

May 10, 2017

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RE: City of Hallandale Beach
11th Street School
Supplemental Study
Evaluation of Dismissal Operations at
at Similar Facilities
MMPA Job No 15-1201-0003

Mike:

At the request / direction of the City Commission this office conducted observations of dismissal queues at four similar elementary schools and researched queue estimation techniques for such schools. We then re-evaluated the traffic impact study / queue report using the lessons learned. Technical materials reviewed included one research project funded by the Federal Highway Administration, two sponsored by state Departments of Transportation and one technical paper presentation to a professional society.

For this study independent observations of school queues at dismissal time were conducted and recorded for four schools. These results were supplemented with data from prior school queue studies conducted by this firm. The schools observed in May 2017 included public, charter and private elementary schools in Broward County. Arrival queues were observed at two of the schools.

Where the arrival traffic patterns were observed, the maximum queues during morning drop off were less than ½ the afternoon queue. The AM queues are shorter despite peak AM school traffic being greater than the PM peak hour traffic. This observation is consistent with observations reported by others in technical papers. The shorter morning queues are governed by arrive and service rates, while the afternoon queues are primarily the result of accumulated demand (vehicles) before service (loading) commences.

The locations of the backs of queue were recorded, queue lengths measured using the measurement tool on Google Earth and estimates made on the spacing of vehicles. The lengths of queue (in feet) were plotted against the number of enrolled students and a best fit regression analysis performed to determine the function that best explains the relationship between the number of students and length of queue.

City of Hallandale Beach

School Queue Study

May 10, 2017

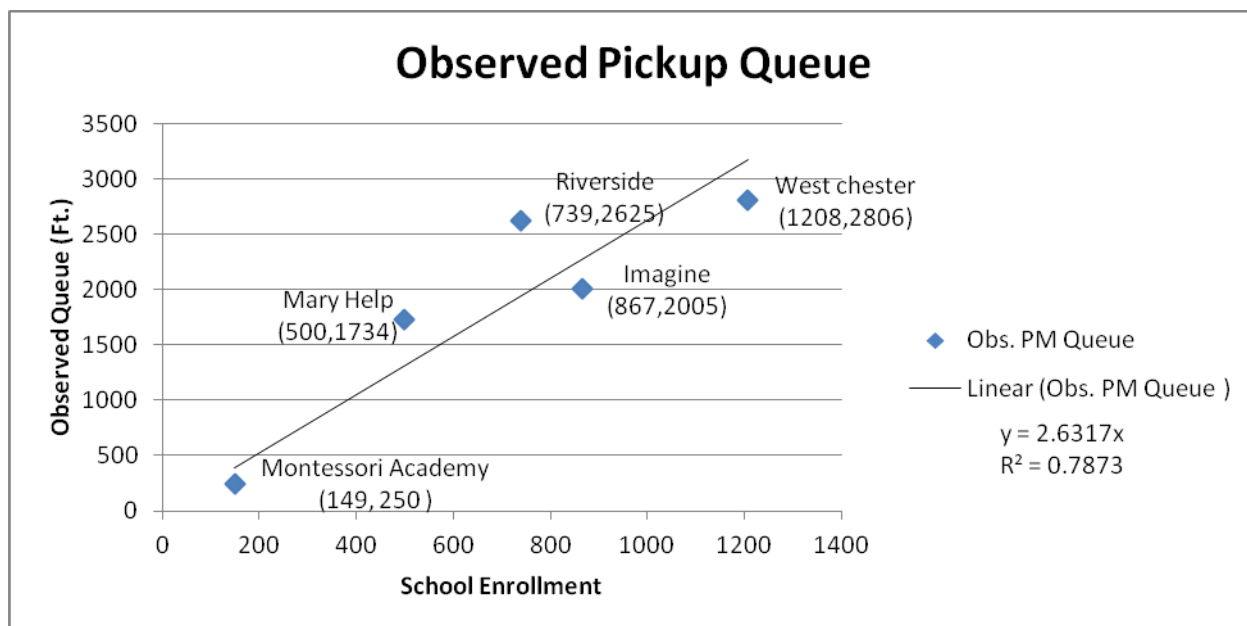
Page 2

It should be noted that while some schools in the study included grades k-8, the actual dismissals observed were for grades k-5. The proposed 11th Street school is proposed to include Pre K - 5. Inclusion of Pre K is not expected to result in significant deviations from the observed behavior at other schools.

Observations

School Name	Enrollment	Observed PM Queue Length (ft)
Imagine School at Broward (Charter) 6001 Westview Drive, Coral Springs	867	2806
Mary Help of Christians (private) 6000 N. University Drive, Parkland	500	1725
Riverside Elementary School (public) 11450 Riverside Drive, Coral Springs	739	2625
Westchester Elementary (public) 12405 Royal Palm Blvd. Coral Springs	1208	2806
Montessori Academy (charter), data on file 6300 Lake Worth Road, Greenacres	149	250

These data were plotted and a best fit linear regressions trend line added. The following chart is a graphical representation of the relation between the length of the queue at pickup and the number of students enrolled in the school.



Available Models

This study's data were collected using queue length, any queue prediction measures found during research were converted from vehicles to distance using an average vehicle length (measured front bumper of lead car to front bumper of following car) of 25 ft. or that reported in the study. Studies found during the research phase of this project uniformly utilized school enrollment as the independent variable.

Dustin Qualls, P.E. PTOE reported in *The Greening of Student Pick-Ups at School Dismissal*¹ a maximum vehicle queue length (in vehicles) of approximately 0.06 cars per student. South Carolina DoT² recommends 900 to 1200 ft. of stacking for elementary schools with 200 to 600 students. While Cooner, et. al.³ at the Texas Transportation Institute suggest slightly less stacking may be appropriate (for Texas Schools).

The North Carolina Department of Transportation has studied this matter in detail and promotes the Municipal School Transportation Assistance MSTA School Queue calculator. The MSTA School Queue Calculator requires the number of enrolled students and the category of the school public/private/charter, elementary, middle and high school to compute the expected queue.

Analysis and Commentary

The observed queues are bracketed by the curves for the predicted public and private school queues [graphic to follow] using MSTA. The observed queues exhibited good correlation ($R^2 = 0.78$) when the total overall student population is used as the independent variable. In other words, more than 75% of the variation in queue length from school to school is due to differences in number of students enrolled. The remaining variation may be due to availability of bus transportation, sidewalk condition, weather, or as we go into below, roadway design.

One school, Riverside Elementary School exhibited a higher rate of queue generation than expected. The longer queues occurred despite this school having walkers, bikes and buses. One possible explanation for this is the roadway configuration in the vicinity of the school. The school abuts a two lane collector which carries 950 peak hour trips. The increased queue length observed here may be due to entrapped thru traffic on the adjoining roadway. When the data point for Riverside Elementary is removed from the regression analysis, the R^2 value jumps to 0.90. Ninety percent of the variation in queue length is explained by differences in the total number of students attending.

¹ The Greening of Student Pick-Ups at School Dismissal, Dustin W. Qualls, P.E., PTOE, TexITE Technical Paper Submittal, 2010.

² Guidelines for School Transportation Design, South Carolina Department of Transportation (undated)

³ Traffic Operations and Safety at Schools: Recommended Guidelines, Cooner, et. al., Texas Transportation Institute 2004

Vehicle spacing in South Florida appears to be longer than that used in other jurisdictions. The typical reported spacing between vehicles corresponds to 4 to 9 ft. This office observed larger gaps between vehicles in the queue, on the order of one or more vehicle lengths separation. We estimate typical vehicle queue space in South Florida to be around 35 ft. (front bumper to front bumper)

One school, Mary Help of Christians, provided this office with a complete breakdown of dismissal operations including times and numbers of students dismissed. This data point was used to test whether the best fit queue estimate could be used, inputting the number of dismissed students. We conclude from this test that the overall enrollment should be used with the rate of 225 ft. queue/100 students. It is possible and even likely that a different relationship exists between dismissed students and resulting queue, but this was beyond the scope of this study.

Comparison of methods

To supplement the current observations, queuing data for a fifth school (previously studied by this office) were included. The best fit line to the data from five (5) South Florida Schools supports utilizing a linear function at a rate of 2.23 ft. of dismissal queue per student. In non-engineering speak, for every 100 students enrolled, expect the line of cars at dismissal to be approximately 225 ft. long.

The observed queue rate in South Florida falls between the MSTA projected rates for public and private schools of 165 ft./100 enrolled students and 425 ft of vehicle queue / 100 enrolled student. The observed rate is comparable to that reported in the Texas study. However, the observed rate results in predicted queues considerably longer than predicted using the applicant's method which utilizes **dismissed student**.

Recommendations

After reviewing published technical reports and conducting our own observations of school dismissal operations, it is our professional opinion that a rate of 225 ft. of queue per 100 enrolled students is an appropriate estimate of the maximum daily queue associated with school dismissal. Our best estimate of the dismissal queue for the SW 11th Street school, with 420 students is 945 ft., which roughly equates to 27 vehicles. The applicant's estimate of a 10 vehicles queue is consistent with the queue associated with a 150 student school.

The current plan depicts storage for approximately 18 vehicles onsite. The remaining 9 or 10 (depending on rounding) would queue up on public rights of way surrounding this site. The actual number and length of this queue will change depending on the number of loading positions, the effectiveness of staff in processing vehicles, driver behavior and the amount of space between vehicles. Theoretically with disciplined parents / drivers,

attentive students, and enough service (loading) positions, the queue at dismissal could be reduced and contained onsite. Theoretical, not likely.

Additional Considerations

1. Queues are expected to extend beyond the school entrance. The excess queue should approach the school in a clockwise direction (that is staying on the right hand side and only making right hand turns) and wrap the school property. Queues not contained on-site should be positioned on the east, SW 4th Terrace then, if necessary, along eastbound SW 10th Street, immediately adjacent to the school. This will minimize chances that an individual's driveway is blocked and will keep traffic on the side of the street maintained by the school.
2. Neighborhood traffic may deviate from their customary routes to avoid the expected queue. The well developed roadway grid in this sector of the City allows use of alternate routes to avoid the school congestion. We anticipate that most of these deviations will result in minimal changes to the overall trip length and travel time.
3. Sufficient Staff should be allocated to:
 - a. Identify incoming vehicles and radio ahead to match the student with the vehicle.
 - b. Facilitate or assist in the loading of younger students in a timely manner
 - c. Re-direct drivers whose child is not ready to visitor parking spaces or back around for another go.
4. The City and applicant should consider the impacts of adding a westbound lane between SW 4th Terrace and the project entrance. An additional lane would reduce interference between the queue and thru traffic on SW 11th Street. However traffic operations at the entrance to the school may suffer without the creation of gaps created by a queue spill back.
5. Queuing on SW 11th Street may discourage cut through traffic between Dixie and Hallandale Beach Boulevard.
6. Utilizing a police detail at peak traffic times to facilitate traffic flow may be desirable.
7. I recommend a wait and see approach before implementing channelization, turn prohibitions or other restrictive measures (such as bollards).
8. For purposes of estimating driveway volumes, the applicant should use the ITE Land Use for Private Schools (ITE Land Use 534). The applicant's use of the Elementary School rate (with zero pass by capture) is an acceptable estimate of the new trips generated by the proposed use when analyzing the overall roadway network.
9. School operations will affect the performance of SW 11th Street. This office recommends the applicant model the intersection of the project driveway with SW 11th Street as an all-way stop (a proxy for police control) and a minor street stop. The driveway volumes should be based on trip generation rates for Private School.

City of Hallandale Beach

School Queue Study

May 10, 2017

Page 6

10. Traffic operations of this school will need to be monitored. The school administration will need to maintain the effectiveness of the pickup system. To help ensure problems with traffic don't get out of hand, the City could propose an intermediate cap on school capacity. This way the school has an incentive to keep systems running smoothly and the City has a real world opportunity to observe the effectiveness of the applicant's claims of future performance

Regards,

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Senior Professional

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