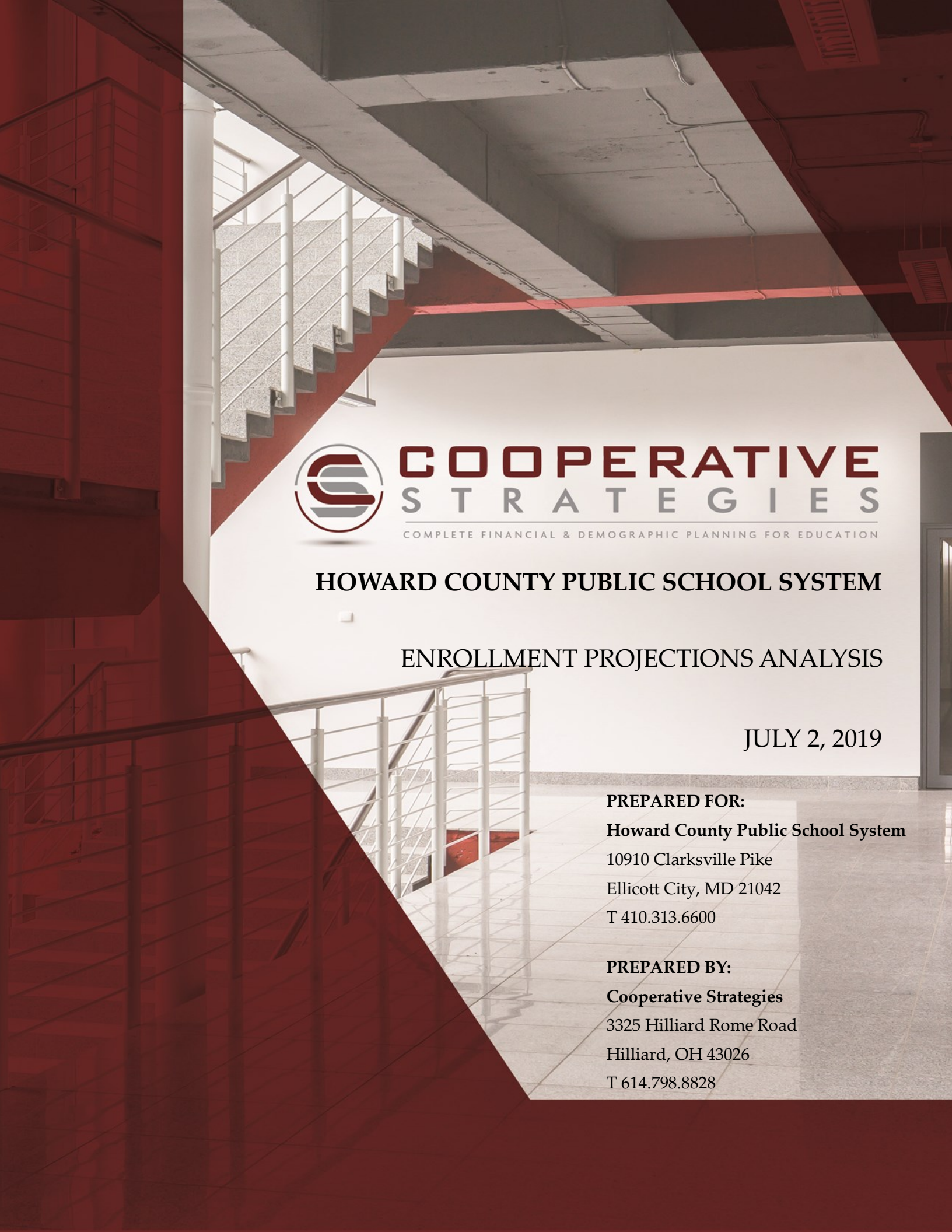

COOPERATIVE STRATEGIES

COMPLETE FINANCIAL & DEMOGRAPHIC PLANNING FOR EDUCATION

HOWARD COUNTY PUBLIC SCHOOL SYSTEM

ENROLLMENT PROJECTIONS ANALYSIS

JULY 2, 2019

PREPARED FOR:

Howard County Public School System

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ACKNOWLEDGMENTS

On behalf of Cooperative Strategies, we would like to extend our appreciation to the Howard County Public School System for the opportunity to assist them in developing this Enrollment Projections Analysis. As a planning team, we hope that this document will serve the Howard County Public School System for years to come.

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EXECUTIVE SUMMARY

In April 2019, Cooperative Strategies was contracted by the Howard County Public School System [HCPSS] to provide an evaluation of the enrollment projection methodologies and processes currently in place in the School System. Cooperative Strategies reviewed the following information in order to perform the evaluation:

- HCPSS enrollment projection files for 2015, 2016, 2017, and 2018
- Description of HCPSS Enrollment Projection Methodology, July 23, 2018
- Maryland Department of Planning [MDP] enrollment projections for 2015, 2016, 2017, and 2018
- HCPSS Projection Accuracy Reports for 2016, 2017, 2018, 2019
- Official Enrollment for HCPSS for school years 2009-10 through 2018-19

Findings:

Upon review of the above information, Cooperative Strategies believes the methodologies, data, and processes used by HCPSS are sound and produce accurate results. HCPSS primarily uses the cohort -survival methodology while incorporating components for housing, preschool aged students, and out-of-district students. The housing component accounts for apartment turnover, re-sales of existing homes, and first-time sales of newly constructed housing units. The preschool component accounts for preschool aged students moving into previously constructed housing units. The out-of-district component accounts for students who live outside the school attendance boundary being studied. HCPSS is transparent with their methodology posting a description with accompanying graphic on their website (this can also be found in Appendix B of this report). The data used by HCPSS to develop enrollment projections are in line with recommended national best practices and data from outside sources are updated as datasets become available, ensuring the enrollment projections are consistently based on the best data available at the time the enrollment projections are developed.

Recommendations:

Although, the current process in place by HCPSS are sound and produce accurate results, we recommend the School System consider the following:

- HCPSS is currently preparing to launch a new software. Throughout the process of putting in place the new software, HCPSS should develop a technical and user manual ensuring the inputs, outputs, and technical code are well documented.
- HCPSS should provide a report focused on the enrollment projections that is released prior to the feasibility study. The enrollment projections report should outline all data and methodologies used to develop the enrollment projections. Included in this report should be the enrollment projection accuracy report already being developed annually by HCPSS Office of School Planning [OSP].
- HCPSS should compare historical September 30 versus end of year enrollment counts for each school year to identify common trends that can be considered in the development of enrollment projections.
- HCPSS should incorporate a review process of preliminary enrollment projections, by school, by grade, with administrative staff as determined appropriate by the Superintendent. This review process provides an opportunity for additional feedback regarding area-specific development, school-specific program or policy changes, and neighborhood perception to be considered if it was not already considered in the preliminary enrollment projections development.

These recommendations will increase transparency throughout the process and provide more public confidence in the validity and accuracy of the enrollment projections and the processes, data, and methodologies used.

INTRODUCTION

When projecting future enrollments, it is vital to track the number of live births, the amount of new housing activity, and the change in household composition. In addition, any of the following factors could cause a significant change in projected student enrollment:

- Boundary changes
- New school openings
- Changes / additions in program offerings
- Preschool programs
- Change in grade configuration
- Student transfer policy changes
- Interest rates / unemployment shifts
- Intra- and inter-district transfer
- Magnet / charter / private school opening or closure
- Zoning changes
- Unplanned new housing activity
- Planned, but not built, housing
- School closure
- Changes in school or neighborhood perception

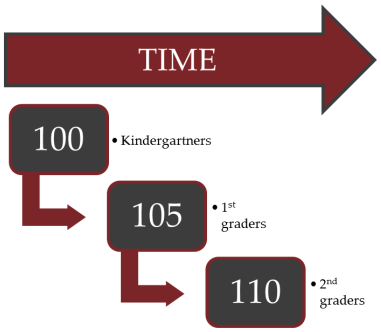
Obviously, certain factors can be gauged and planned for far better than others. For instance, it may be relatively straightforward to gather housing data from local builders regarding the total number of lots in a planned subdivision and calculate the potential student yield. However, planning for changes in the unemployment rate, and how these may either boost or reduce public school enrollment, proves more difficult. In any case, it is essential to gather a wide variety of information in preparation for producing enrollment projections.

When looking ahead at a school district's enrollment over the next two, five, or ten years, it is helpful to approach the process from a global perspective. For example: How many new homes have been constructed each year? How many births have occurred each year in relation to the resident population? Is housing experiencing a turnover—if so, what is the composition of families moving in/out? Are more or less students attending private school or being home-schooled? What has the unemployment rate trend been over the past ten years? What new educational policies are in place that could affect student enrollment figures?

In developing enrollment projections, it is helpful to approach the process from a global perspective. There are five methodologies that have been developed to project student enrollment. They are summarized on the following pages.

ENROLLMENT PROJECTION METHODOLOGIES

Cohort Survival Method



The cohort survival methodology (sometimes referred to as the grade progression ratio method) is a widely used enrollment projection model that is applied by many school districts and state and federal agencies to project K-12 enrollment.

A cohort is a group of persons [in this case, students]. The cohort survival enrollment projection methodology uses historic live birth data and historic student enrollment to "age" a known population or cohort throughout the school grades. For instance, a cohort begins when a group of kindergarteners enrolls in grade K and moves to first grade the following year, second grade the next year, and so on.

A "survival ratio" is developed to track how this group of students increased or decreased in number as they moved through the grade levels. By developing survival ratios for each grade transition [i.e. 2nd to 3rd grade] over a ten year period of time, patterns emerge. A projection ratio for each grade transition is developed based on analysis of the survival ratios. The projection ratios are used as a multiplier in determining future enrollment.

For example, if student enrollment has consistently increased from the 8th to the 9th grade over the past ten years, the survival ratio would be greater than 100% and could be multiplied by the current 8th grade to develop a projection for next year's 9th grade. This methodology can be carried through to develop ten years of projection figures. Because there is not a grade cohort to follow for students coming into kindergarten, resident live birth counts are used to develop a birth-to-kindergarten survival ratio. Babies born five years previous to the kindergarten class are compared in number, and a ratio can be developed to project future kindergarten enrollments.

The cohort survival method is useful in areas where population is stable [relatively flat, growing steadily, or declining steadily], and where there have been no significant fluctuations in enrollment, births, and housing patterns from year to year. The cohort survival methodology inherently considers the net effects of factors such as migration, housing, dropouts, transfers to and from charter schools, open enrollment, and deaths. This methodology does not assume changes in policies, program offerings, or future changes in housing and migration patterns.

Housing Method

Enrollment projections can be determined by analyzing the housing data for areas that make up a school district. Yield factors can be established comparing the total number of single-family homes and the number of students. For example, if student enrollment is 100 and there are 200 single-family homes, then the yield factor would be, on average, 0.5 students per home.

Once yield factors are established, the number of students a new single-family home or subdivision may yield can be estimated by multiplying the yield factor by the number of new single-family homes there are projected.

In using this methodology, housing demolitions and neighborhood turnover must be examined. For instance, if housing demolitions have increased rapidly over recent years while new housing starts have remained relatively constant over many years, the conclusion may be that some of the new housing will simply be replacements for the families displaced by the demolitions. Housing value and household composition would also need to be analyzed to confirm that this indeed is the case. It is possible that enrollment may remain flat, or even decline, although there is new housing in the area.

Land Saturation Analysis

Housing data also drives the land-saturation analysis enrollment methodology. In areas where there is a high rate of development and the future development patterns in the area are clear, a "build-out" scenario can be developed. The scenario takes into consideration the remaining acreage to be developed, planned rate of completion, zoning policies, density per acre, type of housing, and ratios of school-age children per household type. This method is particularly useful in areas experiencing rapid growth.

Regression-Based Forecasting Methods

There are several regression-based forecasting methods that may be used in conjunction with the cohort survival method to increase the accuracy of projections. In forecasting, it is useful to study the neighborhoods to determine if they are growing, stable, or declining in numbers of school-age children. Many variables may affect the environmental condition of a school district, including live births, building and occupancy permits, transportation plans, and land use plans.

Migration / Change in Household Composition

The change in household composition over time is one of the most difficult factors to predict. Neighborhoods often go through cycles of newer homes housing younger families. As the families remain in the neighborhood, students become older and eventually the home becomes an "empty nest." At some point, the housing unit is sold and a new family moves in. As simple as it may seem, it is extremely complex to track who lives in each household.

Geographic Information Systems

While not a methodology, the need for better tools and easier manipulation of data has led to a relatively new industry standard in planning—Geographic Information Systems [GIS]. GIS technology allows school districts to quickly analyze data sets including birth data, housing information, and enrollment statistics. When paired with enrollment projections, GIS becomes an invaluable information-management and decision-making tool. Often, county or city offices are already implementing GIS technology and data can be shared and expanded among these organizations in the district.

Most enrollment projections include some combination or variation of each of the methods listed above, including those developed by HCPSS. However, unforeseen variables and circumstances can and will change student enrollment. The presence of these variables suggest that projections be used as a guide and not an absolute. It is important to remember that successful enrollment projections are both a science and an art. The science is knowing which information to gather and how to use the forecasting methodologies. The art is in analyzing the output and when and how to use the information.

HCPSS METHODOLOGY

The Howard County Public School System enrollment projection model is based on a modified cohort survival method, using the September 30 student head counts. However, students who can be attributed to housing transactions such as apartment turnover, re-sales of existing homes, first-time sales of newly-constructed homes, as well as out-of-district and preschool students who have moved into existing homes have been removed from the total population that is projected through the cohort survival method and projected separately based on different methodologies appropriate to each category. The description of the methodology provided by HCPSS, which is available on their website, can be found in Appendix B of this report.

Enrollment projections are produced by school, by grade. These projections are then summed to determine a System-wide enrollment projection. This allows for consideration to be given to trends specific to school boundaries such as live birth counts, programmatic changes, and housing development.

HCPSS has access to data not typically available to most school systems throughout the country. The wealth of this information greatly enhances the enrollment projections produced by HCPSS.

- Geocoded live birth counts aggregated to elementary boundaries provided by the Maryland Department of Health and Mental Hygiene
- Projected County-wide live birth counts from Maryland Department of Planning in five-year increments
- Existing and projected housing units, by type of unit (single-family, detached; single-family, attached; apartment; mobile home; and unknown), by boundary
- Student yields from re-sales of existing homes as well as new housing units constructed over the past ten years by type of unit
- Feed rates - Historical and projected percentage of students feeding from one school to another (i.e., elementary to middle school or middle school to high school)

ENROLLMENT PROJECTION ACCURACY

The Howard County Public School System enrollment projections produced for school years 2015-16, 2016-17, 2017-18, and 2018-19 were compared to the actual enrollment of each year and analyzed for accuracy at System-wide, by grade and by school, by grade levels. In addition, Cooperative Strategies reviewed the accuracy of the enrollment projections developed by the Maryland Department of Planning [MDP] for HCPSS as well as all school districts in Maryland for comparative purposes.

Overall, the System-wide enrollment projections developed by HCPSS are highly accurate, with better accuracy for the first year of projection during the time period studied. The enrollment projections for HCPSS developed by MDP are more accurate beyond one year into the future. However, in comparison to the Mean Absolute Percent Error [MAPE] of enrollment projections that were done for all districts in Maryland by MDP, the enrollment projections produced by HCPSS were consistently more accurate.

State Reported Actuals				MDP Projections			
Districtwide Comparision		HCPSS		Howard County		All Districts	
Projection	Forecast Year	Absolute Difference	Absolute Percent Error	Absolute Difference	Absolute Percent Error	Mean Absolute Difference	Mean Absolute Percent Error
2015	2015	204	0.38%	184	0.34%	223	0.90%
	2016	227	0.42%	128	0.24%	310	1.10%
	2017	607	1.09%	170	0.31%	593	1.90%
	2018	810	1.43%	360	0.64%	794	2.90%
2016	2016	233	0.43%	302	0.56%	210	0.70%
	2017	592	1.07%	310	0.56%	491	1.50%
	2018	1043	1.84%	380	0.67%	609	2.00%
2017	2017	219	0.39%	230	0.41%	267	0.90%
	2018	264	0.47%	150	0.27%	415	1.60%
2018	2018	126	0.22%	10	0.02%	228	0.80%

It should be noted that the enrollment projections that were developed by MDP differ from those that were developed by HCPSS in some significant ways. First, the enrollment projections developed by HCPSS are done at the school level and rolled up to the System-wide level. The enrollment projections done by MDP are done at the system-wide level and are not broken down by

school. This is important to note as larger sample sizes typically yield more accurate results than smaller sample sizes. Second, HCPSS uses a modified cohort-survival method to project enrollment, as described earlier in this report. MDP uses a more traditional cohort survival, or grade-succession, method. Finally, it is important to recognize the purposes of the enrollment projections. HCPSS utilizes enrollment projections for boundary and school level facility planning and budgeting. The MDP enrollment projections are used primarily for state-level budget planning. The purpose of the enrollment projections drives the methodology used to develop the enrollment projections and the level of detail the enrollment projections require.

HCPSS Enrollment Projections by Grade SY 2015-16

	HCPSS Actual				HCPSS 2015 Projection				MDP 2015 Projection (Howard County)			
Grade	2015-16	2016-17	2017-18	2018-19	2015-16	2016-17	2017-18	2018-19	2015-16	2016-17	2017-18	2018-19
K	3,788	3,800	3,817	3,956	3,729	3,784	3,926	4,029	3,650	3,640	3,710	3,760
1	3,904	3,946	4,043	4,044	3,897	4,007	4,072	4,220	3,900	3,810	3,810	3,880
2	4,176	4,086	4,123	4,218	4,158	4,067	4,187	4,240	4,180	4,070	3,980	3,980
3	4,139	4,280	4,233	4,223	4,072	4,279	4,178	4,288	4,050	4,270	4,150	4,060
4	4,158	4,243	4,409	4,366	4,129	4,203	4,429	4,315	4,130	4,180	4,410	4,290
5	4,118	4,264	4,387	4,546	4,100	4,247	4,321	4,549	4,110	4,240	4,290	4,530
6	4,263	4,224	4,413	4,568	4,271	4,278	4,449	4,493	4,270	4,250	4,390	4,440
7	4,281	4,361	4,315	4,507	4,270	4,393	4,410	4,564	4,260	4,370	4,350	4,490
8	4,186	4,330	4,468	4,373	4,193	4,379	4,509	4,511	4,190	4,330	4,440	4,420
9	4,395	4,598	4,673	4,832	4,458	4,670	4,871	5,000	4,510	4,710	4,870	4,990
10	4,168	4,216	4,418	4,503	4,205	4,287	4,479	4,674	4,220	4,330	4,560	4,710
11	3,905	3,994	4,024	4,278	3,855	4,038	4,118	4,293	3,860	4,050	4,170	4,380
12	4,153	4,006	4,147	4,156	4,093	3,943	4,128	4,204	4,120	3,970	4,170	4,280
Total	**53,634**	**54,348**	**55,470**	**56,570**	**53,430**	**54,575**	**56,077**	**57,380**	**53,450**	**54,220**	**55,300**	**56,210**
K-5 Total	24,283	24,619	25,012	25,353	24,085	24,587	25,113	25,641	24,020	24,210	24,350	24,500
6-8 Total	12,730	12,915	13,196	13,448	12,734	13,050	13,368	13,568	12,720	12,950	13,180	13,350
9-12 Total	16,621	16,814	17,262	17,769	16,611	16,938	17,596	18,171	16,710	17,060	17,770	18,360
PROJECTION DELTA FROM ACTUAL												
K					59	16	-109	-73	138	160	107	196
1					7	-61	-29	-176	4	136	233	164
2					18	19	-64	-22	-4	16	143	238
3					67	1	55	-65	89	10	83	163
4					29	40	-20	51	28	63	-1	76
5					18	17	66	-3	8	24	97	16
6					-8	-54	-36	75	-7	-26	23	128
7					11	-32	-95	-57	21	-9	-35	17
8					-7	-49	-41	-138	-4	0	28	-47
9					-63	-72	-198	-168	-115	-112	-197	-158
10					-37	-71	-61	-171	-52	-114	-142	-207
11					50	-44	-94	-15	45	-56	-146	-102
12					60	63	19	-48	33	36	-23	-124
Total					**204**	**-227**	**-607**	**-810**	**184**	**128**	**170**	**360**
K-5 Total					198	32	-101	-288	263	409	662	853
6-8 Total					-4	-135	-172	-120	10	-35	16	98
9-12 Total					10	-124	-334	-402	-89	-246	-508	-591
PERCENTAGE FROM ACTUAL												
K					1.6%	0.4%	2.9%	1.8%	3.6%	4.2%	2.8%	5.0%
1					0.2%	1.5%	0.7%	4.4%	0.1%	3.4%	5.8%	4.1%
2					0.4%	0.5%	1.6%	0.5%	0.1%	0.4%	3.5%	5.6%
3					1.6%	0.0%	1.3%	1.5%	2.2%	0.2%	2.0%	3.9%
4					0.7%	0.9%	0.5%	1.2%	0.7%	1.5%	0.0%	1.7%
5					0.4%	0.4%	1.5%	0.1%	0.2%	0.6%	2.2%	0.4%
6					0.2%	1.3%	0.8%	1.6%	0.2%	0.6%	0.5%	2.8%
7					0.3%	0.7%	2.2%	1.3%	0.5%	0.2%	0.8%	0.4%
8					0.2%	1.1%	0.9%	3.2%	0.1%	0.0%	0.6%	1.1%
9					1.4%	1.6%	4.2%	3.5%	2.6%	2.4%	4.2%	3.3%
10					0.9%	1.7%	1.4%	3.8%	1.2%	2.7%	3.2%	4.6%
11					1.3%	1.1%	2.3%	0.4%	1.2%	1.4%	3.6%	2.4%
12					1.4%	1.6%	0.5%	1.2%	0.8%	0.9%	0.6%	3.0%
Total					**0.38%**	**0.42%**	**1.09%**	**1.43%**	**0.34%**	**0.24%**	**0.31%**	**0.64%**
K-5 Total					0.8%	0.1%	0.4%	1.1%	1.1%	1.7%	2.6%	3.4%
6-8 Total					0.0%	1.0%	1.3%	0.9%	0.1%	0.3%	0.1%	0.7%
9-12 Total					0.1%	0.7%	1.9%	2.3%	0.5%	1.5%	2.9%	3.3%

HCPSS Enrollment Projections by Grade SY 2016-17

	HCPSS Actual			HCPSS 2016 Projection			MDP 2016 Projection (Howard County)		
Grade	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
K	3,800	3,817	3,956	3,801	3,900	4,026	3,710	3,760	3,810
1	3,946	4,043	4,044	4,064	4,110	4,227	4,060	3,980	4,040
2	4,086	4,123	4,218	4,064	4,253	4,300	4,080	4,240	4,160
3	4,280	4,233	4,223	4,314	4,213	4,405	4,310	4,210	4,380
4	4,243	4,409	4,366	4,282	4,474	4,384	4,290	4,470	4,360
5	4,264	4,387	4,546	4,275	4,431	4,631	4,280	4,410	4,590
6	4,224	4,413	4,568	4,266	4,451	4,623	4,260	4,420	4,570
7	4,361	4,315	4,507	4,371	4,388	4,576	4,380	4,370	4,540
8	4,330	4,468	4,373	4,320	4,476	4,493	4,350	4,440	4,440
9	4,598	4,673	4,832	4,605	4,767	4,932	4,640	4,820	4,940
10	4,216	4,418	4,503	4,203	4,420	4,581	4,210	4,430	4,630
11	3,994	4,024	4,278	4,012	4,054	4,265	4,030	4,060	4,280
12	4,006	4,147	4,156	4,004	4,125	4,170	4,050	4,170	4,210
Total	**54,348**	**55,470**	**56,570**	**54,581**	**56,062**	**57,613**	**54,650**	**55,780**	**56,950**
K-5 Total	24,619	25,012	25,353	24,800	25,381	25,973	24,730	25,070	25,340
6-8 Total	12,915	13,196	13,448	12,957	13,315	13,692	12,990	13,230	13,550
9-12 Total	16,814	17,262	17,769	16,824	17,366	17,948	16,930	17,480	18,060
PROJECTION DELTA FROM ACTUAL									
K				-1	-83	-70	90	57	146
1				-118	-67	-183	-114	63	4
2				22	-130	-82	6	-117	58
3				-34	20	-182	-30	23	-157
4				-39	-65	-18	-47	-61	6
5				-11	-44	-85	-16	-23	-44
6				-42	-38	-55	-36	-7	-2
7				-10	-73	-69	-19	-55	-33
8				10	-8	-120	-20	28	-67
9				-7	-94	-100	-42	-147	-108
10				13	-2	-78	6	-12	-127
11				-18	-30	13	-36	-36	-2
12				2	22	-14	-44	-23	-54
Total				**-233**	**-592**	**-1,043**	**-302**	**-310**	**-380**
K-5 Total				-181	-369	-620	-111	-58	13
6-8 Total				-42	-119	-244	-75	-34	-102
9-12 Total				-10	-104	-179	-116	-218	-291
PERCENTAGE FROM ACTUAL									
K				0.0%	2.2%	1.8%	2.4%	1.5%	3.7%
1				3.0%	1.7%	4.5%	2.9%	1.6%	0.1%
2				0.5%	3.2%	1.9%	0.1%	2.8%	1.4%
3				0.8%	0.5%	4.3%	0.7%	0.5%	3.7%
4				0.9%	1.5%	0.4%	1.1%	1.4%	0.1%
5				0.3%	1.0%	1.9%	0.4%	0.5%	1.0%
6				1.0%	0.9%	1.2%	0.9%	0.2%	0.0%
7				0.2%	1.7%	1.5%	0.4%	1.3%	0.7%
8				0.2%	0.2%	2.7%	0.5%	0.6%	1.5%
9				0.2%	2.0%	2.1%	0.9%	3.1%	2.2%
10				0.3%	0.0%	1.7%	0.1%	0.3%	2.8%
11				0.5%	0.7%	0.3%	0.9%	0.9%	0.0%
12				0.0%	0.5%	0.3%	1.1%	0.6%	1.3%
Total				**0.43%**	**1.07%**	**1.84%**	**0.56%**	**0.56%**	**0.67%**
K-5 Total				0.7%	1.5%	2.4%	0.5%	0.2%	0.1%
6-8 Total				0.3%	0.9%	1.8%	0.6%	0.3%	0.8%
9-12 Total				0.1%	0.6%	1.0%	0.7%	1.3%	1.6%

HCPSS Enrollment Projections by Grade SY 2017-18

	HCPSS Actual		HCPSS 2017 Projection		MDP 2017 Projection (Howard County)	
Grade	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
K	3,817	3,956	3,867	3,974	3,760	3,810
1	4,043	4,044	4,036	4,100	3,950	3,970
2	4,123	4,218	4,103	4,221	4,110	4,120
3	4,233	4,223	4,202	4,221	4,190	4,230
4	4,409	4,366	4,375	4,306	4,400	4,340
5	4,387	4,546	4,354	4,492	4,360	4,520
6	4,413	4,568	4,347	4,463	4,370	4,510
7	4,315	4,507	4,309	4,438	4,320	4,480
8	4,468	4,373	4,423	4,402	4,420	4,390
9	4,673	4,832	4,716	4,811	4,770	4,930
10	4,418	4,503	4,385	4,498	4,450	4,600
11	4,024	4,278	4,061	4,243	4,070	4,310
12	4,147	4,156	4,073	4,137	4,070	4,210
Total	**55,470**	**56,570**	**55,251**	**56,306**	**55,240**	**56,420**
K-5 Total	25,012	25,353	24,937	25,314	24,770	24,990
6-8 Total	13,196	13,448	13,079	13,303	13,110	13,380
9-12 Total	17,262	17,769	17,235	17,689	17,360	18,050
PROJECTION DELTA FROM ACTUAL						
K			-50	-18	57	146
1			7	-56	93	74
2			20	-3	13	98
3			31	2	43	-7
4			34	60	9	26
5			33	54	27	26
6			66	105	43	58
7			6	69	-5	27
8			45	-29	48	-17
9			-43	21	-97	-98
10			33	5	-32	-97
11			-37	35	-46	-32
12			74	19	77	-54
Total			**219**	**264**	**230**	**150**
K-5 Total			75	39	242	363
6-8 Total			117	145	86	68
9-12 Total			27	80	-98	-281
PERCENTAGE FROM ACTUAL						
K			1.3%	0.5%	1.5%	3.7%
1			0.2%	1.4%	2.3%	1.8%
2			0.5%	0.1%	0.3%	2.3%
3			0.7%	0.0%	1.0%	0.2%
4			0.8%	1.4%	0.2%	0.6%
5			0.8%	1.2%	0.6%	0.6%
6			1.5%	2.3%	1.0%	1.3%
7			0.1%	1.5%	0.1%	0.6%
8			1.0%	0.7%	1.1%	0.4%
9			0.9%	0.4%	2.1%	2.0%
10			0.7%	0.1%	0.7%	2.2%
11			0.9%	0.8%	1.1%	0.7%
12			1.8%	0.5%	1.9%	1.3%
Total			**0.39%**	**0.47%**	**0.41%**	**0.27%**
K-5 Total			0.3%	0.2%	1.0%	1.4%
6-8 Total			0.9%	1.1%	0.7%	0.5%
9-12 Total			0.2%	0.5%	0.6%	1.6%

HCPSS Enrollment Projections by Grade SY 2018-19

Grade	HCPSS Actual 2018-19	HCPSS 2018 Projection 2018-19	MDE 2018 Projection (Howard County) 2018-19
K	3,956	3,835	3,880
1	4,044	4,030	4,020
2	4,218	4,246	4,230
3	4,223	4,221	4,250
4	4,366	4,346	4,370
5	4,546	4,551	4,540
6	4,568	4,598	4,530
7	4,507	4,494	4,520
8	4,373	4,357	4,390
9	4,832	4,887	4,930
10	4,503	4,459	4,490
11	4,278	4,249	4,250
12	4,156	4,171	4,160
Total	**56,570**	**56,444**	**56,560**
K-5 Total	25,353	25,229	25,290
6-8 Total	13,448	13,449	13,440
9-12 Total	17,769	17,766	17,830
PROJECTION DELTA FROM ACTUAL			
K		121	76
1		14	24
2		-28	-12
3		2	-27
4		20	-4
5		-5	6
6		-30	38
7		13	-13
8		16	-17
9		-55	-98
10		44	13
11		29	28
12		-15	-4
Total		**126**	**10**
K-5 Total		124	63
6-8 Total		-1	8
9-12 Total		3	-61
PERCENTAGE FROM ACTUAL			
K		3.1%	1.9%
1		0.3%	0.6%
2		0.7%	0.3%
3		0.0%	0.6%
4		0.5%	0.1%
5		0.1%	0.1%
6		0.7%	0.8%
7		0.3%	0.3%
8		0.4%	0.4%
9		1.1%	2.0%
10		1.0%	0.3%
11		0.7%	0.7%
12		0.4%	0.1%
Total		**0.22%**	**0.02%**
K-5 Total		0.5%	0.2%
6-8 Total		0.0%	0.1%
9-12 Total		0.0%	0.3%

Enrollment Projections by School

The table below illustrates the accuracy of the enrollment projections developed by HCPSS by school using the Mean Absolute Percent Error [MAPE]. The mean absolute percentage error [MAPE], also known as mean absolute percentage deviation [MAPD], is a measure of prediction accuracy of a forecasting method in statistics. It usually expresses accuracy as a percentage where A_t is the actual value and F_t is the forecast value. The difference between A_t and F_t is divided by the actual value A_t again. The absolute value in this calculation is summed for every forecasted point in time and divided by the number of fitted points n. Multiplying by 100% makes it a percentage error.

$$\mathrm{M} = \frac{100\%}{n} \sum_{t=1}^{n} \left| \frac{A_t - F_t}{A_t} \right|,$$

As shown in the table below, the average percent error of all elementary school projections for the 2018-19 school year, produced in the 2018 enrollment projections, had an error of 3.6 percent; middle schools had an error of 3.2 percent; and high schools had an error of 1.7 percent. In addition, this illustrates the tendency described earlier in the report regarding smaller sample sizes generally yielding less accurate results than larger sample sizes.

Mean Absolute Percent Error

School Level	Projection 2018	Projection 2017	Projection 2016		Projection 2015		
	2018-19	2017-18	2016-17	2017-18	2015-16	2016-17	2017-18
ES	3.6%	3.4%	2.9%	4.6%	3.3%	5.3%	7.8%
MS	3.2%	2.6%	2.9%	3.2%	2.4%	4.2%	4.2%
HS	1.7%	1.8%	2.0%	3.1%	1.7%	2.7%	4.7%
Total	3.2%	2.9%	2.8%	4.0%	2.8%	4.6%	6.3%

Detailed accuracy tables by school are included in Appendix A of this report.

HOUSING PROJECTION ACCURACY

The Howard County Public School System incorporates housing unit projection data from the Howard County Department of Planning and Zoning for future years into the enrollment projection model. Cooperative Strategies compared the housing projections used in the 2015 through 2017 enrollment projection models to the actuals obtained from the enrollment projection files for later years. Consistent with the accuracy of enrollment projections, the housing projections one year out were most accurate. Apartment and multi-family unit projections were significantly less accurate over the 3 years of projections that were studied.

Mean Absolute Percent Error

Housing Type	Projection 2017	Projection 2016		Projection 2015		
	2017-18	2016-17	2017-18	2015-16	2016-17	2017-18
SFD	2.2%	0.6%	6.1%	0.5%	1.1%	6.4%
SFA	3.6%	0.9%	5.5%	0.8%	1.2%	5.9%
APT	4.7%	1.9%	9.4%	5.4%	7.2%	18.3%
MH	7.1%	0.0%	13.9%	1.4%	1.4%	14.2%

ENROLLMENT PROJECTION TOOL / SOFTWARE

The Howard County Public School System enrollment projection tool / software currently consists of a number of Excel spreadsheets which contain information relative to historical enrollment, live birth counts, housing, preschool age students moving into the School System, and out-of-district students. This information is then run through a FoxPro based software developed by a previous employee, who has since retired from the Howard County Public School System. HCPSS currently uses FoxPro 2.6a, which is no longer supported by Microsoft and has compatibility issues with current Windows operating systems. HCPSS is in the process of updating the enrollment projection tool / software.

Recommendation:

A software update would provide the School System an opportunity to document and simplify input and output tables. There are output tables developed from the current tool / software that are not documented clearly. In addition, a user manual as well as a technical manual should be developed upon launch of the tool / software. This will be highly beneficial in the event of staffing turnover on either the part of HCPSS OSP staff or the developer of the software.

REPORTING

The Howard County Public School System publishes the enrollment projections in the Feasibility Study presented to the Board of Education in June of each year. This study also presents capital planning options and redistricting scenarios.

Recommendation:

While the feasibility study provides a good resource for the Board of Education in capital planning and redistricting scenarios, it may be beneficial to provide a separate, stand alone enrollment projections report prior to the Feasibility Study presentation.

The enrollment projections report should clearly illustrate methodology, data used in the analysis and development of enrollment projections, as well as enrollment projections by school, by grade and System-wide, by grade. An overview of the accuracy of the previous enrollment projections should be provided. Any areas of concern should be addressed with an explanation of how they were remedied for the current enrollment projections.

The enrollment projections report should include clear tables and graphs outlining all data used in the development of the enrollment projections. These data sets include, but are not limited to:

- Historical enrollment, by school, by grade
- Historical enrollment, System-wide, by grade
- Comparison and accuracy of previous enrollment projections, by grade, by school; and System-wide, by grade
- Historical live birth counts by elementary school boundary and County-wide
- Projected live birth counts as provided by MDP
- Housing information to the level of detail analyzed in the development of the enrollment projections, including, but not limited to:
    - Housing Yields
        - System-wide average for each housing type
        - By elementary boundary
    - Planned Development Summary

- Available maps illustrating historical and/or projected growth throughout the County
- Projected Enrollment, by School, by Grade
- Projected Enrollment, System-wide, by Grade

It should be noted that enrollment projections are both a science and an art. The science is knowing which information to gather and how to use the forecasting methodologies. The art is in analyzing the output and knowing when and how to use the information. For example, not all data used in the development of enrollment projections is included in a formula (science), but may be used in the determination of projection ratios and methodologies (art).

ENROLLMENT PROJECTIONS BY PLANNING POLYGON

The Howard County Public School System develops enrollment projections by school, by grade. In years that boundaries may be adjusted, the Office of School Planning staff breaks down the school-level enrollment projections to a planning polygon level. A planning polygon is a geographic area used as a planning tool for boundary review and adjustments. The OSP staff utilizes the same data used in the development of the enrollment projections by school except at the planning polygon level to determine the breakdown. For example, live births, historical number of students in the planning polygon, housing development within each planning polygon, etc. This is done in an effort to produce the most accurate enrollment projection for the school attendance area while still providing a projection by planning polygon, when needed, for potential boundary adjustments.

Some common questions that are asked include:

- "Why does School Planning project student enrollment by school attendance area, rather than planning polygon?"
- "If data is available by planning polygon, why not project by planning polygon?"
- "Isn't a projection by planning polygon more accurate?"

It is important to remember that enrollment projections developed based on larger sample sizes will typically yield more accurate results than a smaller sample size. HCPSS has 701 total planning polygons compared to 42 total elementary schools. As we saw earlier in this report when comparing the accuracy of the enrollment projections developed by HCPSS by school to those developed by MDP at the System-wide level, the MDP enrollment projections based on a larger sample size was more accurate than the rollup of school level projections to the System-wide level. It is likely that enrollment projections developed by planning polygon will be less accurate at the school and System -wide level when rolled up.

Recommendation:

Based on the multiple purposes of the enrollment projections, the data considered in the breakdown of the school-level to planning polygon level enrollment projections, and the methodology used to develop the enrollment projections by school, it is our opinion that the enrollment projections should continue to be developed at the school-level and broken down, when needed, to the planning polygon level.

An important consideration when reporting information regarding historical and projected enrollment at the planning polygon level is that HCPSS adheres to the Family Educational Rights and Privacy Act of 1974 [FERPA], which restricts access to student records. Values less than or equal to 5% have been replaced with "<=5%" and values greater than or equal to 95% have been replaced with ">=95%". Additionally, student counts less than 10 or any numbers that allow that information to be derived are also redacted. With this in mind, we do not recommend publishing planning polygon level data in the enrollment projections reporting.

ADDITIONAL RECOMMENDATIONS

Based on the review of the enrollment projection process, methodology, and reporting, it is recommended that the Howard County Public School System continue to use the modified cohort survival method, as described in this report and on the HCPSS website, as the primary method in determining enrollment projections based on the high level of accuracy these projections produce while incorporating available and important datasets.

Cooperative Strategies presented a high level reporting of the findings of this enrollment projections analysis to the HCPSS Board of Education on June 13, 2019. As a result of questions and concerns raised by Board members, the following additional recommendations are provided for consideration:

- HCPSS should compare historical September 30 versus end of year enrollment counts for each school year to identify common trends that can be considered in the development of enrollment projections. More detailed analysis should be done for schools that have wide deviations between the September 30 and end of year enrollment counts and whether the accuracy of the enrollment projections reflect similar deviations.

- A practice in place in many school districts throughout the country involves obtaining feedback on preliminary, baseline enrollment projections from various administrative positions such as school principals or area superintendents that may be incorporated into the final enrollment projections. Feedback could provide additional perspective on factors such as local development, school program or policy changes, and changing neighborhood perception. If this practice is adopted by HCPSS, it is recommended that feedback is well documented and any adjustments made due to the feedback obtained is also well documented. In addition, a reconciliation process would need to be in place and documented in order to prevent overall over– or under-projecting System-wide enrollment. Not only does the documentation maintain the transparency currently in place by HCPSS, but will aide the OSP in annual accuracy report analysis to continuously improve the enrollment projections provided.

CONCLUSION

Cooperative Strategies is pleased to have had the opportunity to provide the Howard County Public School System with this enrollment projections analysis. We hope this document will provide the necessary information to make informed decisions about the future of the School System.

APPENDIX A

The tables that follow illustrate the accuracy of the 2015, 2016, 2017, and 2018 enrollment projections produced by HCPSS by school.

2015 Projection Accuracy by School

	HCPSS Actual			HCPSS 2015 Projection			Difference				Absolute Error		
School	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2018-19	2015-16	2016-17	2017-18
Atholton ES	395	435	459	366	380	397	29	55	62	56	7.3%	12.6%	13.5%
Bellows Spring ES	672	667	749	668	688	733	4	-21	16	-76	0.6%	3.1%	2.1%
Bollman Bridge ES	665	665	631	708	738	758	-43	-73	-127	-95	6.5%	11.0%	20.1%
Bryant Woods ES	357	379	397	322	326	331	35	53	66	85	9.8%	14.0%	16.6%
Bushy Park ES	596	590	602	611	604	612	-15	-14	-10	-15	2.5%	2.4%	1.7%
Centennial Lane ES	728	739	765	683	705	737	45	34	28	-14	6.2%	4.6%	3.7%
Clarksville ES	465	430	432	467	457	442	-2	-27	-10	-4	0.4%	6.3%	2.3%
Clemens Crossing ES	502	531	550	500	500	501	2	31	49	-24	0.4%	5.8%	8.9%
Cradlerock ES	436	457	468	425	416	392	11	41	76	67	2.5%	9.0%	16.2%
Dayton Oaks ES	595	621	619	602	606	607	-7	15	12	31	1.2%	2.4%	1.9%
Deep Run ES	727	738	760	708	773	831	19	-35	-71	-214	2.6%	4.7%	9.3%
Ducketts Lane ES	769	826	891	754	854	989	15	-28	-98	-558	2.0%	3.4%	11.0%
Elkridge ES	770	817	849	790	815	817	-20	2	32	49	2.6%	0.2%	3.8%
Forest Ridge ES	741	703	693	744	726	753	-3	-23	-60	-80	0.4%	3.3%	8.7%
Fulton ES	753	832	878	756	808	834	-3	24	44	68	0.4%	2.9%	5.0%
Gorman Crossing ES	644	666	776	672	726	766	-28	-60	10	28	4.3%	9.0%	1.3%
Guilford ES	450	440	411	490	506	523	-40	-66	-112	-131	8.9%	15.0%	27.3%
Hammond ES	638	640	651	647	665	691	-9	-25	-40	-75	1.4%	3.9%	6.1%
Hollifield Station ES	722	744	811	713	725	757	9	19	54	98	1.2%	2.6%	6.7%
Ilchester ES	673	653	615	698	682	655	-25	-29	-40	-26	3.7%	4.4%	6.5%
Jeffers Hill ES	463	455	428	467	464	454	-4	-9	-26	-48	0.9%	2.0%	6.1%
Laurel Woods ES	560	541	574	561	556	576	-1	-15	-2	-8	0.2%	2.8%	0.3%
Lisbon ES	427	446	455	410	415	430	17	31	25	4	4.0%	7.0%	5.5%
Longfellow ES	434	419	408	428	430	418	6	-11	-10	-8	1.4%	2.6%	2.5%
Manor Woods ES	704	759	794	716	761	854	-12	-2	-60	-339	1.7%	0.3%	7.6%
Northfield ES	702	710	748	677	684	700	25	26	48	35	3.6%	3.7%	6.4%
Phelps Luck ES	584	585	548	553	552	531	31	33	17	18	5.3%	5.6%	3.1%
Pointers Run ES	706	735	721	722	738	764	-16	-3	-43	61	2.3%	0.4%	6.0%
Rockburn ES	639	636	647	605	595	592	34	41	55	-1	5.3%	6.4%	8.5%
Running Brook ES	465	470	459	517	568	590	-52	-98	-131	-177	11.2%	20.9%	28.5%
St Johns Lane ES	729	701	703	725	726	730	4	-25	-27	-9	0.5%	3.6%	3.8%
Stevens Forest ES	418	398	390	404	401	405	14	-3	-15	-16	3.3%	0.8%	3.8%
Swansfield ES	608	601	605	555	534	520	53	67	85	43	8.7%	11.1%	14.0%
Talbott Springs ES	439	447	459	433	431	433	6	16	26	45	1.4%	3.6%	5.7%
Thunder Hill ES	559	558	544	552	568	586	7	-10	-42	-57	1.3%	1.8%	7.7%
Triadelphia Ridge ES	528	560	553	523	561	568	5	-1	-15	-45	0.9%	0.2%	2.7%
Veterans ES	847	861	861	848	868	870	-1	-7	-9	-2	0.1%	0.8%	1.0%
Waterloo ES	577	567	581	562	576	580	15	-9	1	-23	2.6%	1.6%	0.2%
Waverly ES	707	707	695	688	664	620	19	43	75	236	2.7%	6.1%	10.8%
West Friendship ES	312	326	327	278	271	264	34	55	63	151	10.9%	16.9%	19.3%
Worthington ES	539	527	515	537	524	502	2	3	13	-2	0.4%	0.6%	2.5%

School	HCPSS Actual			HCPSS 2015 Projection			Difference				Absolute Error		
	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18	2018-19	2015-16	2016-17	2017-18
Bonnie Branch MS	687	713	716	671	696	726	16	17	-10	-2	2.3%	2.4%	1.4%
Burleigh Manor MS	774	819	807	771	812	837	3	7	-30	-43	0.4%	0.9%	3.7%
Clarksville MS	598	560	552	621	606	565	-23	-46	-13	119	3.8%	8.2%	2.4%
Dunloggin MS	609	617	630	615	644	649	-6	-27	-19	5	1.0%	4.4%	3.0%
Elkridge Landing MS	734	700	693	716	691	684	18	9	9	72	2.5%	1.3%	1.3%
Ellicott Mills MS	808	829	853	788	789	832	20	40	21	7	2.5%	4.8%	2.5%
Folly Quarter MS	634	616	663	607	604	633	27	12	30	31	4.3%	1.9%	4.5%
Glenwood MS	562	517	495	577	561	561	-15	-44	-66	-40	2.7%	8.5%	13.3%
Hammond MS	582	593	554	582	603	581	0	-10	-27	-39	0.0%	1.7%	4.9%
Harpers Choice MS	543	570	596	546	574	595	-3	-4	1	-68	0.6%	0.7%	0.2%
Lake Elkhorn MS	493	530	548	500	503	548	-7	27	0	27	1.4%	5.1%	0.0%
Lime Kiln MS	719	729	734	724	728	717	-5	1	17	-70	0.7%	0.1%	2.3%
Mayfield Woods MS	672	685	712	681	712	748	-9	-27	-36	-39	1.3%	3.9%	5.1%
Mount View MS	745	792	819	743	757	779	2	35	40	39	0.3%	4.4%	4.9%
Murray Hill MS	604	669	700	624	673	700	-20	-4	0	20	3.3%	0.6%	0.0%
Oakland Mills MS	454	443	472	431	434	438	23	9	34	50	5.1%	2.0%	7.2%
Patapsco MS	700	687	706	718	723	744	-18	-36	-38	-32	2.6%	5.2%	5.4%
Patuxent Valley MS	631	639	618	676	737	707	-45	-98	-89	-83	7.1%	15.3%	14.4%
Thomas Viaduct MS	602	633	687	570	604	676	32	29	11	-66	5.3%	4.6%	1.6%
Wilde Lake MS	564	556	610	573	599	648	-9	-43	-38	-29	1.6%	7.7%	6.2%
Atholton HS	1445	1456	1479	1447	1439	1503	-2	17	-24	-46	0.1%	1.2%	1.6%
Centennial HS	1470	1511	1614	1455	1480	1555	15	31	59	-10	1.0%	2.1%	3.7%
Glenelg HS	1250	1207	1173	1268	1221	1211	-18	-14	-38	-82	1.4%	1.2%	3.2%
Hammond HS	1276	1300	1301	1299	1319	1387	-23	-19	-86	-42	1.8%	1.5%	6.6%
Howard HS	1782	1837	1914	1751	1803	1885	31	34	29	-9	1.7%	1.9%	1.5%
Long Reach HS	1505	1554	1636	1522	1626	1756	-17	-72	-120	-262	1.1%	4.6%	7.3%
Marriotts Ridge HS	1203	1264	1332	1209	1231	1285	-6	33	47	81	0.5%	2.6%	3.5%
Mt Hebron HS	1523	1582	1571	1504	1599	1649	19	-17	-78	-66	1.2%	1.1%	5.0%
Oakland Mills HS	1141	1174	1161	1101	1153	1132	40	21	29	118	3.5%	1.8%	2.5%
Reservoir HS	1519	1481	1527	1510	1546	1629	9	-65	-102	-176	0.6%	4.4%	6.7%
River Hill HS	1208	1154	1157	1266	1224	1252	-58	-70	-95	130	4.8%	6.1%	8.2%
Wilde Lake HS	1252	1248	1276	1279	1297	1352	-27	-49	-76	-83	2.2%	3.9%	6.0%

2016 Projection Accuracy by School

School	HCPSS Actual		HCPSS 2016 Projection		Difference		Absolute Error	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Atholton ES	435	459	420	444	15	15	3.4%	3.3%
Bellows Spring ES	667	749	701	755	-34	-6	5.1%	0.8%
Bollman Bridge ES	665	631	669	706	-4	-75	0.6%	11.9%
Bryant Woods ES	379	397	388	397	-9	0	2.4%	0.0%
Bushy Park ES	590	602	591	597	-1	5	0.2%	0.8%
Centennial Lane ES	739	765	752	773	-13	-8	1.8%	1.0%
Clarksville ES	430	432	443	418	-13	14	3.0%	3.2%
Clemens Crossing ES	531	550	520	526	11	24	2.1%	4.4%
Cradlerock ES	457	468	440	440	17	28	3.7%	6.0%
Dayton Oaks ES	621	619	607	597	14	22	2.3%	3.6%
Deep Run ES	738	760	791	831	-53	-71	7.2%	9.3%
Ducketts Lane ES	826	891	820	940	6	-49	0.7%	5.5%
Elkridge ES	817	849	808	817	9	32	1.1%	3.8%
Forest Ridge ES	703	693	760	798	-57	-105	8.1%	15.2%
Fulton ES	832	878	827	853	5	25	0.6%	2.8%
Gorman Crossing ES	666	776	651	705	15	71	2.3%	9.1%
Guilford ES	440	411	480	473	-40	-62	9.1%	15.1%
Hammond ES	640	651	648	667	-8	-16	1.3%	2.5%
Hollifield Station ES	744	811	733	768	11	43	1.5%	5.3%
Ilchester ES	653	615	647	625	6	-10	0.9%	1.6%
Jeffers Hill ES	455	428	459	451	-4	-23	0.9%	5.4%
Laurel Woods ES	541	574	548	561	-7	13	1.3%	2.3%
Lisbon ES	446	455	425	448	21	7	4.7%	1.5%
Longfellow ES	419	408	444	445	-25	-37	6.0%	9.1%
Manor Woods ES	759	794	748	841	11	-47	1.4%	5.9%
Northfield ES	710	748	703	723	7	25	1.0%	3.3%
Phelps Luck ES	585	548	571	565	14	-17	2.4%	3.1%
Pointers Run ES	735	721	722	719	13	2	1.8%	0.3%
Rockburn ES	636	647	621	645	15	2	2.4%	0.3%
Running Brook ES	470	459	505	539	-35	-80	7.4%	17.4%
St Johns Lane ES	701	703	721	709	-20	-6	2.9%	0.9%
Stevens Forest ES	398	390	427	422	-29	-32	7.3%	8.2%
Swansfield ES	601	605	612	611	-11	-6	1.8%	1.0%
Talbott Springs ES	447	459	448	450	-1	9	0.2%	2.0%
Thunder Hill ES	558	544	585	599	-27	-55	4.8%	10.1%
Triadelphia Ridge ES	560	553	556	558	4	-5	0.7%	0.9%
Veterans ES	861	861	876	881	-15	-20	1.7%	2.3%
Waterloo ES	567	581	602	591	-35	-10	6.2%	1.7%
Waverly ES	707	695	698	672	9	23	1.3%	3.3%
West Friendship ES	326	327	306	313	20	14	6.1%	4.3%
Worthington ES	527	515	527	508	0	7	0.0%	1.4%

School	HCPSS Actual		HCPSS 2016 Projection		Difference		Absolute Error	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Bonnie Branch MS	713	716	727	769	-14	-53	2.0%	7.4%
Burleigh Manor MS	819	807	820	812	-1	-5	0.1%	0.6%
Clarksville MS	560	552	585	561	-25	-9	4.5%	1.6%
Dunloggin MS	617	630	642	613	-25	17	4.1%	2.7%
Elkridge Landing MS	700	693	701	708	-1	-15	0.1%	2.2%
Ellicott Mills MS	829	853	803	852	26	1	3.1%	0.1%
Folly Quarter MS	616	663	630	660	-14	3	2.3%	0.5%
Glenwood MS	517	495	547	564	-30	-69	5.8%	13.9%
Hammond MS	593	554	597	585	-4	-31	0.7%	5.6%
Harpers Choice MS	570	596	574	590	-4	6	0.7%	1.0%
Lake Elkhorn MS	530	548	491	523	39	25	7.4%	4.6%
Lime Kiln MS	729	734	724	740	5	-6	0.7%	0.8%
Mayfield Woods MS	685	712	705	742	-20	-30	2.9%	4.2%
Mount View MS	792	819	749	791	43	28	5.4%	3.4%
Murray Hill MS	669	700	641	660	28	40	4.2%	5.7%
Oakland Mills MS	443	472	465	479	-22	-7	5.0%	1.5%
Patapsco MS	687	706	698	722	-11	-16	1.6%	2.3%
Patuxent Valley MS	639	618	675	645	-36	-27	5.6%	4.4%
Thomas Viaduct MS	633	687	638	691	-5	-4	0.8%	0.6%
Wilde Lake MS	556	610	545	608	11	2	2.0%	0.3%
Atholton HS	1456	1479	1401	1434	55	45	3.8%	3.0%
Centennial HS	1511	1614	1511	1586	0	28	0.0%	1.7%
Glenelg HS	1207	1173	1201	1173	6	0	0.5%	0.0%
Hammond HS	1300	1301	1289	1333	11	-32	0.8%	2.5%
Howard HS	1837	1914	1855	1944	-18	-30	1.0%	1.6%
Long Reach HS	1554	1636	1595	1724	-41	-88	2.6%	5.4%
Marriotts Ridge HS	1264	1332	1218	1254	46	78	3.6%	5.9%
Mt Hebron HS	1582	1571	1594	1657	-12	-86	0.8%	5.5%
Oakland Mills HS	1174	1161	1162	1160	12	1	1.0%	0.1%
Reservoir HS	1481	1527	1498	1536	-17	-9	1.1%	0.6%
River Hill HS	1154	1157	1216	1238	-62	-81	5.4%	7.0%
Wilde Lake HS	1248	1276	1284	1327	-36	-51	2.9%	4.0%

2017 Projection Accuracy by School

School	HCPSS Actual 2017-18	HCPSS 2017 Projection 2017-18	Difference 2017-18	Absolute Error 2017-18
Atholton ES	459	458	1	0.2%
Bellows Spring ES	749	711	38	5.1%
Bollman Bridge ES	631	709	-78	12.4%
Bryant Woods ES	397	418	-21	5.3%
Bushy Park ES	602	599	3	0.5%
Centennial Lane ES	765	745	20	2.6%
Clarksville ES	432	428	4	0.9%
Clemens Crossing ES	550	542	8	1.5%
Cradlerock ES	468	430	38	8.1%
Dayton Oaks ES	619	611	8	1.3%
Deep Run ES	760	772	-12	1.6%
Ducketts Lane ES	891	867	24	2.7%
Elkridge ES	849	826	23	2.7%
Forest Ridge ES	693	719	-26	3.8%
Fulton ES	878	871	7	0.8%
Gorman Crossing ES	776	700	76	9.8%
Guilford ES	411	436	-25	6.1%
Hammond ES	651	644	7	1.1%
Hollifield Station ES	811	783	28	3.5%
Ilchester ES	615	604	11	1.8%
Jeffers Hill ES	428	444	-16	3.7%
Laurel Woods ES	574	547	27	4.7%
Lisbon ES	455	438	17	3.7%
Longfellow ES	408	416	-8	2.0%
Manor Woods ES	794	798	-4	0.5%
Northfield ES	748	730	18	2.4%
Phelps Luck ES	548	586	-38	6.9%
Pointers Run ES	721	704	17	2.4%
Rockburn ES	647	677	-30	4.6%
Running Brook ES	459	497	-38	8.3%
St Johns Lane ES	703	690	13	1.8%
Stevens Forest ES	390	408	-18	4.6%
Swansfield ES	605	618	-13	2.1%
Talbott Springs ES	459	447	12	2.6%
Thunder Hill ES	544	567	-23	4.2%
Triadelphia Ridge ES	553	550	3	0.5%
Veterans ES	861	872	-11	1.3%
Waterloo ES	581	555	26	4.5%
Waverly ES	695	684	11	1.6%
West Friendship ES	327	336	-9	2.8%
Worthington ES	515	500	15	2.9%

School	HCPSS Actual 2017-18	HCPSS 2017 Projection 2017-18	Difference 2017-18	Absolute Error 2017-18
Bonnie Branch MS	716	721	-5	0.7%
Burleigh Manor MS	807	795	12	1.5%
Clarksville MS	552	528	24	4.3%
Dunloggin MS	630	614	16	2.5%
Elkridge Landing MS	693	704	-11	1.6%
Ellicott Mills MS	853	890	-37	4.3%
Folly Quarter MS	663	636	27	4.1%
Glenwood MS	495	526	-31	6.3%
Hammond MS	554	552	2	0.4%
Harpers Choice MS	596	563	33	5.5%
Lake Elkhorn MS	548	564	-16	2.9%
Lime Kiln MS	734	730	4	0.5%
Mayfield Woods MS	712	711	1	0.1%
Mount View MS	819	811	8	1.0%
Murray Hill MS	700	669	31	4.4%
Oakland Mills MS	472	464	8	1.7%
Patapsco MS	706	710	-4	0.6%
Patuxent Valley MS	618	627	-9	1.5%
Thomas Viaduct MS	687	645	42	6.1%
Wilde Lake MS	610	619	-9	1.5%
Atholton HS	1479	1471	8	0.5%
Centennial HS	1614	1609	5	0.3%
Glenelg HS	1173	1141	32	2.7%
Hammond HS	1301	1332	-31	2.4%
Howard HS	1914	1942	-28	1.5%
Long Reach HS	1636	1663	-27	1.7%
Marriotts Ridge HS	1332	1296	36	2.7%
Mt Hebron HS	1571	1573	-2	0.1%
Oakland Mills HS	1161	1176	-15	1.3%
Reservoir HS	1527	1514	13	0.9%
River Hill HS	1157	1220	-63	5.4%
Wilde Lake HS	1276	1298	-22	1.7%

2018 Projection Accuracy by School

School	HCPSS Actual 2018-19	HCPSS 2018 Projection 2018-19	Difference 2018-19	Absolute Error 2018-19
Atholton ES	445	456	-11	2.5%
Bellows Spring ES	725	671	54	7.4%
Bollman Bridge ES	660	646	14	2.1%
Bryant Woods ES	419	390	29	6.9%
Bushy Park ES	593	584	9	1.5%
Centennial Lane ES	734	755	-21	2.9%
Clarksville ES	419	419	0	0.0%
Clemens Crossing ES	491	470	21	4.3%
Cradlerock ES	462	464	-2	0.4%
Dayton Oaks ES	650	604	46	7.1%
Deep Run ES	665	677	-12	1.8%
Ducketts Lane ES	563	673	-110	19.5%
Elkridge ES	865	857	8	0.9%
Forest Ridge ES	679	685	-6	0.9%
Fulton ES	918	949	-31	3.4%
Gorman Crossing ES	810	794	16	2.0%
Guilford ES	401	399	2	0.5%
Hammond ES	623	642	-19	3.0%
Hollifield Station ES	879	826	53	6.0%
Ilchester ES	607	578	29	4.8%
Jeffers Hill ES	403	428	-25	6.2%
Laurel Woods ES	569	588	-19	3.3%
Lisbon ES	451	449	2	0.4%
Longfellow ES	420	402	18	4.3%
Manor Woods ES	650	635	15	2.3%
Northfield ES	747	727	20	2.7%
Phelps Luck ES	540	528	12	2.2%
Pointers Run ES	869	834	35	4.0%
Rockburn ES	577	553	24	4.2%
Running Brook ES	452	499	-47	10.4%
St Johns Lane ES	726	694	32	4.4%
Stevens Forest ES	384	388	-4	1.0%
Swansfield ES	574	606	-32	5.6%
Talbott Springs ES	471	458	13	2.8%
Thunder Hill ES	526	535	-9	1.7%
Triadelphia Ridge ES	563	570	-7	1.2%
Veterans ES	863	885	-22	2.5%
Waterloo ES	565	582	-17	3.0%
Waverly ES	835	802	33	4.0%
West Friendship ES	401	394	7	1.7%
Worthington ES	475	484	-9	1.9%

School	HCPSS Actual 2018-19	HCPSS 2018 Projection 2018-19	Difference 2018-19	Absolute Error 2018-19
Bonnie Branch MS	751	777	-26	3.5%
Burleigh Manor MS	808	804	4	0.5%
Clarksville MS	666	668	-2	0.3%
Dunloggin MS	661	639	22	3.3%
Elkridge Landing MS	745	715	30	4.0%
Ellicott Mills MS	869	883	-14	1.6%
Folly Quarter MS	660	647	13	2.0%
Glenwood MS	492	480	12	2.4%
Hammond MS	572	563	9	1.6%
Harpers Choice MS	505	546	-41	8.1%
Lake Elkhorn MS	580	557	23	4.0%
Lime Kiln MS	632	626	6	0.9%
Mayfield Woods MS	726	780	-54	7.4%
Mount View MS	837	834	3	0.4%
Murray Hill MS	720	697	23	3.2%
Oakland Mills MS	519	507	12	2.3%
Patapsco MS	712	739	-27	3.8%
Patuxent Valley MS	686	652	34	5.0%
Thomas Viaduct MS	654	707	-53	8.1%
Wilde Lake MS	632	628	4	0.6%
Atholton HS	1511	1516	-5	0.3%
Centennial HS	1594	1664	-70	4.4%
Glenelg HS	1199	1197	2	0.2%
Hammond HS	1378	1356	22	1.6%
Howard HS	1898	1908	-10	0.5%
Long Reach HS	1566	1586	-20	1.3%
Marriotts Ridge HS	1422	1376	46	3.2%
Mt Hebron HS	1632	1590	42	2.6%
Oakland Mills HS	1232	1217	15	1.2%
Reservoir HS	1589	1595	-6	0.4%
River Hill HS	1387	1411	-24	1.7%
Wilde Lake HS	1316	1350	-34	2.6%

APPENDIX B

The description of the HCPSS Enrollment Projection Methodology published by the School System on their website is included on the following page.

HCPSS Enrollment Projection Methodology

The Office of School Planning (OSP) produces an updated enrollment projection every year, compiling updated data including projected housing construction, historical and projected births, housing resales, and student population characteristics. The data are provided by Howard County Department of Planning and Zoning (DPZ), MD Department of Health and Mental Hygiene (DHMH), MD Department of Planning (MDP), and HCPSS Student Information System.

Since Howard County is rapidly growing, OSP supplements the industry-standard cohort survival method by incorporating student yield rates for housing transactions that could generate new students. At each step in our process, the goal is to use historical data to select the rate that performs best at predicting the future, while considering local knowledge, development and planning trends, and historical accuracy. Our system includes tools to help determine which data points have historically been the best indicators of future enrollment.

In 2013 and 2015, Dejong-Richter (now known as Cooperative Strategies) reviewed the OSP's projection methodology. This review concluded that OSP enrollment projection methods are valid, producing accurate results compared to other methods and surrounding districts. These findings were presented to the Board of Education.

The modified cohort survival method used by OSP begins with prior year official enrollment (green box). Moving up the diagram, factors are added starting with the non-housing factors (cohort survival), then the housing factors and out of district, leading to a projection for September 30th of the following year and beyond. Middle and High School projections are developed in the same fashion, substituting rising 6th and 9th grade cohorts for K, and excluding Pre-K move-ins.

What is it?		How is it calculated?
Official K-12 enrollment counts submitted to MD Dept. of Education	Prior Year Official Sept. 30th Enrollment	ACTUAL COUNT OF STUDENTS ENROLLED (AND VERIFIED) IN AN ATTENDANCE AREA ON SEPTEMBER 30 OF EACH SCHOOL YEAR.
A count of actual and projected births by ES attendance area (mother's address at time of birth is used) received from DHMH, compared to Kindergarten (K) enrollment (five years later) to generate an annual birth to K "survival rate." This calculation excludes students who are associated with newly constructed homes, re-sales of existing homes, or apartment turnover. Five years of annual rates are evaluated to predict a future rate.	Birth to Kindergarten Matriculation	BIRTHS FROM 5 YRS AGO / BIRTH TO K MATRICULATION = SURVIVAL RATE SELECTED RATE X FUTURE BIRTHS = FUTURE BIRTH TO K MATRICULATION
Rate of a cohort's "survival" to the next grade. This calculation excludes students who are associated with newly constructed homes, re-sales of existing homes, or apartment turnover. For example, calculates how many 3rd graders came from previous year's 2nd graders. Rates from previous five years are updated annually and used to inform rate for future cohort survival.	Cohort Survival (non-housing)	ENROLLMENT FOR ANY GRADE / PRIOR GRADE ENROLLMENT FROM PRIOR YEAR EACH GRADE'S SELECTED RATE X PROJECTED ENROLLMENT FOR THAT GRADE = COHORT SIZE IN NEXT GRADE FOR NEXT YEAR
Rate of students yielded from apartment turnover. Five years of historical rates are updated each year to reflect students arriving at each school due to change in apartment address. Land use data for each address is from DPZ parcel database and MDP assessment data.	Apartment Turnover Yield	# OF ARRIVALS FROM APTS / # OF APTS IN THAT YEAR = YIELD RATE SELECTED YIELD RATE X # APARTMENTS IN EACH FUTURE YEAR = PROJECTED STUDENT YIELD
Rate of students yielded from resales of existing homes. Five years of historical rates are updated each year to reflect students arriving at each school whose address matches a record found in the MDP sales database.	Resale Yield	# OF ARRIVALS FROM RESALES / # OF HOMES IN THAT YEAR = YIELD RATE SELECTED YIELD RATE X # OF HOMES IN EACH FUTURE YEAR = PROJECTED STUDENT YIELD
Rate of students yielded from homes built within the last 4 years, who moved in as pre-school-aged. Five years of historical rates updated each year to reflect K students arriving at each school whose address matches a building permit from the last four years.	Pre-K move-ins	# OF ARRIVALS FROM NEW HOMES (IN LAST 4 YRS) / # OF NEW HOMES IN LAST 4 YRS = YIELD RATE SELECTED YIELD RATE X # NEW, <4YR OLD HOMES IN EACH FUTURE YEAR = PROJECTED STUDENT YIELD
Rate of students yielded from new residential units in each year. Five years of historical rates are updated each year to reflect students arriving at each school whose address matches a building permit from the previous year. Spearate rates are calculated for Single family detatched, townhomes, and multi-family unit types using building permit data from DPZ. Projection of future units also from DPZ, Research Division.	New Construction Yield	# OF ARRIVALS FROM NEW HOMES / # OF NEW HOMES = YIELD RATE (CALCULATED FOR EACH UNIT TYPE AT EACH SCHOOL) SELECTED YIELD RATE X # PROJECTED UNITS IN EACH FUTURE YEAR = PROJECTED STUDENT YIELD
Count for # of students who attend a school other than that assigned by their address. Each year, a five-year average for each school is calculated and applied to that schools geographic projection, resulting in an enrollment projection.	Out of District	# OF STUDENTS WHO LIVE HERE BUT ATTEND ELSEWHERE + # THAT LIVE ELSEWHERE AND ATTEND HERE = OOD COUNT 5 YEAR HISTORICAL AVG IS ADDED TO GEOGRAPHIC PROJECTION
	Future Year Projected Sept. 30th Enrollment	

REVISED: July 23, 2018