PROJECT SUMMARY

Dynamic Flashing Yellow Arrow Phase Mode Selection

Project Location:
Systemwide

Start – Finish Date:
March 2021 – August 2023

Project Status:
Complete

Project Partners:
SRF Consulting Group

MnDOT Project Cost:
$161,000

Projects with Similar Characteristics:
N/A

Project Description:

This project focused on utilizing high-resolution signal data, crash data, and volume data to analyze safety impacts associated with the three left-turn phasing modes that flashing yellow arrows could operate in and determine when the various modes should operate. The three modes were as follows:

- Protected only.
- Protected-permissive.
- Permissive only.

The project team needed to analyze the data in two different methods to better understand the results. The analysis was completed for 9 scenarios with different combinations of:

- Speed (Low / High)
- Lateral Offset (Positive / Negative)
- Left-Turn Lane (Single / Dual)

The result of this project was a methodology that could be used for future analysis and incorporation of safety data into FYA operations decisions. No specific updates were made to the existing FYA phase mode decision spreadsheet.

Project Objective:

The project objective was to analyze and quantify the safety impacts associated with the three left-turn phasing modes that flashing yellow arrow (FYA) could operate in and incorporate the results into the decision-making process for determining when the various left-turn phasing modes should operate.

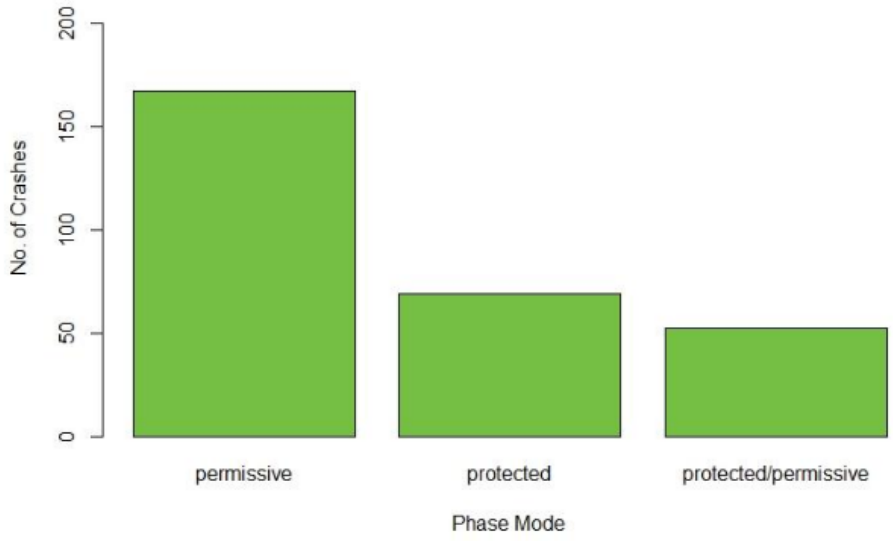

Figure 1: Crash Count per Left-Turn Phasing Mode (250 Crash Sample Size)

Project Accomplishments:

The project developed a methodology to address the following Minnesota ITS development objectives:

- A-1-01: Reduce number of vehicle crashes.
- A-1-10: Reduce number of crashes at signalized intersections.
- A-2-01: Reduce number of roadway fatalities.
- A-2-11: Reduce number of fatalities at signalized intersections.
- A-2-22: Reduce number of roadway injuries.
- A-2-32: Reduce number of injuries at signalized intersections.

Key Findings:

Crashes

Results of the alternate analysis generally showed higher crash rates at higher volumes. However, some scenarios had a relatively low number of crashes, making it challenging to draw definitive conclusions.

Limited Crash Data and Existing FYA Operations

A challenge for this project was the limited crash data and existing FYA operations. Due to the limited available data, it was challenging to draw conclusive results, and the methodology should be re-analyzed in the future when more FYAs are active around the state.

Lessons Learned:

- High-resolution signal data was a key piece of data to determine which left-turn phasing mode was in operation throughout the days historically. While the high-resolution signal data was useful, post-processing was still required to incorporate the data into the analysis.
- Using high-resolution signal data and combining it with crash data and turning movement volumes allowed the relationship between left-turn phasing modes and crashes to be developed.

Potential Next Steps for MnDOT:

- Perform additional analyses in the future to incorporate additional FYA operating intersections with the original data set to re-evaluate the FYA time-of-day decisions from this original project.
- Investigate impacts of changing phases with Flashing Yellow Arrow on Signal Phase and Timing development and broadcast.

Left-Turn Volume Range	Number of Time Periods	Number of Time Periods with a Crash	Percent of Time Periods with a Crash	Crash Ratio
0 – 50	11,480,407	48	0.000418%	--
50 – 100	2,115,497	20	0.000945%	2.26
100 – 150	759,276	4	0.000527%	1.26
150 – 200	378,693	0	0%	0
200 – 250	162,928	0	0%	0
250 – 300	104,389	1	0.000958%	2.29
300 – 350	40,511	0	0%	0
350 – 400	26,599	1	0.003760%	8.99
400 – 450	17,980	0	0%	0
> 450	42,587	0	0%	0

Figure 2: Sample Data Results for Scenario 2 (High Speed, Negative Lateral Offset, Single Left Turn Lane)