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BELL TIME STUDY AND TRANSPORTATION IMPACT ANALYSIS
Phase 1

Syosset Central School District
March 13, 2019

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Ms. V. Dolly Kranz
Assistant to the Superintendent for Teaching and Learning
Syosset Central School District
99 Pell Lane
Syosset, NY 11791

Dear Ms. Kranz:

School Bus Consultants, LLC (SBC) is pleased to submit the enclosed report covering the first phase of our work for Syosset Central School District (SCSD). In the report that follows, we have evaluated several possible school bell time alternatives to identify a structure that allows high schools to commence at a later time, and estimate the cost and service impact of the different options. While the cost of student transportation at the school district is generally within the expected range, we are confident that the recommendations in this report will enable the school district to accomplish their goal of moving high school times back without dramatically increasing the need for additional resources.

We would like to thank you and the staff at SCSD for the cooperation and assistance given to SBC during the course of this Phase 1 review.

Sincerely,

Giovanni Cosentino
Project Manager

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Introduction and Background

The Syosset Central School District (SCSD) provides educational services to more than 6,200 students. Transportation services are provided to the District's seven elementary schools, two middle schools, and one high school. In addition to the District's schools, transportation is also provided to alternative and private schools bringing the total students served by SCSD transportation to just over 6,700.

SCSD is in the process of evaluating the bell schedule with the objective to move Syosset High School to a later start time. To assist in this endeavor, SCSD contracted with School Bus Consultants (SBC) to develop potential bell time alternatives and conduct a detailed analysis that identifies how these alternatives would impact the District's transportation operations.

Our work plan was broken into two phases. Phase one seeks to document an initial set of viable bell time options that best meets the objectives of the school district. If SCSD elects to proceed with Phase two, SBC will engage with stakeholders to better understand how the bell time scenarios meet the broader needs of the community.

Phase one commenced with establishing an operational baseline which was necessary to support a comparison of the current bell time structure with any proposed alternative model and to determine if the system is operating in an efficient, effective, and cost competitive manner. Following that, various bell time scenarios were analyzed, resulting in the presentation of three bell time alternatives that best illustrate how changes to the current bell time structure would affect transportation.

During this process, our study sought to answer the following questions and make specific recommendations on the best bell time alternative:

- How the current cost and service performance indicators compare to accepted industry standards and benchmarks? What the cost related performance metrics say about the cost efficiency of the operation?
- What impact the current bell time structure have on transportation? What changes to the bell time structure would allow the start time for Syosset High School to start later with a minimal impact to the resources required to complete transportation operations?

The balance of this assessment aims to answer these questions, as well as to satisfy the described objectives and work plan above.

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Executive Summary

Performance Analysis, Cost Baseline, Routing Assessment

Transportation services are currently being delivered efficiently and effectively.

For the fiscal year 2017-2018, the cost of home-to-school transportation for approximately 6,744 regular and special education students within the SCSD network was $8,473,945. Based on this amount, the annual cost per assigned route bus for all types of transportation was calculated to be $71,813 with the average annual cost per student of $1,253. Based on a combined fleet of 118 buses and a 180-school day year, the daily cost per bus is approximately $398 per day.

While the cost of transportation appears to be reasonable, transportation performance in relation to cost cannot be analyzed or considered alone absent an understanding of the level of service that is being provided (or expected by stakeholders). Discussed below and within multiple assessment sections, analyses indicate that services are being provided at a high level for both regular and special education students across the service area.

Transportation services are being provided in a three-tier structure with 118 buses performing a total of 474 daily runs. In addition to home to school service, the transportation department also provides service for elementary students in the morning that participate in clubs and choir, late afternoon runs for students receiving additional help, and late run service for students in afterschool athletics and clubs.

The routing structure, deployment, and service metrics leads SBC to conclude that SCSD is running a transportation operation that provides high service quality to their students in an efficient manner. There may be opportunities leverage actual ridership data to improve efficiencies by increasing the number of students assigned to runs with available capacity. The largest constraint to efficiency in the current system is the limited available “work time” for the afternoon routes that has contributed to a need for additional buses to accommodate afternoon runs. SBC recommends examining bell time alternatives that would increase the amount of “work time” between tiers in the afternoon. Furthermore, SBC recommends that SCSD examines their routing data to identify inconsistencies to ensure the routing data reflects what is actually occurring.

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Alternative Bell Time Structure Analysis

Achieving a later start time for the high school is feasible, but not without compromises that will affect transportation costs, start times for other schools, the length of the instructional day, or other areas such as extracurricular programming.

A later high school start time can be achieved, but there are factors that constrain the range of feasible solutions. SBC has analyzed and submitted eleven alternative bell time options to SCSD. These examined known constraints and those identified by staff over the course of the project. Based upon our research and analyses of SCSD transportation operations, SBC concludes that it is feasible for SCSD to change high school starts times. However, to accommodate this goal without a significant increase in transportation cost, it will require SCSD to move beyond the stated constraint that limits the latest school start to 9:30 AM as illustrated in alternative two as presented. Doing so would meet the District's goal of moving high school beginning bell times to 8:30 AM, potentially with no additional transportation costs.

In the event that SCSD is unable to move beyond the constraints required in alternative two, SBC recommends alternative five as this alternative minimally alters middle school and elementary school bell times, impacts high school after school activities by only 26 minutes, and provides SCSD the best opportunity to efficiently utilize the bus fleet by consolidating middle school and high school runs where possible.

Performance Analysis and Cost Baseline

To fully understand the financial efficiency and service performance of a student transportation organization, a review and analysis of cost, route, run, and student data was completed. A baseline cost assessment is also necessary to establish a point of comparison of the direct impacts of any recommended changes or alternative service delivery model.

Our cost and service analysis began with the examination of all transportation related expenditures that included wage and benefit information for SCSD transportation department staff, and the complete cost of contracted service providers. Additionally, expenditures such as extra-curricular or athletic trip costs were calculated but excluded from the baseline cost analysis to ensure that the true cost of home-to-school transportation was well understood.

In conjunction with the analysis of route design and implementation, several key performance metrics were derived, which are useful not only for a comparison against industry standards, but also to establish a baseline for comparison if SCSD were to further explore operational changes. These results are explained in detail directly below.

SBC utilized SCSD's 2017-2018 transportation expenditures to identify the cost of home-to-school transportation alone, (extracurricular, field trips, and athletics omitted). SCSD serves approximately 6,744 general and special education students riders equating to a total cost of $8,473,945. Based on this figure, the annual cost per bus metric for all types of transportation is $71,813 with an annual cost per student of $1,253. Based on a combined bus fleet of 118 buses/vans and a 180-school day year, the daily cost per bus is approximately $398 per day. While results may vary across the nation, these metrics appear to be in line and reasonable for a school district in New York, the northeast in general, and expected for the level of service offered within the SCSD system. The annual cost of the present transportation program, at $8.4 million or 3.8 percent of the total district budget of $223,702,174 is within the expected range of four to six percent.

Further analysis of transportation expenditures illustrated an annual cost of $961 per regular education and $9,290 for students with special needs who require more specialized transportation. While the transportation costs for special needs students is approximately $8,328 more than regular education students, it is typical for the costs of students with special needs to range from five to ten times higher than the cost for general education students.

In conjunction with the analysis of cost, important service metrics were also calculated. Based on these results, which are discussed in full detail in the following section, run times and capacity utilization indicate that services are being provided at a high level in a cost-effective manner. These results are summarized in the follow **Table 1**.

Table 1: Performance Metrics

Performance Metric	Special Needs	Regular Ed
Daily Buses Operated	32	86
Annual Operating Cost per Daily Route Bus	69,381	$72,715
Annual Cost Per Rider	$9,290	$961
Number of Buses per 100 Students	1.7	
Average Run Times	29 minutes	
Capacity Utilization (General Education)	82 percent	

Conclusions and Recommendations

While the overall cost of service is a prime metric to be consistently monitored and managed, for a system to be both effective and efficient, a balance between cost and service must be considered. This notion will be discussed in greater detail within the following section. Overall, services are being delivered in a manner that provides a high level of service and a planned capacity utilization of 82 percent are a good indication of why costs for the transportation operation are reasonable.

Routing Assessment

SBC's bell time structure analysis provides a detailed examination of critical factors such as school bell times, run times, asset utilization, and capacity utilization. Results of these analyses provide key operational performance indicators that will help to diagnose and understand the overall effectiveness and efficiency of the current bell time structure. The following results are based on the analysis of the provided data and are designed to illustrate both the current level of performance and also potential opportunities for improvement.

Service Description and Bell Times

Services are being provided in a three-tier transportation structure with 118 buses performing 474 runs for 6,744 planned students. In addition to home to school service, the transportation department also provides early service for elementary students in the morning that participate in clubs and choir, late afternoon runs for student receiving additional help, and late run service for students in afterschool athletics and clubs. The three-tier bell time structure begins with the high school starting at 7:39 AM and ending at 2:26 PM, followed by the second-tier composed of middle schools with bell times beginning at 8:05 AM and ending at 2:46 PM, elementary schools are the final-tier starting at 9:15 AM and ending at 3:15 PM.

There is approximately 26 minutes and 70 minutes between the 1st and 2nd tier and the 2nd and third tier respectively in the morning. While in the afternoon the "work time" between the tiers is consolidated with 20 minutes and 29 minutes between the 1st and 2nd tier and the 2nd and third tier respectively. The large difference in the afternoon compared to the morning "work time" between the 2nd and 3rd tier is due to length of day difference of 41 minutes. The variance in work time between the morning and afternoon tiering limits the possible run time length that is required to have a successful multi-tier routing structure. The current bell time structure illustrating available work time between current tiers is presented in the following **Figure 1 and Table 2.**

Figure 1: Current Bell Time Distribution

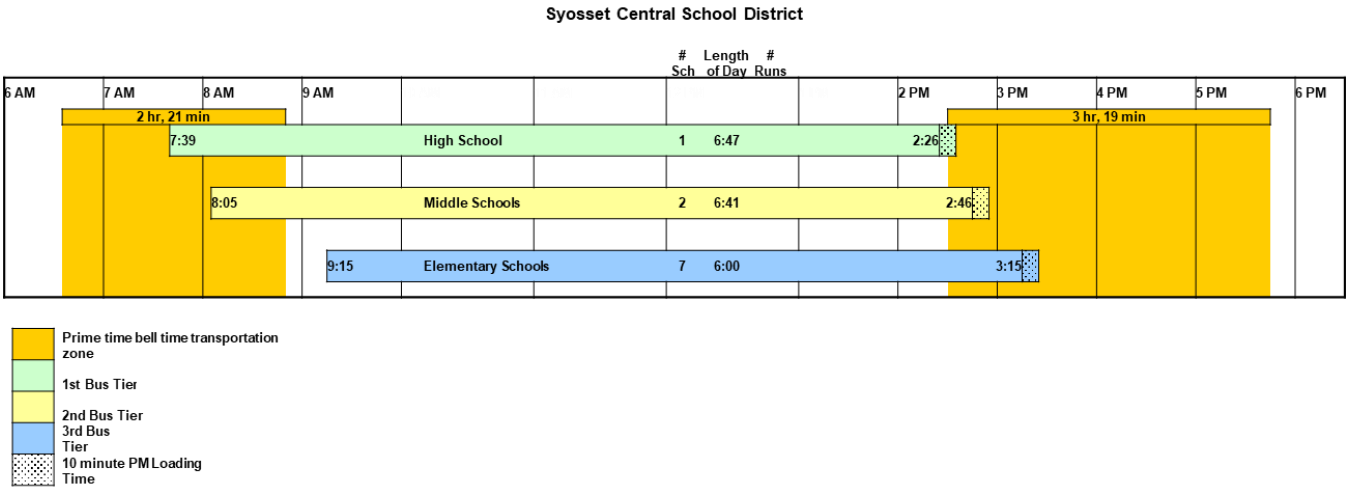


Table 2: Work Time Between Tiers

Tier	Time Between Tier AM	Time Between Tier PM
1st and 2nd Tier	0:26	0:20
2nd and 3rd Tier	1:10	0:29

The analysis of run times provides an important indication of the level of service provided by a transportation organization. Based on the analysis of SCSD provided data, the average run time is 29 minutes. Having less time between bell times than the average run time of 29 minutes does not allow some buses to perform multi-tiered routes. As **Table 3** illustrates, while average run times are reasonable in terms of service quality, the limited time between bells, especially in the afternoon, places extra stress on the operation.

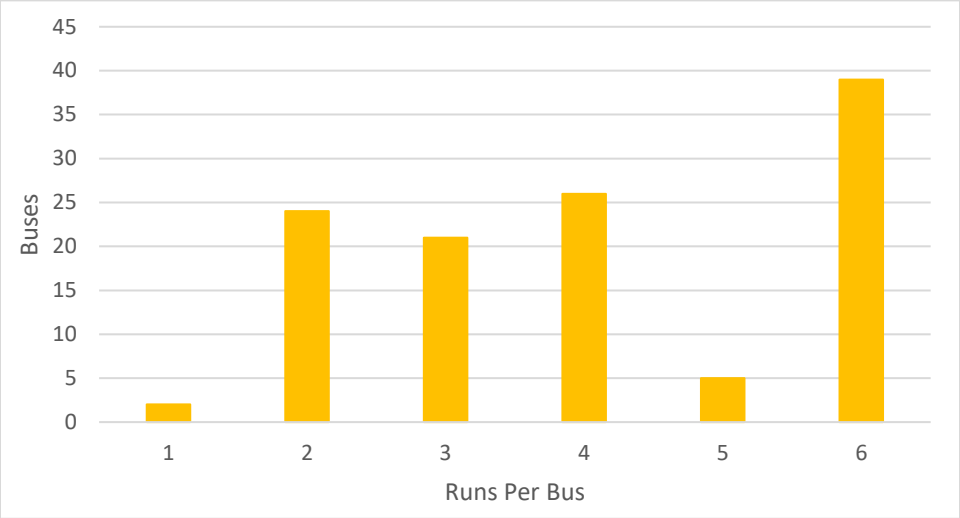
Table 3: Average Run Times by Program

Program	Morning Average Run Time	Afternoon Average Run Time
High School	0:24	0:25
Middle School	0:23	0:23
Elementary School	0:21	0:20
Other Schools	0:48	0:50

With three bell time tiers it is expected that buses average six daily runs, one run for each of the three tiers in the morning and one run for each of the tiers in the afternoon. While theoretically this would be the desired result, operationally, it is typically not achievable due to the bell time structure and time and distance constraints. Some of SCSD routes are held back by some of these constraints as the buses are currently averaging 4.08 runs per bus.

As shown in **Figure 2** below, approximately 39 (33 percent) of the buses perform six runs as expected. While at first glance it seems that SCSD could greatly improve their asset utilization by adding additional runs to routes with less than six runs, the majority of routes with fewer than 6 runs are special education routes and routes that service private or alternative school, which have longer run times.

Figure 2: Runs per Bus



Figures 3 and 4 aids in further highlighting the impact of bell times on asset utilization. Each figure illustrates the number of buses that are currently deployed for each of the morning and afternoon tiers with students riding. The peak deployment for the morning is during the high school tier, which requires at least 93 vehicles, nine buses more than the deployment during the Elementary tier. The morning deployment illustrates characteristics of a well-functioning three-tiered system as there are distinct peaks indicating the utilization of assets and distinct valleys that indicate there is enough "work time" between tiers for buses to dead head to the next run in their route. In addition to the normal tiers in the morning deployment, SCSD also provides early runs starting at 8:00 AM and ending at 8:25 AM for elementary students that participate in extracurricular activities such as choir.

The afternoon deployment lacks the distinct peaks and valleys described in the morning deployment. This is due to the compression of "work time" between each of the tiers. The "work time" compression occurs due to the differences in length of day (LOD) for each of the programs. The high school and middle school programs have similar LODs at 6:47 and 6:41 respectively. The elementary schools however, have a LOD of only six hours. While the time between the middle school and elementary school tier in morning is just over an hour, the discrepancy in LOD reduces the time between tiers in the afternoon to only 29 minutes, limiting the number of buses that can complete middle school and elementary school runs in the afternoon, resulting in an increase need of buses for a peak deployment of 128 buses.

It is important to note that the peak deployment of buses illustrated in **Figure 4** exceeds the total number of route buses indicated previously (118). This is due to data quality/limitation issues that can limit the accuracy of our analysis. For example, within the routing data, there are buses scheduled to make multiple runs within an overlapping time period (40 buses). These data inconstancies were mainly isolated to the afternoon data. Our model works with the route data provided and the overlapping runs result in a false representation of what is actually occurring. Although the results will show more buses than are actually used, the model will still indicate how a change in bell times will positively or negatively affect the resources required. SBC did make observation at school sites and received GPS data, however GPS data was not received for all runs, therefore the data could not be used in the bell time model analysis.

Figure 3: Morning Deployment Model

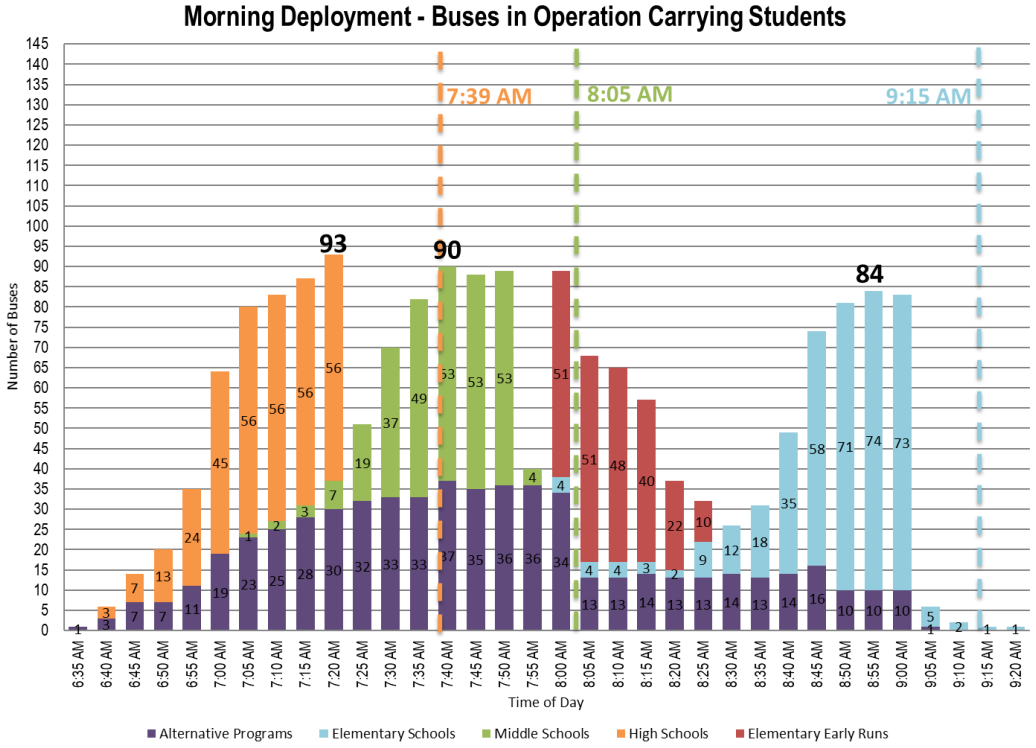
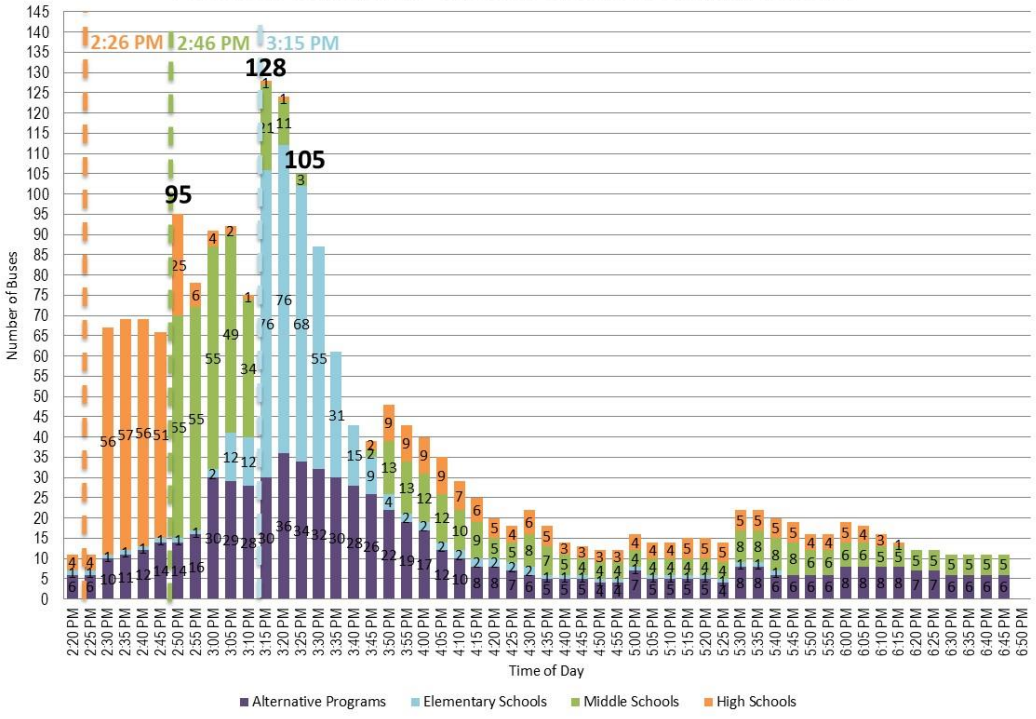


Figure 4: Afternoon Deployment Model



Seating capacity utilization is yet another important indicator of overall effectiveness of a routing network. In conjunction with asset utilization, utilizing seating capacity to the greatest degree possible is a primary goal of an effective routing network. Based on the analysis of the assigned number of students per bus, the overall actual capacity utilization rate is approximately 82 percent, and is an excellent result. It should be noted that the calculation for capacity utilization is based on the SCSD practice of elementary bus capacity limits of 66 students and middle school and high school capacity limits of 44 students. This practice is in line with industry best practices as it contributes to rider comfort for larger students, which has also been observed to influence positive student behavior. SCSD conducted student counts November 5th-9th to identify the number of students actually riding the buses, with a response rate of 89 percent. Based on the collected counts, the observed actual capacity utilization is 52 percent, indicating there may be opportunities to increase the number of students on the majority of the runs. These results are illustrated in the following **Table 4**. It should be noted that special education and alternative programs were not included in this analysis as vehicle capacity for these routes were not known.

Table 4: Seating Capacity Utilization

Program	Morning Average Planned Capacity Utilization	Afternoon Average Planned Capacity Utilization	Morning Average Actual Capacity Utilization	Afternoon Average Actual Capacity Utilization
High School	98%	98%	57%	55%
Middle School	78%	76%	54%	46%
Elementary School	73%	73%	47%	53%

While the number of runs per bus and capacity utilization percentage can be illustrative, combining these analyses to understand the total number of buses currently being utilized can provide additional insight into the overall effectiveness and efficiency of the system. Based on approximately 6,744 students actively being transported across 118 buses, the ratio of buses per 100 students is 1.7. This is a higher number than the expected range of 1.1 to 1.3, especially considering the high planned capacity utilization results, but is largely explainable by the special needs requirements of the system and the use of vans for some routes, with a lower level of both asset and capacity utilization in this segment of the service.

Conclusions and Recommendations

The routing structure, deployment, and service metrics leads SBC to conclude that SCSD is running a transportation operation that provides high service quality to their students in an efficient manner. There may be opportunities leverage actual ridership data to improve efficiencies by increasing the number of students assigned to runs with available capacity. The largest constraint to efficiency in the current system is the limited available “work time” for the afternoon routes that has contributed to a need for additional buses to accommodate afternoon runs. SBC recommends examining bell time alternatives that would increase the amount of “work time” between tiers in the afternoon. Furthermore, SBC recommends that SCSD examines their routing data to identify inconsistencies to ensure the routing data reflects what is actually occurring.

Alternative Bell Time Structure Analysis

As mentioned above, SCSD would like to determine how moving high school start times from 7:39 AM to 8:30 AM would affect transportation operations. SBC utilized guidance from the SCSD Bell Time Review Committee and internal stakeholder surveys to develop three alternative bell time structures. The goal of these alternatives is to move the high school bell time back without compromising efficiency of the transportation operation and without reducing the high level of customer service currently provided. The following alternatives use the exact same runs as the current system and only adjusts the start and end time of each run to adjust it to its associated school bell times. All alternative program runs were kept consistent as these program's bell times would not be altered in the process. While this report only includes three alternative bell time structures, other alternatives were examined, but were not included because they failed to meet the goals of this endeavor.

Alternative One

Alternative one adjusts the tier sequencing with middle school as the first tier but maintains its current bell time starting at 8:05 AM and ending at 2:46 PM. The second tier would be high school starting at 8:30 AM and ending at 3:17 PM, this would essentially take the place of the elementary school's early runs. The third tier would be elementary school and would maintain its current start time of 9:15 and end time of 3:15. Below **figures 5 and 6**, illustrate the morning and afternoon deployment models for alternative one. The morning deployment model has a peak deployment of 126 buses and the afternoon deployment model has a peak deployment of 179 buses. This alternative would compress the "work time" between tiers in the morning and in the afternoon. The loss of "work time" between tiers and moving the high school start time later causes the majority of the high school runs to coincide with alternative schools (other) runs resulting in at least an increase of 43 percent to the number of route buses that would be required. The compress time between tiers in the afternoon would essentially result in a two-tiered system in the afternoon between elementary and high school runs.

Pros	Cons
• Middle School times remain constant • Elementary school times remain constant • High school is moved to the recommended start time of 8:30 AM	• Requires a significant increase in required routes buses. • Requires revisions to the elementary early pick-up program as high school runs will encroach on these early runs. • High school afternoon activities will be pushed back by 51 minutes

Figure 5: Alternative One Morning Deployment Model

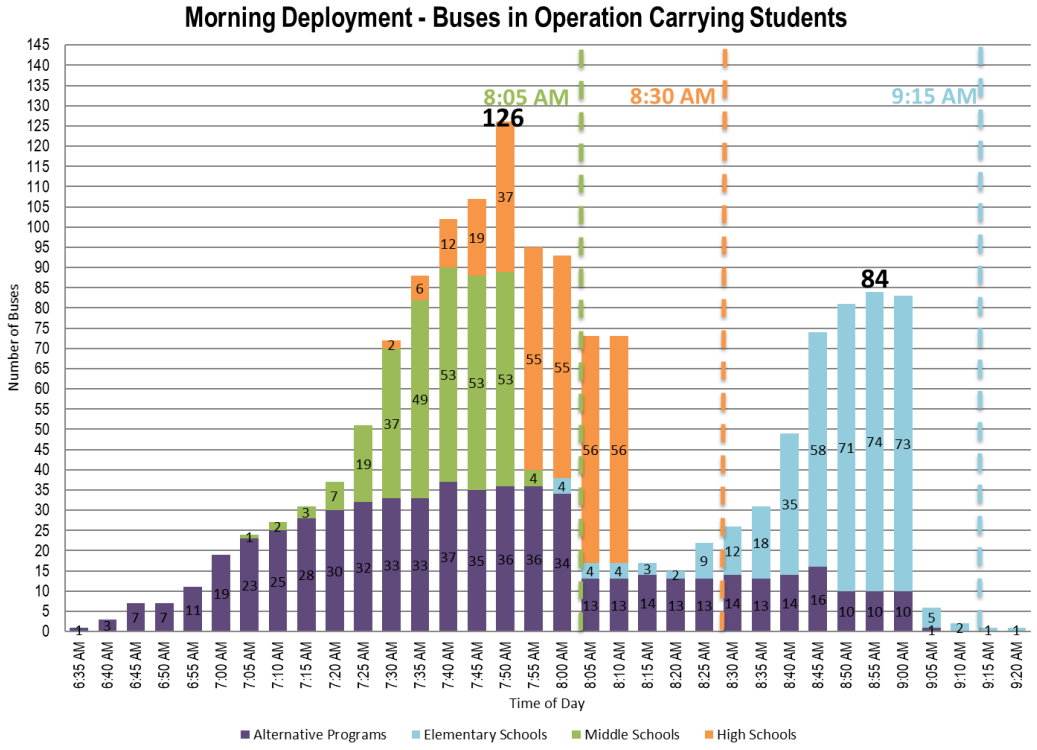
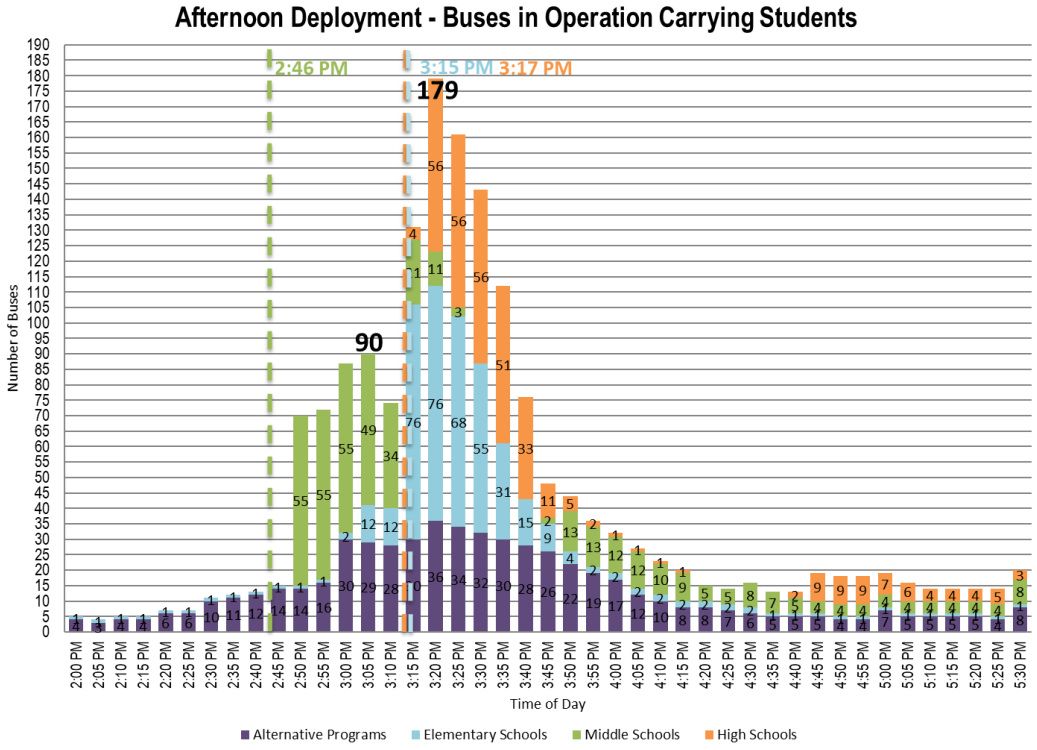


Figure 6: Alternative One Afternoon Deployment Model



Alternative Two

Alternative two adjusts the tier sequencing with high school serving as the first tier starting at 8:30 AM and ending at 3:17 PM. The second tier would be elementary schools starting and ending 15 minutes earlier than the current time with bell times at 9:00 AM and 3:00 PM. Moving elementary bell times earlier would prevent an overlap in high school and elementary runs in the afternoon. The third tier would be middle school with a starting time of 9:30 and end time of 4:11. Below **figures 7 and 8**, illustrate the morning and afternoon deployment models for alternative two. The morning deployment model has a peak deployment of 116 buses and the afternoon deployment model has a peak deployment of 123 buses. While this alternative would compress the "work time" between tiers in the morning leading to the elimination of the early morning elementary runs, it increases the overall available work time in the afternoon by 22 minutes helping to spread out the time of demand. This alternative provides a potential no cost solution but requires middle school to start and end at a later time.

Figure 7: Alternative Two Morning Deployment Model

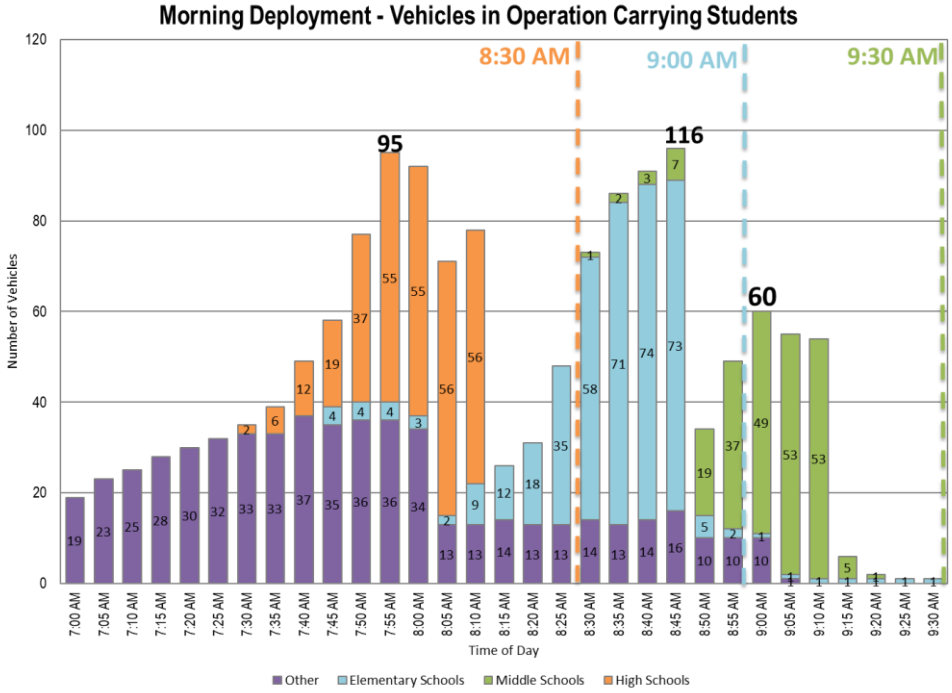
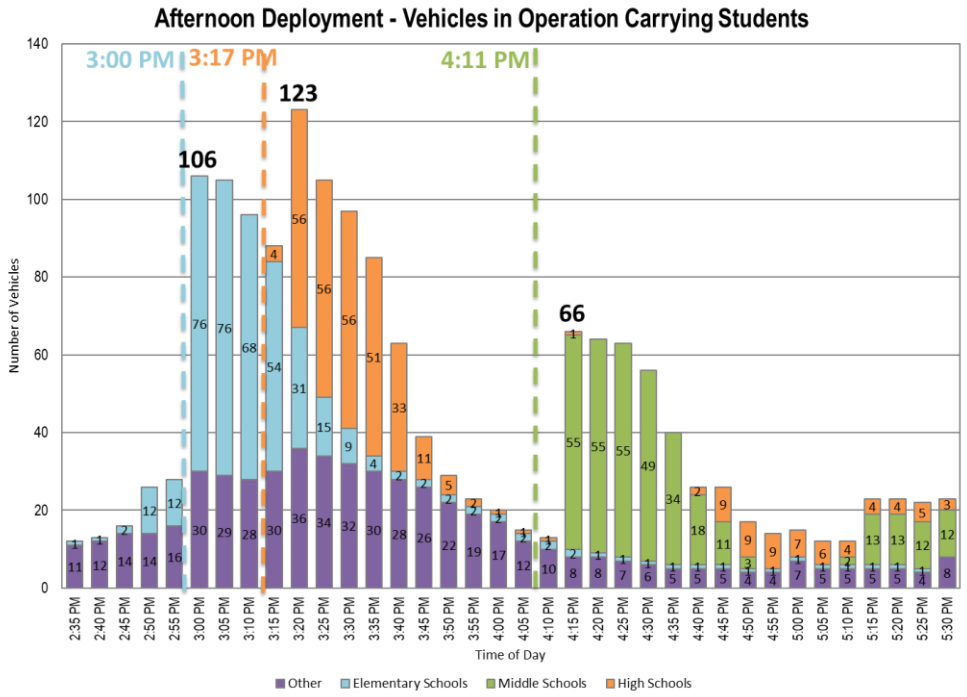


Figure 8: Alternative Two Afternoon Deployment Model



Pros	Cons
• High school is moved to the recommended start time of 8:30 AM • Potential no cost solution	• Elementary times are changed • The elementary early pick-up program would no longer be viable • Middle school would begin and release later • High school afternoon activities will be pushed back by 51 minutes

Rationale for Constraint Deviation

Constraints for alternative development were discussed during meetings between SBC staff and SCSD leadership. It was established that SCSD would not consider alternative bell times that have middle school or high school bell times earlier than 8:05 AM and elementary bell times that commence later than 9:15 AM. These constraints reduce the overall available busing window by 26 minutes (28 percent). Under these constraints, it is not possible to move the high school start times later without a significant increase in route buses as shown in alternative one. Therefore, SBC developed alternatives that deviate from these constraints in an effort to provide options that will limit the number of additional buses required.

Alternative Three

This alternative moves high school from the first tier into the second tier. The first tier for this alternative would be middle school, which would commence at 7:55 AM, 10 minutes earlier than the current time and end at 2:36 PM. The second tier would be high school starting at 8:25 AM and would end at 3:12 PM. Elementary schools would remain in the last tier but would start 20 minutes later at 9:35 AM and end at 3:35 PM. Below **figures 9 and 10**, illustrate the morning and afternoon deployment models for alternative two. The peak deployment for this alternative would be at least 139 buses. The current bell time structure has a peak deployment of 128 buses in the afternoon, but as mentioned before, the current afternoon data is inflated due to data inconsistencies. This alternative would require a potential increase of 11 route buses to accommodate the afternoon. In addition to the increase in required resources, after school activities for high school students would be impacted, as high school students would be released 46 minutes later than under the current structure. This structure would allow elementary early runs to continue but would begin 20 minutes later than the current time.

Pros	Cons
• High school is moved to the start time of 8:25 AM • Elementary early pick-up program is unaffected	• Elementary times are moved 20 minutes later • Middle school would begin 10 minutes earlier • High school afternoon activities will be pushed back by 46 minutes • Potential increase of 11 route buses

Figure 9: Alternative Three Morning Deployment Model

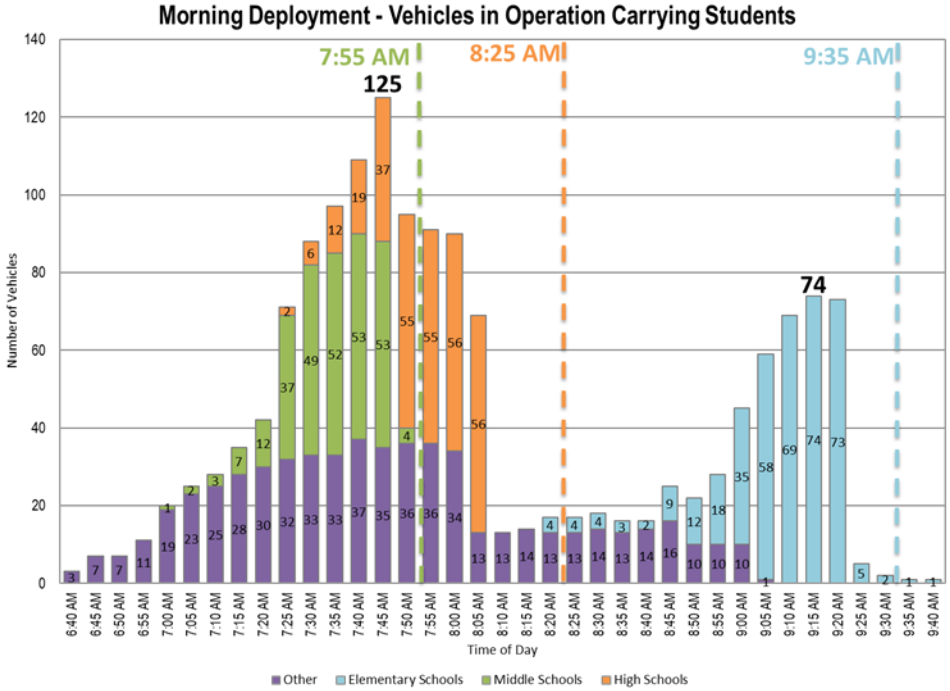
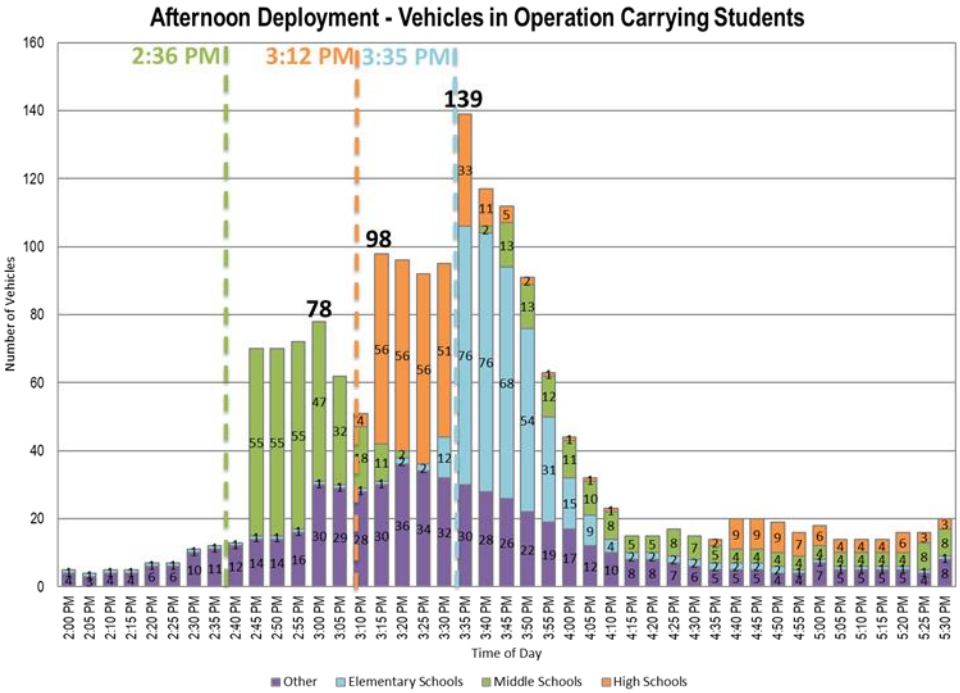


Figure 10: Alternative Three Afternoon Deployment Model



Alternative Four

Alternative four changes the structure of the system from a three-tier system to a two-tier system. Middle school and high school runs would share the first tier with the middle schools retaining their current bell times staring at 8:05 AM and ending at 2:46 PM, while the high school would start at 8:10 AM and end at 2:57 PM. The final tier would remain elementary with a starting time of 9:25 AM and ending at 3:25 PM, 10 minutes later than the current bell time. This alternative limits the work time between middle schools and high schools runs by only 5 minutes in the morning and 11 minutes in the afternoon. This would require the buses to make middle school and high school runs at the same time resulting in a peak morning deployment of at least 145 buses and would require 27 (22 percent) buses in addition to the current fleet of 118.

Pros	Cons
• High school is moved to the start time of 8:10 AM • Elementary early pick-up program is unaffected	• Elementary times are moved 10 minutes later • High school afternoon activities will be pushed back by 31 minutes • Potential increase of 27 route buses • Middle and high school students would ride the same bus • Requires a more intensive rerouting process to combine tiers

Figure 11: Alternative Four Morning Deployment Model

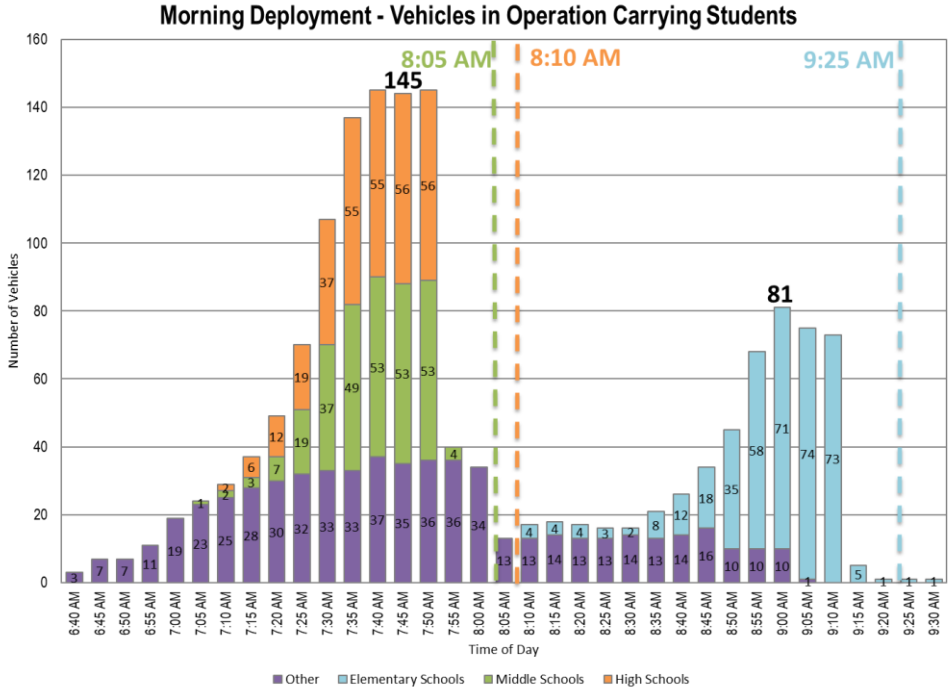
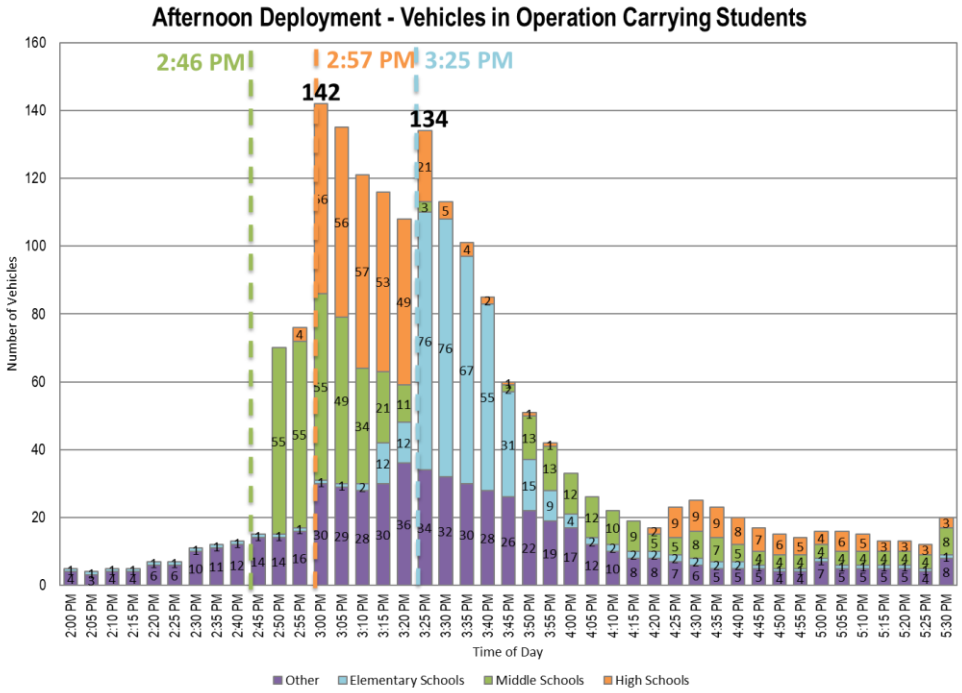


Figure 12: Alternative Four Afternoon Deployment Model



Alternative Five

Similar to alternative four, alternative five also consolidates the system into two tiers. This alternative however, moves the starting time for middles schools earlier by 5 minutes starting at 8:00 AM and ending at 2:41 PM. In the same tier, high school would start at 8:05 AM and end at 2:51 PM. The final tier would remain elementary starting at 9:20 AM and ending at 3:20 PM, five minutes later than the current bell time. This alternative would have a morning peak deployment of at least 146 buses and would require 28 (23 percent) buses in addition to the current fleet of 118. This alternative is beneficial in that it accomplishes SCSD's goal of moving high school start times later and would only impact after school activities for high school students by 26 minutes. Furthermore, this alternative would only deviate from constraints outlined by SCSD by five minutes for the first tier and five minutes for the last tier.

Pros	Cons
• High school is moved to the start time of 8:05 AM • Elementary early pick-up program is unaffected	• Elementary times are moved 5 minutes later • Middle school start times are moved 5 minutes earlier • High school afternoon activities will be pushed back by 26 minutes • Potential increase of 28 route buses • Middle and high school students would ride the same bus • Requires a more intensive rerouting process to combine tiers

Figure 13: Alternative Five Morning Deployment Model

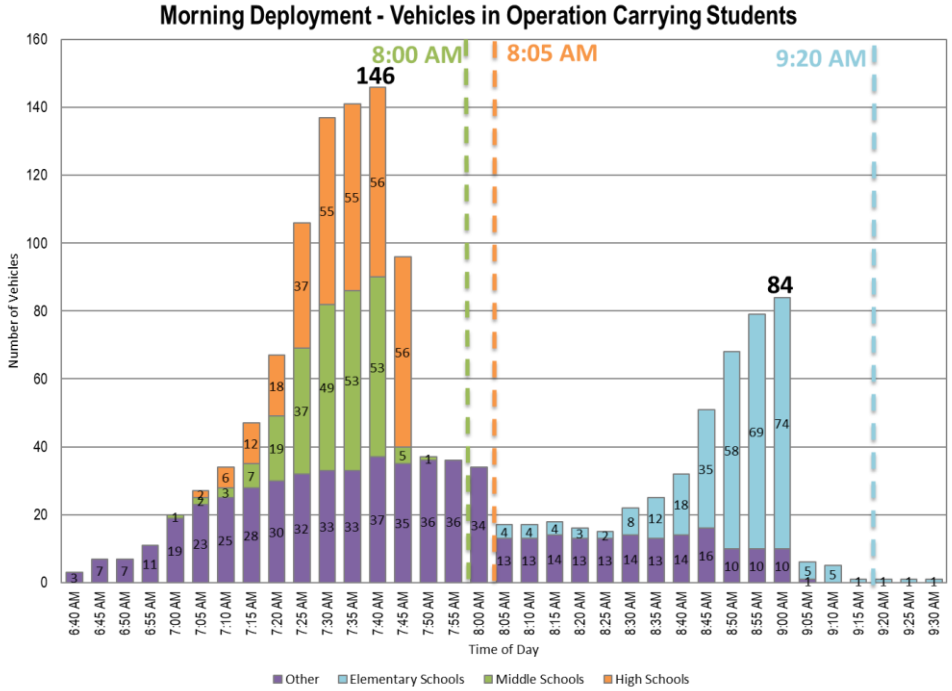
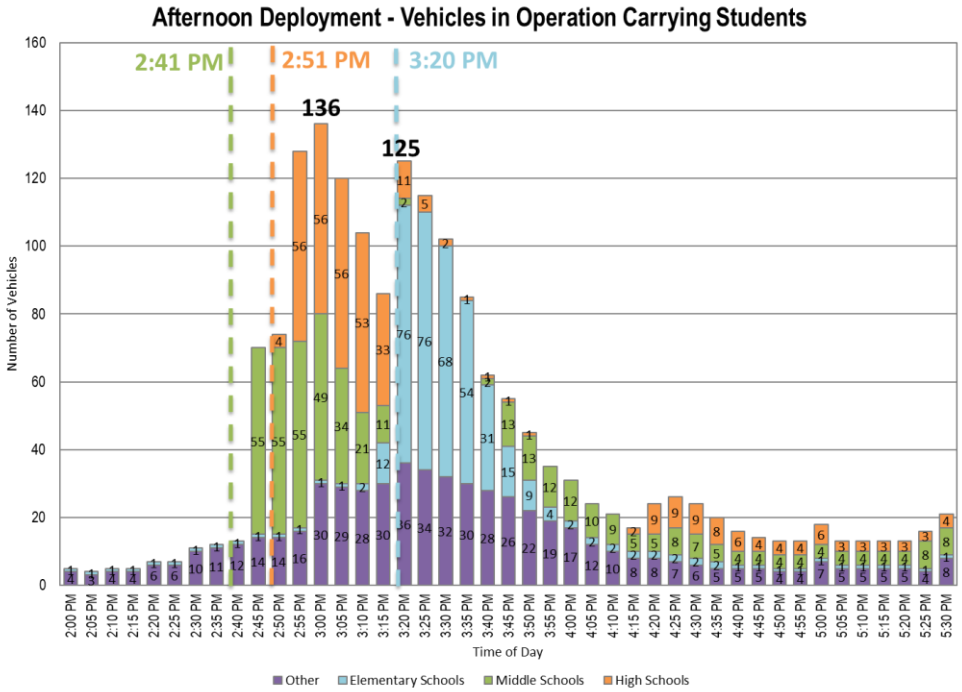


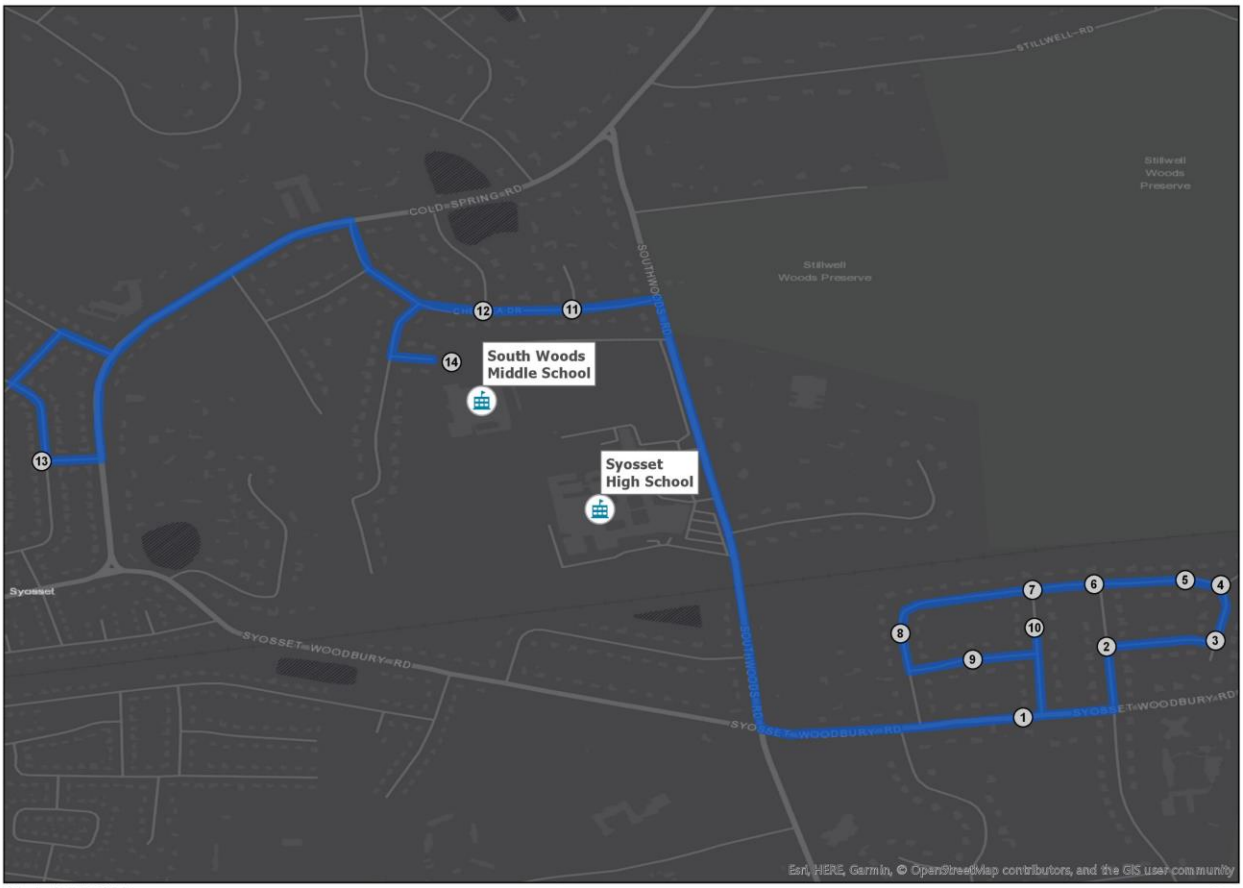
Figure 14: Alternative Five Afternoon Deployment Model



Run Consolidation

Scenarios four and five would increase the need of route buses by at least 22 percent and 23 percent respectively. While this is a significant increase, the overlap of middle school and high school runs presents an opportunity to reduce this increase by developing combination runs that include middle and high school students on the same runs. Consolidating two runs into one requires that the current runs each have available capacity on the bus and have short enough runs times to accommodate the additional students. SBC took an average of the daily student counts collected November 5th- 9th and determined that runs that had 22 students or less and that had a run time duration of 30 minutes or less were candidates for potential consolidation. **Figures 15 and 16** illustrate current middle school and high school runs that overlap the same geographic area. **Figure 17** demonstrates how these two runs could be consolidated into a single run. Utilizing the November counts, this would result in a ridership count of 30 students and a run time of 23 minutes. Using this criterion, SBC identified 35 middle and high school runs in the morning and 43 middle and high school runs for afternoon that could potentially be consolidated. It is important to note that this process would require a rerouting of the SCSD system to identify viable consolidations. The consolidation of these runs could possibly make bell time alternatives three and four more feasible options, as the increase in required routes buses would be reduced.

Figure 15: Current South Woods Middle Run

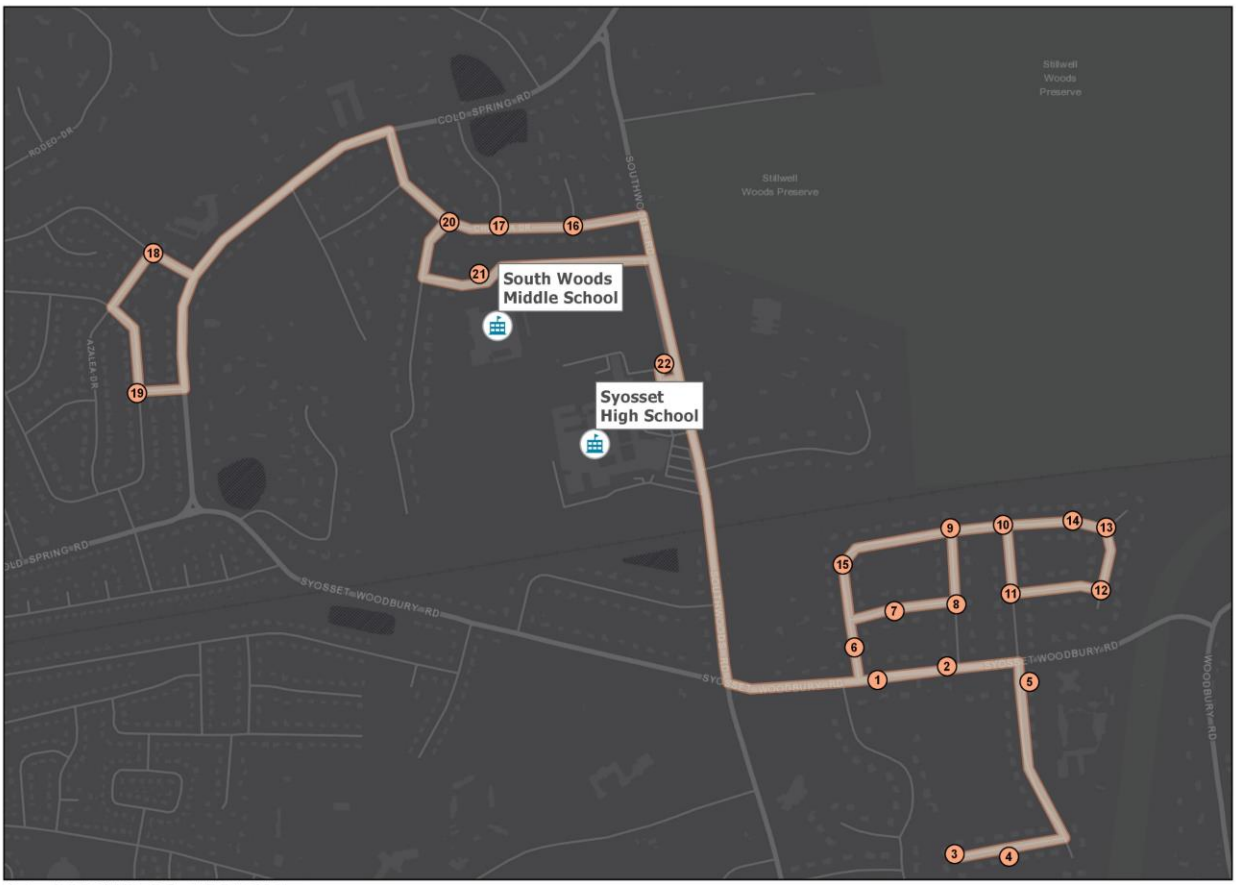


27 AM SW

Current Run Time	Students Planned	Nov. Count Avg.
20 Minutes	27	14

Figure 16: Current Syosset High School Run

Figure 17: Potential Middle and High School Combination Run



24 AM SHS/27 AM SW
Combined Ride Time
23 Minutes

Alternative Six

Similar to alternative two, this alternative adjusts the tier sequencing with middle school serving as the first tier starting at 7:50 AM and ending at 2:31 PM. High would be placed in the second tier with a starting time of 8:20 AM and an ending time of 3:07 PM. Elementary schools would continue to serve as the final tier with a starting time of 9:15 AM and an ending time of 3:15 PM. Below **figures 18 and 19**, illustrate the morning and afternoon deployment models for alternative six. The morning deployment model has a peak deployment of 104 buses and the afternoon deployment model has a peak deployment of 168 buses. This alternative expands the "work time" between the first and second tier in the afternoon providing ample time for the majority of middle schools runs to be completed before the high schools afternoon bell. However, the "work time" between the second and third tier is compressed from 29 minutes to 8 minutes which causes the high school and elementary periods of peak demand to coincide. This overlap leads to a potential increase in required route buses of 40 (31 percent) buses in addition to the current fleet of 118.

Pros	Cons
• High school is moved to the start time of 8:20 AM • Elementary early pick-up program is unaffected	• Elementary times are moved 5 minutes later • Middle school start times are moved 15 minutes earlier • High school afternoon activities will be pushed back by 41 minutes • Potential increase of 31 route buses

Figure 18: Alternative Six Morning Deployment Model

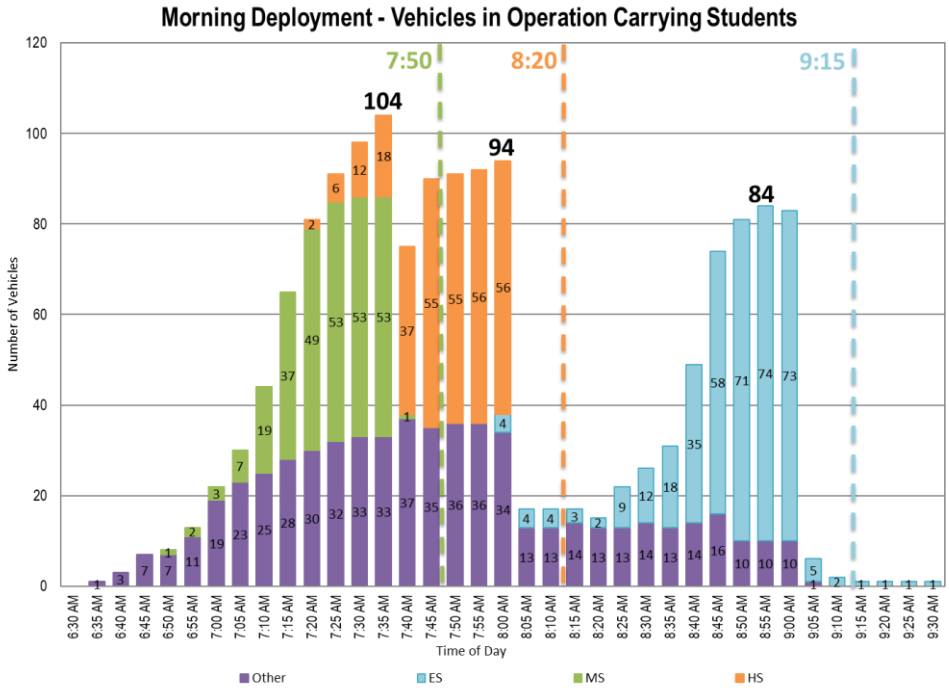
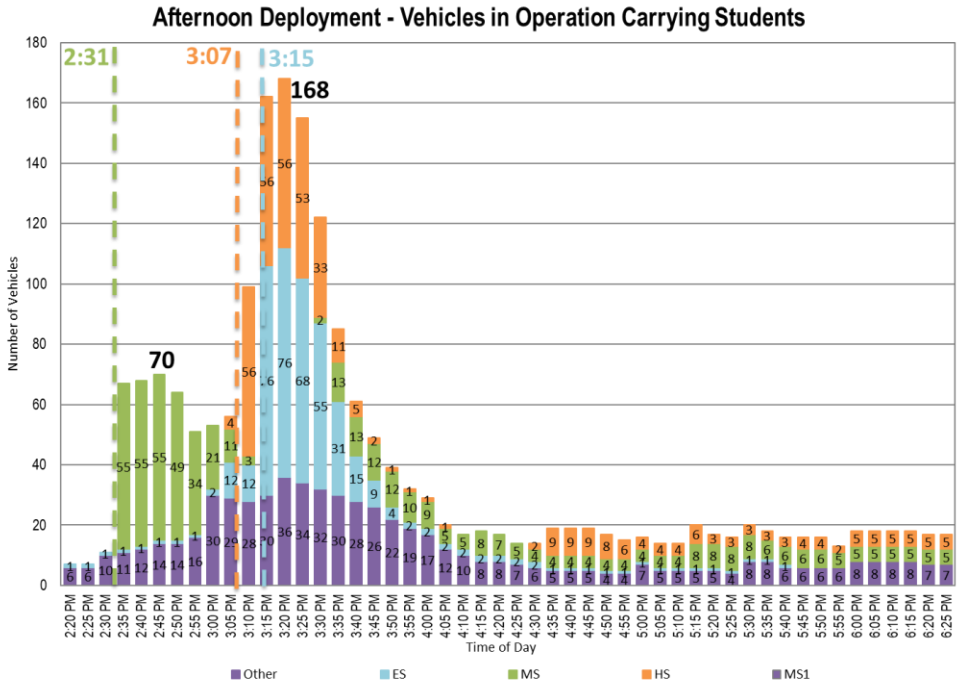


Figure 19: Alternative Six Afternoon Deployment Model



Alternative Six B

Alternative six went through several variations to determine if minor adjustments to bell times within in this tier sequence would present a reduction in the number of additional buses required. **Figure 20 and 21** illustrate the results of alternative six B. This variation moved middle and high start times earlier and elementary times later. The purpose of these adjustments are to alleviate the overlapping demand for high and elementary schools in the afternoon. These adjustments provide a potential no cost solution.

Pros	Cons
• High school is moved to the start time of 8:10 AM • Elementary early pick-up program is unaffected • Potential no cost solution	• Elementary times are moved 10 minutes later • Middle school start times are moved 20 minutes earlier • High school afternoon activities will be pushed back by 31 minutes

Figure 20: Alternative Six B Morning Deployment Model

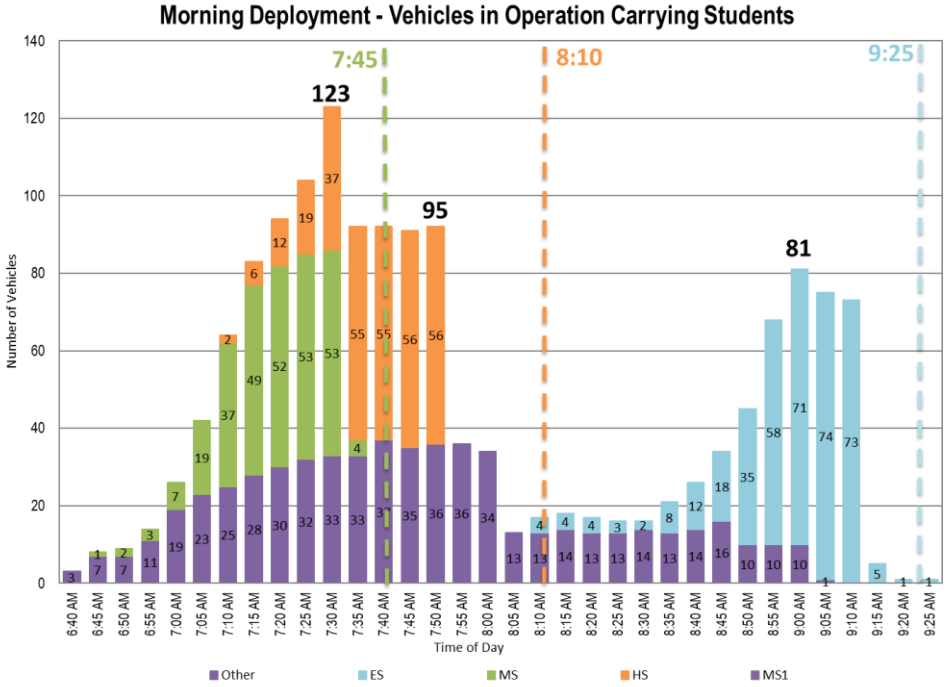
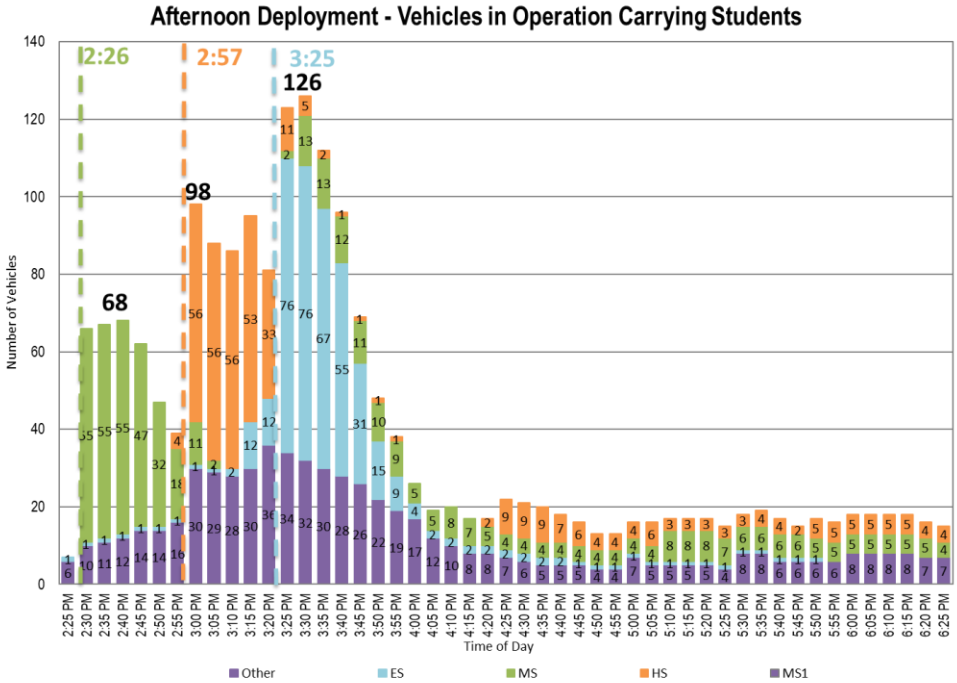


Figure 21: Alternative Six B Afternoon Deployment Model



Athletics Trips

In addition to home to school transportation, SCSD also provides transportation services to students who participate in athletics. While SCSD utilizes separate buses, for home to school services and athletic trip services, SBC examined the athletic trips for the 2017-2018 school year to determine if there would be additional overlap in bus services if bell times were adjusted. During the 2017-2018 school year SCSD averaged 6.5 athletic trips daily with 20 trips occurring in a single day as the maximum. The peak period of athletic trips occurs between 2:45 PM and 7:00 PM, which coincides with the peak period of buses performing home to school services. If bell time changes due occur, athletic trips will continue to overlap home to school services but will not affect the number of buses utilized as SCSD utilizes separate buses for athletic trips.

SCHOOL BUS CONSULTANTS

Conclusions and Recommendations

SCSD desires to revise their bell schedule to move Syosset High School closer to the recommended Start School Later guidelines of 8:30 AM school start time. The science behind the sleep research is clear on the benefits of later start times for high school students. However, constraints identified by SCSD and used by SBC for development of alternative bell times, eliminates several potential options. SBC has submitted twelve alternative bell time options to SCSD.

Metrics	Current	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Bell Times	HS: 7:39-2:26 MS: 8:05-2:46 ES: 9:15-3:15	MS: 8:05-2:46 HS: 8:30-3:17 ES: 9:15-3:15	HS: 8:30-3:17 ES: 9:00-3:00 MS: 9:30-4:11	MS: 7:55-2:36 HS: 8:25-3:12 ES: 9:35-3:35	MS: 8:05-2:46 HS: 8:10-2:57 ES: 9:25-3:25	MS: 8:00-2:41 HS: 8:05-2:51 ES: 9:20-3:20
Bell Change Description	N/A	Require ES early pick-up program revisions	Move MS to last tier	Move ES to later starting time	Consolidate MS and HS runs, move ES later start	Move MS earlier Consolidate MS and HS runs, move ES later start
Peak AM Deployment	93	126	116	125	145	146
Peak PM Deployment	128	179	123	139	142	136
Transportation Window	2 hours 25 minutes	1 hour 41 minutes	2 hours 11 minutes	2 hours 39 minutes	1 hour 59 minutes	1 hour 59 minutes

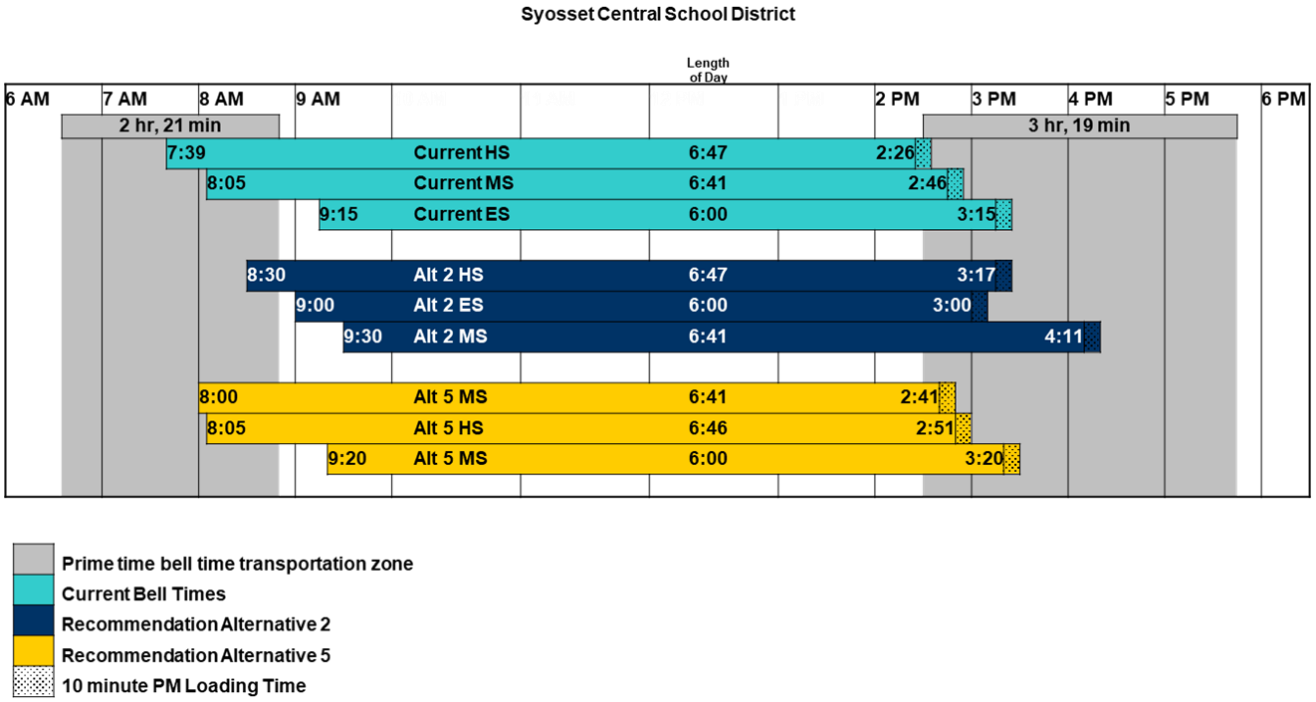
Metrics	Alt 6	Alt 6B
Bell Times	MS: 7:50-2:31 HS: 8:20-3:07 ES: 9:15-3:15	MS: 7:45-2:26 HS: 8:10-2:57 ES: 9:25-3:25
Bell Change Description	Move MS earlier	Move MS earlier and Es later
Peak AM Deployment	104	123
Peak PM Deployment	168	126
Transportation Window	2 hour 9 minutes	2 hour 39 minutes

For example, earliest bus stop arrival time, a constraint identified by SCSD precluded flipping the elementary and high school tiers as it would require elementary students to arrive at bus stops too early. Comparably, as illustrated in alternative one, constraining the transportation window in the morning to 8:05 AM-9:15 AM consolidates the available time for buses to complete runs. This constraint of decreasing the transportation window is problematic as it would increase the need for bus drivers by 43 percent rendering this option too costly and operationally difficult as there also is a national shortage of bus drivers, further complicating this potential solution.

Based on our research and analyses of SCSD transportation operations, SBC concludes it's feasible for SCSD to change high school starts times. However, to accommodate this goal without a significant increase in transportation cost, SBC recommends SCSD move beyond the stated constraint that limits the latest school start to 9:30 AM as illustrated in alternative two. Doing so would require the District to discontinue the early morning elementary runs, but will satisfy the District's goal of moving the high school's beginning bell time to 8:30 AM, potentially with no additional transportation costs.

If SCSD decides to keep the constraints required in alternative two, SBC recommends alternative five as this alternative minimally alters middle school and elementary school bell times, impacts high school after school activities by only 26 minutes, and provides SCSD the best opportunity to efficiently utilize the bus fleet by consolidating middle school and high school runs where possible. The figure below illustrates the current bell time structure in comparison with the recommended alternatives.

The options presented to SCSD throughout this process represent the available alternative options. The recommendations above represent the most viable options for SCSD as other alternatives presented will have a larger impact to transportation costs, start times for other schools, the length of the instructional day, or other areas such as extracurricular programming. If SCSD elects to choose an alternative other than the recommendations presented, the District must determine which additional compromises they are willing to accept to move forward.

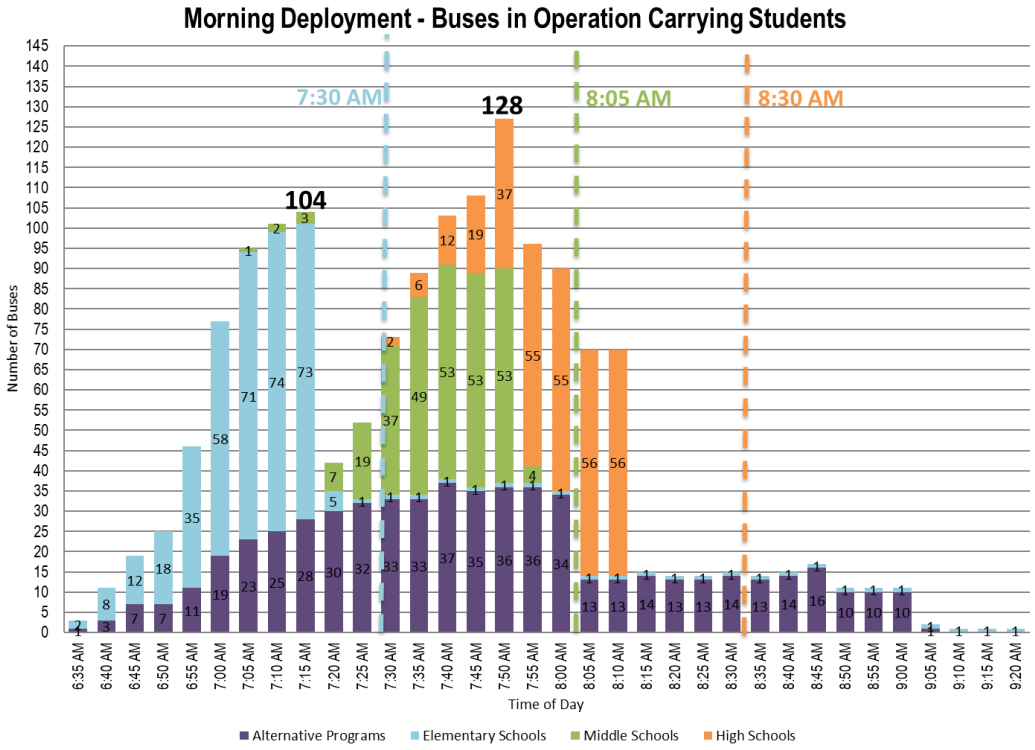


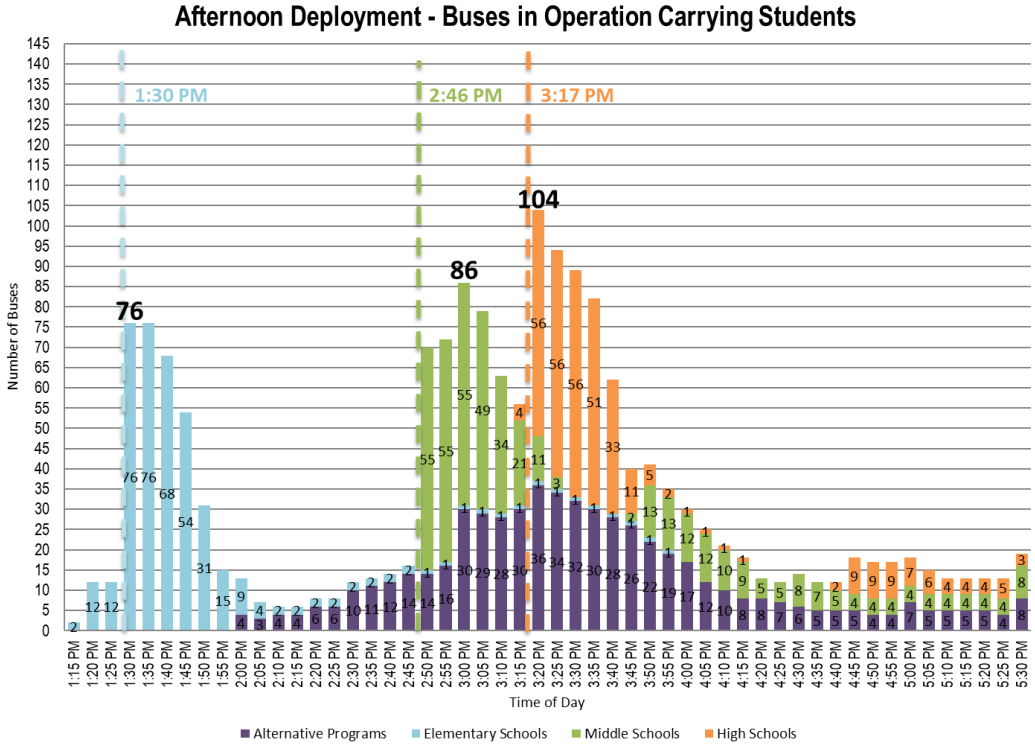
Appendix

The following text and figures contain a number of the additional alternatives that were presented to SCSD staff throughout the analytical process. Due to specific constraints such as elementary schools starting prior to 8:00 AM and extending the elementary school's length of day, these alternatives were deemed unviable by District staff and were not included in the main text of the report.

Alternative Seven

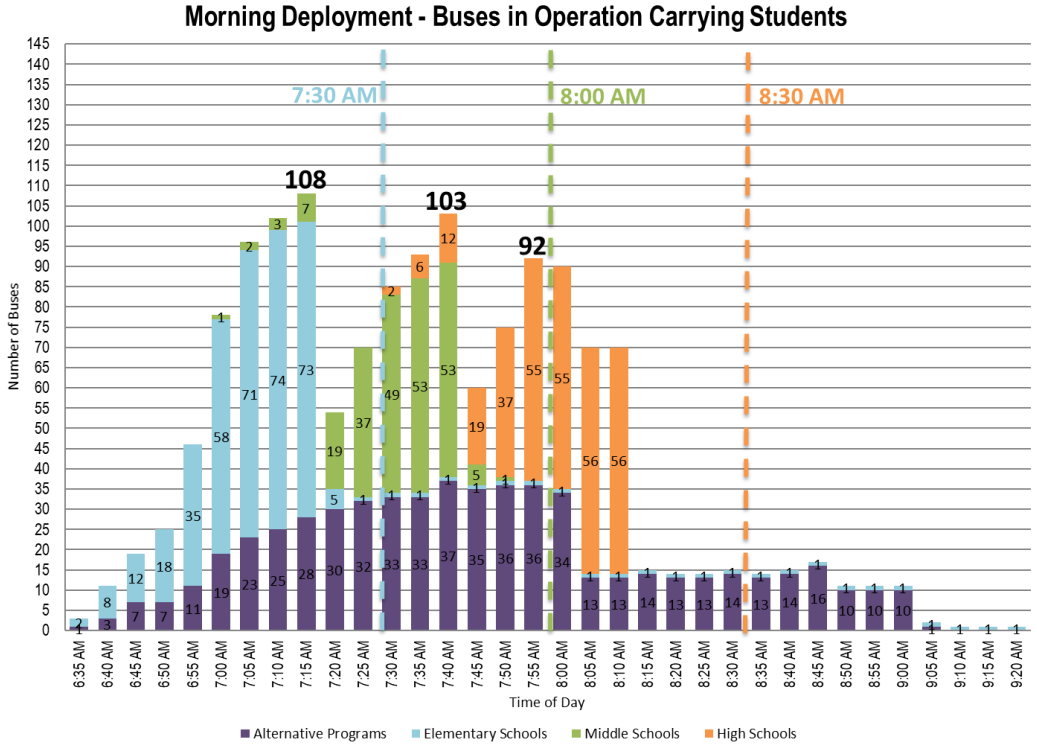
This alternative flips the elementary and high school tiers with the middle school tier remaining the same. This first tier for this alternative would be elementary, which would start at 7:30 AM and end at 1:30 PM. The second tier would be middle school starting at 8:05 AM and would end at 2:46 as is consistent with the current structure. The last tier will be high school, with a starting time of 8:30 and ending at 3:17 PM. Below illustrates the morning and afternoon deployment models for alternative one. The morning deployment model has a peak deployment of 128 buses and the afternoon deployment model has a peak deployment of 104 buses. The current peak deployment for the bell time structure is 128 buses in the afternoon, but as mentioned before, the current afternoon data is inflated due to data inconsistencies. This alternative would require an increase of buses to accommodate the morning runs by 15 buses. This alternative and the remaining alternatives that follow do not include the elementary early runs, as these would not be possible with elementary as the first tier. In addition to the increase in required resources, after school activities for high school students would be impacted, as high school students would be released 51 minutes later than under the current structure.

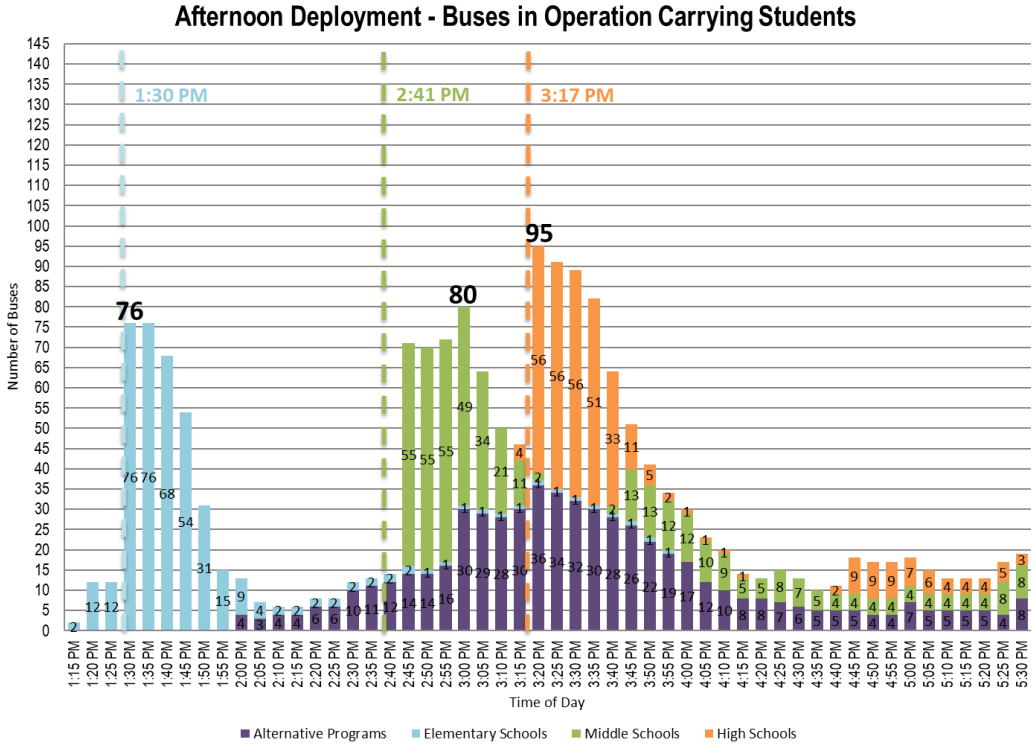

Morning Deployment - Buses in Operation Carrying Students
Number of Buses
Time of Day
7:30 AM
8:05 AM
8:30 AM
104
128
Alternative Programs
Elementary Schools
Middle Schools
High Schools


Afternoon Deployment - Buses in Operation Carrying Students
Number of Buses
Time of Day
1:30 PM
2:46 PM
3:17 PM
76
86
104
Alternative Programs
Elementary Schools
Middle Schools
High Schools

Alternative Eight

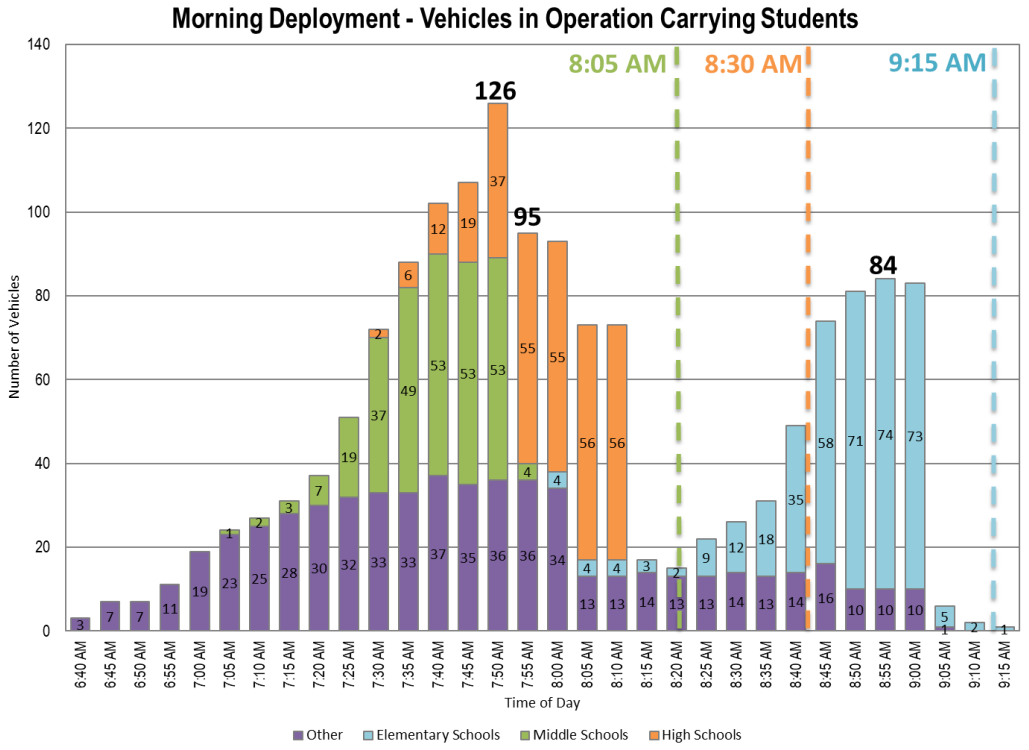
Alternative eight is similar to alternative one in that the sequence for elementary and high school are flipped. In addition to switching the sequence of the tiers, the bell time for the middle school tier adjusted to start and end five minutes earlier. The first tier for this alternative would be elementary, which would start at 7:30 AM and end at 1:30 PM. The second tier would be middle school starting at 8:00 AM and ending at 2:41. The last tier would be high school, which will start at 8:30 and end at 3:17 PM. Below illustrates the morning and afternoon deployment models for alternative eight. The morning deployment model has a peak deployment of 108 buses and the afternoon deployment model has a peak deployment of 95 buses. This alternative could result in a potential decrease of buses that would be required to accommodate transportation operations. This alternative, however, would affect every student within the SCSD school system in that bell times for each school would be modified.

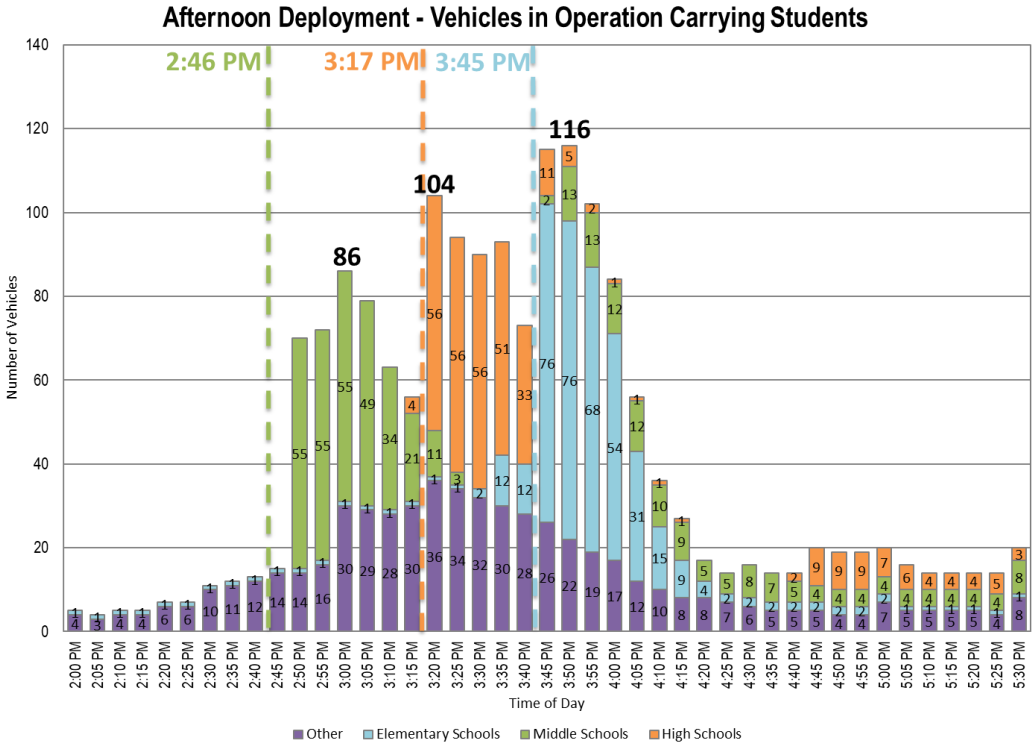




Alternative Nine

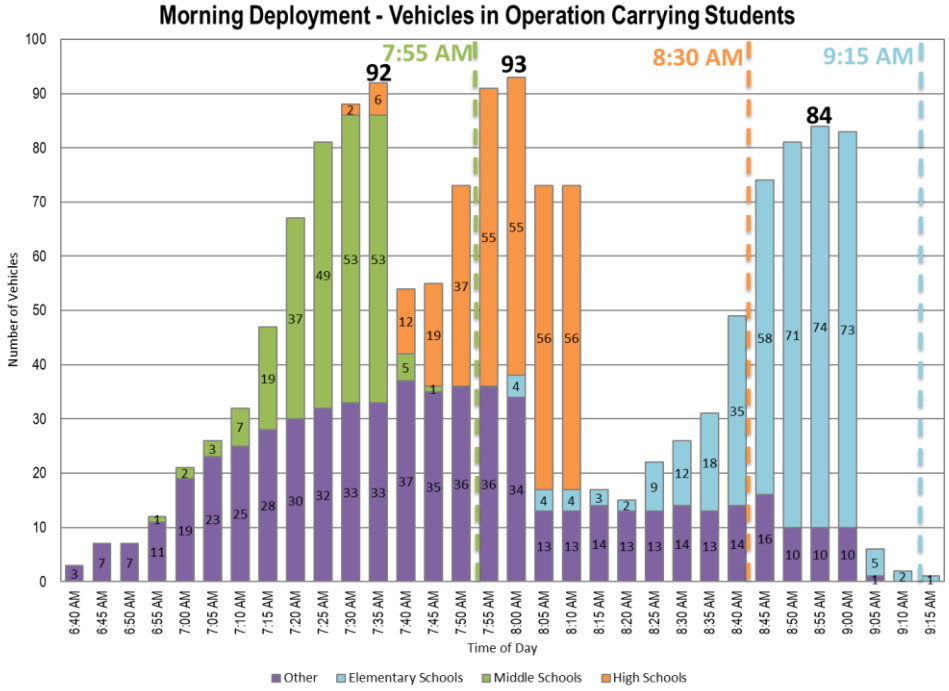
This alternative adjusts the tier sequencing with middle school as the first tier, maintaining its current bell time starting at 8:05 AM and ending at 2:46 PM. The second tier would be high school starting at 8:30 AM and ending at 3:17 PM. The third tier would keep elementary schools in their current spot and would maintain its current start time of 9:15 AM, but the end time would be changed to 3:45 PM. This alternative relies on extending the instructional day for elementary schools by 30 minutes. Below illustrate the morning and afternoon deployment models for this alternative. The morning deployment model has a peak deployment of 126 buses and the afternoon deployment model has a peak deployment of 116 buses. The additional 30 minutes of instructional time for elementary schools in the afternoon increases the amount of "work time" between the 2nd and 3rd tier and results in the majority of the elementary runs occurring as the peak need for alternative runs subsides. This alternative would potentially increase the number of required route buses by 8.

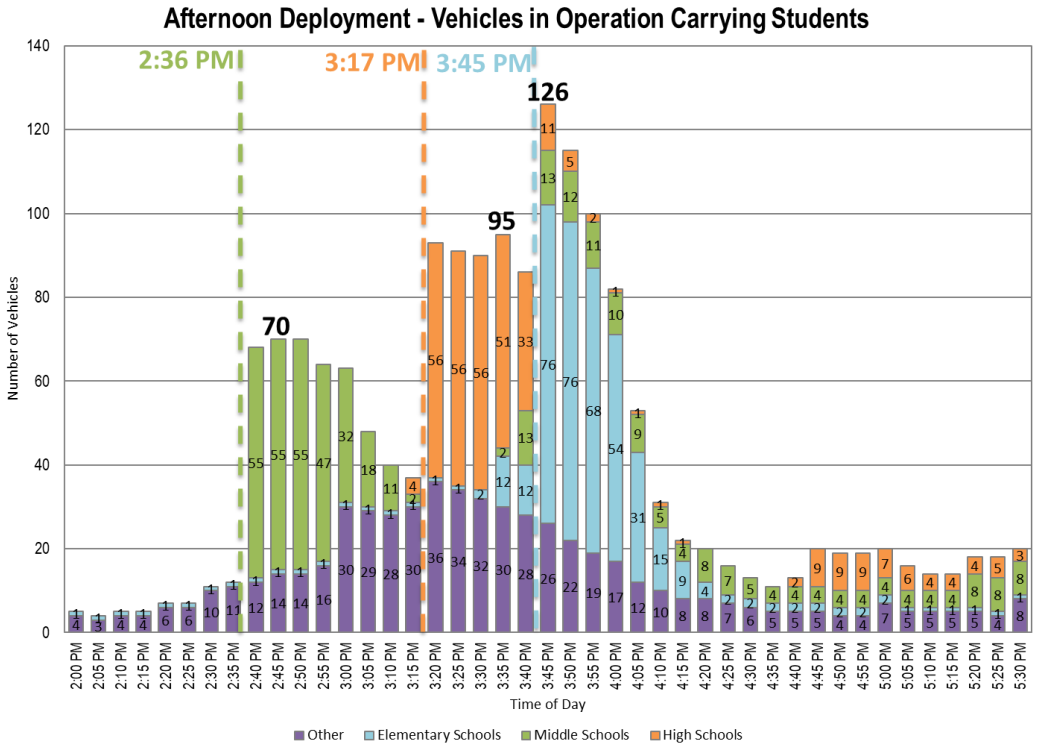

Morning Deployment - Vehicles in Operation Carrying Students
8:05 AM
8:30 AM
9:15 AM
126
95
84
Number of Vehicles
Time of Day
Other
Elementary Schools
Middle Schools
High Schools


Afternoon Deployment - Vehicles in Operation Carrying Students
2:46 PM
3:17 PM
3:45 PM
116
104
86
Number of Vehicles
Time of Day
Other
Elementary Schools
Middle Schools
High Schools

Alternative Ten

The tier sequencing in alternative ten would start with middle school and follow with high school and elementary schools respectively. The start and end time for middle school would be moved earlier by 10 minutes with a starting bell occurring at 7:55 AM and an ending bell at 2:36 PM. The second tier would be high school starting at 8:30 AM and ending at 3:17 PM. The third tier would keep elementary schools in their current spot and would maintain its current start time of 9:15 AM, and maintain the 30 minute length of instructional day extension as in alternative four, resulting in an afternoon bell time of 3:45. Below illustrates the morning and afternoon deployment models for this alternative. The morning deployment model has a peak deployment of 93 buses and the afternoon deployment model has a peak deployment of 126 buses. Moving the middle school earlier by 10 minutes provides additional "work time" for a total of 35 minutes between the 1st and 2nd tier. This alternative would keep the morning route needs consistent with the present structure and potentially reduce the number of buses required in the afternoon.




Afternoon Deployment - Vehicles in Operation Carrying Students
2:36 PM
3:17 PM
3:45 PM
126
95
70
Number of Vehicles
Time of Day
Other
Elementary Schools
Middle Schools
High Schools

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