Analysis of Current Building Capacity Calculation Methods

Key Findings

1. MMSD's current building capacity calculation methods are similar to those used by other school districts.
2. There is no single "best" or "most common" capacity calculation method used by other school districts.
3. Changing the district's capacity factors (students allowed per room) and lowering the district's current target capacity for middle and high schools from 90% capacity to 80% capacity would provide a more accurate estimate of our schools' student capacities and bring MMSD practices closer in line with those used in other school districts.

Background

School districts routinely calculate the number of students each of their school buildings can accommodate. This practice illustrates which schools are overcrowded or underutilized, and it assists districts in making decisions related to programming, school boundaries, and future construction projects. Building capacities are fluid, depending on the programming offered at a school and its current configuration of rooms. In MMSD, these capacity determinations are used primarily for making internal transfer decisions and prioritizing building projects.

This report explores the following three questions:

1. How does MMSD currently calculate school building capacity?
2. What capacity calculation practices are recommended by research and used in other school districts?
3. What changes should MMSD make to its capacity factors and capacity calculation methods to bring them in line with best practices?

Data and Methods

This report uses district data on enrollment, classroom capacity, and building dimensions as well as room use information collected from school principals. In answering Question 1, we reviewed MMSD capacity reports and discussed the methods with the responsible Research & Program Evaluation Office analyst.

In answering Question 2, we sampled common capacity calculation methods from other school districts, architecture firms that work on K-12 buildings, and academic literature. Specifically, we examined two types of school districts: Wisconsin districts and the largest districts in the country. The Wisconsin districts include: Verona, Middleton-Cross Plains, Waunakee, Marshall, Monona Grove, Sun Prairie, McFarland, Shorewood, Waupun, Platteville, Ripon, Green Bay, and Milwaukee. The remaining districts we sampled were Chicago, New York, Philadelphia, Atlanta, Montgomery Co., Fairfax Co., Austin, Newark, Seattle, and Baltimore. This provided both a local and national account of common capacity calculation methods.

Correspondingly, we sampled methods from both local architecture firms and the largest firms in the country. The two local firms were Eppstein Uhen Architects and Plunkett Raysich Architects. EUA provided the calculations for Verona, Shorewood, Middleton-Cross Plains, Waupun, Waunakee, Marshall, and Monona Grove. PRA provided the calculations for Sun Prairie, Platteville, McFarland, Ripon, and Green Bay. We also examined the methods of Cropper-GIS and Fanning Howey. We collected all information from publicly published reports, and we followed up with interviews with two architecture firms and three school districts. Academic literature was sought out, but we found nothing authoritative relating specifically to best capacity calculation methods.

In answering Question 3, we split the question into two parts. First, we examined our current capacity factors (students allowed per room) to determine if they should be changed. These capacity factors describe only how many students would be allowed to sit in each homeroom and do not refer to the district's preferred class sizes. Second, we applied the four most common methods used by other school districts and architecture to MMSD enrollment, capacity, and building dimension data. These simulations demonstrated how different school capacity percentages would be if MMSD

adopted a new calculation method. We then evaluated the options based on how well each met three goals considered important to MMSD:

1. ***The method is easy to use, explain, and understand.*** This goal considers if we already have or collect the necessary data, how easy it would be for RPEO to explain the method, and if a principal could easily understand their school's calculation after reading RPEO's explanation.
2. ***The method is both precise and flexible.*** Components of accuracy include being sensitive to changes in room use, considering the realities of the scheduling difficulties at the middle and high school levels, and considering square foot per student recommendations.
3. ***The method gives us actionable and reasonable results.*** The method chosen should show differentiation among schools in order to be useful to the district, and it must help officials prioritize over-capacity buildings. The results of the simulated capacity percentages factor into this goal.

Findings

Question 1: How does MMSD currently calculate school building capacity?

In MMSD, the School Capacities Fall 2016 report (2016-11-4) is completed by the Research & Program Evaluation Office (RPEO). The annual report, published each fall, outlines the number of students each school can serve in its current configuration and the school's current and future (five-year) operating capacity percentages. The report flags schools with an operating capacity above 90%. It does not address the quality of the facilities, how schools schedule their rooms, or if schools are using their space in the most optimal way. Principals self-report room usages for their school, and the information is checked by RPEO and the Chief of Schools Office.

In the report, MMSD uses two separate capacity calculation formulas – one for elementary schools and one for middle and high schools. For elementary schools, capacity is calculated by multiplying the current number of homerooms by the number of students allowed to sit in a homeroom. The number of homerooms is calculated by counting the number of well-ventilated rooms that are 500 square feet or larger and are not a library, gymnasium, auditorium, or cafeteria. Then, rooms not used for primary K-5 instruction (e.g. art, music, OT/PT, strings, and 4K) are subtracted to arrive at the total number of available homerooms. For a school's final capacity calculation, the number of available homerooms is multiplied by the school's capacity factor, or the number of students who can sit in a homeroom. These capacity factors describe only how many students would be allowed to sit in each homeroom and do not refer to the district's preferred class. Put differently, it is a "desks per classroom" factor, not a "students per teacher" factor.

This number can range from 17 to 24.67 students and depends on the grades the school serves and if the school is in the Achievement Gap Reduction (AGR) program. AGR schools are allowed to utilize smaller class sizes in their effort to close the math and reading achievement gaps for their low-income students. Table 1 describes MMSD's capacity factors.

Table 1: Current Capacity Factors

Type	Capacity Factor
AGR (formerly SAGE) K-5	19.67
AGR K-2	17
AGR 3-5	22.3
Other K-5	22.33
K-2	20.67
3-5	24.67
Middle Schools	18
Conventional High Schools	23
Shabazz	21

For middle and high schools, capacity is calculated by multiplying the current number of rooms by the capacity factor. Rooms include instructional spaces and gyms. Since room use at the middle and high school levels is highly variable, the calculation makes no adjustment based on how the room is being used during the current year.
Finally, RPEO provides supplemental capacity information to the school board that includes a "maximum homeroom capacity" for each elementary school, which calculates what the capacity of each school would be if they were using their maximum homeroom configuration. A school's maximum homeroom estimate is arrived at by starting with the total number of possible K-5 classrooms and then subtracting 4K classrooms and four additional rooms (art, music, OT/PT, and one room whose use is determined by the school). For a school's final maximum homeroom capacity, the number of maximum homerooms is multiplied by the capacity factor. This measure of capacity demonstrates the maximum possible capacity of a school assuming the continued presence of art, music, OT/PT, and one additional room for a non-homeroom use, not just the capacity of the school as it is currently configured. Unlike the current configuration capacity, the maximum homeroom capacity is relatively stable and would only be changed by remodeling, construction, or a change in a school's number of 4K rooms.

Summary for Question 1

MMSD's Research and Program Evaluation Office calculates school capacity and reports it annually. The primary report uses two formulas – one for elementary schools and one for middle and high schools. The elementary formula takes the current number of homerooms in a school and multiplies it by the school's capacity factor (students allowed per room). The middle and high school formula takes the number of instructional spaces and gyms and multiplies it by the school's capacity factor. The target operating capacity for all schools is 90%. Finally, RPEO also calculates a maximum capacity for each elementary school that is detailed in a supplemental report.

Question 2: What capacity calculation practices are used in other school districts?

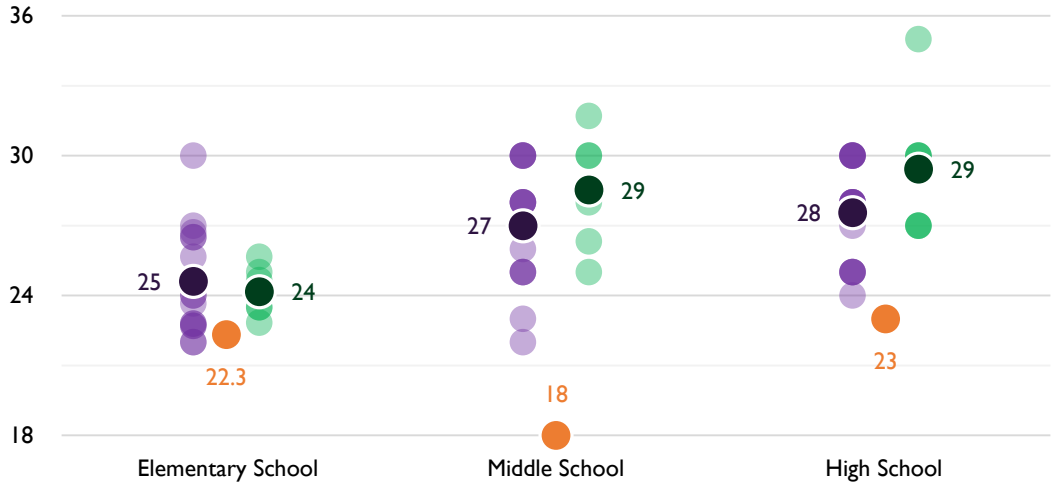
Many Wisconsin school districts hire an outside firm to complete their capacity calculations, while larger school districts tend to use their own research department or facilities department. The most basic capacity calculation methods count the number of classrooms in a school and multiply this by the number of students allowed to sit in a room. However, districts differ in how many students they allow to sit in a class, how they count classrooms, how they treat not-core classrooms and what additional information they include in their calculations (e.g. square footage of the room, square footage of the building, restrictions caused by scheduling, and different classroom capacities for different types of classes). Most of the researched districts' methods are a combination of the methods and adjustments described below, and some calculate capacity in multiple ways in an attempt to get a more complete picture of their school buildings. A summary of these industry practices can be found in Appendix A.

Capacity factors

Districts often set guidelines called capacity factors, establishing how many students are allowed to sit in a classroom. These factors usually vary by grade level, class type, and if the classroom is used for special education rooms. Additionally, many districts set lower capacity factors for high-poverty schools.

Figure 1 illustrates the range of the average capacity factors (not including special education, elective, low-income, or pre-K rooms) for the districts studied. The graph is broken down by school type and where the district is located. Darker areas of the spreads are points where multiple schools fall. The Dane County school districts are represented in green, and the averages are shown in outlined dark green dots. These include Verona, Middleton-Cross Plains, Waunakee, Monona Grove, Marshall, Sun Prairie, and McFarland. The other districts are represented in purple, and the averages are shown in outlined dark purple dots. These include Shorewood, Waupun, Platteville, Ripon, Green Bay, Milwaukee, Chicago, New York, Philadelphia, Atlanta, Montgomery Co., Fairfax Co., Austin, Newark, Seattle, and Baltimore. MMSD's capacity factors are represented in orange: 22.3 for elementary schools, 18 for middle schools, and 23 for high schools. MMSD's capacity factors fall at or near the bottom of all three spreads.

Figure 1: Range of capacity factors for standard rooms



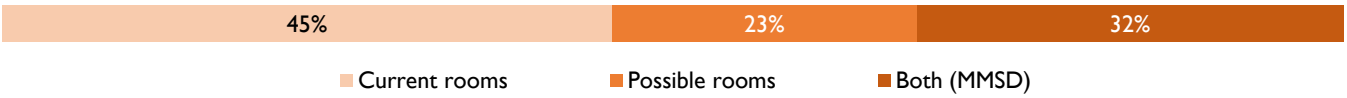
Rooms Included in the Calculations

Districts most commonly count classrooms in two ways. They count the rooms currently used as classrooms or count all rooms that have the potential to be used as classrooms. Most districts that count all potential classrooms make adjustments elsewhere in their formulas to make the estimate more reflective of how school buildings are used.

Districts that only count the rooms currently used as classrooms include Atlanta, Fairfax County, Austin, and Newark. Districts that count all rooms that have the potential to be used as classrooms include Milwaukee, Chicago, New York City, Philadelphia, and Baltimore. Some districts either do not specify how they count their rooms or they provide the results of both methods.

The chart below illustrates how the school districts and firms researched counts classrooms. It shows that most districts consider a room a classroom and count it if it is currently being used as a classroom. MMSD performs calculations using both methods of room counting.

Figure 3: Rooms counted



Usage Adjustments and Target Capacities

Some districts adjust their calculation methods to account for scheduling difficulties, variations in class sizes, variations in programming, and teachers' planning periods. They do this either by applying a "usage adjustment" to their final capacity number or by setting a "target capacity." Usage adjustments are usually described as adjustments made to account for the reality that, during the course of a day, classrooms occasionally sit empty either because of scheduling challenges or teachers' planning periods. Target capacities are usually described as an ideal operating capacity that allows for flexibility throughout the school year. Unfortunately, these definitions are not uniform, districts identify multiple reasons for using both, and they are occasionally used interchangeably. In this report, usage adjustments and target capacities are discussed together because, ultimately, both decrease the number of students the district thinks a school building can serve comfortably.

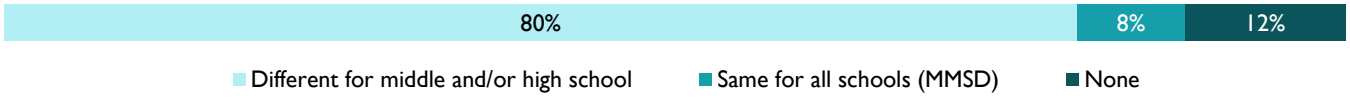
Usage adjustments and target capacities are used more frequently at the middle and high school levels, but some districts and architecture firms include them in elementary school calculations as well. Middle and high schools tend to have significant scheduling difficulties to consider, so they often receive bigger adjustments. Typical usage adjustment factors range from 0.75 to 0.9 (with 0.8 and 0.85 being the most common), meaning capacity estimates are reduced by between 10% and 25%. Typical target capacities range from 80%-105% (with most falling between 80% and 90%).

When districts and architecture firms use usage adjustments, they decide on the size of the adjustment in one of three ways. The first way is to count the number of periods a school's schedule contains, assume rooms will be empty for one or two of them, and apply this rate to all rooms. For example, a school with an 8 period day would apply a usage adjustment factor between 0.75 and 0.88 to all rooms. The second way some districts select the size of the adjustment is to choose what they consider to be an "optimal" utilization rate and apply it to all rooms. The final way districts determine usage adjustments is to determine each room's actual utilization on a typical day. Plunkett Raysich Architects uses this method, noting how many periods each specific room is used and applying the resulting rate to that room.

School districts that use usage adjustments and/or target capacities include Milwaukee, New York City, Philadelphia, Atlanta, Montgomery County, Fairfax County, Austin, Newark, Seattle, Baltimore, and districts using Plunkett Raysich Architects or Eppstein Uhen Architects. Representatives from Montgomery County Public Schools, Eppstein Uhen Architects, and Plunkett Raysich Architects noted the importance of applying a special usage adjustment factor or target capacity to middle and high schools to account for the flexibility needed at these levels to accommodate scheduling challenges, variance in class sizes, specialized classes (e.g. applied technology), and teacher planning time.

The chart below illustrates how the school districts and firms researched applied usage adjustments or target capacities. It shows that most districts studied do apply a usage adjustment or target capacity, and most apply a special adjustment to their middle and/or high schools. MMSD uses the same target capacity (90%) for all schools.

Figure 4: Type of usage adjustment or target capacity

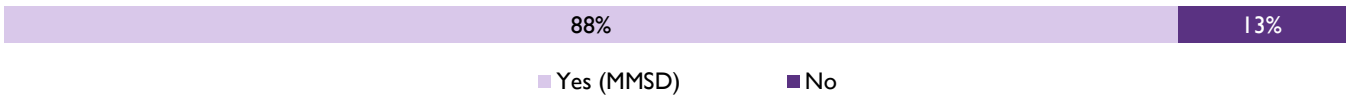


Treatment of Non-Core Classrooms

Most districts treat non-core classrooms (e.g. music and art) differently than core classrooms. These rooms are often either excluded from the count of classrooms or assigned a different classroom capacity. School districts that treat non-core classrooms differently include Milwaukee, Chicago, New York City, Atlanta, Fairfax County, Austin, Seattle, Baltimore, and districts using Plunkett Raysich Architects, Eppstein Uhen Architects, or Cropper-GIS.

The chart below illustrates how the school districts and firms researched treated non-core classrooms. It shows that the formulas used by most districts treat non-core classrooms differently from core classrooms. MMSD treats non-core classes differently.

Figure 5: Treats non-core rooms differently



Classroom Square Feet

Architecture firms often calculate capacities based on the square footage of each classroom in a school. To arrive at a school's capacity, a room's square footage is divided by the recommended per student square footage. The resulting number is the capacity of that room. The process is repeated for all rooms, and the room capacities are summed to arrive at the building capacity. Either the firm has a recommended square footage per student they use or the district has set these guidelines in advance. For example, Eppstein Uhen Architects uses 55 sq. ft. per kindergarten student, 35 sq. ft. per elementary student, and 30 sq. ft. per middle and high school student. Recommendation for a typical classroom range from 30-55 square feet per student, depending on the grade of the student.

Some districts do not use classroom square feet as the primary determinant of a room's capacity but still consider room size when calculating capacity. For example, Newark Public Schools calculates a classroom's capacity using state class-

size standards but adjusts the capacity downward if the classroom is smaller than the state recommends. Overall, Newark Public Schools and districts using Eppstein Uhen Architects or Fanning Howey consider classroom square footage in their capacity calculations.

The chart below illustrates how the school districts and firms researched considered classroom square footage. It shows that over half of districts do not consider classroom square footage in their capacity calculations. MMSD does not consider classroom square footage in it calculations.

Figure 6: Considers classroom square footage

Gross Building Square Feet

Eppstein Uhen Architects is one of the few firms studied that included a capacity calculation based on the gross square footage of the school building. This is one of three capacity calculations they report, and they note it should be used as a baseline estimate only. The most significant weakness of this method is that two schools with the same number of identically-sized classrooms can end up with different capacity results if one has particularly small or large auxiliary facilities (e.g. gymnasiums, cafeterias, and auditoriums). EUA has provided this and their other two estimates to a number of districts in Wisconsin, including Middleton-Cross Plains, Shorewood, Waupun, Verona, Waunakee, and Marshall. When deciding how many gross square feet students in different types of schools need, EUA considers industry standards and 15-year trends in Wisconsin school building size. In their most recent publicly available report (Shorewood School District), EUA allots 150 sq. ft. per elementary student, 180 sq. ft. per middle school student, and 230 sq. ft. per high school student.

Additionally, Austin Independent School District calculates school capacity based on gym size and cafeteria size as supplements to their standard capacity calculations. We categorize this as a district that considers building square footage.

The chart below illustrates how the school districts and firms researched considered building square footage. It shows that most districts do not consider building square footage in their capacity calculations. MMSD does not consider classroom square footage in it calculations.

Figure 7: Considers building square footage

Summary for Question 2

There is no clear "best" or "most common" capacity calculation method, though some trends do appear. Most districts consider a room a classroom if it is currently being used as one; most apply a special usage adjustment or target capacity to their middle and high schools; most treat non-core classrooms differently; just over half do not consider classroom square footage; and most do not consider building square footage. MMSD's practices align with most of these trends, however, it does not apply a special usage adjustment or target capacity to their middle and high schools.

Question 3: What changes should MMSD make to its capacity factors and capacity calculation methods to bring them in line with best practices?

Below, we consider each part of this question separately. First, we consider changes to the capacity factors (students allowed per room) used in the capacity calculation methods. We examine the options, discuss the options, and make a final recommendation. Second, we consider changes to our capacity calculation methods following the same format: examining the options, discussing the options, and making a final recommendation.

Consideration #1: Capacity Factors

Capacity factors describe how many students can sit in a classroom, and are used by all 25 districts studied for this report. In MMSD, these factors are used to calculate building capacity, make internal transfer decisions, and prioritize building projects; they do not necessarily reflect the district's preferred class sizes. As noted earlier, it is a "desks per classroom" factor, not a "students per teacher" factor. MMSD's capacity factors are lower than the average capacity factors used by other districts, particularly at the middle and high school levels. MMSD could adjust the capacity factors to bring them more closely in line with MMSD school board policy and the practices of other districts.

The new capacity factors would be based on the section (class) capacity numbers MMSD uses to make Internal Transfer decisions. This is a logical source because, when making Internal Transfer decisions, the district looks first at a school's capacity and second at the capacity of the school's pertinent sections. Thus, it would be natural for both calculations to use the same capacity factors.

Tables 2 and 3 show how the two options, the current factors and the proposed factors, compare. The proposed elementary capacity factors are rounded averages based on the internal transfer section capacity numbers and the type of school. The middle school capacity factor is applied to conventional high schools to maintain consistency across secondary schools and keep the proposed capacity factors similar to those of other school districts.

Table 2: Current capacity factors

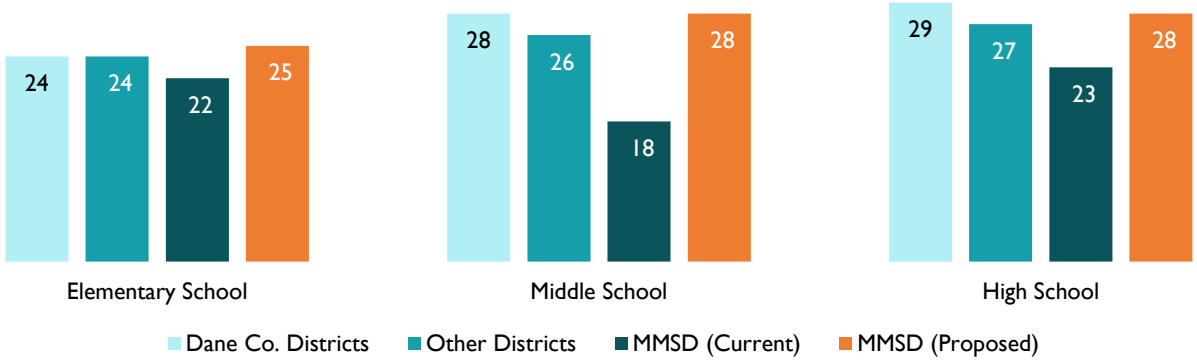
School Type	Capacity Factor
AGR (formerly SAGE) K-5	19.67
AGR K-2	17
AGR 3-5	22.3
Other K-5	22.33
K-2	20.67
3-5	24.67
Middle Schools	18
Conventional High Schools	23
Shabazz	21

Table 3: Proposed capacity factors

School Type	Capacity Factor
AGR (formerly SAGE) K-5	22
AGR K-2	19
AGR 3-5	24
Other K-5	25
K-2	23
3-5	27
Middle Schools	28
Conventional High Schools	28
Shabazz	21

Figure 8 illustrates how the proposed factors for standard (non-AGR/SAGE) classrooms would compare to the average capacity factors of other districts in Dane County and across the country. It shows that the proposed factors are far more similar to those of other districts than MMSD's current factors, particularly at the middle and high school levels.

Figure 8: Proposed capacity factors (for standard rooms) compared to other districts



Recommendation: Implement New Capacity Factors

Using the existing factors would provide consistency between past and future capacity calculations, and the substantial change in the middle and high school factors will significantly affect these school's capacity determinations. However, the new factors more closely align with the factors used by other school districts, and we believe the proposed capacity factors will provide more realistic results. **We recommend the district use the new capacity factors proposed in Table 3 in all future capacity calculations.**

Consideration #2: Adjusting the Current Calculation Method

After determining the new capacity factors, we consolidated the most common approaches not currently being used by MMSD into four alternative methods. Then, these options were applied to MMSD enrollment, capacity, and building dimension data to demonstrate how different school capacity percentages would be if MMSD adopted a new calculation method or supplemented its current method with a new one.

Each option and its effect on MMSD school capacity percentages is described below. These effects ultimately help us determine how reasonable and actionable each method is. The capacity calculations for MMSD schools under each option can be found in Appendix B, and the formulas used for each method can be found in Appendix C.

Status Quo: No change – As described earlier, MMSD currently uses one capacity formula for elementary schools and another for middle and high schools. For elementary schools, the number of rooms currently used as classrooms are counted, and the number of rooms used for other activities (e.g. music, art, and 4K) is subtracted. This classroom count is multiplied by the school's current capacity factor to arrive at the school's student capacity. For middle and high schools, student capacity is determined by counting the number of instructional spaces and gyms and multiplying that number by the school's capacity factor. Schools of any level are flagged if they are above 90% capacity. For the 2016-2017 school year, 21 schools were identified as being above ideal capacity, and one school was identified as being over 100% capacity.

Option 1: New capacity factors only – Option 1 maintains the current calculation methods and only changes the capacity factors to those discussed in the previous section and listed in Table 3. When Option 1 is applied to MMSD's 2016-2017 data, two buildings are identified as being above ideal capacity, and no buildings are identified as being over 100% capacity.

Option 2: New capacity factors and target capacities – Option 2 maintains the current capacity calculation methods (with the new capacity factors) but flags middle and high schools as "above ideal capacity" if they are above 80% capacity instead of 90% capacity. Based on the practices of other districts, this is a typical target capacity for middle and high schools, and it recognizes the scheduling difficulties present at these levels. When Option 2 is applied to MMSD's 2016-2017 data, two buildings are identified as being above ideal capacity, and no buildings are identified as being over 100% capacity.

Option 3: New capacity factors and usage adjustment factors for middle and high schools – Option 3 maintains the current capacity calculation methods (with the new capacity factors) for elementary schools. For middle and high schools, each school would have its new student capacity factor multiplied by a usage adjustment factor. The school's usage factor would represent each room being unscheduled for one period of the day. For example, West High School uses an eight-period schedule, so its usage factor would be 7/8, or 0.88. These factors would range from 0.75 for La Follette High School to 0.88 for West High School and a number of middle schools. As the district does now, schools of any level would be flagged if they were above 90% capacity. This option effectively makes two downward adjustments to what we consider to be the ideal capacity for middle and high schools: the first is the usage adjustment factor and the second is the 90% target capacity. When Option 3 is applied to MMSD's 2016-2017 data, two buildings are identified as being above ideal capacity, and no buildings are identified as being over 100% capacity.

Option 4: Capacity by gross square feet – Option 4 offers a perspective of school capacity that is significantly different than that offered by the first two options and the status quo. Calculating capacity by a building's gross square footage can offer insight into the sufficiency of all the spaces a student comes in contact with during the day, including gyms, auditoriums, cafeterias, and hallways. We selected capacity by gross square feet as an option instead of capacity by classroom square feet because MMSD does not currently have classroom size information for all rooms in all schools.

This option would use the gross square feet per student as suggested by Eppstein Uhen Architects in its most recent capacity report (Verona Area School District): 150 sq. ft. per elementary student, 180 sq. ft. per middle school student, and 230 sq. ft. per high school student. A building's capacity would be its gross square footage divided by the recommended gross square feet per student. For example, the capacity by gross square foot for Allis Elementary School would be 82000/150, or 547 students. As the district does now, schools of any level would be flagged if they were above 90% capacity.

MMSD has a number of instances where two schools share one building. In these situations, the two gross square feet per student recommendations would be averaged. Buildings that house an elementary and middle schools would allot 165 sq. ft. per student, and buildings that house a middle and high school would allot 205 sq. ft. per student. This approach was used instead of calculating each sharing school's capacity based on the gross square footage of the building they use. While each school has its own space within a shared building, some rooms, hallways, and storage areas may be used by both programs. Using an average sq. ft. per student allotment provides a general picture of the building's capacity.

When Option 4 is applied to MMSD's 2016-2017 data, five buildings are identified as being above ideal capacity, and 21 buildings are identified as being over 100% capacity. These results are significantly different from the status quo and the first two options because those calculations rely on a pre-determined class size and do not account for the physical size of classrooms or ancillary spaces. Thus, a school with small classrooms and/or supplemental spaces may be determined to be at ideal operating capacity according to the current methods but over capacity once we consider the small size of the building's spaces. Similarly, a school with large classrooms and/or supplemental spaces may be determined to be over ideal operating capacity according to the current methods but at ideal capacity once we consider the large size of the building's spaces.

In making our second recommendation, we first considered how each option would change how many schools the district considers above ideal capacity as well as the district's average building capacity estimation. Table 4 summarizes these findings and allows us to begin to compare the options.

Table 4: Summary of effects of capacity calculation options

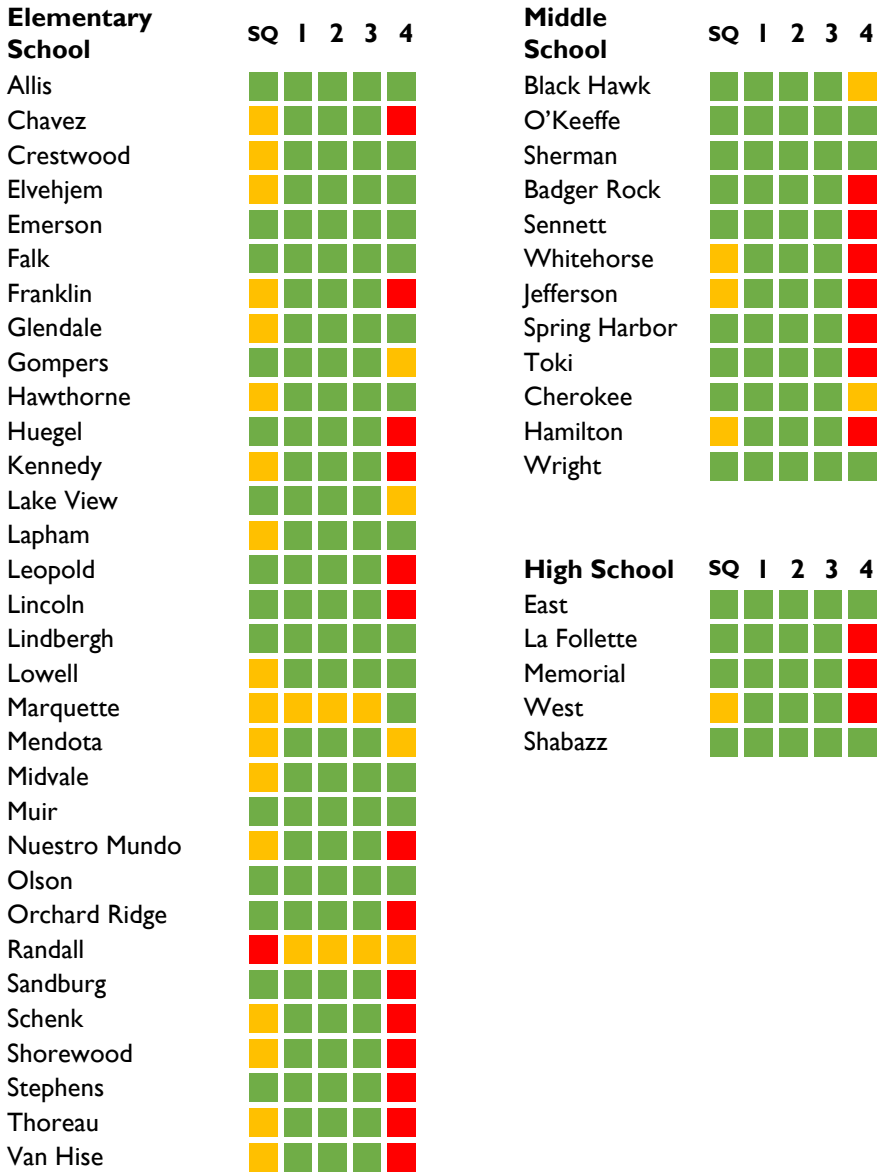
	Status Quo No change	**Option 1** New capacity factors only	**Option 2** New capacity factors & target capacities	**Option 3** New capacity factors & usage adjustments	**Option 4** Gross square feet
Number of buildings at or above ideal capacity, but below 100%	21	2	2	2	5
Number of buildings at or above 100% capacity	1	0	0	0	21
Average MMSD building capacity	85%	71%	71%	74%	98%

As noted earlier, the results of Option 4 are significantly different from the other options because Option 4 relies on the physical size of classrooms and ancillary spaces and not a pre-determined capacity factor. The results of this option indicate that the square footage per student recommendation at the time many of MMSD's buildings were constructed was much lower than current space recommendations. Schools today provide a number of services they did not provide when they were first constructed, usually relating to technology, serving special populations, and offering unique programming.

On their own, the results summarized in Table 4 do not provide enough information to select an option. It only illustrates how different Option 4 is from the others.

We next looked specifically at how the methods vary in how they affect the capacity determination of each school. Figure 9 provides a quick visual that illustrates these variations. Green indicates that the school's capacity is found to be below the target capacity, gold indicates the capacity is at or above target capacity but still below 100%, and red indicates the capacity is at or above 100%.

Figure 9: School-specific effects of capacity calculation options



We see that the results of Option 4 are significantly different from the results of the other options. It suggests that, based on gross square footage, a majority of MMSD's middle schools and high schools and over 40% of its elementary schools are over 100% capacity. Again, the results illustrated in Figure 9 do not provide enough information to select an option. It only illustrates how different Option 4 is from the others.

To make a final recommendation, we combine the information above with an evaluation of how well all five methods meet the following three goals: (1) The method is easy to use, explain, and understand; (2) The method is both precise and flexible; and (3) The method gives us actionable and reasonable results. The decision matrix below (Table 5) summarizes how well each method performs on these goals and their criteria.

Table 5: Decision Matrix

Goals	Criteria	Capacity Calculation Methods				
		Status Quo: *No change*	***Option 1***: *New capacity factors only*	***Option 2***: *New capacity factors & target capacities*	***Option 3***: *New capacity factors & usage adjustments*	***Option 4***: *Capacity by gross SF*
The method is easy to use, explain, and understand.	Do we already have or collect the necessary data?	Yes	Yes	Yes	Yes	Yes
	Is the method easy to explain?	Yes	Yes	Yes	Yes	Yes
	Is the method easy to understand?	Yes	Yes	Yes	No	Yes
The method is both precise and flexible.	Is the method sensitive to changes in room use?	Yes	Yes	Yes	Yes	No
	Does the method consider the scheduling difficulties present in middle and high schools?	No	No	Yes	Yes	No
	Does the method consider sq. ft. per student recommendations?	No	No	No	No	Yes
The method gives us actionable and reasonable results.	Do the results help district officials prioritize over-capacity buildings?	Yes	Yes	Yes	Yes	No
	How many schools are considered above capacity but below 100% capacity?	21	2	2	2	5
	How many schools are considered at or above 100% capacity?	1	0	0	0	21
	What is the average capacity of MMSD school buildings?	85%	71%	71%	74%	98%

All methods are relatively easy to explain and understand, and MMSD has the necessary data for all methods. Option 3 (usage adjustments for middle and high schools) is likely the most difficult to understand because it involves multiple downward adjustments. The methods vary in how well they meet the "precision and flexibility" goal, though Options 2 and 3 are the only options that meet multiple criteria in this area. Finally, four of the five methods produce actionable and reasonable results that would help district officials prioritize over-capacity buildings and make decisions concerning programming and future construction. The results of Option 4 may not be considered actionable and reasonable on their own because they are not sensitive to changes in room use, and it results in 21 school buildings being labeled as at or above 100% capacity compared to one under the current method. This dramatic difference may be of limited practical use to district officials making decisions concerning programming and future construction.

Recommendation: Implement New Capacity Calculation Method

Option 2 stands out as being easy to explain and understand, sensitive to changes in room use, and considerate of the scheduling difficulties present in middle and high schools. It also produces actionable and reasonable results. **We recommend the district adopt Option 2, keeping the elementary school target capacity at 90% and lowering the middle and high school target capacities to 80%.**

Summary of Recommendations for Question 3

To better align MMSD's practices with those of other districts, we make two recommendations:

1. We recommend the district use the new capacity factors proposed in Table 3 in all future capacity calculations.
2. We recommend the district adopt Option 2, keeping the elementary school target capacity at 90% and lowering the middle and high school target capacities to 80%.

The first adjustment would make our methods more similar to those of other districts, and the second adjustment would increase the accuracy of the district's methods by recognizing that middle and high schools face different constraints than elementary schools.

It is important to reiterate that, in MMSD, school capacity determinations are used primarily for making Internal Transfer decisions and prioritizing building projects. Additionally, the recommended capacity factors are not a comment on preferred class size; they only reflect the number of students a typical room could physically seat. Any recommendations in this report about capacity factors do not insinuate a recommendation about preferred class sizes.

Moreover, the idea of a 27 student capacity factor for middle and high schools is tempered by the 80% target capacity. For example, if a school's 80% target capacity is applied at the classroom level, the target capacity of a middle or high school classroom is essentially 21.6 students. While classroom-level calculations would not be performed during the district's regular capacity calculation procedure, it can be useful to think of the school target capacities and the classroom capacity factors interacting in this way.

Finally, Option 4 could be a useful supplemental calculation for the district to make. It demonstrates how appropriate a school's capacity factor is for the size of its building and provides another measure of the building's suitability for its student population.

Appendix A: Summary of Industry Practices

School District or Architecture Firm	Rooms Counted	Treats Non-Core Rooms Differently	Usage adjustment or target capacity (To account for scheduling or ideal operation)			Considers Square Footage	Capacity Factor (students allowed per room)
			Elementary	*Middle*	*High*		
Madison Metropolitan School District, WI	Both current and possible	Yes	Target: 90%	Target: 90%	Target: 90%	No	E: 22.33 M:18 H: 23
Eppstein Uhen Architects *Used by: Verona, WI; Shorewood, WI; Waupun, WI; Waunakee, WI; Middleton–Cross Plains, WI; Marshall, WI; Monona Grove, WI*	Both current and possible	Yes	Target: 90%	Target: 80%	Target: 80%	Yes	Averages: E: 24 M: 27.5 H: 28.9
Plunkett Raysich Architects *Used by: Sun Prairie, WI; Platteville, WI; Ripon, WI; McFarland, WI; Green Bay Area Public Schools, WI*	Current	Yes	UA: None Target: 90%	UA: Actual utilization Target: 85%	UA: Actual utilization Target: 80%	No	Averages: E: 24.7 M: 29.2 H: 29
Cropper-GIS	Current	Yes	None	None	None	No	District specific
Fanning Howey	N/A	No	None	None	None	Yes	District specific
Milwaukee Public Schools, WI	Possible	Yes	None	UA: 0.75	UA: 0.75	No	27
Chicago Public Schools, IL	Possible	Yes	None	None	None	No	30
New York City Department of Education, NY	Possible	Yes	None	UA: 0.875 (lower for electives)	UA: 0.875 (lower for electives)	Yes	E: 22.7 M: 28 H: 30
The School District of Philadelphia, PA	Possible	No	UA: 0.75	UA: 0.75	UA: 0.75	No	E: 26.5 M/H: 28
Atlanta Public Schools, GA	Current	Yes	Target: 80%-90%	Target: 80%-90%	Target: 80%-90%	No	E/M: 22 H: 25
Montgomery County Public Schools, MD	N/A	N/A	None Target: 80%-100%	UA: 0.85 Target: 80%-100%	UA: 0.90 Target: 80%-100%	No	E: 22.8 M/H: 25
Fairfax County Public Schools, VA	Current	Yes	None	None	UA: 0.85 (lower for electives)	No	E: 26.5 M: 27 H: 28

School District or Architecture Firm	Rooms Counted	Treats Non-Core Rooms Differently	Usage adjustment or target capacity (To account for scheduling or ideal operation)			Considers Square Footage	Capacity Factor (students allowed per room)
			Elementary	*Middle*	*High*		
Austin Independent School District, TX	Current	Yes	UA: 0.85-0.95 Target: 75%-115%	UA: 0.70-0.75 Target: 75%-115%	UA: 0.70-0.75 Target: 75%-115%	Yes	E: 22 M/H:28
Newark Public Schools, NJ	Current	No	UA: 0.9	UA: 0.85-0.9	UA: 0.85	Yes	E: 22.7 M: 23 H: 24
Seattle Public Schools, WA	N/A	Yes	UA: 0.85	UA: 0.83	UA: 0.83	No	E: 26.7 M/H: 30
Baltimore County Public Schools, MD	Possible	Yes	None	UA: 0.85	UA: 0.85	No	E: 22.8 M/H: 25

Students per room refers to non-special education, non-elective, non-low-income, K-12 rooms. Simplified for display purposes.

Appendix B: How the Calculation Options Would Change MMSD Capacity Numbers

	Status Quo *No change*		Option 1 *New capacity factors only*		Option 2 *New capacity factors & target capacities*		Option 3 *New capacity factors & usage adjustments*		Option 4 *Capacity by gross SF*	
School	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**
Elementary Schools										
Allis	511	77%	572	69%	572	69%	572	69%	547	72%
Chavez	625	97%	700	87%	700	87%	700	87%	587	103%
Crestwood	374	93%	418	83%	418	83%	418	83%	451	77%
Elvehjem	424	93%	475	83%	475	83%	475	83%	482	82%
Emerson	433	83%	484	75%	484	75%	484	75%	478	75%
Falk	334	89.7%	374	80%	374	80%	374	80%	444	68%
Franklin	351	98%	391	88%	391	88%	391	88%	345	100%
Glendale	472	97%	528	86%	528	86%	528	86%	526	87%
Gompers	295	81%	330	72%	330	72%	330	72%	Shared - see below	
Hawthorne	393	92%	440	82%	440	82%	440	82%	436	82%
Huegel	531	88%	594	79%	594	79%	594	79%	427	109%
Kennedy	536	93%	600	83%	600	83%	600	83%	448	112%
Lake View	315	82%	352	73%	352	73%	352	73%	270	96%
Lapham	207	93%	230	83%	230	83%	230	83%	420	46%
Leopold	767	89%	858	80%	858	80%	858	80%	576	119%
Lincoln	535	78%	576	73%	576	73%	576	73%	392	107%
Lindbergh	216	81%	242	73%	242	73%	242	73%	230	77%
Lowell	354	91%	396	81%	396	81%	396	81%	459	70%
Marquette	222	99.5%	243	91%	243	91%	243	91%	Shared - see below	
Mendota	334	91%	374	81%	374	81%	374	81%	329	92%
Midvale	459	93%	513	83%	513	83%	513	83%	482	89%
Muir	452	85%	506	76%	506	76%	506	76%	460	84%

	Status Quo *No change*		Option 1 *New capacity factors only*		Option 2 *New capacity factors & target capacities*		Option 3 *New capacity factors & usage adjustments*		Option 4 *Capacity by gross SF*	
School	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**
Elementary Schools (cont.)										
Nuestro Mundo	315	99%	352	88%	352	88%	352	88%	260	120%
Olson	536	75%	600	67%	600	67%	600	67%	576	70%
Orchard Ridge	354	80%	396	72%	396	72%	396	72%	Shared - see below	
Randall	370	102%	405	94%	405	94%	405	94%	410	92%
Sandburg	492	84%	550	75%	550	75%	550	75%	385	107.1%
Schenk	452	98%	506	88%	506	88%	506	88%	Shared - see below	
Shorewood	469	94%	525	84%	525	84%	525	84%	406	109%
Stephens	581	88%	650	79%	650	79%	650	79%	480	106.7%
Thoreau	433	92%	484	82%	484	82%	484	82%	390	102%
Van Hise	402	98%	450	87%	450	87%	450	87%	Shared - see below	
Middle Schools										
Black Hawk	576	68%	896	43%	896	43%	784	50%	Shared - see below	
O'Keeffe	774	64%	1204	41%	1204	41%	1054	47%	Shared - see below	
Sherman	684	61%	1064	39%	1064	39%	931	45%	Shared - see below	
Badger Rock	126	60%	196	39%	196	39%	169	45%	75	101%
Sennett	918	73%	1428	47%	1428	47%	1190	56%	546	122%
Whitehorse	522	91%	812	58%	812	58%	696	68%	Shared - see below	
Jefferson	540	93%	840	60%	840	60%	720	70%	450	112%
Spring Harbor	306	88%	476	57%	476	57%	417	65%	181	149%
Toki	774	74%	1204	48%	1204	48%	1032	56%	Shared - see below	
Cherokee	630	76%	980	49%	980	49%	858	56%	497	96%
Hamilton	846	98%	1316	63%	1316	63%	1128	73%	Shared - see below	
Wright	324	79%	504	51%	504	51%	432	59%	306	83%

	Status Quo *No change*		Option 1 *New capacity factors only*		Option 2 *New capacity factors & target capacities*		Option 3 *New capacity factors & usage adjustments*		Option 4 *Capacity by gross SF*	
School	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**	**Student Capacity**	**Percent of Capacity**
High Schools										
East	2737	58%	3332	48%	3332	48%	2856	56%	2002	80%
La Follette	2346	66%	2856	55%	2856	55%	2142	73%	1439	108%
Memorial	2323	82%	2828	68%	2828	68%	2424	79%	1591	120%
West	2300	95%	2800	78%	2800	78%	2450	89%	1574	139%
Shabazz	252	40%	252	40%	252	40%	210	48%	Shared - see below	
Shared Buildings										
Gompers/Black Hawk	–	–	–	–	–	–	–	–	636	99%
Marquette/O'Keeffe	–	–	–	–	–	–	–	–	808	89%
Orchard Ridge/Toki	–	–	–	–	–	–	–	–	690	124%
Schenk/Whitehorse	–	–	–	–	–	–	–	–	722	127%
Van Hise/Hamilton	–	–	–	–	–	–	–	–	808	151%
Sherman/Shabazz	–	–	–	–	–	–	–	–	641	81%

Yellow text indicates the percent of capacity is above the target capacity but below 100%
Red text indicates the percent of capacity is 100% or more
Lapham's capacity by gross square feet does not include the square footage of the building's third floor, which is currently in use by Innovative & Alternative programming.
Marquette/O'Keefe's shared capacity by square feet does not include the square footage of the rooms in use by Innovative & Alternative programming (SAPAR).

Appendix C: Option Formulas

Status quo

Elementary: (# available homerooms - # rooms used for other activities) x (current capacity factor)
Middle & high: (# instructional spaces and gyms) x (current capacity factor)

Option 1: New capacity factors only

Elementary: (# available homerooms - # rooms used for other activities) x (new capacity factor)
Middle & high: (# instructional spaces and gyms) x (new capacity factor)

Option 2: New capacity factors and target capacities

Elementary: (# available homerooms - # rooms used for other activities) x (capacity factor)
Middle & high: (# instructional spaces and gyms) x (capacity factor)

Option 3: New capacity factors and usage adjustment factors for middle and high schools

Elementary: (# available homerooms - # rooms used for other activities) x (capacity factor)

Middle & high: (# instructional spaces and gyms) x (capacity factor) x $\frac{\text{\# core periods - 1}}{\text{\# core periods}}$

Option 4: Capacity by gross square feet

Elementary, middle, & high: $\frac{\text{gross building square feet}}{\text{recommended gross sq. ft. per student}}$

Shared buildings: $\frac{\text{gross building square feet}}{\text{average recommended gross sq. ft. per student}}$