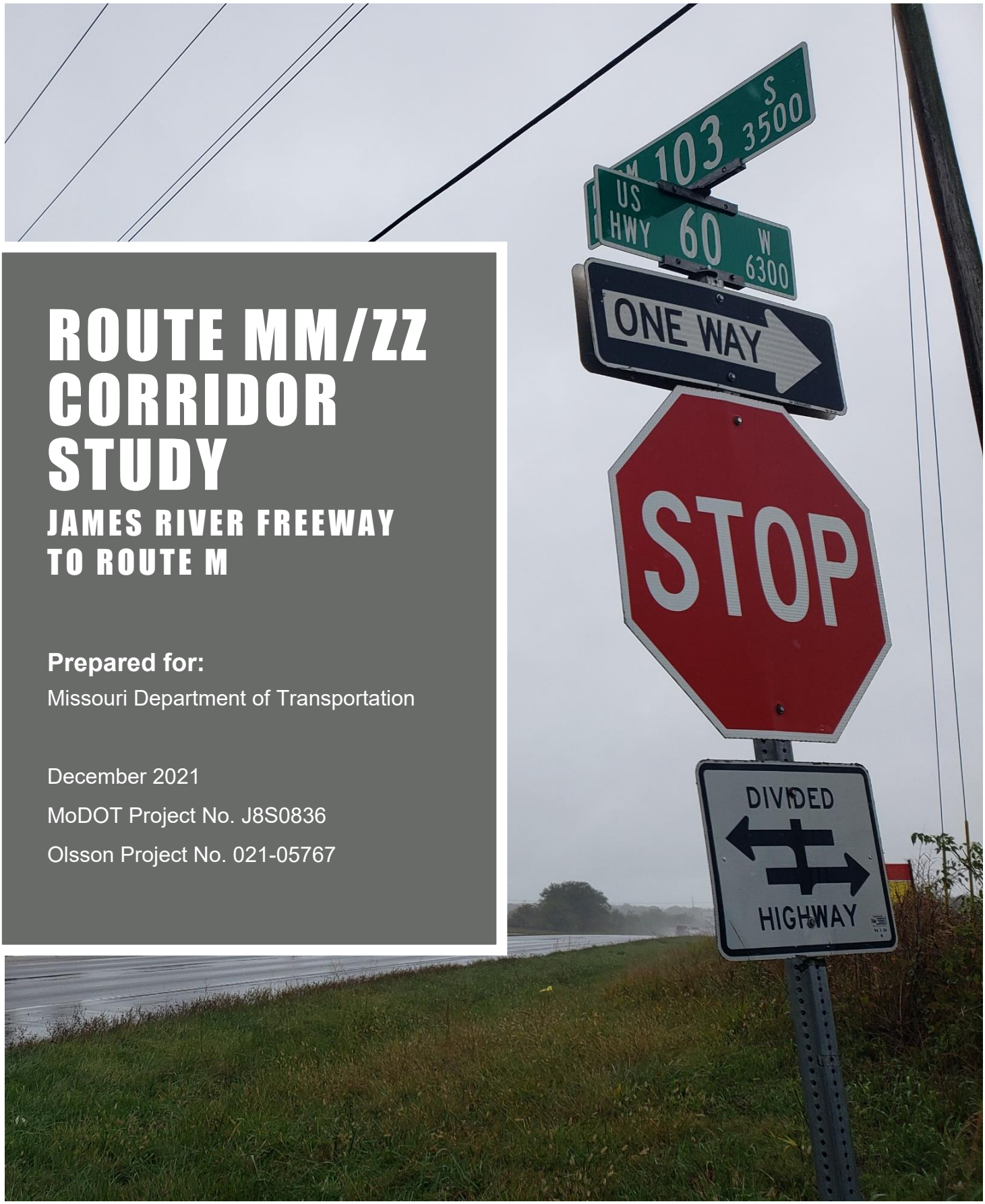


# ROUTE MM/ZZ CORRIDOR STUDY

## JAMES RIVER FREEWAY TO ROUTE M

**Prepared for:**

Missouri Department of Transportation

December 2021

MoDOT Project No. J8S0836

Olsson Project No. 021-05767

olsson®

OZARKS TRANSPORTATION ORGANIZATION
A METROPOLITAN PLANNING ORGANIZATION

REPUBLIC MISSOURI

MoDOT

# EXECUTIVE SUMMARY

The purpose and need of this project are to provide traffic analysis, modeling, and forecasting with recommendations for staged project implementation of the conceptual Route MM corridor alignment to meet projected forecasts. This report summarizes the analysis associated with the proposed realignment of Route MM in Republic, Missouri. This realignment would include two rail overpasses and coincide with the closure of multiple at-grade rail crossings in the area. Considering that this corridor is a critical north-south connector for the region and is experiencing significant development activity in its vicinity, it is important to consider how the future demands can be accommodated to preserve the integrity of the corridor for all users.

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The existing conditions pertaining to the capacity, safety, and roadway and bridge design considerations of the current alignment are described as well as the expected constraints for the future no-build scenario if no improvements are made. In order to determine the future needs of the corridor, the Ozarks Transportation Organization's (OTO) travel demand model was updated to include the expected development interests within the study area.

Four baseline alternatives were considered for the future cross-section of the realigned Route MM: three-lane vs five-lane section and partial build vs full build alignment. Under the partial build alignment, the realignment of Route MM between Farm Road 160 and US 60 would initially be constructed and tie into Farm Road 103. Full build alignment would continue the realignment south of US 60 and directly tie into Route ZZ rather than Farm Road 103. Based on the findings of this study, Farm Road 103 would quickly reach capacity under the Partial Build alignment. Thus, it was determined that the Full Build alignment would be preferred. Based on the projected traffic volumes, a five-lane cross-section is expected to be needed along Route MM north of US 60 with a three-lane section along Route ZZ between US 60 and Route M.

Under this roadway configuration the expected 2045 design year average daily volumes for the Route MM/ZZ corridor are expected to range from 22,720 vehicles per day to 33,100 vehicles per day between James River Freeway and US 60. The highest ADTs are expected at the development access points nearest to these two main highways. Depending on how these areas develop and access is allowed, raised medians should also be considered immediately south of James River Freeway and immediately north of US 60 to control access points and increase capacity along Route MM. Route ZZ south of US 60 is expected to be approximately 12,250 vehicles per day by 2045 as a three-lane section.

If demand continues in the area as expected, this full build realignment could be programmed by the year 2027 given that Route MM three-lane capacities are expected to be reached between 2027-2032 north of US 60. South of US 60, the full build realignment is recommended as a three-lane roadway based on the volume projections. This section of Route ZZ is expected to be approximately 12,250 vpd, which is below the typical three-lane capacity, by the design year 2045.

The main connection points of the realigned Route MM corridor are at Farm Road 160, US 60, and Route ZZ. The intersection of Route MM and Farm Road 160 is expected to operate acceptably as a dual lane roundabout or signalized intersection, with the roundabout configuration resulting in the shortest delays and queues overall. Two viable roundabout configurations are presented, one of which includes a free westbound right-turn and is preferrable considering it is associated with expected lower delays and crash frequency. The intersection of Route MM and US 60 is anticipated to be signalized. If volumes materialize as expected, the intersection will be reaching capacity near 2045 and be in need of re-evaluation, potentially considering innovative intersection types to accommodate demand. The intersection of Route ZZ with Route M is expected to operate acceptably as a hybrid roundabout, a portion of which includes two circulating lanes to accommodate the heaviest movements.

A conceptual cost was also conducted for the anticipated facility types along the corridor. At the time of this report, appropriate cost estimate assumptions were still in discussions with MoDOT staff. A summary of the anticipated costs will be presented in a separate submittal document.

It is understood that construction of the conceptual corridor configuration may not be feasible until funding becomes available. The table below discusses potential traffic outcomes to consider when pairing the various Route MM realignment projects.

| Scenario | Potential Outcome |
|---|---|
| J8S0836D Constructed, J8S0836C Not Constructed, FR 103 Is Aligned with Full Access | • Traffic expected to utilize FR 103 until capacity is reached (within 3 years of initial project completion assuming unimproved FR capacity of 5,000 vpd).<br>• Once FR 103 capacity is reached, additional traffic likely to reroute to Rt M and US 60. |
| J8S0836D Constructed, J8S0836C Not Constructed, FR 103 Is Aligned with RIRO Access | • Traffic expected to reroute to Rt M and US 60.<br>• Rt M between US 60 and Rt ZZ design year 2045 ADT increases to 12,840 vpd, potentially warranting widening to 3-lane if left-turn volumes are heavy.<br>• US 60 between Rt M and “new” Rt MM design year 2045 ADT increases to 45,180 vpd.<br>• According to OTO capacity thresholds, US 60 has a future capacity of 53,250 vpd. While not over capacity, increased congestion would be expected, and a weave scenario from Rt M, to US 60 to New Rt MM would be introduced.<br>• FR 103 between US 60 and Rt M design year 2045 ADT of 3,620 vpd (3,300 vpd northbound). |
| J8S0836D Constructed, J8S0836A Not Constructed | • Traffic expected to utilize Rt MM until capacity is reached (possibly as early as 2027 north of FR 156 and 2032 south of FR 156).<br>• Rt MM capacity north of FR 160 expected to be 17,500 vpd as a 3-lane roadway. |

# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# 1. INTRODUCTION AND OBJECTIVE

The Missouri Department of Transportation (MoDOT) contracted with Olsson to provide support for the Route MM corridor improvement project. The corridor project encompasses Route MM beginning at the Route 360/James River Freeway (referred through report as "James River Freeway" or simply "JRF") interchange, continuing south through US 60, and along Route M east through the roundabout at Farm Road 103. The existing Route MM corridor is being considered for realignment to the east which may include a railroad overpass, new signalized intersection with US 60, and two new roundabout intersections. The objectives of the project were to update the Ozarks Transportation Organization's (OTO) travel demand model and use it to conduct operational and safety analyses, determine an appropriate lane configuration for the railroad overpass bridge, and review projected costs. At the time of this report, appropriate cost estimate assumptions were still in discussions with MoDOT staff. A summary of the anticipated costs will be presented in a separate submittal document. The conceptual location of the corridor is illustrated on **Figure 1.**

The entire study corridor includes the following sub-sections. Additional sub-sections are also be discussed further, if applicable, later in the report:

- J8S0836A – Route MM between James River Freeway and Farm Road 160 with additional improvements south of Farm Road 160 as needed.
- J8S0836B – Route MM between I-44 and James River Freeway
    - (Planned project, but recommendations to this section are not directly included in the scope of this report)
- J8S0836C – Route ZZ between US 60 and Route M
- J8S0836D – Route MM between Farm Road 160 and US 60

## 1.1. Project Approach

The work phases included data collection, capacity and safety analyses, evaluation of corridor characteristics, and estimation of improvement costs.

MoDOT provided existing turning movement count data and historical crash data. MoDOT also designated three corridor classification options for consideration.

Historical crash data and Highway Safety Manual (HSM) crash prediction methodology were reviewed to identify existing crash patterns and to determine if the future intersection concepts (Route MM & Farm Road 160 roundabout, Route MM & US 60 signal, and Route ZZ & Route M roundabout) are expected to have a low number of crashes. The re-aligned highway segment was also evaluated to determine the appropriate cross section, three-lane or five-lane road/bridge, to accommodate existing and future traffic growth, and projected costs.

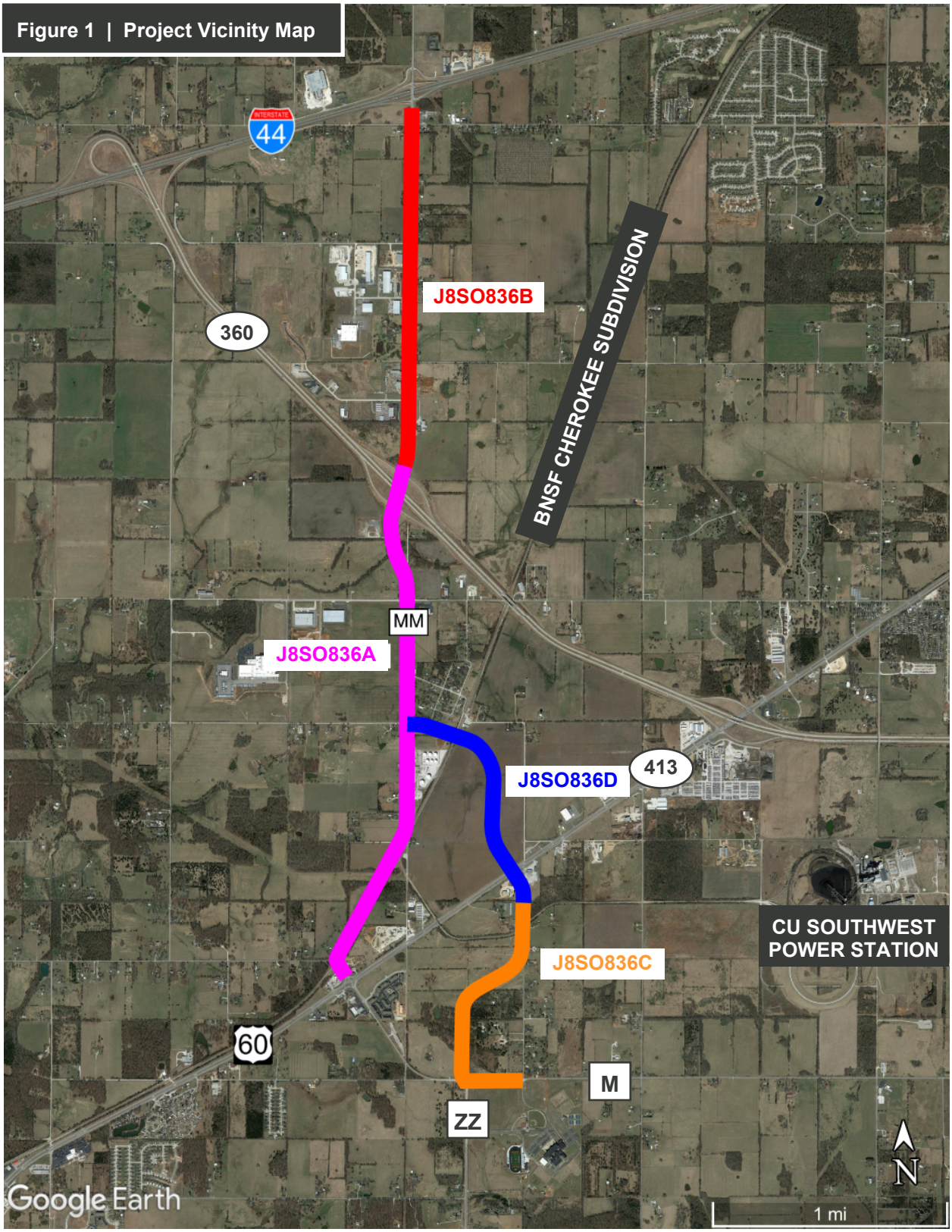



**Figure 1. Project Vicinity Map**

# 2. EXISTING CONDITIONS

A review of the existing conditions of the corridor was conducted. Existing turning movement counts (TMC) and annual average daily traffic (AADT) volumes were provided by MoDOT and/or utilized from recent traffic studies along the corridor. Historical crash data, crash rates, and record as-built drawings were also provided by MoDOT. A field review was conducted to identify possible safety or operational concerns along the corridor.

## 2.1. Traffic Volume and Operations

The traffic pattern along Route MM is development and commuter driven with heavier northbound traffic in the AM peak hour and predominantly southbound traffic in the PM peak hour. A noticeable eastbound traffic pattern was also observed in the AM along US 60, Route M, and JRF with westbound volumes heavier in the PM.

The 2020 AADT along Route MM between JRF and US 60 was approximately 7,830 vehicles per day (vpd) based on data provided on MoDOT's Datalink website.

Capacity analysis was performed for the existing corridor conditions using Synchro Version 11 for signalized and stop-controlled intersections, and Sidra Version 9.0 was used for roundabouts. Based on the existing capacity analysis, results are as follows:

US 60 & Route MM

The intersection of US 60 & Route MM operates at a LOS D during the AM peak hour and LOS F during the PM peak hour. Extensive mainline queueing occurs in the peak directions, eastbound in the AM and westbound in the PM. Mainline left-turning movements as well as side street operations are also at or near capacity. This is primarily due to the heavy commuter traffic (primarily eastbound in AM, westbound in PM) as well as heavy turning movement to and from Route MM. The US 60 corridor is being considered for widening to a 6-lane facility to provide additional capacity. The southbound approach also experiences delay with queueing that at times extends to the at-grade rail crossing, which is undesirable and presents a safety concern.

Route M & Route ZZ

The intersection of Route M & Route ZZ operates a LOS C during the AM peak hour and LOS D during the PM peak hour; however, heavy turning movements to/from the south and east legs of the intersection experience congestion at times. This is exemplified by the westbound left-turn movement which operates at a LOS E in the PM. This left-turn queue may not clear within a given cycle.

US 60 and Farm Road 103

The existing unsignalized intersection of US 60 and Farm Road 103 was also observed to experience poor levels of service for the stop-controlled minor street. Both the northbound and southbound approaches have a LOS F during the AM and PM peak hour periods.

Existing peak hour traffic conditions are illustrated in **Figures 2-4**.

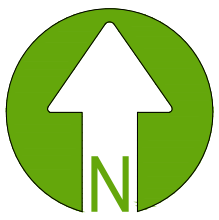
Traffic count data collected for this project is provided in **Appendix A**. Detailed capacity analysis results are provided in **Appendix B.**

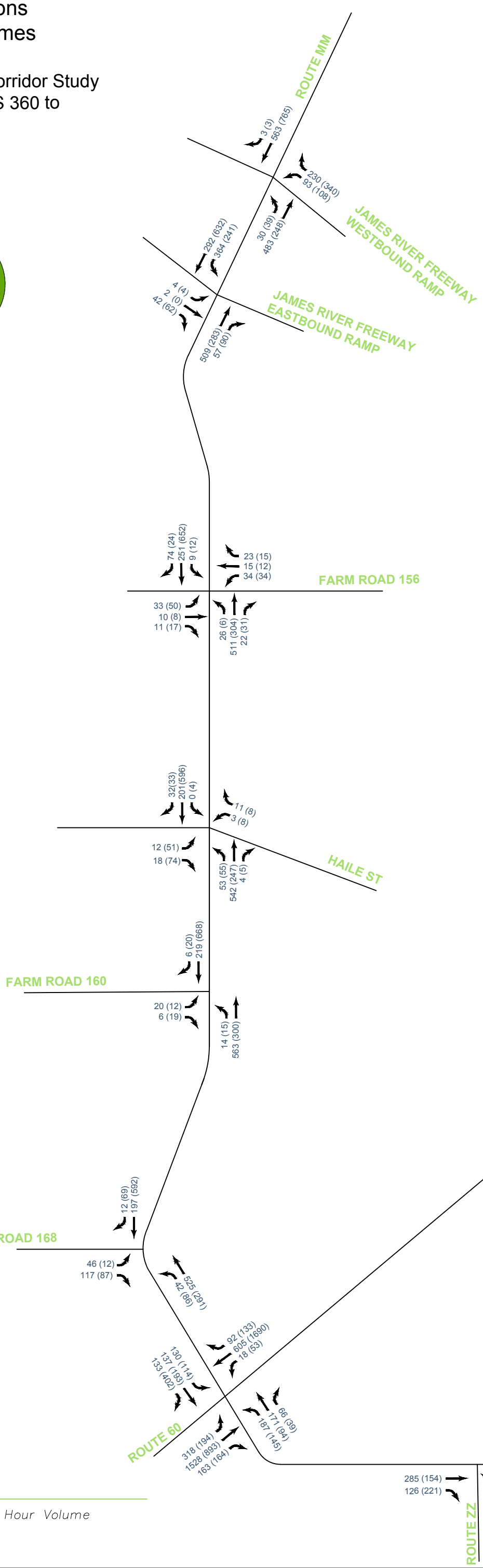
# FIGURE 2

## Existing Conditions
## Peak Hour Volumes

J8S0836 Traffic Corridor Study
Route MM from US 360 to
Route M/ZZ

Republic, MO
Greene County




*LEGEND*

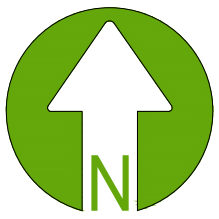
AM (PM) *Peak Hour Volume*

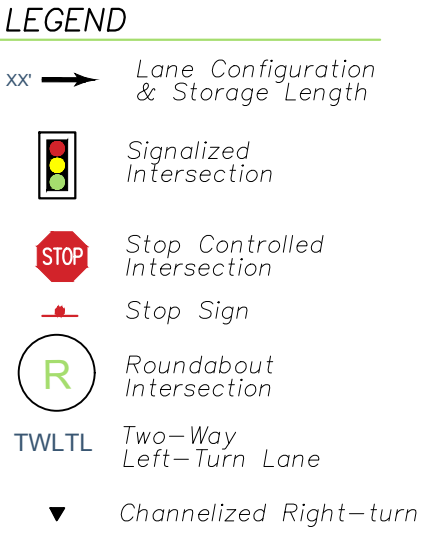
# FIGURE 3

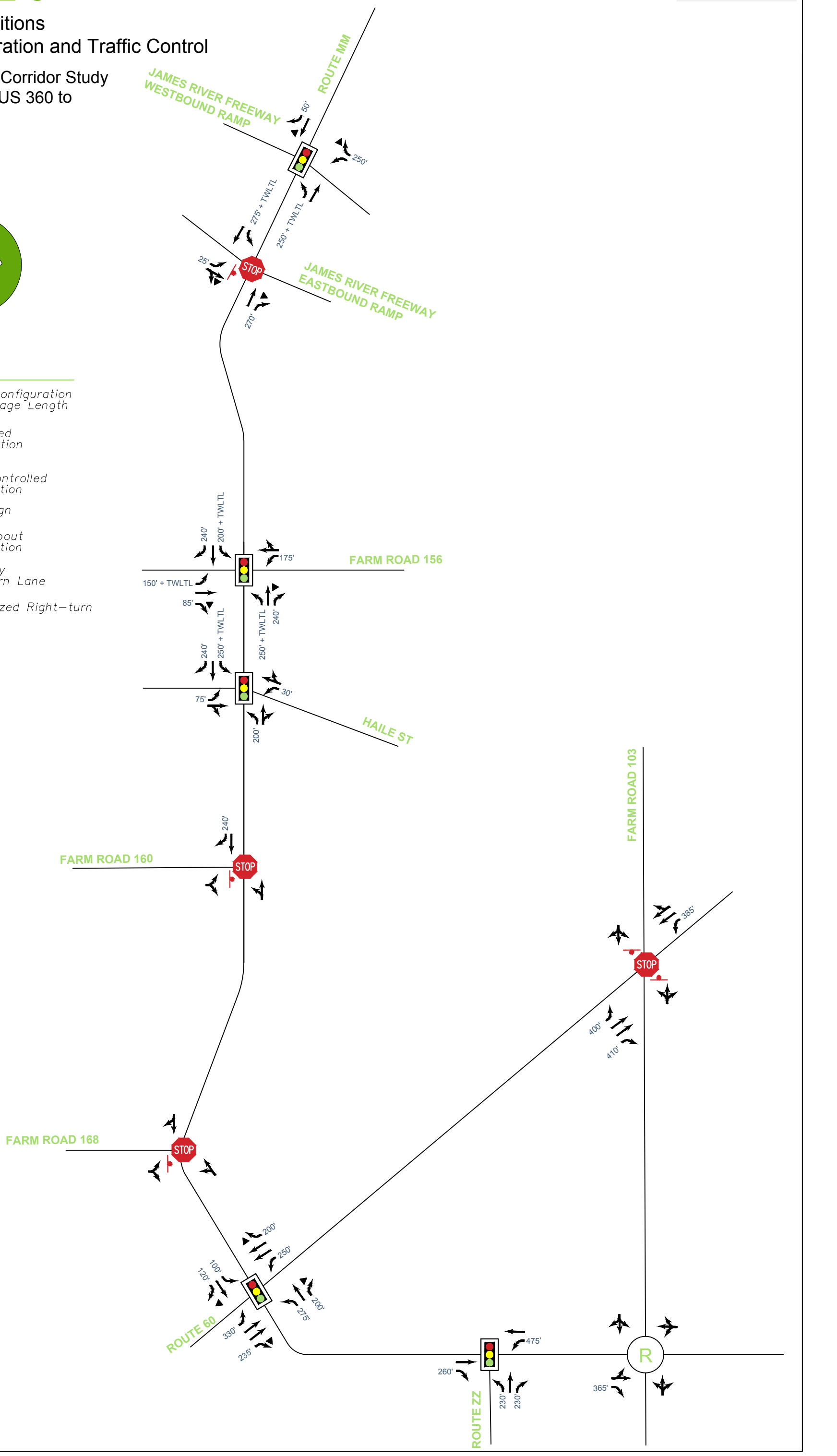
## Existing Conditions
## Lane Configuration and Traffic Control

J8S0836 Traffic Corridor Study
Route MM from US 360 to
Route M/ZZ

Republic, MO
Greene County



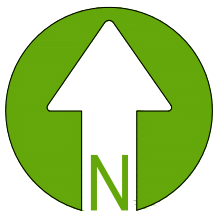



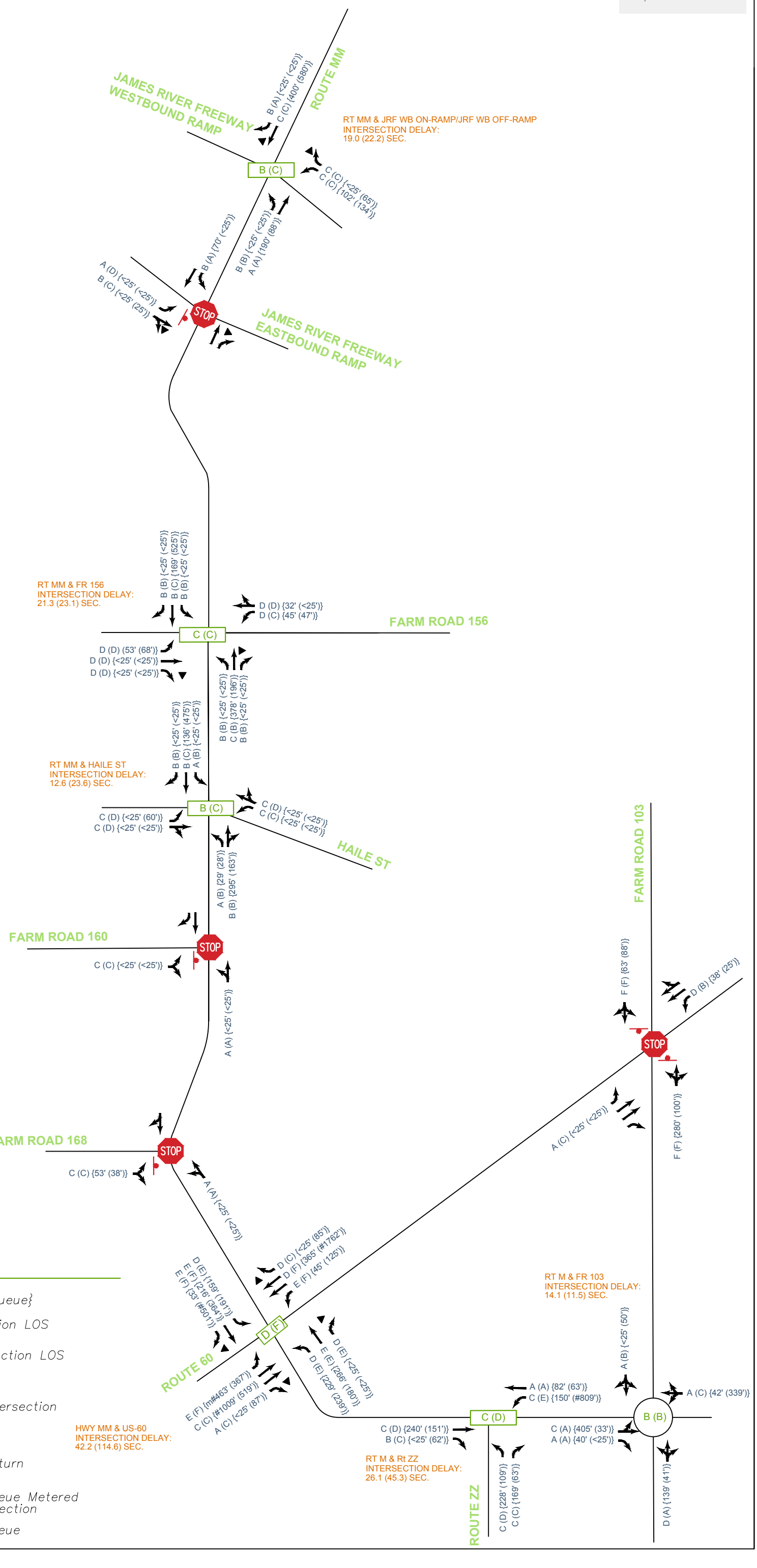
# FIGURE 4

Existing Conditions
Capacity Analysis

J8S0836 Traffic Corridor Study
Route MM from US 360 to
Route M/ZZ

Republic, MO
Greene County



## 2.2. Existing Crashes

Crash data from 2015-2019 as well as partial year 2020-2021 were reviewed to identify “hot spots” within the corridor. A map of the existing hot spots is shown in **Figures 5** and **6**. This heat map shows the areas where crashes are most commonly occurring as well as the assigned location of all fatal and injury crashes reviewed for this study. A summary of the crash severity and crash type within the study area is shown in **Table 1**.

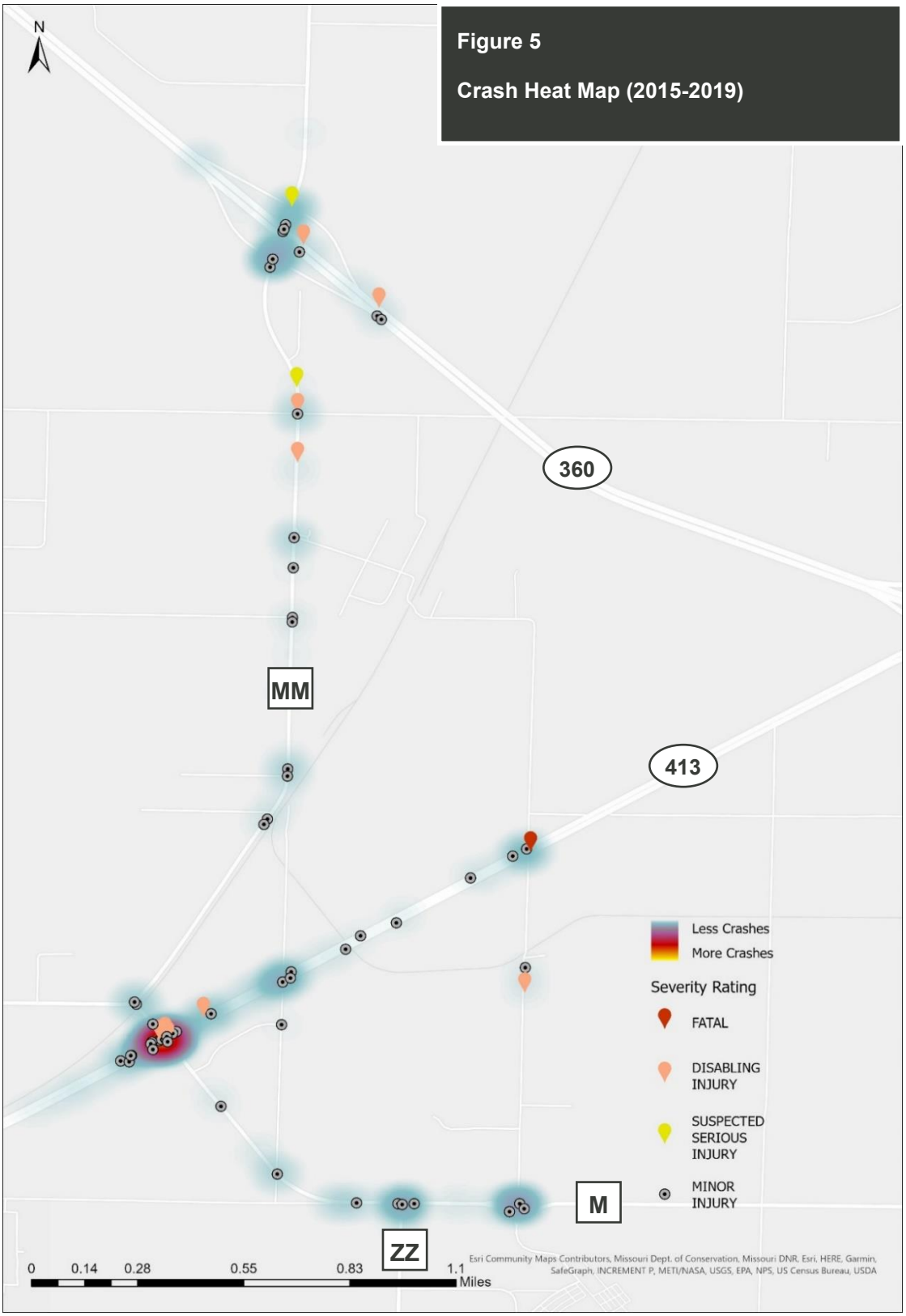



**Figure 5. Crash Heat Map (2015-2019)**


**Figure 6. Crash Heat Map (Partial 2020-2021)**

**Table 1. Crash Summary Statistics.**

| | 2015-2019 Crashes | 2020-2021 Crashes |
|---|---|---|
| Crash Severity | 74% PDO | 68% PDO |
| | 21% Minor Injury | 27% Minor Injury |
| | 4% Disabling or Suspected Serious Injury | 3% Disabling or Suspected Serious Injury |
| | <1% Fatal | 2% Fatal |
| Common Crash Types | 50% Rear End | 46% Rear End |
| | 17% Angle, Left Turn, Left/Right Turn Right Angle | 17% Angle, Left Turn, Left/Right Turn Right Angle |
| | 15% Out of Control | 18% Out of Control |

Note: 2020-2021 crashes are partial years and/or not considered “official” at the time of this report.

Based on the information provided, crashes most commonly occurred at the following locations:

- US-60 & Route MM signalized intersection
  - A high proportion of these crashes were rear end crashes likely related to congestion at the intersection.
  - Injury crashes primarily were characterized as rear end, angle, passing, and head on collisions.
- Route M & Route ZZ signalized intersection
  - Mostly property damage only rear end crashes likely related to congestion at the intersection.
  - Injury crashes were mostly rear ends with one right angle.
- Route M & Farm Road 103 roundabout (constructed late 2019, unsignalized prior)
  - Crashes as an unsignalized intersection mostly included right angle, rear end, and out of control crashes.
  - Immediately after roundabout construction, primarily out of control crashes were observed. It is possible this is a result of the new construction, and the ultimate crash behavior post-construction is to be determined.
- US 60 & Farm Road 103
  - Included one fatal left turn right angle crash occurred at the unsignalized crossing.

- Route MM and James River Freeway Ramps
    - Westbound Ramp: Primarily left/right angle crashes, some of which resulted in injuries. A traffic signal was installed in 2021 which may reduce this crash type.
    - Eastbound Ramp: Included one fatal pedestrian crash where road/light conditions were poor. Multiple left/right turn injury crashes were also noted.
- Horizontal Curves of Route MM
    - Multiple out of control injury crashes. Many of these occur at the sharp, near 90-degree turn north of the rail crossing but were also observed at the curve south of Magellan Pipeline.

Crashes from 2020-2021 were generally more severe than those observed from 2015-2019. This followed the national trend that although traffic volumes were impacted by COVID-19, crashes were generally more severe.

Based on the crash information reviewed for this study, there were no reported crashes that could be attributed to the at-grade rail crossings proposed for removal. However, while there was not a recent historical crash pattern, it does not mean that one could present itself in future years, especially as development activity continues and traffic volumes increase.

Additional crash summary graphics are provided in **Appendix A**.

## 2.3. Corridor Characteristics

A field review was conducted for the Route MM corridor and study intersections. The field review focused on safety concerns, traffic control, geometric deficiencies, and other pertinent information to the study.

The Route MM corridor is currently classified as ‘minor arterial’ by MoDOT, referencing the *Functional Classification Map* for the Springfield urban area. The Route MM corridor for the purposes of this report was reviewed in three sections.

- Segment 1: James River Freeway to Farm Road 160
- Segment 2: Farm Road 160 to US 60
- Segment 3: US 60 to Farm Road 103 (Route MM transitions to Route M in this segment)

*Segment 1:* Route MM was recently upgraded to a three-lane roadway for this entire north-south segment. The posted speed limit is currently 55 mph with plans to be lowered to 45 mph. The north side of this segment has a diamond interchange with James River Freeway. Terrain is highest at the interchange overpass and is mostly level to the south, with horizontal curves between JRF and Farm Road 156.

Existing access is provided on both sides of the corridor, which serves a new Amazon warehouse facility west of Route MM, but otherwise low traffic generators. Two public roadway

intersections, Farm Road 156 which serves commercial development and Haile Street which serves residences in in the former Village of Brookline, MO. Traffic signals were recently added at the northern interchange ramp, Farm Road 156, and Haile Street.

The existing bridge consists of skewed 285.2-foot, 2-span continuous composite plate girder bridge with non-integral, semi-deep abutments. The most recent bridge inspection report from August 18, 2020 indicates the overall bridge is in good working condition. The bridge deck rating is shown as satisfactory (6), but an MMA overlay is requested in 2024. If an overlay is completed, new glands at the expansion joints should be considered at that time. No additional deficiencies or recommendations are being made from Olsson's site visit.

With the recent widening between Farm Road 156 and Farm Road 160, a 2-foot shoulder was added along the east side of Route MM. Though the addition of this offset provides a greater clear zone, the large transmission power poles still slightly encroach into the roadway clear zone based on the roadway speed and AADT.

*Segment 2*: South of Farm Road 160, Route MM is a two-lane undivided roadway that curves southwest and crosses the railroad tracks at-grade at a sharp, near 90-degree turn in close proximity to the signalized intersection with US 60. The posted speed limit is 55 mph with lowered advisory speed limits, 45 mph and 15 mph, at the two horizontal curves. Multiple access points are provided in the vicinity of the Magellan Pipeline with sparse driveway density further south. Terrain of the roadway is mostly level with a sag curve just north of the rail crossing.

Based on the roadway speed and AADT, the following obstructions appear to be located within the desired clear zone:

- Power poles within the northern section of this corridor.
- A crossroad RCB located approximately 190 feet south of Farm Road 160.
- Mature tree growth north of the railroad crossing on the west side of Route MM.

*Segment 3:* South of US 60, Route MM transitions to Route M and becomes an east-west, two-lane roadway. The posted speed limit is 55 mph with lowered advisory speed limits near the horizontal curve and roundabout with Farm Road 103. Roadway access is primarily limited to public roadway intersections. The roadway is mostly level near US 60 and transitions to rolling terrain in the vicinity of Route ZZ and Farm Road 103.

Notable deficiencies in this segment include:

- The existing Farm Road 101 and Farm 170 intersection Route M at a very sharp angle on a horizontal curve. The intersection angles create difficult head turning movements.
- The Farm Road 101 intersection sight distance is blocked by vegetation along the right-of-way line looking eastward.

# 3. TRAVEL DEMAND MODEL UPDATE

The OTO regional travel demand model (TDM) was updated for the study area in order to determine future traffic demands along the corridor.

## 3.1. Future Year Land Uses and Projects

Future Land Uses:

Projected development activity was provided by the City of Republic and included potential areas for residential, commercial, and industrial activity. Projected development utilized in analysis is depicted in **Figure 7**. For TDM input, these areas were assumed to be in place by the year 2045 and were assumed to develop at the following floor-area-ratios (FAR): 0.40 for industrial, 0.3 for office, and 0.22 for retail. Four dwelling units/acre for single family housing and 24 dwelling units/acre for multifamily residential housing were also assumed for projected residential areas.

Conceptual, Planned, and Committed Projects:

Nearby planned roadway improvements influencing traffic patterns were also assumed to be in place for the future year conditions. This primarily includes widening US 60 to a six-lane section (conceptual stage) within the study area and widening Route MM to a 5-lane section between I-44 and James River Freeway north of the study area. This information was derived from Olsson's previous involvement with the J8S3159 MoDOT 413/60 Corridor Study (Phase 1) and a cost share agreement between MoDOT and the City of Republic. The following at-grade railroad crossings were also assumed to be closed: FR 93 north of US 60, FR 170 north of US 60, Route MM north of US 60, Haile/Orr Street north of US 60, and FR 103 south of US 60; FR 101 north of US 60 is expected to remain open until alternate access can be provided. Further information regarding the railroad crossings can be found in the MoDOT safety study of the BNSF Cherokee Subdivision line from M.P. 251 to M.P. 258 in Greene, Christian, and Lawrence Counties completed in 2018.

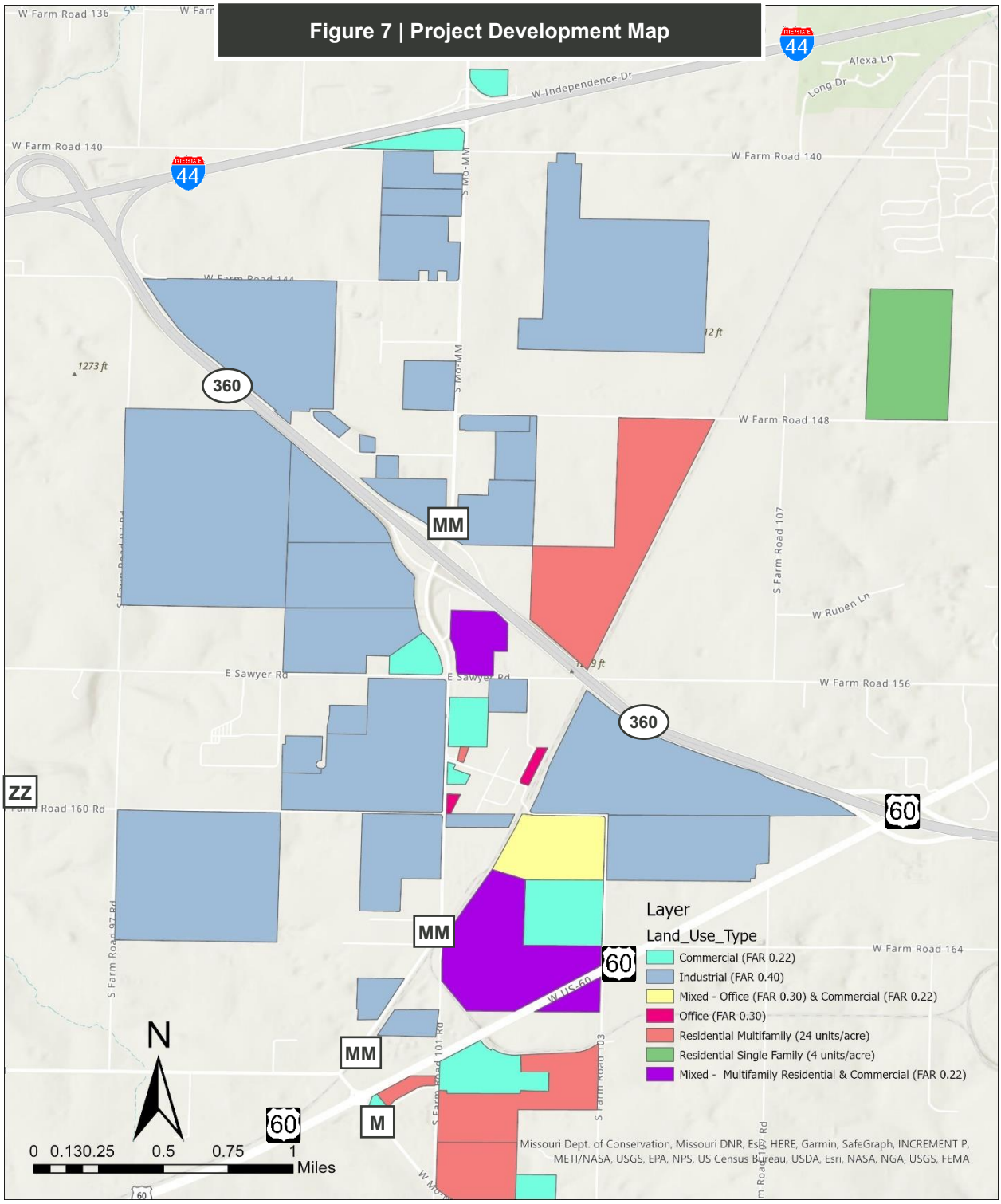



**Figure 7. Project Development Map**

## 3.2. Roadway Template Alternatives

The TDM was updated for multiple roadway configurations that were initially considered for this project. These include:

- Five-lane Section of Realigned Route MM
- Three-lane Section Extension of Route ZZ to US 60
- Partial Build Alignment (includes realignment of Route MM from Farm Road 160 with railroad overpass to US 60 and connects with the existing Farm Road 103 alignment)
- Full Build Alignment (includes Partial Build plus extension of Route ZZ to US 60)

**Figures 8 and 9** below illustrates the conceptual Partial and Full Build Alignments considered for this study.


**Figure 8. Partial Build Alignment**


**Figure 9. Full Build Alignment**

# 4. ROADWAY ALTERNATIVES INITIAL FINDINGS

During the initial evaluation process, two important discoveries were made when comparing the five-lane vs three-lane and partial build vs full build alignments.

## 4.1. No Build Option

In addition to evaluating the proposed alternatives, a 'No-Build' base condition was considered. The No-Build condition included consideration of committed roadway improvements such as the widening of US 60 and the widening of Route MM north of JRF. This scenario analysis is intended to check the travel pattern and performance of existing road links while considering potential future developments expected to take place through 2045.

According to the TDM, multiple road segments in the study area are expected to operate with a volume-to-capacity (v/c) ratio close to or above 1.0. A summary of the expected v/c ratios at a few select roadway segments are shown in **Table 2**.

**Table 2. Existing Route MM/M Alignment v/c ratio for Future No Build**

| Location | V/C Ratio |
|---|---|
| Rt MM between JRF and FR 156 | 1.22 |
| Rt MM between FR 156 and FR 160 | 0.98 |
| Rt MM between FR 160 and US 60 | 0.81 |
| Rt M between US 60 and Rt ZZ | 0.59 |

It should be noted that the segment capacities considered by the TDM are not directly related to the five-lane and three-lane segment capacities described in Section 232.3 of the MoDOT EPG or the directional capacities considered by the OTO. In general, the TDM assigns a higher roadway capacity than typically considered in the EPG. This may result in an artificially high level of attraction to these roadways. Moreover, the model is unable to account for specific interactions such as the negative effect at-grade rail crossings have on capacity. Thus, the projected traffic volumes derived from the TDM are expected to be a conservatively high estimate.

## 4.2. Future Full Build vs Partial Build Comparison

Under the partial build configuration, the realigned Route MM would form a signalized intersection with Farm Road 103. Vehicles traveling from Route ZZ must either utilize Farm Road 103 or US 60, both of which would include multiple 90-degree turns through controlled intersections.

Based on the TDM projections, Farm Road 103 would quickly reach capacity under the partial build configuration. Assuming a capacity of approximately 5,000 vpd and a linear annual growth rate, Farm Road 103 would be over capacity by the year 2025.

In addition to the needed capacity, the full build configuration would provide the following benefits:

- Improved connectivity from Route ZZ to Route MM
- Reduced traveling distance from Route ZZ to Route MM
- Eliminate delay and travel time encountered at additional, intermediate intersections (the signal at US 60 & Route M and/or the roundabout at Farm Road 103 & Route M)
- Minimize potential conflicts from existing residential driveways

## 4.3. Five-Lane vs Three-Lane Comparison

Based on the TDM forecasts, Route MM would be expected to have significantly different attraction depending on the ultimate cross section. **Table 3** shows the projected ADTs of the realigned Route MM at different locations along the corridor for the future year 2045.

**Table 3. Route MM/ZZ 2045 5-lane and 3-lane Average Daily Traffic Volumes.**

| Location | 5-lane Configuration | V/C Ratio | 3-lane Configuration | V/C Ratio |
|---|---|---|---|---|
| Rt MM between JRF and FR 156 | 27,100-33,000 | 1.23 | 18,790-20,060 | 1.75 |
| Rt MM between FR 156 and FR 160 | 24,260-25,160 | 0.88 | 16,880-18,480 | 1.44 |
| Rt MM between FR 160 and US 60 | 22,970-31,480 | 1.10 | 11,900-19,090 | 1.53 |
| Rt ZZ between US 60 and Rt M | 13,800 | 0.46 | 10,750 | 0.72 |

Note: Volume-to-capacity ratios are based on the segment volumes projected by the TDM divided by the roadway capacities considered by the OTO for each facility type.

As shown in the table above, in comparing the expected future volumes to the expected roadway capacities based on discussions with OTO staff, the three-lane section would be well over capacity for the roadway section north of US 60. Section 232.3 of the MoDOT Engineering Policy Guide (EPG) outlines when three and five lane facilities are typically considered. Three-lane facilities may be used where AADT in the design year is less than 17,500 vpd, whereas five-lane facilities may be used up to 28,000 vpd and a raised median considered where volumes exceed 28,000 vpd. The highest ADTs are expected at the development access points nearest to James River Freeway and US 60 indicating that these roadways are significant attractions for nearby development trips. Depending on how these areas develop, raised medians should also be considered should these volumes materialize to provide additional capacity and controlled access points.

The ADT comparison indicates that there is latent demand if Route MM is constructed as a three-lane roadway, particularly for the section north of US 60. Roadway users prefer to utilize Route MM, given that it is a vital north-south connection, but a three-lane roadway would ultimately become constrained in multiple locations. The Route ZZ segment south of US 60 is not expected to exceed the typical three-lane segment capacity. **Table 4** below details the expected future volumes and v/c ratios of the corridor presented in the TDM if a 5-lane section is constructed north of US 60 and a 3-lane section is constructed south of US 60.

**Table 4. Anticipated Route MM/ZZ 2045 Average Daily Traffic Volumes.**

| Location | 5-lane North of US 60, 3-lane South of US 60 | V/C Ratio |
|---|---|---|
| Rt MM between JRF and FR 156 | 27,500-33,100 | 1.20 |
| Rt MM between FR 156 and FR 160 | 24,110-25,750 | 0.89 |
| Rt MM between FR 160 and US 60 | 22,720-30,620 | 1.08 |
| Rt ZZ between US 60 and Rt M | 12,250 | 0.82 |

The ultimate 2045 five-lane full build traffic volumes and the typical roadway capacities described in Section 232.3 of the EPG were used to determine the approximate timeline when the expected volumes would exceed a three-lane capacity, and thus when a five-lane facility should be considered. This is illustrated in **Table 5** below assuming a linear growth pattern.

**Table 5. Anticipated Timeline of Roadway Improvements.**

| Location | Expected Timeline for 5-lane Configuration |
|---|---|
| Rt MM between JRF and FR 156 | 2027 |
| Rt MM between FR 156 and FR 160 | 2032 |
| Rt MM between FR 160 and US 60 | 2030 |
| Rt ZZ between US 60 and Rt M | 2065 |

The time horizon presented in **Table 5** is based on a linear growth pattern interpolated between existing daily traffic volumes to the future year 2045 projected volumes. The estimated year represents the time when the projected traffic volumes exceed a three-lane segment capacity of 17,500 vehicles per hour, per MoDOT EPG. Considering that the earliest time of construction for the recommended improvements is expected to be approximately 2025, the three-lane capacity threshold for all Route MM roadway segments north of US 60 would be within 7 years of anticipated construction. Thus, it is not recommended to construct a three-lane cross-section for Route MM north of US 60. A five-lane cross-section is recommended between James River Freeway and US 60. In addition, raised medians should also be considered in locations where development activity is heaviest (possibly immediately south of James River Freeway and immediately north of US 60) to allow for controlled access points and increased capacity along Route MM.

Based on the projected traffic volumes, the roadway section of Route ZZ between US 60 and Route M is not expected to reach the typical three-lane facility segment capacity for the design year 2045. However, additional capacity may be needed at controlled intersections. See **Section 5** for further discussion on intersection capacities.

*It should be noted that these projection years are highly dependent on the rate of development activity and programmed improvements of adjacent roadways. For example, if development grows at a quicker rate, this projected timeline may shorter. Likewise, if Route ZZ or Route M are improved, travel patterns could shift resulting in more vehicles utilizing the southern section of Route ZZ between US 60 and Route M.*

# 5. ANALYSIS OF PREFERRED CONCEPTUAL CONFIGURATION

The preferred concept for the realigned Route MM is expected to include a five-lane cross-section north of US 60 and a three-lane cross-section south of US 60 within the study area. The ultimate traffic condition was reviewed for the 2045 full build out condition with the assumed development areas in place as described in **Section 3.1**.

The following intersection configurations in the vicinity of the study area were considered for analysis:

- Route MM & James River Freeway Westbound Ramps – Traffic signal (existing)
- Route MM & James River Freeway Eastbound Ramps – Traffic signal (recommended due to projected left-turn traffic)
- Route MM & Farm Road 156 – Traffic signal (existing)
- Route MM & Haile Street – Traffic signal (existing)
- Route MM & Farm Road 160 – Roundabout or traffic signal (conceptual)
- "Old" Route MM & US 60 – Traffic signal (existing)
- "New" Route MM & US 60 – Traffic signal (conceptual)
- Route ZZ & Route M – Roundabout or traffic signal (conceptual)
- Route M & Farm Road 103 – Roundabout (existing)

Safety analysis was performed using HSM methodologies for key intersection locations including the intersection of Route MM with Farm Road 160 and US 60 and the intersection of Route ZZ with Route M.

## 5.1. Safety Analysis

Future crashes for the 2045 design year were predicted using the Federal Highway Association's (FHWA) Interactive Highway Safety Design Model (IHSDM). This tool applies HSM methodologies to predict crashes for a variety of facility types. For this project, future crashes were reviewed at the critical connection points of the re-aligned Route MM corridor: the conceptual roundabout at Route MM & Farm Road 160, traffic signal at Route MM & US 60, and roundabout at Route ZZ & Route M.

The IHSDM utilizes crash prediction modules developed from National Cooperative Highway Research Program (NCHRP) 17-58 for Six-Lane Urban/Suburban Arterials and NCHRP 17-70 for Roundabouts. These methodologies have recently been developed and thus were not incorporated into the HSM 1st Edition but are likely intended for inclusion in the future HSM 2nd Edition.

A summary of the future year 2045 crashes at these critical connection points are illustrated in **Table 6**. HSM calibration factors have not been developed for these facility types at the time of

this report. Thus, the standard crash outputs provided by the model are provided below. The multiple roundabout configurations considered for this project are included for comparison.

**Table 6. Future Year 2045 Crash Prediction.**

| Intersection | Predicted FI Crash Frequency (crashes/yr) | Predicted PDO Crash Frequency (crashes/yr) | Predicted Total Crash Frequency (crashes/yr) | Predicted Intersection Crash Rate (crashes/ million veh) |
|---|---|---|---|---|
| Route MM & Farm Road 160 Roundabout (*with Free WBR*) | 1.2 | 8.5 | 9.7 | 2.0 |
| Route MM & Farm Road 160 Roundabout (*with Yielding WBR*) | 1.8 | 8.5 | 10.3 | 2.2 |
| Route MM & US 60 Signal | 12.5 | 11.0 | 23.5 | 0.9 |
| Route ZZ & Route M Roundabout (*Hybrid without WBR Slip*) | 1.5 | 8.5 | 9.9 | 2.1 |
| Route ZZ & Route M Roundabout (*Hybrid with WBR Slip*) | 0.9 | 8.0 | 8.9 | 1.9 |

Based on the crash prediction results, fewer crashes would be expected at the Route MM & Farm Road 160 roundabout configuration with a free westbound slip right-turn lane as opposed to dual yielding right-turn lanes. Similarly, the addition of a yielding westbound slip right-turn lane at the Route ZZ & Route M roundabout is expected to result in fewer crashes as well.

IHSDM input and output data for this crash prediction are provided in **Appendix C**.

## 5.2. Signalized Intersection Capacity Analysis

Signalized intersection capacity was performed using Synchro Version 11 applying HCM Methodologies. A summary of the future operations expected at each signalized intersection is provided below.

<u>Route MM & James River Freeway Westbound Ramps – Traffic signal (existing)</u>

- LOS B and LOS C overall in AM and PM respectively.
    - Considers widening of Route MM striped as a five-lane section (see JRF Eastbound Ramps for more details regarding bridge widening).

  - Considers widened off-ramp to provide dual right-turn and a single left-turn movement.
  - Assumed signal coordination along Route MM between James River Freeway and Haile Street.

Route MM & James River Freeway Eastbound Ramps – Traffic signal (recommended)

- LOS A and LOS B overall in AM and PM respectively.
  - Considers six-lane bridge to accommodate two through lanes in each direction and dual southbound left-turn lanes, which are expected to be warranted considering the anticipated development activity.
  - Two receiving lanes would be required on the on-ramp before merging to one.
  - Assumed signal coordination along Route MM between James River Freeway and Haile Street.
  - A heavy northbound right-turn movement is expected and should be monitored, particularly if a traffic signal with dual left-turn lanes is installed.

Route MM & Farm Road 156 – Traffic signal (existing)

- LOS C overall during AM and PM peak hours.
  - Considers widening of Route MM to a five-lane section.
  - Considers single left and right-turn lanes in all directions.
  - Assumed signal coordination along Route MM between James River Freeway and Haile Street.
  - Depending on how the east leg of Farm Road 156 develops (and its future access points), a heavy westbound right-turn movement could be expected and should be monitored.

Route MM & Haile Street – Traffic signal (existing)

- LOS A and LOS B during AM and PM respectively.
  - Considers widening of Route MM to a five-lane section.
  - Considers single left-turn lanes in all directions as well as a dedicated southbound right-turn lane.
  - Assumed signal coordination along Route MM between James River Freeway and Haile Street.

Route MM & Farm Road 160 – Roundabout or traffic signal (conceptual)

A coordinated traffic signal with dual southbound left, dual westbound right-turn lanes, and single left-turn lanes in the remaining directions is expected to operate at a LOS B during peak periods. Variations of a roundabout were also considered at the intersection of Route MM &

Farm Road 160, which are expected to result in less delay and queueing. It should be noted that while considered to be acceptable, the signalized operations are expected to be slightly less desirable while also requiring more approach lanes compared to the roundabout. Roundabout operations are described in the next section.

"Old" Route MM & US 60 – Traffic signal (existing)

- LOS B and LOS C during AM and PM respectively.
    - Considers widening of US 60 to six-lane section.
    - Assumed east-west signal coordination along US 60.
    - North leg only serves local developments since the at-grade rail crossing would be removed.
    - Considers dual northbound left-turn lanes and single-left turn lanes at all other approaches considering the expected turning movements.
    - Considers single north/south through lanes and single right-turn lanes at all approaches.

"New" Route MM & US 60 – Traffic signal (conceptual)

- LOS E during AM and PM peak hours.
    - Considers widening of US 60 to six-lane section.
    - Considers re-aligned Route MM constructed with two north/south through lanes in each direction.
    - Considers dual left-turn lanes the eastbound, westbound, and southbound directions and a single northbound left-turn lane.
    - Considers single right-turn lanes in all directions.
    - Assumed east-west signal coordination along US 60.
    - *Given that this intersection is on the threshold of failure under 2045 full build conditions, special consideration should be given to protect right-of-way in the vicinity of the intersection. This includes but is not limited to considerations for high-capacity alternative intersection geometrics.*
    - *Heavy left-turn movements are expected for the eastbound, westbound, and southbound directions. These traffic patterns are partially driven by the improved north-south corridor but also depend on how the area develops, including the trip split between this intersection and other future development access points (e.g., Farm Road 107 to the east).*

Route ZZ & Route M – Roundabout or traffic signal (conceptual)

Based on the expected segment ADT along Route ZZ between US 60 and Route M, a three-lane section is expected to be adequate. Based on overall intersection delay alone, a traffic

signal with single through and dedicated left and right-turn lanes in all directions would operate at a LOS D during peak periods. However, multiple movements would encounter undesirable amounts of delay which could result in excessive queueing in all four directions.

It is expected that additional lanes would be needed to accommodate this queueing at the signal. Important turn lanes to consider include two through lanes in the northbound and southbound direction as well as dual westbound left-turn lanes. However, this widening at the signal may be difficult to transition back to a three-lane section.

Variations of a roundabout were also considered at the intersection of Route ZZ & Route M, which are described in the next section.

## 5.3. Roundabout Capacity Analysis

Roundabout intersection capacity was performed using Sidra Version 9.0 applying HCM methodologies. A summary of the future operations expected at each roundabout configuration is provided below.

Route MM & Farm Road 160 – Roundabout or traffic signal (conceptual)

Two roundabout configurations were considered: one with a free westbound slip right-turn lane and the second with dual yielding westbound right-turn lanes. Both configurations are expected to be acceptable. The free right-turn option is expected to have the least amount of delay and is the preferred option. However, as the area develops, consideration should be given to the potential weave scenario that may be introduced with northbound Route MM traffic merging into a single right-turn lane at the roundabout.

- A free westbound slip right-turn results in a LOS A overall in AM and PM peak hours.
    - Considers yielding westbound through/left and free westbound right-turn.
    - Considers two circulating lanes for dual southbound left-turn movements.
    - All approaches are expected to operate at a LOS C or better with acceptable queueing.
- Yielding dual westbound right-turns result in LOS B overall in AM and PM peak hours.
    - Considers westbound through/left/right and dedicated right-turn with both lanes yielding before entering the circulatory roadway.
    - Considers two circulating lanes for dual southbound left-turn movements.
    - The 95$^{th}$-percentile queue for the westbound approach is expected to be approximately 258 feet during the AM peak hour.

Route ZZ & Route M – Roundabout or traffic signal (conceptual)

Two roundabout configurations were considered: one without a westbound slip right-turn and one with a westbound slip right-turn lane.

- Without a westbound slip right-turn, the roundabout operates at a LOS B and LOS C during AM and PM respectively.
    - Considers two circulating lanes for dual southbound through movements and two southbound receiving lanes on Route ZZ. The analysis results indicate that the second receiving lane should be a minimum of 400 feet.
    - Considers free northbound right-turn lane.
    - Considers four-lane section on the east leg for a dedicated westbound left-turn, shared westbound through/right, eastbound receiving lane from the circulatory roadway and eastbound receiving lane for the free northbound right-turn lane.
    - All approaches are expected to operate at a LOS C or better except for the shared westbound through/right. The westbound through/right is expected to operate at a LOS D with a 95$^{th}$-percentile queue of 632 feet in the PM peak hour.
- With a westbound slip right-turn, the roundabout operates at a LOS B during both AM and PM peak hours.
    - Considers the same lane configuration as described above with the addition of a dedicated westbound slip right-turn to reduce queueing.
    - All approaches are expected to operate at a LOS C or better. The westbound through lane queue is expected to reduce to approximately 171 feet in the PM.

A traffic signal was also considered at the intersections of Route MM with Farm Road 160 and Route ZZ with Route M; signalized operations of both intersections are described in **Section 5.2**. However, the reviewed roundabout configurations are expected to operate acceptably and require fewer approaching lanes. Because the roundabout is the preferred intersection type at this location, capacity analysis results in the figures below are for the roundabout configurations. Traffic signal operations are provided in the Appendix for comparison.

<u>Route M & Farm Road 103 – Roundabout (existing)</u>

- LOS A overall in both AM and PM peak hours.
    - Considers two circulating lanes to allow two east-westbound lanes in each direction.
    - Considers one approaching lane in the north-south direction.
    - All approaches are expected to operate at a LOS B or better with acceptable queueing.

Future year 2045 peak hour traffic conditions are illustrated in **Figures 10-12**.

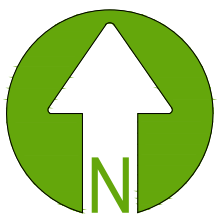
Detailed capacity analysis results are provided in **Appendix B**.

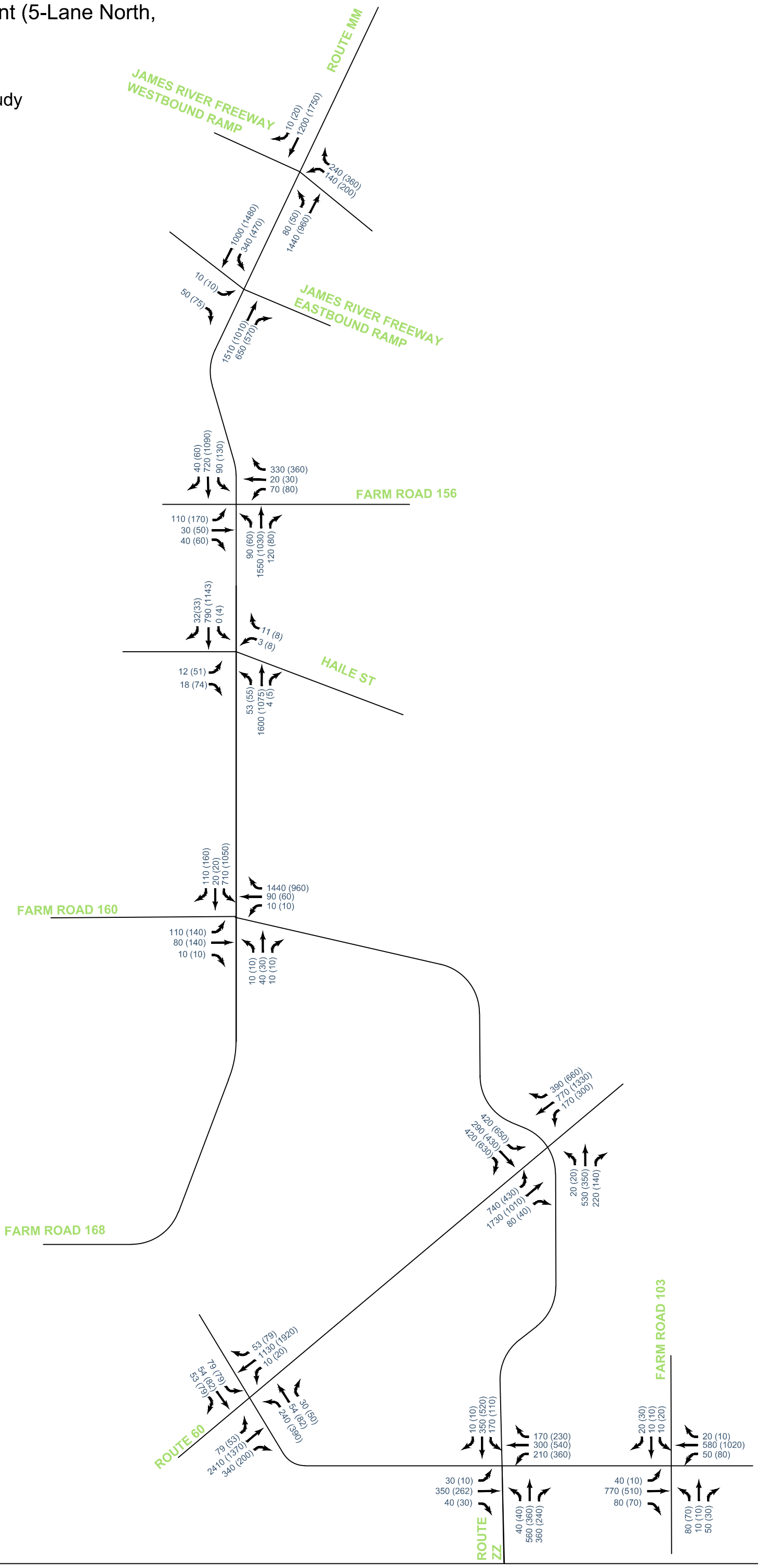
# FIGURE 10

## 2045 Full Build Alignment (5-Lane North, 3-Lane South) Peak Hour Volumes

J8S0836 Traffic Corridor Study
Route MM from US 360 to
Route M/ZZ

Republic, MO
Greene County




*LEGEND*

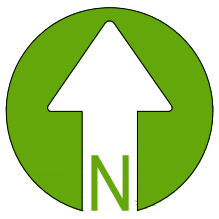
AM (PM) *Peak Hour Volume*

# FIGURE 11

## 2045 Full Build Alignment (5-Lane North, 3-Lane South)
## Lane Configuration and Traffic Control

J8S0836 Traffic Corridor Study
Route MM from US 360 to
Route M/ZZ

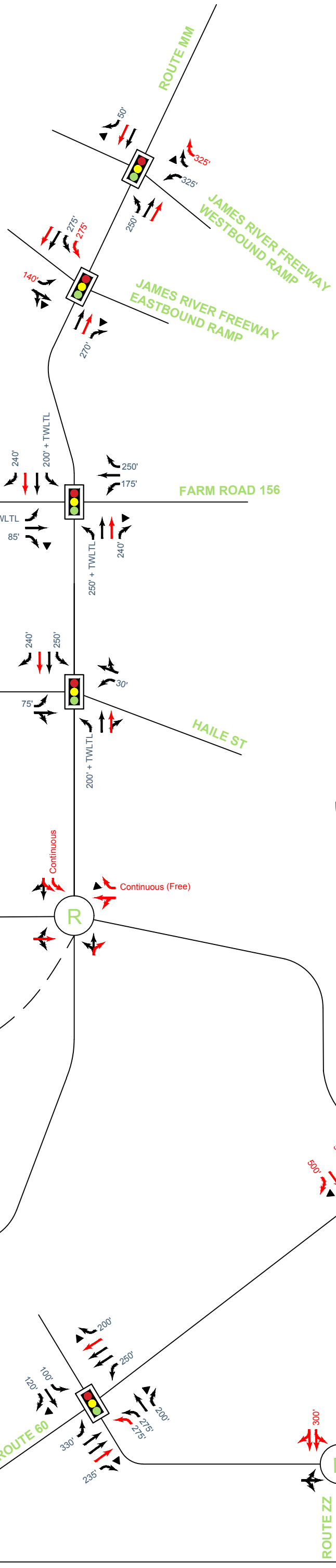
Republic, MO
Greene County




*LEGEND*

- *XX' → *Lane Configuration & Storage Length*
- *XX' → *Future Lane Configuration & Storage Length*
- Signalized Intersection
- STOP — Stop Controlled Intersection
- Stop Sign
- TWLTL — Two-Way Left-Turn Lane
- ▼ Channelized Right-turn

*Assumed turn lane length utilized for capacity analysis. The ultimate turn lane length should at least accommodate the 95th-percentile queue and if possible provide for proper deceleration distance.

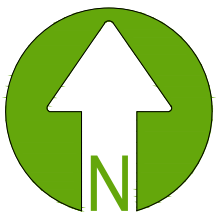


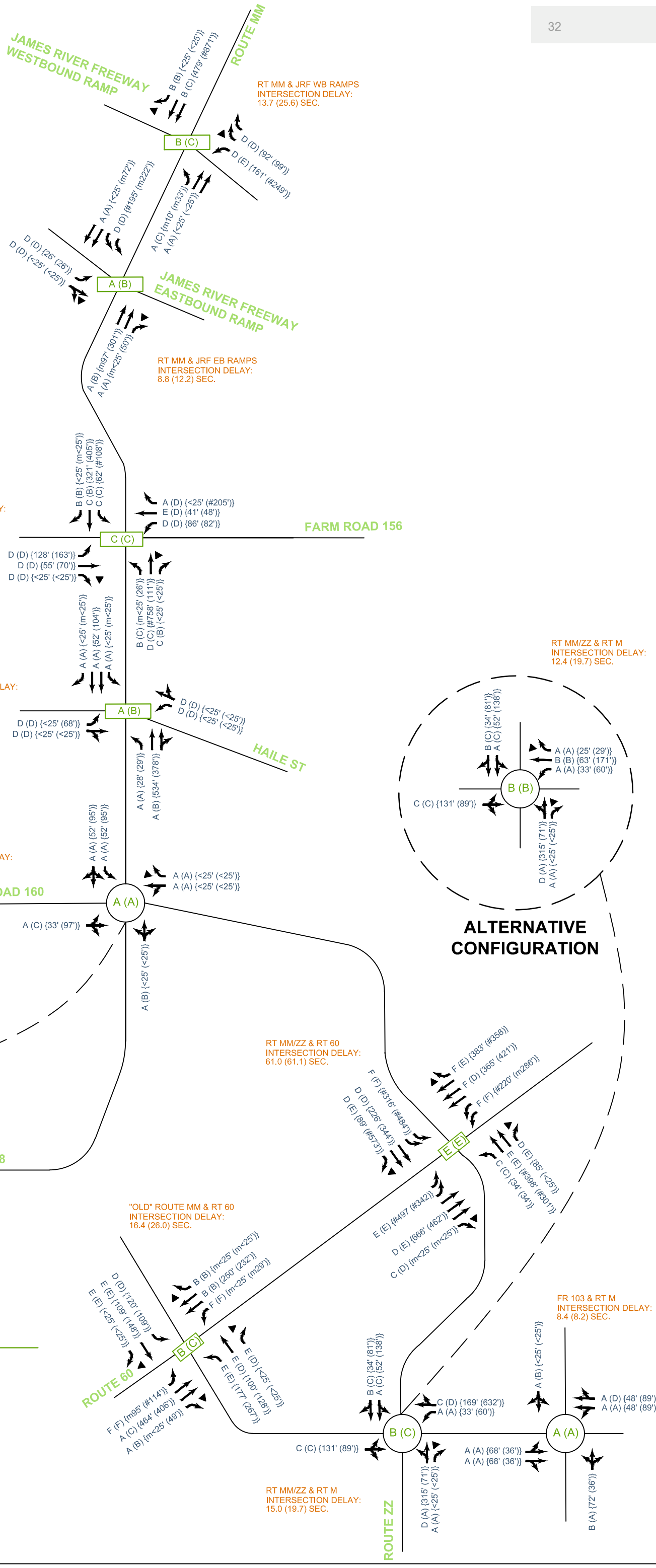
# FIGURE 12

## 2045 Full Build Alignment (5-Lane North, 3-Lane South) Capacity Analysis

J8S0836 Traffic Corridor Study
Route MM from US 360 to
Route M/ZZ

Republic, MO
Greene County




### LEGEND

| | |
|---|---|
| AM (PM) {AM' (PM')} | Movement LOS & {95th–Percentile Queue} |
| AM (PM) | Signalized Intersection LOS |
| | Lane Geometry |
| STOP | Stop Controlled Intersection |
| | Stop Sign |
| | Channelized Right–turn |
| # | 95th–Percentile Queue Exceeds Capacity |

## 5.4. Additional Corridor Construction Timeline Considerations

It is understood that construction of the preferred conceptual corridor configuration may not be feasible until funding becomes available. At the time of this report, funding for project J8S0836D (from Farm Road 160 to US 60) is currently funded. Funding for projects J8S0836A (from JRF to Farm Road 160) and J8S0836C (from US 60 to Route M) are in the process of being programmed but are not funded at this time. J8S0836B (from I-44 to JRF) is a planned project is and not directly included in the scope of this report; this widening is assumed to be in place for this study. For reference, the project map is previously shown in **Figure 1**.

**Table 7** below discusses potential outcomes for various scenarios when pairing the Route MM realignment projects assuming development activity continues as expected.

**Table 7. Route MM Project Pairing Scenarios.**

| Scenario | Potential Outcome |
|---|---|
| J8S0836D Constructed, J8S0836C Not Constructed, FR 103 Is Aligned with Full Access | • Traffic expected to utilize FR 103 until capacity is reached (within 3 years of initial project completion assuming unimproved FR capacity of 5,000 vpd).<br>• Once FR 103 capacity is reached, additional traffic likely to reroute to Rt M and US 60. |
| J8S0836D Constructed, J8S0836C Not Constructed, FR 103 Is Aligned with RIRO Access | • Traffic expected to reroute to Rt M and US 60.<br>• Rt M between US 60 and Rt ZZ design year 2045 ADT increases to 12,840 vpd, potentially warranting widening to 3-lane if left-turn volumes are heavy.<br>• US 60 between Rt M and “new” Rt MM design year 2045 ADT increases to 45,180 vpd.<br>• According to OTO capacity thresholds, US 60 has a future capacity of 53,250 vpd. While not over capacity, increased congestion would be expected, and a weave scenario from Rt M, to US 60 to New Rt MM would be introduced.<br>• FR 103 between US 60 and Rt M design year 2045 ADT of 3,620 vpd (3,300 vpd northbound). |
| J8S0836D Constructed, J8S0836A Not Constructed | • Traffic expected to utilize Rt MM until capacity is reached (possibly as early as 2027 north of FR 156 and 2032 south of FR 156).<br>• Rt MM capacity north of FR 160 expected to be 17,500 vpd as a 3-lane roadway. |

# 6. SUMMARY

The purpose and need of this project are to provide traffic analysis, modeling, and forecasting with recommendations for staged project implementation of the conceptual Route MM/ZZ corridor alignment. This report summarizes the analysis associated with the proposed realignment of Route MM and Route ZZ in Republic, Missouri. This realignment would include two rail overpasses and coincide with the closure of multiple at-grade rail crossings in the area. Considering that this corridor is a critical north-south connector for the region and is experiencing significant development activity in its vicinity, it is important to consider how the future demands can be accommodated to preserve the integrity of the corridor for all users.

The existing conditions pertaining to the capacity, safety, and roadway and bridge design considerations of the current alignment are described as well as the expected constraints for the future no-build scenario if no improvements are made. In order to determine the future needs of the corridor, the Ozarks Transportation Organization's (OTO) travel demand model was updated to include the expected development interests within the study area.

Four baseline alternatives were considered for the future cross-section of the realigned Route MM: three-lane vs five-lane section and partial build vs full build alignment. Under the partial build alignment, the realignment of Route MM between Farm Road 160 and US 60 would initially be constructed and tie into Farm Road 103. Full build alignment would continue the realignment south of US 60 and directly tie into Route ZZ. Based on the findings of this study, Farm Road 103 would quickly reach capacity under the Partial Build alignment. Thus, it was determined that the Full Build alignment would be preferred. The corridor is expected Based on the projected traffic volumes, a five-lane cross-section is expected to be needed along Route MM north of US 60 with a three-lane section along Route ZZ between US 60 and Route M.

Under this roadway configuration the expected 2045 design year average daily volumes for the Route MM corridor are expected to range from 22,720 vehicles per day to 33,100 vehicles per day between James River Freeway and US 60. The highest ADTs are expected at the development access points nearest to these two main highways. Depending on how these areas develop, raised medians should also be considered immediately south of James River Freeway and immediately north of US 60 to control access points and increase capacity along Route MM.

If demand continues in the area as expected, this full build realignment could be programmed by the year 2027 given that Route MM three-lane capacities are expected to be reached between 2027-2032 north of US 60. South of US 60, the full build realignment is recommended as a three-lane roadway based on the volume projections. This section of Route ZZ is expected to be approximately 12,250 vpd, which is below the typical three-lane capacity, by the design year 2045.

The main connection points of the realigned Route MM/ZZ corridor are at Farm Road 160, US 60, and Route M. The intersection of Route MM and Farm Road 160 is expected to operate acceptably as a dual lane roundabout or signalized intersection, with the roundabout configuration resulting in the shortest delays and queues overall. Two viable roundabout configurations are presented, one of which includes a free westbound right-turn and is preferrable considering it is associated with expected lower delays and crash frequency. The intersection of Route MM and US 60 is anticipated to be signalized. If volumes materialize as expected, the intersection will be reaching capacity near 2045 and be in need of re-evaluation, potentially considering innovative intersection types to accommodate demand. The intersection of Route ZZ and Route M is expected to operate acceptably as a hybrid roundabout, a portion of which includes two circulating lanes to accommodate the heaviest movements.

It is understood that construction of the preferred conceptual corridor configuration may not be feasible until funding becomes available. The table below discusses potential traffic outcomes to consider when pairing the various Route MM realignment projects.

| Scenario | Potential Outcome |
|---|---|
| J8S0836D Constructed, J8S0836C Not Constructed, FR 103 Is Aligned with Full Access | • Traffic expected to utilize FR 103 until capacity is reached (within 3 years of initial project completion assuming unimproved FR capacity of 5,000 vpd).<br>• Once FR 103 capacity is reached, additional traffic likely to reroute to Rt M and US 60. |
| J8S0836D Constructed, J8S0836C Not Constructed, FR 103 Is Aligned with RIRO Access | • Traffic expected to reroute to Rt M and US 60.<br>• Rt M between US 60 and Rt ZZ design year 2045 ADT increases to 12,840 vpd, potentially warranting widening to 3-lane if left-turn volumes are heavy.<br>• US 60 between Rt M and “new” Rt MM design year 2045 ADT increases to 45,180 vpd.<br>• According to OTO capacity thresholds, US 60 has a future capacity of 53,250 vpd. While not over capacity, increased congestion would be expected, and a weave scenario from Rt M, to US 60 to New Rt MM would be introduced.<br>• FR 103 between US 60 and Rt M design year 2045 ADT of 3,620 vpd (3,300 vpd northbound). |
| J8S0836D Constructed, J8S0836A Not Constructed | • Traffic expected to utilize Rt MM until capacity is reached (possibly as early as 2027 north of FR 156 and 2032 south of FR 156).<br>• Rt MM capacity north of FR 160 expected to be 17,500 vpd as a 3-lane roadway. |