between 25 and 54 years of age. *Exhibits 1-2* and *1-3* illustrate the age structure of the Brookline population in 2000 and in 2010.

Exhibit 1-2
The Public Schools of Brookline
Brookline Population Age Structure
(Total Number by Category)
2000 to 2010



Source: United States Census Bureau.

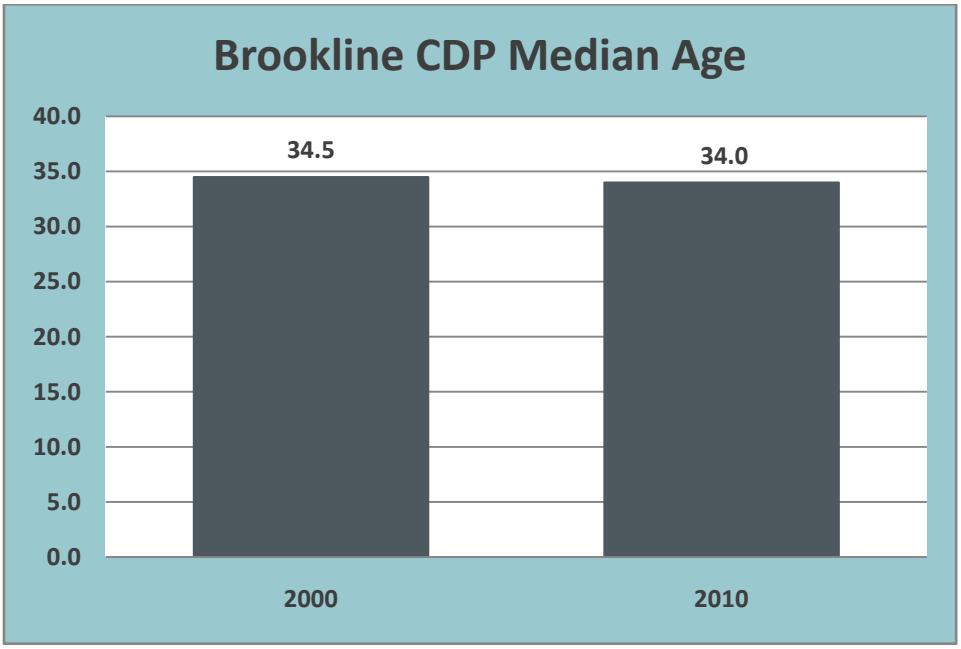
Exhibit 1-3
The Public Schools of Brookline
Brookline Population Age Structure
(Percentage of Population)
2000 to 2010



Source: United States Census Bureau.

An analysis of the age structure does not necessarily lead to any specific conclusions, but it does offer some interesting observations. The *Under 5 to 20-24* age groups increased from 2000 to 2010. The growth in school age children reflects the current increase in enrollment. The *25-34 to 45-54* age groups all saw a decrease in population from 2000 to 2010, while the 55-59 to 65-74 age groups saw the largest increases by percentage. Since the 25-34 to 45-54 age groups comprise the largest segment of the population, their decrease explains why the median age has decreased slightly. *Exhibit 1-4* shows the decrease in median age from 2000 to 2010.

Exhibit 1-4
The Public Schools of Brookline
Brookline Median Age of Population
2000 to 2010



Source: United States Census Bureau.

Looking at the percent change in population at each age segment reveals additional observations about the population in Brookline. *Exhibit 1-5* shows the percent change in population for each age segment.

Exhibit 1-5
Brookline Percent Change in Population (By Age Segment)
The Public Schools of Brookline
2000 to 2010

Age Segment	% Change
Under 5	21.6%
5 to 9	19.8%
10 to 14	-3.6%
15 to 19	4.1%
20 to 24	18.1%
25 to 34	-6.4%
35 to 44	-8.7%
45 to 54	-15.8%
55 to 59	19.4%
60 to 64	70.8%
65 to 74	16.5%
75 to 84	-5.9%
85 and over	-1.0%

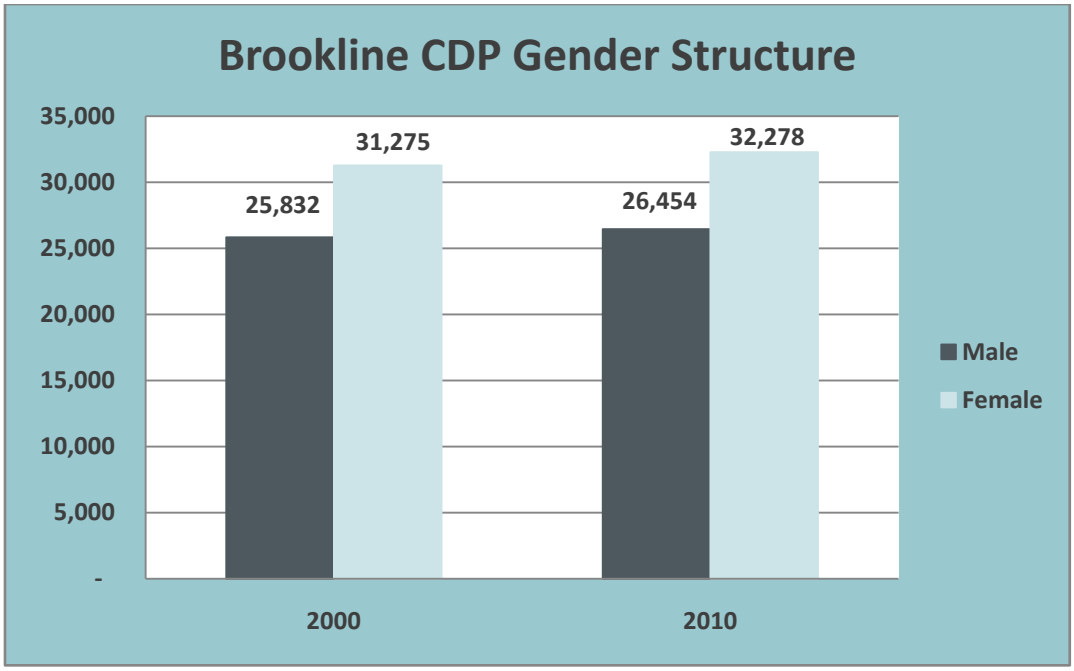
Source: U.S. Census Bureau

Exhibit 1-5 shows that the *Under 5* population increased 21.6% from 2000 to 2010, and the *5 to 9* age segment increased 19.8 percent over that period of time. So children who have just started school or are getting ready to start school are increasing in number.

The age segments in *Exhibit 1-5* that are shaded in green highlight the child-bearing years for women. Of note is the decrease in population for the 25-34 and 35-44 age groups, which are the primary age groups for having children. This decrease could result in fewer school age children, but has not been the case thus far.

Exhibit 1-5 shows the percent change in total population for both men and women. When a population is analyzed for its potential to add school age children, women are the primary concern. Therefore, a look at the gender structure of the population is important. *Exhibit 1-6* illustrates that the number men and women both increased from 2000 to 2010, but the number of men and women as a percentage of total population remained the same: 45 percent male and 55 percent female.

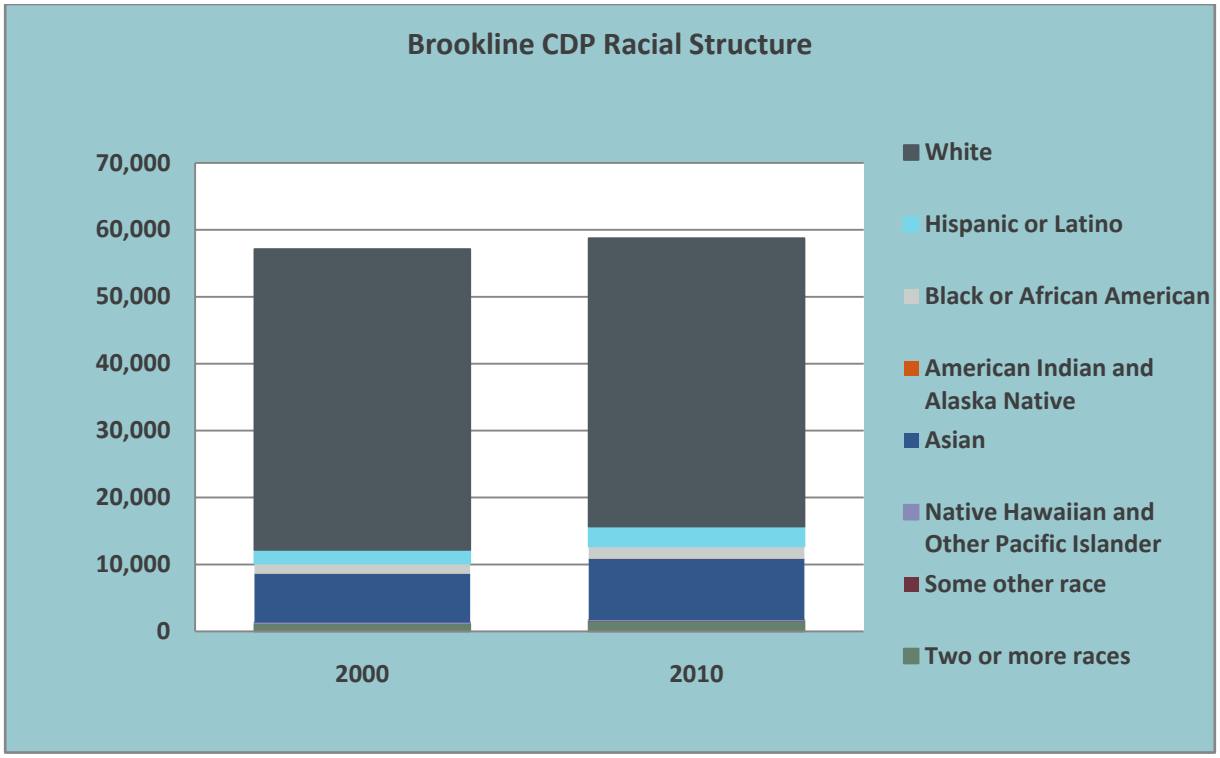
Exhibit 1-6
The Public Schools of Brookline
Brookline Gender Structure
(Total Population by Gender)
2000 to 2010



Source: United States Census Bureau.

A brief look at the racial composition of the community is important as well, though not critical to the development of an enrollment forecast. The White population is the largest racial segment comprising 79 percent of the population in 2000 and 73 percent in 2010. The Asian population grew three percent (from 13 percent to 16 percent) between 2000 and 2010. *Exhibit 1-7* illustrates the racial structure in Brookline for 2000 and 2010.

Exhibit 1-7
The Public Schools of Brookline
Brookline Racial Structure
(Total Population by Race)
2000 to 2009



Source: United States Census Bureau.

The foregoing data provides an important understanding of context as we begin to analyze the district's historical enrollment.

Historical Enrollment

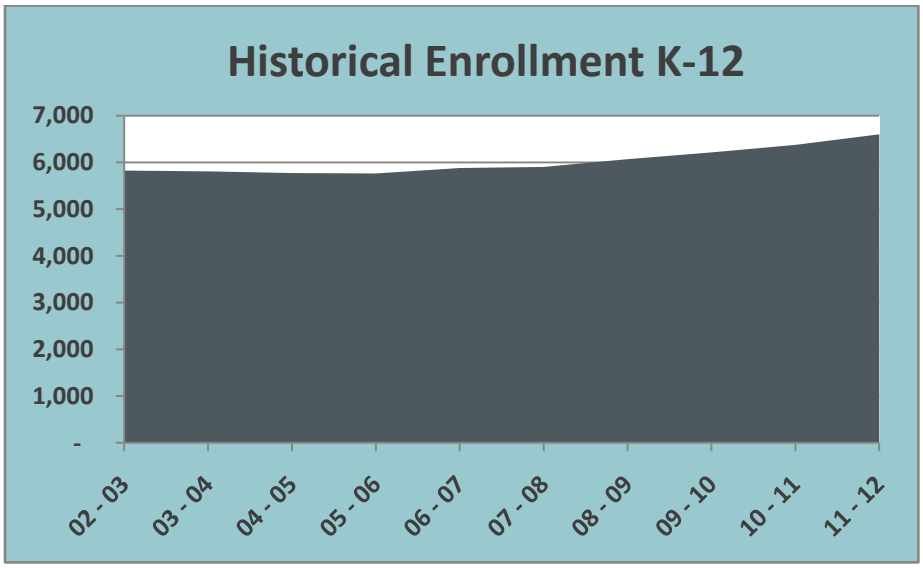
The core body of data used to develop an enrollment projection is historical enrollment. Total enrollment in The Public Schools of Brookline stood at 5,828 students in the 2002-03 school year. Since then, enrollment has increased 13.32 percent to 6,604 students in the 2011-12 school year. *Exhibit 1-8* details the enrollment history of K-12 students in the district for the past ten years. *Exhibit 1-9* charts the data shown in *Exhibit 1-8.*

Exhibit 1-8
The Public Schools of Brookline
Enrollment History
2002-2011

	02 - 03	03 - 04	04 - 05	05 - 06	06 - 07	07 - 08	08 - 09	09 - 10	10 - 11	11 - 12
K	430	406	418	484	549	495	549	593	546	602
1	430	439	430	427	496	527	514	559	621	551
2	414	432	456	437	423	514	554	513	572	658
3	424	411	426	465	452	438	539	544	532	566
4	453	418	421	423	452	449	449	537	530	532
5	447	446	414	417	435	448	445	450	532	538
6	463	437	455	413	406	408	442	435	445	517
7	455	464	401	432	416	394	407	443	426	437
8	462	448	465	398	425	425	391	395	448	426
9	471	474	455	465	421	432	450	409	402	458
10	492	492	485	465	474	443	435	467	428	420
11	470	491	476	470	467	456	446	428	460	433
12	417	453	473	470	467	477	451	444	436	466
K-8	3,978	3,901	3,886	3,896	4,054	4,098	4,290	4,469	4,652	4,827
9-12	1,850	1,910	1,889	1,870	1,829	1,808	1,782	1,748	1,726	1,777
Total	5,828	5,811	5,775	5,766	5,883	5,906	6,072	6,217	6,378	6,604

Source: The Public Schools of Brookline, 2012.

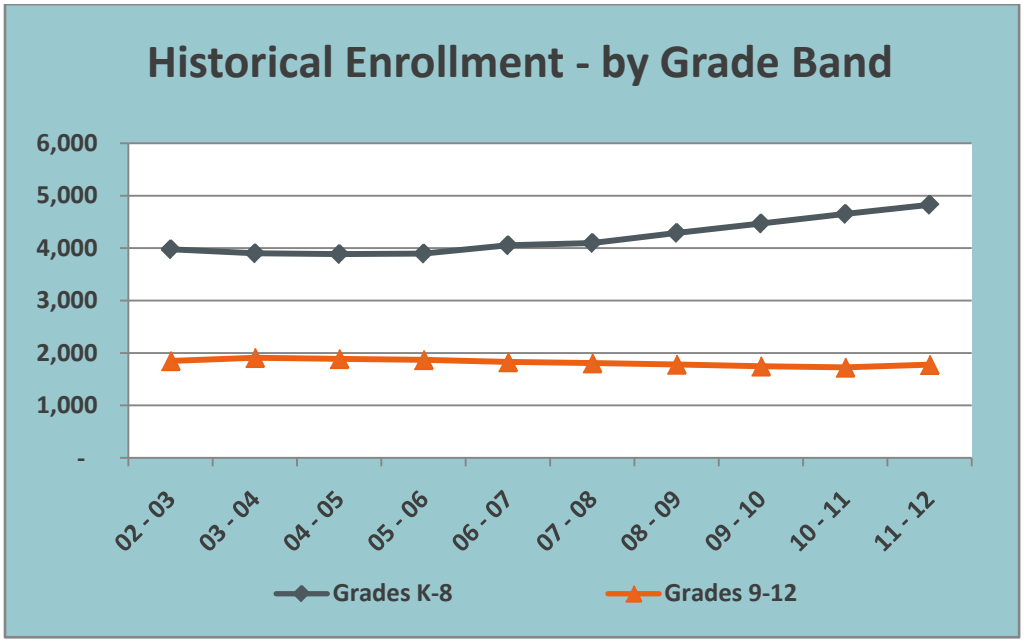
Exhibit 1-9
The Public Schools of Brookline
Historical Enrollment
2002-2011



Source: The Public Schools of Brookline, 2012

An examination of historical enrollment at the grade band level reveals that the increase in overall enrollment over the last ten years has been led by an increase in enrollment at the K-8 grade band, which increased by 21.34 percent. The 9-12 grade band decreased 3.95 percent, which reflects the decline in K-8 enrollment earlier in the decade. That decrease is now working through the 9-12 grades. *Exhibit 1-10* illustrates the historical enrollment for each grade band.

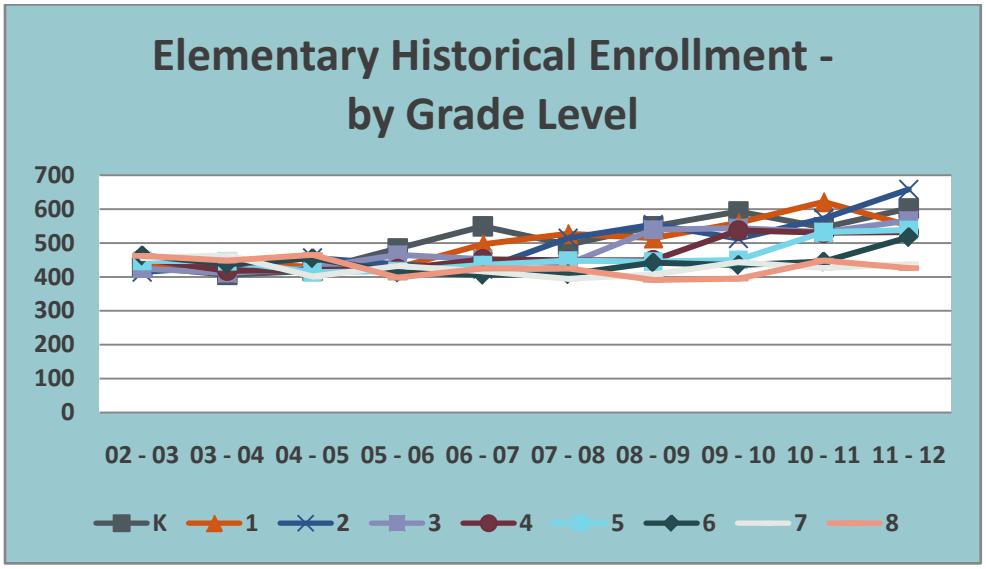
Exhibit 1-10
The Public Schools of Brookline
Historical Enrollment by Grade Band



Source: The Public Schools of Brookline, 2012

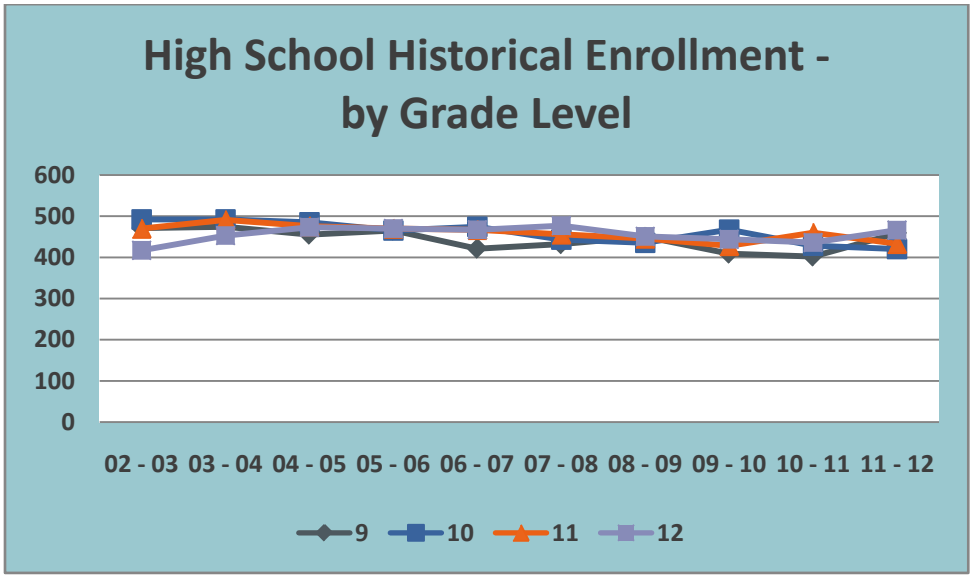
A closer look at historical enrollment at individual grade levels reveals some trends. Kindergarten enrollment appears to have been the driving force behind the increase in elementary grade level enrollments. The high school grade level enrollments do not indicate any particular grade influencing the overall trend in historical enrollment, though, as stated above, the decreasing grade level enrollments appear to follow to decline in enrollment at the K-8 level earlier in the decade. The following *Exhibits 1-11* and *1-12* illustrate the historical enrollment for each grade level.

Exhibit 1-11
The Public Schools of Brookline
Historical Elementary School Enrollment by Grade Level



Source: The Public Schools of Brookline, 2012.

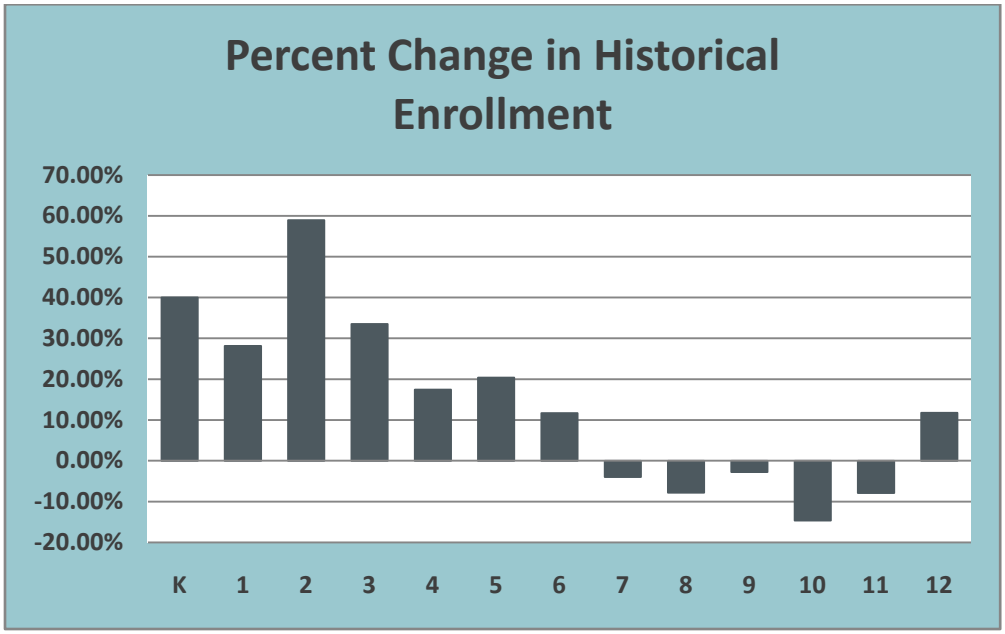
Exhibit 1-12
The Public Schools of Brookline
Historical High School Enrollment by Grade Level



Source: The Public Schools of Brookline, 2012.

A look at the percentage change in enrollment at each grade level over the last ten years further reflects that the lower grades have experienced the greatest increase in enrollment. *Exhibit 1-13* illustrates the percent change in historical enrollment for each grade level.

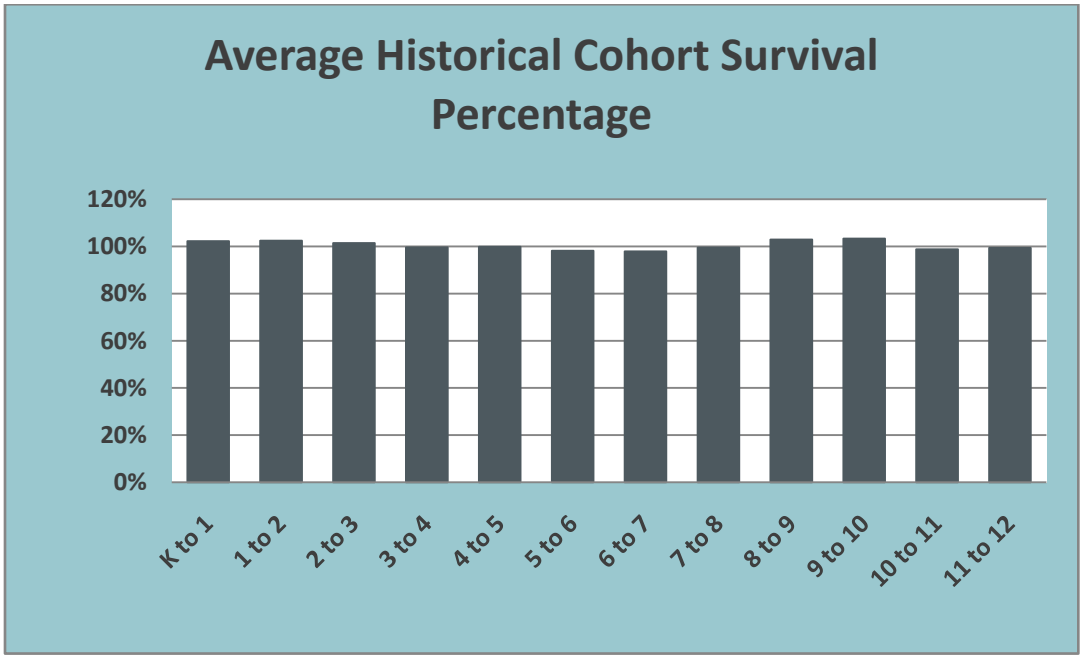
Exhibit 1-13
The Public Schools of Brookline
Percent Change in Enrollment by Grade Level
2002-2011



Source: The Public Schools of Brookline, 2012

As *Exhibit 1-13* illustrates, grades K-6 all experienced increasing enrollment over the last decade, with K-3 grade levels experiencing the most significant increase. The increase for grade two was nearly 60 percent over that period of time. The increase in enrollment in the younger grades will lead to an increase in enrollment in the older grades as the current younger cohorts progress through the grade levels, a conclusion supported by an analysis of the district's average historical cohort survival rate illustrated in *Exhibit 1-14.*

Exhibit 1-14
The Public Schools of Brookline
Percent Change in Enrollment by Grade Level
2002-2011



Source: The Public Schools of Brookline, 2012

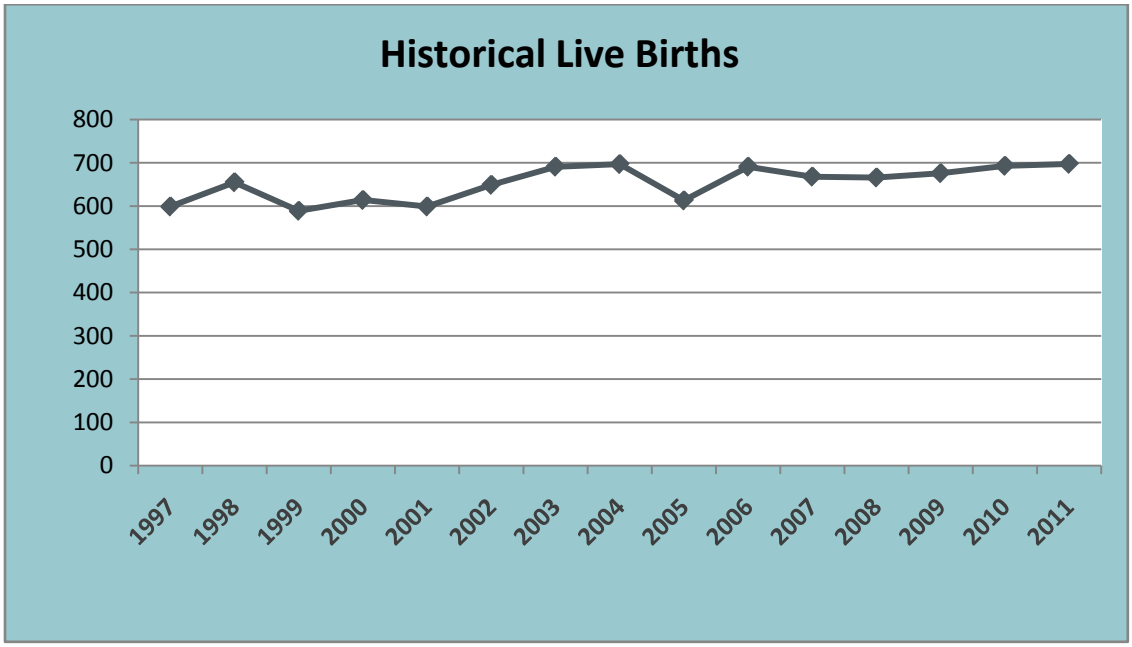
Exhibit 1-14 illustrates the average percentage of students who progress with their age group, or *cohort,* to the next grade level. As *Exhibit 1-14* shows, The Public Schools of Brookline maintains its student population as students advance to the next level.

The trends observed in the historical enrollment data will form a key component of the enrollment projections prepared as a part of this study.

Live Births and Kindergarten Enrollment

A second key component to analyzing potential future enrollment is an examination of live birth trends in the district and the live-births-to-kindergarten capture rate. A steady or increasing birth rate in the district could lead to additional students in the district, which would also push future enrollment higher. In Brookline, live births have been trending upward since 1997. *Exhibit 1-15* shows the trend of historical live births for the district.

Exhibit 1-15
The Public Schools of Brookline
Historical Live Births
1997-2011

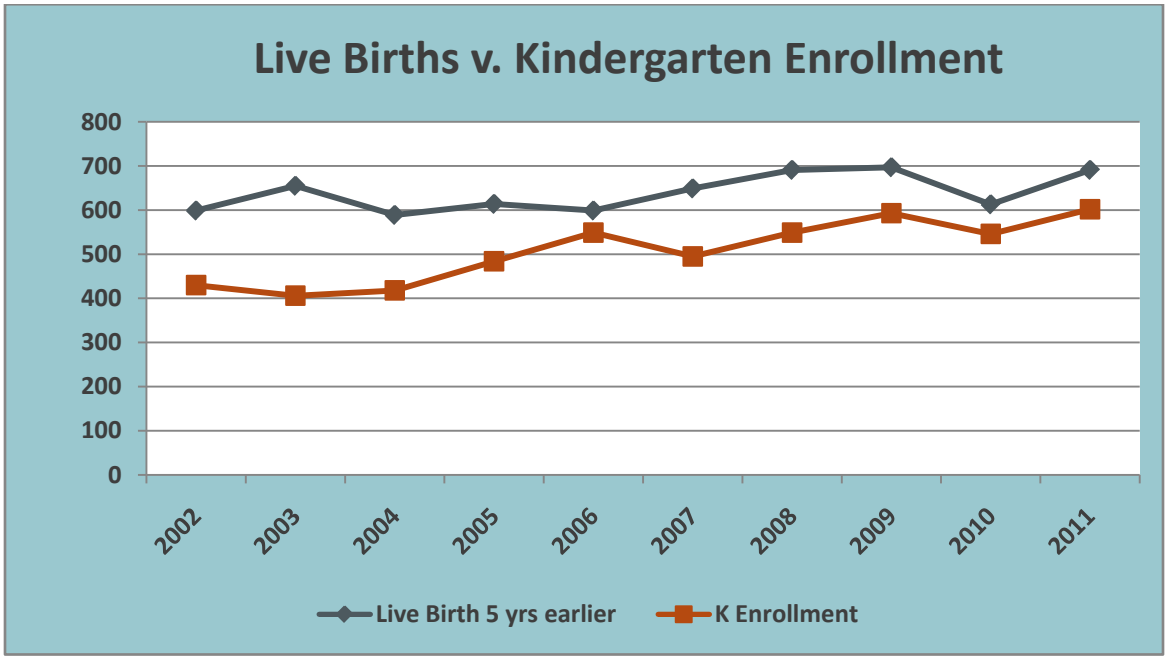


Source: State of Massachusetts, 2012

There are two interesting observations to draw from *Exhibit 1-15*. First, live births hovered around 600 each year from 1997 to 2001. Second, from 2002 through the present, live births have generally been around 700 each year. As we begin to look toward a live birth forecast, something around 700 live births per year appears to be a reasonable expectations based on historical live birth data.

When examining the ratio of live births to kindergarten enrollment, live-birth data is collected for the past fifteen years and kindergarten enrollment for the past ten years. For example, a child born in 1990 would enroll in kindergarten in 1995 at the age of five. Therefore, in this analysis, we are looking at how many children are enrolled in kindergarten as compared to the number of children born in the town five years before a particular school year. *Exhibit 1-16* compares the district's historical kindergarten enrollment to the live birth data.

Exhibit 1-16
The Public Schools of Brookline
Historical Preschool Enrollment, Kindergarten Enrollment and Historical Live Birth Data



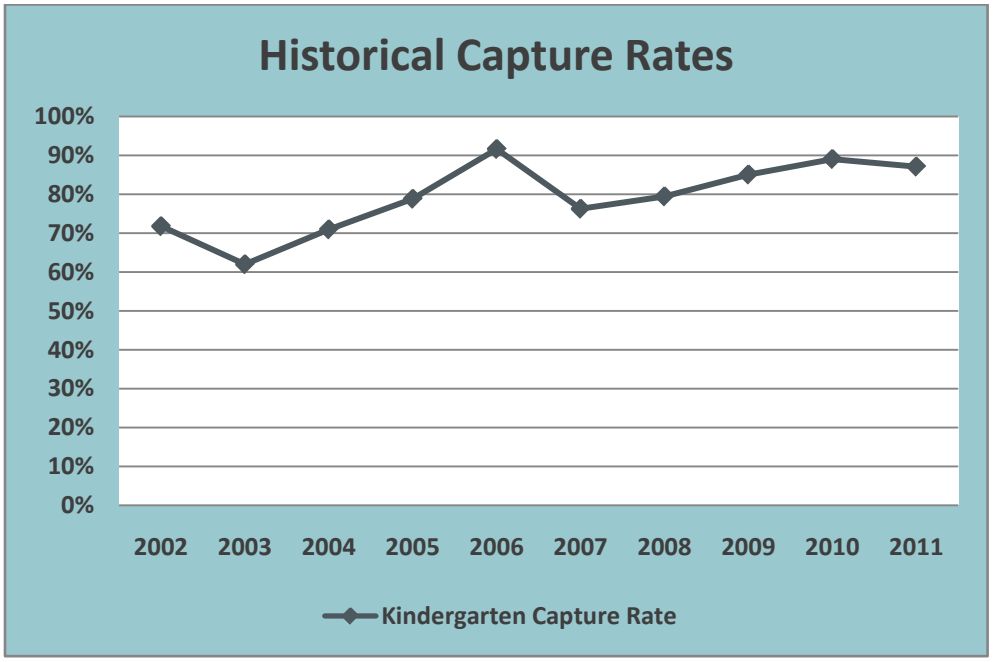
Source: State of Massachusetts, 2012; The Public Schools of Brookline, 2012

Two statistics are critical to understanding the relationship between live births and both preschool and kindergarten enrollment in the district: correlation coefficient and capture rate.

The correlation coefficient for kindergarten enrollment to live births is 0.578. The correlation coefficient calculates the relationship between two series of data. A correlation coefficient of 1 indicates a strong relationship; a correlation coefficient of 0 indicates a weak relationship. A 0.578 correlation coefficient is a somewhat strong relationship, which indicates that trends in live births are a good potential indication of future kindergarten enrollments.

The capture rate measures the percentage of live births that resulted in kindergarten enrollment five years later. Over the last ten years, the district's kindergarten capture rate has averaged 79.22 percent and has generally trended upward over the last ten years, as *Exhibit 1-17* illustrates.

Exhibit 1-17
The Public Schools of Brookline
Historical Capture Rates



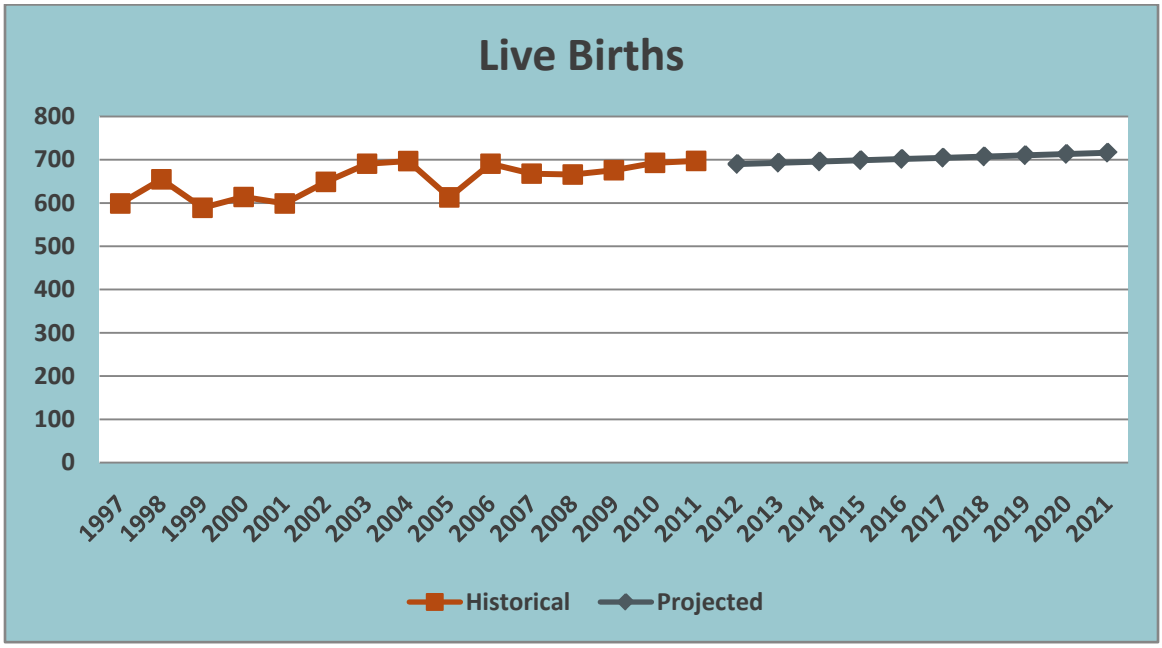
Source: MGT of America, Inc., 2012

The Historical Capture Rates begin to help explain why enrollment in grades K-3 has increased over the last several years. A greater number of live births in the district are resulting in children enrolled in kindergarten. The increasing capture rate appears to be a significant driver for the increase in enrollment. In addition, the capture rate has been close to or above 80 percent for the last five to seven years, indicating a shift in trends from ten years ago when the capture rate was around 70 percent. In order to capture the recent trend, MGT has used the average capture rate for the last five years – 83.4 percent district-wide - when forecasting future kindergarten enrollment.

Based on the increasing trend in life births over the last ten years, live births over the next ten years are expected to continue to increase, though not at a significant rate. MGT projects live births using linear regression, or "line of best fit", and MGT considered using only the most recent five years of live birth data for the regression forecast due to the recent increase in live births. However, a five year analysis results in a forecast that approaches 800 live births by 2021. An increase of 100 live births per year over the next ten years seems unlikely given the decrease in child-bearding age population.

A ten year regression analysis generates a forecast that increases slightly over the next ten years, but remains around 700 live births, which is consistent with the number of live births over the last ten years during which time the child-bearing age population declined. Accordingly, MGT used ten years of historical data to generate the live births forecast for the district. *Exhibit 1-18* illustrates the projected live births for the district.

Exhibit 1-18
The Public Schools of Brookline
Projected Live Births



Source: MGT of America, Inc., 2012.

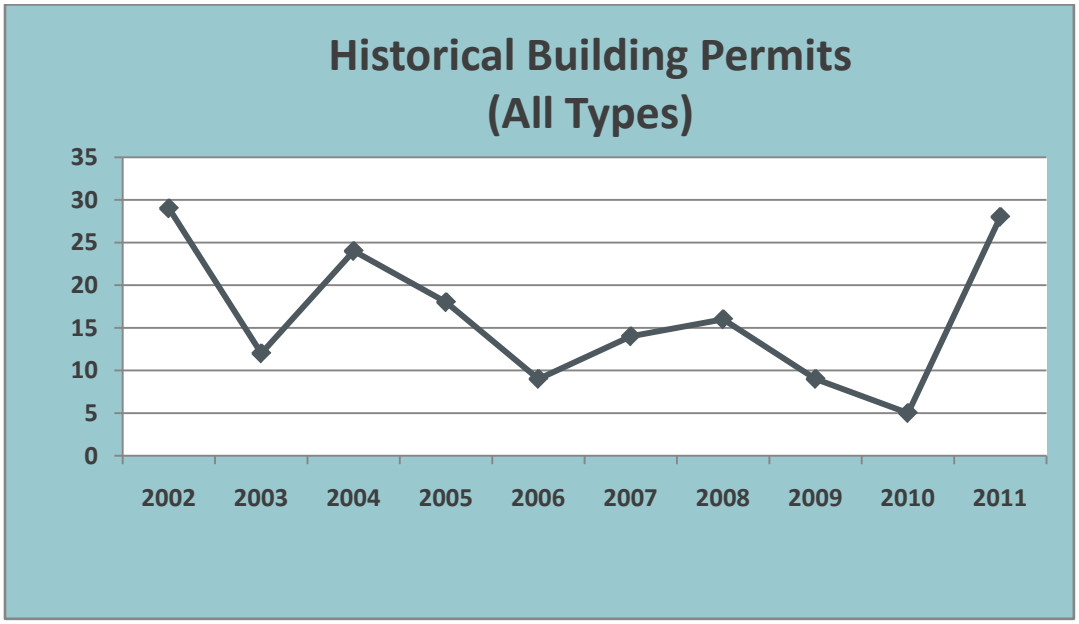
The slow increase in projected live births should stabilize future K-8 enrollment.

Housing Units

A third key piece of data used to develop enrollment projections is analyzing the trends in housing units in the district. The Census recorded 26,448 households in Brookline in the 2010 Census. This number provides a starting point for this analysis, but building permits provide additional information upon which to base a forecasted number of households following the 2010 Census.

Since 2002, the number of housing permits issued in Brookline each year has generally trended downward with an odd spike in 2011. *Exhibit 1-19* illustrates the number of housing permits issued each year since 2002 in Brookline.

Exhibit 1-19
Town of Brookline
Brookline Historical Residential Building Permits

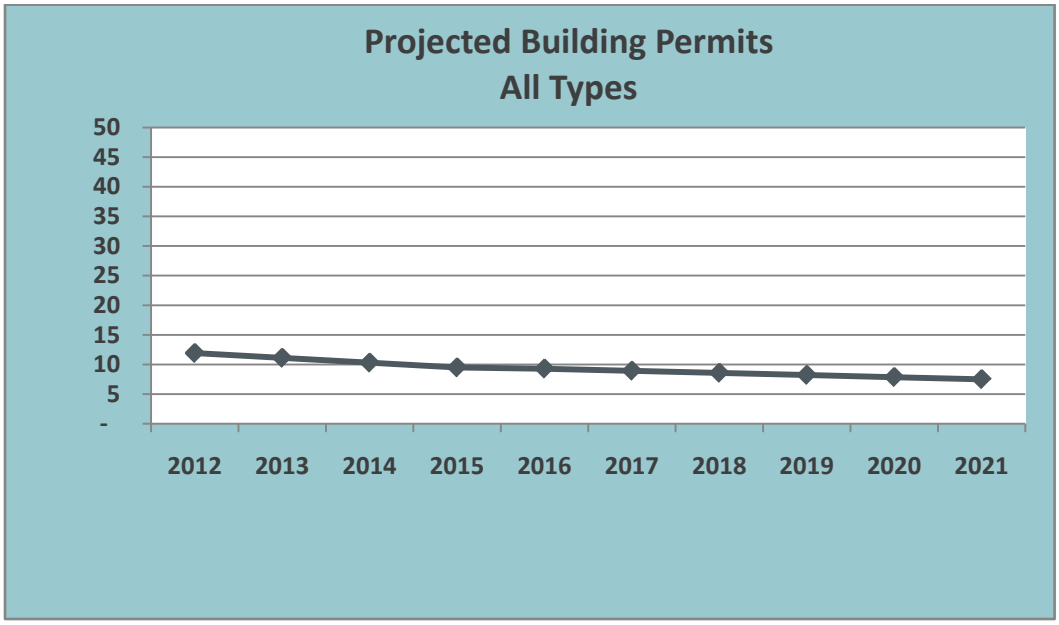


Source: Town of Brookline, 2012.

The foregoing *Exhibit 1-19* includes both single and multi-family building permits. The historical building permits are difficult to interpret. The decrease in permits from 2008 through 2010 appears to reflect the influence of the current economic recession. However, the spike in 2011 is inconsistent with an economy that is still struggling. In addition, Brookline is a built-out community, meaning there are few green spaces left for new housing development. For the most part, new housing development will come from redevelopment of single family residential into multi-family residential.

The difficulty interpreting the historical building permit data makes projecting building permits difficult as well. Using simple linear regression, MGT has developed a building permit projection, but the data should be read with caution. Reportedly, there is a developer planning a new 160 unit development on the Northside of Brookline. If that development becomes a reality and/or the economy regains steam, driving new redevelopment of single to multi-family residential areas, the projected building permits could be wildly understated. *Exhibit 1-20* illustrates the projected building permits.

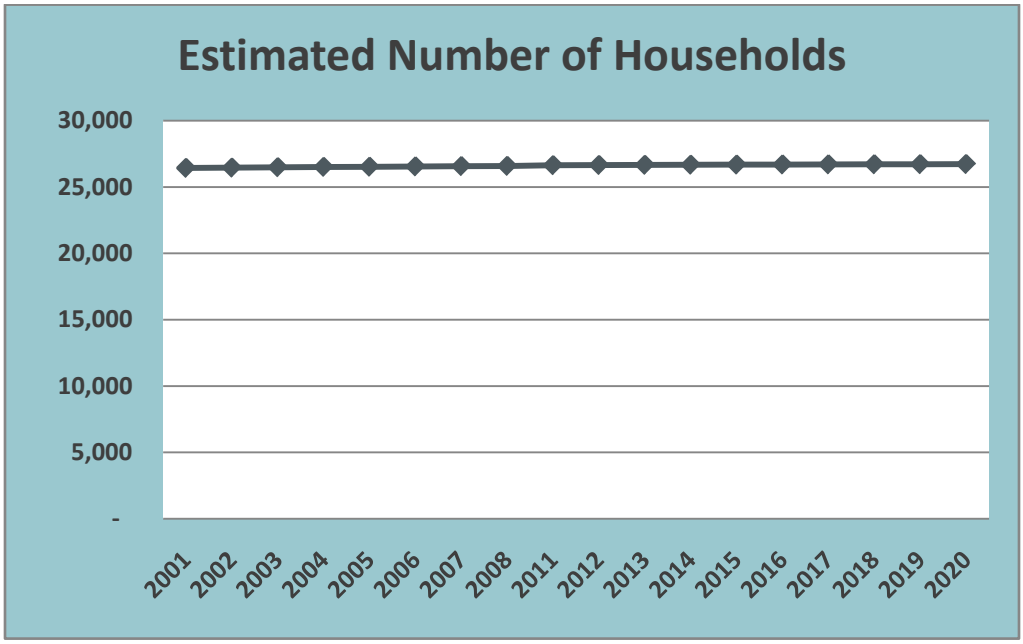
Exhibit 1-20
Brookline, Massachusetts – Projected Residential Building Permits



Source: MGT of America, Inc., 2012

If we combine the historical and projected building permits and assume that each permit will result in a built residential unit, we can estimate the number of households in the district. Again, beginning with the number of households established by the 2000 Census, the historical and projected building permits combine to provide an estimated number of households by adding the annual number of historical or projected building permits to the number of households in 2000, which is illustrated by *Exhibit 1-21*. For this analysis, a multi-family permit is treated as accounting for three households in the total for the district.

Exhibit 1-21
Brookline, Massachusetts – Estimated Number of Households

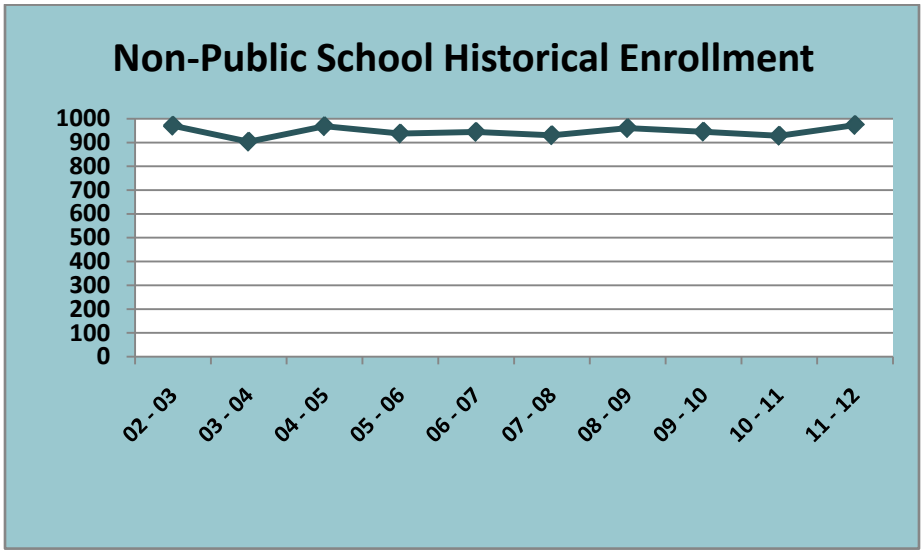


Source: MGT of America, Inc., 2012.

NON-PUBLIC SCHOOL ENROLLMENT

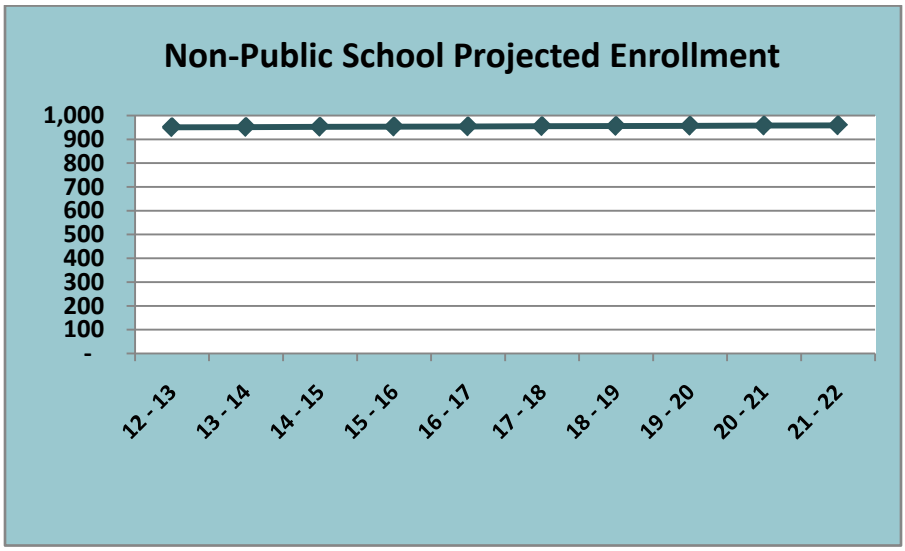
Non-public school enrollment in Brookline has been very stable over the last ten years, increasing a mere 0.31 percent and ranging between 900 and 975 students. Given the flat historical non-public school enrollment, projected non-public school enrollment is likewise expected to be flat and be around 950 students on average. *Exhibit 1-21* illustrates the ten-year historical non-public school enrollment, while *Exhibit 1-22* illustrates the projected non-public school enrollment.

Exhibit 1-21
Brookline, Massachusetts – Historical Non-Public School Enrollment



Source: MGT of America, Inc., 2012

Exhibit 1-22
Brookline, Massachusetts – Historical Non-Public School Enrollment



Source: MGT of America, Inc., 2012

Conclusions and Observations about Historical Data

- The recent increase in K-5 enrollment will push enrollment upward as those cohorts progress through the grade levels. In particular, the recent decrease in 9-12 enrollment is expected to reverse as the K-8 increase in enrollment progresses to the high school level.
- The projected live births will stabilize K-8 enrollment over the next ten years, as live births are expected to be fairly level.

- Housing permits are extremely difficult to interpret and project. The current economic conditions weigh heavily on optimism for future housing development, but it is unclear whether the 2011 spike in housing units is just an anomaly or a longer lasting trend.

- Non-public school enrollment is expected to continue to average about 950 students, with no greater or lesser impact on enrollment in The Public Schools of Brookline than historically experienced.

ENROLLMENT PROJECTION METHODOLOGY

Enrollment projections are merely an *estimate* of future activity based on the historical data and information provided. As demonstrated by the district calculations over the past ten years, there can be constant variations in growth. Projections can be highly accurate, but it must be remembered that they are an estimate based on historical data and the identification of trends. During the implementation of any of the recommendations provided, it is critical that the district reassess these numbers on a regular basis and adjust plans accordingly.

MGT uses four "base" models - *Average Percentage Annual Increase, Cohort Survival, Linear Regression*, and *Student-per-Housing Unit* – as the foundation of its enrollment projection methodology. MGT then generates a weighted average of these four "base" models to arrive at its enrollment projection.

A rule of thumb when forecasting enrollment is that the models should use as many years of historical data as there are years in the projection period. In other words, if the model is projecting enrollment for five years from now, then five years of historical data is used. If the model is projecting enrollment for ten years from now, then ten years of historical data is used. For projecting one and two years into the future, two years of historical data is used to identify a sufficient trend. Each of the following "base" model draws data in this manner for their calculations.

The ***Average Percentage Annual Increase Model*** calculates future school enrollment growth based on the historical average growth from year to year for each grade level. This simple model multiplies the historical average percentage increase (or decrease) by the prior year's enrollment to project future enrollment estimates. For example, if enrollment in first grade decrease 5 percent from 2000 to 2001 and decreased seven percent from 2001 to 2002, then the average percentage increase/decrease would be six percent, and six percent would be the factor used to project future enrollment in this base model.

The ***Linear Regression Model*** uses a statistical approach to estimating an unknown future value of a variable by performing calculations on known historical values. Once calculated, several future values for different future dates can then be plotted to provide a "regression line" or "trend line". MGT has chosen a "straight-line" model to estimate future enrollment values, a model that finds the "best fit" based on the historical data.

The ***Cohort Survival Model*** calculates the growth or decline in a grade level over a period of ten years based on the ratio of students who attend each of the previous years, or the "survival rate". This ratio is then applied to the incoming class to calculate the trends in that class as it "moves" or graduates through the school system. For example, if history shows that between the first and second grades, the classes for the last ten years have grown by an average of 3.5 percent, then the size of incoming classes for the next ten years is calculated by multiplying them by 103.5 percent. If

the history shows a declining trend, the multiplying factor would be 100 percent minus the declining trend number.

The determination of future kindergarten enrollment estimates is critical, especially for projections exceeding more than five years. MGT sought to develop a kindergarten projection model representative of Brookline's current situation and reflective of the increase in capture rate over the last ten years. In addition, a 564 kindergarten students are already enrolled for the 2012-13 school year, and that number is expected to increase by September 2012. So, for purposes of this study, MGT assumed a kindergarten capture rate of 100 percent for the 2012-13 school year to reflect the large anticipated kindergarten class. Then, MGT calculated the average kindergarten capture rate for the last four years and next year (100 percent capture rate for 2012-13). That five year average is 88.14 percent for the district. Accordingly, the projected kindergarten enrollment for years 2 through 10 of the projection period assumes a kindergarten capture rate of 88.14 percent of the live births (historical and projected) five years prior.

The ***Students-per-Household Model*** utilizes the estimated number of households as its base data. Using the housing unit data and historical enrollment data, MGT created a student generation factor for each projected housing unit. By taking the total enrollment by grade level and dividing it by the current housing levels, a *student generation factor* (SGF) was calculated for each grade level. This factor indicates the number of students within each grade level that will be generated by each new housing unit.

Once each of these four base models has been calculated, MGT generates a weighted average of each of models. A weighted average allows the analysis to reflect all of the trends observed in the historical data and the over-arching themes from the qualitative information gathered in this process. The weighted average also works to maximize the strengths of each of the base models.

Two models, the average percentage annual increase model and the linear regression model, emphasize historical data. These models are quite effective predictors if there is no expectation of unusual community growth or decline and student population rates have minimal fluctuation.

The Cohort Survival Model also uses historical enrollment numbers, but takes into account student-mobility patterns and the effects of the natality rates in prior years. The Cohort Survival model is perhaps the best-known predictive tool using this type of data. However, like the annual percentage annual increase model and the linear regression model, the Cohort Survival model loses its predictive capabilities in communities that experience, or are expecting to experience, more rapid growth.

The Students-per-Household model allows the planner to take into account projections for housing developments and general growth in the county. This model looks forward and is based on the input from local planners. The planning information is important and the district should continue to monitor this information.

CROSS-SECTIONAL DATA ANALYSIS

To assist in identifying the appropriate model weighting, MGT performed an analysis of data from a cross-section of data from 2000 and 2010. *Exhibit 1-23* identifies the cross-sectional data. The discussion follows.

Exhibit 1-23
Brookline, Massachusetts – Data for Cross-Sectional Analysis

Data	2000	2010	Change	% Change
Total Population	57,107	58,732	1,625	3%
Child-Bearing Age Population	29,593	29,159	(434)	-1%
% Child-Bearing Age of Total Population	52%	50%		
Increase in School Age Children	7,398	7,785	391	5%
Increase in Enrollment	5,961	6,217	256	4%
School Capture Rate	81%	80%	65%	
Live Births	614	693	79	13%
% of Child-Bearing Age Having Children	4%	5%		
Kindergarten Capture Rate	65%	89%	24%	
Kindergarten Enrollment	407	546	139	34%

Source: U.S. Census Bureau, 2012; The Public Schools of Brookline, 2012; MGT of America, Inc., 2012

Exhibit 1-23 gathers information from a variety of sources and provides some interesting observations. First, while the total Brookline population increased from 2000 to 2010 by 1,625 people (three percent), the child-bearing age population (ages 15 – 44) decreased by 434 people. The decrease in child-bearing age population is only one percent, but it is, nevertheless, declining and accounting for a smaller percentage of the total population (52 percent in 2000 to 50 percent in 2010).

From 2000 to 2010, the number of school-age children increased from 7,398 to 7,785, representing an increase of 391 potential students, or five percent. Similarly, over that same period of time, enrollment in the district increased four percent from 5,961 to 6,217 (256 student increase). The "school capture rate", i.e., that percentage of the school-age children that enroll in the district, stayed essentially the same with 81 percent in 2000 and 80 percent in 2010. Furthermore, 65 percent of the additional 391 school age children became students in the district.

Returning to the discussion of live births, there were 614 live births in Brookline in 2000, while there were 693 live births in 2010. That is a 13 percent increase. However, the percentage of the child-bearing age population represented by those children increased only slightly from four percent to five percent.[1]

With respect to kindergarten enrollment, total kindergarten enrollment increased 34 percent from 407 in 2000 to 546 in 2010. This increase was driven by the increase in the kindergarten capture rate from 65 percent in 2000 to 89 percent in 2010.

[1] This analysis assumes that the two parents for each live birth were included in the Brookline population total for the relevant Census period. This analysis also assumes that no set of parents had twins or triplets.

The cross-sectional data analysis supports the conclusion that the increase in enrollment has been driven in large part by the increasing kindergarten capture rate. There are fewer child-bearing age people in the district, and the district is capturing fewer of the school-age children. Yet, enrollment, specifically kindergarten enrollment, is increasing. Why? Part of the answer appears to be the significant increase in the kindergarten capture rate.

Part of the answer might also be that school-age children are moving into the district after spending the first part of their life somewhere else. This conclusion would help explain, in part, why enrollment has gone up in grades K-3 while the child-bearing age population has decreased.

Given these conclusions and the observations drawn from the historical data, it appears appropriate that the Cohort Survival model have the greatest weight in order to reflect the movement of the increase in K-3 enrollment as it advances through the district. However, additional analysis is necessary to determine how much weight to give the Cohort Survival model.

Sensitivity Analysis

To identify the appropriate model weighting, MGT conducted a "sensitivity analysis" in which various percentage weighted are applied to each of the four based models. MGT then compared the results of the different scenarios to one another to arrive at the appropriate weighted average for the enrollment projection. *Exhibit 1-24* identifies the various sensitivity models for this analysis.

Exhibit 1-24
Sensitivity Analysis Models

	A	B	C	D	E	F
Average Percentage Growth	20%	30%	0%	5%	10%	25%
Students per Household	10%	10%	0%	5%	10%	25%
Cohort Survival	50%	50%	100%	85%	70%	25%
Linear Regression	20%	10%	0%	5%	10%	25%
2021-22						
K-8 Enrollment	5,661	5,805	5,376	5,414	5,451	5,563
9-12 Enrollment	2,096	2,119	2,481	2,369	2,258	1,924
K-12 Enrollment	7,757	7,924	7,857	7,783	7,709	7,488

Source: MGT of America, Inc., 2012.

Sensitivity Models A and B assign a mix of weights across the four base models, with the greatest weight on the Cohort Survival model. However, these models place too great an emphasis on the Linear Regression and Average Percentage Growth models. Within these models, the increasing enrollment trend in K-8 runs counter to the decreasing enrollment trend in 9-12 and does not allow either one to reflect that a change in the respective trend might occur. More weight is needed in the Cohort Survival and less in the Linear Regression and Average Percentage Growth models. The Students-per-Household is appropriately low and needs to have some impact to reflect the potentially steady influence of housing in the district.

Sensitivity Model F is a straight average of the four models, and it goes too far away from the Cohort Survival and places too great an emphasis on the remaining three models.

Sensitivity Model C goes too far the other way. Its complete reliance on the Cohort Survival Model does not allow for any influence from students moving into the district after they are born, which is captured to varying extents by the other three models.

Sensitivity Model E comes closer to reflecting the conclusions and observations of the historical data and the cross-sectional analysis. The 70 percent weight given to Cohort Survival is more appropriate, but the 10 percent each to the other three models might put too much emphasis still on factors outside of the influence of the increase in enrollment at the K-3 grades.

Sensitivity Model D appears to have the right mix of weights. An 85 percent weight for Cohort Survival allows the increase in K-3 enrollment to move through the district and push 9-12 enrollment up, while, at the same time, the five percent weight for Average Percentage Growth, Students-per-Household, and Linear Regression allows the influence of students moving into the district to be included in the model. Accordingly, MGT used the weights in Sensitivity Model D for the enrollment projections in this study.

Exhibit 1-25 identifies the weights used to generate the enrollment projections in this study.

Exhibit 1-25
Weights Used to Generate Weighted Average of "Base" Models

Model	Weight
Average Percentage Growth	5%
Students-Per-Household	5%
Cohort Survival	85%
Linear Regression	5%

Source: MGT of America, Inc., 2012.

ENROLLMENT PROJECTIONS

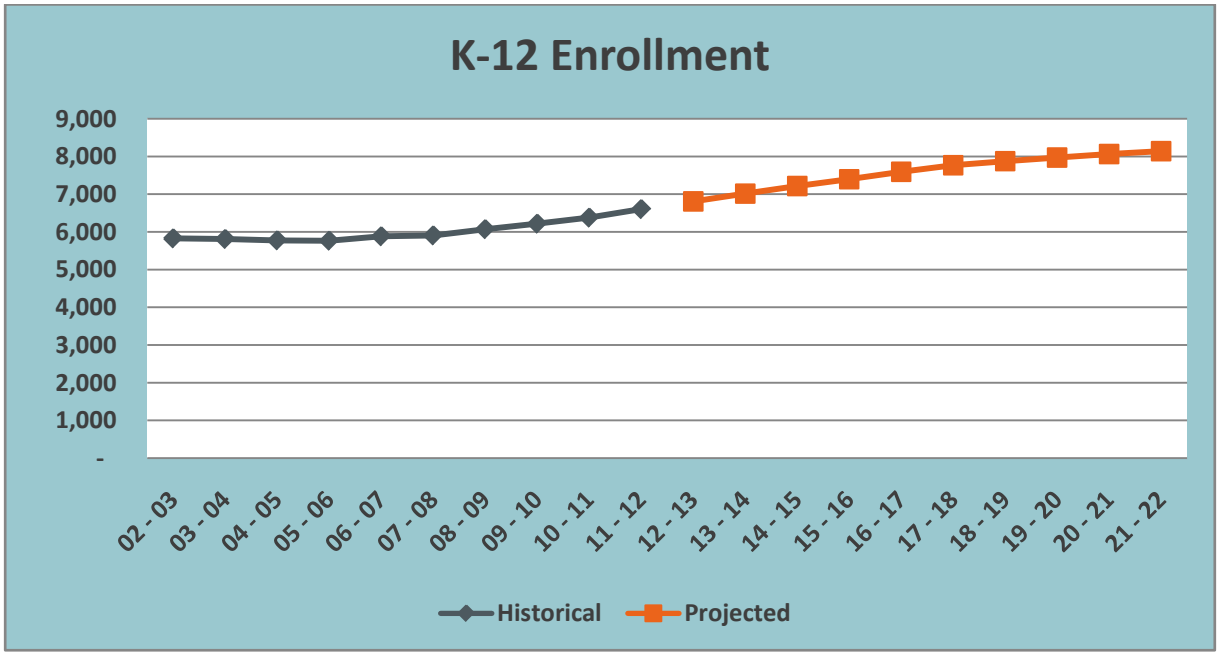
MGT has utilized the foregoing methodology to forecast enrollment for the district over the next ten years. *Exhibit 1-26* identifies the projected enrollment for each grade level. *Exhibit 1-27* illustrates the historical and projected enrollment for the entire district.

Exhibit 1-26
The Public Schools of Brookline – Projected Enrollment

	12 - 13	13 - 14	14 - 15	15 - 16	16 - 17	17 - 18	18 - 19	19 - 20	20 - 21	21 - 22
K	653	587	590	606	614	608	614	622	628	632
1	599	654	589	604	611	618	618	625	628	632
2	583	653	709	636	651	661	669	666	674	680
3	647	577	630	691	628	642	645	649	646	651
4	551	635	566	633	694	623	636	642	643	636
5	533	559	652	583	642	704	632	644	647	647
6	529	532	554	638	566	624	686	615	625	628
7	498	507	505	531	614	541	593	649	582	591
8	439	499	508	509	532	611	539	590	644	578
9	443	459	522	525	523	551	629	554	607	663
10	472	450	458	524	533	528	555	636	558	614
11	422	471	452	463	522	531	525	551	631	556
12	444	434	481	454	466	526	534	527	552	635
K-8	5,015	5,202	5,305	5,431	5,551	5,632	5,633	5,704	5,716	5,674
9-12	1,796	1,814	1,912	1,967	2,045	2,136	2,244	2,267	2,349	2,468
Total	6,810	7,017	7,218	7,398	7,595	7,768	7,877	7,970	8,065	8,142

Source: MGT of America, Inc., 2012

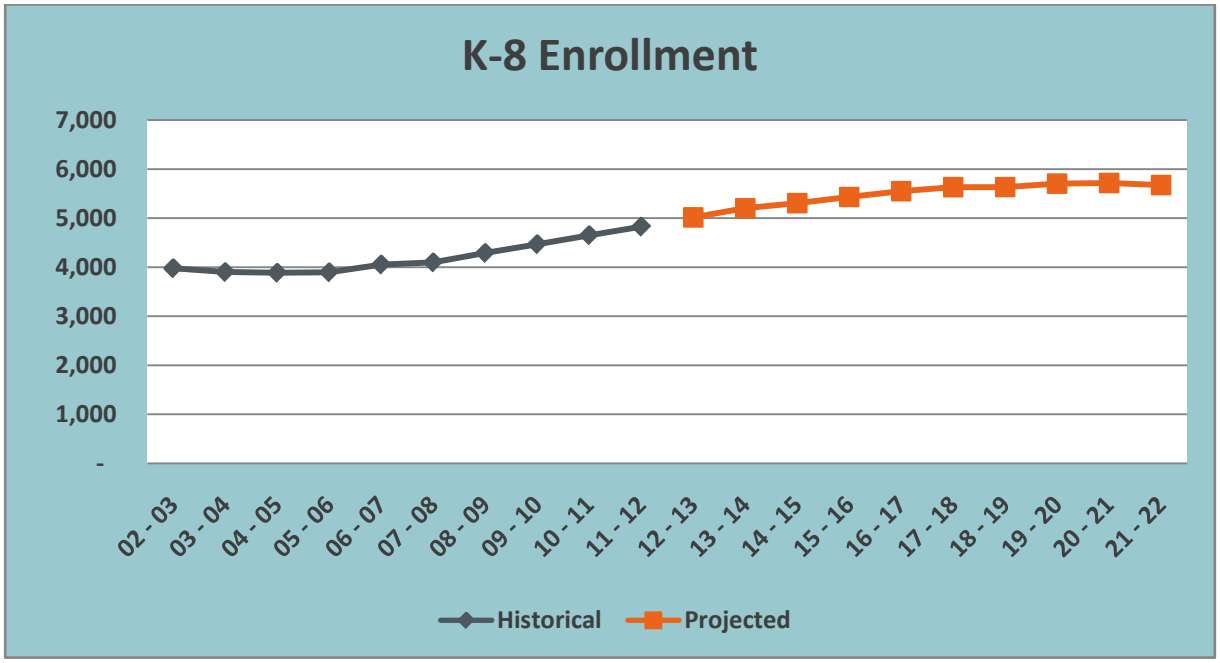
Exhibit 1-27
The Public Schools of Brookline
Historical and Projected Enrollment – K-12



Source: MGT of America, Inc., 2012.

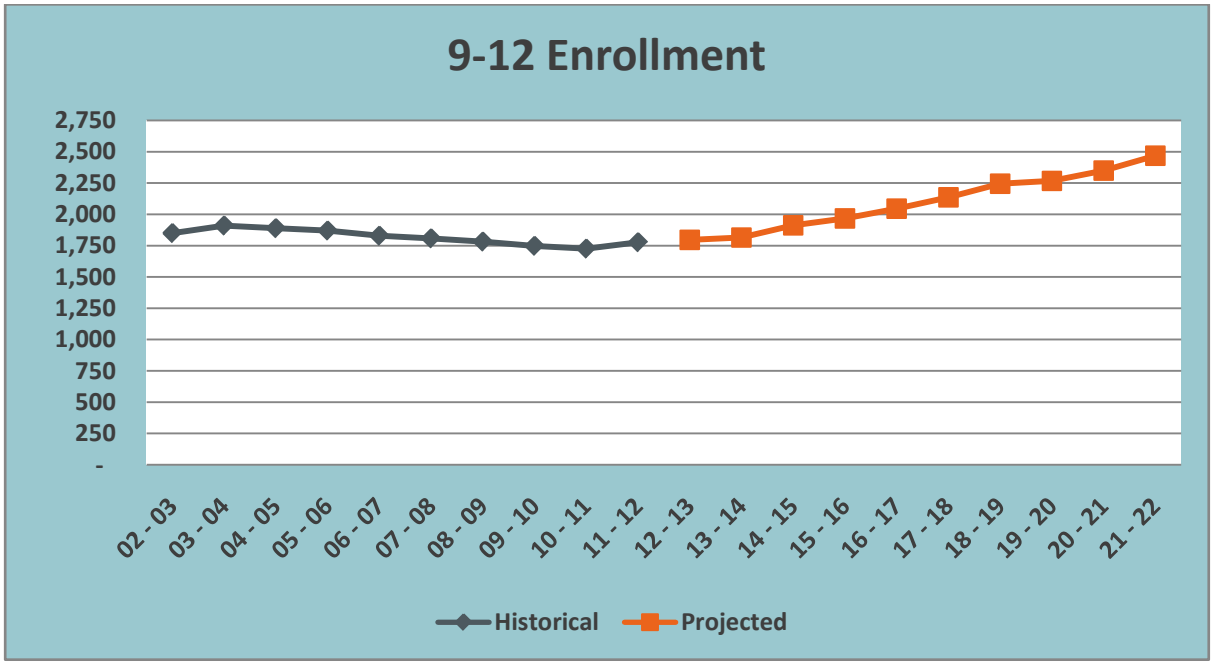
As the foregoing *Exhibit 1-27* shows, enrollment across the district is expected to continue to increase over the next ten years. The following *Exhibits 1-28* and 1-*29* illustrate the historical and projected enrollment at each grade band.

Exhibit 1-28
The Public Schools of Brookline
Historical and Projected Enrollment – K-8



Source: MGT of America, Inc., 2012.

Exhibit 1-29
The Public Schools of Brookline
Historical and Projected Enrollment – 9-12



Source: MGT of America, Inc., 2012.

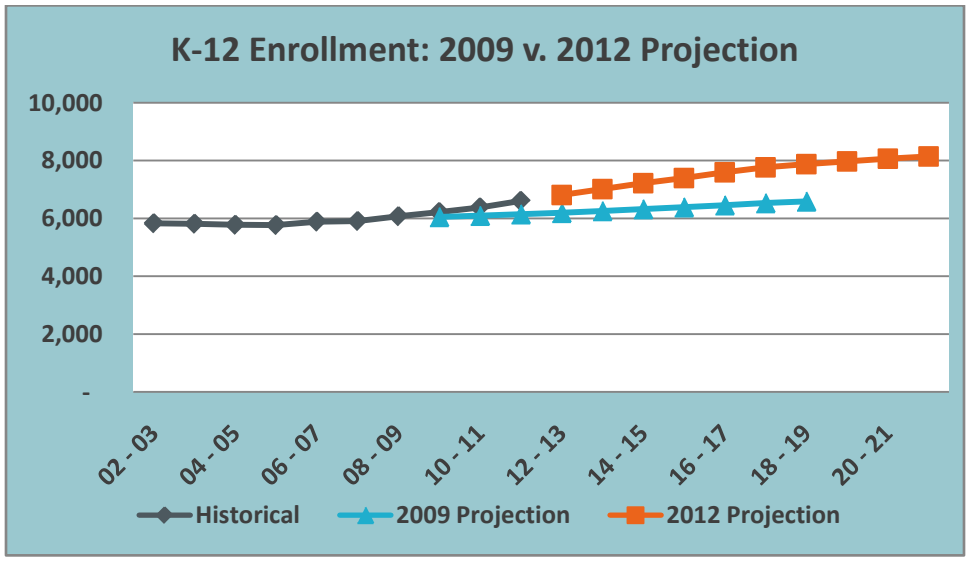
Comparison to 2009 Enrollment Study

In 2009, MGT prepared enrollment projections for The Public Schools of Brookline. This 2012 report is intended to update the 2009 projections, which forecasted lower enrollment than what the district has experienced. In addition, the 2012 projected enrollments also exceed the 2009 projected enrollment.

Explaining the difference is left somewhat to conjecture, but it appears that the increases in kindergarten enrollment noted in 2009 continued longer than anticipated. The increase is the number of school age children in the *Under 5* through *5 to 9* age groups in the 2010 Census supports this conclusion.

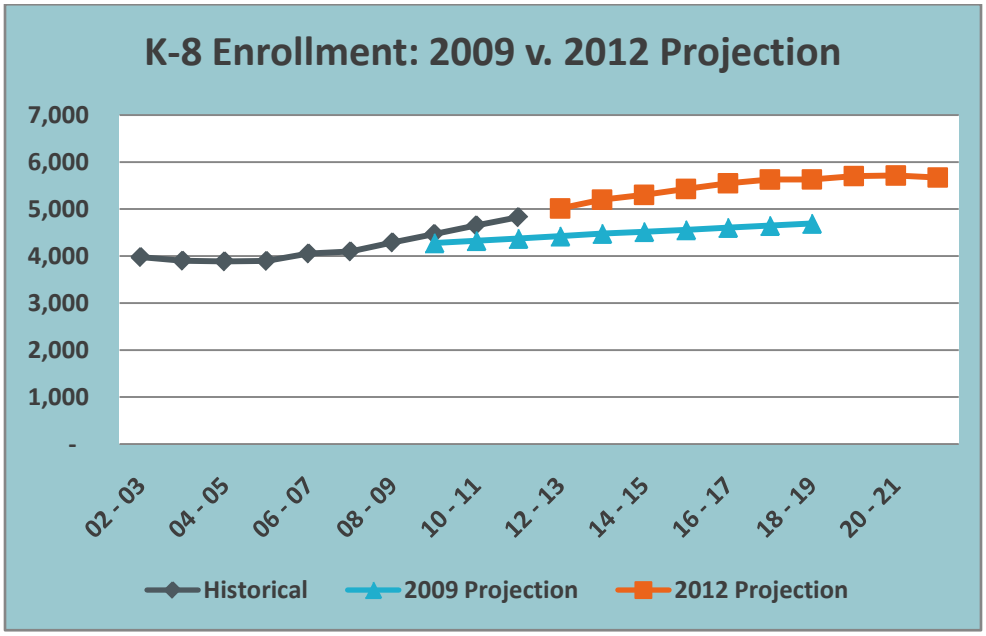
Exhibits 1-30 through *Exhibit 1-32* illustrate the historical enrollment from the 2002-03 school year, the 2009 enrollment projection, and the 2012 enrollment projection. The 2012 projections for K-12 and K-8 exceed the 2009 projections, which is easily explained by the greater-than-expected increase in K-3 over the last few years. At the 9-12 level, the 2012 tracks the 2009 projection fairly closely for two years, until the increasing enrollment at the K-8 grade band begins to push 9-12 enrollment up.

Exhibit 1-30
The Public Schools of Brookline
Historical and Projected Enrollment – K-12
Comparison of 2009 and 2012 Projections



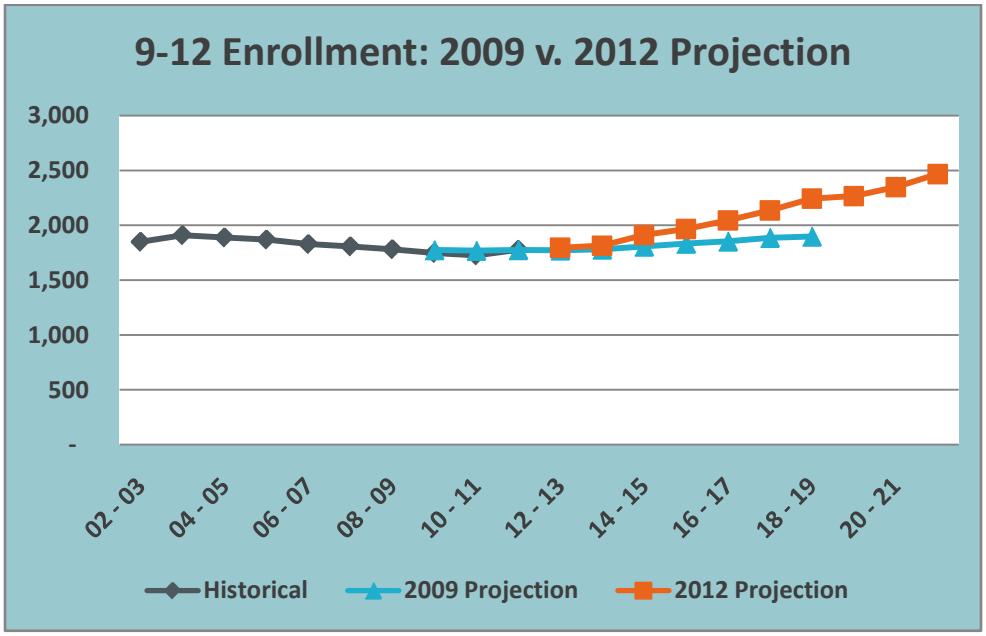
Source: MGT of America, Inc., 2012.

Exhibit 1-31
The Public Schools of Brookline
Historical and Projected Enrollment – K-8
Comparison of 2009 and 2012 Projections



Source: MGT of America, Inc., 2012.

Exhibit 1-32
The Public Schools of Brookline
Historical and Projected Enrollment – 9-12
Comparison of 2009 and 2012 Projections



Source: MGT of America, Inc., 2012.

SECTION TWO: CAPACITY AND UTILIZATION ANALYSIS

Introduction

This chapter contains the capacity and utilization analysis conducted by MGT. The capacity of a facility is defined as the number of students the facility can accommodate. More specifically, a school's capacity is the number of students which can be accommodated given the specific educational programs, the class schedules, the student-teacher ratios, and the size of the rooms. MGT's capacity model, called the *Instructional Use Model*, includes a scheduling factor which recognizes that some classrooms are not occupied during teacher preparation times, and that every class will not have the maximum number of students enrolled. The Instructional Use Model is designed to reflect how the building actually functions. While there are other methods for calculating the capacity of a school, the Instructional Use Model is most appropriate because it most accurately reflects how the schools are used. Utilization is calculated by dividing the number enrolled at the school by its capacity.

School Building Capacity

MGT uses the Instructional Use Model to calculate a school's capacity. The Instructional Use Model counts the number of the various types of instructional rooms and multiplies that number by a students-per-room or *loading* factor to identify the gross capacity for the school. The gross capacity is then multiplied by a scheduling factor, which takes into account the realities of how the space is used. For example, high school students move from room to room and enroll in a variety of courses. As a result, some rooms will sit empty or will be less than fully occupied at any given time. Teacher preparation periods will also contribute to rooms not being used for instruction at a particular time. Therefore, MGT uses a 75 percent scheduling factor to reduce the gross capacity of the building to reflect the unused rooms due to the realities of how a high school functions. An elementary school, on the other hand, has students that remain in one room for most of the school day. Therefore, MGT uses a 90 percent scheduling factor for elementary schools to reflect the fairly consistent, day-long use of elementary classrooms. The guidelines used for these calculations are listed below.

Exhibit 2-1
The Public Schools of Brookline – Instructional Use Model Standards

Instructional Use Model Standards	
Room Type	**Students/Room**
Pre-Kindergarten/Preschool Capacity	0
Kindergarten Capacity (Full-Day)	20
Classroom (1-3)	22
Classroom (4-12)	24
Art (9-12)	24
Music (9-12)	24
Performing Arts	44
Science (9-12)	22
Voc./Industrial Tech, Foods, Etc. (9-12)	22
PE (9-12)	44
Computer Lab (9-12)	22
Spec. Ed. – Severe	8
Spec. Ed. – Resource	0
Portable	0
Scheduling Factors	
Elementary Schools	**90%**
High Schools	**75%**

Source: MGT of America, Inc., 2012

The following example shows how MGT used the Instructional Use Model to calculate the capacity of Brookline High School:

Exhibit 2-2
The Public Schools of Brookline
Example Calculation of Capacity – Brookline High School

Room Type	Number of Classrooms x	Students/Classroom	= Capacity
General Classrooms	69	24	1,656
Art	6	24	144
Music	2	24	48
Performing Arts	3	44	132
Science	24	22	528
Vocational Education	15	22	330
Physical Education	8	44	352
Computer Labs	2	22	44
Special Ed (Self-Contained)	2	8	16
Special Ed (Resource)	0	0	0
Total capacity (w/o scheduling factor) = 3,250			
x High school scheduling factor of 75%			
Brookline high school capacity =2,438			

Source: MGT of America, Inc., 2012

Using the Instructional Use Model, as shown in *Exhibit 2-2*, MGT has calculated the capacity for each of the district's school buildings. *Exhibits 2-3* through *2-5* identify each school or building's capacity by grade band or site type.

Exhibit 2-3
The Public Schools of Brookline
Elementary School Capacities by Site

Site Name	Capacity
Elementary Schools	
Baker K-8	679
Devotion K-8	752
Driscoll K-8	574
Heath K-8	553
Lawrence K-8	572
Lincoln K-8	437
Pierce K-8	634
Runkle K-8	616
Elementary School Total	**4,817**

Source: MGT of America, Inc., 2012.

Exhibit 2-4
The Public Schools of Brookline
High School Capacities by Site

Site Name	Capacity
High School	
Brookline High School	2,438
High School Total	**2,438**

Source: MGT of America, Inc., 2012.

Exhibit 2-5
The Public Schools of Brookline
Other Building Capacities by Site

Site Name	Capacity
Other Buildings	
Baldwin Alternative School	113
Lynch Recreation Center	74
Other Building Total	**187**

Source: MGT of America, Inc., 2012.

Capacity and Enrollment – Utilization Analysis

The effective management of school facilities requires a school's capacity and enrollment to be matched. When capacity exceeds enrollment (underutilization), operational costs are higher than necessary and facilities may need to be re-purposed or the facilities may need to be removed from inventory. When enrollment exceeds capacity (overutilization), the school may be overcrowded and capital expenditures may need to be increased. MGT has calculated and analyzed the present utilization rates for each grade band based on the enrollment information in the preceding chapter and the capacity information above-noted. Also identified below are the utilization rates from the 2009 facilities master plan study, as well as the key to the chart colors.

Key:
Greater than 100%
Between 90% and 100%
Between 80% and 90%
Between 70% and 80%
Less than 70%

Exhibit 2-6
The Public Schools of Brookline
2009 Utilization Analysis by Grade Band

2009 Utilization Analysis					
Grade Band	Capacity	Enrollment		Utilization	
		2008	2017-18	Current	2018-19
K-8	4,459	4,290	4,693	96%	105%
9-12	2,438	1,772	1,898	73%	78%
K-12	6,897	6,062	6,587	88%	96%

Source: MGT of America, Inc., 2009.

Exhibit 2-7
The Public Schools of Brookline
2012 Utilization Analysis by Grade Band

2012 Utilization Analysis					
Grade Band	Capacity	Enrollment		Utilization	
		Current	2021-22	Current	2021-22
K-8	4,817	4,827	5,674	100%	118%
9-12	2,438	1,777	2,468	73%	101%
K-12	7,150	6,604	8,142	91%	112%

Source: MGT of America, Inc., 2012.

Exhibit 2-8
The Public Schools of Brookline
2009 Utilization Analysis by School

2009 Utilization Analysis					
Site	Capacity	Enrollment		Utilization	
		2008	2018-19 Projected	Current	2018-19 Projected
Baker K-8	679	672	725	99%	107%
Devotion K-8	752	689	718	92%	95%
Driscoll K-8	470	403	455	86%	97%
Heath K-8	420	402	439	96%	105%
Lawrence K-8	572	557	600	97%	105%
Lincoln K-8	437	469	510	107%	117%
Pierce K-8	634	630	703	99%	111%
Runkle K-8	495	468	561	95%	113%
Brookline HS	2,438	1,772	1,898	73%	78%

Source: MGT of America, Inc., 2009.

Exhibit 2-9
The Public Schools of Brookline
2012 Utilization Analysis by School

2012 Utilization Analysis					
Site	Capacity	Enrollment		Utilization	
		Current	2021-22 Projected	Current	2021-22 Projected
Baker K-8	679	678	798	100%	118%
Devotion K-8	752	764	903	102%	120%
Driscoll K-8	574	530	665	92%	116%
Heath K-8	553	494	577	89%	104%
Lawrence K-8	572	623	679	109%	119%
Lincoln K-8	437	545	657	125%	150%
Pierce K-8	634	699	839	110%	132%
Runkle K-8	616	494	555	80%	90%
Brookline HS	2,438	1,777	2,468	73%	101%

Source: MGT of America, Inc., 2012.

Capacity and Utilization Conclusions

Simply put, The Public Schools of Brookline are out of space in the K-8 buildings. In 2009, it appeared that the projected enrollment would create the need for more space. Now, in 2012, the need for more space is immediate, and the future is only going to make the need greater.

Brookline High School is a similar story. The 2009 utilization analysis indicated that the high school had ample room to accommodate future enrollment growth, but the 2012 analysis shows that the high school will be very crowded by the end of the next ten years.