Potential Bell Time Study
Prepared for
Middleton-Cross Plains Area School District
Middleton, WI

Submitted by:

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Executive Summary

Transfinder Professional Services was contracted to offer suggestions for school bell times. This study provides an initial platform for the Middleton-Cross Plains Area School District 2014-2015 school year. The study considers providing like bus service next year while the district considers moving 5th grade students to the middle school level while addressing transportation service issues.

The objective of this bell time study is to minimize the impact that changing grade levels has on overall route demands. Transfinder Professional Services team has completed five new bell time scenarios to address these concerns. All of the scenarios cannot be considered cost neutral since they will likely impact transportation operational expenses. The goal of these scenarios is to minimize the number of individual buses that are operated by the district daily.

Key Performance Indicators

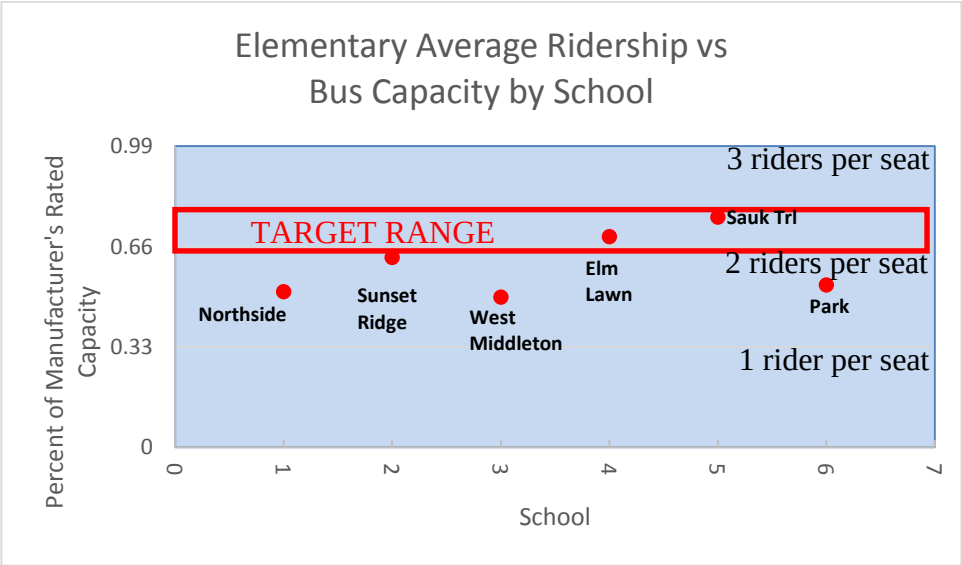
Key Performance Indicators (KPIs) are a measurement of your current transportation operation. KPIs allow you to compare your operational performance year after year. They can also provide a comparison of your own performance in relation to other school districts of similar size, if that information is available. This report provides the baseline for you to use in further comparisons.

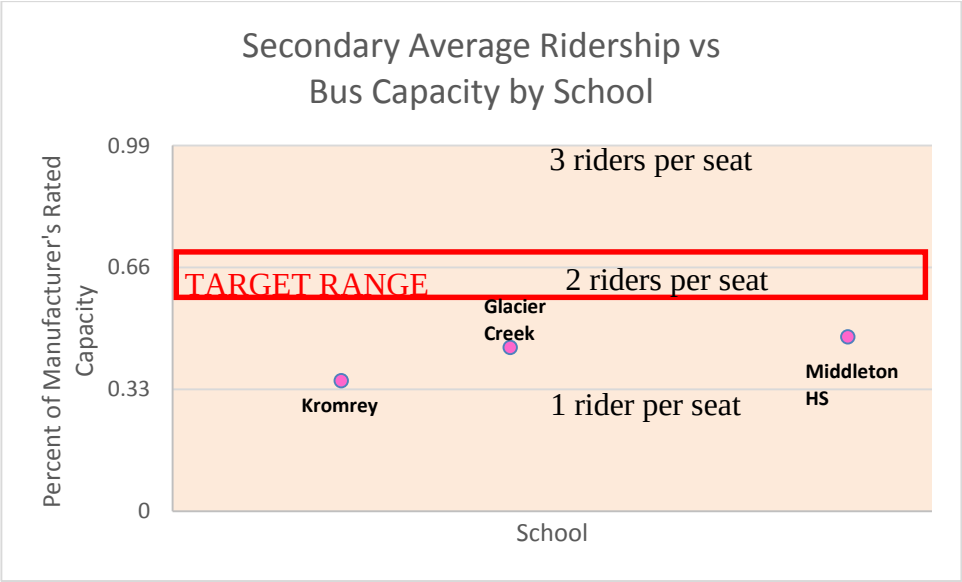
School bell times and student ride time form the basis for routing efficiency. The more time the bus has to pick up or deliver students, increases the potential for completely utilizing every bus. The following chart shows the run times with the "dead head time" to and from the parking lot included. The buses are shown on the vertical axis and run minutes are shown on the horizontal axis.

The daily ridership numbers were based on the highest number of riders actually boarding the buses over a period of time taken from district records. Actual daily ridership numbers are typically lower than counts where riders are counted that may not ride daily.

The following charts show the utilization of the buses by school based on manufacturer's rated capacity for each bus. The rated capacity places 3 students on every bus seat which is not possible for buses serving secondary grades. An acceptable range for elementary grade trips is

between 66% and 80% of capacity. Likewise, an acceptable range for secondary trips is between sixty percent and seventy percent. Sixty-six percent of capacity is 2 riders per seat and 80% is approximately 3 riders per seat for ½ the bus and 2 riders per seat for the rest.





The charts indicate that several schools are below the target range. Trips below target range are typically facing restrictions by the pickup and delivery windows available to the Transportation Department. The true test for maximum efficiency is to evaluate ridership versus bus capacity by school using the same criteria as in the above charts.

The following chart shows actual student riders by school with both current trips and potential trips if adequate time is allotted between school bells to allow all trips to be completed between bell tiers. The chart shows the absolute maximum potential savings that the district could realize if time and student ride length were not considered. This chart does not address potential grade level changes being considered by the district for next school year.

	Riders	Runs	Potential Runs	Delta
Northside	218	6	5	-1
Sunset Ridge	488	11	10	-1
West Middleton	386	11	8	-3
Elm Lawn	295	6	6	0
Saulk Trail	215	4	5	1
Park	303	8	7	-1
Totals	1905	46	41	-5
Kromrey	402	16	9	-7
Glacier Creek	535	17	12	-5
Totals	937	33	21	-12
Middleton HS	805	24	17	-7
Total	805	24	17	-7
Total Potential Bus Reduction				-5

There is a secondary service issue that the district is currently experiencing. Several buses are either delivering students early or arriving to take them home late every day. The following chart shows the scheduled times for service at schools taken from district data. The times shown in this chart do not reflect student ride time. This chart shows bus travel time which is considerably longer than student ride time.

	school	end	school	end	school	end
4			Glacier Creek	7:50		
5			Glacier Creek	7:37		
6	Middleton HS	7:36	Kromrey	7:33	West Middleton	8:10
7	Middleton HS	7:40	Kromrey	7:45	Sauk Trail	8:10

8	Middleton HS	7:35			Elm Lawn	8:10
9			Kromrey	7:25	West Middleton	8:10
13					Sunset Ridge	8:10
18			Glacier Creek	7:50	Sunset Ridge	8:10
20	Middleton HS	7:24			Elm Lawn	8:07
21	Middleton HS	7:26	Kromrey	7:32	Northside	8:10
22	Middleton HS	7:35	Kromrey	7:39	Sunset Ridge	8:10
23	Middleton HS	7:27	Kromrey	7:23	Sunset Ridge	8:10
27			Glacier Creek	7:40	Sunset Ridge	8:10
28	Middleton HS	7:30			Northside	8:07
29	Middleton HS	7:32	Kromrey	7:38	Elm Lawn	8:05
30			Glacier Creek	7:55		
31					Park	8:10
34	Middleton HS	7:34	Kromrey	7:29	Sauk Trail	8:10
35			Glacier Creek	7:52	Park	810
36	St Peters	7:50				
37	Middleton HS	7:23	Kromrey	7:42	Elm Lawn	8:05
38			Glacier Creek	7:45		
48			Glacier Creek	7:48	Park	8:10
54	Middleton HS	7:32			West Middleton	8:10
55	Middleton HS	7:27			Northside	8:10

Scheduled more than 30 minutes before the bell

Scheduled 10 or fewer minutes before the bell

Scheduled 10 minutes after the bell

56	Middleton HS	7:32			Sunset Ridge	8:10
57	Middleton HS	7:25			West Middleton	8:10
58					Park	8:10
59	Middleton HS	7:40	Kromrey	7:35	Sauk Trail	8:10
62					West Middleton	8:10
63			Glacier Creek	7:52	Park	8:10
64			Glacier Creek	7:51	Park	8:10
65	Middleton HS	7:40	Kromrey	7:38		
66					West Middleton	8:10
74					Sunset Ridge	8:10
77			Glacier Creek	7:39	Sunset Ridge	8:10
78			Glacier Creek	7:42	St Francis	7:55
79	Middleton HS	7:28			Sauk Trail	8:03
80			Glacier Creek	7:55	Park	8:10
81	Middleton HS	7:34	Kromrey	7:30	Northside	8:10
82	Middleton HS	7:27	Kromrey	7:23	Elm Lawn	8:05
83			Glacier Creek	7:55	St Francis	7:41
84	Middleton HS	7:25			Sunset Ridge	8:10
85	Middleton HS	7:30			Sunset Ridge	8:09
Route	school	start	school	start	school	start
4	Glacier Creek	3:30			West Middleton	3:05
5	Glacier Creek	3:33				
6	Kromrey	3:33	Middleton HS	3:38	West Middleton	3:05

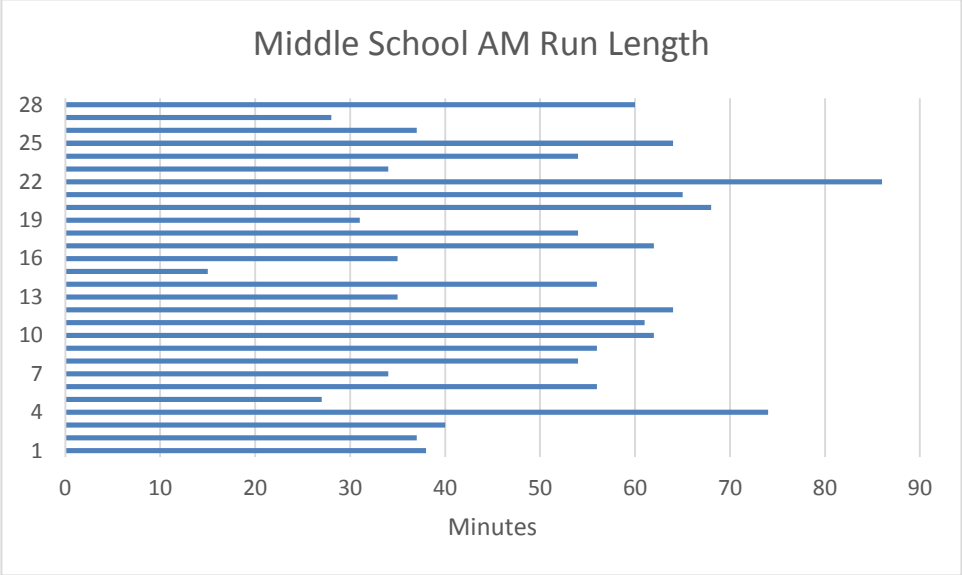
7	Kromrey	3:33	Middleton HS	3:38	Sauk Trl	3:05
8			Middleton HS	3:38	Elm Lawn	3:05
9	Kromrey	3:42			West Middleton	3:05
13					Sunset Ridge	3:05
18	Glacier Creek	3:33			Sunset Ridge	3:05
20			Middleton HS	3:40	Elm Lawn	3:05
21	Kromrey	3:33	Middleton HS	3:38	Northside	3:05
22	Kromrey	3:33	Middleton HS	3:38	Sunset Ridge	3:05
23	Kromrey	3:33	Middleton HS	3:38	Sunset Ridge	3:05
27	Glacier Creek	3:33			Sunset Ridge	3:05
28			Middleton HS	3:38	Northside	3:05
29	Kromrey	3:33	Middleton HS	3:38	Elm Lawn	3:05
30	Glacier Creek	3:33				
31					Park	3:05
34	Kromrey	3:33	Middleton HS	3:38	Sauk Trl	3:05
35	Glacier Creek	3:33			Park	3:05
36					St Peters	3:10
37	Kromrey	3:30	Middleton HS	3:50	Elm Lawn	3:05
38	Glacier Creek	3:33				
48	Glacier Creek	3:36			Park	3:05
54			Middleton HS	3:40	West Middleton	3:05
55			Middleton HS	3:38	Northside	3:05
56			Middleton HS	3:38	Sunset Ridge	3:05

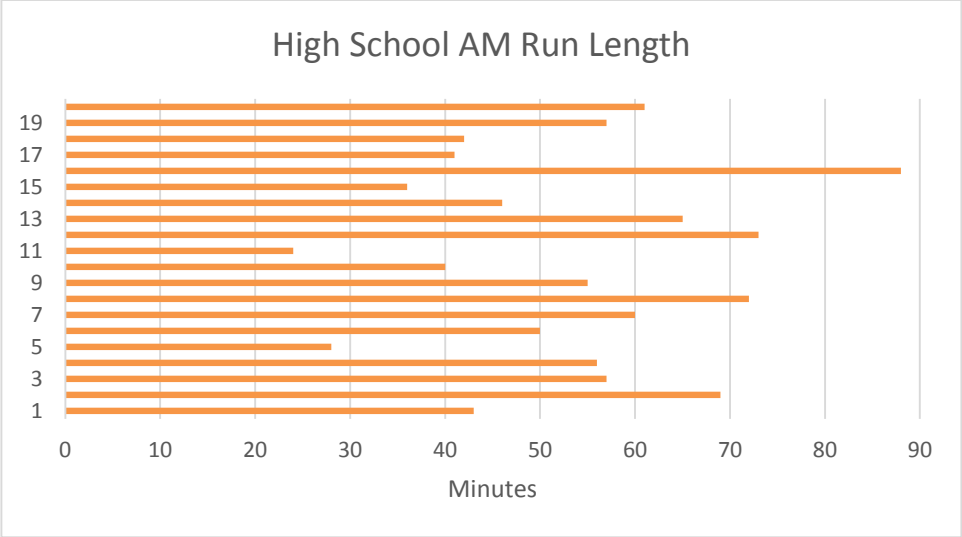
57	Glacier Creek	3:38	Middleton HS	3:38	West Middleton	3:05
58					Park	3:05
59	Kromrey	3:33	Middleton HS	3:38	Sauk Trl	3:05
62					West Middleton	3:05
63	Glacier Creek	3:33			Park	3:05
64	Glacier Creek	3:33			Park	3:05
65	Kromrey	3:33	Middleton HS	3:38		
66					West Middleton	3:05
74					Sunset Ridge	3:05
77	Glacier Creek	3:33			Sunset Ridge	3:05
78	Glacier Creek	3:36				
79			Middleton HS	3:42	Sauk Trl	3:05
80	Glacier Creek	3:33			Park	3:05
81	Kromrey	3:33	Middleton HS	3:38	Northside	3:05
82	Kromrey	3:33	Middleton HS	3:38	Elm Lawn	3:05
83	Glacier Creek	3:33				
84			Middleton HS	3:38	Sunset Ridge	3:05
85			Middleton HS	3:38	Sunset Ridge	3:05

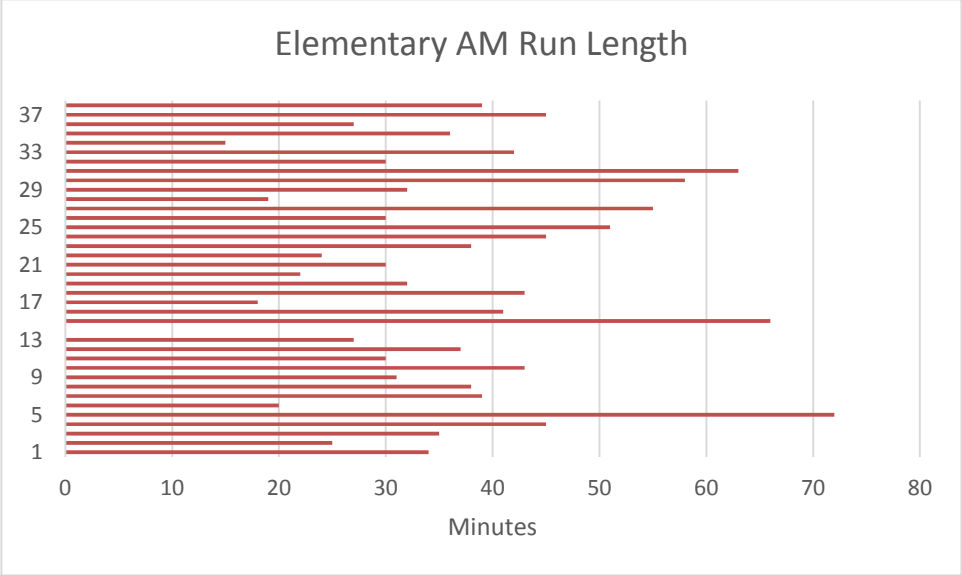
Buses that are routinely scheduled early or late create situations where school staffs are required to manage student behavior for extended periods of time. This type of issue is typically the result of bell times that are too close together to complete multiple bus trips without adding additional buses.

The district does not routinely modify bus trips to reflect students that actually ride the bus. This practice lends to longer bus runs than required. The traffic patterns and bell tier spacing appears to create most of the current service issues but significant reductions in overall run time may be achieved with routine route maintenance focusing on efficiency. Some buses were observed making large loops while not picking up or delivering students. Additionally, bus stops should be reviewed for placement to maximize route efficiency while maintaining safety and district service parameters.

The following charts illustrate the current length of runs by grade level. All bell time scenarios are based on attempting to reflect current run lengths. The run length is the total time the bus travels. It is not an indication of student ride time. All times shown incorporate bus travel time without students on the bus (dead head time).




High School AM Run Length
19
17
15
13
11
9
7
5
3
1
0
10
20
30
40
50
60
70
80
90
Minutes


Elementary AM Run Length
37
33
29
25
21
17
13
9
5
1
0
10
20
30
40
50
60
70
80
Minutes

SCENARIO #1

This scenario eliminates buses dropping students off early and arriving late to take them home under the current tier bell times. The difference in length of school day differences between the grade levels with the elementary tier being approximately 45 minutes shorter than the secondary tier and in the last bell tier creates a scenario that mandates either additional buses, buses running early and late and/or both. This is an issue that is worsened in the afternoon since loading times shorten available run times by as much as 10 minutes per school which decreases the ability of buses to increase efficiency due to lack of time before servicing the next set of schools.. The current bell times are:

Grade Level	Start	End	Length of Day
High	7:55	3:32	7:37
Middle	8:05	3:25	7:20
Elementary	8:15	2:59	6:44

There are two potential solutions to correct this issue. The first is that the district could choose to maintain current routing patterns and continue to experience early and late service. This solution is expected to require an additional 8 runs. Secondly, the district could choose to address current service issues. Addressing current service issues with the current routing paradigms is expected to add an additional 6 routes.

It is estimated that as many as 14 additional bus routes would be needed to allow all students to be transported in a timely manner once 5th grade student riders are moved to middle school if other efficiency measures are not implemented. Even with enhanced efficiency measures being put in place, the district would expect to add as many as 7 additional bus runs.

The first bell time scenario positives:

- All bell times fall into the start and end times provided by the district.
- All bell times meet the daily instructional times currently utilized by the district.
- All school arrival and departure times are considered in the scenario.
- All existing bus stops and runs are duplicated in the plan.

The first bell time scenario negatives:

- As many as 14 additional bus runs must be created to handle grade level changes.

SCENARIO #2

Again, this scenario, like scenario #1, strives to eliminate buses dropping students off early and arriving late to take them home. However, this scenario does not increase the number of routes needed by transportation. It addresses the issue by moving bell times to allow the buses to complete their routes within the times allotted by the bell tiers while implementing efficiency measures. The current number of middle school routes could be sufficient to accommodate the additional 5th grade students if efficiency measures were implemented.

This scenario assumes that shortening morning high school runs can be accomplished by creating additional runs on other buses that impact the existing runs. Shortening the existing long high school runs assumes that portions of the runs are handled by as many as 9 or more other routes to keep all runs inside the high school/middle school pickup windows.

This scenario would have the elementary school move to an earlier bell schedule while the secondary schools move to later bell time schedules. The concern with this scenario is that in order to accommodate the current length of runs, at least 45 minutes must be created between bells. An example of this bell structure follows:

Grade Level	Start	End	Length of Day
Elementary	7:40	2:35	6:55
Middle	8:25	3:55	7:30
High	9:10	4:43	7:33

The second routing scenario has the following positives:

- All school arrival and departure times were considered in the scenario.
- However, the 9 very long high school runs that overlapped into the elementary tier are assumed to be shortened by splitting the runs over as many as 20 other high school runs.
- The total number of bus routes is maintained at 44 assuming that the 9 very long High School runs can be shortened with other existing buses.
- Moving high school to the last tier responds to the latest instructional research for student achievement.

The second routing scenario has the following negatives:

- All bell times do not fall into the start and end time ranges provided by the district. Afternoon bell times are considerably after 4:00 pm.
- The 4K program will be tiered with the high school level which will not accommodate their program needs.

SCENARIO #3

This scenario would allow the district to minimize the additional number of bus routes needed to move the 5th grade students to the middle school level while adopting a more palatable bell schedule. This scenario would utilize the previously mentioned efficiency routing scenario while changing grade level tier placement. The elementary length of school day is considerably shorter than secondary length. In the afternoon, this creates a very small delivery window for secondary schools in the current tier model. Changing the elementary grade level to the early tier reduces secondary delivery issues. Creating an operating window that is slightly larger than current times would allow the district to minimize additional bus needs. Examples of this bell structure follows:

OPTION A

Grade Level	Start	End	Length of Day
Elementary	7:40	2:35	6:55
Middle	8:15	3:45	7:30
High	8:20	3:53	7:33

OPTION B

Grade Level	Start	End	Length of Day
Elementary	7:45	2:40	6:55
Middle	8:20	3:50	7:30
High	8:25	3:58	7:33

This scenario is expected to require 3 additional routes to accommodate the additional students.

The third routing scenario has the following positives:

- All bell times fall into the start and end time ranges provided by the district.
- All bell times add the daily instructional times requested by the district.
- All school arrival and departure times were considered in the scenario.
- However, the 9 very long high school runs that overlapped into the elementary tier are assumed to be shortened by splitting the runs over as many as 9 other high school runs.
- Moving high school to the last tier responds to the latest instructional research for student achievement.

The third routing scenario has the following negatives:

- The total number of bus routes is increased to 47 assuming that the 9 very long High School runs can be shortened with other existing buses.

SCENARIO #4

This scenario looks at splitting elementary schools between middle and high school tiers. It does not allow the district to minimize the additional number of bus routes needed to move the 5th grade students to the middle school level and solve service issues while adopting a two tier bell schedule. This scenario would utilize the previously mentioned efficiency routing scenario while changing grade level tier placement. Creating an operating window that is slightly larger than current times would allow the district to minimize additional bus needs. Examples of this bell structure follows:

Grade Level	Start	End	Length of Day
Elementary/Middle	7:40	2:35/3:10	6:55/7:30
Elementary/High	8:20	3:15/3:53	6:55/7:33

This scenario is expected to require 20 additional routes to accommodate the additional students at two tiers. Additionally, the afternoon bell times combined with up to 10 minutes loading at the schools seriously decreases the ability of buses to increase efficiency due to lack of time before servicing the next set of schools.

The fourth routing scenario has the following positives:

- All bell times fall into the start and end time ranges provided by the district.
- All bell times add the daily instructional times requested by the district.
- All school arrival and departure times were considered in the scenario.
- However, the 9 very long high school runs that overlapped into the elementary tier are assumed to be shortened by splitting the runs over as many as 9 other high school runs.
- The 4K program will be tiered during the high school level to accommodate their program needs.
- Moving high school to the last tier responds to the latest instructional research for student achievement.

The fourth routing scenario has the following negatives:

- The total number of bus routes is increased to 64 in the afternoon assuming that the 9 very long High School runs can be shortened with other existing buses.

SCENARIO #5

This scenario looks at keeping elementary schools at the last tier. It does not allow the district to minimize the additional number of bus routes needed to move the 5th grade students to the middle school level and solve service issues while adopting a two tier bell schedule. This scenario would utilize the previously mentioned efficiency routing scenario while changing grade level tier placement. Creating an operating window that is slightly larger than current times would allow the district to minimize additional bus needs. Examples of this bell structure follows:

Grade Level	Start	End	Length of Day
Middle/High	7:40/7:45	3:05/3:13	7:30/7:33
Elementary	8:20	3:15	6:55

As can be seen in the above diagram, this scenario requires the buses to serve all of the schools at virtually the same time since the length of school day creates a single tier in the afternoon. This scenario is expected to increase the number of routes by at least 30 in the afternoon.

The fifth routing scenario has the following positives:

- All bell times fall into the start and end time ranges provided by the district.
- All bell times add the daily instructional times requested by the district.
- All school arrival and departure times were considered in the scenario.
- However, the 9 very long high school runs that overlapped into the elementary tier are assumed to be shortened by splitting the runs over as many as 9 other high school runs.

The fifth routing scenario has the following negatives:

- The total number of bus routes is increased to approximately 74 in the afternoon assuming that the 9 very long High School runs can be shortened with other existing buses.

Efficiency Routing

Scenarios #2, #3, #4 and #5 utilize efficiency routing techniques to minimize the number of additional bus routes needed to move the 5th grade into the middle school level. The main features of this efficiency routing are:

- Stops that state "Does not ride" or that have no students at the appropriate grade level are deleted from the routes.
- Stops are recombined between runs to level the student rider loads and to reduce longer operational times in many instances.
- Student rider loads are oversubscribed in some instances on the assumption that some of the students do not actually ride on a regular basis. This assumption is based on the district ridership data that exists today. If all of the listed students rode daily, the buses would be extremely overloaded.
- Existing stops will be re-ordered in many instances to minimize travel times and reduce overlapping with other runs.
- The afternoon load times at all schools will be reduced to be within 7 minutes after the bell.
- Am and pm runs may not be always mirrored. This means that some stops may be on different buses morning and afternoon.

For the purposes of this study, the follow definitions may be helpful:

- Run - The portion of a route from the first student pick up until all students are discharged from the bus (also called Trips)
- Route - A collection of one or more runs operated in a continuous manner. A route is from the initial parking location for the bus through a run or runs and back to the parking location.

It is important to note that every student who is currently riding a school bus continues to receive bus service.