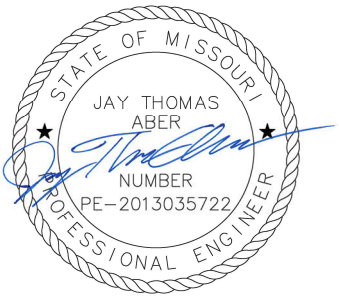
TECHNICAL MEMORANDUM

TO: Sara Copeland, Director of Community Development, North Kansas City, MO

FROM: Jay Aber, PE, PTOE Lead Traffic Engineer

SUBJECT: Armour Road Speed, Travel Time, & Safety Analysis in North Kansas City

DATE: July 23, 2020



INTRODUCTION AND SUMMARY

This analysis was initiated by the City of North Kansas City, Missouri to determine the impact of the Armour Road Bike Lanes project on Armour Road from Fayette Street to Ozark Street. This project represented the first phase of implementation of the Armour Road Complete Street plan. The complete street improvements within the study area include mid-block pedestrian crossings with pedestrian refuge islands, protected bike lanes, streetscaping, on-street parking, and signal optimization.

Figure 1 is an excerpt from the Armour Road Complete Street study depicting these improvements. To quantify the impact of these improvements to motor vehicles, a travel time study and speed study were performed. To determine the safety impacts of the project the crash records before and after the improvement were analyzed to measure any noticeable changes in the safety along the corridor.

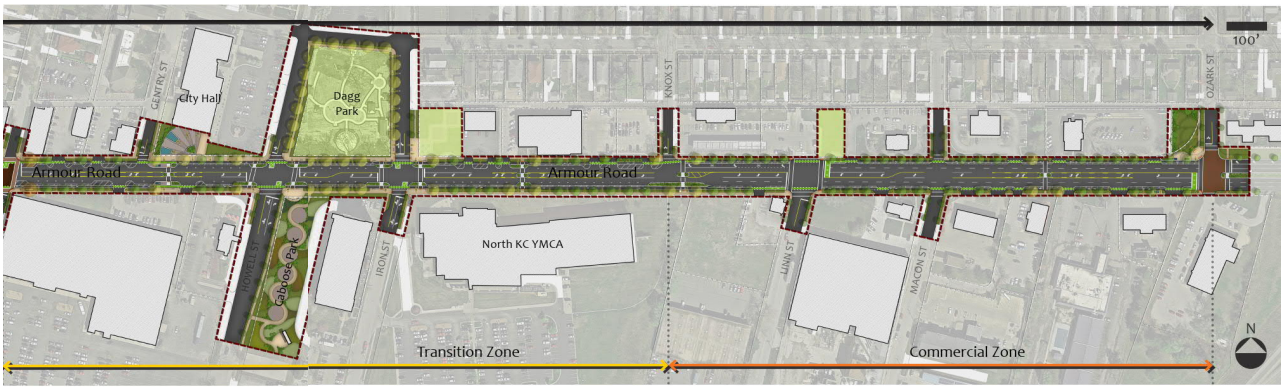


Figure 1: Armour Road Complete Street Concept Sketch

TRAVEL TIME STUDY

On Thursday July 16th, 2020, a travel time study was performed along the Armour Road corridor to determine the amount of time required to traverse from Burlington Street to Ozark Street for both the westbound and eastbound movements. Data was collected between 4:30pm to 5:30pm. Previous travel time studies had been conducted in similar manners in May 2017 and October 2019. This data was used to compare to the peak hour travel times

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generated using traffic modeling software before, during, and after construction. This information is displayed in **Figure 2** through **Figure 5**. The modeled travel times were developed using the Synchro modeling software during the planning process.

Figure 2 displays the travel times before construction began in May 2017. For both eastbound and westbound traffic, the modeled and measured times were relatively similar with the measured time being slightly greater than the modeled. Measured travel times were measured in the range of between approximately three and four minutes to traverse the corridor from Burlington to Ozark.

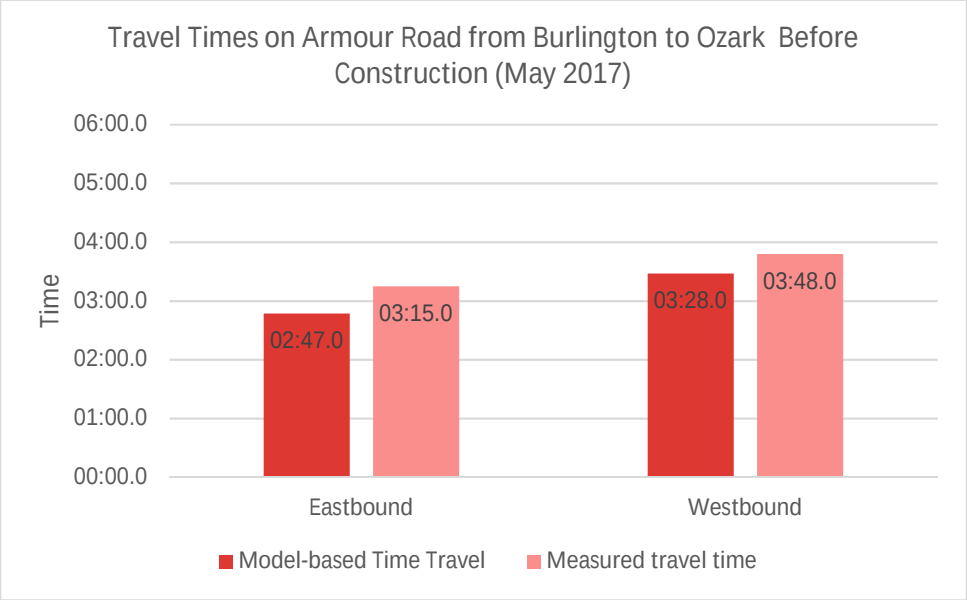

Figure 2: Travel Time along Armour Road from Burlington to Ozark before Construction for the Afternoon Peak Hour (May 2017)

Figure 3 displays the travel times after construction of the Armour Road Bike Lanes project was complete, but before the optimization of signal timing along Armour Road had taken plans. This data set of travel times were collected in October 2019. This represents the worst-case scenario for traffic because the traffic volumes were at their peak and the traffic signals had not yet been optimized to provide the best traffic flow possible on the street. For eastbound traffic, the measured time was about two minutes less than what was predicted by the modeled time. Similarly, for westbound traffic, the measured time was about thirty seconds less than the modeled time. However, because the signals had not been optimized, the variance in travel time speeds could be extreme from day to day and from cycle to cycle. Therefore, it is expected that the actual average travel time during this period was likely somewhere between the measured and modeled travel times. Measured travel times were measured in the range of between approximately three and four minutes to traverse the corridor from Burlington to Ozark.

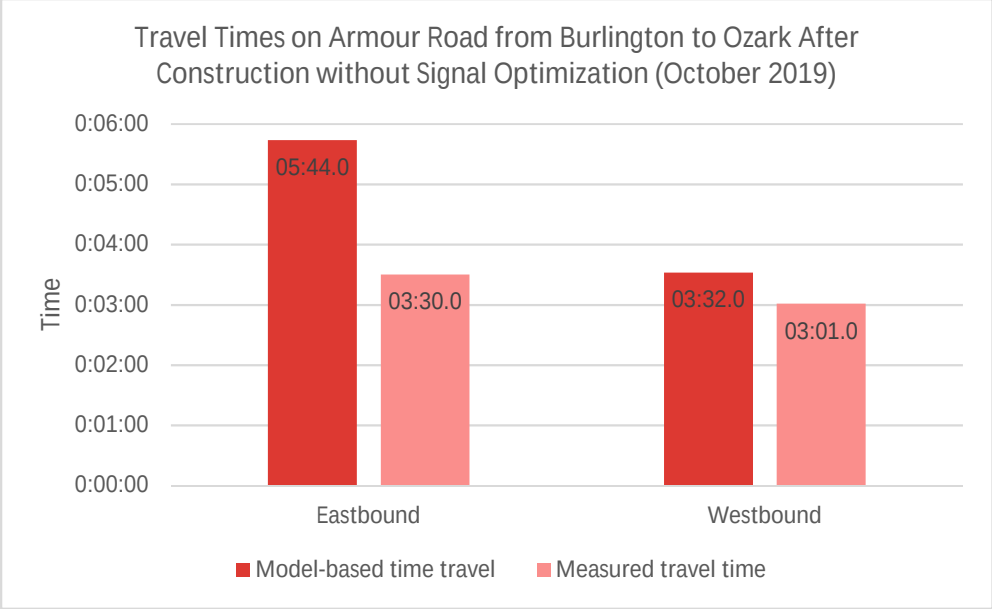

Figure 3: Travel Time along Armour Road from Burlington to Ozark before Signal Optimization Afternoon Peak Hour (October 2019)

Figure 4 displays the travel times after construction in July 2020 at a time when the signal optimization had been conducted. For eastbound traffic and westbound traffic, the measured time was about a minute and a half less than the predicted modeled time. The modeled travel times range in the three to four-minute range. The difference between the modeled and measured travel time is likely due primarily to reduced traffic volumes resulting from the COVID-19 pandemic. If traffic volumes were at the same level as pre-COVID-19 levels, it is expected that the travel time would be similar to the modeled travel times.

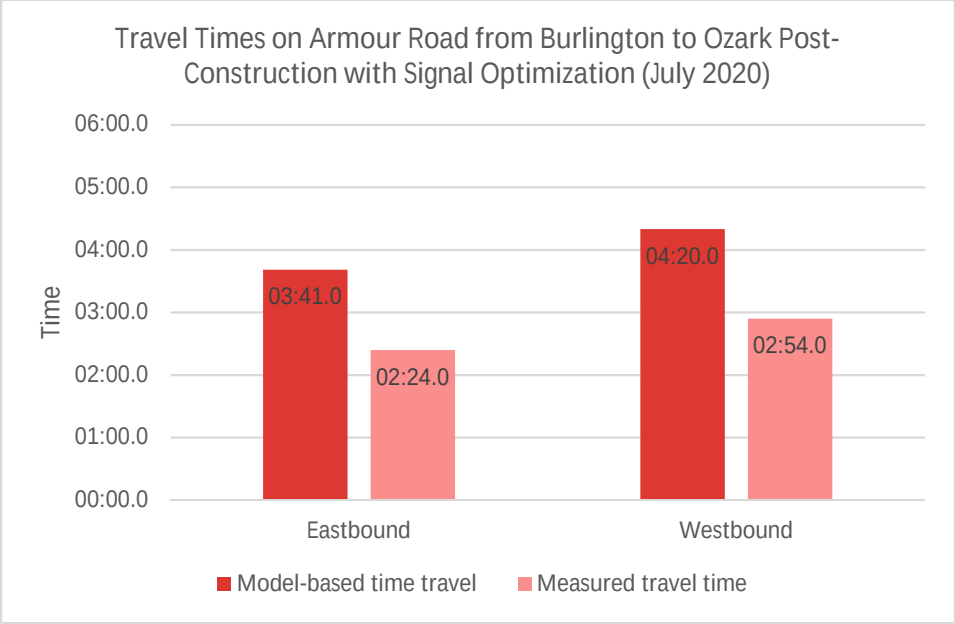

Figure 4: Travel Time along Armour Road from Burlington to Ozark after Signal Optimization Afternoon Peak Hour (July 2020)

Figure 5 displays a comparison of the measured travel times on Armour Road in the various stages. This includes the travel time measured pre-construction, just after construction was completed but the traffic signal timing had not been optimized, and after construction once the traffic signals had been optimized. The figure shows that travel times have not varied widely throughout the project. **Current measured travel times on Armour Road are approximately 25% shorter than the measured travel times before the Armour Road Bike Lanes project was implemented.** Even if traffic volumes increased to pre-COVID-19 levels, it is expected that travel times would remain in the three to four-minute time range.

Anecdotal evidence suggests there is a perception of increased traffic despite small changes in travel times. This likely is a result of additional queueing experienced along the corridor as a result of the project. Longer queues lead to a perceived increase in traffic congestions. However, queue lengths have a low correlation with actual travel time when experienced on corridors of signalized intersections that act as a coordinated system, as is the case on Armour Road. In this type of coordinated system, it is desirable to have "platoons" of cars that are closely spaced so that these cars can efficiently move through a traffic signal on the green phase. This results in time periods with heavy traffic flow followed by periods of light traffic flow, corresponding to the "green band." Because most drivers find themselves driving in the platoons, coordinated signal systems can appear to be highly congested, when this is actually the most efficient operation of a signalized corridor. Coordinated signal systems can also lead to higher levels of delay on side streets entering the main corridor. This is a result of the need for a fixed signal cycle length to provide progression and the "green band" for efficient main street operations.

It should be noted that the decreased traffic volumes correspond well with data across the region due to COVID-19 impacts. The reduction in traffic volumes is likely not related to drivers choosing alternate routes to avoid Armour Road. Indeed, with travel times lower then pre-construction levels, it is unlikely that any driver would choose to drive through the Avenues or the Industrial District if their destination was on Armour Road or they were passing through from Burlington Street to I-29.

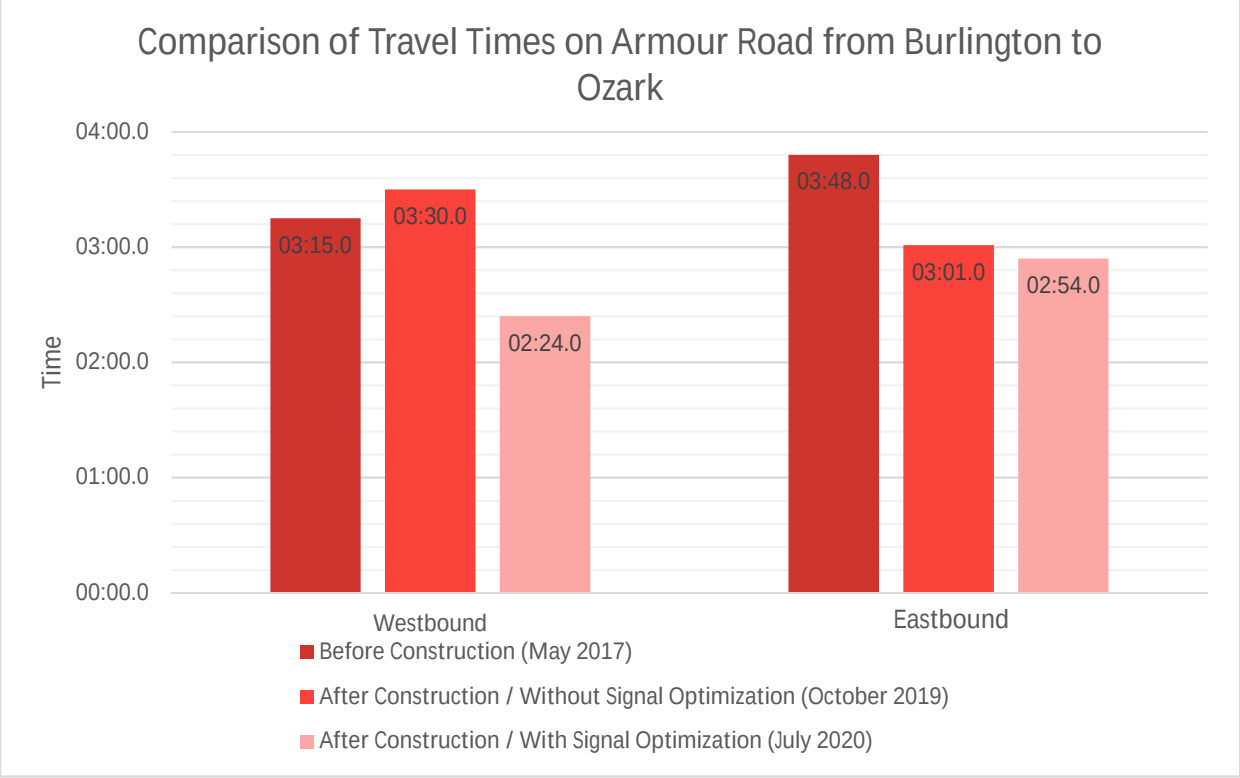

Figure 5: Comparison of Measured Travel Times on Armour Road from Burlington to Ozark

SPEED STUDY

A spot speed study was conducted by WSP staff along Amour Road between Iron Street and Knox Street to determine free-flow (85th percentile) speed of vehicles on Tuesday July 16, 2020 between 3:00pm to 4:00pm. The speed of vehicles was measured with a handheld radar device. Vehicles which were decelerating for a turn or red traffic signal, yielded to pedestrians, or accelerating after a turn or green traffic signal were not recorded since they did not maintain a constant speed profile along the corridor.

Based on the resulting data observations shown in **Table 1**, the 85th percentile speed on this section of Armour Road was determined to be 32 mph. The 85th percentile speed is the speed at which 85 percent of the public is traveling at or below. **The average speed was found to be 29 mph.** Nearly 95% of drivers fell within the 10-mph pace speed range of 24 – 34 mph. This indicates that the speeds are not widely distributed under typical mid-day conditions.

Table 1: WSP Results of Spot Speed Tests on Armour Road

Approach	Posted (mph)	Minimum (mph)	Maximum (mph)	Average (mph)	Median (mph)	Mode (mph)	85th Percentile (mph)	Pace Speed (mph)	Percent in Pace
Armour Road (Westbound & Eastbound)	25	22	38	29	28	27	32	24-34	94.80%

The North Kansas City Police Department performed two other spot speed studies along Armour Road at the intersections of Knox Street and Fayette Street from December 31, 2019 to January 9, 2020. and March 5-7, 2020, respectively. As shown in **Table 2**, the 85th percentile speed for Armour Road & Knox Street is higher than the 85th percentile speed for Armour Road & Fayette Street. **The average speeds were measured to be 27 mph near Fayette and 30 mph near Knox.** Speeds are lower near Fayette Street than Knox Street. The average speeds collected by the Police Department are similar to the average speed collected by WSP.

The fact that only 56% of drivers were within the 10-mph pace of 26 – 35 mph indicates a wider distribution of speeds and a higher prevalence of drivers far exceeding the speed limit. However, far fewer high-speed drivers were counted near Fayette and 77% of drivers were within the 10-mph pace at that location. This indicates that the complete street elements which are more numerous and substantial from Iron Street westward are proving more effective speed control as drivers enter downtown. Additional complete street elements near Knox Street and eastward could be implemented to further control drivers' reckless behaviors in this area.

Table 2: North Kansas City's Police Department Speed Study on Armour Road

Approach	Posted (mph)	Average (mph)	85th Percentile (mph)	Pace Speed (mph)	Percent in Pace
Armour Road & Knox Street	25	30	36	26-35	56%
Armour Road & Fayette Street	25	27	31	23-32	77%

TRAFFIC CITATION ANALYSIS

The most recent speeding and illegal truck route citations for Armour Road from Macon Street to Swift Street were requested from the North Kansas City Police Department. The number of recorded citations given to motorists before and after construction on Armour Road are shown in **Table 3** and **Table 4**, respectively. Before construction there were a total of 71 truck route citations and after construction there were a total of 23 citations in a 6-month period. **This represents a 68% decrease in illegal truck traffic citations resulting from the Armour Road Bike**

Lanes project. Similarly, before construction there were a total of 59 speeding citations and after construction there were a total of 45 citations during the same 6-month period. **This represents a 24% decrease in speeding citations resulting from the Armour Road Bike Lanes project**.

This reduction is likely not a result of lowered levels of police enforcement on the corridor. Considering most drivers are largely complying with the speed limits as seen in the speed study and anecdotal evidence suggests much less truck traffic on Armour Road through downtown, this reduction in citations is likely a result of better compliance with laws. However, it should be noted that citation data is not a complete indication of driver behavior as many factors go into whether or not an officer will enforce any particular violation and whether or not a ticket is issued if a driver is pulled over.

Table 3: Traffic Citations within the Study Area before Construction

Before Construction	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Total
Truck Route	10	11	11	21	12	6	71
Speeding	12	7	8	9	12	11	59

Table 4: Traffic Citations within the Study Area after Construction

After Construction	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Total
Truck Route	12	5	3	1	1	1	23
Speeding	10	13	3	5	12	2	45

SAFETY ANALYSIS

Crashes involving drivers, pedestrians, bicyclists and transit users is a public safety and mobility issue. Therefore, a comparative crash analysis was done to compare before and after construction to determine the effectiveness of the Armour Road Bike Lanes project. It is important to note that Armour Road Bike Lane project construction began approximately June 1, 2019 and ended approximately September 15, 2019. There was another period of construction work for the QuikTrip on Armour Road & Ozark Street and Armour Road & I-35 which began approximately September 1, 2019 and ended approximately January 31, 2020. The areas and durations where work zones were present were excluded from the crash analysis as they do not represent the long-term configuration of the roadway and have differing crash trends.

Before construction began on Armour Road, between January 1, 2018 to May 31, 2019 (seventeen months), there were a total of 101 crashes along Armour Road from Fayette Street to Ozark Street including 20 injury crashes and 81 property damage only crashes. After construction ended, between September 15, 2019 and July 15, 2020 (10 months), there were a total of 56 crashes along Armour Road including 9 injury crashes and 47 property damage only crashes. As shown in **Figure 6**, the frequency of injury and property damage only crashes decreased after construction of the Armour Road complete street. **Injury crashes on Armour Road decreased by about 24% and property damage only crashes decreased by about 1%.** Reducing fatal and injury crashes was a primary goal of the Armour Road Bike Lanes project, which has been achieved.

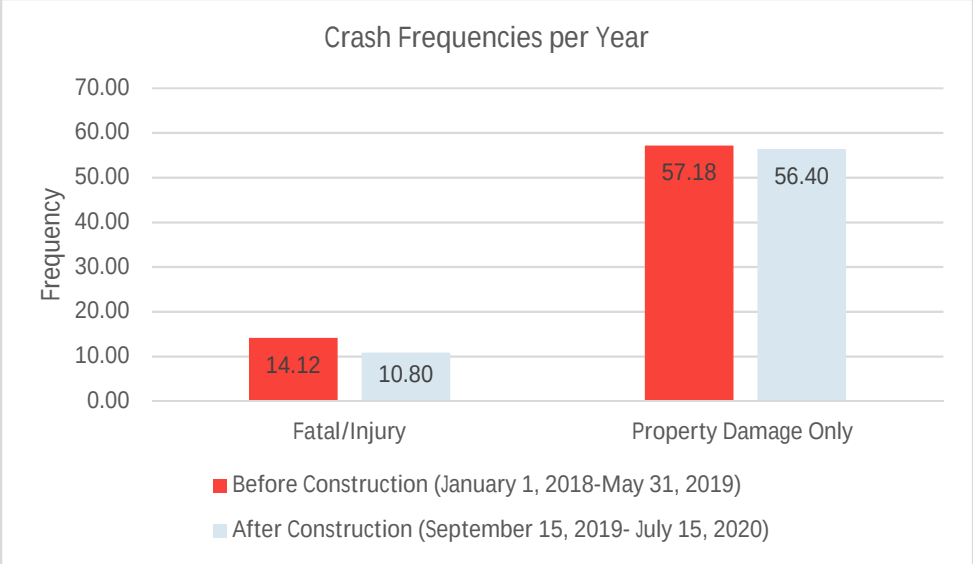

Figure 6: Crash Frequency per Year (before and after Construction)

The cost of crashes to society can be calculated using USDOT methodology. This cost includes the full cost of crashes on society as a whole including costs such as medical costs, loss of productivity, insurance claims, lawsuits, property damage, and more. The estimated cost to society resulting from crashes during this pre-construction period is approaching an average total cost of about $2,639,000 per year. The estimated cost to society resulting from crashes during the post-construction period is now approaching an average total cost slightly greater than $2,060,000 per year. **Figure 7** depicts the difference**. In total, crash costs decreased by 22% as a result of the Armour Road Bike Lanes project.**

If this trend continues, the annual crash cost savings of the project will be approximately $597,000 per year. The Armour Road Bike Lanes project will achieve a benefit-to-cost ratio of greater than 1.0 within one year of implementation. Utilizing traditional benefit-to-cost methodology of estimating crash costs over a 20-year project lifecycle period, the **Armour Roads Bike Lane project will have a benefit-to-cost ratio of approximately 17.8:1.**

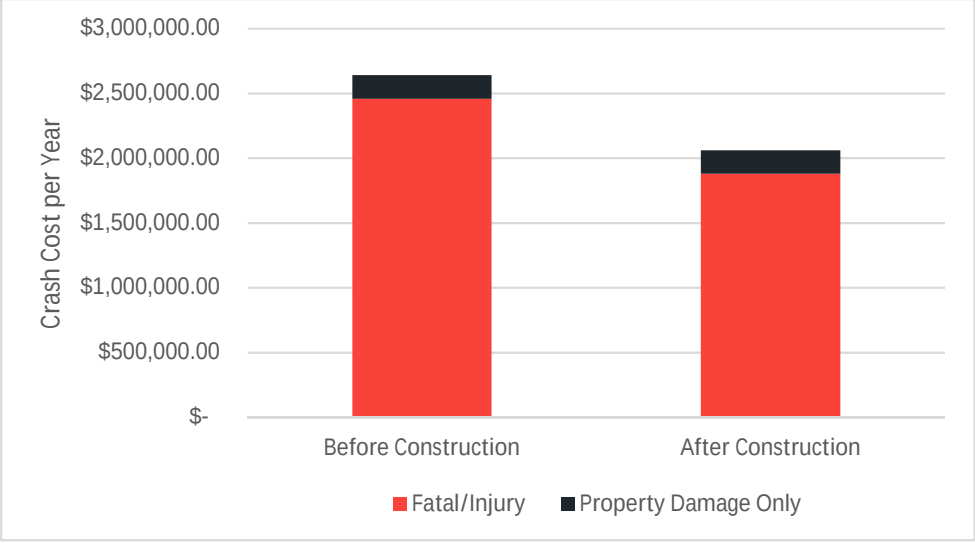

Figure 7: Crash Cost Analysis per Year before and after construction

There has been a substantial reduction in traffic volumes on Armour Road throughout the COVID-19 pandemic. Traditional thinking is that reduction in traffic volumes naturally leads to a reduction in traffic crashes, injuries, and deaths. However, the opposite effect has been observed across the U.S. and in the Kansas City Metro region. Nationally, traffic death rates (number of deaths as compared to total vehicle miles traveled) has increased substantially. The National Safety Council found that traffic death rates increased 36% in April 2020 across the U.S. compared to the previous year.[1] Locally, similar trends have been seen. In Missouri, traffic volumes have dropped significantly in 2020 but fatal crashes have increased. The number of fatal crashes in Missouri in mid-June was 11% higher in 2020 than that time in 2019 despite the reduced traffic volumes.[2] The primary reason attributed to this is increased vehicle speeds and inattention by drivers on roadways with fewer cars. Kansas City Police Department and the Missouri Highway Patrol have both noted an increase in speed related citations during the stay-at-home orders.[3,4]

For these reasons, it is particularly important to note the reduction in the number of injury crashes on Armour Road. If the Armour Road Complete Street project had not been implemented, there is a high likelihood that injury crashes would have increase as a result of the COVID pandemic. It is also important to note that the speed study shows that drivers are largely complying with the speed limits set on Armour and that police citations for speeding have been reduced post-implementation. This likely would not be the case if the Armour Road Complete Street project had not been constructed.

FUTURE TRAFFIC TRENDS ON ARMOUR ROAD

The COVID-19 pandemic has led to a reduction in mobility and traffic volumes. Since the pandemic began, traffic volumes fell dramatically and then slowly increased, but still have not come back to pre-COVID-19 levels. Passenger car travel in the U.S. remains approximately 10% - 15% lower than pre-pandemic levels. This can be seen in **Figure 8**. This trend has been seen on Armour Road and has led to a reduction in travel time on the street.

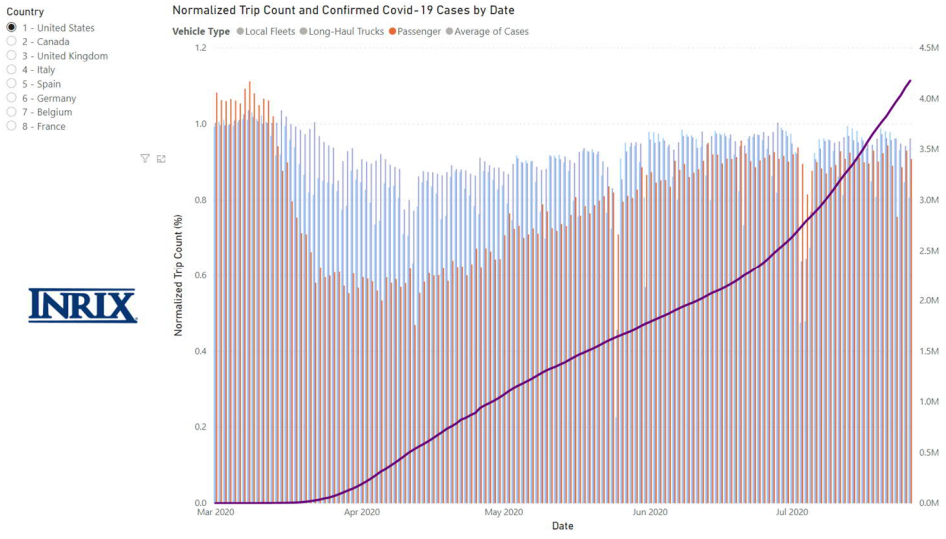

Figure 8: Traffic Volumes in the United States Correlated with COVID-19 Cases (Source: INRIX, July 29, 2020)

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[1] https://www.nsc.org/in-the-newsroom/motor-vehicle-fatality-rates-jump-366-in-april-despite-quarantines
[2] https://www.stltoday.com/news/local/crime-and-courts/missouri-reports-spike-in-traffic-deaths-on-state-roadways/article_306474f9-4c2a-5999-bd8b-89424ec9b39d.html
[3] https://www.kshb.com/news/coronavirus/missouri-traffic-fatalities-increase-as-highway-traffic-decreases
[4] https://www.kshb.com/news/coronavirus/kansas-city-police-report-increase-in-speeding-during-stay-at-home-order

Based on similar data from Canada, where the transport system and travel patterns are similar but the COVID-19 pandemic has largely been contained, passenger vehicle travel has not increased back to pre-pandemic levels. Instead, it has stabilized at approximately 10% lower traffic volumes across the country. This is shown in **Figure 9**. This is likely due to continued stay-at-home orders, job loss, and a greater number of people working from home. Similar trends are expected in the U.S. as the pandemic progresses, and it is anticipated that traffic volumes will not rebound to pre-COVID-19 levels in the near future.

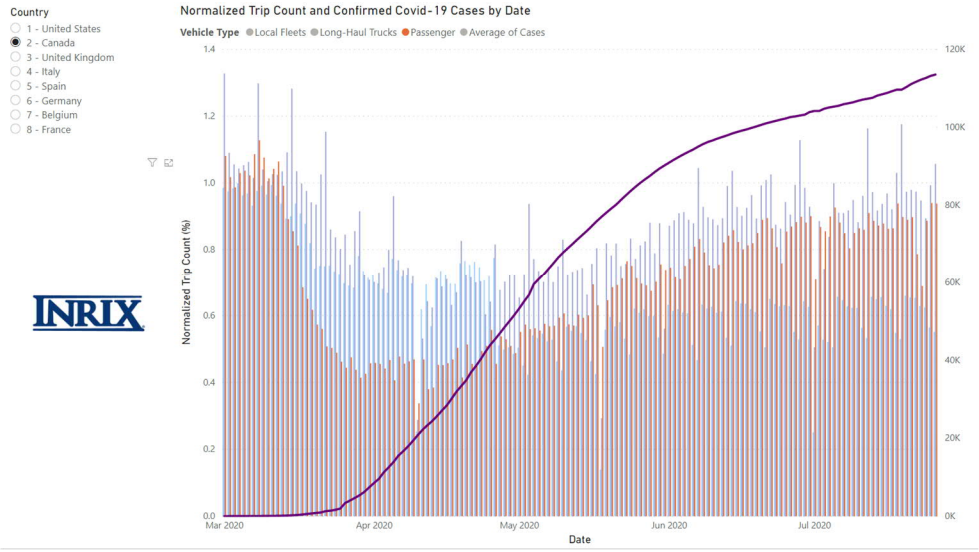

Figure 9: Traffic Volumes in Canada Correlated with COVID-19 Cases (Source: INRIX, July 29, 2020)

According to the most recent models from the Institute for Health Metrics and Evaluation (IHME), it is expected that number of deaths resulting from COVID-19 is likely to continue to increase in the U.S. through November and likely beyond. **Figure 10** shows the predicted number of deaths according to the IHME model. This indicates that COVID-19 will be a significant factor in the daily lives of North Kansas City residents and impact travel behaviors for a long time to come. IHME also predicts mobility trends related to COVID-19, and **Figure 11** shows the results of the modeling. This is in line with the travel data noted earlier and points to continued reduction in mobility of around 15% reduction in overall mobility into the foreseeable future.

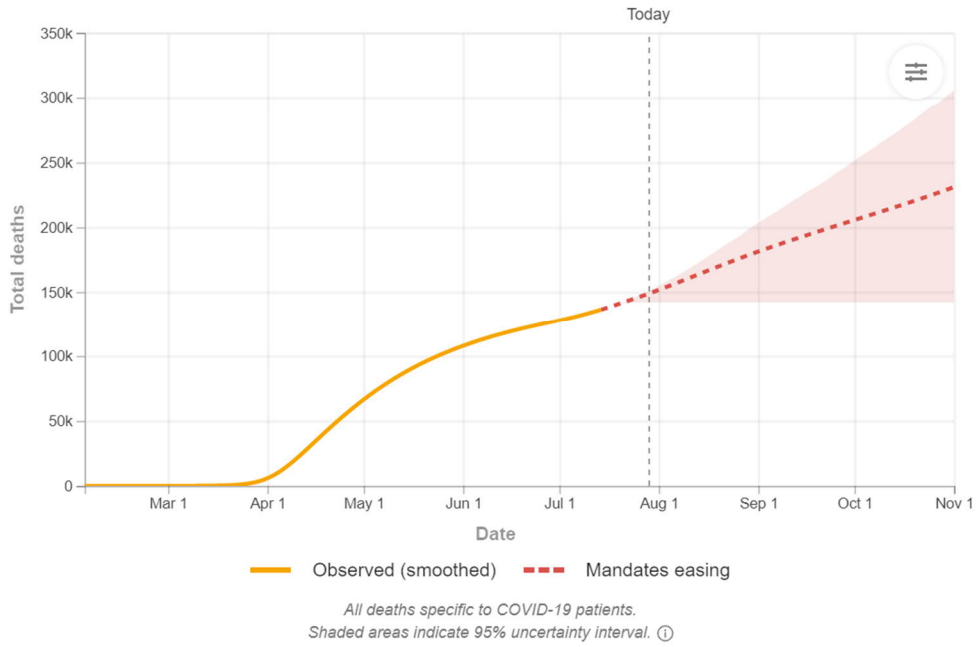

Figure 10: Total COVID-19 Deaths to Date and Predicted Through November 1, 2020 (Source: IHME, July 29, 2020)

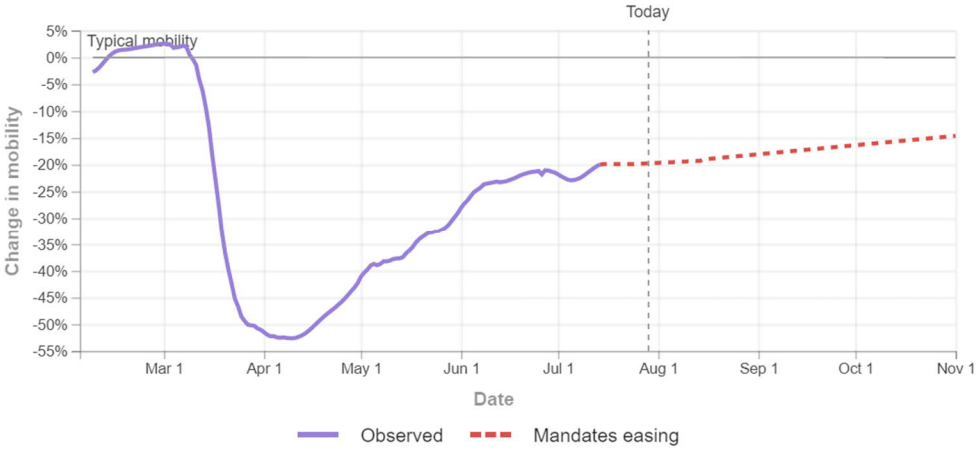

Figure 11: Change in Mobility Related to COVID-19 to Date and Predicted Through November 1, 2020 (Source: IHME, July 29, 2020)

COVID-19 has also changed to where, when, and how people are traveling. The Google COVID-19 Community Mobility Report from July 25, 2020 in **Figure 12** shows that fewer people are traveling to workplaces and retail destinations and more people are traveling to parks. Much of the traffic on Armour Road is related to commute trips to work in and out of downtown Kansas City and trips to retail and dining destinations. Because of this, the drop in traffic on Armour Road is likely to be sustained well into the future, as the employees working in Downtown Kansas City are typically professional office staff who can typically most easily work remotely and the trend of more remote work is likely to extend past the containment of the COVID-19 pandemic.

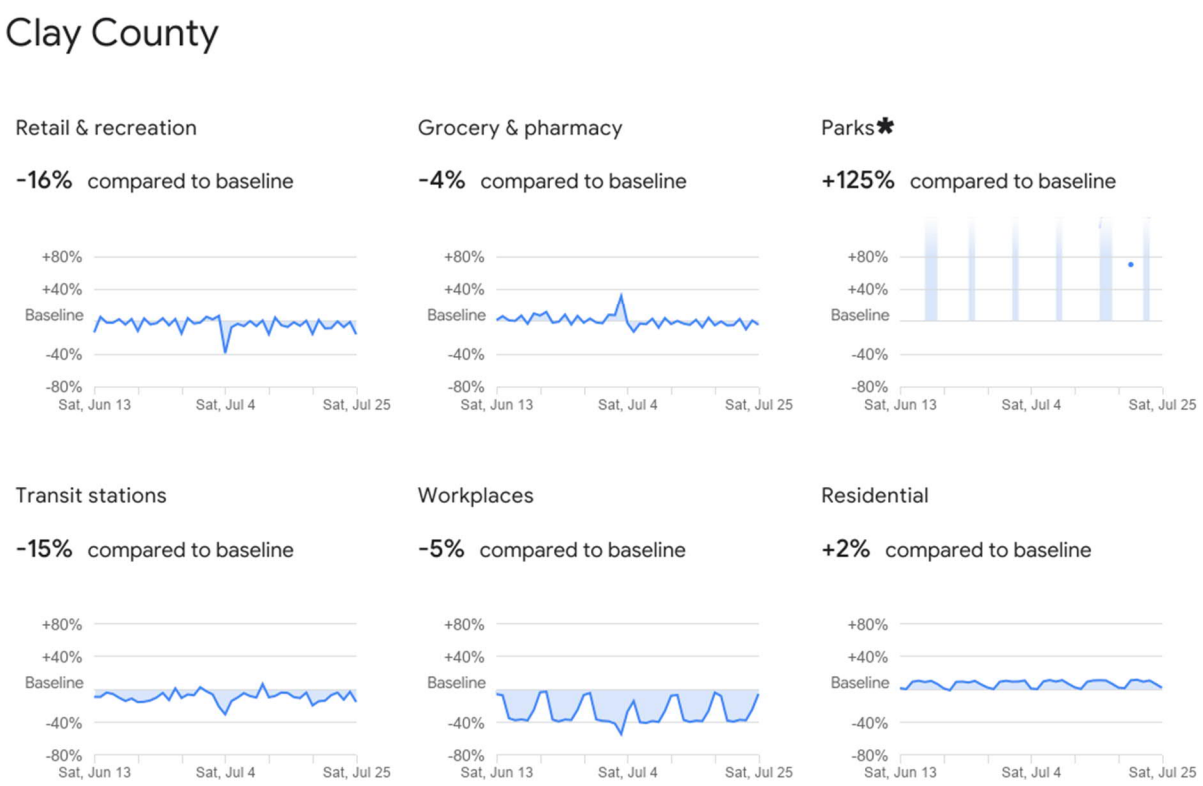

Figure 12: Google COVID-19 Community Mobility Report (July 25, 2020)

Another consideration of future traffic trends is the pending reconstruction of the Buck O'Neill bridge on US-169 across the Missouri River. This project, expected to start construction within the next year, will replace the existing 4-lane bridge with a 6-lane bridge that includes bicycle and pedestrian facilities. The bridge will also have direct ramp connections from US-169 to I-70 and I-35 so that drivers will not encounter a traffic signal at the south end of the bridge as exists today. This will dramatically increase traffic capacity on US-169 and is expected to dramatically reduce commuter traffic volumes in North Kansas City in turn. Traffic models created with the design development of this project predict a more than 25% reduction in traffic on Burlington in North Kansas City once the bridge project is finished.

Other factors, including the trend towards more online shopping, more remote work, more preferences for people to live near where they work, more preference towards walking, biking, and transit use as desirable alternate modes of transportation, and general lack of population growth in the Kansas City Metro region, will further impact the traffic volumes on Armour Road. Taking all of these things into consideration, it is unlikely if traffic volumes will increase to the levels seen on Armour Road previously experienced in the near future. **The traffic volumes on Armour Road may never increase to the levels of the past.**

SUMMARY

The Armour Road Bike Lanes project, the first phase of implementation of the Armour Road Complete Street Plan, has resulted in improved safety, reduced speeds, reduced numbers of police citations, and not impacted mobility. The street conversion has reduced injury crashes on the street by 24%. In this same time period, fatal crashes increased by 11% across Missouri. Based on the crash cost analysis, the project will have reduced overall crash cost to society above the planning, design, and construction costs in less than one year. The project is predicted to have a benefit-to-cost ratio of 17.8:1 over a 20-year lifecycle period. Improving safety on Armour Road was a primary goal of the Armour Road Complete Street plan.

Average speeds of drivers today are typically around 28 mph. The number of speeding citations given by the NKCPD on Armour Road has reduced by 24%. In this same time period, police and highway patrol departments across the region have noted significant increases in the number of speed-related citations. The number of illegal truck use citations given by NKCPD on Armour Road has decreased by 68%. Reducing vehicle speeds and reducing illegal truck maneuvers on Armour Road were two goals of the Armour Road Complete Street plan.

Today, travel times are approximately 25% shorter to drive on Armour from Burlington to Ozark than were measured prior to construction. While this travel time may increase in the future as traffic volumes stabilize due with the containment of the COVID-19 pandemic, it is unlikely that this increase will happen in the near future. Furthermore, given a variety of external factors the traffic volumes on Armour Road may never increase back to the levels seen prior to the Armour Road Bike Lanes project.