2.4 Data Analysis
Proximity

2.4 Data Analysis
Proximity
Figures

What does proximity mean in this analysis?

In this report, proximity refers to the spatial relationships between students and schools, as well as between different schools.

Proximity is used to understand the distances between schools in MCPS, which is useful for understanding the difficulty or ease with which students get to school.

This analysis treats the proximity and distance of general education students separately from that of choice students, as choice students generally travel greater distances to attend specific programs. All analysis presented in this section excludes choice students, except for the third subsection, which focuses on special conditions including choice programs.

Proximity by the Numbers

- Many students (32% of elementary school students, 40% of middle school students, and 37% of high school students) do not attend the school closest to where they live.*
- The average distance to school for elementary school students is 1.2 miles, for middle school students is 2.2 miles, and for high school students is 2.5 miles.*
- 38% of elementary school students, 25% of middle school students, and 29% of high school students live in their school's walk zone.

* This excludes students who attend schools outside their assignment area for reasons such as choice or magnet programs.

Section Overview

This set of analyses is divided into three subsections:

- Proximity to Schools
- Proximity and Walk Zones
- Special Conditions: Split Articulation, Choice, Magnet, and Paired schools

Each subsection opens with a set of key insights.

Proximity at a Glance

What does proximity mean in this analysis?

Covering over 500 square miles, Montgomery County Public School district's geography is both large and varied. The district includes rural, suburban, metropolitan, and urban areas[1]. While the population density of MCPS as a whole is over 2,000 persons/square mile, densities vary widely between the rural areas upcounty and the highly urbanized areas downcounty and along I-270.[2] Across the district, mobility and modes of travel vary widely. While 37% of elementary school students, 25% of middle school students, and 28% of high school students live in their school's walk zones—meaning MCPS has determined they have a safe and accessible route to school and live within the approved distance for each level-- most students depend on car and bus trips of varying distances.

In addition to the district's size and varied density, recent and continued growth plays into the school system's proximity challenges. In the last decade, MCPS student enrollment increased by about 15%[3]. During that same time, the population of Montgomery County has grown from around 972,000 to over 1.05 million, amounting to an 8% increase overall. With 15% more students traveling to school now than 10 years ago, in a denser and more congested district, proximity to schools is of great concern to MCPS and many of its families. While this study cannot account for the varied times of student trips to school or the variable of traffic (see **What About Traffic?** at right), proximity is a crucial planning question for MCPS: how does the number of road-miles traveled vary for students across the district each day?

MCPS strives to create neighborhood schools, where students live as close as possible to school. The district also strives to maximize the number of students who walk to school. Student proximity to schools is an important planning consideration for MCPS, as laid out in Policy FAA,

What about traffic?

As a populous and dense County situated in one of the most highly congested metropolitan regions in the Country,[1] traffic is a strong concern for many residents in Montgomery County.

Traffic is a multi-factor variable that includes elements like time of departure, means of transportation, roadwork, and more. These variables are not consistently quantifiable across the school system. Therefore, the study focuses on factors that are more fixed and universally applicable, such as the average road distance to school, when analyzing the district through the proximity lens. MCPS analyzes traffic patterns and congestion when conducting localized studies for facilities planning and boundary changes.

For further reading and resources on proximity and transportation in MCPS (and more broadly), see: the **Further Reading** section, **page 406**.

1 See, for example: "2019 Urban Mobility Report." 2019. Texas A&M University. https://static.tti.tamu.edu/tti.tamu.edu/documents/mobility-report-2019.pdf.

1 See **Introduction Section**, starting on page 288, for more discussion of density zones in Montgomery County.

2 Population density data via U.S. Census Bureau American Community Survey 2018.

3 Three major drivers of student population trends—resident live births, aging of the student population, and migration patterns-- are discussed in depth in the FY 2021-2026 CIP.

which names geography as a key factor in educational facilities planning. As cited in this policy, the school system has an ongoing commitment to "community involvement in schools."[1] Additionally, MCPS aims for as many students to live in walk-zones as possible, and participates in the national Safe Routes to School program to promote the safety of student walkers and bikers. [2]

Proximity to school is not only important for students, families, and communities, but also for the school district's resources. MCPS transports about 100,000 students every day, in nearly 1,200 buses.[3] As enrollment in the school system has grown, so too has the amount of resources needed to transport this growing student body each day. Among other measures to increase resources for transportation, the proposed FY 2021 budget calls for expanding MCPS's bus fleet with an additional 17 buses to the district's inventory to accommodate growing enrollment.[4]

Proximity in Context

This analysis represents a snapshot in time of proximity across the school system today. For some context about underlying conditions including population growth and development trends in the county, see **Montgomery County Context on page 63**. Other relevant resources and further reading related to proximity to schools can be found in Further Reading section under **Proximity and Student Outcomes: on page 410.**

1 "Policy FAA: Educational Facilities Planning." 2018. Board of Education of Montgomery County. https://www.montgomeryschoolsmd.org/departments/policy/pdf/faa.pdf.

2 "Safe Routes to School." n.d. Montgomery County Public Schools. https://www.montgomeryschoolsmd.org/saferoutes/.

3 "Supporting Our Students—Investing in Our Future." n.d. MCPS Budget 101. https://www.montgomeryschoolsmd.org/budget-101/index.html.

4 "The Superintendent's Recommended Budget in Briefg: FY2021 Operating Budget." 2019. Montgomery County Public Schools. https://www.montgomeryschoolsmd.org/uploadedFiles/departments/budget/fy2021/FY2021_Budget-In-Brief_121919.pdf.

Proximity Methodology

Measures of Proximity

This section examines three aspects of proximity in MCPS:

1. **Where students live in relation to their school (with a focus on road network distance)**
2. **The role that school assignment area geography plays in student travel distance**
3. **MCPS-designated walk zones**

By examining these three aspects of proximity, we are pursuing some larger questions:

- How does the likelihood of students being able to walk to schools differ across the district?
- How do existing school assignment areas affect the distance that students travel to school?

To address these questions, we conducted the following stages of analysis:

First, we looked at the average **distance** between students' home and school by school level, based on current school boundaries. We examined whether this average road network distance varies across the district, including factors such as attendance area size and population density. This analysis compares student travel distance across levels and between clusters to understand how proximity challenges differ.

Next, we analyzed **walkability** to school, by looking at the proportion of students living in MCPS-designated walk zones and the average walk distance from school by school level. This section identifies walkshed areas—total potential walkable areas based on walkable roadways but not taking into account the hazardous features that MCPS uses to determine walk zones-- for each school based on the walk distances outlined above and uses the **Mapbox Isochrones API** to determine generalized walksheds.[1]

Finally, we considered the impact of **special conditions** in MCPS on proximity, including school choice programs, consortia, paired schools, and distinct articulation patterns.

Which students "count" in these analyses?

Unlike our analysis of utilization and diversity, this set of analyses is largely based on student-level data (as opposed to school-level data). Because this is student-level data and it relates to proximity to school, we exclude--or "freeze"--certain students from these analyses so that our analysis paints a clear and accurate picture of school proximity as it relates to school boundaries. Some students select a school that is farther away from their home school for a variety of reasons, which can throw off distance-based analysis. In other cases (such as consortia), school assignment operates differently than the rest of the district:

Choice students: unless otherwise noted, choice students (those who attend specialized programs at schools other than their base schools, including magnet programs, language immersion, and special education programs) are frozen from this set of analyses, and handled separately in Subsection 4: Special Conditions.

COSA students: students who have requested a change of school assignment through COSA are frozen from this set of analyses. Consortia students: in the case of students who reside within a consortium, the student's current school is counted as their base school, so long as it is within the consortium. Additionally, the impact of consortia on proximity is discussed in Subsection 3: Special Conditions.

(continued on the next page)

1 See: https://docs.mapbox.com/api/navigation/#isochrone.

As in other chapters of this report, our focus is on groups of nearest schools and countywide trends, as opposed to individual schools. To facilitate closer inspection of schools across MCPS, we have included detailed maps of school locations by geographic zone in the **Appendix B1: Geographic Zones on page 428**. Unless otherwise noted, data on student proximity to schools are based on data for the 2019-2020 school year.

Defining Scales of Analysis for Proximity

Researchers use many different approaches for thinking about proximity. How do you define the scales of analysis when examining proximity in a school system? We consider scale on a case by case basis. Often in this section, we compare particular sets of nearby schools, based—for example—on the group of schools that constitute the closest school(s) for some student(s) in a given attendance area. In other cases, we focus on wider trends, comparing regions of the district (such as peripheral regions versus central ones), or regions based on population density.

Consortia students: in the case of students who reside within a consortium, the student's current school is counted as their base school, so long as it is within the consortium. Additionally, the impact of consortia on proximity is discussed in Subsection 3: Special Conditions.

Key Data Sources

- Student level data, school boundaries, and school level data provided by MCPS reflecting the 2019-2020 school year
- 2021-2026 CIP Plan (Superintendent's Recommended FY2021 Capital Budget and the FY 2021-2026 Capital Improvements Program)
- Fiscal Year 2016 Educational Facilities Master Plan and Amendments to the FY 2015-2020 Capital Improvements Program
- Superintendent's Recommended FY 2011 Capital Budget and the FY 2011-2016 Capital Improvements Program
- U.S. Census Bureau ACS 2018
- MCPS Division of Capital Planning

Analyses Conducted

A. Proximity to Schools

1. Comparing Proximity Across Attendance Areas
2. Proportion of Students Assigned to Closest School, by School Level
3. Proximity and Population Density
4. Relative Distance: Difference Between Current School and Closest School

B. Proximity and Walk Zones

1. Proportion of Students who Live within the Walk Zone
2. Difference in Percentage of Students in Walk Zone vs. Walkshed
3. Average Walk Distance for Students within Walk Zones

C. Special Conditions

1. Split Articulation Patterns (Elementary to Middle Schools)
2. Split Articulation Patterns (Middle to High Schools)
3. Choice/Magnet Programs
4. Consortia

2.4 Data Analysis Proximity

A. Proximity to Schools

MCPS covers roughly 500 square miles of land and ranges from highly urbanized areas near Washington, D.C. to more rural parts of the county further north. For the most part, density of schools largely corresponds with the attendance area's population density. This section investigates the average distance that students travel to school in MCPS, focusing on districtwide trends. We start with a snapshot of the current distance traveled by students at each school level. Then, we compare distance traveled to population density. Finally, we analyze the average distance between current school and closest school to better understand how the density of schools impacts proximity.

Questions:

How does average road-distance traveled to school vary among students across the district?
How many students, on average, attend the school located closest to where they live? Does this vary by school level?
Does proximity to school correlate with population density?
What is the relationship between the distance to a student's current school and closest school?

Analyses:

A.1 Comparing Proximity Across Attendance Areas
A.2 Proportion of Students Assigned to Closest School, by School Level
A.3 Proximity and Population Density
A.4 Relative Distance: Difference Between Current School and Closest School

Insights

1. One way we examine proximity is by looking at the average distance that students travel to school, using roadway distance. Generally, students living in larger school attendance areas travel greater distances to school.

This is true when comparing schools at the same level, and it is also related to the trend that students travel farther to school as they progress from elementary, to middle, to high school.

We can understand this trend by looking at the average distance traveled by students, by school level:

- The average distance to school for all elementary schools is 1.2 miles, with a school minimum and maximum of 0.4 miles and 3.5 miles, respectively. Elementary school students tend to live closer to school—and those in the Rockville cluster and Downcounty Consortium are the closest to school on average.
- The average distance to school for all middle schools is 2.1 miles, with a school minimum and maximum of 1 mile and 4.2 miles, respectively.
- The average distance traveled to school for high schools is 2.5 mi, with a school minimum and maximum of 1.5 mi and 4.9 mi, respectively. In the Northeast Consortium, high school students at Blake HS travel the farthest distance on average to school—4.9 miles. High school students in Seneca Valley live the closest to school, on average: 1.5 miles.

2. In this section, we look at the proportion of students assigned to their closest schools as another way to understand proximity. When we break this measure of proximity down by school level, we find that middle school students are less likely than elementary and high school students to attend the school closest to their home.

At the middle school level, about 60% of students attend the school closest to their home, as compared with around 69% at the elementary school level and 68% at the high school level.

3. It can also be informative to look at how this measure of proximity ranges from cluster to cluster. The proportion of students who attend their closest schools varies widely by cluster.

The proportion of students who attend their closest school ranges from 54% in the Magruder cluster up to nearly 95% in the Poolesville cluster. This variation may be due to land use distribution and density, as well as where schools are sited relative to population densities.

4. Having observed this variation across the district, this analysis explores how schools of the same level (ES, MS, or HS) vary from cluster to cluster in terms of the proportion of students who attend their closest school. The widest disparities are at the middle school level.

- At the elementary school level, cluster averages range from approximately 56% to approximately 86% of students who attend their closest school (a range of about 30 percentage points).
- At the middle school level, the cluster averages range from 29% to 100% of students who attend their closest school. At over 70 percentage points, this is by far the widest range of any school level.
- At the high school level, cluster averages range from roughly 49% to 95% of students who attend their closest school. This range of over 40 percentage points is wider than the ES level, but still much smaller than the middle school level.

5. There is a correlation between the proportion of students who attend their closest school and the distance traveled to school at all levels. In general, where a higher proportion of students attend their closest schools, these students also tend to travel shorter distances.

This trend is most pronounced at the middle and high school levels, although there are significant exceptions at each level:

- The elementary schools and middle school in the Poolesville cluster upset this trend: 86% of elementary students attend their closest school, however the average distances traveled by students to these schools ranks the highest across all clusters. Poole MS similarly upsets this trend at the middle school level, with 93% of students attending their closest school but with an average travel distance of nearly three miles.
- At the high school level, the Magruder cluster presents itself as an outlier, with only 49% of students attending their closest school while the average travel distance to this school is roughly 3.4 miles.

6. In this analysis, we also consider the relationship between population density and distance traveled to school. In general, students in more densely populated areas live closer to school than those in less densely populated parts of the county.

Though this is the trend, there are notable outliers. There are cases of very low-density attendance areas that serve relatively compact communities. Poolesville HS, for example, has the lowest population density of all schools as well as one of the lowest travel distances for high schools.

7. Students in more densely populated areas tend to live closer to school than their peers in less densely populated parts of the county. This trend follows a geographic pattern: schools that are closer to the I-270 corridor tend to have students travel shorter distances to school.

This points to another underlying geographic factor to be considered when thinking about proximity in MCPS. Students who attend schools toward the interior of the county generally experience shorter distances to school than students who attend schools toward the edges of the county (except for the Downcounty region). However, there are notable outliers to this trend at each school level.

8. Island assignment attendance areas have an impact on average distance to school at all levels. Generally, students living in island assignment attendance areas tend to travel greater distances to school.

Students living in island assignment attendance areas tend to travel farther distances to school. This is true even when their schools are located in densely populated areas. This trend is seen at each school level:

- At the elementary school level, the average distance traveled to school in island assignment attendance areas is 2.6 miles, compared to the district average for elementary schools of 1.2 miles.
- At the middle school level, the average distance traveled to school in island assignment attendance areas is 4.1 miles, compared to the average of 2.2 miles.
- The average distance traveled at the high school level is 4.5 miles for island assignment attendance areas and 2.5 miles for contiguous attendance areas.
- There are some cases where students in island assignments travel distances below the average for their school level: Gaithersburg HS and Wootton HS students travel 1.1 and 0.5 mi on average to school, respectively. Students at six of 14 middle schools with island assignments travel less, on average, than the MS average of 2.2. 11 of 36 ES with island assignments travel less than the ES average of 1.2 mi.

In this first set of analyses, **Proximity to Schools**, we create a snapshot of proximity across MCPS, starting with the average distance students travel to school. In these analyses, distances are calculated using road-network distance to compute the miles traveled between each student and their school. We calculate the average distance traveled using school attendance areas as the scale of comparison.

As the crow flies?

In each of the proximity analyses in this report, we use road network distance to calculate how far students live from their schools. Road network distance approximates walking or automobile routes by using the current system of roads or sidewalks to calculate distance. So, distance in these analyses accounts for realistic routes using geospatial network data and not straight lines between points.

Participants at a regional public meeting at Blair High School on January 11, ,2020 (photo credit: C.D. Boykin)

A.1 Comparing Proximity Across School Attendance Areas

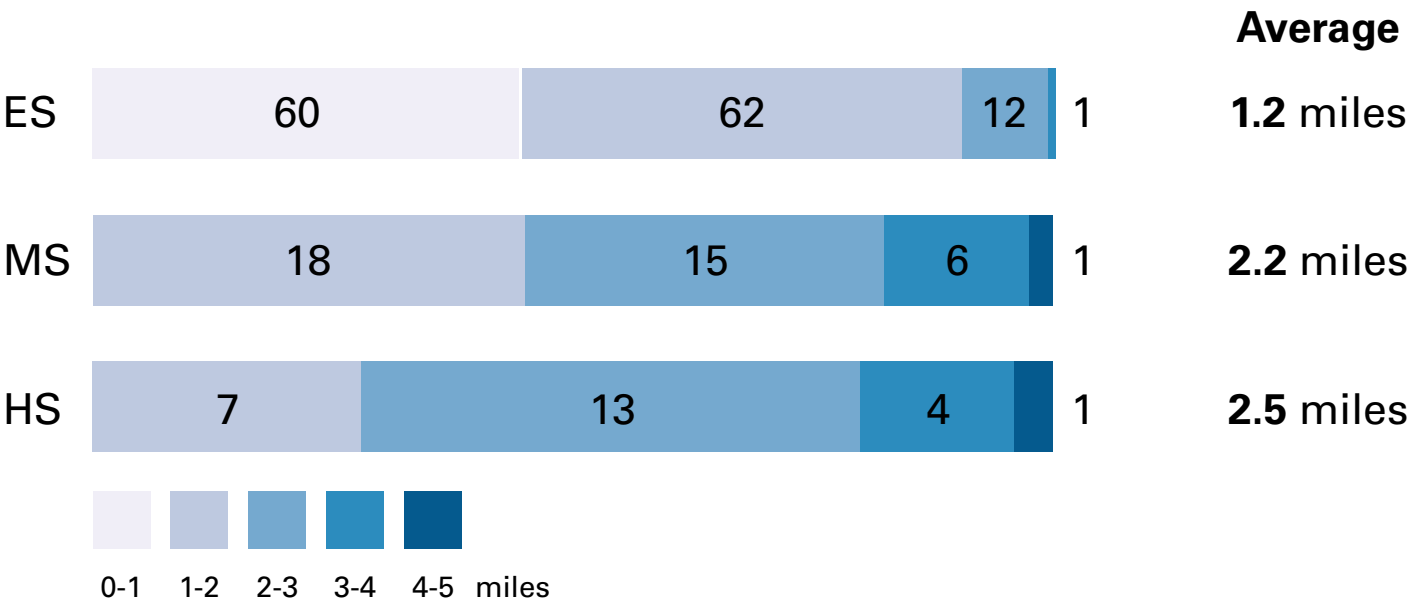


Figure 2.4.1 *Average Distance to Schools (by school level)*

The average distance to school increases as students move from elementary school to middle and high school levels—with students traveling the shortest distances, on average, at the elementary school level. This is partly because as attendance area geographies become larger, there is an increase in travel distance to schools.

At the high school level, attendance areas are generally much larger and therefore travel distances are on average higher than at the other levels (2.5 miles, compared to 1.2 miles at the elementary level and 2.1 miles at the middle school level). These numbers reflect the average distance traveled to school at each level (i.e. comparing schools) as opposed to measuring the average distance traveled by students (i.e. the average distance traveled by all students, regardless of current school).

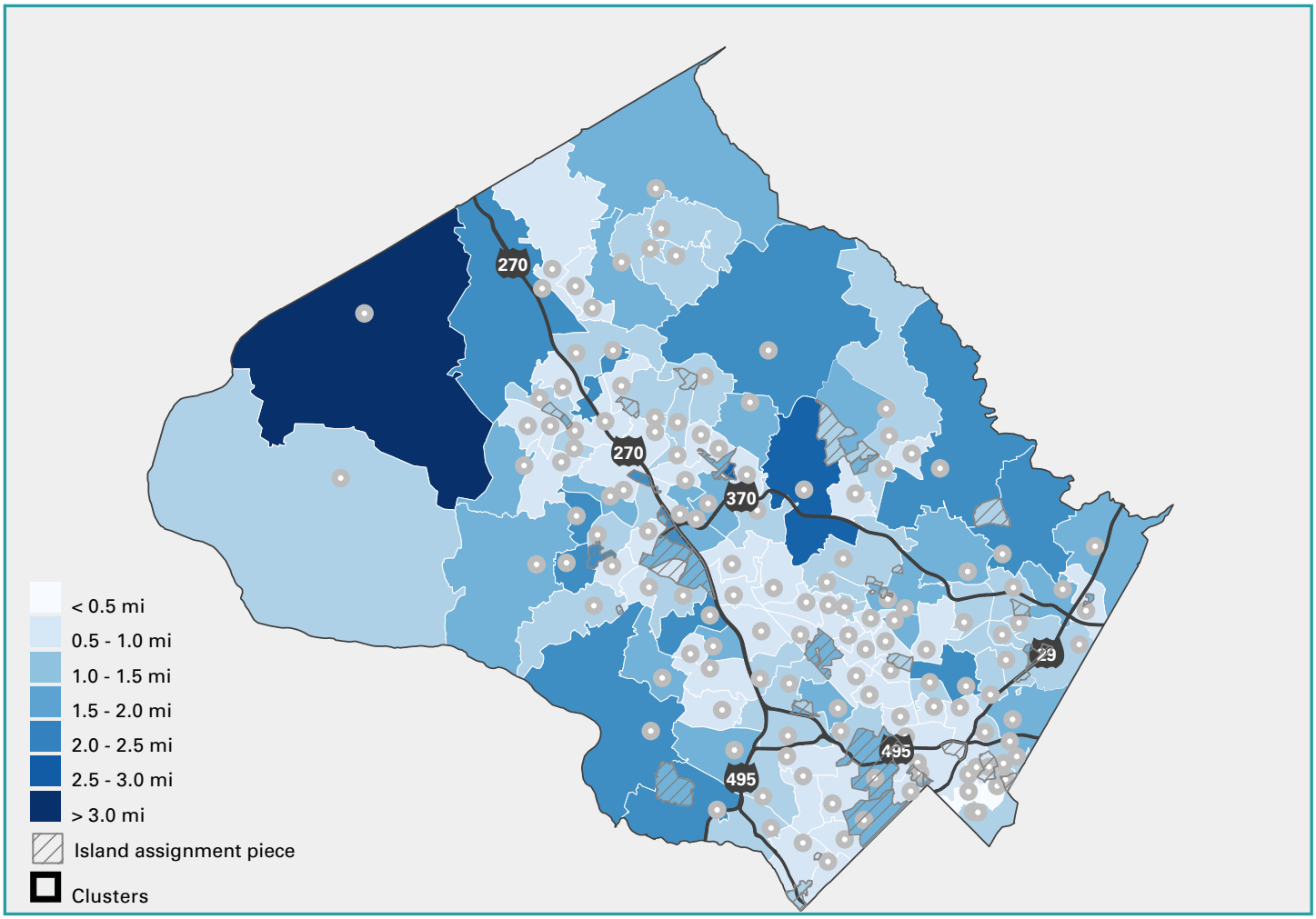


Figure 2.4.2 *Average Distance to Elementary Schools (non-choice students)*

The map above illustrates average distance traveled to school at the elementary school level. The color of the school attendance area corresponds to the average number of miles traveled by students who attend that school—with darker colors representing greater average distances traveled. By looking at average distances traveled by attendance area at the county scale, we start to see some patterns in terms of both geographic trends, and overall distribution of average distances to school by school level.

How is this range of school proximities distributed throughout the district? To answer this question, we take the middle school level on the following pages as an example to better understand the geography of average distances to school by school attendance area.

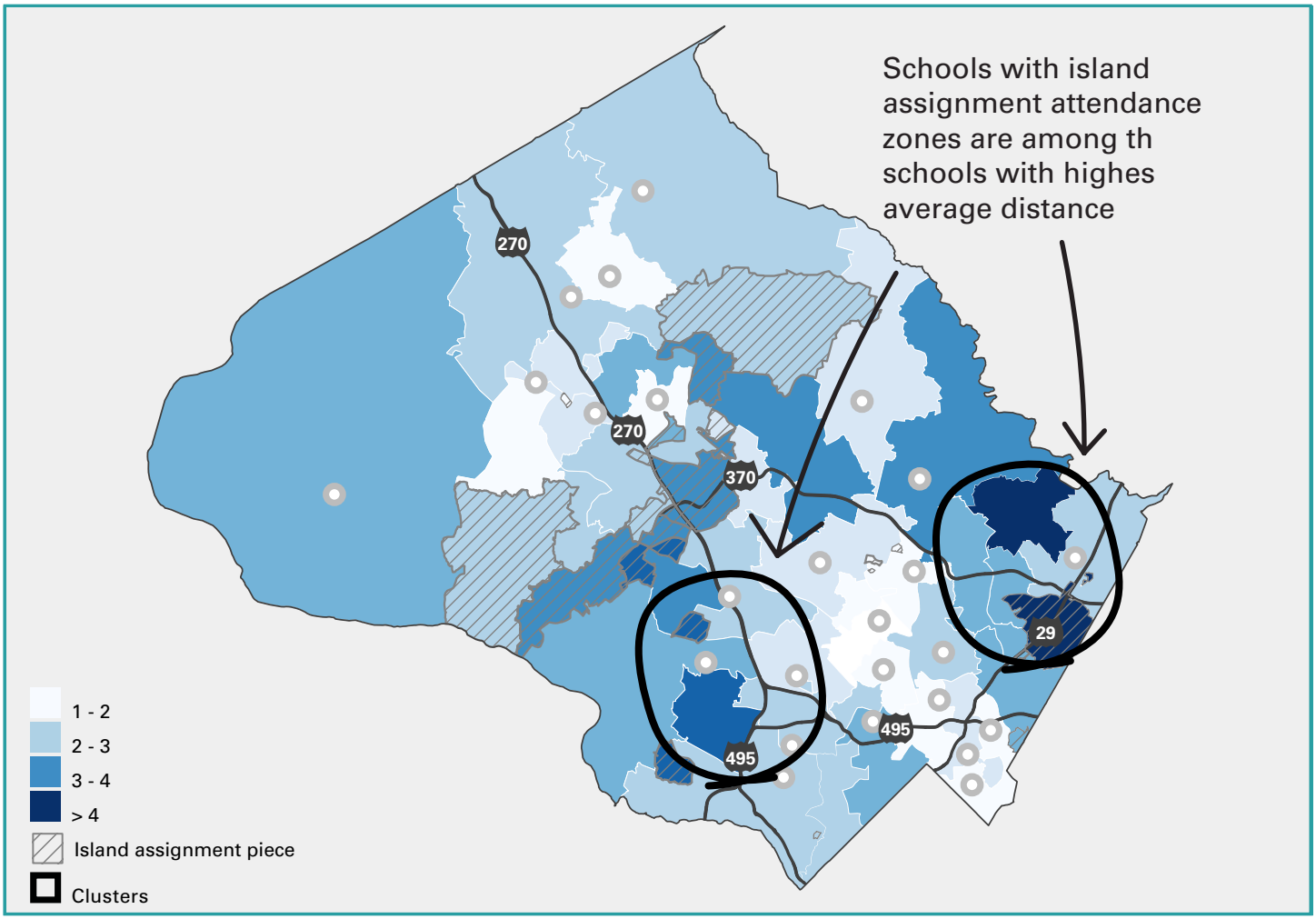


Figure 2.4.3 *Average Distance to Middle Schools (non-choice students)*

At the middle school level, schools with island assignment attendance areas have considerably higher average travel distances than their neighbors. Two schools with multi-part island assignment attendance areas stand out as having the highest average distances to school: Briggs Chaney MS (4.2 miles) and Cabin John MS (3.5 miles). These attendance areas are highlighted on the map above. For more on island assignments and proximity, see **Appendix D2: Proximity for island attendance areas on page 501.**

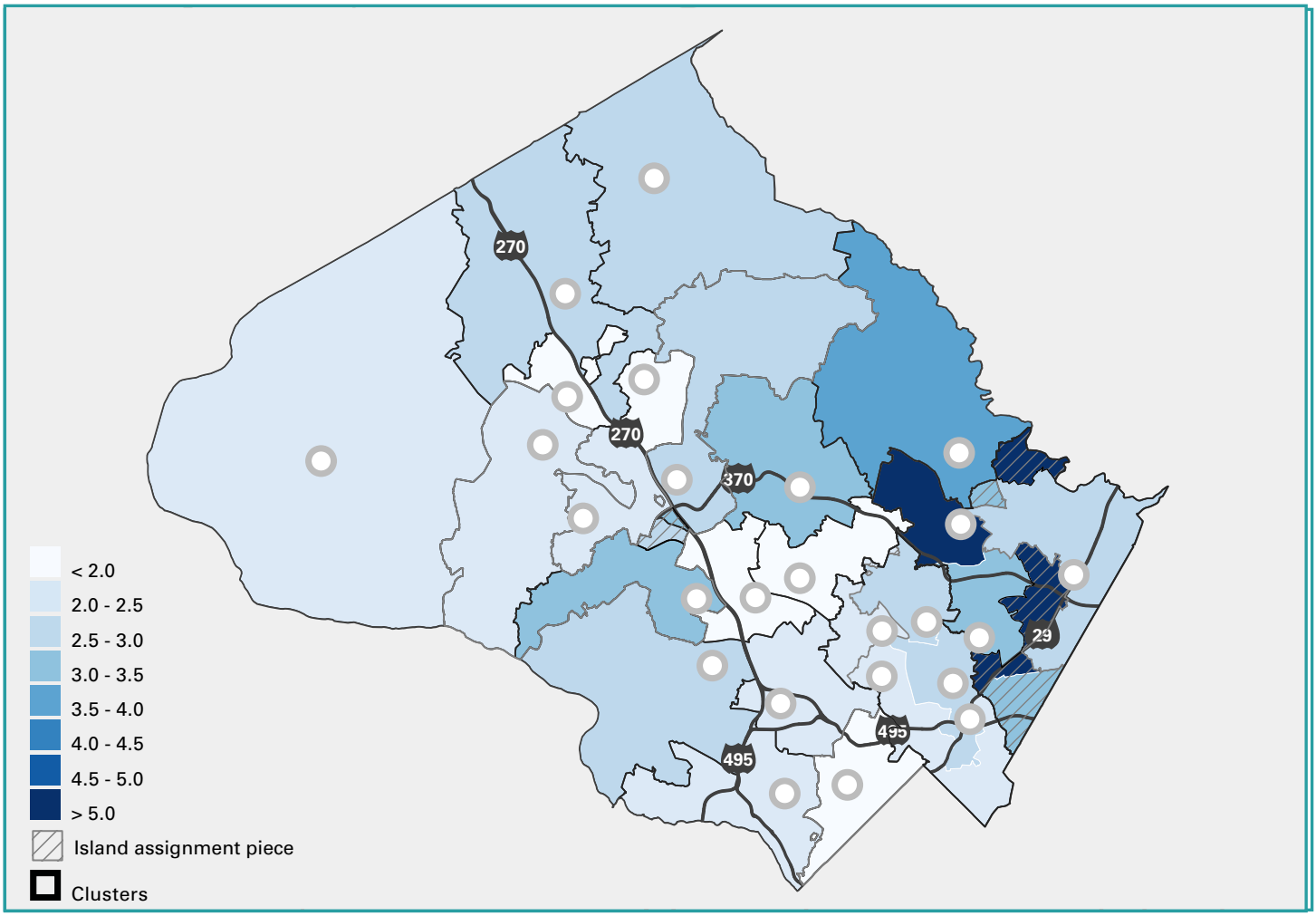


Figure 2.4.4 *Average Distance to High Schools (non-choice students)*

Another trend emerges when we map average travel distances across the county. Across all school levels, students in more densely populated areas tend to live closer to school than their peers in less densely populated parts of the county. This trend follows a geographic pattern: schools that are closer to the I-270 corridor tend to have students travel shorter distances to school. However, there are notable outliers to this trend at each school level.

A similar pattern emerges at the high school level, where the island assignment school split between Sherwood and Northeast Consortium presents itself as an outlier in terms of average distance to school compared with other clusters throughout the district.

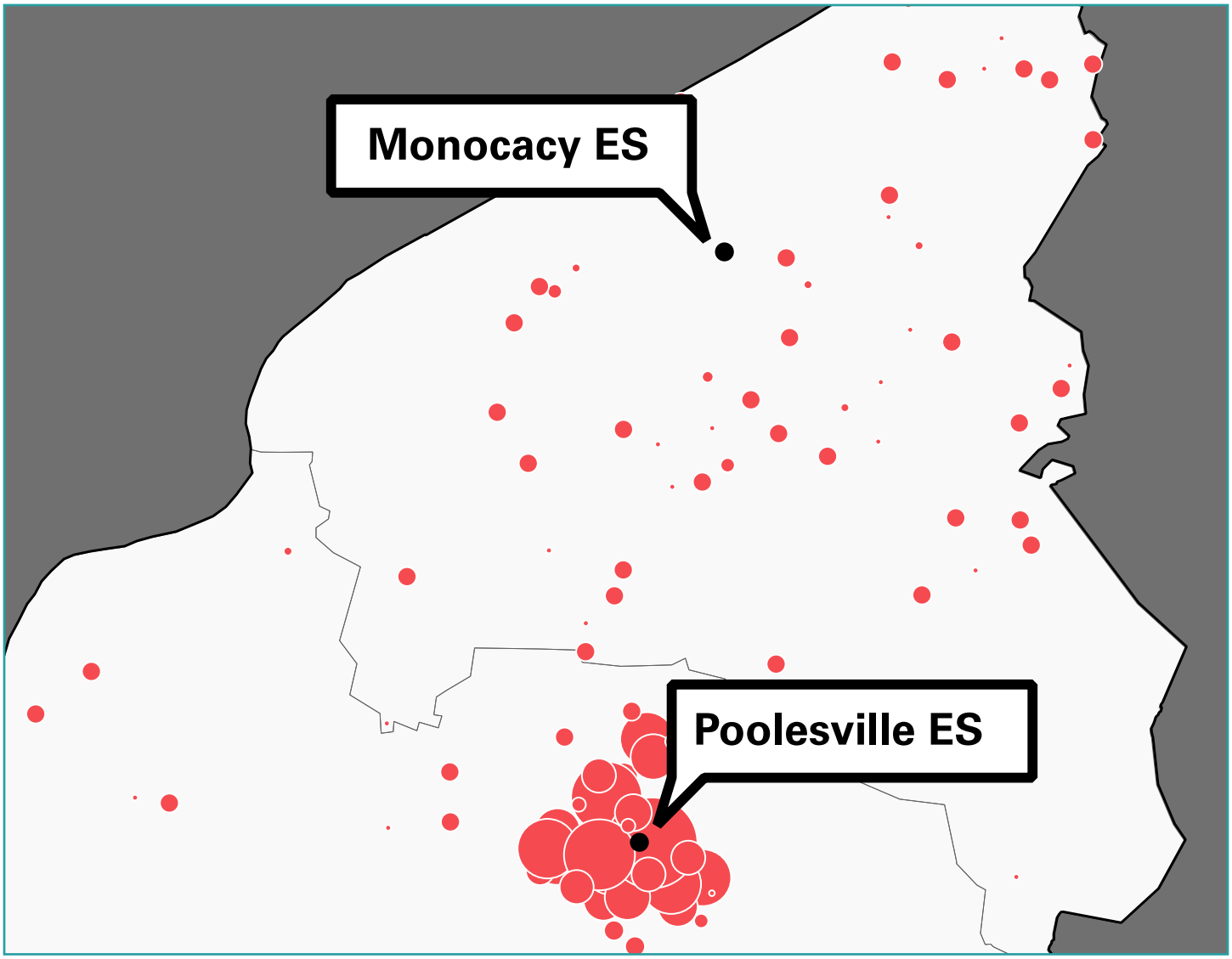


Figure 2.4.5 *Student Density in the Poolesville ES and Monocacy ES Attendance Areas*

The distribution of residential areas within a school attendance area is another important consideration to understand proximity in MCPS. For example, at the elementary school level, the average distance to school is 1.2 mi, although students at Monocacy ES travel an average 3.48 mi to school. Students at neighboring Poolesville ES have a much lower average distance to school, signaling that even though both attendance areas are quite large, most students at Poolesville ES live near the school whereas students in Monocacy are spread throughout the attendance area.

This is illustrated in **Figure 2.4.5**, above, which shows the building footprints in each attendance area to give a sense of the distribution of population throughout each zone. This theme is explored in more detail in the following section.

A.2 Proportion of Students Assigned to Closest School, by School Level

How likely are students to attend the school that is closest to their home? And how does this vary across school levels?

The table below shows each cluster or consortium in the district, and the proportion of students who go to their closest school, by school level. The table also shows average distances traveled to school by cluster, by school level.

This table demonstrates the variability across the district and across school levels in terms of the proportion of students who attend the school closest to where they live. There is a wide range of values not only between school levels, but also among schools within the same high school clusters and consortia.

Across all school levels, at least half of all students attend the school that is closest to their home. This is true for most students at each level in each cluster, however there are certain exceptions: five of the six instances where this is not the case are at the middle school level (shown in the table below). At the elementary school level, between 56% and 86% of students go to their closest schools on average. However, at the middle school level, the range extends from 29% of students attending their closest schools, up to 100%. The range at the high school level (49% - 95%), is larger than the elementary school level, but not as large as at the middle school level.

Cluster	% students at closest school ES	% students at closest school MS	% students at closest school HS	Cluster total proportion is closest	Avg. Dist. to ES (mi)	Avg. Dist. to ES (mi)	Avg. Dist. to ES (mi)	Cluster total avg. distance
Bethesda-Chevy Chase*	72.19%	56.35%	81.78%	73.48%	0.95	2.39	1.94	1.64
Clarksburg*†	76.14%	59.86%	66.88%	69.77%	0.99	2.60	2.52	1.80
Winston Churchill	71.65%	56.93%	75.17%	69.17%	1.38	3.07	2.83	2.36
Damascus*†	57.34%	82.09%	85.89%	72.97%	1.49	1.78	2.83	1.96
Downcounty Consortium†	66.69%	70.09%	65.02%	69.39%	0.94	1.38	2.13	1.34
Gaithersburg	59.28%	30.32%	68.49%	58.70%	1.14	2.89	2.53	1.94
Walter Johnson	58.98%	71.16%	60.12%	61.33%	1.31	1.86	2.24	1.70
Col. Zadok Magruder	71.68%	29.38%	49.37%	53.66%	1.45	2.56	3.45	2.34
Richard Montgomery	78.21%	67.27%	58.00%	69.33%	1.01	2.19	1.97	1.62
Northeast Consortium†	64.26%	53.91%	49.10%	60.22%	1.41	2.94	3.32	2.31
Northwest	64.65%	92.13%	50.04%	60.94%	1.20	1.26	2.25	1.57
Poolesville	86.29%	93.40%	95.41%	94.75%	1.52	2.88	2.01	2.04
Quince Orchard	72.92%	40.83%	61.56%	59.82%	1.29	2.30	2.20	1.86
Rockville	67.02%	46.82%	72.28%	62.50%	0.94	1.72	1.84	1.40
Seneca Valley*	74.54%	60.06%	88.45%	72.84%	1.09	1.71	1.51	1.41
Sherwood†	56.36%	88.32%	73.98%	68.03%	1.46	1.90	3.65	2.29
Watkins Mill	76.92%	100.00%•	77.88%	80.59%	1.05	1.04	1.94	1.33
Walt Whitman	69.58%	55.06%	93.83%	74.31%	1.16	2.17	2.11	1.74
Thomas S. Wootton	74.05%	46.45%	52.99%	58.94%	1.27	3.09	3.20	2.36
Average by cluster	69.41%	63.18%	69.80%		1.21	2.2	2.45	

Figure 2.4.6 *Proportion of Students Who Attend Their Closest School, by School Level*

** Denotes school with elementary to middle school inter-cluster articulation, inter-cluster split articulation, or intra-cluster split articulation, described on* ***C1. Split Articulation Patterns and Proximity (Elementary to Middle) on page 302****.*

†Denotes cluster or consortium with middle to high school alternative articulation.

• Neelsville MS is included as part of the Clarksburg cluster, although some students from Watkins Mill articulate to this school.

A.3 Proximity and Population Density

Having seen a general trend of shorter average travel distances in more densely populated regions of the county, we now look more closely at the correlations between population density of school attendance areas and average distance to school.

Across all three school levels, there is a correlation between population density and average distance to school: the denser an attendance area is, the more likely it is to have a lower average distance to school.

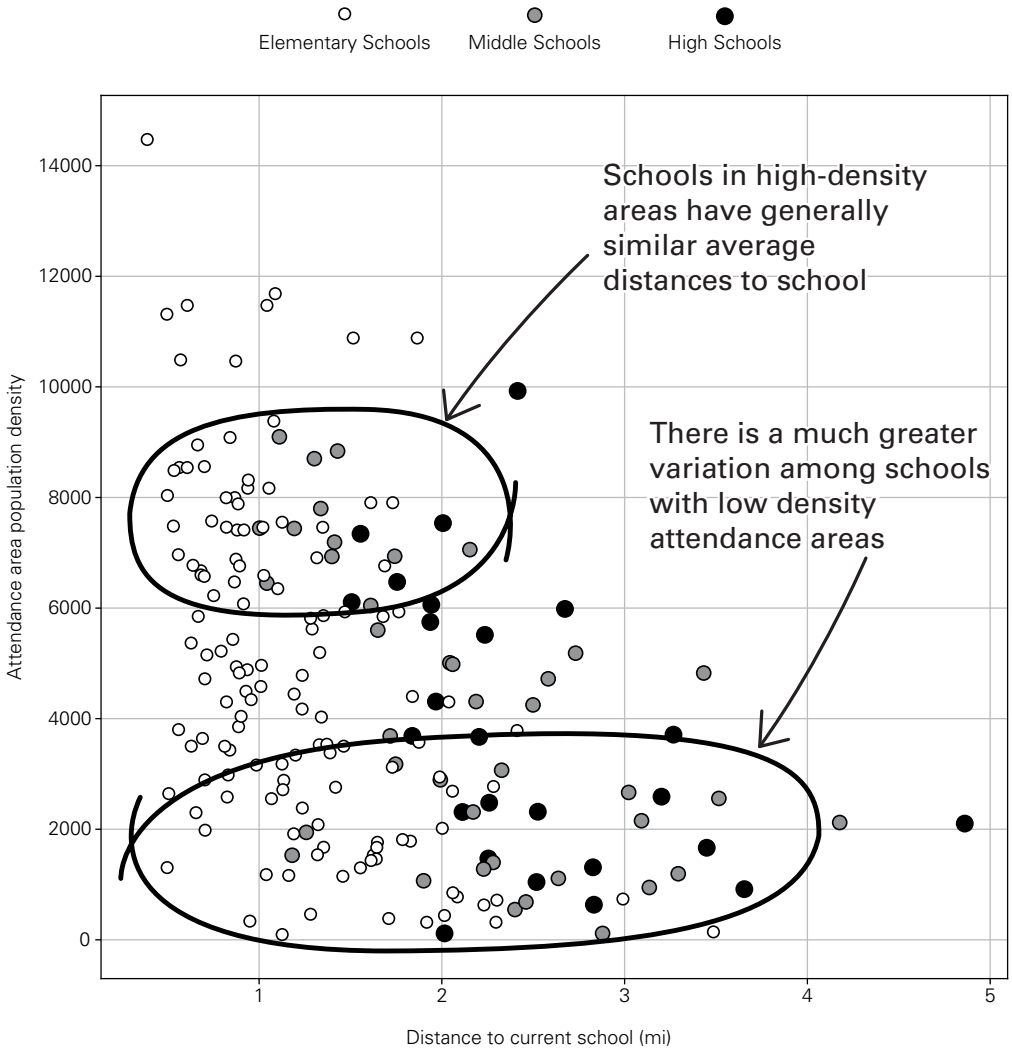


Figure 2.4.7 *School Attendance Area Population Density Compared with Average Distance to School (all school levels)*

The figure above illustrates the correlation between population density and average distance to school for each school in the district. The x-axis measures the average distance traveled to school, and the y-axis represents the population density of the school attendance area. The size and color of the points corresponds to school level.

Overall, we see a negative trend, as expected: students in attendance areas with higher population densities tend to also travel fewer miles, on average, to school.

Furthermore, although there is large variation across school levels, the general trend suggests that more densely populated school attendance areas have very similar average distances to school to one another, while there is a wider variation in distances to school in more rural areas.

The median population density for elementary school attendance areas is 4,444 persons per square mile. Of the elementary schools that are above the median population density, the total range between average distances to school at the school level is 1.48 miles. For schools below the median population density, that range is 2.99 miles.

The same pattern is apparent at the middle and high school levels as well: school attendance areas in denser areas are more alike in terms of the average distance traveled to school than school attendance areas in less dense areas. The map in Figure 2.4.8 Population Density and Median Distance to School (on the following page) illustrates the relationships between population density and distance to school, at the elementary school level.

Participants in a table discussion at a regional public meeting at Gaithersburg High School on December 5, 2019 (photo credit: Rodrick Campbell)

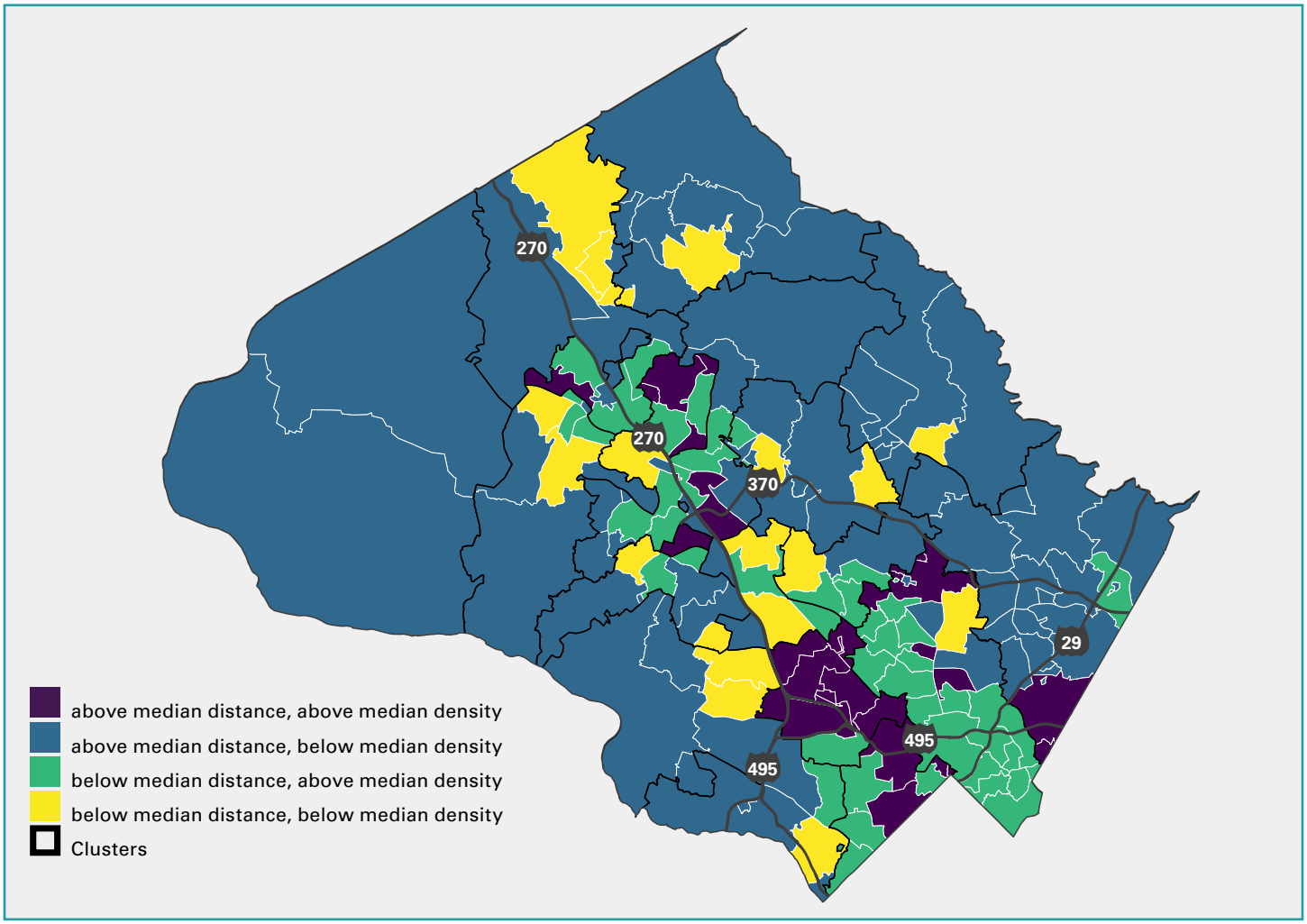


Figure 2.4.8 *Population Density and Median Distance to School (Elementary Schools)*

The map above expresses the data from Figure 2.4.9 below, using the following categories:

- **Purple attendance areas** are above the median distance to school, and above the median population density: these areas are denser than the county median, but students are further from school on average than their peers in adjacent, similarly dense urban areas.
- **Blue attendance areas** are above the median distance to school, and below the median population density.
- **Green attendance areas** are below the median distance to school, and above the median population density: these tend to cluster around the I-270 corridor and southern parts of the county.
- **Yellow attendance areas** are below the median distance to school, and below the median population density. Although these areas are less densely populated, students travel relatively short distances to school.

Map on the previous page reveals patterns in population density and average distance to school for elementary schools across the county. The blue and green attendance areas align with the larger trend of greater density and lower distances to school, while the purple and yellow attendance areas provide interesting exceptions to this norm.

School	Population Density (persons/square mile)	Avg. Distance to School (mi)
Poolesville Elementary	95.53	1.13
Monocacy Elementary	143.61	3.49
Damascus Elementary	317.78	1.92
Laytonsville Elementary	318.49	2.30
Little Bennett Elementary	337.95	0.95
Darnestown Elementary	385.57	1.71
Clarksburg Elementary	440.05	2.01
Greenwood Elementary	462.60	1.28
Sherwood Elementary	630.49	2.23
Potomac Elementary	717.62	2.30

Figure 2.4.9 *Top Ten Greatest Distances to School and Attendance Area Population Density for Elementary Schools.*

(Complete tables for elementary, middle, and high schools can be found in ***Appendix D4: Population density and average distance to school on page 505****)*

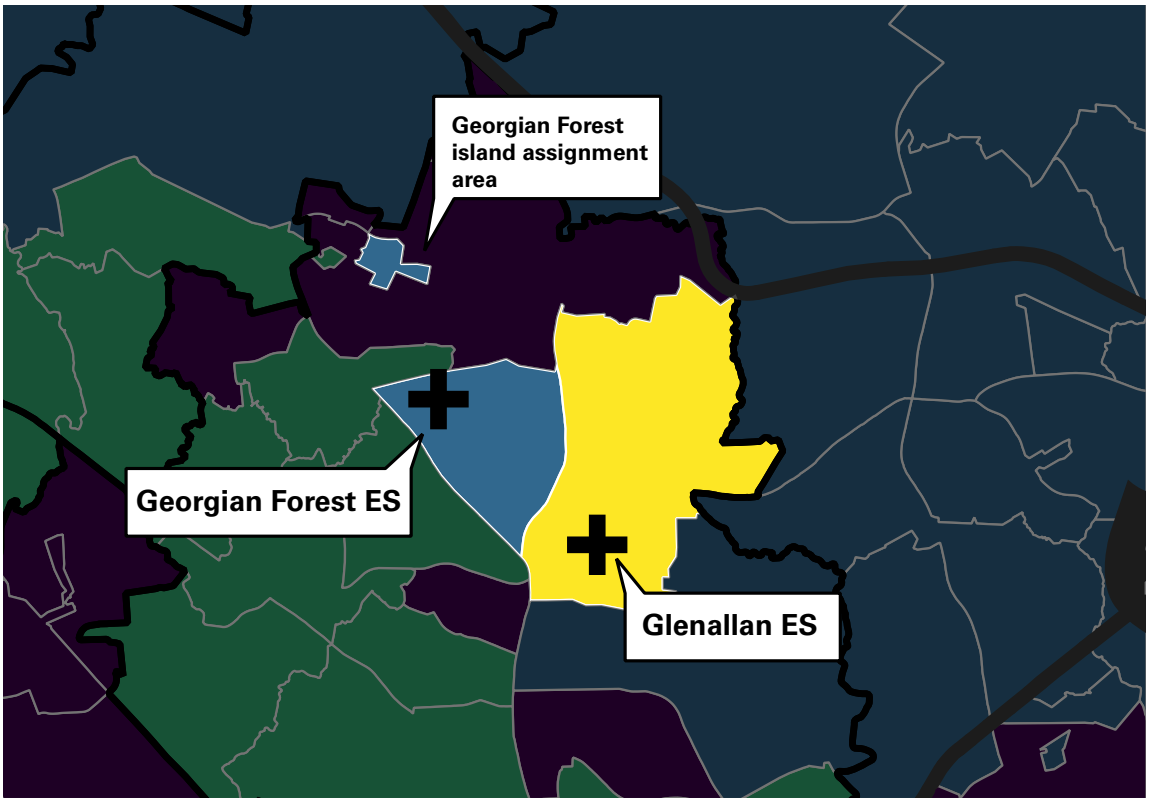


Figure 2.4.10 *Case study: Georgian Forest ES and Glenallan ES Attendance Areas, by Population Density and Average Distance to School*

The case study above illustrates the relationship between population density and average distance to school. The Georgian Forest ES attendance area is smaller than the neighboring Glenallan ES attendance area, but its island attendance area piece contributes to higher average distances to school: students who live in that portion of the attendance area must travel through parts of the Bel Pre ES and/or Harmony Hills ES attendance areas to reach the school itself. Glenallan ES, on the other hand, is also below the median population density of elementary attendance areas in the county, but a portion of that attendance area is Wheaton Regional Park and open space near the Anacostia River; although the attendance area is larger than that of Georgian Forest ES, students tend to live closer to school on average.

A.4 Relative Distance: Difference Between Current School and Closest School

Given the variable conditions across the district, how can we contextualize our understanding of proximity to schools? One way to begin to do this is by looking at proximity to schools relative to other nearby schools. Oftentimes, a student's assigned base school is not the closest school to their home. On average, how far apart is a student's closest school, and the school they are actually assigned to attend?

This portion of the analysis inspects the difference in distance between a student's current school and the schools closest to where they live. The goal of this analysis is to better understand how attendance area geographies impact the total distance that students travel to attend school.

The table below shows the ten middle schools for which current students have the greatest difference in distance between their current school (the leftmost column) and the school that is closest to them.

The schools shown in the table below are chosen to illustrate the concept and provide better context on whether students are assigned to their closest schools. Complete tables for each school at each level can be found in .

School	Average distance from home to school (mi)	Average distance from home to closest school (mi)	Number of distinct closest schools for students in attendance area (including base school)	Difference in distance (mi) between current school and closest school	Normalized Difference in Distance** (Difference in distance between school and average of three closest schools)	Percent students who live closest to this school
Briggs Chaney Middle*	4.18	2.34	5	1.84	0.74	18.36%
Cabin John Middle*	3.52	1.98	6	1.54	0.82	50.26%
Forest Oak Middle*	3.43	1.92	6	1.51	0.73	3.96%
Neelsville Middle*	2.73	1.61	3	1.12	0.33	54.69%
Redland Middle	3.29	2.30	7	0.99	0.52	14. 71%
White Oak Middle*	3.02	2.08	7	0.94	0.05	41.71%
Francis Scott Key Middle*	2.50	1.67	4	0.83	-0.08	66.83%
North Bethesda Middle	2.04	1.28	5	0.77	1.06	43.89%
William H. Farquhar Middle	3.14	2.44	4	0.70	-0.68	46.98%
Robert Frost Middle*	3.09	2.40	4	0.69	-0.14	46.45%

*Denotes schools with an island assignment
** Calculated as (distance to current school – average distance to three closest schools)

Figure 2.4.11 *Ten Schools with Greatest Difference in Distance Between Current School and Closest School (Middle School)*

In the table above, we see the ten middle schools where the difference in distance between students' closest school and their base school is the widest. Let's take a closer look at what the columns in this table are telling us:

- **Average Distance from Home to School:** The second column shows the average distance, in miles, between students' homes and their current school (the school in the leftmost column).
- **Average Distance from Home to Closest School:** The third column shows the average distance, in miles, between students' homes and their closest school (which varies depending on where a student lives).

- **Number of Distinct Closest Schools for students in Attendance Area:** The fourth column over tells us how many different closest schools there are among all students at this school (including the base school, named in column one). In the first row, for example, while some students at Briggs Chaney live closest to Briggs Chaney, there are some students who live closer to school A, and others who live closer to school B, C, D or E. Altogether, this makes five schools to which some students living in the Briggs Chaney attendance area live closest.
- **Difference in Distance Between Current School and Closest School:** this column (column five) represents the difference between column two (average distance from home to school) and column three (average distance from home to closest school). This column tells us that the students at these middle schools tend to have some other school closer to their home then their base school (if all students attended their closest school, this distance would be 0).
- **Normalized Difference in Distance:** this column (column six) offers more context to this disparity. To calculate this value, we find the average distance between students and each of their closest three schools, excluding their current school. If students in an attendance area live in close proximity to many schools, we would expect this relative proximity value to be negative or very low (for example, in a densely populated area with many schools). If students in an attendance area tend to live farther away from schools (for example, in a less densely populated area with fewer schools)–, we would expect this value to be positive or higher.
- **Proportion of Students Who Attend their Closest School:** the final column over (column seven) offers the percentage of students at the school who attend their closest school. This value validates the measures in column six. In schools where the value in column six is closer to 0, the proportion of students who attend their closest school is generally higher.

By calculating the average distance between students and their three closest schools, we are adding greater context to the statistic of whether students are assigned to their closest schools. This analysis also provides greater context to island assignment attendance areas – which tend to present greater proximity challenges for students. Although this trend may be true, we can see in this analysis that some island assignment schools are still, on the whole, a closer option for the average student.

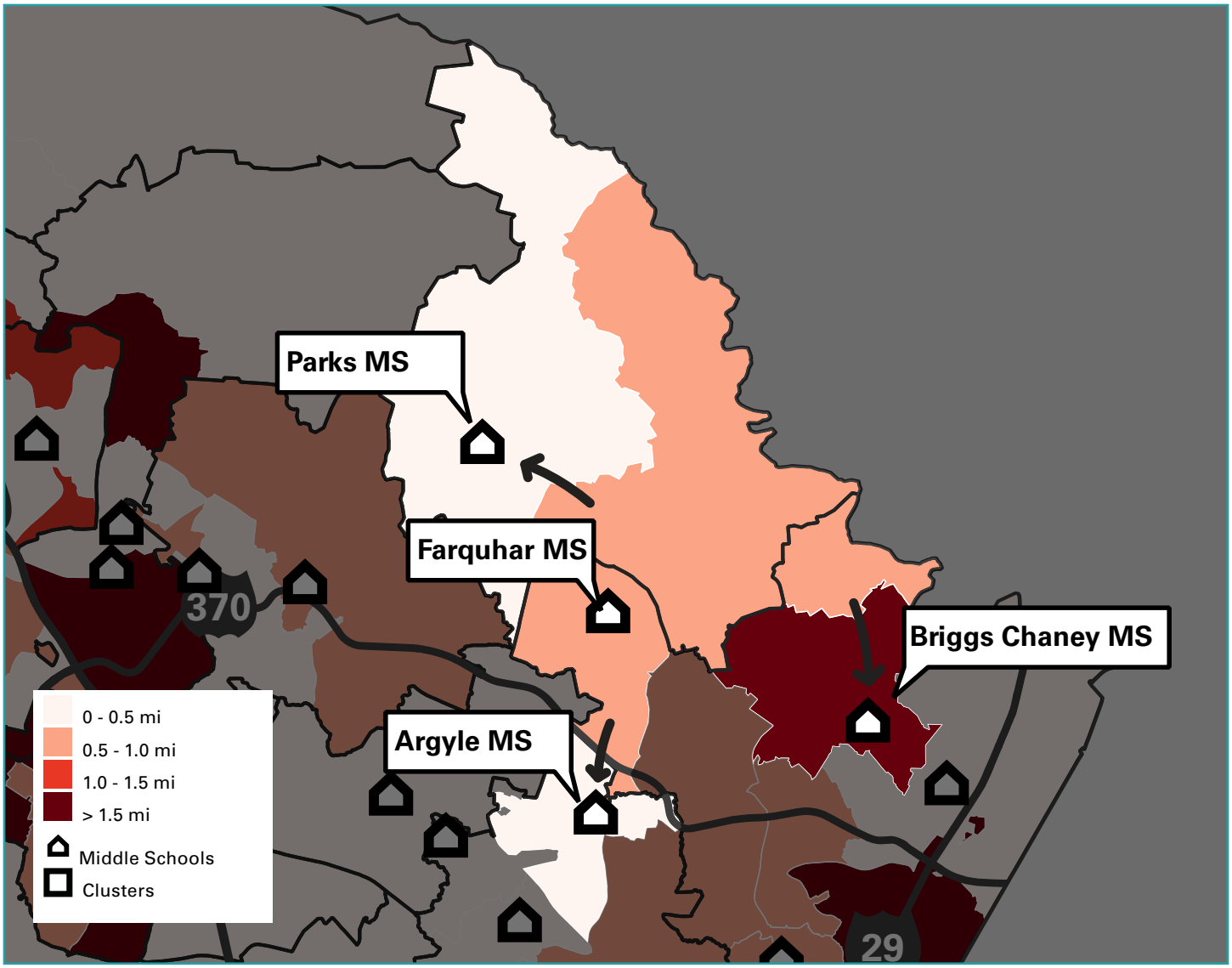


Figure 2.4.12 *Case Study of Relative Distance to Schools: Farquhar MS*

There are many cases throughout the district where there is one school closer to a student's home than their base school--and it may be easy to assume that students should go to that school. But this analysis suggests that there is a wider network of schools that are in proximity to the many students in the attendance area, and proximity should be viewed with this context in mind.

The map above uses Farquhar MS to illustrate the relative proximity analysis in this section. At Farquhar, the average student lives 3.14 miles from school. On average, they are 2.4 miles away from their closest school – which may or may not be Farquhar.

We know that not all students live closest to Farquhar, given that the difference in distance between students' closest school and Farquhar MS is on average 0.70 (for students whose closest school is Farquhar, this value would be 0 miles). In the case of Farquhar MS students, there are four schools that are the closest

school to those students: Briggs Chaney MS, Argyle MS, Parks MS, and Farquhar MS (the base school).

From here, we calculate relative proximity to Farquhar by subtracting the average distance of students to their three closest schools from their average distance to Farquhar. This value is -0.68 miles , meaning that, when considered together, most students who attend Farquhar live closest to Farquhar when we normalize school proximity by factoring in other nearby schools.

At some schools, this means that while certain pockets of students may be closer to other schools, the attendance area of the school that they attend minimizes travel distance for the student body of that school as a whole. In other cases, the difference in distance between a school and the average of the closest three schools is positive. This implies that there is a group of schools which are, on average, closer to students than their current school, and that the current attendance areas do not effectively minimize travel distance for students.

Regional public meeting at Blair High School, January 11, 2020 (photo credit: C.D. Boykin)

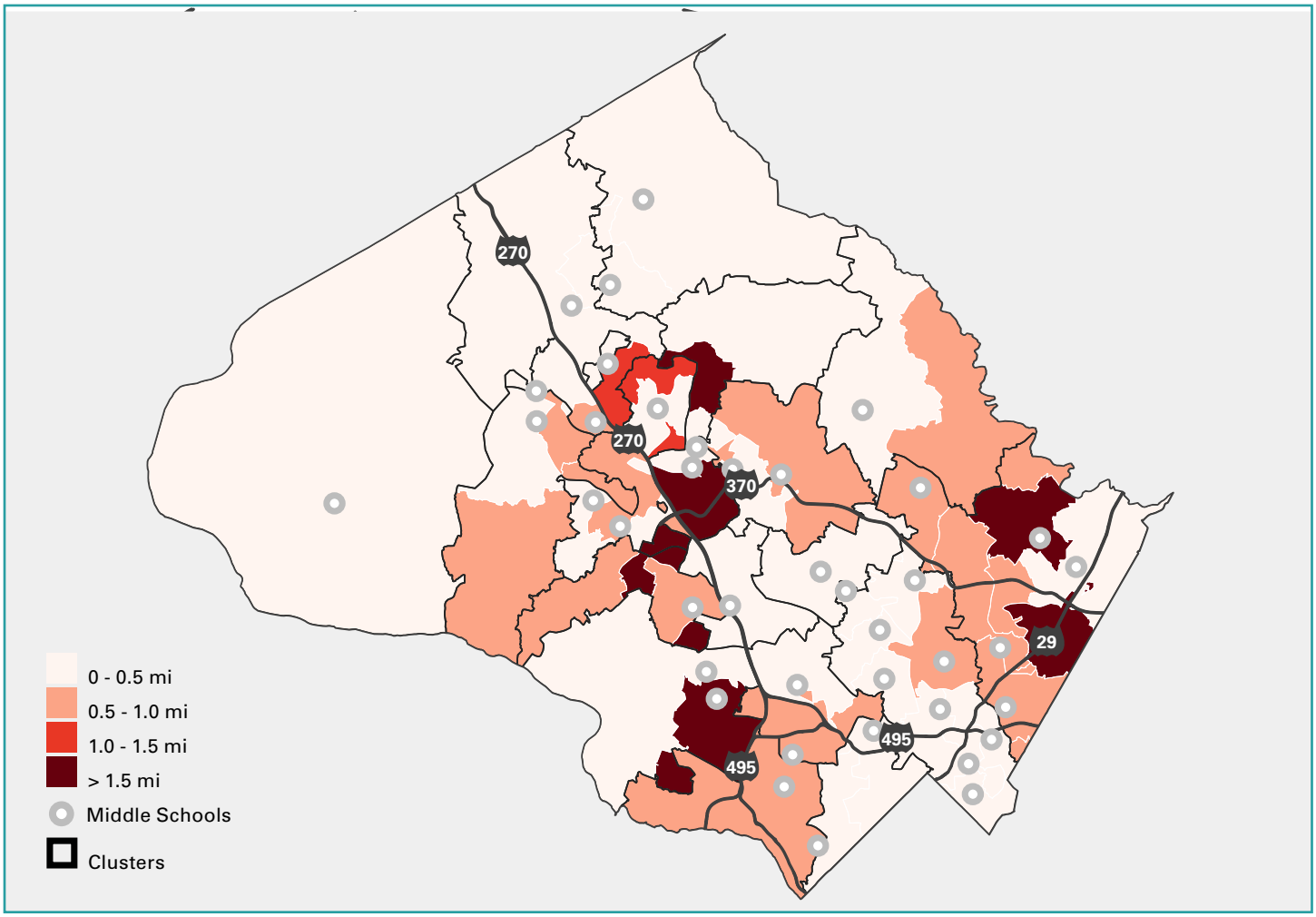


Figure 2.4.13 *Ten Schools with Greatest Difference in Distance Between Current School and Closest School (Middle School)*

The map above illustrates Difference in Distance Between Current School and Closest School (shown in **Figure 2.4.11 - Ten Schools with Greatest Difference in Distance Between Current School and Closest School (Middle School)**).

While the majority of schools with great disparities in this regard are island assignments, we can see in this map that there are also a number of contiguous attendance areas throughout the district with relatively higher differences in distance than others.

2.4 Data Analysis Proximity

B. Proximity and Walk Zones

MCPS aims for as many students to walk to school as possible and designates particular areas around schools as walk zones. In this set of analyses, we examine these geographies, as well as other factors related to walkability to schools in MCPS.

Questions:

What is a walk zone and how are its boundaries determined?
What is the proportion of students living within MCPS designated walk zones, across schools and levels?
Within MCPS walk zones, how far do students live from school on average?

Analyses:

B.1 Proportion of Students in the Walk Zone
B.2 Difference in Percentage of Students in Walk Zone vs. Walk Shed
B.3 Average Walk Distance for Students within Walk Zones

Insights

1. Elementary school students are most likely to live within their school's walk zone.

At the elementary school level, 38% of students live within their school's walk zone. At the middle and high school levels, these numbers are 25% and 29%, respectively. A higher proportion of high school students live in the walk zone than middle school students.

2. On average, students living in walk zones tend to live at least a half mile away from school. This increases across school levels.

Elementary school students who live within their school's walk zone live 0.51 miles away from school on average. Middle school students in the walk zone live 0.86 miles away on average, and high school students live 1.2 miles away on average.

3. More than half of all the elementary schools have less than 50% of students within the walk zone.

This increases at the middle school and high school levels: more than three-quarters of all the middle schools and high schools have less than 50% of the students within the walk zone.

4. Students who live in the I-270 corridor area are more likely to live within their school's walk zone than in other parts of the county.

This suggest a correlation between population density and the likelihood of students living within their school's walk zones.

5. Not all schools have walk zones.

Due to traffic hazards and roadway conditions around schools, not all schools have walk zones. Schools in less densely populated areas on the periphery of the county are more likely not to have walk zones. 12 of 135 elementary schools, two of 40 middle schools and two of 25 high schools do not have walk zones.

6. At each school level, MCPS sets a maximum distance that student walkers can reasonably walk, or walk-radius, and a walk-zone, which accounts for the actual walkable routes within this radius. There is often a considerable difference between the percentage of students who live within the walk-radius and the MCPS-defined walk zone, suggesting that walkability is not simply a matter of proximity to school.

About 46% of students overall (across all grade levels) are within the MCPS defined walk -radius polygon (one mile for elementary students, 1.5 miles for middle school students, and two miles for high school students). But only 32% are within MCPS DOT-designated walk zones for their school. That means that 14% of students (46%-32%) who theoretically live close enough to school to walk, do not actually have a viable walking route to school. In these cases, optimizing walkers may be a question of traffic safety, land use, and other factors, rather than distance.

Introduction to Walk Zones

MCPS aims for as many students as possible to walk to school, and through MCPS DOT (the school system's Department of Transportation), MCPS regularly assesses the walkability of neighborhoods around schools to determine whether a route is safe and appropriate for students at each school level. As seen in the box, **MCPS Walk Zone Standards**, MCPS also sets a threshold for the maximum walking radius for walk zones at each school level: ranging from one to two miles from a student's home.

To better understand walk zones, it is important to understand the difference between the walk radius and the **walk zone polygon.**

The walking radius defines a general area of potential walkability: this is more or less a circle drawn around a school, with the radius of the appropriate school level walk zone (1, 1.5, or 2 miles). Within this radius, we first must adjust to road-network distance (in other words, 1 mile via existing roads and walkways). From there, the road-network distance must be further adjusted to account for hazards and barriers that may make a walking route unsuitable for students.[1] This final adjusted area is the MCPS walk zone.

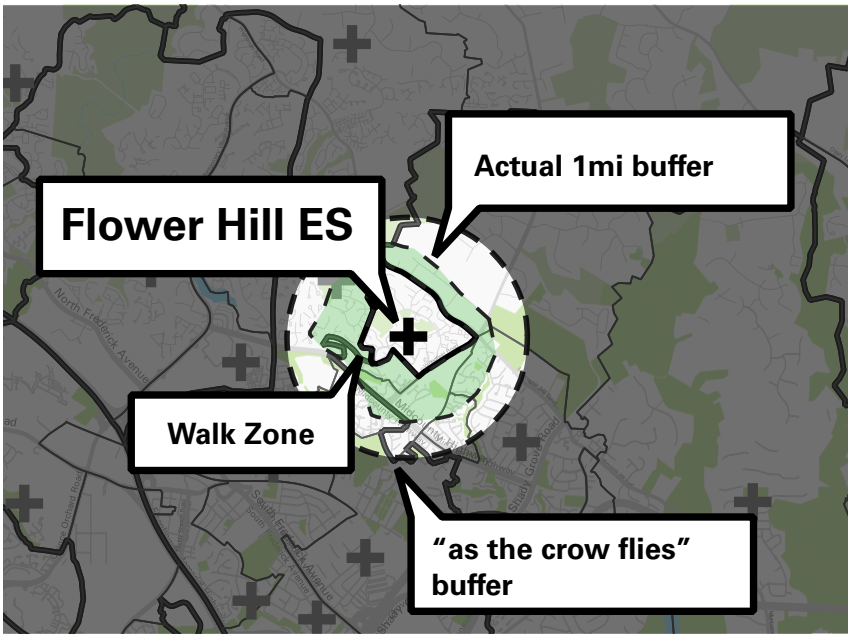


Figure 2.4.14 *Walk Zones, Walksheds, and the Walk Radius*

1 For more on walkability and street networks, see: Angela Coullias. 2013. "Barriers and Facilitators of Walkability: Analysis of Street Networks and Urban Design Characteristics Around Central Florida Elementary Schools." University of Florida. https://ufdcimages.uflib.ufl.edu/UF/E0/04/56/37/00001/COULLIAS_A.pdf.

MCPS Walk Zone Standards[1]

MCPS walk zones are aligned with the district standards for bus service. The walk zone standards are as follows, provided there is a safe route as determined by MCPS DOT:

- Elementary school students: 1 mile walking radius
- Middle school students: 1.5 mile walking radius
- High school students: 2 mile walking radius

The MCPS DOT analyzes safety and walkability conditions to recommend appropriate walking zones and routes to schools.

1 For more on walk zones policy in MCPS, see Policy EEA; "Policy EEA: Student Transportation." 2008. Board of Education of Montgomery County. https://www.montgomeryschoolsmd.org/departments/policy/pdf/eea.pdf.

Let's look at current walk zone polygons when compared to the walk-radius mandated by MCPS DOT.

About 46% of students overall (across all grade levels) are within the MCPS designated potential walk-shed area. But only 32% are within the walk zone. That means that 14% of students who theoretically live close enough to school to walk, do not actually have a viable walking route to school. This may be due to a variety of factors, ranging from unsafe walking and biking conditions to disconnected pedestrian networks. In some cases, this can be attributed to factors such as inadequate sidewalks, high traffic speed and volume, fences or walls, and absence of crossing guards to facilitate safe crossing of the street.

B.1 Proportion of Students in Walk Zones

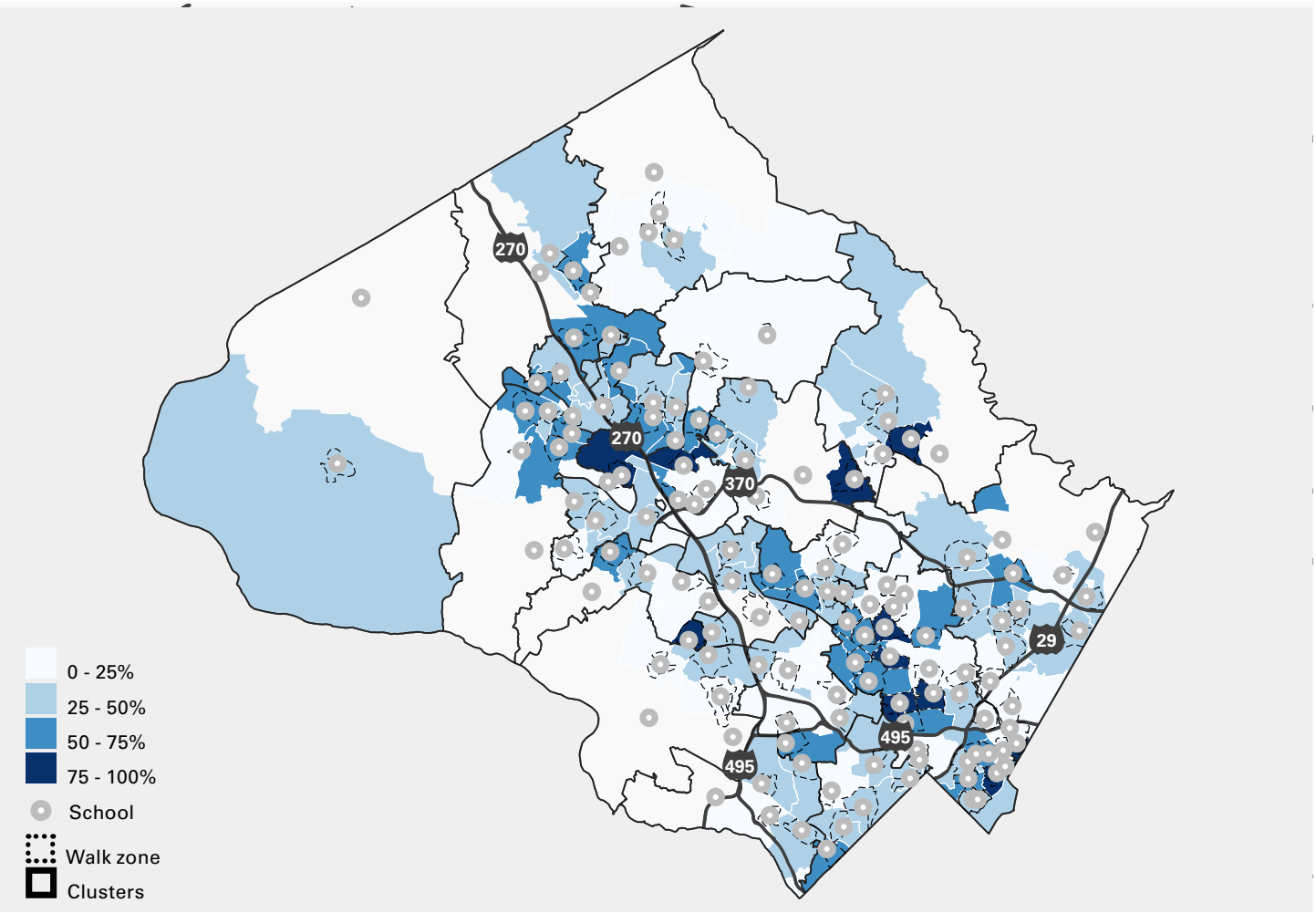


Figure 2.4.15 *Map of Proportion of Students in Walk Zones (Elementary School)*

More students live within their school's walk zone at the elementary school level than at the middle or high school level. Yet, the proportion of students by schools ranges widely. At nearly a quarter of elementary schools, less than 25% of students live within the walk zone. On the other hand, there are 13 schools with very high proportions of students living in the walk zone (75-100%).

At the middle and high school levels, there is a lower proportion of students living in walk zones overall. Interestingly—although high school attendance areas are larger-- there is a greater proportion of students that live in the walk zone at the high school level than at the middle school level. Note that 123 of 135 elementary schools, 38 of 40 middle schools, and 23 of 25 high schools have walk zones.

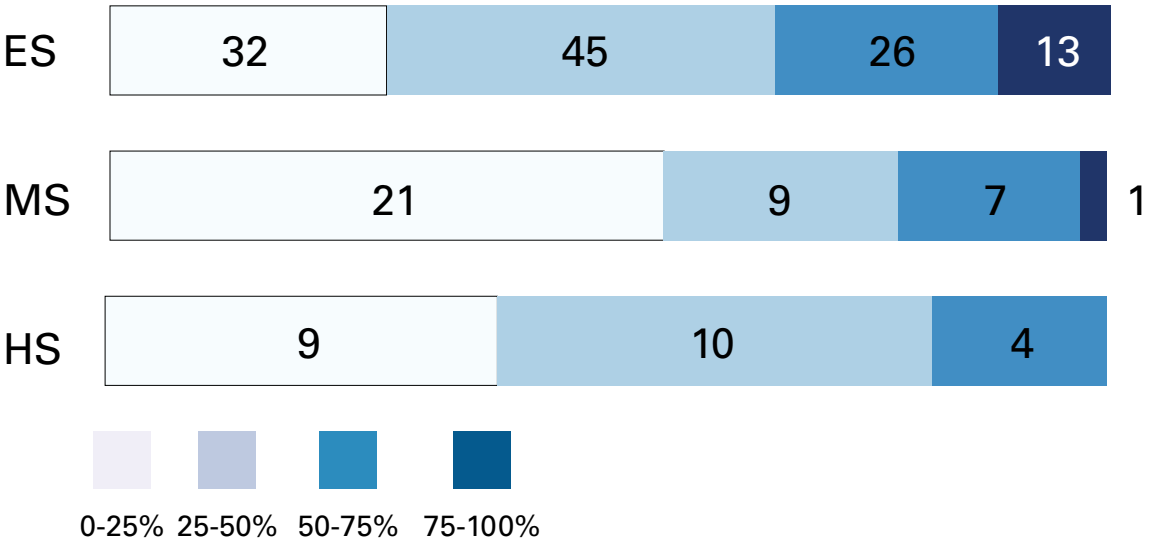


Figure 2.4.16 *Proportion of Students in Walk Zones, by School Level*

B.2 Difference in Percentage of Students in Walk Zone vs. Walkshed

MCPS's walk zones are generally 1 mile for elementary schools, 1.5 miles for middle schools, and 2 miles for high schools. But in actuality, walk zones are far smaller due to factors like hazardous conditions and major roadways.
This section identifies walkshed areas—total potential walkable areas based on walkable roadways but not taking into account the hazardous features that MCPS uses to determine walk zones-- for each school based on the walk distances outlined above and uses the Mapbox Isochrones API to determine generalized walksheds. These walksheds provide approximate isochrones (or, connective lines on a map) for different travel modes based on travel time. After iterative testing, walk zones that approximate 1, 1.5, and 2 mile walk distances were created and the number of students at a school within these zones was compared to the number of students within official walk zones. The difference between these numbers was identified to determine the impact that physical conditions of neighborhoods have on limiting students' eligibility to walk to school. To illustrate this point, the table in **Figure 2.4.20** shows the top ten largest disparities between the percentage of students in the walk zone vs. the percentage of students in the calculated walkshed.

School	% current students in walk zone	% current students in 1mi walkshed	% difference
Bethesda ES	7.56%	85.98%	78.43%
Rock Creek Forest ES	30.73%	100.00%	69.27%
Bells Mill ES	23.44%	75.72%	52.28%
Fields Road ES	34.03%	84.62%	50.58%
Germantown ES	36.19%	85.07%	48.88%
Woodlin ES	10.75%	55.98%	45.23%
Montgomery Knolls ES	20.98%	62.67%	41.69%
Somerset ES	36.38%	77.61%	41.23%
Sargent Shriver ES	52.73%	92.36%	39.63%
Burnt Mills ES	20.92%	60.23%	39.31%

Figure 2.4.17 *Top Ten Cases with the Greatest Difference in Percentage of Students in One Mile Walkshed vs. Walk Zone (Elementary School)*

A complete list of proportion of students in walk zones and walksheds, by school, is available in ***Appendix D7: Percentage of students in walk zone vs. walkshed on page 520.***

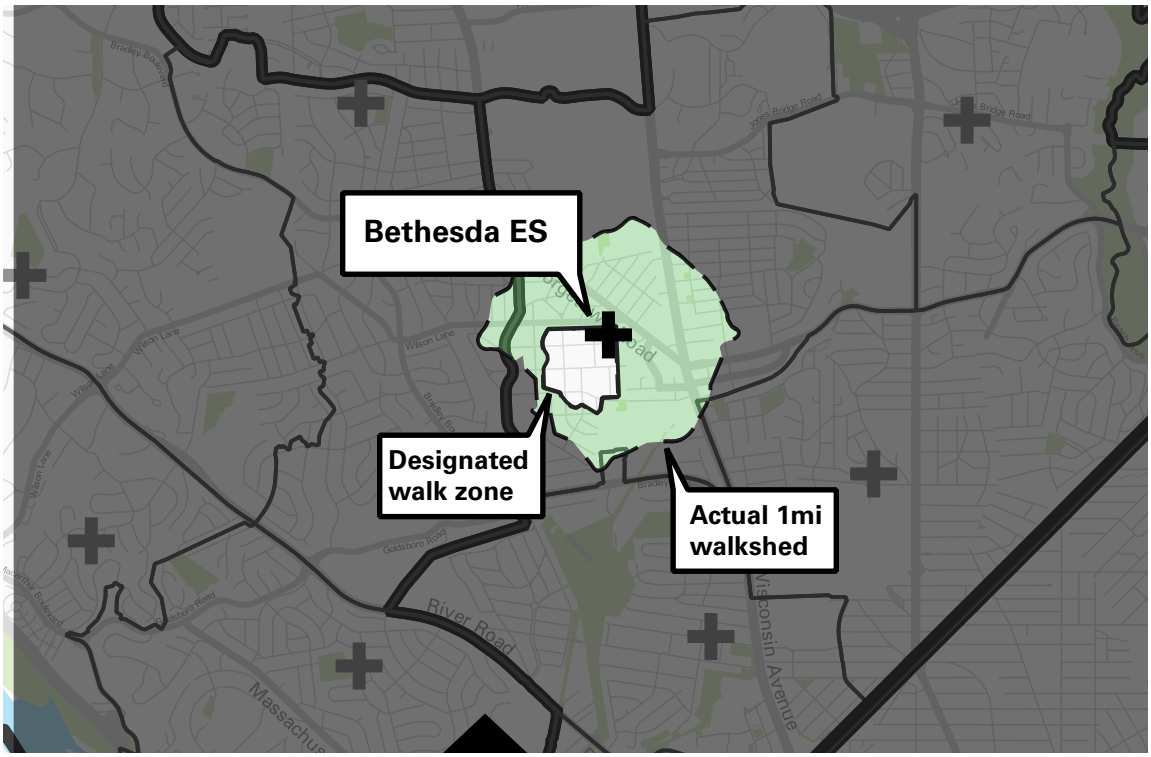


Figure 2.4.18 *Map of Bethesda ES, its MCPS-assigned walk zone, and calculated 1mi walkshed*

Case Study: Bethesda ES

Bethesda Elementary School's walk zone currently includes less than ten percent of its current students. However, the walkshed polygon, which represents a one-mile walk distance from Bethesda ES, includes roughly 86% of all Bethesda students who live in the attendance area. This analysis only includes students who currently attend Bethesda ES and live in the attendance area. Major roadways and other unsafe conditions limit the extent of walk zones. In the case above, Wilson Lane and Arlington Road have been assessed by MCPS DOT as unsafe for elementary school aged children to cross safely to walk to school. The average difference across all elementary schools is 14.88%.

Although the difference between walk zones and walksheds is less pronounced overall at the middle school level, several cases exist where over 25% of students at a given middle school are excluded from the walk zone based on unsafe roadway conditions or other hazards. The average difference between percentage of students in the walk zone and the walkshed at the middle school level is 13.96%.

The average difference at the high school level is slightly less than at the elementary and middle school levels (11.81%). However, there are still several notable cases where over 25% of students are excluded from the potential walk zone at their school due to roadway conditions. *(continued on next page)*

School	% current students in walk zone	% current students in 1.5 mi walkshed	% difference
Silver Spring International MS	23.24%	66.52%	43.28%
Eastern MS	49.08%	89.53%	40.45%
Shady Grove MS	12.64%	46.28%	33.64%
Tilden MS	9.67%	39.89%	30.22%
A. Mario Loiederman MS	54.07%	80.99%	26.91%
Martin Luther King, Jr MS	30.09%	56.74%	26.65%
Thomas W. Pyle MS	18.13%	43.15%	25.02%
Takoma Park MS	55.19%	78.62%	23.43%
Sligo MS	46.25%	69.37%	23.12%
Newport Mill MS	59.13%	77.40%	18.27%

Figure 2.4.19 *Ten cases with the Greatest Difference in Percentage of Students in 1.5 mi Walkshed vs. Walk Zone (Middle School)*

A complete list of the proportion of students in walk zones and walksheds, by school, is available in ***Appendix D7: Percentage of tudents in Walk Zone vs. Walkshed on page 520****.*

School	% current students in walk zone	% current students in 2mi walkshed	% difference
Walt Whitman HS	22.95%	61.76%	38.81%
Paint Branch HS	3.05%	35.86%	32.81%
Damascus HS	4.48%	30.58%	26.10%
Clarksburg HS	21.44%	46.65%	25.20%
Montgomery Blair HS	8.10%	31.22%	23.12%
Walter Johnson HS	17.57%	40.68%	23.11%
Poolesville HS	53.08%	75.57%	22.50%
Rockville HS	40.83%	61.61%	20.77%
Bethesda-Chevy Chase HS	30.40%	48.56%	18.16%
Winston Churchill HS	34.05%	45.84%	11.78%

Figure 2.4.20 *Ten Cases with the Greatest Difference in Percentage of Students in 2 mi Walkshed vs. Walk Zone (High School)*

A complete list of the proportion of students in walk zones and walksheds, by school, is available in ***Appendix D7: Percentage of Students in Walk Zone vs. Walkshed on page 520****.*

The walkshed of Walt Whitman HS, for example, is bisected by River Road, a major thoroughfare without sidewalks and with only two crossings (both at-grade) anywhere near the school. Clearly these are not safe walkable conditions, nor do these present viable conditions for students to walk to school. These differences point to the external transportation and roadway infrastructure that impacts the walkability of attendance areas that are outside of the purview of MCPS.

B.3 Average Walk Distance for Students within Walk Zones

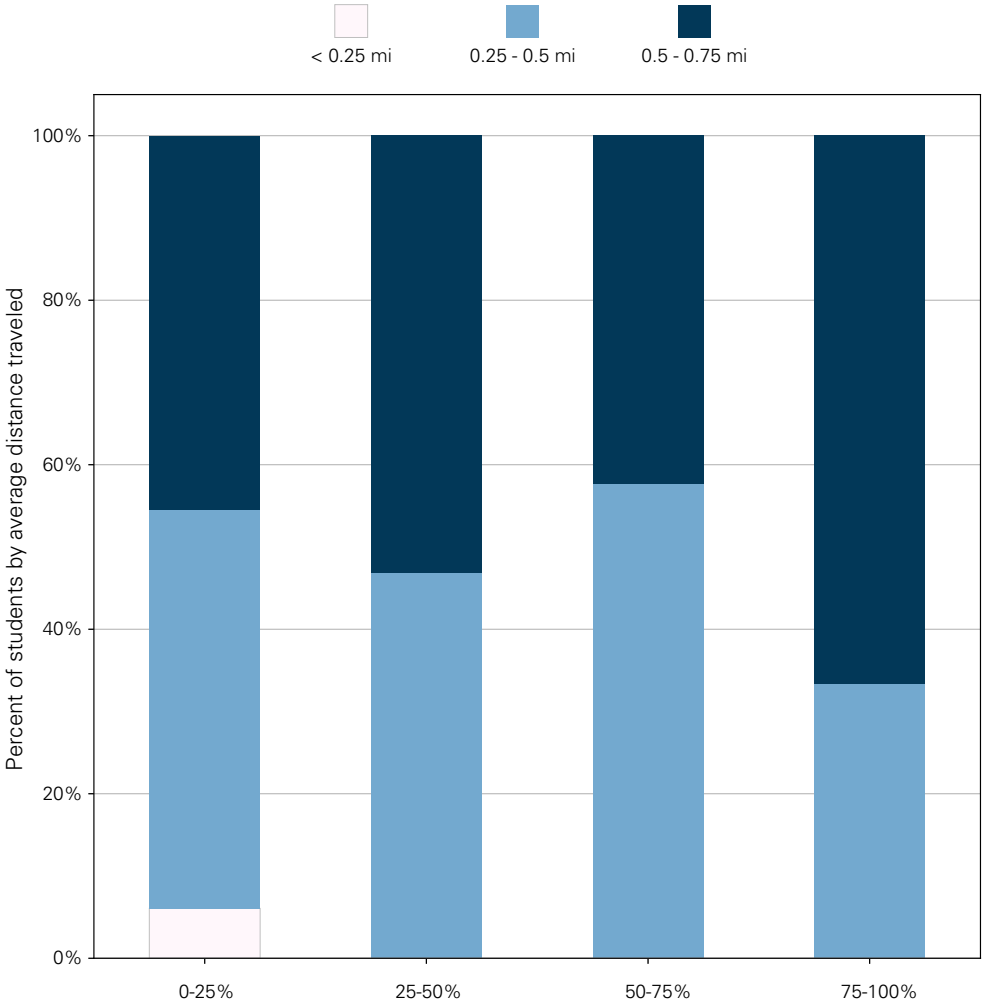


Figure 2.4.21 *Proportion of Students within the Walk Zone (Elementary Schools)*

In the graph above, the x-axis represents the proportion of students in the walk zone (elementary school level), and the y-axis represents the average distance between students' home and school.

Of the elementary schools with over 75% of students within the walk zone, 58% of these students live within a half mile of school. This proportion is only slightly higher than for schools with a smaller percentage of students living within the walk zone. However, at schools with less than 25% of students in the walk zone, 6% of these students live less than a quarter mile away. Although the proportion of students within the walk zone varies by school, around half of students who are in the walk zone live within a half mile walking distance of school. The school with the shortest average walk distance to school is Cedar Grove ES (0.2 miles), and the school with the largest average walk distance to school is Washington Grove ES (0.9 miles).

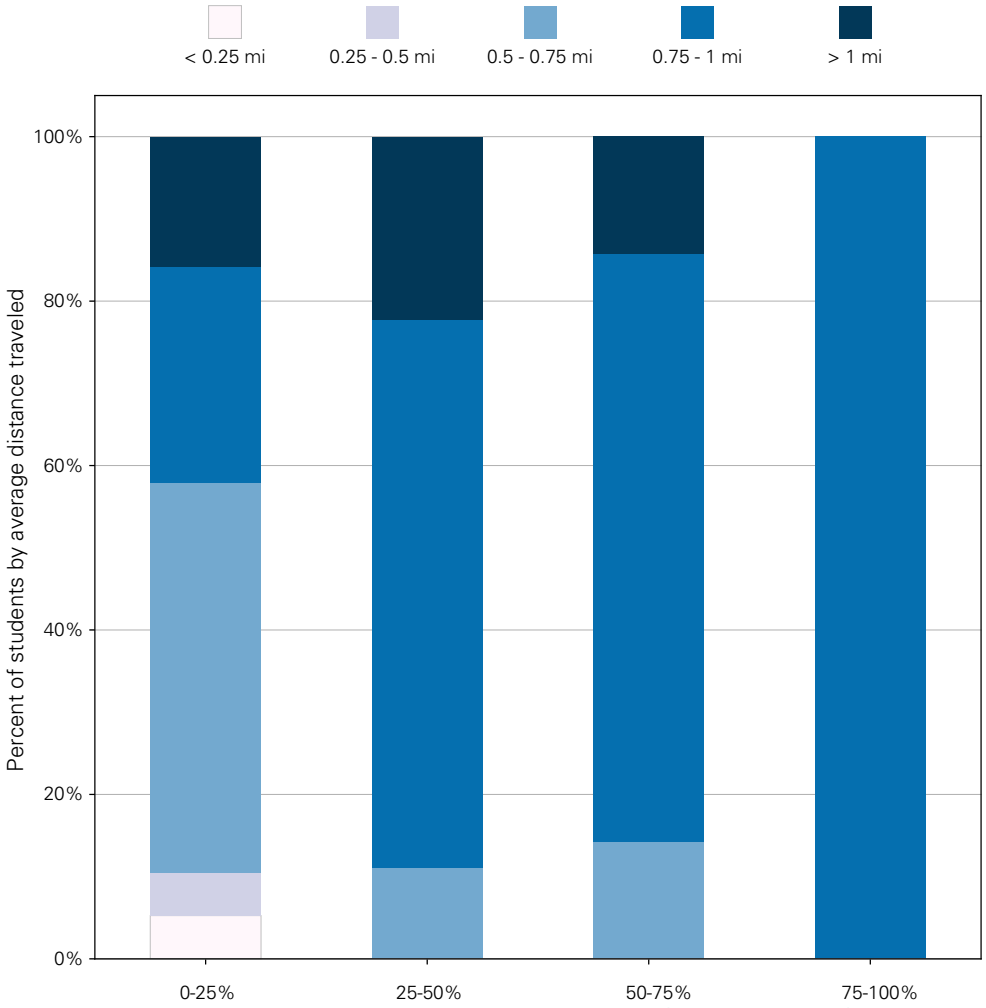


Figure 2.4.22 *Proportion of Students within the Walk Zone (Middle Schools)*

This relationship shifts drastically at the middle school level. Of the middle schools that have more than 50% of their students within the walk zone, over 80% of these students live more than 0.75 miles away. Interestingly, only middle schools with less than 25% of students in the walk zone have students who live less than half a mile away, although these students make up less than 5% of all students at their respective schools.

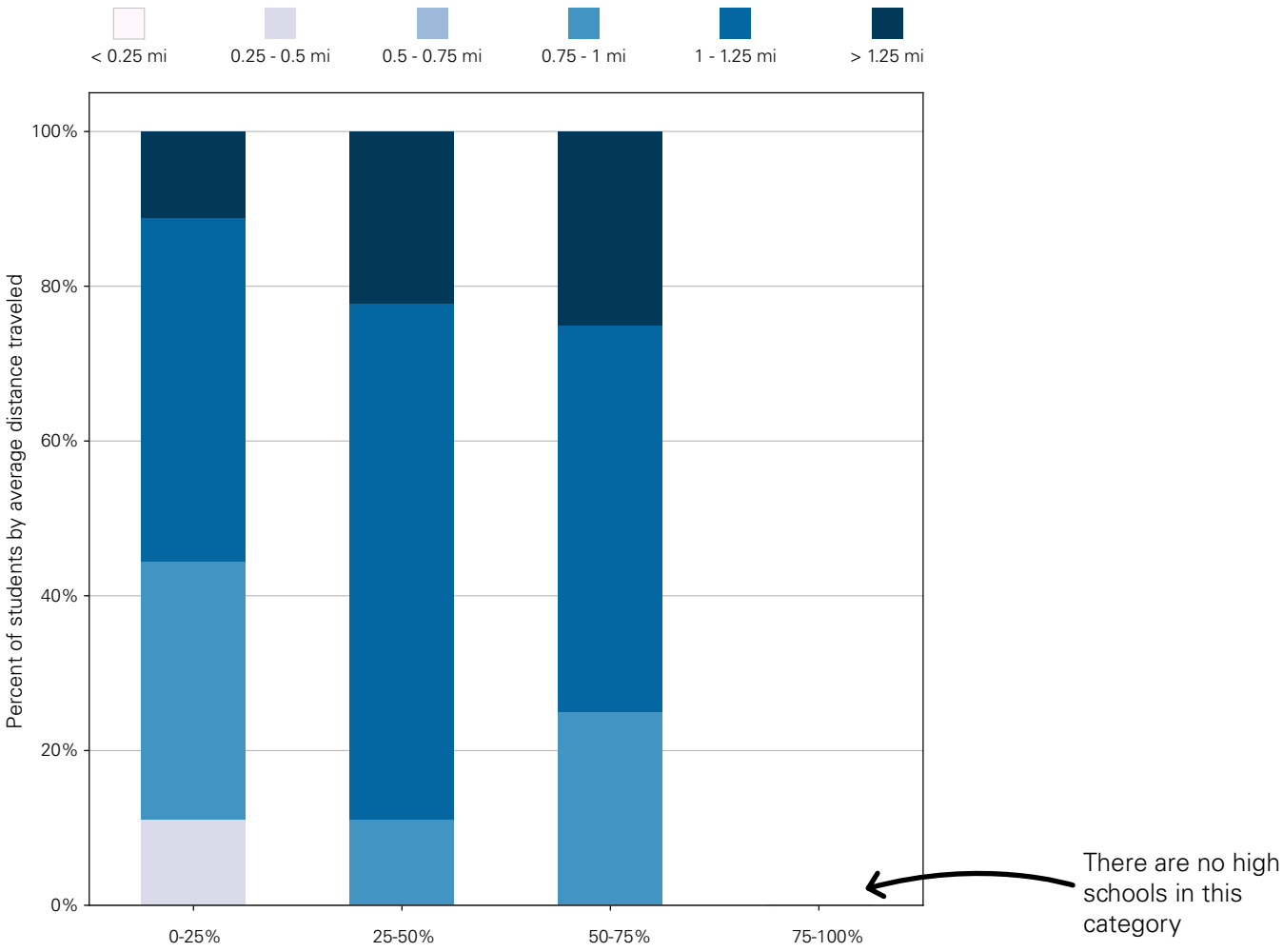


Figure 2.4.23 *Proportion of Students within the Walk Zone (High Schools)*

At the high school level, students in the walk zone generally live further away from school than students at the elementary and middle school levels: at high schools with over 50% of students in the walk zone, the average distance from school is over 0.75 miles.

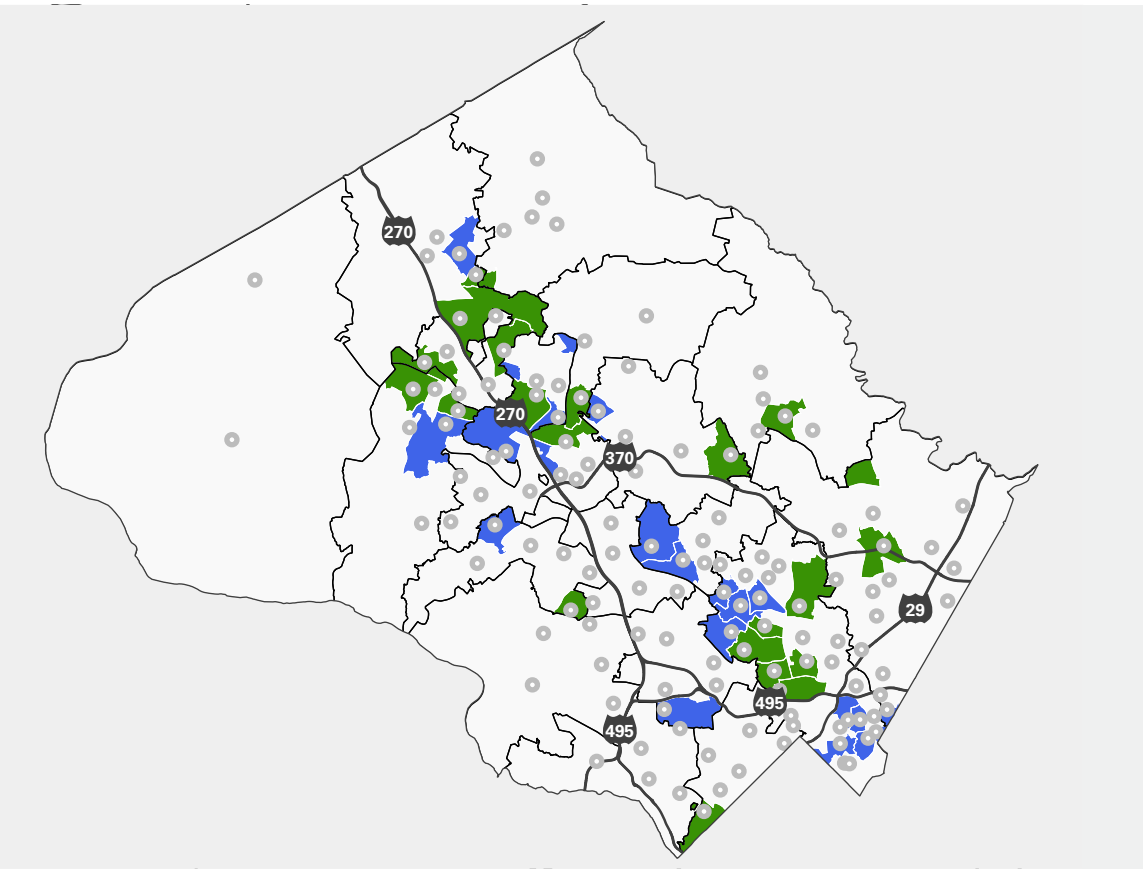


Figure 2.4.24 *Map of Elementary Schools with Over 50% of Students within the Walk Zone.*

The map above shows elementary school attendance areas that have more than 50% of students within the walk zone. Schools in blue are those for which greater than 50% of students live within the walk zone and the average distance to school for these students is less than half a mile. The green schools are cases where more than 50% of students live within the walk zone but are on average more than half a mile away from school.

More than 50% of students who live in the schools shown if blue live within a half mile to school. This suggests that distance may be less of a factor in determining whether students walk to school compared to elsewhere. Schools shown in green also have more than 50% of students within the walk zone, but the average distance from school for these students is over half a mile.

At the middle school level, there are no cases where greater than 50% of students live within the walk zone and less than 0.5mi away on average, while there are eight cases where over 50% of students live within the walkshed and are over half a mile away from school on average. At the high school level, four schools have more than 50% of their students within the walk zone, but these students live on average more than half a mile away from school. Similar maps for MS and HS can be found in **Appendix D8: Walk distance ranges for students with at least 50% of students in walk zone on page 525**.

2.4 Data Analysis
Proximity

C. Special Cases

There are a number of special conditions that may impact our understanding of proximity in MCPS. This includes split and cross-cluster articulation patterns, in which primary students feed into multiple different secondary schools or articulate across cluster lines. Next, many MCPS students choose not to attend their base school as part of MCPS's school choice programs. Additionally, 30% of students districtwide reside within high school consortia and attend consortia schools, in which articulation patterns operate differently than the rest of the county. This section looks at these special conditions in MCPS, through the lens of proximity.

Questions:

How do special conditions in MCPS impact proximity to schools?
What trends can we see between proximity and school choice?
What does proximity to schools look like in the county's two high school consortia, as compared with the rest of the county?
How much farther do choice students travel on average by grade level?

Analyses:

C.1 Split Articulation and Proximity (Elementary to Middle)
C.2 Split Articulation and Proximity (Middle to High)
C.3 Choice and Magnet Programs and Proximity
C.4 Consortia and Proximity

Insights

1. One set of special conditions we explore are different forms of articulation between elementary schools and middle schools, to better understand how they relate to proximity. There are 19 instances in which elementary school students do not all simply articulate to a single middle school within their cluster. And there are six cases of split articulation between middle and high schools.

Among the 25 instances mentioned above, we can observe three types of articulation patterns in the school system today:

a. Inter-cluster articulation: where all elementary school students at a school articulate to a middle school located in a different cluster (this kind of articulation does not take place at the MS to HS level). Ten elementary schools articulate to a middle school in a different cluster, and six middle schools have this kind of articulation pattern.

b. Intra-cluster split articulation: where primary students (ES or MS) articulate to multiple secondary schools but within the same cluster. Five elementary schools in the district articulate this way (at the MS level, this only happens in consortia).

c. Inter-cluster split articulation: where primary students articulate to multiple secondary schools – both in the same and different clusters than that of the primary school itself. Four elementary schools have this kind of articulation pattern, and no middle schools do.

2. In cases where elementary students travel across cluster boundaries to attend a middle school in a different cluster (inter-cluster articulation), the average travel distance is slightly greater than the district average.

Students at these schools travel just slightly farther to school on average (2.3 miles) than the district average of 2.1 miles.

3. In cases of intra-cluster split articulation (where elementary school students travel within cluster boundaries to attend different middle schools), there is not a clear trend between the proportions of students going to each school and the distances traveled.

Although this kind of articulation pattern may impact proximity to school for certain students, there is no clear relationship between intra-cluster split articulation and proximity to schools at the district level. Students at King and Clemente MS, for instance, travel comparable distances to school, and tend to travel less than the districtwide MS average. On the other hand, students at Farquhar MS and White Oak MS travel comparable distances to school, and tend to travel somewhat farther than the districtwide average.

4. Oftentimes, inter-cluster split articulation (where 100% of elementary students at a school articulate to a middle school in another cluster) occurs where

elementary school attendance areas are quite large.

This may be done for a variety of reasons ranging from balancing enrollments based on underlying demographic trends, to ensuring that students attend their closest schools.

5. The Northeast Consortium (NEC) seems to experience greater challenges with proximity than many other areas of the district—consortia or not.

Some factors that underlie this include a high number of island assignment attendance areas, and areas of lower density within the consortia. The Downcounty Consortium (DCC) experiences fewer proximity related challenges, based on factors in this analysis.

6. Choice students travel the farthest to attend the choice program at Poolesville HS. This is the only school where over half of students are choice students from outside of the school's attendance area.

52% of Poolesville HS students are choice students from outside the school's attendance area, and these students travel an average of 11.7 miles to school.

7. Of high school choice programs, Blake HS has the lowest difference in distance traveled between choice and non-choice students.

Choice students at Blake travel an average of 6.1 miles to school, which is 1.27 miles more than their non-choice pers.

8. High school choice students, who choose to attend a school other than their base school travel on an average approximately eight miles.

There are three high schools where more than 10% students attending that school come from outside the cluster. Poolesville (51.66%), Blaire HS (13.61%), and Montgomery HS (20.62%).

9. 39.8% of NEC students, and 30.6% of DCC students do not attend the school closest to where they live.

This places the NEC above and the DCC below the districtwide average of 33.5% students who do not attend their closest school.

10. The school with the highest average distance to school in both consortia is Blake HS, which also has the highest average travel distance in the district.

The average student travels 4.9 miles to Blake HS, which is in the NEC. On the other hand, the lowest average distance to school in both consortia is Wheaton HS in the DCC, where the average student travels only 1.5 miles. This is well under the average of 2.5 miles for high school students across the district.

C1. Split Articulation Patterns and Proximity (Elementary to Middle)

In the standard articulation pattern in MCPS, students move from elementary school, to middle school, to high school within the same high school cluster. However, 19 elementary schools and six middle schools in the county have "split articulations." In these cases, students at an elementary school or middle school do not all attend the same secondary school. In other cases, elementary school students may be assigned to cross cluster boundaries for middle school.

At the elementary to middle school level, we can observe three types of articulation patterns in the school system today:

- **Inter-cluster articulation:** In these cases, 100% of students from an elementary school articulate to a middle school in another cluster. Ten elementary schools articulate to a middle school in a different cluster.
- **Intra-cluster split articulation:** Elementary schools that articulate to multiple middle schools within the same cluster. Five elementary schools in the county articulate this way.
- **Inter-cluster split articulation:** Elementary schools that articulate to multiple middle schools – both in the same and different clusters than the elementary school itself. Four elementary schools have this kind of articulation pattern.

These forms of articulation may have been created over time for a number of reasons—including to balance enrollment at the middle school level. One way to frame the discussion around split articulation and proximity is to ask questions such as: What is the impact of these split articulations on proximity to schools? By sending students across cluster boundaries, or splitting up groups of primary students, does split articulation tend to facilitate more students attending schools closer to home?

In the following maps and tables, we explore the 19 cases of **split and inter-cluster articulation** between elementary and middle schools.

Inter-Cluster Articulation

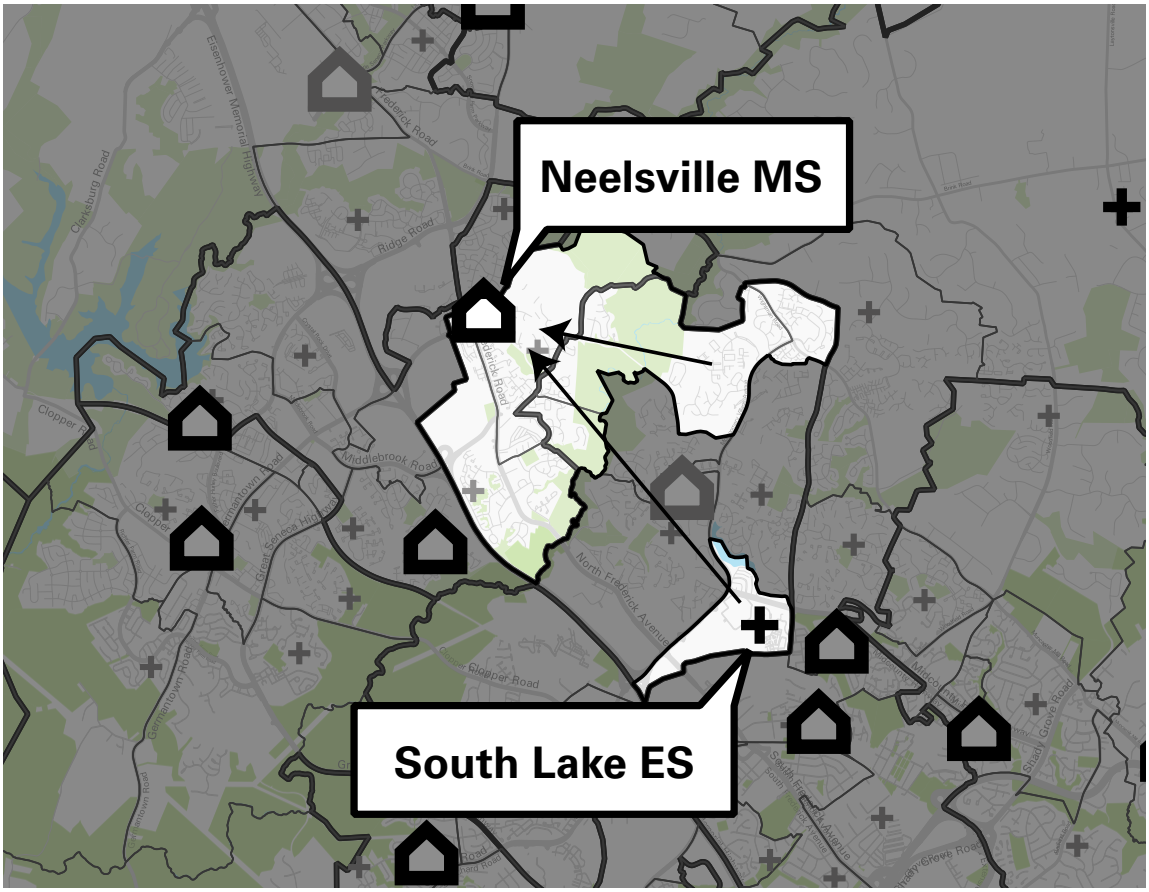


Figure 2.4.25 *Inter-cluster Articulation Example: South Lake ES*

South Lake ES is an example of an elementary school that articulates to a middle school in a different cluster (to Neelsville MS in Clarksburg). As seen in the graphic above, students cross over from the Watkins Mill cluster, to the Clarksburg cluster. These students attend Watkins Mill HS.

The table in **Figure 2.4.26 Inter-cluster Articulation (ES to MS) on page 304** details the cases where all students at an elementary school attend the same middle school in a different cluster. From left to right, the table shows the elementary school, the middle school to which it articulates, the proportion of students at the middle school who attend the school closest to home, and the average distance to school for students.

ES	MS	MS: proportion of students who attend their closest school	MS: avg. distance to school (miles)
South Lake (Watkins Mill)	Neelsville (Clarksburg)	55%	2.73
Clopper Mill (Northwest)	Clemente (Seneca Valley)	38%	1.74
Germantown (Northwest)	Clemente (Seneca Valley)	38%	1.74
Wilson Wims (Clarksburg)	Hallie Wells (Damascus)	69%	1.18
Snowden Farm (Clarksburg)	Hallie Wells (Damascus)	69%	1.18
Sherwood (Sherwood)	Farquhar (Northeast Consortium)	47%	3.14
Brooke Grove (Sherwood)	Farquhar (Northeast Consortium)	47%	3.14
Darnestown (Northwest)	Lakelands Park (Quince Orchard)	31%	2.28
Cold Spring (Wootton)	Cabin John (Winston Churchill)	50%	3.52
Stone Mill (Wootton)	Cabin John (Winston Churchill)	50%	3.52
MS Average		**61%**	**2.2**

Figure 2.4.26 *Inter-cluster Articulation (ES to MS)*

The average distance to school, and the proportion of students for whom their middle school is closest at the receiving middle schools ranges considerably: from 31% for students at Lakelands Park to 67% for students at Hallie Wells, the average distance to school for these schools is 2.4 mi, only slightly higher than the middle school average distance of 2.2 miles.

Middle schools with inter-cluster articulation patterns exhibit a range of proximity values that largely mirror the district as a whole. On average, these middle schools have about 59% of students attending the closest school, as compared to a districtwide average of 61%.

Intra-cluster Split Articulation

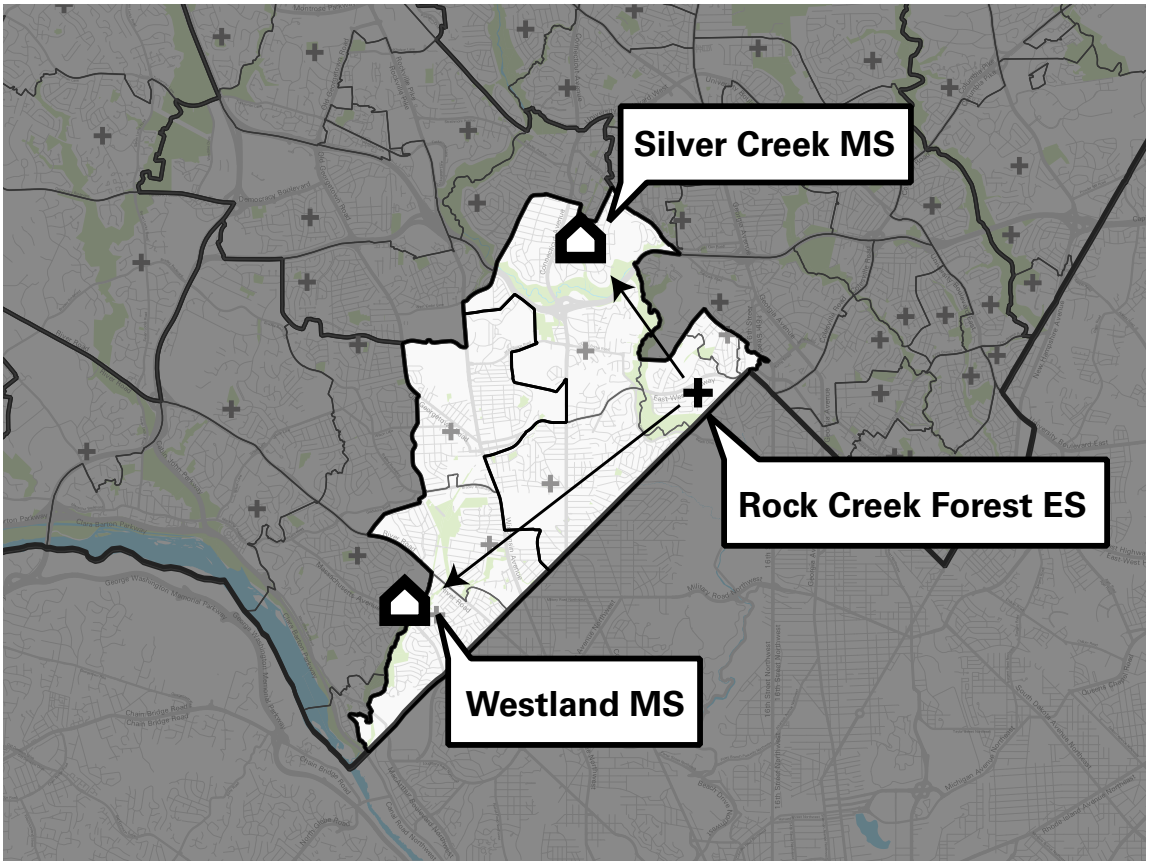


Figure 2.4.27 *Intra-cluster Split Articulation Example: Rock Creek Forest ES*

The graphic above illustrates an example of intra-cluster split articulation. In this case, Rock Creek Forest ES split articulates to two different middle schools: Westland MS and Silver Creek MS. Both of these schools are within the Bethesda-Chevy Chase cluster.

Elementary school	Cluster	Middle schools	% of ES students in MS attendance area	Avg. distance to school for MS
Ride	Seneca Valley	King / Clemente	72% / 28%	1.6 mi / 1.7 mi
Fairland	Northeast Consortium	Briggs Chaney / Banneker	74% / 26%	4.2 mi / 2 mi
Cloverly	Northeast Consortium	Briggs Chaney / Farquhar	80% / 20%	4.2 mi / 3.1 mi
Stonegate	Northeast Consortium	White Oak / Farquhar	57% / 43%	3 mi / 3.1 mi
Rock Creek Forest	Bethesda-Chevy Chase	Silver Creek / Westland	100%/ --	2.6 mi / 2.2 mi
MS Average				**2.2**

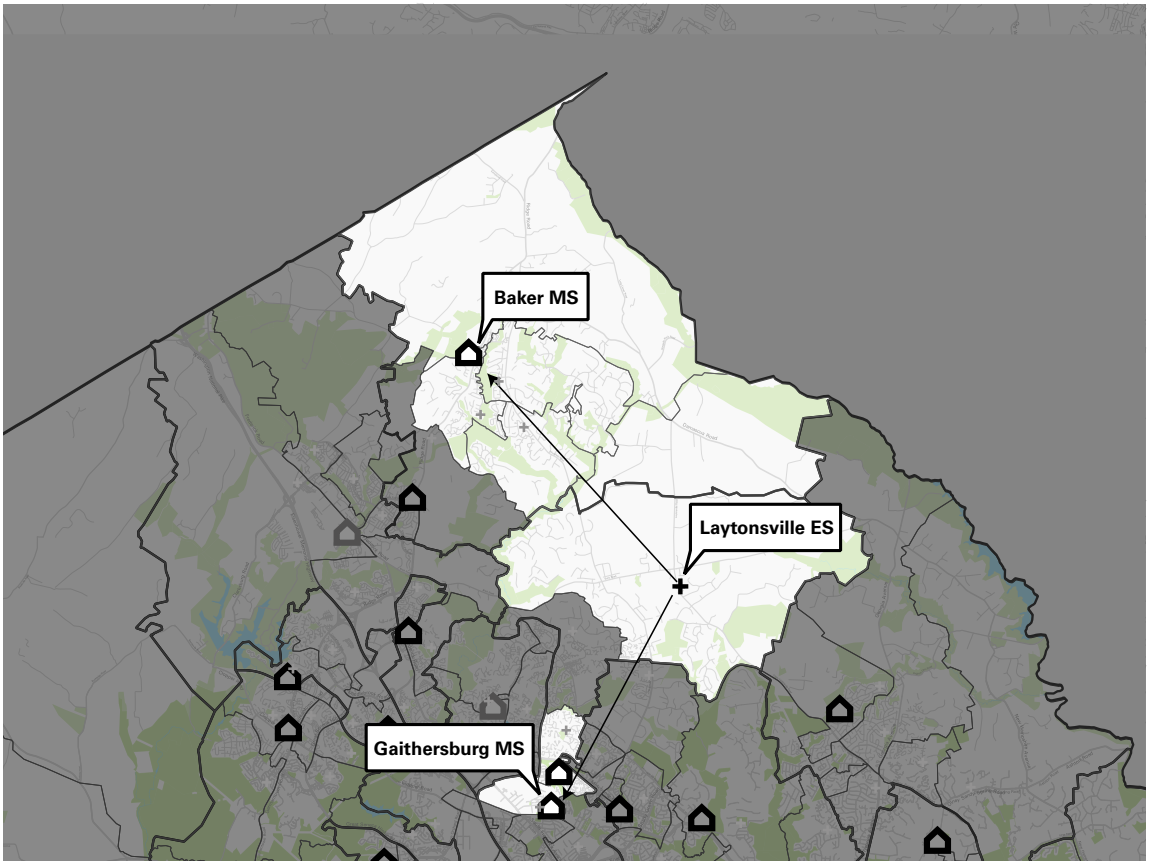
Figure 2.4.28 *Intra-Cluster Split Articulation*

The table in **Figure 2.4.28. Intra-Cluster Split Articulation** illustrates cases where students articulate to multiple middle schools within the same cluster (intra-cluster split articulation).[1] The data in the fourth and fifth columns is split to show the proportion of students at each elementary school that live in each middle school attendance area, and thus what the "split" is between schools.

The fifth column shows the average distance that all students travel to the middle schools in that row. There is not a clear trend between proportions of students going to each school and the distances traveled. Students at King and Clemente MS travel roughly the same distances on average to middle school. On the other hand, students at Briggs Chaney MS travel on average much farther than students at Banneker MS (although this is due in part to the island assignment attendance area of Briggs Chaney).

1 The middle school magnet consortia schools are excluded from this table and are discussed in Subsection III: Special Cases.

Inter-cluster Split Articulation



☐ Cluster boundaries ☐ School attendance areas + Elementary school Middle school

Figure 2.4.29 *Inter-Cluster Split Articulation Example: Laytonsville ES*

At times, inter-cluster split articulation occurs where elementary school attendance areas are quite large. See figure above, which shows Laytonsville ES attendance area in relation to Gaithersburg MS. This kind of articulation pattern may also arise due to the location of middle schools in relation to elementary school attendance areas. The case study above (Laytonsville ES), in particular, demonstrates how split articulation and non-contiguous boundaries can be used to minimize the distance that students travel to attend middle school.

Elementary school	ES cluster	Middle school(s)	% of ES students who live in MS attendance area	Avg. distance to MS	MS cluster(s)
Laytonsville	Gaithersburg	Baker / Gaithersburg	12% / 88%	2.4mi / 2.2mi	Damascus, Gaithersburg
Great Seneca Creek	Northwest	Kingsview / Clemente	34% / 66%	1.3mi / 1.7mi	Northwest, Seneca Valley
Stedwick	Watkins Mill	Montgomery Village / Neelsville	54% / 46%	1mi / 2.7mi	Watkins Mill, Clarksburg
Diamond	Northwest	Lakelands Park, Ridgeview	95%/5%	2.3 mi / 2.3 mi	Quince Orchard
MS Average				**2.2**	

Figure 2.4.30 *Inter-cluster Split Articulation (Elementary to Middle School)*

C2. Split Articulation Patterns and Proximity (Middle and High Schools)

In the standard articulation pattern in MCPS, students move from elementary school, to middle school, to high school within the same high school cluster. However, 19 elementary schools and six middle schools in the district have split articulations.

At the middle to high school level, only one of the three kinds of articulation patterns discussed in Section 3.1 can be seen in the school system today:

- **Inter-cluster split articulation:** In this case, middle schools articulate to two different high schools in two different clusters. Six middle schools have this kind of articulation pattern.

Similar to the elementary to middle school relationship discussed above, this form of articulation may have been created over time for a number of reasons—including to balance enrollment at the high school level. These six instances of split articulation affect the same six clusters that are impacted by split articulations at the elementary to middle school level, indicating that split articulation at one school level begets this kind of articulation at the next level.

In the following maps and tables, we explore these six cases of split articulation between middle and high schools.

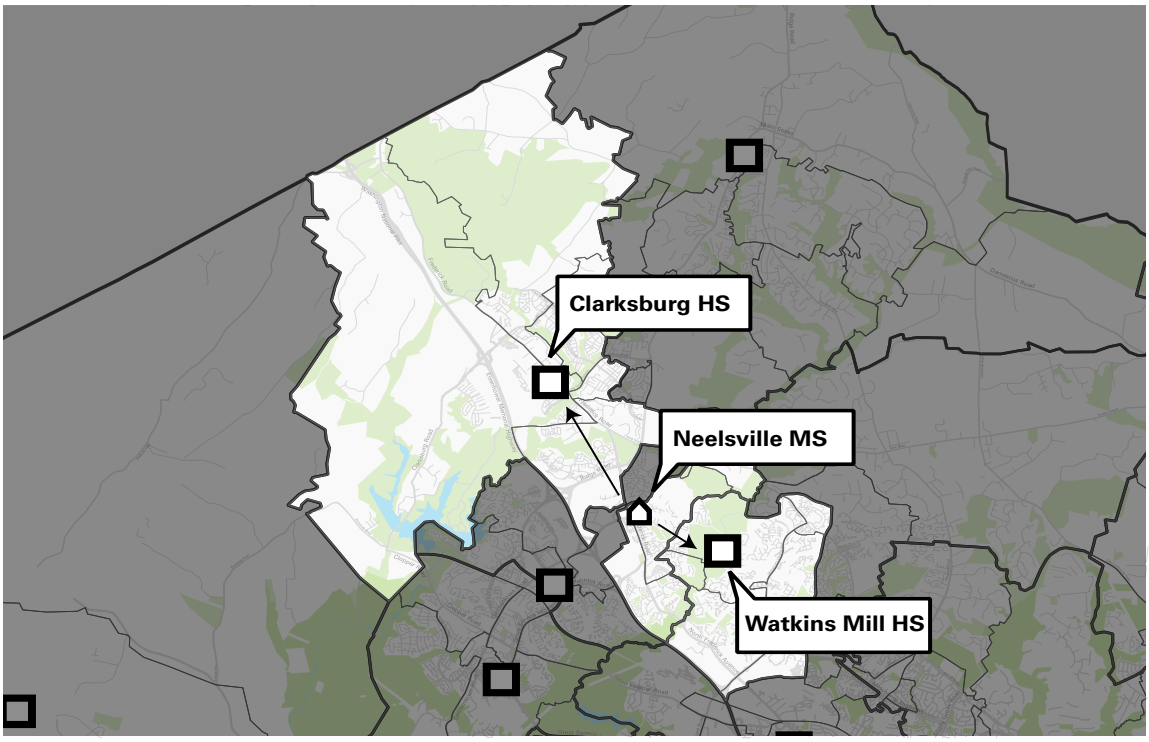


Figure 2.4.31 *Example of Inter-cluster Articulation for Neelsville MS*

The example in **Figure 2.4.31** shows the Neelsville MS attendance area along with the two high schools to which Neelsville articulates: Watkins Mill HS and Clarksburg HS. In the case study above, 51.7% of Neelsville MS students attend Clarksburg HS, while 48.3% attend Watkins Mill HS. As seen in the figure below, students who attend Clarksburg HS travel, on average, 2.5 miles, whereas students who attend Watkins Mill HS travel, on average, 1.9 miles. These averages include students from both of the middle schools that articulate to these high schools in each case, but raise interesting questions about the impacts that split articulation cases such as this may impact the distance traveled to school for high school students.

As with the other five cases of split articulation between middle and high schools, Neelsville MS also receives elementary school students in part through split articulation (in this case from South Lake ES).

Middle school	MS cluster	High schools	% of MS students who live in HS attendance area	Avg. distance to HS for all students at these schools	HS cluster or consortia
Neelsville	Clarksburg	Clarksburg, Watkins Mill	51.7% / 48.3%	2.52mi / 1.94mi	Clarksburg, Watkins Mill
Clemente	Seneca Valley	Northwest, Seneca Valley	65% / 35%	2.25mi/1.51mi	Northwest, Seneca Valley
Hallie Wells	Damascus	Clarksburg, Damascus	65.2% / 34.8%	2.52mi/2.83mi	Clarksburg, Damascus
Farquhar	Northeast Consortium	Sherwood, Blake, Paint Branch, Springbrook	60.8%/39.2%*	3.65mi/4.86mi**	Sherwood, Northeast Consortium
Lakelands Park	Quince Orchard	Northwest, Quince Orchard	32.3% / 67.7%	2.25mi/2.2mi	Northwest, Quince Orchard
Cabin John	Winston Churchill	Winston Churchill, Wootton	57.2%/42.8%	2.83mi/3.2mi	Winston Churchill, Thomas Wootton

*The portion of Farquhar MS that overlaps with Blake HS's service area articulates into Northeast Consortium (not just Blake HS)
** Average distance to Blake HS shown here

Figure 2.4.32 *Inter-cluster Split Articulation (Middle to High School)*

C3. Choice/Magnet Programs

As of the 2019-2020 school year, approximately 9.48% of students across all levels attend a school other than their home school. This number excludes students who reside within a consortium, as well as students enrolled in special education programs outside of their home schools. While some of these students have requested a special change of school assignment through COSA, many attend schools outside of their base schools as part of MCPS's school choice and magnet programs.

How much farther do choice students travel on average than other students in MCPS? What proportion of students at schools with choice programs travel from outside the attendance area for these programs? The table below begins to explore these questions at the high school level.

High School	% choice / outside attendance area*	Avg. distance traveled by students in attendance area	Average distance traveled by choice students	Difference in distance between choice and non-choice
Poolesville	51.66%	2.01	13.73	11.72
Blair	13.61%	2.41	9.64	7.23
Einstein	2.50%	2.01	8.63	6.62
Montgomery	20.62%	1.97	7.40	5.43
Springbrook	1.52%	3.27	8.65	5.38
Kennedy	2.69%	2.67	5.77	3.09
Watkins Mill	4.31%	1.94	4.34	2.39
Average		**2.32**	**8.31**	**5.98**
HS County Average		**2.5**		

*These are students whose base school Is different from their current school and who live outside of their current school's attendance area. It does not include COSA transfer students or special education students. For Einstein HS Kennedy HS, and Blair HS, these numbers only include enrolled students who reside outside of the Downcounty Consortium.

Corresponding tables for the ES and MS levels are available in **Appendix D9: Choice and Magnet Programs on page 527** .

Figure 2.4.33 *Proximity and School Choice (High Schools)*

C4. Consortia

How does proximity compare between consortia and the district as a whole?

Consortia	Average ES Distance to School (mi)	Average MS Distance to School (mi)	Average HS Distance to School (mi)	% of students whose current school is not their closest school
DCC	0.94	1.38	2.13	30.6%
NEC	1.41	2.94	3.32	39.8%
District (including consortia)	**1.2**	**2.2**	**2.5**	**33.5%**

Figure 2.4.34 *Proximity for Consortia Students*

The table above shows some of the key proximity statistics we have reviewed earlier in this chapter, taking the two high school consortia as a special case. Given the unique circumstances of school articulation in these schools, we compare these values with hopes of seeing how proximity to schools compares between consortia and the district as a whole.

Students across school levels in the Downcounty consortia travel, on average, smaller distances than the average student in MCPS and are more likely to attend the school closest to where they live. On the other hand, students in the Northeast consortia travel greater distances to school than the average MCPS student and are significantly less likely to attend their closest school.

One underlying factor behind this discrepancy is the number of island assignments in the Northeast Consortium (5 ES, 3 MS, 2 HS), and areas of low population density within the consortium. The Downcounty Consortium is more densely populated and has fewer island assignments at the MS and HS levels (6 ES, 1 MS, 1 HS).

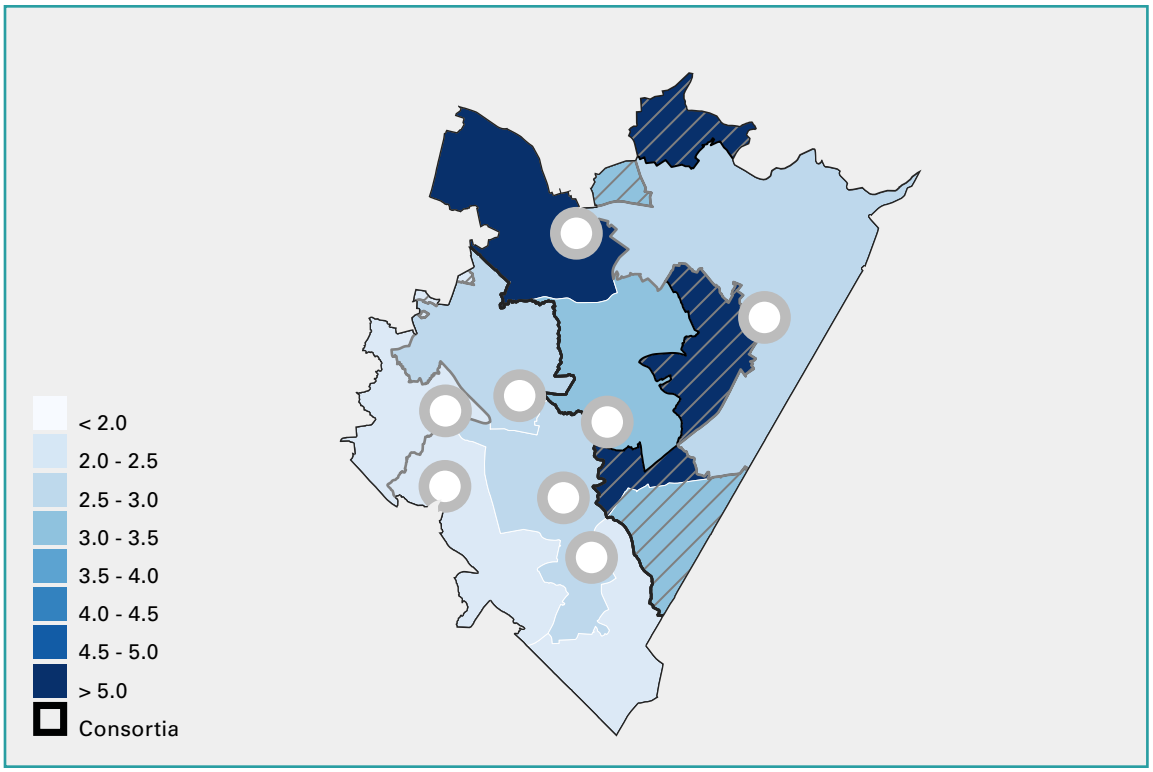


Figure 2.4.35 *Distance to School Among Consortia High Schools*

Above, we see a map of proximity to schools of high schools within the two consortia. Whereas elsewhere in this chapter, consortia are treated as one cluster in comparisons of other high school clusters—here we seek to gain a better understanding of how schools within the consortia compare to one another.

The school with the highest average distance to school in both consortia is Blake HS in the NEC, at 4.9 miles. Blake HS has the highest average travel distance in the county.

The lowest average distance to school in both consortia is Wheaton HS in the DCC, where the average student travels only 1.5 miles. This is well under the average of 2.5 miles for high school students across the county.

Further Inquiry

These analyses of proximity reveal several initial insights about the current conditions of school boundaries, assignment patterns, student proximity to schools, and district-provided transportation in MCPS. There are many possible directions for further inquiry, including but certainly not limited to the list below.

Directions for further inquiry:

- Analysis of historical changes in walk zones, bus ridership, and distance to school
- Further analysis of residential densities in relation to school locations
- Walk zone and land use patterns, including socioeconomics as a factor in walkability
- An analysis of roadway types and proximity
- Analysis of bus route scheduled duration and distance[1]
- Analysis of distances between students and bus stops

In addition to the directions above, there is ample opportunity for analysis of the interrelatedness of the key lenses in this report: utilization, diversity, proximity, and assignment stability. Future stages of this comprehensive boundary analysis will focus on the interconnected aspects of these four lenses.

1 Pending available data.