Later Start Times for Fairfax Schools Part II
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In May 2006, LWVFA examined the issue of later high school start times and the Management Partnership Services, Inc. (MPS) January 2006 Phase 1 report to the FCPS School Board. In that report, MPS estimated the cost of later high school start times to be $44 million. In its December 2006 Phase 2 report, MPS lowered the worst case estimate for later high school start times to $9.2 million. This material will summarize the May 2006 program and the MPS Phase 2 report. The May 2006 program can be found at http://www.lwv-fairfax.org/May06ProgTopicSleep.pdf Note: Since Fairfax City contracts with FCPS for services, any changes will also affect them.

SUMMARY OF LWVFA LATER START TIME PROGRAM (JUNE 2006)

FCPS Task Force
In 1997, the School Board created a Task Force to Study High School Opening Times. They found that adolescents generally are not getting the nine hours of sleep they need and that sleep deprivation has a negative impact on learning, health, and academic performance. Teenagers, who do not get enough sleep, are at risk for automobile crashes, depressed moods, and problems with peer and adult relationships. The Task Force recognized that later high school and middle school start times can reduce unsupervised after-school time, potentially lessening criminal and other dangerous behaviors. However, accommodating student activities, athletics, and work hours were major considerations for which it had no satisfactory solution. The Task Force recommended that technical and strategic expertise beyond what is available to FCPS should be considered to facilitate transportation improvements and/or enable changes in bell schedules. They also noted that the sheer size of the school division and its interrelated and interdependent programs and activities was an additional constraint affecting bell changes. Smaller school districts, which have changed their bell schedules, did not face the massive transportation constraints which impede FCPS's efforts.

Sleep Research
Adolescents have more difficulty going to bed early and waking up in the morning than younger children. This is because our biological clocks govern our circadian rhythms—the daily cycles of alertness alternating with sleepiness. The alertness period of the cycle is strong enough to keep people awake when they should be exhausted—an effect very familiar to jet-lagged travelers and night-shift workers. Circadian rhythms differ among age groups—teenagers' cycles of alertness and drowsiness undergo a phase-delay that makes them wide-awake when their younger siblings–and their parents-are falling asleep.

The hormones of puberty also can reset the biological clock; in fact, one of the first signs of puberty is a change in sleep schedule. Melatonin, the hormone that tells the body to prepare for sleep, is secreted later in the evening for adolescents than for younger children. The average teenager's fall-asleep time is around 11 p.m. This pushes the natural wake-up time later, and students with early classes experience elevated melatonin levels into the school day. Teenagers need 9-10 hours of sleep per night to be at their best both physically and mentally. On average, teens are getting about 7½ hours of sleep on school nights. Twenty-five percent of kids are getting 6½ hours of sleep or less.

Teens are building huge sleep deficits, night after night. Teenagers can't make up for all their lost sleep by sleeping in on the weekends. Sleep deprivation is cumulative. The lack of sleep must be made up or paid back in order for optimal brain functioning to occur. However, sleeping longer than a couple of hours past one's usual wake-up time can wreak havoc on the adolescent biological clock, making the Monday morning return to school more difficult than ever.

The University of Minnesota's Center for Applied Research and Educational Improvement surveyed students regarding sleep, school, and lifestyle in three similar school systems—one of which had changed its start time. It was found that:

1. Students in the school with a later start time reported an almost identical bedtimes to that of students in other schools. Students with a later start time are not staying up any later because they know they can make up their sleep in the morning. Consequently, teens in schools that changed their start times were receiving about 5 hours more sleep a week than students in schools that had not made the switch.

2. Fewer students reported falling asleep in class, arriving late to school, and feeling tired during the day in the later-starting school than in other schools.

3. Students in all three districts who reported less sleep overall were the sleepiest in school and were the ones who reported receiving the lowest grades.

4. Students at the later-starting school reported higher grades overall than those in districts with earlier start times.

The consequences of sleep deprivation during the teenage years are particularly serious.   Learning suffers because sleep deprivation impairs the ability to be alert, pay attention, solve problems, cope with stress and retain information.   Other consequences include:

1. Increased risk of driving accidents, injuries and death

2. Increased likelihood of stimulants/substance abuse

3. Emotional and behavioral problems such as Irritability, depression, poor impulse control and violence.

Efforts in Fairfax County

In January 2004, an organization named SLEEP (Start Later for Excellence in Education Proposal) was started by two Fairfax parents, Phyllis Payne and Sandy Evans. Their goal is to change FCPS middle and high school start times to later in the morning to correspond with teen sleep needs and improve health, quality of life, and school performance.

In July, 2005, the School Board hired MPS, Inc. as a consultant to evaluate the current FCPS pupil transportation system, including an evaluation of the current 3-tier bell schedule, and recommend changes that would support later start times for secondary schools. "Over 117 thousand average daily transported students are bused using approximately 1,136 assigned buses on a three-tier bell schedule to 242 schools and educational programs," MPS stated in its Phase 1 report issued January 12, 2006.

Table 1: FCPS 3-Tier Bell Schedule

Tier	Morning Bell Start Times	Afternoon Bell End Times
1	7:20-7:30	2:10-2:20
2	8:00-8:35	2:50-3:10
3	8:45-9:15	3:20-3:50

Most high schools and middle schools start around 7:20 a.m. and elementary schools start around either 8:35 a.m. or 9:10 a.m. This allows a single school bus to handle up to three routes each morning and afternoon. The morning transportation window is 1 hour

and 55 minutes (from 7:20-9:15). But in the afternoon, the transportation window is only 1 hour and 40 minutes (from 2:10-3:50.) This is because elementary schools have an instructional day which is typically 20 minutes shorter than the secondary schools. Since the Tier 3 routes are primarily elementary schools, buses have 20 minutes less time to get from Tier 2 schools to Tier 3 schools

MPS studied several scenarios for changing the bus schedules to allow the high schools to start later. However, MPS had to incorporate specific assumptions and constraints from the School Board into their models. These included a requirement that high school start times be between 8 and 9 a.m. MPS' final scenarios, reported in January 2006 (Phase 1), changed the high schools' opening bell times to 8:30 a.m. This resulted in a combined estimated 51 percent increase in the number of buses required, with an estimated increase of $44 million in annual amortized capital and operating costs.

MPS cited four primary reasons why moving the high schools to the <u>middle tier</u> would result in a very significant increase in fleet size and transportation operating and capital costs.

1.The shorter instructional day in elementary school reduces the window of time available to pick students up at dismissal.

2.The constraint reducing the transportation window from approximately one hour and 55 minutes to one hour and 35 minutes will require additional buses.

3. The constraint that elementary school students can not be at bus stops before morning twilight requires additional bus routes to transport the same number of students.

4. Nontraditional programs greatly extend route times because buses must transport students across greater distances at lower passenger capacity utilization.

In its January 2006 report, MPS did not recommend adopting these costly scenarios. Instead, they recommended modeling the cost and service impact of a later high school start time under a different set of constraints and assumptions. On April 6, 2006, the School Board directed MPS to go ahead with a Phase 2 report.

At the end of the LWVFA May program material, members were asked if they would consider a concurrence in favor of later high school start times. Most units reported that they would like to hear the MPS Phase 2 report before dealing with concurrence. It is

important to note that the mission of MPS is to provide analytical resources to help solve student transportation issues. MPS services include evaluating bus routing and scheduling, and operations and fleet management. <u>MPS does not make or recommend policy or programmatic changes.</u>   Implementing a later school start time is a policy change, and MPS <u>does not</u> address whether this policy should be instituted in its report.

MPS PHASE 2 REPORT

The MPS Phase 2 report[1], presented to the School Board on December 11, 2006, covered two topics:
1. Reducing the load on the transportation system and
2. Later high school and middle school start times.
It concluded with an assessment of the impact of the alternatives. Following is a summary of that report:

TRANSPORTATION OPTIONS
According to MPS, "FCPS has one of the largest and most complex student transportation systems in the country, and does an excellent job utilizing student and transportation management information systems to assist in structuring and managing transportation service delivery*.*" But the Phase 1 study revealed that the FCPS transportation system has been pushed to the breaking point, and that any major additional service demands, absent relief in other areas, would cause the system to break down or, alternatively, require major new investment in additional capacity. In Phase 2, MPS was asked to study four transportation options:
Option 1: Eliminate busing for students attending out of boundary programs;
Option 2: Consolidate bus stops;
Option 3: Increase secondary school walking distance;
Option 4: Optimize school attendance boundaries to minimize transportation demands.

MPS evaluated these options to determine whether the <u>number of buses</u> required to operate the system could be reduced. The difficulty is that eliminating or modifying an individual bus route does not necessarily have a measurable impact on reducing the number of buses required to operate the system. Eliminating a route only eases the demands on the bus assigned to that route; it does not mean that the bus can be eliminated from the system.

Option 1. Eliminate Out Of Boundary Busing
The first option analyzed by MPS eliminated transportation for all students who are transported to magnet or gifted and talented (GT) programs outside their home school boundaries. Magnet and GT students are typically transported on routes along with other students attending the regular education programs of the host school. Eliminating magnet and GT student busing is therefore not simply a matter of isolating individual bus routes that carry these students and removing them from the system. The regular education students would still need to be accommodated on alternate routes. Despite this, eliminating transportation to out of boundary programs would have a significant favorable impact on reducing the number of buses required to operate the rest of the system.

Table 2: Number of Buses Needed for Option 1

	Now	With Out of Boundary Busing Eliminated	Change
Morning	*163*	*125*	*(38)*
Afternoon	*156*	*143*	*(13)*

*Note: In all cases, fewer buses can be eliminated in the afternoon routes because the shorter elementary school day decreases the afternoon transportation window.

Making out of boundary attendance at magnet and GT programs ineligible for transportation service will have an impact on the educational program goals of the school division, and the school board must determine if that is appropriate. Also, the intertwined nature of the bus route system is such that many existing and seemingly uninvolved route assignments would need to be adjusted at the same time this is implemented.

Option 2. Consolidate Bus Stops
Because the number of bus stops on a given route directly impacts both the running time and street track, reducing the number of stops may shorten a bus route, and the potential exists to reduce the number of buses needed to transport the same number of students. When planning the consolidated stops, MPS used the following constraints: only actual existing bus stops were used; stops were consolidated if the distance between them was less than three tenths (0.3) of a mile; stops for special education students were not eliminated; and stops at residences in hazardous locations were retained. The results indicated that over 25% of the stops would be eliminated, bus travel miles would be reduced 3.3%, and the average bus ride would be reduced 6.3%.

Table 3: Number of Buses needed for option 2

	Now	With Stops Eliminated	Change
Morning	163	156	(7)
Afternoon	156	155	(1)

With the stops eliminated, the average bus ride would be reduced by 4 minutes in the morning and by 10 minutes in the afternoon. In student transportation, even small changes in bus running time can have a significant impact on the cost of the fleet. The savings illustrated by this analysis would demand an enormous operational undertaking. The location of bus stops is a politically sensitive subject and reevaluating bus stop locations requires that careful standards of safety and placement be considered. Usually, this requires the creation of a task force and a considerable amount of public outreach. Therefore, the cost in goodwill and administrative effort needs to be weighed intelligently against the expected benefit in operational savings.

Option 3. Increase Walking Distances
This option examines the impact of extending the walk zone distance for secondary students from 1.5 miles to 2 miles. Where pedestrian access was obviously hazardous, natural barriers exist, or where only a small segment of a development was within the 2 mile limit, MPS reduced the extended walk zone appropriately. Increasing the walk zone distance produced a 63% increase in the number of walkers. An average of 2.6 bus routes would be eliminated for each middle school and 2.1 routes for each high school, for a combined 12% reduction in the number of bus routes.

Table 4: # of Buses Needed for Option 3

	Now	**With Increased Walk Zone**	**Change**
Morning	163	154	(9)
Afternoon	156	150	(6)

At first glance this would seem to provide a simple means of reducing the number of buses required. But, the stops which were eliminated were very close to the school and little, if any, route time reduction is associated with elimination of these stops. Also, any change to the walking zones would require a tremendous effort on the part of the transportation department and school administrative staff, and would require an extensive public outreach strategy. To achieve a real reduction in the number of fleet resources needed would also entail a complete restructuring of the bus routes at each of these schools, and this would require a system-wide restructuring.

Option 4. Optimize Boundaries
In this option, attendance boundaries were optimized to create more efficient bus routing. Because of the interdependent nature of attendance boundaries, any change to one boundary will create a concomitant change to the adjacent boundary. This "domino effect" would continue until every boundary in the school division was optimized. The school boundaries at FCPS have evolved over time to meet various programmatic and building resource demands, but this often was at the expense of topographically logical, contiguous borders around the schools. At first glance, it would appear that correcting these boundaries would yield a substantial savings in transportation. But, the analysis showed that the impact is less than might be expected. First, the actual time savings is small enough that it would not have a meaningful impact on fleet resources. Second, not all of the schools need to have modifications to their boundaries; only 67 out of 277 (24%) had boundary anomalies. Lastly, when one boundary is shifted to reduce the anomaly, another boundary may have to be extended to maintain the same number of students at each school.

ANALYSIS OF BELL TIME ALTERNATIVES
Taking advantage of the Phase 1 study results, the school board asked MPS to develop a rolling bell schedule that had schools sequenced as follows within a 1 hour and 45 minute bell window

First Bell	Elementary schools
Second Bell	All high and secondary schools, and elementary schools
Third Bell	All middle schools and remaining elementary schools

The school board also asked MPS to model at least one scenario including this bell schedule without any window constraint and without adding buses.

MPS developed and analyzed the following scenarios
Scenario 1: High Schools on Tier 2 with a 1 hour and 45 minute transportation window: first starting bell at 8:00 a.m., last starting bell at 9:45 a.m.
Scenario 2: High Schools on Tier 2 with a 1 hour and 35 minute transportation window: first starting bell at 8:00 a.m., last starting bell at 9:35 a.m.

Scenario 3: No new buses/no cost configuration - High Schools on Tier 2 with no predetermined transportation window: first starting bell at 8:00 a.m., last starting bell to be determined.

An additional constraint stated that elementary students should be picked up after morning twilight.

Table 5: # of Buses Needed for Scenario 1

	Now	Scenario 1	Change
Morning	163	151	(12)
Afternoon	156	171	+ 15

Table 6: # of Buses Needed for Scenario 2

	Now	Scenario 2	Change
Morning	163	171	+8
Afternoon	156	177	+21

Scenarios 1 and 2

MPS first examined the change in resources required to implement Scenarios 1 and 2:

In addition to the number of buses needed for the change, the starting and ending times of the bus routes, and the total running time for the buses must also be considered when analyzing the bell time alternatives.

Table 7: AM Route Start & End Time for Scenarios 1&2

Morning Analysis	Now	With Sc 1	With Sc2
Number of Buses	163	151	171
Earliest Route Starts	5:21 AM	6:34 AM	6:33 AM
Latest Route Ends	9:10 AM	9:40 AM	9:30 AM
Duration (hours,mins)	3H 49 m	3H 6m	2H 57m
Total Time (min)	15,809	15,469	15,190
Deadhead Time (min) (% of total)	3,152 19.9%	2,606 16.8%	2,452 16.1%

Table 8: PM Route Start & End Times for Scenarios 1 & 2

Afternoon Analysis	Now	With Sc1	With Sc2
Number of Buses	156	171	177
Earliest Route Starts	2:17 PM	2:40 PM	2:40 PM
Latest Route Ends	5.51 PM	6.20 PM	6:20 PM
Duration (Hrs Min)	3h 34 min	3h 40 min	3h 40 min
Total Time (Min)	17,492	17,294	17,096
Deadhead Time (% of Total)	2,408 13.8%	2,774 16.0%	2,566 15.0%

In both Scenarios 1 & 2, the Earliest Route Start time begins in the morning approximately 70 minutes later than under the present bell schedule. The Latest Route Ending times in both the morning and afternoon were approximately 30 minutes later than under the present bell schedule. Both Scenarios 1 & 2 had a decrease in deadhead time in the morning, but increased the deadhead time in the afternoon. Deadhead time is the amount of time required to link each route with the next route. In the morning, deadhead time is computed from the school at the end of the first route to the starting location of the second route. In the afternoon, deadhead time is computed from the end of the first route to the school where the second route begins.

In both Scenarios 1 & 2, fewer buses were able to handle three or four routes in the afternoon. As a result, in Scenario 1, the change in resource requirements decreased in the morning by 7%, but increased in the afternoon by almost 10%. In Scenario 2, the resource requirements increased by approximately 5% in the morning and 13% in the afternoon. The differing impact in the morning and afternoon is caused primarily by the shorter instructional day (approximately 20 minutes) at the elementary schools.

Scenario 3

In this Scenario, which had the requirement that the resources remain fixed, the results are as follows:

Table 9:AM Route Start & End Times for Scenario 3

Morning Analysis	Now	With Sc 3
Number of Buses	163	163
Earliest Route Starts	5:21 AM	6:31 AM
Latest Route Ends	9:10 AM	9:50 AM
Duration (Hours Min)	3 Hrs 49 mins	3 Hrs 19 min
Total Time (Min)	15,809	16, 346
Deadhead Time (min)	3, 152	3,046
% of Total	19.9%	18.5%

Table 10: PM Route Start & End Times for Scenario 3

Afternoon Analysis	Now	With Sc 3
Number of Buses	156	163
Earliest Route Starts	2.17 PM	2.57 PM
Latest Route Ends	5.51 PM	6.32 PM
Duration (hours Min)	3h 34 mins	3h 35 min
Total Time (min)	17,492	16,866
Deadhead Time (min)	2,408	2,489
% of Total	13.8%	14.8%

In Scenario 3, the Earliest Route Start time is also 70 minutes later than the present schedule, but the buses arrive at the schools later than under Scenarios 1 and 2. In the afternoon, the first buses depart later and the last routes end later than under Scenarios 1 and 2. The standout aspect of Scenario 3 is the impact that the constraint on fixed resources has on the dismissal times. According to MPS, the requirement to not add additional resources can be met, but only if a time penalty is accepted in the form of later dismissals. The latest schools would dismiss at 4:35 p.m., 15 minutes later than the latest dismissal in Scenario 1. With scenario 3, if FCPS does not wish to add buses and not want any school to start before 8:00 a.m., it will be forced to add time and have some students dismiss at rush hour in the afternoon.

*Note: The Scenario 3 Bell Schedule does not conform with the School Board's request for elementary schools to be on Tier 1, high schools to be on tier 2 and middle schools to be on Tier 3. Putting elementary schools on the first tier can eliminate some of the transportation problems associated with the shorter instructional day, but would result in an additional cost of 20 minutes +/- daily for every driver,as they waited for the secondary schools to release. This was incompatible with a no cost scenario.[2] MPS also put a middle school on Tiers 1 & 2 in Scenario 1 and 2.

Using a sample of 23 schools in three pyramids MPS developed new bell schedules for each scenario:

Table 11 Proposed Bell Schedule (23 school sample)

	Now	Scenar 1	Scenar 2	Scenar 3
Tier 1	**3 High** 7:20-2:10 **3 Middle** 7:30- 2.20	**9 Elem** 8:00-2:35 to 8:35-3:10 **1 Middle** 8:20-3:10	**9 Elem** 8:00-2:35 to 8:35-3:10 **1 Middle** 8:20-3:10	**3 High** 8:04-2:55 to 8:27-3:17 **3 Middle** 8:00-2:50
Tier 2	**10 Elem** 8:10-2:50 to 8:35-3:10	**3High** 8:50 -3:40 **2 Middle** 8:55 -3:45	**3High** 8:50 -3:40 **2 Middle** 8:55 -3:45	**10 Elem** 8:45-3:26 to 9:18 3.54
Tier 3	**7 Elem** 9:00-3:35 to 9:15-3:55	**8 Elem** 9:35-4:10 to 9:45-4:20	**8 Elem** 9:35-4:15	**7 Elem** 9:43-4:19 to 9:55-4:30

Under any of these scenarios, FCPS would be required to develop a new system for transporting students to Thomas Jefferson High School for Science and Technology in in the morning.

IMPACT OF THE ALTERNATIVES

Changes to the bell time structure, expanding walking distances, redistricting school boundaries, consolidating bus stops, and limiting or eliminating transportation to non-traditional and enhanced educational programs that operate division-wide each have a distinctive and collective impact on the cost of transportation and on the quality and convenience of the service being provided. Importantly, any of these changes by themselves will influence a highly interlinked system such as FCPS in systemic way. A change in one will unavoidably lead to changes in the others.

Based on the total current regular education transportation cost of 68.5 million, the annual cost impact for each of the seven options examined in phase 2 are summarized in the table below:

Table 12: Estimated Cost of Various Options/Scenarios

Option/ Scenario	Cost Impact (000,000)
Option 1 Eliminate Out-of Boundary	($8.4)- ($5.7)
Option 2 Consolidate Bus Stops	$0 - ($2.9)
Option 3 Increase Secondary Walk	($0.9) -($3.7)
Option 4 Optimize School Boundaries	($2.2) - ($7.5)
Scenario 1 H.S. to Tier 2: 1 h 45 m	($3.4) - ($6.6)
Scenario 2 H.S. to Tier 2 1hr 35 min	($5.9) - ($9.2)
Scenario 3 : H.S. to tier 2 : No Cost /bus	$ 0000

The results for options 1 – 4 indicate that savings can be achieved. MPS estimates the potential savings to be between 0-8% of current transportation costs. The results for the bell time alternatives indicate that later secondary school start times can be accomplished for an incremental cost increase of 10-13%. Combining service level reductions in some areas (e.g., consolidating bus stops) with increases in others (e.g., shifting secondary school start times) can potentially be achieved with a reasonable increase in expenditures.

While appearing financial feasible, there are practical constraints. None of the proposed changes can be implemented individually without a concurrent reengineering of the entire transportation system. As a result, MPS recommends proceeding with extreme caution and with a long-term commitment in mind. The School Board must be prepared to reconsider the basic transportation guidelines system-wide, and to assume significant risk over a multi-year reengineering effort that will fundamentally change the entire transportation system.

MPS does not recommend whether the FCPS should implement the changes evaluated. These are policy and programmatic decisions that extend well beyond questions of transportation cost or service quality. In a transportation system context, however, MPS strongly recommends against implementation   unless the School Board is prepared to undertake the following:
1. Establish and support a comprehensive rewrite of transportation policies including, but not limited to: eligibility criteria (by program, student type, etc.); walk distance to school; walk distance to stops; etc.
2. Defend against exception-based policy changes;
3. Permit a comprehensive reengineering of the transportation system to be undertaken in simulation, using the revised policies and desired bell times as the basis; Consider input from this simulation exercise in the establishment of optimal bell times, given base starting parameters for start times by school type.
4. Allow for a minimum of two school years to undertake the reengineering effort before any implementation (pilot program or system-wide) is considered.

NEXT STEPS FOR FCPS
On February 8, 2007 the School Board voted to add $300,000 as a placeholder in the FY 2008 budget for the purpose of addressing the MPS recommendations. At a School Board work session held February 12, board members told the staff that they did not support further study of options to eliminate busing for out of boundary programs or to increase the secondary school walking distance. Dean Tisdadt, the chief operating officer of the Department of Facilities and Transportation Services, said that his staff was already working on consolidation of bus stops.[2]

CONCLUSION
The MPS report discusses logistical considerations, financial costs, and political ramifications. It does not address the students themselves or their needs. It does not consider adolescent sleep patterns, the effects of sleep deprivation, the hours when adolescents are most alert and receptive to learning, or whether the benefits of adequate sleep outweigh the logistical challenges inherent in revising school schedules. FCPS will be reengineering its transportation system over the next few years and will have to decide soon if later start times should be incorporated.

Endnotes
[1] "Transportation Options and Phase 2 Bell Time Analysis for the Fairfax County Public Schools," Management Partnership Services, Inc., 9710 Traville Gateway Drive, #363, Rockville MD 20850, December, 2006.
[2] .Linda Farbry, FCPS Office of Transportation Director e-mail to author 3-5-07.
[3] Ginger Shea, note to author, February 26, 2007