Spack CONSULTING
ENGINEERING TRAFFIC FORWARD

Technical Memorandum

To: Derek Leuer, MnDOT Traffic Safety Engineer
From: Max Moreland, P.E. and Bryant Ficek, P.E., P.T.O.E.
Date: February 17, 2017
Re: Median Acceleration Lane Usage

Purpose of Report and Study Objectives

At some side-street stop controlled intersections on MnDOT roads throughout the state of Minnesota, median acceleration lanes (MALs) have been constructed on state highways. These MALs are intended to allow left turning vehicles from the side streets and u-turning vehicles on the mainline to make their turn into an available lane without needing to wait for a gap in the highway through traffic, thereby reducing the delay and hopefully improving the safety at the intersection. An image of a MAL is shown in Figure 1 in the Appendix.

The purpose of this report is to monitor some of the MALs in Minnesota to see if and how they are being utilized. The analysis in this report separates passenger vehicles from heavy trucks to see if the utilization of the MALs is impacted by the vehicle type. Both ends of the MALs are observed in the analysis to determine if vehicles are using the MALs for their full length or only partially.

Summary of Results

The usage of twelve different median acceleration lanes (MALs) in the state of Minnesota were monitored for a week at each location. The data collected shows that an average of 82% vehicles that have the option to use an MAL will do so over the course of a day. An average of 20% of vehicles that have the option to use an MAL will use it for the entire length until they are forced to merge into the through lane of the mainline. During peak hour times this increases to 87% of vehicles utilizing a MAL and 24% of vehicles using the entire length of the MAL.

A higher percentage of passenger cars were seen to use the MALs than heavy vehicles, though a higher percentage of heavy vehicles use the entire length of the MAL than passenger cars. There was not a strong correlation found between mainline AADT and MAL usage, though generally higher AADTs lead to higher MAL utilization but lower utilization of the entire MAL.

Locations

Twelve different MALs were looked at as a part of this study. Those locations were:

A. Trunk Highway (TH) 10 eastbound at Benton County State Aid Highway (CSAH) 31 near Rice, Minnesota
B. TH 23 northeast bound at 36th Avenue near St Cloud, Minnesota
C. TH 23 eastbound at Fairway Drive near Cold Spring, Minnesota
D. TH 65 southbound at 245th Avenue near Bethel, Minnesota
E. TH 36 westbound (left and U-turn) at Demontreville Trail near Lake Elmo, Minnesota
F. TH 36 westbound (U-turn only) at Demontreville Trail near Lake Elmo, Minnesota
G. TH 61 eastbound at TH 316 near Welch, Minnesota
H. TH 61 eastbound at Goodhue CSAH 18 near Welch, Minnesota
I. TH 52 northbound at TH 57 near Hader, Minnesota
J. TH 14 eastbound at 280th Avenue near Byron, Minnesota
K. TH 60 eastbound at Blue Earth CSAH 109 near Lake Crystal, Minnesota
L. TH 60 westbound at Watonwan CSAH 2 near Butterfield, Minnesota

Figure 2 in the Appendix shows a map of the twelve MAL locations.

Data Collection Process

Cameras were set up at two locations for each MAL. One camera was set up at the intersection to be able to see how many vehicles were making the appropriate left turn or U-turn turn into the MAL or turning into one of the other through lanes. A second camera was set up at the end of the MAL to see how many vehicles use the full length of the MAL.

The results from the camera at the intersection will give a utilization rate for the MAL. Combining that with the results from the camera at the end of the MAL shows how many vehicles use the MAL for the full length.

In addition to the cameras, tube counters were set on both side street approaches, where available, to get directional volume and classification counts. Mainline AADT information was obtained from MnDOT's Traffic Mapping Application.

The cameras and tube counters were set out for a seven-day period at all locations. Due to weather and other events, some locations did not get seven straight days of video data. At least five days of video data were collected at each location with two of the locations having more than seven days of data due to cameras being reset and using videos from both rounds of video collection.

The data from the video counts were then used to determine MAL utilization. Using the peak hour determined from the side street tube counts, peak hour MAL usage results were obtained. For locations E and F that only had u-turn MAL usage, the peak hours were determined to be the hour with the most passenger cars making u-turns.

Data Collection Results

Summarizing all of the data collected, daily and peak hour results were obtained. The results are broken down into vehicles using the MAL as well as vehicles using the entire MAL. Vehicles using the MAL consists of the percentage of vehicles making either a left turn or u-turn that have the option of entering the MAL and choose to do so. Vehicles using the entire MAL consists of the percentage of all vehicles

that have the option to utilize the MAL, choose to do so, and remain in the MAL until forced to merge into the mainline through lane because the MAL ends.

Vehicles were classified into passenger cars and heavy vehicles. Farm vehicles were also looked for during the analysis, but only six total farm vehicles were recorded across all days at all locations. Due to this low volume they are not included in the results. However, of the six farm vehicles two used the MAL and none used the entire length.

Averaging the daily results across all locations shows that 82% of cars use the MAL with 19% of cars using the entire MAL on a daily basis. Daily results also show that 74% of heavy vehicles use the MAL with 28% heavy vehicles using the entire MAL.

Averaging the peak hour results across all locations shows that 87% of cars use the MAL with 23% of cars using the entire MAL during the peak hour. Peak hour results also show that 85% of heavy vehicles use the MAL with 37% heavy vehicles using the entire MAL.

Charts of the daily and peak hour usage rates for each of the MAL locations studied are shown in Chart 1 and Chart 2. Full daily and peak hour results for each day at each location are shown in the Appendix.

Chart 1 – Daily MAL Results by Location

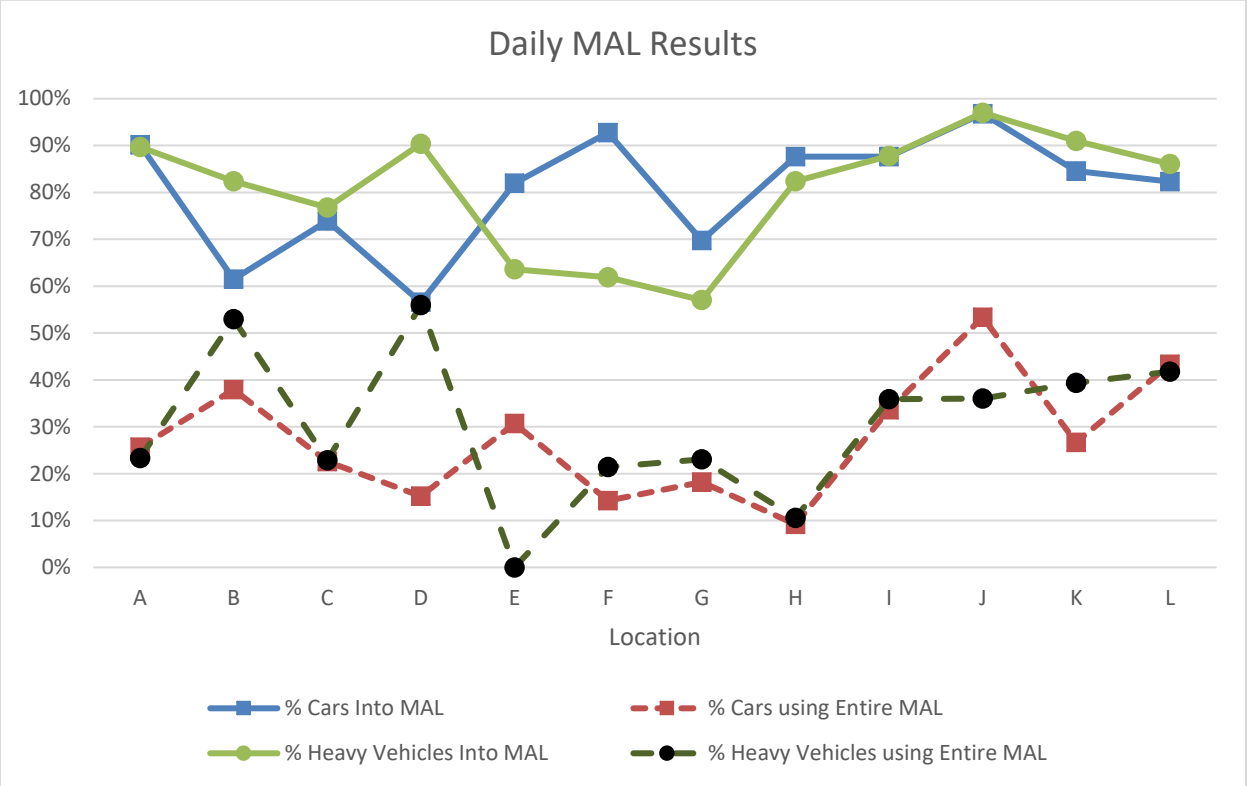
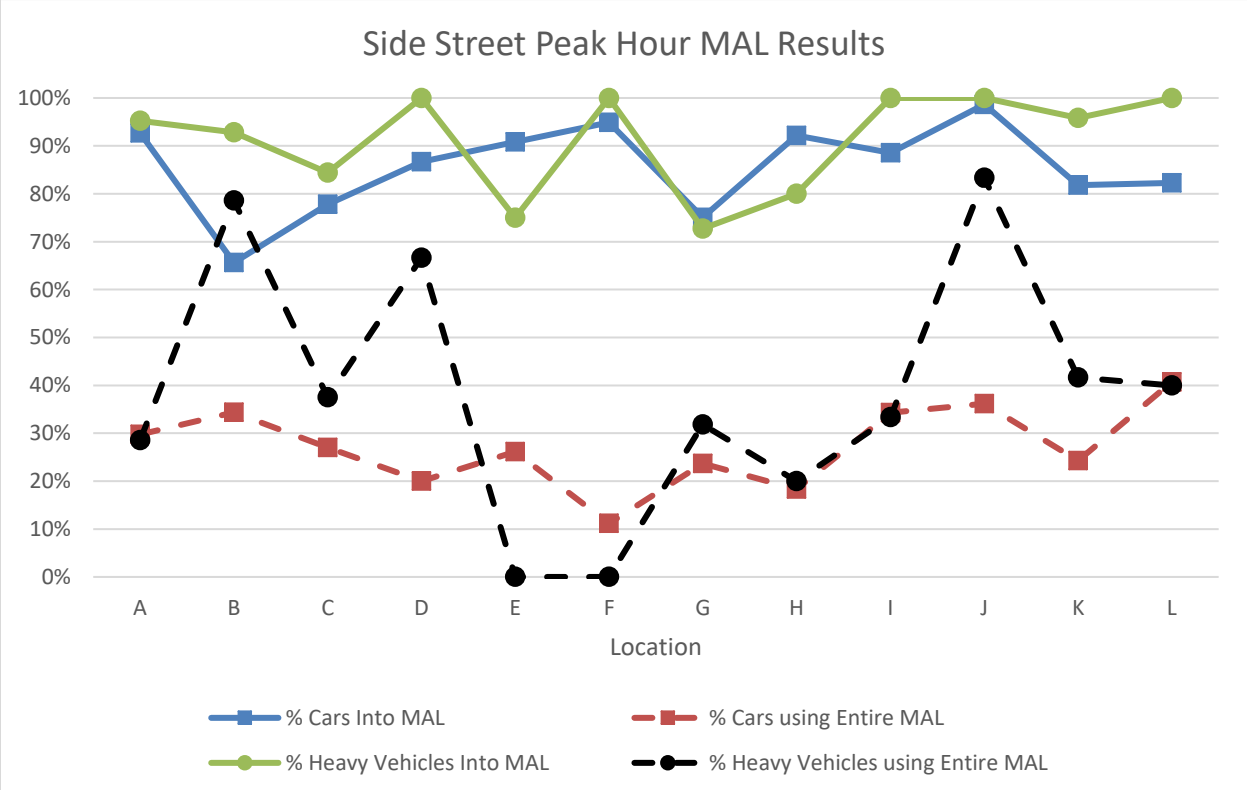


Chart 2 – Peak Hour MAL Results by Location



Safety

To be able to see if there are any safety impacts, crash data for the locations in this study were pulled and compared to crash data at similar sites without MAL's. Data for the MAL sites is from 2011 through 2015 and only includes the periods of time where an MAL existed since some of the locations had their MAL installed after 2011. Data for 32 similar sites without MAL's is from 2009 to 2011 and 2013 to 2015.

Comparing the crash rates at the MAL locations from this study to the control locations shows:

- 50% decrease in fatal and severe injury crashes at MAL locations
- 18% increase in overall crashes at MAL locations
- 21% increase in all injury crashes at MAL locations
- 3% increase in right angle crashes at MAL locations

Analyses

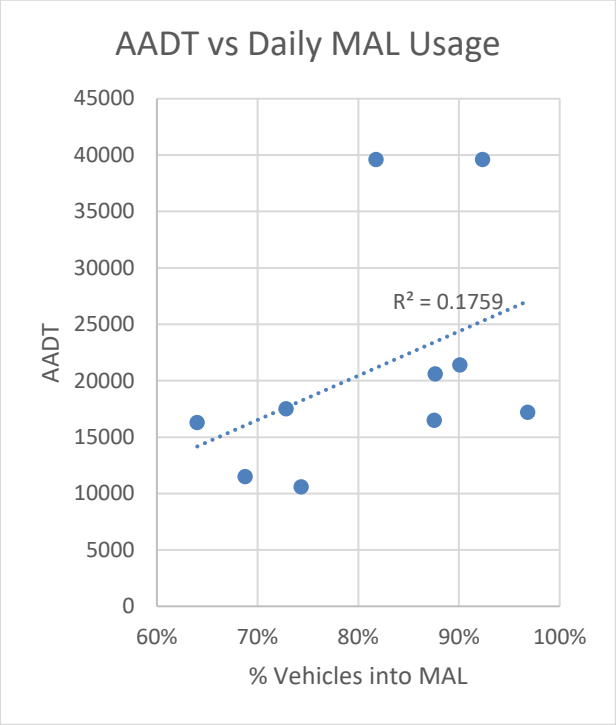
The results listed above, along with Charts 1 and 2, show that a majority of vehicles that have the option to utilize at least some portion of the MAL do so. Most of these vehicles do not use the entire length of the MAL, but there are on average roughly a quarter to a third of vehicles that do.

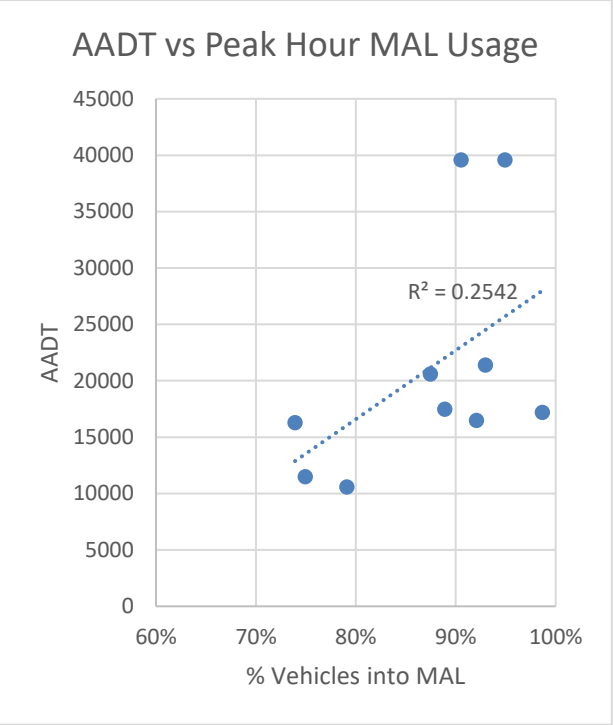
More passenger cars than heavy vehicles use the MAL, but more heavy vehicles use the entire length of the MAL than passenger vehicles. Based on observations made during the video counts, the lower usage by heavy vehicles can at least partly be due to larger turning radii of the heavy vehicles. In instances where there is no opposing mainline traffic, it can be easier for a heavy vehicle to make a wider turn into one of the outside through lanes rather than a tighter turn into the inside MAL. It is somewhat intuitive that if heavy vehicles do use the MAL, more of them will use the entire length than passenger cars since it takes longer for heavy vehicles to accelerate to the speed limit of the highway.

The results shown indicate that the MAL usage numbers during side street peak hour are higher than over the course of the day. As traffic volumes are higher, there are less gaps available on the mainline making it tougher to merge directly into a through lane. This incentivizes drivers to utilize the MAL.

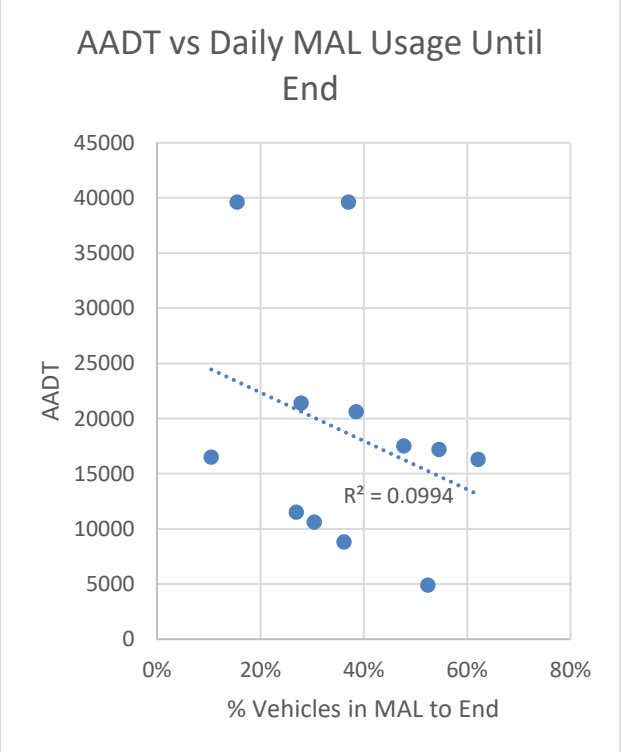
The daily and peak hour MAL usage results were plotted against the AADT of the mainline of each location. There was not a strong correlation found between the AADT of the mainline and the percentage of vehicles using the MAL or staying in the MAL until the end. However, even though the correlation was weak, the data generally showed that as the AADT increased, so did the MAL usage. It also showed that as the AADT increased, the percentage of vehicles staying in the MAL to the end decreased. This data is shown in Charts 3 through 6.

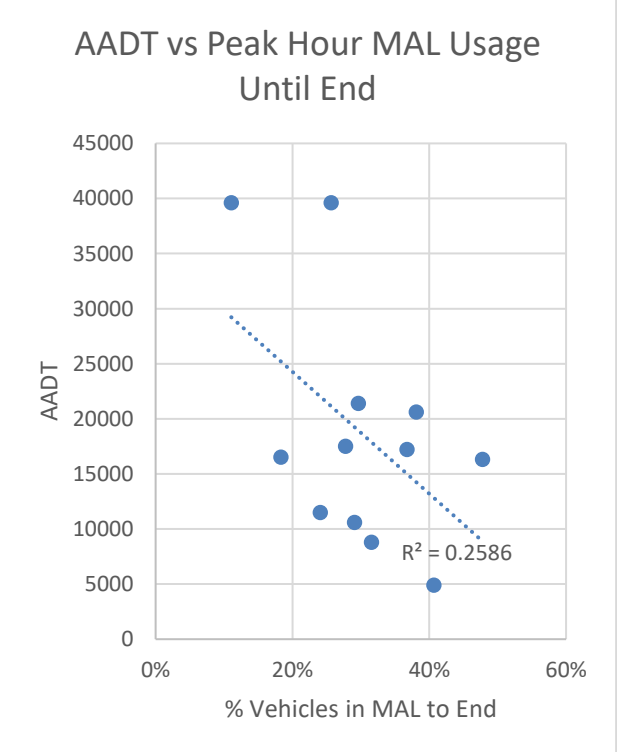
Charts 3 & 4 –AADT vs Daily and Peak Hour MAL Usage Results





Charts 5 & 6 – AADT vs Daily and Peak Hour MAL Usage Until End





Attachments

- Figures 1 & 2
- Daily & Peak Hour Results