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Highland at Dixie Traffic Study

Prepared for
The City of Ft. Mitchell, Kentucky

December 2013

2013858-000

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Appendix A:	Traffic Counts
Appendix B:	Capacity Analyses
Appendix C	Nomograph for a Single Turn Lane at a Signalized Intersection



Scope

The scope of this study is twofold: 1) to analyze the intersection of Highland at Dixie to determine the impact of a proposed right turn lane on Highland and determine the appropriate length of the turn lane based on existing traffic volumes on Highland; and, 2) analyze the internal circulation of Blessed Sacrament School in relation the school's vehicular traffic flow.

While the focus of the study is on Highland, the City wanted one intersection on each side of Highland included in the analysis to see if a proposed right turn lane on Highland would impact either of the adjacent intersections.

Field Data Collection

Manual turn counts were recorded at the intersections of Highland at Dixie, Beechwood at Dixie and Pleasant Ridge at Dixie on Wednesday, November 6, 2013 from 7:00 AM to 9:00 AM, and from 2:00 PM to 6:00 PM. The peak AM period was 7:15 AM to 8:15 AM; the peak early afternoon period was 2:30 to 3:30 PM and the peak late afternoon period was 5:00 PM to 6:00 PM. The traffic counts were recorded in 15 minute increments for each of the streets. The analysis was based on the volumes and conditions that existed at the three intersections on November 6, 2013. Copies of the counts are included in Appendix A.

The turning volumes from westbound Highland onto Dixie Highway during each of the intersection peak hours are listed in Table 1.

Table 1
Traffic Volumes, Westbound Highland onto Dixie Highway

Hour	WB Left Turn onto Dixie	WB Thru Across Dixie	WB Right Turn onto Dixie
7:15 AM to 8:15 AM	154	0	148
2:30 PM to 3:30 PM	93	54	1
5:00 PM to 6:00PM	50	0	46

Dixie Highway Traffic Signals

The traffic signals at the intersections of Beechwood, Highland and Pleasant Ridge are under the jurisdiction of the Kentucky Transportation Cabinet (KTC). Existing signal timings and signal phasing from each of the three intersections was obtained from KTC.

All of the traffic signals on Dixie are in a signal system and changes to one signal can impact the operation of the system. The scope of this analysis included only three intersections, not the entire signal system; consequently, only the existing signal timings were used in our analysis.



Analysis

Synchro Sim Traffic Software Version 8 was used to complete capacity analysis for the three intersections. The analysis was based on the conditions and volumes at Pleasant Ridge at Dixie, Highland at Dixie and Beechwood at Dixie on November 6, 2013. All capacity analyses are included in Appendix B.

Level of Service Analysis (LOS)

Level of service analysis (LOS) is defined by the 2010 *Highway Capacity Manual* to be a function of seconds of vehicle delay. Level of service criteria for signalized intersections is listed below in Table 2

Table 2
Level of Service Criteria
Signalized intersections

Control Delay	LOS: Volume-to-Capacity Ratio
(s/vehicle)	
<10	A
>10-20	B
>20-35	C
>35-55	D
>55-80	E
>80	F

The Levels of Service (LOS) and delays for the each of the studied time periods for existing geometry and with the proposed right turn lane are discussed below and included in Table 3.

Existing Volumes and Existing geometry

7:15 AM to 8:15 AM

Pleasant Ridge at Dixie

The traffic volumes on both Pleasant Ridge and the Blessed Sacrament School driveway are low and the intersection LOS is reasonable for the existing volumes; there are no significant issues. Some queuing was observed on the approaches to the school driveway.

Highland at Dixie

The largest volume of outbound (westbound) traffic on Highland at Dixie is in the AM peak hour as referenced in Table 1. During this time period northbound

traffic volumes on Dixie Highway are very high. The existing Levels of Service (LOS) for the single westbound lane at Dixie is 'F' with 191 seconds of delay.

Queue analysis indicates long queues with the existing single westbound lane that can reach up to 340 feet for the existing single lane.

Beechwood at Dixie

Due to the high volume of eastbound traffic turning left from Beechwood onto Dixie the LOS is 'F'. Queues are long for the northbound left turn movement to Beechwood, which can extend to 315 feet. The southbound volumes on Dixie are approximately 25% of the northbound volumes.

2:30 PM to 3:30 PM

Pleasant Ridge at Dixie

The overall LOS is reasonable due to the low volume of traffic entering Dixie from Pleasant Ridge and from the school driveway.

Highland at Dixie

The westbound movement, is LOS 'E' with the existing single lane.

Beechwood at Dixie

The approach LOS is 'D' for the eastbound and westbound approaches to the intersection. The Eastbound left turn movement from Beechwood to Dixie is LOS 'E'

5:00 PM to 6:00 PM

Pleasant Ridge at Dixie

The overall LOS is very good due to the low volume of traffic entering Dixie from Pleasant Ridge and from the school driveway at this time period.

Highland at Dixie

The overall LOS is 'D' for the existing single westbound lane.

Beechwood at Dixie

The eastbound left turn from Beechwood to Dixie is LOS 'F'. The overall eastbound approach LOS is 'E'.

Existing Volumes with Right Turn Lane Constructed on Highland

7:15 AM to 8:15 AM

The peak hour of the intersection is 7:15 AM to 8:15 AM. With the addition of a right turn lane, the LOS for the westbound approach increases from an 'F' to an 'E' with seconds of delay decreasing from 191 seconds to 59 seconds.



Right Turn Lane Length

Based on the KTC guidelines the length of a turn lane with the recorded AM volumes is 200 feet minimum. CDS also used Sim traffic to model the queues with resultant max queues of 214 feet. The KTC Nomograph: Storage for a single Turn Lane at a Signalized Intersection is included in Appendix C.

Impact of Right Turn Lane on Adjacent Intersections

The construction of a right turn lane on Highland does not negatively impact the adjacent intersections. While the LOS is poor at Beechwood it does not degrade due to the right turn lane. There is some increase in the queue on Dixie at Beechwood but not a significant issue.

Table 3
Delay and Level of Service Summary
Existing And Proposed Right Turn Lane on Highland

		7:15 AM to 8:15 AM				2:30 to 3:30 PM				5:00 to 6:00 PM			
Intersection with Dixie	Approach	Existing		With Proposed Right Turn Lane on Highland		Existing		With Proposed Right Turn Lane on Highland		Existing		With Proposed Right Turn Lane on Highland	
		Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS
Pleasant Ridge/ Blessed Sacrament School	Eastbound	54	D	54	D	41	D	41	D	34	C	34	C
	Westbound	31	C	31	C	37	D	37	D	45	D	45	D
	Northbound	9	A	9	A	2	A	2	A	3	A	3	A
	Southbound	4	A	4	A	5	A	5	A	4	A	4	A
Highland	Eastbound	36	D	38	D	31	C	31	C	44	D	47	D
	Westbound	191	F	59	E	77	E	50	D	54	D	41	D
	Northbound	18	B	14	B	5	A	5	A	3	A	2	A
	Southbound	10	B	9	A	2	A	2	A	7	A	6	A
Beechwood	Eastbound	333	F	333	F	42	D	42	D	57	E	57	E
	Westbound	43	D	43	D	42	D	42	D	43	D	43	D
	Northbound	12	B	14	B	4	A	5	A	4	A	4	A
	Southbound	4	A	4	A	6	A	6	A	7	A	7	A

Results based on conditions/volumes on November 6, 2013

Note: For analysis purposes, Dixie Highway is assumed to be North/South, and all side streets East/West.



Blessed Sacrament School Circulation

CDS met with the school principal to discuss the school's arrival and dismissal protocols. Two CDS personnel observed the operation of Blessed Sacrament School traffic during the morning arrival and afternoon dismissal on Thursday, November 14, 2013, and one staff member observed traffic during the AM arrival on November 19.

Blessed Sacrament school/church is located on the east side of Dixie Highway between Idaho and Virginia Avenues. All traffic - buses and parent pick-up/drop-off - enter at the one-way in driveway at the south end of the school property. All buses exit on the one-way out driveway across from Pleasant Ridge which is signalized. All parent drop-off/pick-ups exit at the north end of the school property onto Idaho Avenue. In bound/out bound traffic flow is the same for both the AM arrivals and PM dismissals; however, internal vehicular staging varies for the morning and afternoon.

There are 610 students at Blessed Sacrament school. Approximately 1/3 of the students walk, 1/3 are bussed, and 1/3 are transported by parents.

AM School Arrival

Figure 1, is an aerial view of the Blessed Sacrament site that illustrates the AM arrivals. Four school staff direct/control arrivals and departures. Five buses transport students to/from school. Parents begin arriving after 7:00 AM classes begin at 7:45 AM.

Passenger vehicles and buses enter the school at the 'In only' access (Photo1) at the southern end of the school property. Passenger vehicles, green lines on Figure 1, enter and travel, in a single line, to Stop Bar 4, see (Photo 2), keeping the space between Stop Bar 1 and Stop Bar 2 open to permit inbound buses, red lines, necessary turning radius to access the 'one-way out only' bus driveway.

There are six passenger vehicles stored between Stop Bar 3 and Stop Bar 4. Students in those six vehicles exit the vehicles and enter the cafeteria, (see Photo 3), only after these students are clear of the vehicles does staff release the six vehicles, permitting them to move to Idaho. Then the next six vehicles pull up between stop bar three and stop bar four and the students from those six vehicles exit the vehicles and enter the cafeteria.



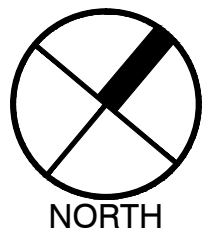


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SCALE: 1" = 80' 0' 20' 40' 80' 160'

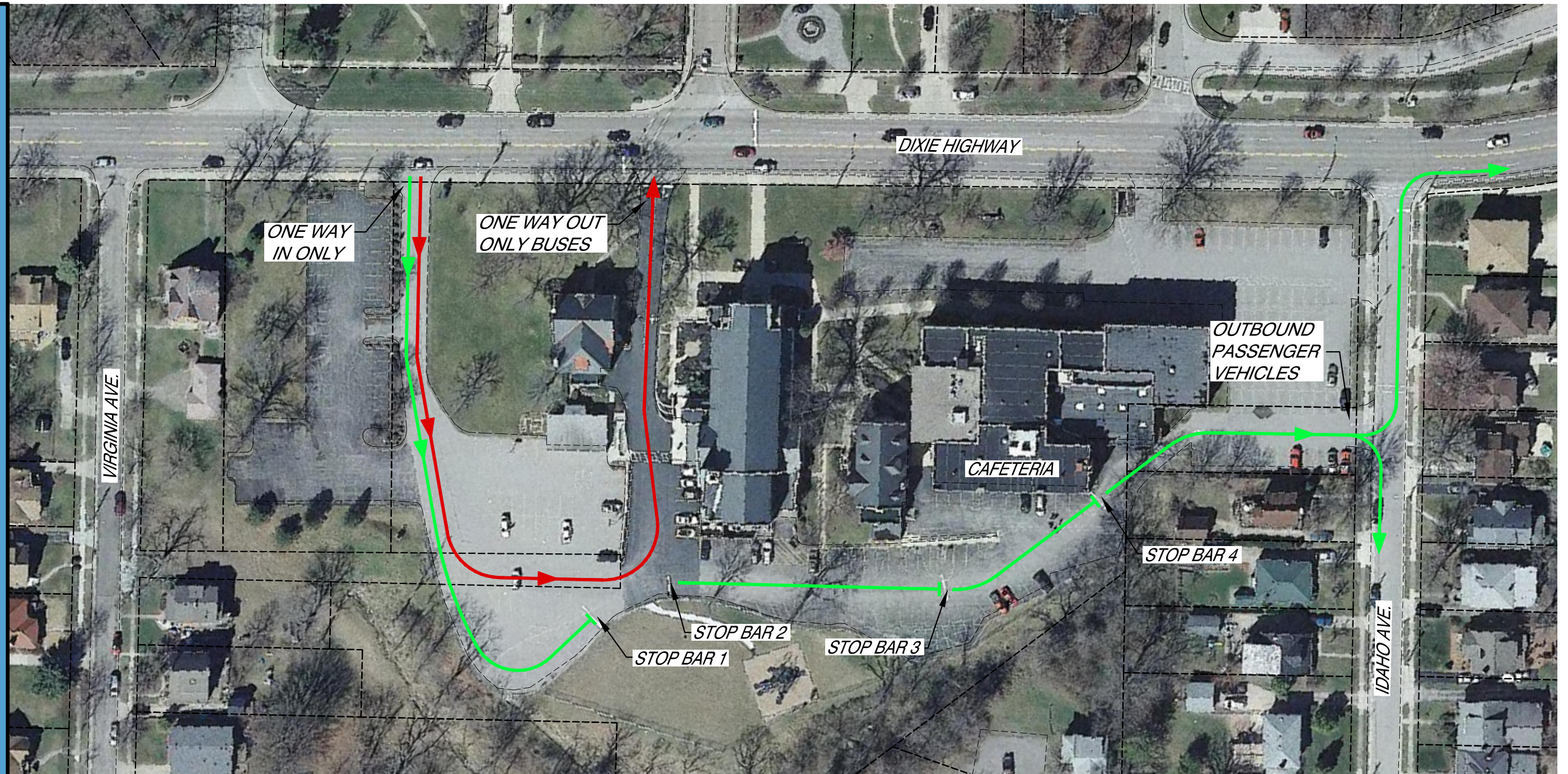
 AUTOMOBILE DROP OFF ROUTE

 SCHOOL BUS DROP OFF ROUTE

VEHICLE TRAFFIC FLOW - AM ARRIVAL

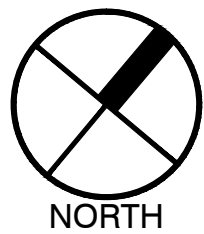
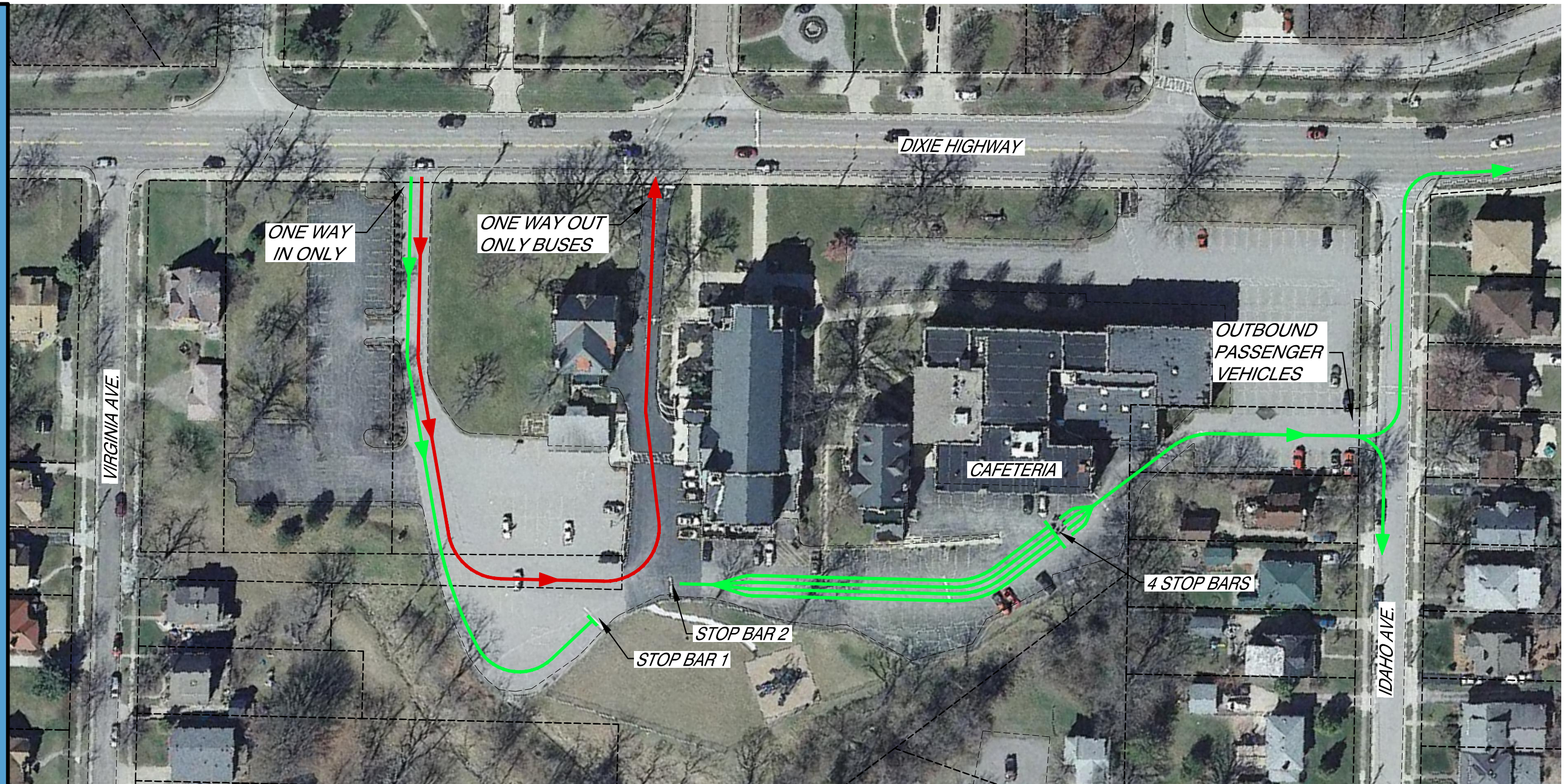
BLESSED SACRAMENT SCHOOL

FIGURE 1





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SCALE: 1" = 80' 0' 20' 40' 80' 160'

AUTOMOBILE
PICK UP ROUTE

SCHOOL BUS
PICK UP ROUTE

VEHICLE TRAFFIC FLOW - PM DISMISSAL

BLESSED SACRAMENT SCHOOL

FIGURE 2

Each group of passenger vehicles exits the school site at the north end of the school property at Idaho Avenue. School traffic has the option to turn left or right onto Idaho, but not left onto Dixie, Prohibition signs are posted on school property at the exit driveway, See Photo 4 and on Idaho at Dixie, Photo 5.

During the AM arrival on November 14, CDS observed traffic queued from the parking lot back to Dixie. On that morning, the apparent cause was traffic exiting the school drive at Idaho was stopped because the school traffic attempting to turn right onto Dixie was backed up into the school driveway preventing all school outbound traffic from moving.

On the morning of November 19, 172 passenger vehicles exited the school access onto Idaho as follows:

Table 4
Passenger Vehicles Exiting onto Idaho

Access	Left Turn Westbound	Right Turn Eastbound
School Exit at Idaho	95	77

Traffic on Idaho at Dixie is prohibited from turning left onto Dixie during the school arrivals and dismissals. During this count observation, no vehicles attempted to turn left from Idaho onto Dixie.

Photo 1
School Entrance, One-Way In



Photo 2
Stop Bar 4 for AM Traffic



Photo 3
Single Row of Six Vehicles, AM

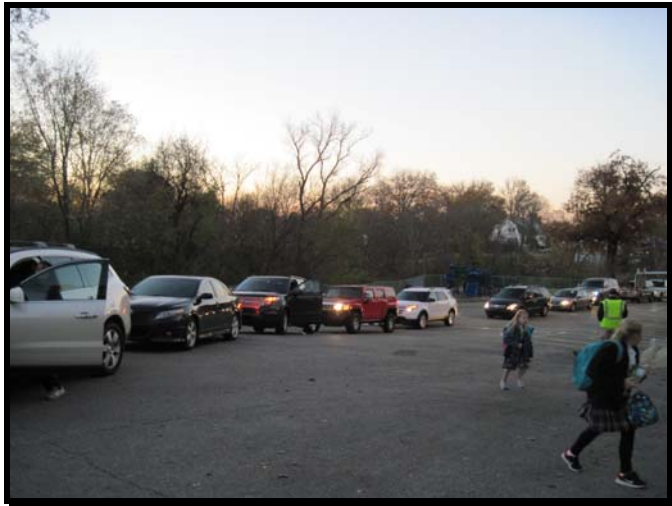


Photo 4
Turn Prohibition on School's Exit Drive at Idaho



Photo 5
Turn Prohibition on Idaho at Dixie



Bus Transportation

Five buses bring students to the school. The morning arrival and afternoon dismissal bus scenarios are the same. Buses enter the one-way entrance driveway and turn left to access the one-way outbound driveway adjacent to the church. Students access the buses from the front of the Church/school. Buses and passenger vehicle traffic are separated. See Photos 3, 4, and 5.

Photo 6
Bus Arrivals/Dismissals, One-Way Out



Photo 7
Bus Arrivals/Dismissals, One-Way



Photo 8
Bus Arrivals/Dismissals, One-Way Out



Photo 9
One-Way Out Bus Access, Signal at Dixie



PM School Dismissal

CDS personnel observed afternoon dismissal on November 14. School dismissal is at 2:30 PM. Parents begin lining up early. Traffic circulation in the afternoon is similar to the AM arrival only in that the in/out access driveways are the same. The dismissal circulation is illustrated on Figure 2.

In the afternoon as passenger vehicles enter, four rows of traffic are formed, keeping the space open between Stop Bar 1 and Stop Bar 2 for entering buses. The four rows travel to four numbered stop bars close to the cafeteria access, see Photo 10. Photo 11 depicts the rows of vehicles stopped at the four stop bars.

Just prior to dismissal school staff obtain the names of parents in each vehicle by row. All students remain in the cafeteria until released by a staff member.

When dismissal begins a staff member calls each student by vehicle row number. After all the students from all four rows of traffic enter the vehicles and there are no students outside the vehicles, the staff release one row at time beginning with Row 1. After the four rows are released, the next rows of vehicles are directed to the stop bars and the process begins again until all vehicles depart.

On this date a total of 115 parents arrived to pick up students. The last group of vehicles moved out at 2:54 PM. The 118 passenger vehicles turned onto Idaho as shown in Table 5

Table 5
PM Passenger Vehicles Turned onto Idaho

Access	Left Turn Westbound	Right Turn Eastbound
School Exit at Idaho	59	59

Of the 59 vehicles that turned left onto Idaho the vehicles turned onto Dixie as shown in Table 6

Table 6
Vehicles Turned Onto Dixie

Access	Left Turn Movement Prohibited	Right Turn
Idaho at Dixie	3	52

Four of the 59 vehicles that turn left onto Idaho turned back into the school's front, far western access.

Photo 10
Numbered Stop Bars



Photo 11
Rows of Vehicles for Dismissal



Internal Site Geometry

The area from stop bar 4 north on the outbound driveway is a narrow restricted area that would make maneuvering for large vehicles difficult to impossible, see Photo 12.

Photo 12
Outbound Access by Cafeteria



Midblock Crosswalk on Idaho

Midblock crosswalk on Idaho across from school. As a midblock crosswalk, it would be desirable for the crosswalk to be lighted. In addition, transverse white lines would make the crosswalk more visible.

Photo 13

Midblock School Crosswalk on Idaho



The school crosswalk signs are located too far from the crosswalk. Signs should be mounted at the crosswalk. The fluorescent yellow-green signs should be used (S1-1). The sign should be 36" x 36" with a downward pointing arrow on each sign (W16-7P) 24"X12"

Photo 14
Crosswalk Signing



Summary and Recommendations

Summary and Recommendations Directly Related to Blessed Sacrament School.

The school's vehicular circulation plan is organized, structured and operates very well; the plan is supervised by four school staff.

Buses and passenger vehicles are separated and students are never on foot when vehicles are moving. Students arriving and departing by passenger vehicle are staged in the cafeteria. The buses use the one-way out driveway across from Pleasant Ridge which is signalized. Students transported by bus enter and exit the school building from the front of the school. Passenger vehicles exit on the north side of the school property onto Idaho. In the AM, it was observed that a small number of passenger vehicles exit the one-way out driveway before the buses arrive.

While it would be desirable to provide access to the signal for all vehicles, the layout of the building, the size of and orientation of the site preclude the ability to provide a circulation that would both separate and stage buses and passenger vehicles entirely on the school property.

There are two recommendations we offer:

1. It would be desirable for the staff who direct/control traffic to wear high visibility safety vests.
2. On the morning of November 14, passenger vehicles on the school property, queued back to Dixie Highway. The apparent cause was traffic exiting the school drive at Idaho was stopped because the school traffic attempting to turn right onto Dixie was backed up into the school driveway preventing all school outbound traffic from moving. During this time period, the school uses, as previously described, a single inbound lane for passenger vehicles. We believe the potential for queuing back onto Dixie Highway could be reduced by forming multiple rows up to but not north of Stop Bar 1. From Stop Bar 2 north, the existing single line could be maintained.

Other than the two above recommendations, it is CDS's opinion that based on the orientation of the buildings, and the size of the site, inbound and outbound circulation, as established by the school, works very well for both bus and passenger vehicle circulation and the safety of the students. We do not recommend nor do we believe there is a reasonable alternate traffic pattern.



Summary and Recommendations Directly Related to the City of Fort Mitchell

Midblock Crosswalk on Idaho:

The crosswalk located on Idaho across from the school: Recommend the following:

- Add lighting to the crosswalk
- Add transverse white lines would make the crosswalk more visible.
- Relocate signs at the crosswalk. Fluorescent yellow-green signs should be used (S1-1). The sign should be 36" x 36" with a downward pointing arrow on each sign (W16-7P) 24"X12

Highland Avenue Right Turn Lane

The analysis indicates the addition of a right turn lane will not negatively impact the operation of the adjacent intersections of Pleasant Ridge/Blessed Sacrament and Beechwood based on the volumes recorded November 6, 2013.

The largest volume of traffic exiting Highland occurs during the AM peak hour. Based on those volumes and the existing signal timings, the KTC guidelines indicate a minimum right turn lane length of 200 feet and a desirable length of 260 feet. Using SimTraffic, CDS modeled the volumes and found expected maximum queue length of 214 feet and we recommend this length for the proposed turn lane.

If the guideline values cannot be accomplished a shorter length will provide an increased level of service; however, there will be times when the left turn traffic will block the right turn lane preventing right turn vehicles from entering the lane.

Signal Timing

CDS believes the LOS can be improved for Highland and Beechwood with signal timing modifications; however, as stated at the beginning of the report, the Dixie Highway traffic signals are in a signal system under the jurisdiction of the Kentucky Transportation Cabinet. Timing changes made to one or two signals can impact the entire system; therefore, evaluation of the complete signal system by the Transportation Cabinet would be necessary for a definitive recommendation.