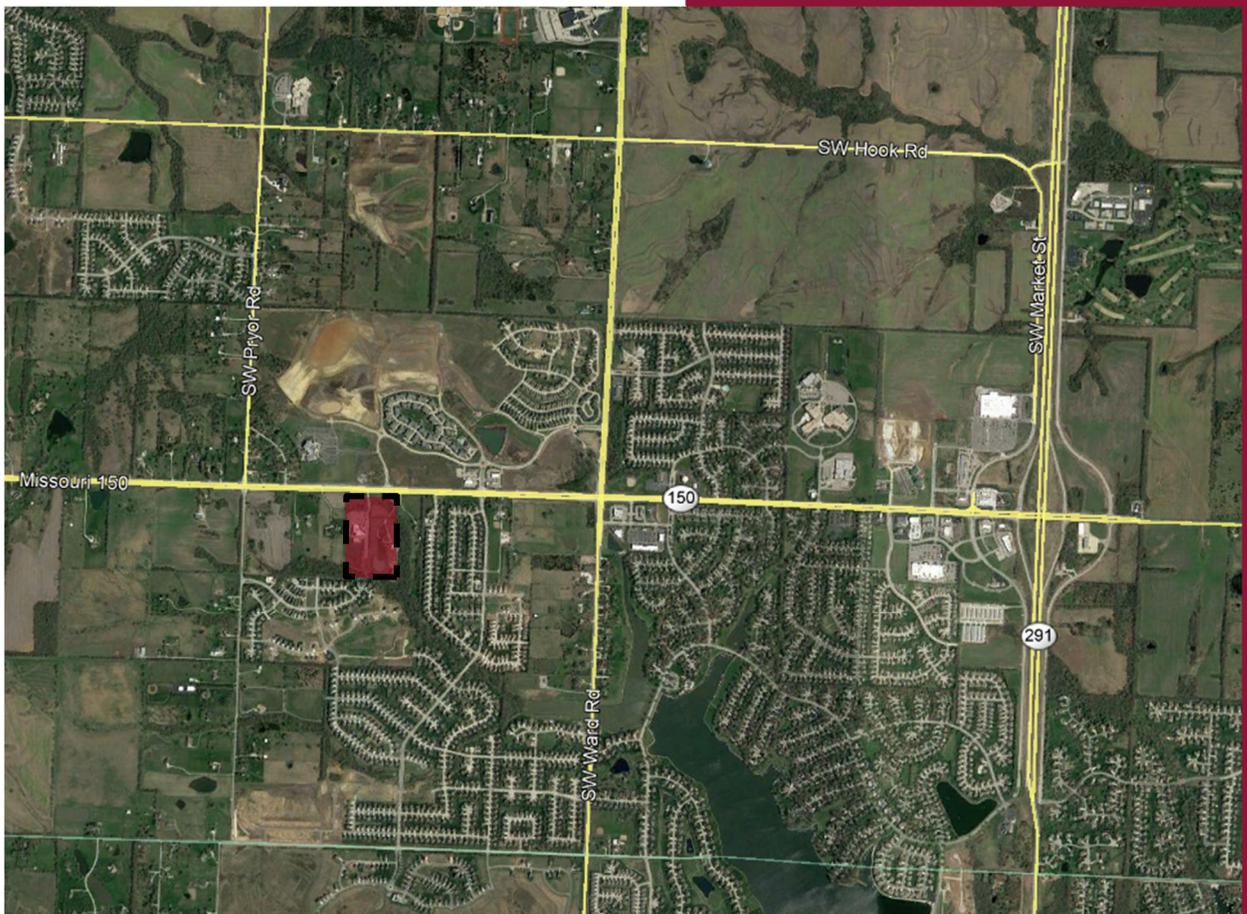


Journey Church International Traffic Impact Study

M-150 Highway and Arboridge Drive
Lee's Summit, Missouri



Prepared for:
Journey Church International

Prepared by TranSystems
December 2019



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December 10, 2019

Mr. Mark Sherfy, PE, PTOE
BHC Rhodes
7101 College Blvd., Suite 400
Overland Park, KS 66210

**RE: Journey Church International Traffic Impact Study
M-150 Highway and Arboridge Drive
Lee's Summit, Missouri**

Dear Mr. Sherfy:

In response to your request and authorization, TranSystems has completed a traffic impact study for the proposed expansion of the existing Journey Church International facility, located at 1601 SW M-150 Highway in Lee's Summit, Missouri. The purpose of this study was to assess the impact of the proposed facility expansion on the surrounding transportation system.

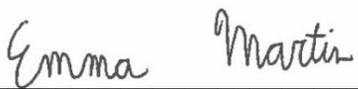
Included in this study is a discussion of the anticipated impact of the proposed development on the adjacent street network and identified improvements to mitigate deficiencies for the following scenarios:

- ▶ Existing Conditions
- ▶ Existing plus Development Conditions

We trust that the enclosed information proves beneficial to you, the City of Lee's Summit, and the Missouri Department of Transportation in this phase of the development process. We appreciate the opportunity to be of service to you and will be available to review this study at your convenience.

Sincerely,
TRANSYSTEMS

By: 
Jeffrey J. Wilke, PE, PTOE

By: 
Emma Martin, E.I.T

EHM:JJW/em/PI01190290
Enclosure

Introduction

TranSystems has completed a traffic impact study for the proposed expansion of the existing Journey Church International facility, located at 1601 SW M-150 Highway in Lee's Summit, Missouri. The purpose of this study was to assess the impact of the proposed facility expansion project on the surrounding transportation system. The location of the development site relative to the major streets in the area is shown on **Figure A-1** in **Appendix A**.

This study also contains a description of the proposed building expansion project and the surrounding transportation infrastructure along with trip generation estimates, trip distribution estimates, capacity analyses, and a summary of the findings.

Proposed Development Plan

The existing church facility includes a 19,686 square foot building with a 320-seat auditorium. The proposed facility will expand to a total area of 68,946 square feet. The expansion will include a 1,200-seat auditorium, which will replace the existing 320-seat auditorium.

Site improvements associated with the proposed development plan include parking lot expansion and access modifications. The existing church driveway is located 280 feet to the west of Arboridge Drive and is limited to right-turns only (right-in/right-out). The existing driveway will be removed as part of the site improvements. A new full-access driveway will be constructed to be the south leg of the existing intersection with Arboridge Drive. This new driveway will follow a horizontal curve to the south of M-150 Highway and then run parallel to the highway, along the north side of the development site. In the future this driveway is to be extended farther west and south to serve as a collector street. An additional right-in/right-out access drive will be constructed onto M-150 Highway approximately 575 feet west of Arboridge Drive intersection, at the northwest corner of the development site. A copy of the proposed site plan showing the access points is included on **Figure A-2** in **Appendix A** for reference.

Study Area

To assess the impacts of the proposed building expansion, the intersections listed below were identified for study during the A.M. and P.M. peak periods.

- ▶ M-150 Highway and Pryor Road
- ▶ M-150 Highway and Arboridge Drive
- ▶ M-150 Highway and existing Journey Church access drive
- ▶ M-150 Highway and proposed Journey Church access drive

Traffic Counts

Turning-movement traffic volume counts were collected at the existing study intersections on Sunday June 24, 2018. The counts were collected at each existing intersection from 9:00 A.M. to 1:00 P.M. The Sunday peak hours at the intersection occurred from 10:45 A.M. to 11:45 A.M. (Sunday Peak Hour 1),

and from 11:45 A.M. to 12:45 P.M. (Sunday Peak Hour 2). The existing lane configurations and traffic control devices have been illustrated on **Figure A-3**, and existing peak hour traffic volumes have been illustrated on **Figure A-4**. Traffic counts are shown in **Appendix B**.

Surrounding Street Network and Land Uses

The existing Journey Church site consists of approximately 10 acres, with some of the site being undeveloped. The proposed development plan encompasses an additional 11 acres to the east, which is currently occupied by a large lot single-family residence. The proposed development site is bounded by large lot single-family residences to the east and west, and is bordered by M-150 Highway to the north. To the south, the site borders single-family residences that are part of a subdivision, which is accessed from Pryor Road.

The portion of M-150 Highway adjacent to the Journey Church site is a four-lane divided principal arterial highway with a posted speed limit of 45 miles per hour. The highway has curbs and gutters along each side with a raised median separating the directions of travel. Sidewalk exists only along the north side of M-150 Highway.

Arboridge Drive extends north of M-150 Highway, and is designated by the City of Lee's Summit as a commercial collector. Arboridge Drive is a two-lane undivided street with curbs and gutters along each side. It serves as one of three access points to the Arborwalk subdivision, which includes residential and commercial land uses. Arboridge Drive also provides access to the Holy Spirit Catholic Church, to the north of M-150 Highway. Arboridge Drive currently ends at its intersection with M-150 Highway, aligning with a residential driveway to the south of M-150 Highway. At the intersection, Arboridge Drive is stop-sign controlled, and M-150 Highway is uncontrolled. There is a median break at the intersection with an eastbound left-turn lane and a westbound right-turn lane.

Pryor Road is a two-lane, undivided major arterial roadway. There are no curbs, gutters, or sidewalks along Pryor Road. The intersection of M-150 Highway and Pryor Road is signalized, with left-turn lanes on all approaches. The existing turn lanes are very short on the Pryor Road approaches and provide less than 50 feet of storage.

Analysis

The scope of analysis for the assessment of the proposed development's impact on the surrounding transportation system is based in large part on the recommended practices of the Institute of Transportation Engineers (ITE), as outlined in their [Traffic Engineering Handbook](#). ITE is a nationally-recognized organization of transportation professionals with members from both private and public sectors. The analysis of the proposed development's impact included development of trip generation and trip distribution estimates as well as a traffic operations assessment for each study scenario. Each of the analysis methodologies and findings are described in the subsequent sections.

Trip Generation

Trip generation estimates were prepared using the ITE's Trip Generation, 10th Edition. Trip generation estimates were based on the number of additional auditorium seats provided as part of the proposed facility expansion project.

Two Sunday peak-hour scenarios were assessed for the purposes of this study. Sunday Peak Hour 1 corresponds to the time period between the two Sunday church services, when there are arrivals and departures. This scenario has a directional distribution of traffic in and out of the site that is consistent with the Sunday peak hour data provided in Trip Generation. As indicated by the traffic counts, Sunday Peak Hour 2 corresponds to the time period when the final Sunday service is dismissing. As evidenced by the existing traffic counts, nearly all of the site-generated traffic exits the site during this time period. Therefore, the directional distribution of the Sunday Peak Hour 2 trips was adjusted to reflect 95 percent of the trips being outbound and 5 percent being inbound to the site. **Table 1** below shows the estimated trips to be generated by the proposed facility expansion project.

Table 1 Trip Generation									
Land Use	Intensity	ITE Code	Average Sunday	Sunday Peak Hour 1			Sunday Peak Hour 2		
				Total	In	Out	Total	In	Out
Church	880 Seats (Additional)	560	1,065	478	234	244	478	24	454

Trip Distribution

The estimated trips generated by the proposed building expansion were distributed onto the street system based on the trip distributions summarized below in **Table 2**. The distributions are based on existing traffic patterns and engineering judgement. The detailed distribution patterns throughout the study intersections are shown in **Appendix B**.

Table 2 Trip Distribution	
Direction	Percentage
North on Arboridge Drive	5%
North on Pryor Road	10%
South on Pryor Road	5%
East on M-150 Highway	60%
West on M-150 Highway	20%
Total	100%

Sight Distances

Intersection sight distance is provided at intersections to allow the drivers of stopped vehicles to depart from their approach and enter or cross the uncontrolled street. These distances are generous, allowing enough distance for the stopped driver to complete their turning or crossing maneuver without requiring through traffic on the uncontrolled street to reduce their speed. Stopping sight distance is the minimum distance required to allow for a vehicle to stop before reaching a stationary object in its path. Sight distance and stopping sight distance evaluation criteria is provided in A Policy on Geometric Design of Highways and Streets (7th Edition), also referred to as the AASHTO Green Book published by the American Association of State Highway and Transportation Officials (AASHTO).

Sight distances were measured in the field at the proposed access drives onto M-150 Highway. The measurements and AASHTO recommend sight distances are shown in **Table 3**.

Location	Direction Looking	Measured Sight Distance, feet	Right-Turn Intersection Sight Distance, feet	Stopping Sight Distance, feet
M-150 and Proposed Access Drive	West	425	430	360
M-150 and Arboridge Drive (south leg)	East	>700	635	360
	West	>700	430	360

The sight distance measurements indicate that the sight distance at the Proposed Access Drive intersection will be very close to the recommended right-turn sight distance. Sight lines looking to the west are somewhat obscured by several street light and utility poles located along the south side of M-150 Highway.

Traffic Operation Assessment

An assessment of traffic operations was made for the scenarios listed below.

- ▶ Existing Conditions
- ▶ Existing plus Development Conditions

The study intersections were evaluated using the Synchro traffic analysis software package. Calculations were performed based on the methodologies outlined in the Highway Capacity Manual (HCM), 6th Edition, which is published by the Transportation Research Board. The operating conditions at an intersection are graded by the “level of service” experienced by drivers. Level of service (LOS) describes the quality of traffic operating conditions and is rated from “A” to “F”. LOS A represents the least congested condition with free-flow movement of traffic and minimal delays. LOS F generally indicates severely congested conditions with excessive delays to motorists. Intermediate grades of B, C, D, and E reflect incremental increases in the average delay per stopped vehicle. Delay is measured in seconds per

vehicle. **Table 4** shows the upper limit of delay associated with each level of service for signalized and unsignalized intersections.

Level of Service (LOS)	Signalized	Unsignalized
A	≤ 10 Seconds	≤ 10 Seconds
B	≤ 20 Seconds	≤ 15 Seconds
C	≤ 35 Seconds	≤ 25 Seconds
D	≤ 50 Seconds	≤ 35 Seconds
E	≤ 80 Seconds	≤ 50 Seconds
F	> 80 Seconds	> 50 Seconds

While LOS measurements apply to both signalized and unsignalized intersections, there are significant differences between how these intersections operate and how they are evaluated. LOS for signalized intersections reflects the operation of the intersection as a whole.

Unsignalized intersections, in contrast, are evaluated based on the movement groupings which are required to yield to other traffic. Typically, these are the left turns off of the major street and the side-street approaches for two-way stop-controlled intersections. At unsignalized intersections lower LOS ratings (D, E and F) do not, in themselves, indicate the need for additional improvements. Many times there are convenient alternative routes to avoid the longer delays. Other times the volumes on the unsignalized approaches are relatively minor when compared to the major street traffic, and improvements such as traffic signal installation may increase the average delay to all users of the intersection.

The LOS rating deemed acceptable varies by community, facility type and traffic control device. In Lee's Summit, LOS C has been identified as the minimum desirable goal for signalized intersections. At unsignalized intersections, the City has identified LOS C as the minimum desirable goal for traffic movements that must yield to other movements. However, LOS D and E at unsignalized movements may be deemed acceptable by the City upon considering other factors such as traffic volumes of subject movements and duration of activity resulting in such levels of service.

The decision to install a traffic signal, which is often considered when lower LOS ratings are projected, should be based on engineering studies and the warrants for traffic signal installation as outlined in the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD). Signals are typically not recommended in locations where there are convenient alternative paths, or if the installation of a traffic signal would have negative impacts on the surrounding transportation system.

Traffic queues were also evaluated as part of the analyses. Long traffic queues which extend beyond the amount of storage available, either between intersections or within turn lanes, can have significant impacts

on operations. The projected vehicular queues were analyzed to ensure the analyses are reflective of the physical constraints of the study intersections and to identify if additional storage is needed for turn lanes.

Existing Conditions

Results of the existing conditions intersection analyses are summarized in **Table 4**. The study intersections were evaluated with the lane configurations, traffic volumes, and traffic control devices shown on **Figures A-3** and **A-4**. **Table 5** provides analysis results for the existing intersection of M-150 Highway and the Journey Church access drive, even though the intersection will be removed with the proposed site improvements. Synchro output files are included in **Appendix C**.

Table 5 Intersection Operational Analysis Existing Conditions					
Intersection	Movement	Sunday Peak Hour 1		Sunday Peak Hour 2	
		LOS ¹	Delay ²	LOS ¹	Delay ²
M-150 Highway and SW Pryor Road	<i>Traffic Signal</i>	B	14.9	B	14.6
M-150 Highway and Existing Access Drive	<i>Northbound</i>	B	11.2	B	11.3
M-150 Highway and Arboridge Drive	<i>Eastbound Left Turn</i>	A	8.5	A	8.5
	<i>Northbound Left Turn</i>	C	21.6	A	0.0
	<i>Southbound Left Turn</i>	C	23.6	C	21.2
	<i>Southbound Right Turn</i>	B	10.4	B	10.2

1 – Level of Service
2 – Delay in seconds per vehicle

The results in the table indicate that the study intersections currently operate at acceptable levels of service during the Sunday peak hours. All queues are contained within the existing storage length of the turn lanes, except for the southbound left-turn movement at Pryor Road and M-150 Highway. The 95th percentile queue length is 65 feet during Sunday Peak Hour 2, which exceeds the short storage length of the existing left-turn lane.

Existing plus Proposed Development Conditions

The Missouri Department of Transportation (MoDOT) access management guidelines are provided in the Engineering Policy Guide (EPG). These guidelines were reviewed to determine if turn lanes are warranted with the addition of traffic from the proposed development.

The revised site access will introduce westbound left-turn movements at the M-150 Highway and Arboridge Drive intersection. The projected traffic volumes for the Existing plus Development Conditions scenario clearly indicate that a westbound left-turn lane is warranted. **Figure 1** shown in **Appendix D** shows the Sunday Peak Hour 1 volumes plotted on the left-turn lane warrant graph for four-lane roadways.

To accommodate this movement, a westbound left-turn lane should be constructed at the intersection with a minimum storage length of 250 feet plus appropriate taper.

Figure 2 in **Appendix D** shows the Sunday Peak Hour 1 and 2 traffic volumes plotted on the right-turn lane warrant graph for four-lane roadways. Based on the warrant analysis, an eastbound right-turn lane is not warranted at the M-150 Highway and Arboridge Drive intersection.

The proposed right-in/right-out access drive on M-150 Highway was also evaluated. **Figure 3** in **Appendix D** shows Sunday Peak Hour 1 and 2 traffic volumes on the right-turn lane warrant graph for four-lane roadways. The traffic volumes for the Sunday Peak Hour 1 are projected to be at the minimum threshold to warrant a right-turn lane. Attendance at churches tends to fluctuate and is not constant from week to week. Given this variability, it is likely that volumes may exceed the threshold for a right-turn lane on Sundays with higher church attendance. Therefore, an eastbound right-turn lane should be constructed with a minimum storage length of 200 feet plus appropriate taper. The addition of this turn lane will require relocating the existing utility and light poles along the south side of M-150 Highway, which will enhance sight lines at the proposed access drive.

The need for turn lanes was also evaluated for the northbound approach to the intersection of M-150 Highway and Arboridge Drive intersection. The EPG does not provide guidance on minor street lane geometry, however the City of Lee's Summit does have an Access Management Code. The Code requires left-turn on collector streets where they intersect major arterial type streets. To meet this requirement and align the north/south through lanes across the intersection, a separate northbound left-turn lane should be provided at the M-150 Highway and Arboridge Drive intersection. The left-turn lane should have a minimum storage length of 250 feet plus appropriate taper to contain the anticipated queues.

Results of the existing plus development conditions intersection analyses are summarized in **Table 6**. This study scenario assessed the study intersections with the addition of traffic generated by the proposed development. The study intersections were evaluated with the lane configurations, traffic volumes, and traffic control devices shown on **Figures A-5** and **A-6**. The analysis includes the aforementioned turn lane improvements. Synchro output files are included in **Appendix C**.

Table 6
Intersection Operational Analysis
Existing plus Approved Development Conditions

Intersection <i>Movement</i>	A.M. Peak Hour		P.M. Peak Hour	
	LOS ¹	Delay ²	LOS ¹	Delay ²
M-150 Highway and SW Pryor Road <i>Traffic Signal</i>	B	10.0	A	9.6
M-150 Highway and Proposed Access Drive <i>Northbound Right Turn</i>	B	11.1	B	11.6

Table 6 - Continued
Intersection Operational Analysis
Existing plus Approved Development Conditions

Intersection	Movement	A.M. Peak Hour		P.M. Peak Hour	
		LOS ¹	Delay ²	LOS ¹	Delay ²
M-150 Highway and Arboridge Drive					
	Eastbound Left Turn	A	8.4	A	8.5
	Westbound Left Turn	A	9.1	A	8.7
	Northbound Left Turn	F	>100	F	>100
	Northbound Through/Right Turn	C	18.8	C	18.9
	Southbound Left Turn	F	>100	E	37.4
	Southbound Through/Right Turn	C	19.4	B	10.6
M-150 Highway and Arboridge Drive					
	Traffic Signal	C	22.4	B	15.9

1 – Level of Service
2 – Delay in seconds per vehicle

The analysis results in **Table 6** show that the M-150 Highway study intersections at Pryor Road and at the proposed access drive are anticipated to operate at acceptable levels of service during the Sunday peak hours. The north- and southbound left-turn movements at the intersection of M-150 Highway and Arboridge Drive are projected to operate at LOS E and F during each of the Sunday peak hours. During both peak hours the 95th percentile queue for the northbound left-turn movement is projected to be more than 10 vehicles. The 95th percentile queue for the southbound left-turn movement is projected to be approximately four vehicles during Peak Hour 1 and one vehicle during Peak Hour 2.

Given the lengthy delays and queues projected for the side street left-turn movements, the intersection of M-150 Highway and Arboridge Drive was evaluated for traffic signal installation. Installation of a traffic signal is typically considered by MoDOT if the criteria of the eight-hour volume warrant (Warrant 1) or the four-hour volume warrant (Warrant 2) are satisfied. To evaluate signal warrants, the Existing plus Development Conditions traffic volumes were plotted on the graph from the MUTCD for the Four-Hour Warrant. The warrant analysis is shown in **Figure 4** on the following page.

As shown in **Figure 4**, both of the Sunday peak hours are projected to significantly exceed the minimum volume thresholds of Warrant 2. To fully satisfy Warrant 2, the traffic volumes for four hours of a typical day must exceed the minimum volume thresholds. Since the proposed development is a church, it is only anticipated to generate significant traffic peaks during several hours each Sunday. Therefore, site generated traffic would not be expected to satisfy the warranting volumes for a duration of four hours on a typical Sunday. Given these findings, the four-hour traffic signal warrant is not projected to be satisfied with traffic generated by the proposed development.

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

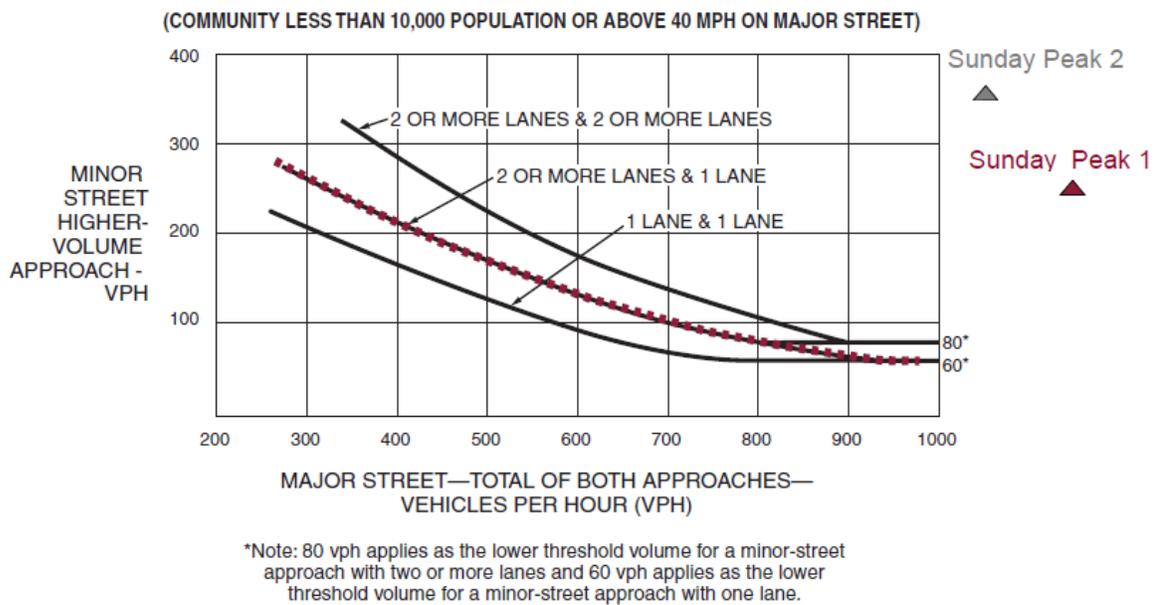


Figure 4: Four-Hour Traffic Signal Warrant Analysis at M-150 and Arboridge Drive

Even though the four-hour warrant is not satisfied with the addition of development traffic, the Arboridge Drive intersection is a candidate for traffic signal installation in the future for several reasons. The intersection is spaced 1,400 feet from the next signalized to the east, and 2,100 feet from the signalized Pryor Road intersection to the west. As a collector street, the traffic volume on Arboridge Drive would be expected to increase in the future as development occurs in the surrounding area. Additional traffic may lead to satisfaction of the warrant. Therefore, the intersection should be monitored for traffic signal installation.

Given that the M-150 Highway and Arboridge Drive intersection is a candidate for signalization, it was evaluated as a signalized intersection in **Table 5**. With the installation of a traffic signal, both Sunday Peak Hours are projected to operate at acceptable levels of service.

Summary

TranSystems has completed a traffic impact study for the proposed expansion of the existing Journey Church International facility located at 1601 SW M-150 Highway in Lee's Summit, Missouri. The purpose of this study was to assess the impact of the proposed facility expansion project on the surrounding transportation system.

As part of the proposed development, access to the site will be modified. The existing driveway access to the Journey Church site will be removed. A new access drive will connect to the existing intersection at M-150 Highway and Arboridge Drive. An additional right-in/right-out access drive will also be constructed on M-150 in the northwest corner of the site.

The new access points will result in some redistribution of existing traffic volumes. With the addition of development traffic, the northbound and southbound movements at M-150 and Arboridge Drive are projected to operate with undesirable levels of service in both the Sunday Peak 1 and 2 scenarios. Both Sunday peak hours exceed the minimum volumes for the four-hour warrant. However, it is not likely that any other hours exceed the minimum volumes, so the warrant is not projected to be met. Additional development within the surrounding area is likely, which may increase volumes to warrant a traffic signal. With the installation of a signal, the intersection is projected to operate at acceptable levels of service.

Several improvements are identified below to accommodate traffic generated by the proposed development.

M-150 and Proposed Access Drive

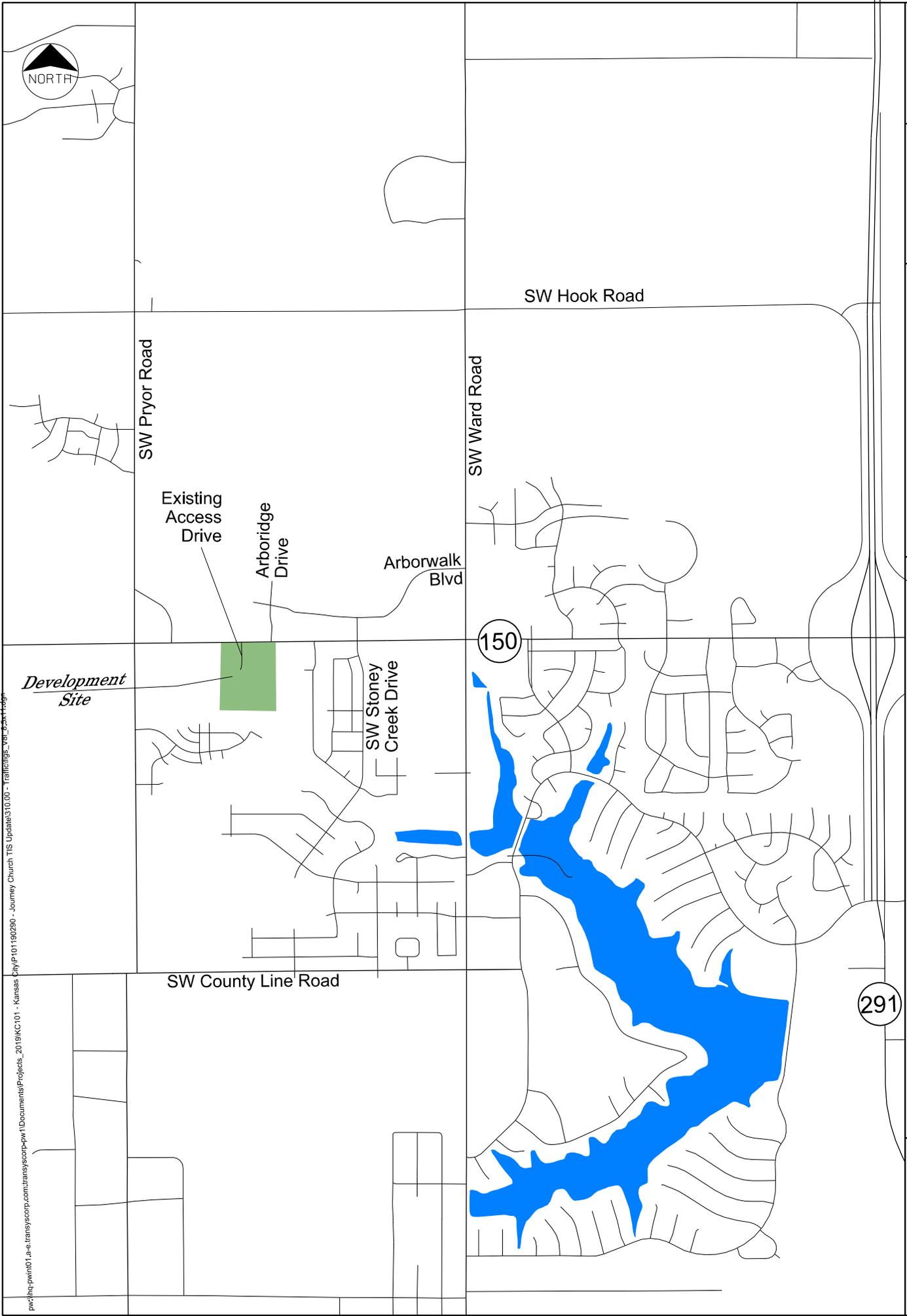
- ▶ Construct an eastbound right-turn lane with a minimum storage length of 200 feet plus appropriate taper.

M-150 and Arboridge Drive

- ▶ Construct a westbound left-turn lane with a minimum storage length of 250 feet plus appropriate taper.
- ▶ Stripe the northbound approach with a shared through/right-turn lane and left-turn lane with a minimum storage length of 250 feet.
- ▶ Monitor the intersection for traffic signal installation when warranted.

Appendix A - Figures

Figure A-1	Location Map
Figure A-2	Site Plan
Figure A-3	Existing Lane Configurations
Figure A-4	Existing Peak Hour Traffic Volumes
Figure A-5	Existing plus Development Lane Configurations
Figure A-6	Existing plus Development Peak Hour Traffic Volumes



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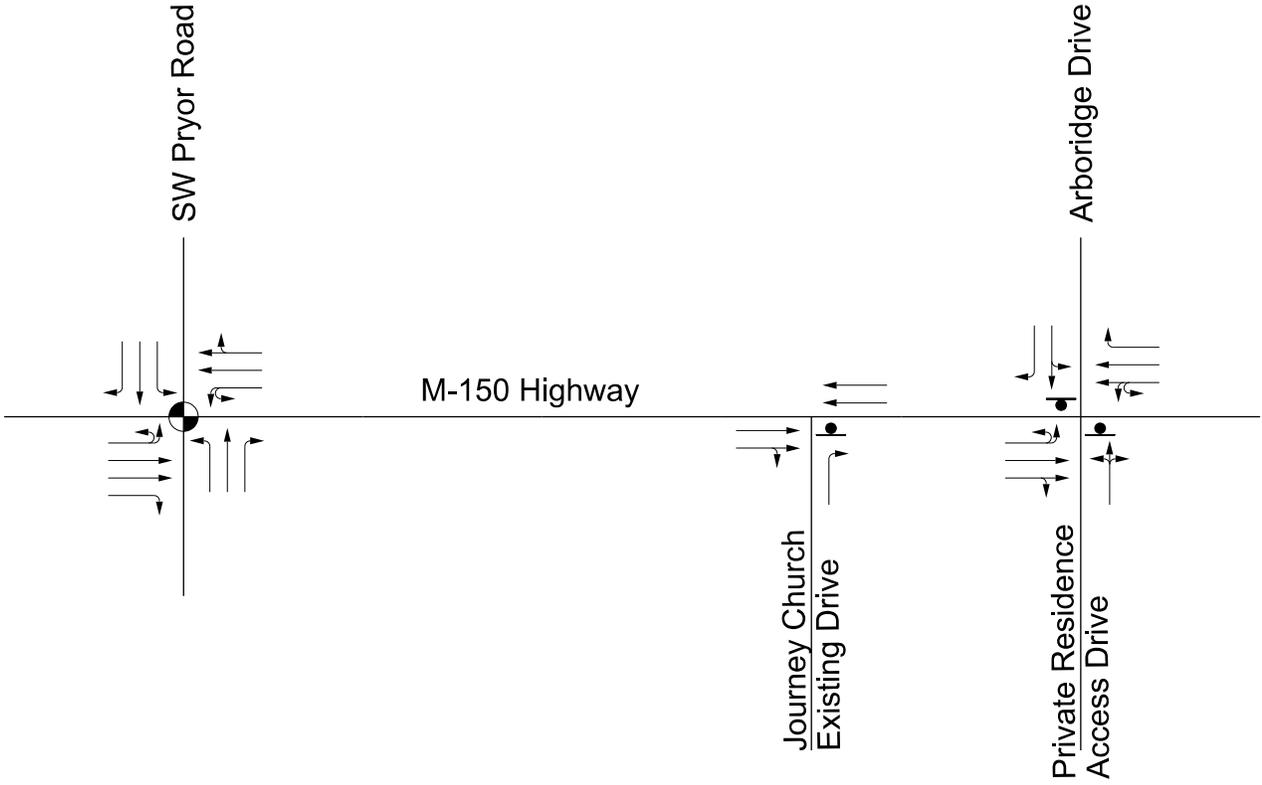


LOCATION MAP

Journey Church International
 Traffic Impact Study
 Lee's Summit, Missouri

December 2019
 No Scale

Figure A-1



Legend

-  - Traffic Signal
-  - Stop Sign
-  - Lane Configuration

Figure A-3

December 2019

No Scale

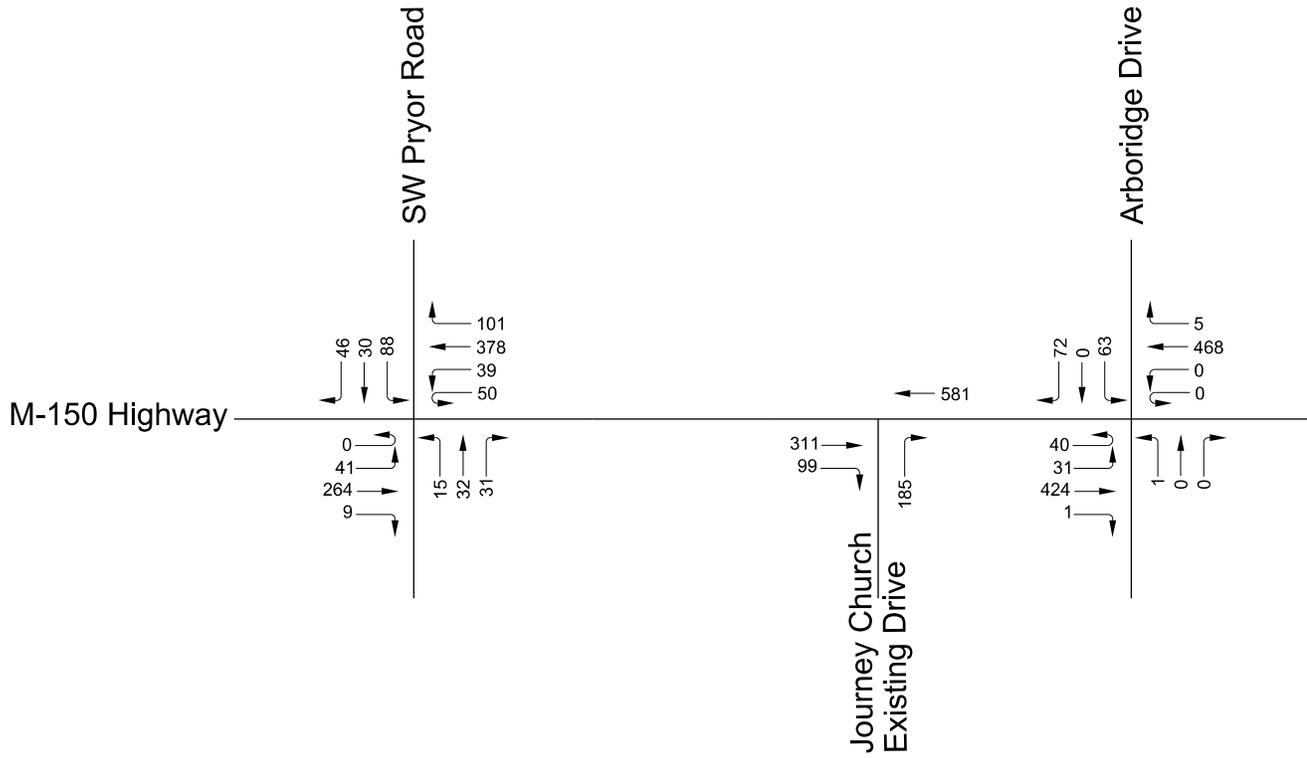
Journey Church International
Traffic Impact Study
Lee's Summit, Missouri

EXISTING LANE CONFIGURATIONS

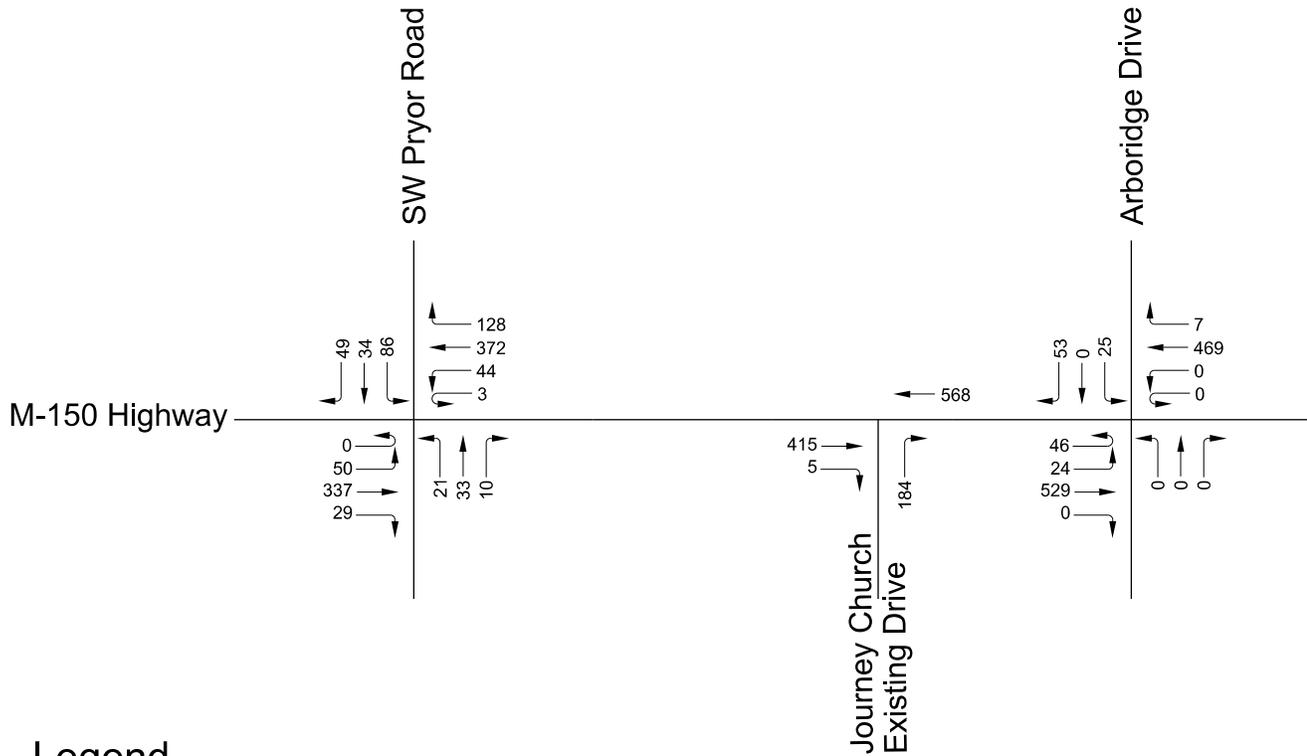




SUNDAY PEAK HOUR 1



SUNDAY PEAK HOUR 2



Legend

123 -Total Hourly Volume

Figure A-4

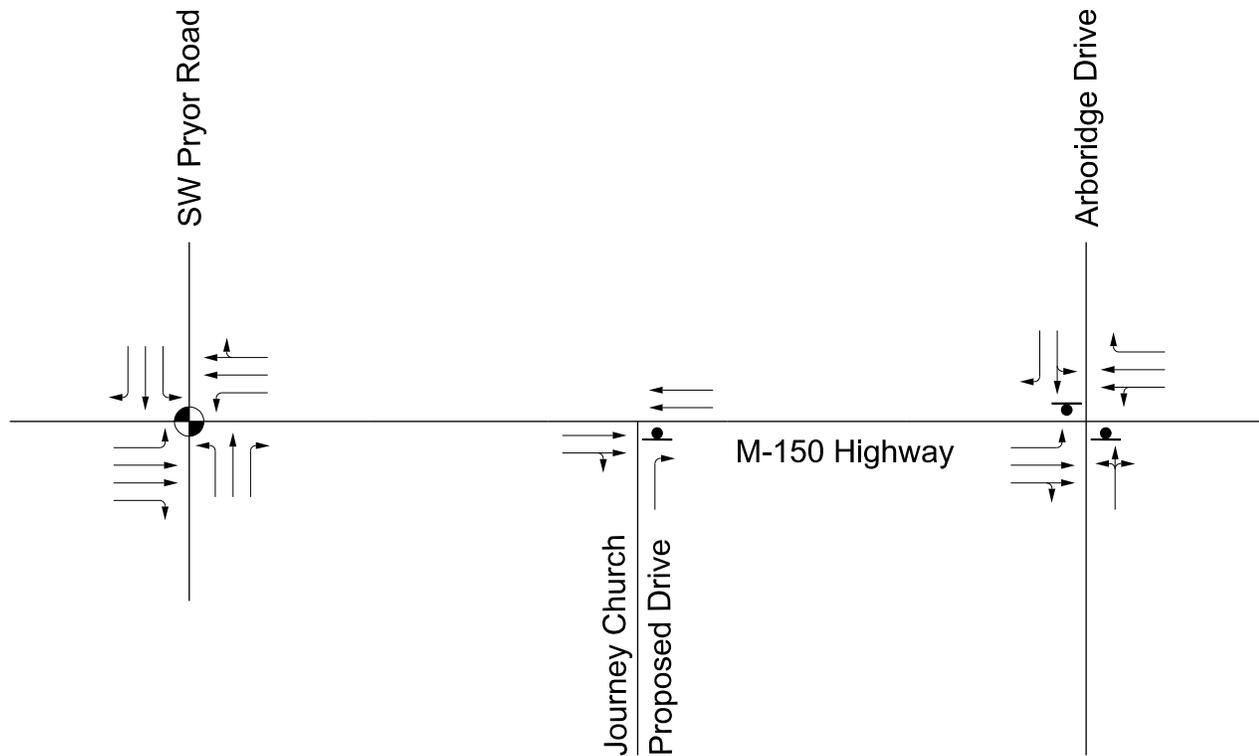
December 2019

No Scale

Journey Church International
Traffic Impact Study
Lee's Summit, Missouri

EXISTING PEAK HOUR
TRAFFIC VOLUMES





Legend

-  - Traffic Signal
-  - Stop Sign
-  - Lane Configuration

EXISTING PLUS DEVELOPMENT
LANE CONFIGURATIONS

Journey Church International
Traffic Impact Study
Lee's Summit, Missouri

December 2019

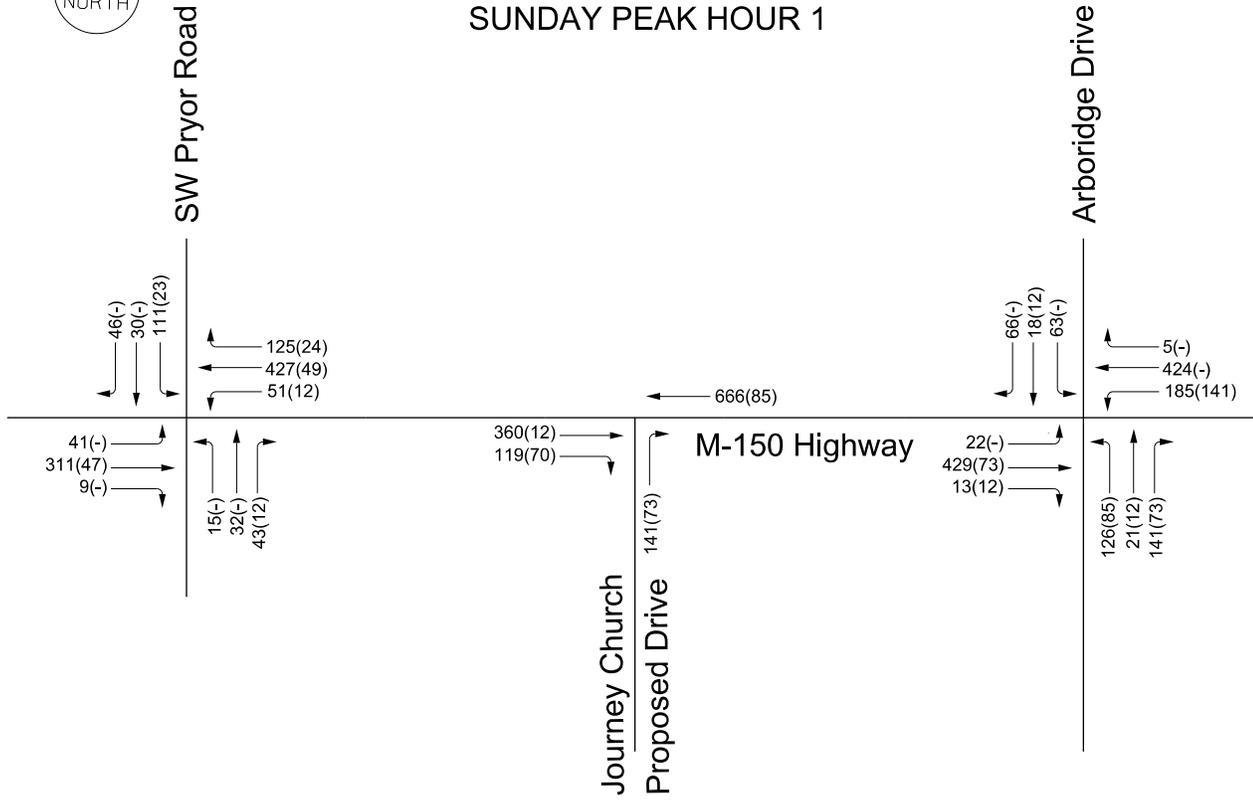
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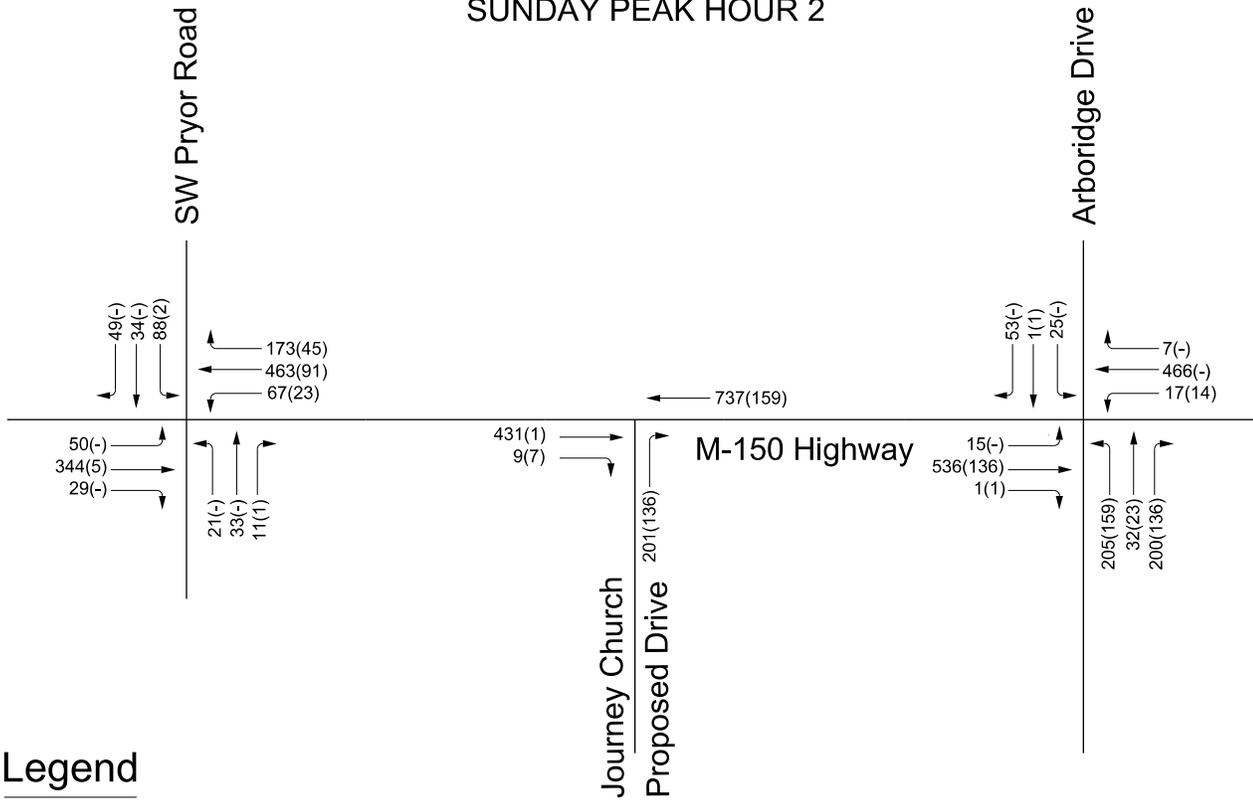
Figure A-5



SUNDAY PEAK HOUR 1



SUNDAY PEAK HOUR 2



Legend

- Total Hourly Volume
- Proposed Development Traffic

December 2019
 Journey Church International
 Traffic Impact Study
 Lee's Summit, Missouri

EXISTING PLUS DEVELOPMENT
 PEAK HOUR TRAFFIC VOLUMES



Figure A-6