**CONCEPT DEVELOPMENT**
2nd Street / 3rd Street Two-way Conversion
Cardinal Boulevard - Broadway

February 8, 2022

Prepared for:
Louisville Metro Public Works

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Project Number:
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# Table of Contents



## LIST OF TABLES

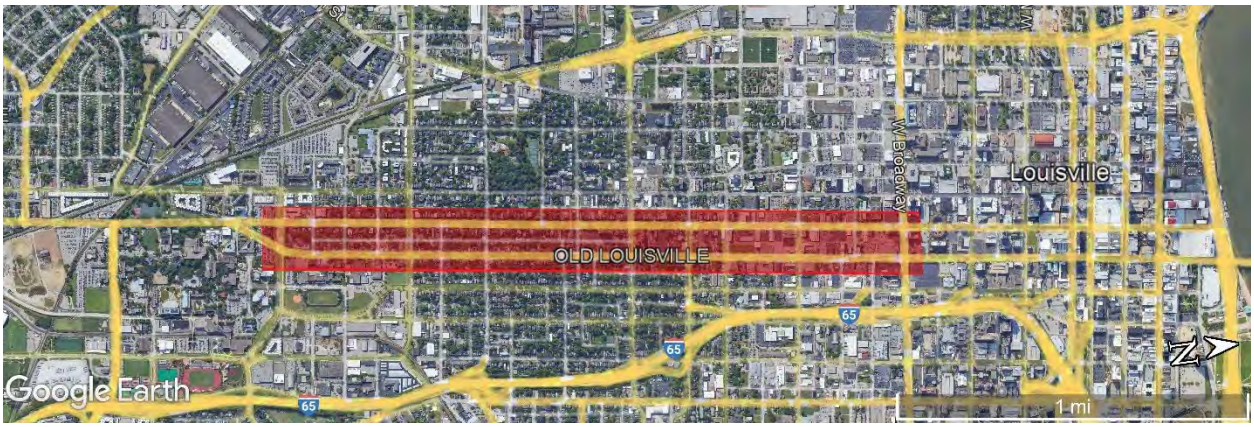
## LIST OF FIGURES



## LIST OF APPENDICES

# 1 Introduction

Stantec was asked by Louisville Metro Public Works to complete a concept development for the two-way conversion of the 2nd Street and 3rd Street one-way couplet south of Broadway in Louisville, Kentucky. 2nd Street and 3rd Street, which carry KY 1020 through Louisville, have already been converted to two-way operation north of Broadway. The couplet begins with the confluence of the two routes south of Cardinal Boulevard at Unity Place in the University of Louisville (UofL) campus. Consideration was given to including the two routes south of Cardinal Boulevard in the concept development; however, UofL is currently working with the Kentucky Transportation Cabinet (KYTC) to revise the configuration of these two routes in that area. These concepts include closure 2nd Street south of Cardinal Boulevard and closure of West Brandeis Avenue between 4th Street and 3rd Street. With these potential closures and the uncertainty of the timing of the two projects, Stantec was asked to develop alternatives and evaluate the two-way conversion of 3rd Street to the south side of Cardinal Boulevard and closure of 2nd Street south of Cardinal Boulevard. The study area is shown in **Figure 1**.




Louisville Metro's Concept Development process includes steps to identify existing conditions and develop and evaluate proposed alternatives including operations, impacts, implementation, and cost estimates. Stantec collected available existing data including field observations and developed a TransModeler traffic simulation model to develop alternatives and evaluate operational impacts.

# 2 Existing Conditions

2nd Street is the northbound route and 3rd Street is the southbound route of this one-way couplet which together is designated as KY 1020. North of Broadway, KY 1020 is the two-way section of 2nd Street and south of Unity Place (which is just south of West Brandeis Avenue), KY 1020 is the two-way section of 3rd Street. Both corridors serve primarily residential land uses between Cardinal Boulevard and Kentucky Street and commercial between Kentucky Street and Broadway.

## 2.1 Data Collection

KYTC provided available turning movement counts and truck classification counts in the area from 2015-2020 (pre-COVID-19). Based on KYTC classification counts, semi-trailers make up less than 0.5% of the daily traffic and 0.1% of the peak hour traffic on 3rd Street. Truck volumes or routing do not appear to be a capacity or safety issue in the study area. The Kentuckiana Regional Planning and Development Agency (KIPDA), the Metropolitan Planning Organization (MPO) for the Louisville region, provided origin-destination matrices from the regional travel demand model as well as 2019 Streetlight Insight™ data for both corridors including travel times, speeds, and estimated turning movements. These data were used in the validation of the TransModeler model used for alternative evaluation.

Stantec obtained obtain available crash data from the Kentucky State Police for three years prior to the COVID-19 pandemic (2017-2019). Crash data prior to 2017 were excluded due to the Ohio River Bridges project which would have been under construction at that time.

Finally, Stantec completed a field inventory to review and verify potential sight obstructions, traffic signal equipment and operations, sidewalk widths and ramps, bicycle accommodations, pavement markings, transit accommodations, signs, on-street parking, drainage features, and utilities.

## 2.2 Crash Data

There were 512 crashes along 2nd Street and 414 crashes along 3rd Steet from 2017-2019. **Figures 2 and 3** show the number and percentage of crashes by type along each corridor. The distribution of crash types was very similar between the two corridors. The predominant types of crashes along both corridors were angle (33-38%), sideswipe (30-33%), and rear-end (21%). **Figures 2 and 3** also show the number of crashes involving fatalities and injuries. The two fatalities along the 2nd Street corridor occurred at Broadway. One of those fatalities involved a pedestrian.

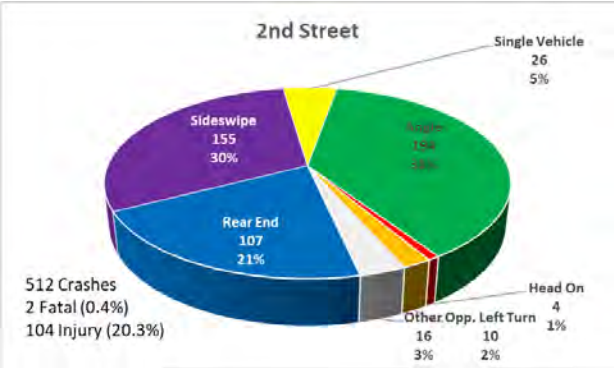



**Figure 2: Crash Types along 2nd Street**

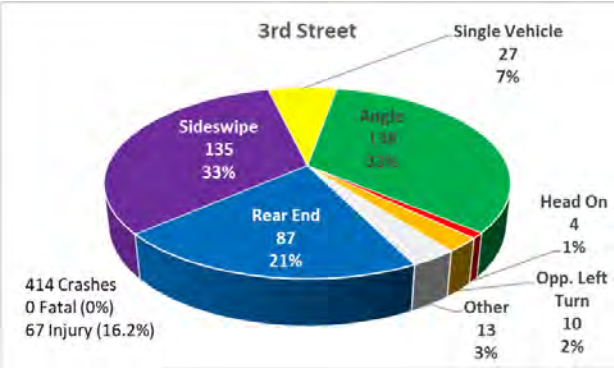



**Figure 3: Crash Types along 3rd Street**

Maps of crashes by type along the corridors can be found in **Appendix A**. Angle crashes are typical along corridors with intersections and access points. The angle crash map in **Appendix A** shows the angle crashes primarily at the intersections with mid-block angle crashes more prevalent north of Kentucky Street where there are more parking lots. On-street parking and narrow lanes are significant factors in the number of sideswipe crashes which can be seen throughout the corridor and primarily located on blocks with frequent parking on both side of the road. Many of the side swipe crashes involved parked cars while the remainder are attributed to lane changes. Rear-end crashes are typical along corridors with frequent stops. Traffic signals and on-street parking are significant factors in the number of rear-end crashes along these corridors which is reflected in clusters of crashes at the intersections and midblock crashes located on blocks with frequent parking on both sides of the road.

The head-on and opposing left-turn crashes along these corridors typically occur at intersections with two-way side streets as expected since these types of crashes are not common on one-way corridors. The single vehicle crashes typically involve crashes with fixed objects due to roadway departure, but they also include crashes involving bicycles and pedestrians. The other types of crashes typically involve backing and parking. Maps of crashes involving bicycles and pedestrians specifically are also provided at the end of **Appendix A**. Crashes involving bicycles are most common along 2nd Street with fewer crashes along the corridors and segments that are wide enough to accommodate bike lanes. Crashes involving pedestrians are most common at the Broadway intersections with several crashes mapped at each intersection.

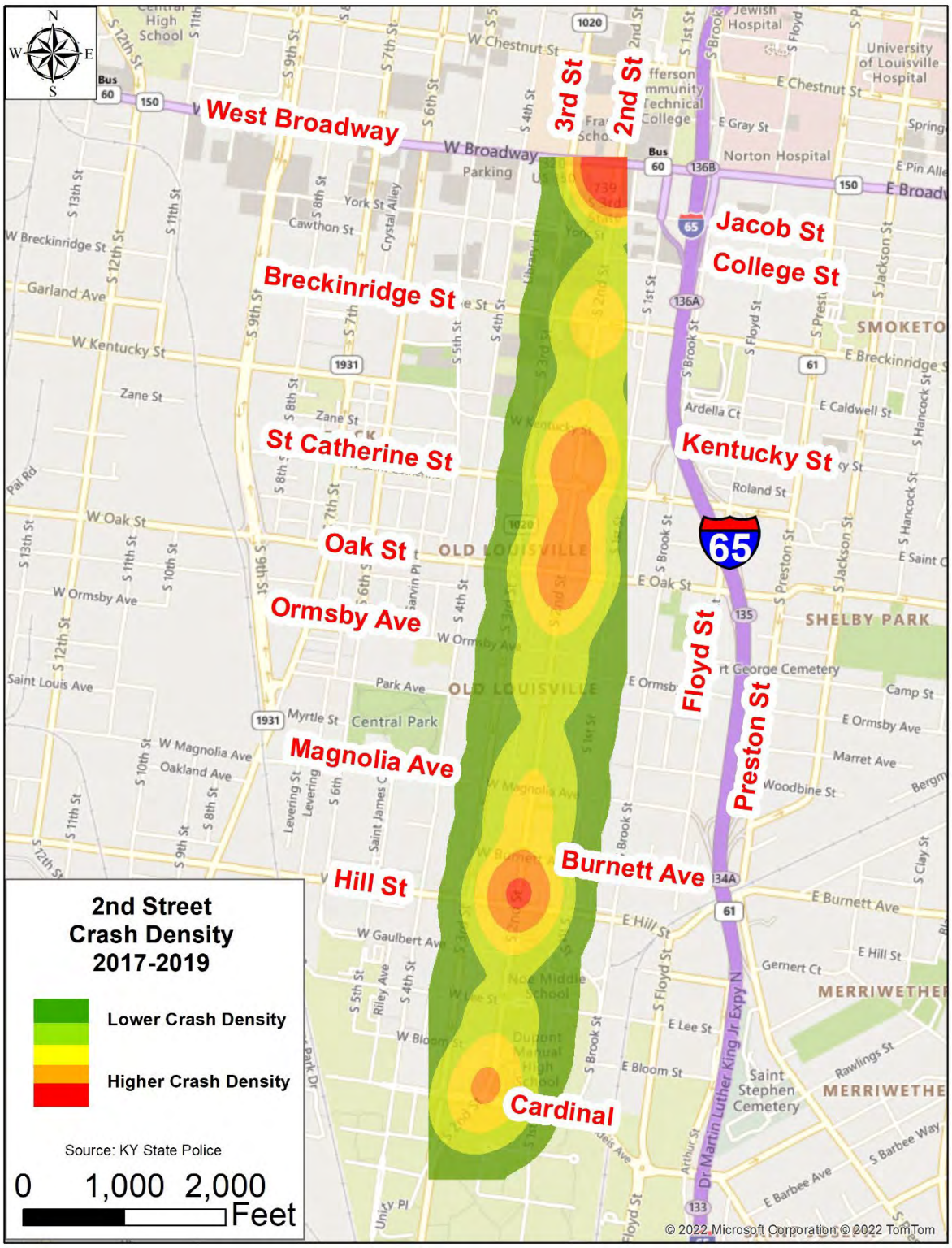



**Figure 4: Heat Map of Crashes along 2nd Street**

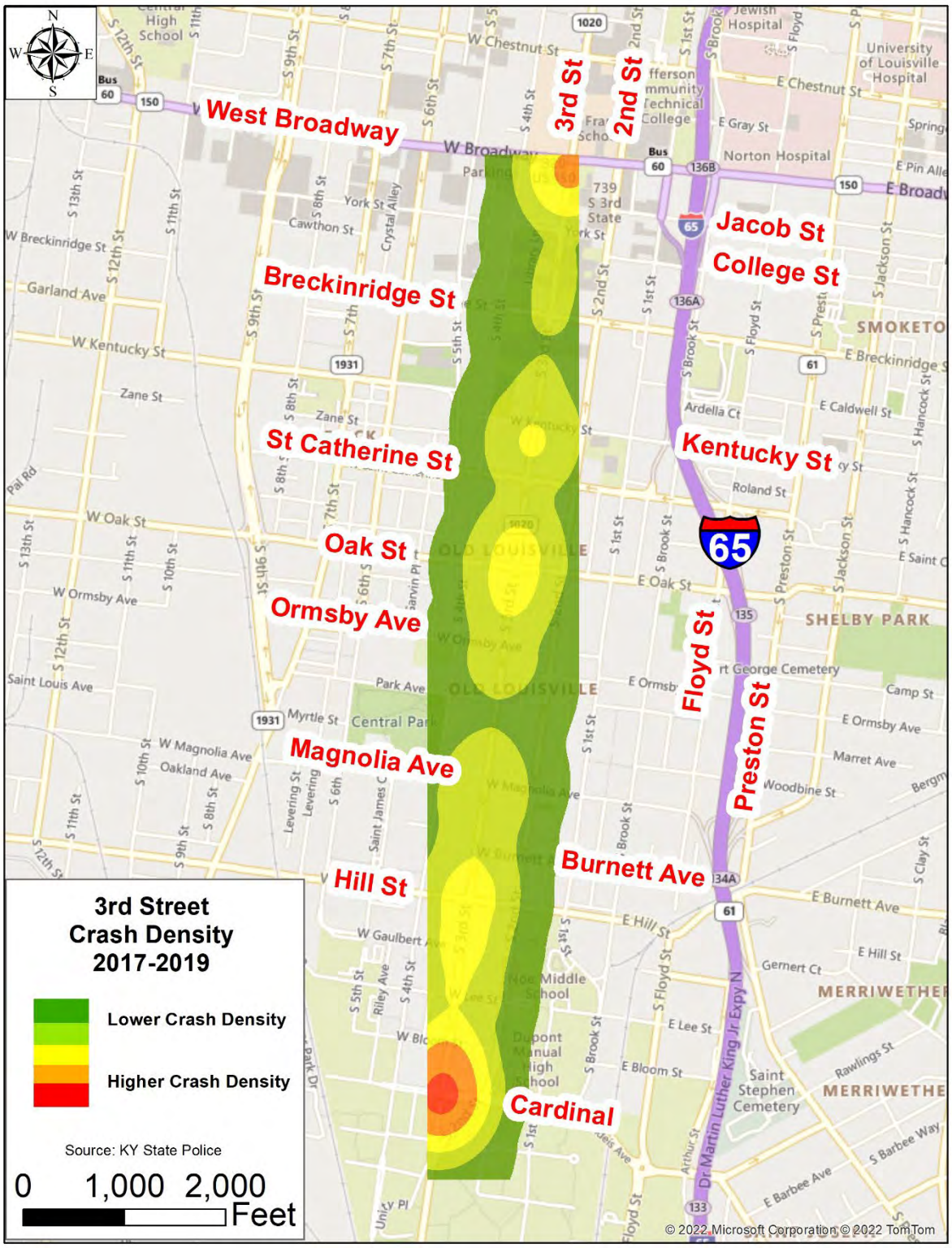



**Figure 5: Heat Map of Crashes along 3rd Street**

## 2.3 Existing Field Inventory

The field inventory includes roadway, buffer, and sidewalk widths as well as multi-modal accommodations, traffic control, and utilities. The field inventory can be seen in **Appendix B**.

### 2.3.1 2nd Street

2nd Street is curbed without gutters on both sides and is 36 feet wide from Cardinal Boulevard to Oak Street accommodating two vehicular travel lanes and parking on both sides. From Oak Street to Jacob Street, 2nd Street is 42 feet wide with the addition of a five-foot bike lane between the travel lane and parking on the right side. 2nd Street widens from 42 feet at Jacob Street to 50 feet at Broadway with the removal of the bike lane and the addition of right-turn and left-turn lanes at Broadway.

Parking on 2nd Street is limited to a maximum of two hours on the east side from Cardinal Boulevard to Gaulbert Avenue and is metered from York to Broadway with parking restricted for turn lanes at Broadway. Parking is also restricted for a right-turn lane at Kentucky Street. Handicap on-street parking is provided at Burnett Avenue and Breckinridge Street.

Sight distance obstructions which may require right-turn-on-red or parking restrictions were noted on some corners during the field inventory. The corners noted in red, on the field inventory in **Appendix B**, include potential sight obstructions for the new direction of traffic when the corridor is converted to two-way operation.

The existing traffic signal heads are mounted on diagonal spans on 2nd Street from Hill Street to Kentucky Street. The signals constructed with mast arms utilize older-style mast arms except for Broadway which has decorative mast arms. The spans are attached to shared-use, wood, utility poles. The only signal with left- turn phasing is at Broadway, and the remainder are in two-phase operation with coordination along the east-west routes. All signals include pedestrian signal indications. Accessible pedestrian indications with audible detectors and enhanced crosswalk markings are provided at Cardinal Boulevard, Oak Street, and Broadway. The remainder of the pedestrian signals are standard and programmed on recall without detection.

2nd Street includes two school zones with flasher assemblies at Cardinal Boulevard for DuPont Manual High School and Lee Street for Noe Middle School and a static school zone with signs at St. Catherine Street for Engelhard Elementary School. The speed limit for 2nd Street is posted at 35 mph in the study area and 25 mph north of Broadway.

Sidewalks are provided on both sides of 2nd Street throughout the corridor with sidewalk ramps, which appear to be compliant with the Americans with Disabilities Act (ADA). The sidewalks are predominantly eight feet wide except for Lee Street to Hill Street which are five feet to seven feet wide. The eight-foot sidewalks are separated from the roadway by a four-foot buffer south of Oak Street. From Oak Street to Kentucky Street the buffer increases to eight feet between the eight-foot sidewalk and the roadway. North of Kentucky Street, the eight-foot sidewalk is located at the back-of-curb including tree planters without a buffer. Between Lee Street and Hill Street, the buffer width varies with the sidewalk width totaling 12 feet.

Louisville Metro has designated 2nd Street as a bike route with a shared lane connection between Cardinal Boulevard and Oak Street. A bike lane is provided on the right from Oak Street to York Street. Bike racks are provided along Broadway and a LouVelo bike share station is located between 2nd Street and 3rd Street at West Brandeis Avenue.

2nd Street is a Transit Authority of River City (TARC) route serving one regular route with stops on most blocks. Water lines and overhead utilities are primarily located on the east side of 2nd Street.

### 2.3.2 3rd Street

3rd Street is curbed without gutters on both sides and is 42 feet wide through the study area accommodating two vehicular travel lanes and a bike lane on the right with parking on both sides.

Parking is metered from Broadway to Kentucky Street and between Cardinal and West Brandeis Avenue. There are also a few metered spaces between Oak Street and Ormsby Avenue on both sides. Handicap on-street parking is provided at the library between Broadway and York Street. Parking is restricted by permit 8 AM to 4 PM from Gaulbert Avenue to Bloom Street and from 8 AM to 6 PM from Bloom Street to Cardinal Boulevard.

Sight distance obstructions which may require right-turn-on-red or parking restrictions were noted on some corners during the field inventory. The corners noted in red, on the field inventory in **Appendix B**, include potential sight obstructions for the new direction of traffic when the corridor is converted to two-way operation.

The traffic signals are a combination of diagonal and box spans and arms on 3rd Street. The signals constructed with mast arms utilize older style mast arms except for Broadway which has decorative mast arms. The spans are attached to shared-use, wood, utility poles. The only signal with left-turn phasing is at Broadway; the remainder are in two-phase operation with coordination along the east-west routes. All the signals include pedestrian signal indications. Accessible pedestrian signals with audible detectors and enhanced crosswalk markings are provided at Broadway, Oak Street, and West Brandeis Avenue. The intersection with York Street includes accessible signals without detection programmed on recall. The remainder of the pedestrian signals are standard and programmed on recall without detection. Enhanced crosswalk markings are also present at Cardinal Boulevard.

Advanced school warning signs are present at Burnett Avenue and Bloom Street. The speed limit for 3rd Street is posted at 35 mph in the study area and 25 mph north of Broadway.

Sidewalk ramps are provided on both sides of 3rd Street throughout the corridor. Approximately half of the ramps appear to be ADA compliant. The sidewalks are predominantly eight to ten feet wide except for the east side from Burnett Avenue to Gaulbert Avenue which are six feet wide. North of Kentucky Street, the sidewalk is located at the back-of-curb without a buffer. The sidewalks include tree planters between York Street and Kentucky Street. South of Kentucky Street, the buffer between the sidewalk and the roadway varies from 18 feet to 20 feet.

Louisville Metro has designated 3rd Street as a bike route with a bike lane provided through the study area except for a 400-foot section from York Street to the south side of the TARC electric bus charging station. The bike lane ends at West Brandeis Avenue. Bike racks are provided near Broadway, Hill Street, and Cardinal Boulevard and a LouVelo bike share station is located between 2nd Street and 3rd Street at West Brandeis Avenue.

3rd Street is a TARC route south of Gaulbert Avenue serving one regular route with stops at Lee Street and Cardinal Boulevard. TARC has an electric bus charging station on 3rd Street between York Street and Breckinridge Street. Water lines and overhead utilities are primarily located on the west side of 3rd Street.

# 3 Traffic Simulation Modeling

## 3.1 Analysis Methodology

Level of service (LOS) analyses were conducted for the intersections and the corridors according to methods prescribed in the 2016 Highway Capacity Manual 6th Edition. LOS is a qualitative measure of traffic on a scale from A to F based on quantitative metrics for different transportation facilities. LOS A represents the highest possible level of operational efficiency where traffic can operate at a free-flowing speed and maneuverability. LOS B represents free-flowing traffic speeds but a higher level of vehicle interaction slightly restricting maneuverability. LOC C represents stable flowing traffic near free-flow speeds with significant restriction to vehicle maneuverability. LOS D represents traffic operating at decreased speeds approaching unstable flow. LOS E represents traffic at full capacity of the facility with unstable flow. LOS F represents a heavily congested or break-down condition. In urban areas, LOS D or better is considered desirable.

For intersections, LOS is measured by the average control delay. A vehicle's control delay is measured as soon as it begins to brake to join the back of a queue forming at an intersection. A vehicle continues to experience control delay until it has passed through the intersection and returned to speed. LOS criteria for signalized intersections are based on the control delay for all controlled movements and approaches and are presented in **Table 1**. The intersection LOS for two-way stop-controlled intersections is based on the average control delay for each minor-street movement and major street left-turn movement. LOS criteria for unsignalized intersections are presented in **Table 2**.

**Table 1: Signalized Intersection Level of Service Criteria**

| Delay (sec/veh) | LOS |
|---|---|
| < 10 | A |
| 10 - 20 | B |
| 20 - 35 | C |
| 35 - 55 | D |
| 55 - 80 | E |
| > 80 | F |

**Table 2: Unsignalized Intersection Level of Service Criteria**

| Delay (sec/veh) | LOS |
|---|---|
| < 10 | A |
| 10 - 15 | B |
| 15 - 25 | C |
| 25 - 35 | D |
| 35 - 50 | E |
| > 50 | F |

In addition to intersection LOS, the corridor LOS was also evaluated using cumulative segment statistics along each corridor. The corridor LOS for urban streets is based on the average travel speed as a function of the base free-flow speed. The base free-flow speed of the two 35 mph corridors is 40 mph. The Highway Capacity Manual 6th Edition LOS criteria for a base free-flow speed of 40 mph is shown in **Table 3**.

**Table 3: Urban Street Level of Service Criteria**

| Avg. Speed (mph) | LOS |
|---|---|
| > 32 | A |
| > 27 | B |
| > 20 | C |
| > 16 | D |
| > 12 | E |
| < 12 | F |

## 3.2 Existing Model Development

Stantec extracted the project study area from the TransModeler Downtown Louisville Traffic Simulation Model network. **Figure 6** shows the study area network. External traffic enters and exits via the periphery links in the network, while internal trips load via centroid connectors attached to the network in various mid-block locations representative of real-world access and trip generation. New AM peak hour (generally from 7:30 am to 8:30 am) and PM peak hour (4:30 pm to 5:30 pm) trip tables were estimated from the most recent available count data and compared with origin-destination trip data from Streetlight Insight™. Like the larger model, separate trip tables were created for single-unit and multi-unit trucks.

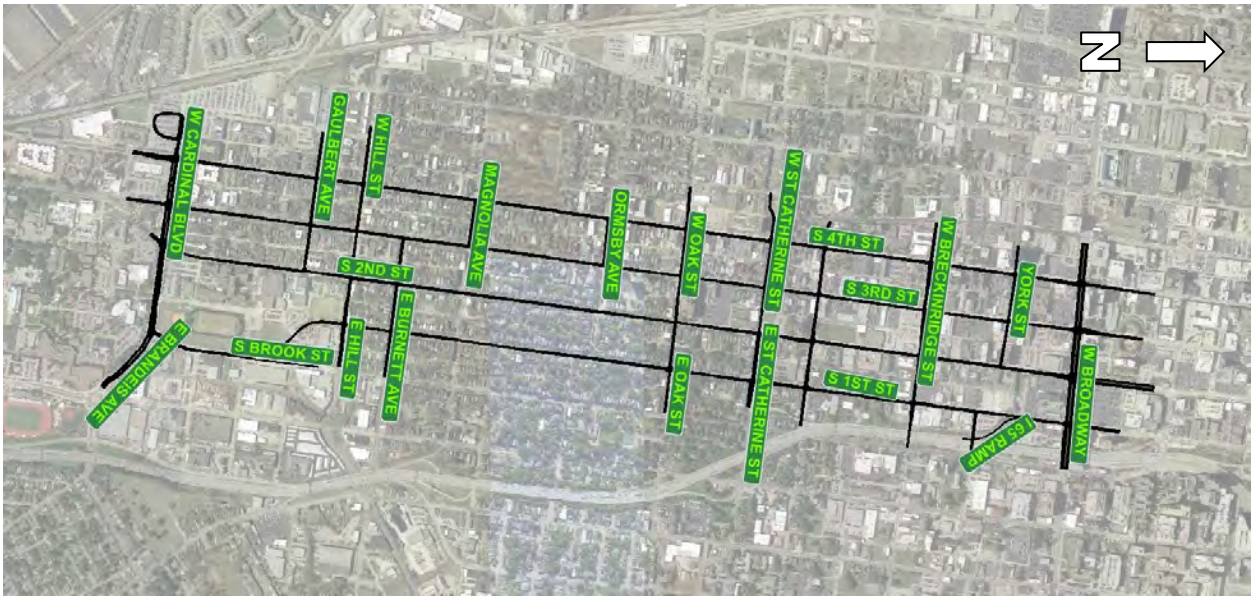



**Figure 6: TransModeler Study Area Network**

The southbound approach on 3rd Street at Broadway was reconfigured to two-way operation in 2020 with a left-turn lane, a through lane, a shared through/right-turn lane, and a northbound receiving lane. However, the existing conditions are modeled with the one-way configuration to match available count data. In the existing model, the southbound approach on 3rd Street at Broadway includes a left-turn lane, two through lanes, and a left-turn lane.

Once the trip tables and operational controls were complete, five (5) model simulations were performed for both AM and PM peak hour scenarios. Average vehicular flow statistics from the model runs were compared to the count data to confirm model validation. As summarized in **Table 4**, corridor travel times and travel speeds were compared with data from Streetlight Insight™ and found to be reasonably comparable for the 2nd Street and 3rd Street corridors. Travel times ranged from 4.0 minutes on 3rd Street during the AM peak hour to 5.4 minutes on 2nd Street in the PM peak hour. Average speeds ranged from 26.7 miles per hour (mph) on 3rd Street during the AM peak hour to 22.3 mph on 2nd Street in the PM peak hour.

**Table 4: Existing Conditions Model Performance Measures**

| | | AM | PM |
|---|---|---|---|
| **2nd Street** | Average Speed (mph) | 24.1 | 22.3 |
| | Average Delay (sec/vehicle) | 6.7 | 11.7 |
| | Travel Time (minutes) | 4.1 | 5.4 |
| **3rd Street** | Average Speed (mph) | 26.7 | 24.9 |
| | Average Delay (sec/vehicle) | 6.7 | 7.6 |
| | Travel Time (minutes) | 4.0 | 4.2 |
| **System-Wide** | Vehicle-Miles Traveled (VMT) | 6,588 | 8,057 |
| | Vehicle-Hours Traveled (VHT) | 337 | 472 |

The signalized intersections on both corridors currently operate at a LOS C or better as seen in the LOS maps in **Appendix C**. The approaches to the two-way stop-controlled intersections at Gaulbert Avenue and Burnett Avenue currently operate at a LOS B or better as seen in **Table 5**. The uncontrolled northbound and southbound approaches include all permissible movements for comparison to the two-way scenarios which only include one lane in each direction.

**Table 5: Existing Two-way Stop Controlled Approach Level of Service**

| Intersection | Period | Northbound | | Southbound | | Eastbound | | Westbound | |
|---|---|---|---|---|---|---|---|---|---|
| | | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS |
| 2nd Street / Gaulbert Avenue | AM | 0.0 | A | | | 9.7 | A | | |
| | PM | 0.0 | A | | | 5.3 | A | | |
| 3rd Street / Gaulbert Avenue | AM | | | 0.0 | A | 3.0 | A | 4.4 | A |
| | PM | | | 0.0 | A | 9.8 | A | 11.7 | B |
| 3rd Street / Burnett Avenue | AM | | | 0.0 | A | | | 6.6 | A |
| | PM | | | 0.0 | A | | | 7.8 | A |

**Table 6** provides the cumulative segment statistics for each corridor and period. In addition to the average speed and LOS, the average volume, average travel time, and average delay are also provided. In urban areas such as this, LOS D or better is acceptable. 3rd Street operates at LOS C in both peak periods and 2nd Street operates at LOS C during the AM peak hour and LOS D during the PM peak hour.

**Table 6: Existing Segment Statistics and Urban Street Level of Service**

| Period | Route | Length (ft) | Avg. Vol. (veh) | Avg. Travel Time (sec) | Avg. Delay (sec/veh) | Avg. Speed (mph) | LOS |
|---|---|---|---|---|---|---|---|
| AM | 2nd | 8752 | 1056 | 254.5 | 106.7 | 22 | C |
| | 3rd | 8644 | 363 | 262.6 | 115.8 | 23.5 | C |
| PM | 2nd | 8752 | 621 | 334.6 | 186.8 | 19.3 | D |
| | 3rd | 8644 | 865 | 276.1 | 129.4 | 22.2 | C |

## 3.3 Two-way Conversion Scenarios

Historic traffic counts have shown little to no growth in peak hour traffic volumes in recent years due to many factors including, but not limited to, minimal land use changes within the surrounding area, the Ohio River Bridges project and improvements to the I-65 corridor, and most recently COVID-19 with more people working remotely. Considering these factors and the uncertainty of future traffic growth, the project team made the decision to evaluate the two-way conversion without traffic growth. Keeping the traffic demand constant also allowed for the evaluation of trip diversions from the adjacent 4th Street and 1st Street routes.

### 3.3.1 TWO-WAY CONVERSION SCENARIO 1

To develop the alternative scenarios, Stantec started by converting 2nd Street and 3rd Street to two-way operation with only a few lane, phasing, and timing changes at the Cardinal Boulevard, Kentucky Street, and Broadway intersections as shown in the following figures and narrative.

The southbound approach on 3rd Street at Broadway was reconfigured to two-way operation in 2020 with a left-turn lane, a through lane, a shared through/right-turn lane, and a northbound receiving lane. In Scenario 1 the shared through/right-turn lane is converted to a dedicated right-turn lane, as shown on **Figure 7**. The northbound approach on 3rd Street at Broadway is modeled with a 150-foot left-turn lane, through lane, 150-foot right-turn lane, and southbound receiving lane matching the lanes on the southbound approach. The signal phasing is also revised to include protective/permissive phases to accommodate northbound and southbound left-turns with adjustments to signal timing. Despite the two-way conversion of 3rd Street north of Broadway, left-turns from eastbound Broadway to northbound 3rd Street remain prohibited and left-turns from westbound Broadway to southbound 3rd Street are restricted during the peak hours via blank-out signs. The two-way conversion scenarios maintain these left-turn prohibitions.

The northbound approach on 2nd Street at Broadway, shown on **Figure 8**, is modeled with a 300-foot left-turn lane and combines the existing right-turn lane and one of the two through lanes into a shared lane to accommodate a new southbound receiving lane. On the southbound approach, the through movement is combined with the right-turn lane to maintain a protected/permissive left-turn phase. Left-turns from eastbound Broadway to northbound 2nd Street remain restricted during the peak hours via blank-out signs. In conformance with the existing left-turn prohibitions at 3rd Street and 2nd Street, the two-way conversion scenarios also prohibit left-turns from westbound Broadway to southbound 2nd Street. No phasing or signal timing changes are included at 2nd and Broadway.

The northbound approach on 3rd Street at Kentucky Street, shown on **Figure 9**, is modeled with a 100-foot right-turn lane. No phasing or signal timing changes are included at 3rd Street and Kentucky Street.

Both the northbound and southbound approaches on 3rd Street at Cardinal Boulevard are modeled with a 125-foot left-turn lane, as shown on **Figure 11**. The eastbound approach on Cardinal Boulevard at 3rd Street is modeled with a 150-foot left-turn lane. Protective/permissive left-turn phases are also provided for all four approaches with adjustments to signal timing.

The southbound approach on 2nd Street at Cardinal Boulevard is modeled with a 125-foot left-turn and 125-foot right-turn lane, as shown on **Figure 12**. The northbound approach on 2nd Street at Cardinal Boulevard is closed. A protective/permissive left-turn phase is provided for eastbound Cardinal Boulevard.


**Figure 7: Scenario 1 - 3rd Street at Broadway**

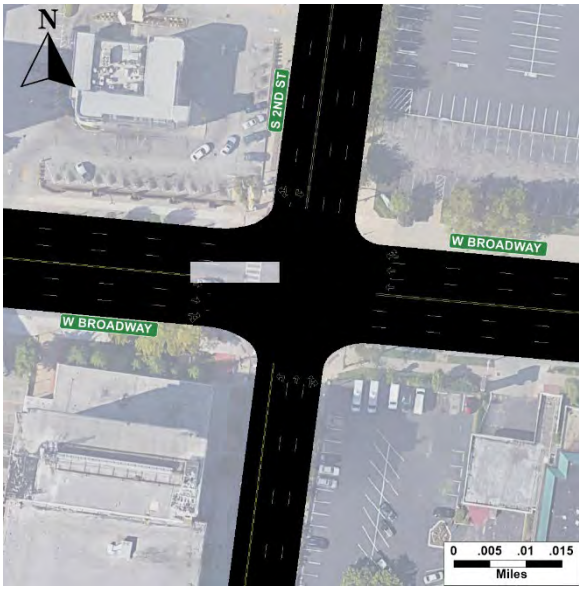



**Figure 8: Scenario 1 - 2nd Street at Broadway**


**Figure 9: Scenario 1 - 3rd Street at Kentucky**

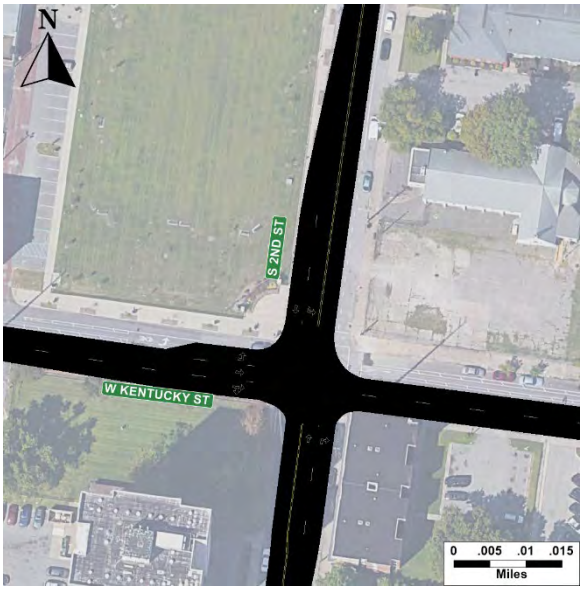



**Figure 10: Scenario 1 - 2nd Street at Kentucky**

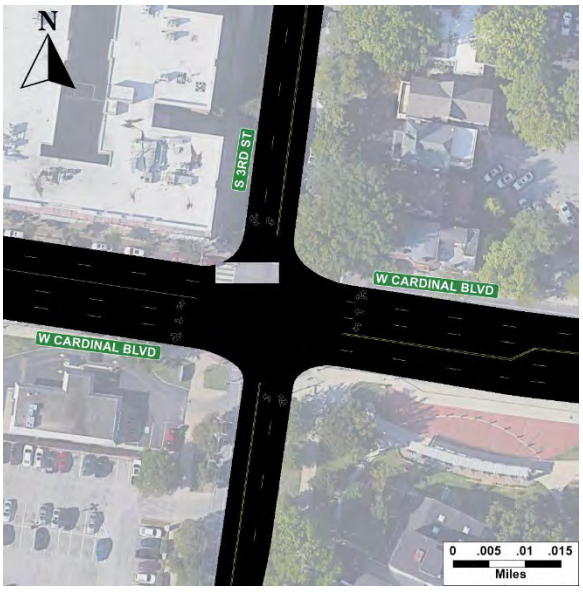



**Figure 11: Scenario 1 - 3rd Street at Cardinal**


**Figure 12: Scenario 1 - 2nd Street at Cardinal**

The remaining intersections did not include any lane, phasing, or timing changes beyond what would be required to accommodate the new movements.

All reported statistics are based on the average of five model runs for each period and scenario between Cardinal Boulevard and Broadway. As seen in the LOS maps in **Appendix C**, the only signalized intersections expected to operate at LOS D or LOS E are on 2nd Street at Oak Street (LOS D), Kentucky Street (LOS E), and Breckinridge Street (LOS D) during the AM peak hour. The remainder of the

signalized intersections on both corridors in the AM and PM peak hours are expected to operate at an overall LOS C or better.

The delay and LOS for the approaches to the two-way stop-controlled intersections at Gaulbert Avenue and Burnett Avenue with Two-way Conversion Scenario 1 are shown in **Table 7**. The uncontrolled northbound and southbound approaches include all permissible movements since there is only one lane in each direction. The delays and LOS shown for the northbound and side street approaches at 3rd Street and Gaulbert Avenue during the PM peak hour are the result of queues from Hill Street.

**Table 7: Scenario 1 Two-way Stop Controlled Approach Level of Service**

| Intersection | Period | Northbound | | Southbound | | Eastbound | | Westbound | |
|---|---|---|---|---|---|---|---|---|---|
| | | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS |
| 2nd Street / Gaulbert Avenue | AM | 0.0 | A | 0.0 | A | 19.3 | C | | |
| | PM | 0.0 | A | 0.0 | A | 5.2 | A | | |
| 3rd Street / Gaulbert Avenue | AM | 0.2 | A | 0.0 | A | 4.6 | A | 7.7 | A |
| | PM | 34.7 | D | 0.0 | A | 85.7 | F | 33.5 | D |
| 3rd Street / Burnett Avenue | AM | 0.0 | A | 0.0 | A | | | 10.9 | B |
| | PM | 0.0 | A | 6.6 | A | | | 30.4 | D |

**Table 8** provides the cumulative segment statistics for each corridor and period by direction for Scenario 1. 3rd Street is expected to operate at LOS C in both directions during the AM peak hour and LOS E in the northbound direction and LOS D in the southbound direction during the PM peak hour. 2nd Street is expected to operate at LOS E in the northbound direction and LOS C in the southbound direction during the AM peak hour and LOS C in both directions during the PM peak hour.

**Table 8: Scenario 1 Segment Statistics and Urban Street Level of Service**

| Direction | | | Northbound | | | | | Southbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | Route | Length (ft) | Avg. Vol. (veh) | Avg. Travel Time (sec) | Avg. Delay (sec/veh) | Avg. Speed (mph) | LOS | Avg. Vol. (veh) | Avg. Travel Time (sec) | Avg. Delay (sec/veh) | Avg. Speed (mph) | LOS |
| AM | 2nd | 8752 | 743 | 579.9 | 431.9 | 15.8 | E | 57 | 916.2 | 768.2 | 21.0 | C |
| | 3rd | 8644 | 266 | 304.5 | 158.6 | 23.5 | C | 308 | 265.9 | 120.0 | 23.7 | C |
| PM | 2nd | 8752 | 455 | 282.4 | 134.4 | 22 | C | 195 | 324.3 | 176.4 | 21.6 | C |
| | 3rd | 8644 | 158 | 856.5 | 710.5 | 15.5 | E | 765 | 377.0 | 231.1 | 17.1 | D |

Despite most of the intersections operating at LOS C or better, congestion was still observed on 2nd Street and 3rd Street northbound during the AM and PM peak hours, respectively, operating with an urban street LOS E in Scenario 1. Therefore, Scenario 2 was developed to provide additional turn lanes along these corridors.

### 3.3.2 TWO-WAY CONVERSION SCENARIO 2

Two-way Conversion Scenario 2 included the turn lanes and signal phasing and timing proposed in Scenario 1. Additionally, left-turn lanes are included on both corridors at Hill Street, St. Catherine Street, and Kentucky Street. 75-foot left-turn lanes are modeled on the northbound and southbound approaches

at Hill Street. 100-foot left-turn lanes are modeled on the northbound approaches at St. Catherine Street and southbound approaches at Kentucky Street.

As seen in the LOS maps in **Appendix C**, all the signalized intersections on both corridors are expected to operate at LOS C better during the AM and PM peak hours.

The delay and LOS for the approaches to the two-way stop-controlled intersections at Gaulbert Avenue and Burnett Avenue with Two-way Conversion Scenario 2 are shown in **Table 9**. The uncontrolled northbound and southbound approaches include all permissible movements since there is only one lane in each direction. The delays and LOS for the northbound and side street approaches at 3rd Street and Gaulbert Avenue are significantly improved over Scenario 1 due to the turn lanes at Hill Street. The side street approaches at 3rd Street and Gaulbert Avenue are expected to operate at LOS C.

**Table 9: Scenario 2 Two-way Stop Controlled Approach Level of Service**

| Intersection | Period | Northbound | | Southbound | | Eastbound | | Westbound | |
|---|---|---|---|---|---|---|---|---|---|
| | | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS |
| 2nd Street / Gaulbert Avenue | AM | 0.0 | A | 0.0 | A | 14.0 | B | | |
| | PM | 0.0 | A | 0.0 | A | 2.1 | A | | |
| 3rd Street / Gaulbert Avenue | AM | 0.1 | A | 0.0 | A | 5.4 | A | 6.0 | A |
| | PM | 3.4 | A | 0.0 | A | 22.8 | C | 23.0 | C |
| 3rd Street / Burnett Avenue | AM | 0.0 | A | 0.0 | A | | | 13.3 | B |
| | PM | 0.0 | A | 0.1 | A | | | 10.8 | B |

**Table 10** provides the cumulative segment statistics for each corridor and period by direction for Scenario 2. 3rd Street is expected to operate at LOS C in both directions during the AM peak hour and LOS D in both directions during the PM peak hour. 2nd Street is expected to operate at LOS D in the northbound direction and LOS C in the southbound direction during the AM peak hour and LOS C in both directions during the PM peak hour.

**Table 10: Scenario 2 Segment Statistics and Urban Street Level of Service**

| Direction | | | Northbound | | | | | Southbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | Route | Length (ft) | Avg. Vol. (veh) | Avg. Travel Time (sec) | Avg. Delay (sec/veh) | Avg. Speed (mph) | LOS | Avg. Vol. (veh) | Avg. Travel Time (sec) | Avg. Delay (sec/veh) | Avg. Speed (mph) | LOS |
| AM | 2nd | 8752 | 696 | 356.4 | 210.2 | 18.2 | D | 139 | 284.2 | 138.0 | 22.5 | C |
| | 3rd | 8644 | 393 | 301.0 | 156.8 | 21.7 | C | 258 | 262.4 | 118.2 | 22.9 | C |
| PM | 2nd | 8752 | 416 | 276.0 | 129.9 | 21.3 | C | 264 | 309.4 | 163.3 | 20.8 | C |
| | 3rd | 8644 | 246 | 436.7 | 292.5 | 19.9 | D | 764 | 340.0 | 195.8 | 17.8 | D |

## 3.4 Traffic Simulation Modeling Summary

Model output statistics for the existing conditions and the two-way conversion scenarios for both the AM and PM peak hours are summarized in the following tables for comparison. **Table 11** presents the average aggregate trip statistics for all trips simulated in the model for each scenario. Completed trips represent all trips that successfully arrived at their pre-established destination, whether that was an internal centroid representing internal trip destinations, or an external node, representing the edge of the

model area. Incomplete trips include trips still in transit or queued for entry into the network at the end of the simulation period. While some incomplete trips are unavoidable, queued trips generally reflect congested conditions limiting the ability of some trips to enter the network at their scheduled time. Incomplete trips were found in all scenarios but were less than 0.5% of total trips.

**Table 11. Aggregate Trip Statistics**

| | Completed Trips | Veh Miles Traveled (VMT) | Veh Hours Traveled (VHT) | Total Delay (hr) | Total Stopped Time (hr) | Total Num. Stops | Avg. Trip Length (mi) | Avg. Travel Time (min) | Avg. Speed (mph) |
|---|---|---|---|---|---|---|---|---|---|
| AM Existing | 11,641 | 6,587.7 | 336.6 | 174.4 | 86.8 | 15,475 | 0.6 | 1.7 | 21.6 |
| AM 2-Way Scenario 1 | 11,432 | 6,344.9 | 396.2 | 239.9 | 134.9 | 21,650 | 0.6 | 2.1 | 18.6 |
| AM 2-Way Scenario 2 | 11,562 | 6,525.3 | 368.8 | 208.5 | 106.4 | 19,121 | 0.6 | 1.9 | 19.6 |
| PM Existing | 13,883 | 8,057.2 | 472.1 | 270.6 | 145.7 | 23,089 | 0.6 | 2.0 | 19.2 |
| PM 2-Way Scenario 1 | 13,707 | 7,910.8 | 508.5 | 310.7 | 164.5 | 25,420 | 0.6 | 2.2 | 18.0 |
| PM 2-Way Scenario 2 | 13,743 | 7,963.8 | 485.1 | 286.6 | 149.5 | 24,327 | 0.6 | 2.1 | 18.5 |

Vehicle Miles Traveled (VMT) reflects only the mileage of trips that reach the network and is therefore best correlated with Completed Trips. The remainder of the aggregate trip statistics illustrate the travel time and delays associated with each scenario.

A summary of the delay and LOS for the approaches to the two-way stop-controlled intersections at Gaulbert Avenue and Burnett Avenue is shown in **Table 12**.

**Table 12: Scenario 2 Two-way Stop Controlled Approach Level of Service**

| Period | | AM | | | | | | | | PM | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intersection | Scenario | Northbound | | Southbound | | Eastbound | | Westbound | | Northbound | | Southbound | | Eastbound | | Westbound | |
| | | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS |
| 2nd Street / Gaulbert Avenue | Existing | 0.0 | A | | | 9.7 | A | | | 0.0 | A | | | 5.3 | A | | |
| | Two-Way Scenario 1 | 0.0 | A | 0.0 | A | 19.3 | C | | | 0.0 | A | 0.0 | A | 5.2 | A | | |
| | Two-Way Scenario 2 | 0.0 | A | 0.0 | A | 14.0 | B | | | 0.0 | A | 0.0 | A | 2.1 | A | | |
| 3rd Street / Gaulbert Avenue | Existing | | | 0.0 | A | 3.0 | A | 4.4 | A | | | 0.0 | A | 9.8 | A | 11.7 | B |
| | Two-Way Scenario 1 | 0.2 | A | 0.0 | A | 4.6 | A | 7.7 | A | 34.7 | D | 0.0 | A | 85.7 | F | 33.5 | D |
| | Two-Way Scenario 2 | 0.1 | A | 0.0 | A | 5.4 | A | 6.0 | A | 3.4 | A | 0.0 | A | 22.8 | C | 23.0 | C |
| 3rd Street / Burnett Avenue | Existing | | | 0.0 | A | | | 6.6 | A | | | 0.0 | A | | | 7.8 | A |
| | Two-Way Scenario 1 | 0.0 | A | 0.0 | A | | | 10.9 | B | 0.0 | A | 6.6 | A | | | 30.4 | D |
| | Two-Way Scenario 2 | 0.0 | A | 0.0 | A | | | 13.3 | B | 0.0 | A | 0.1 | A | | | 10.8 | B |

**Table 13** provides the cumulative segment statistics for each corridor and period by direction for each scenario. Volumes on 2nd Street decrease by approximately 240 vehicles during the AM peak hour with the conversion to two-way operation as traffic shifts over to northbound 3rd Street. During the PM peak hour volumes on both routes increase; 2nd Street increases by approximately 45 vehicles and 3rd Street increases by approximately 100 vehicles. Southbound traffic is being drawn from 4th Street.

As expected, delays and travel times increase and speeds decrease on 2nd Street and 3rd Street when they are converted from one-way to two-way operation due to increased intersection delays associate with more turning movements, friction from opposing traffic, and inability to pass slower moving vehicles.

During the AM peak hour northbound travel times on 2nd Street increase but the northbound travel times on 3rd Street are not significantly less than 2nd Street. Southbound travel times on 3rd Street stay consistent and southbound travel times on 2nd Street are about the same during the AM peak hour.

During the PM peak hour northbound travel times on 2nd Street decrease and are substantially better than northbound travel times on 3rd Street. Southbound travel times on 3rd Street increase and are slightly higher than the southbound travel times on 2nd Street. This seems logical with the termination of 2nd Street at Cardinal Boulevard and the additional travel time that would be required to get over to 3rd Street.

**Table 13. Segment Statistics and Urban Street LOS**

| | | | Direction | Northbound | | | | | Southbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | Route | Length (ft) | Scenario | Avg. Vol. (veh) | Avg. Travel Time (sec) | Avg. Delay (sec/veh) | Avg. Speed (mph) | LOS | Avg. Vol. (veh) | Avg. Travel Time (sec) | Avg. Delay (sec/veh) | Avg. Speed (mph) | LOS |
| AM Peak Hour | 2nd Street | 8752 | Existing | 1056 | 254.5 | 106.7 | 22 | C | N/A | N/A | N/A | N/A | N/A |
| | | | 2-Way Scenario 1 | 743 | 579.9 | 431.9 | 15.8 | E | 57 | 916.2 | 768.2 | 21.0 | C |
| | | | 2-Way Scenario 2 | 696 | 356.4 | 210.2 | 18.2 | D | 139 | 284.2 | 138.0 | 22.5 | C |
| | 3rd Street | 8644 | Existing | N/A | N/A | N/A | N/A | N/A | 363 | 262.6 | 115.8 | 23.5 | C |
| | | | 2-Way Scenario 1 | 266 | 304.5 | 158.6 | 23.5 | C | 308 | 265.9 | 120.0 | 23.7 | C |
| | | | 2-Way Scenario 2 | 393 | 301.0 | 156.8 | 21.7 | C | 258 | 262.4 | 118.2 | 22.9 | C |
| PM Peak Hour | 2nd Street | 8752 | Existing | 621 | 334.6 | 186.8 | 19.3 | D | N/A | N/A | N/A | N/A | N/A |
| | | | 2-Way Scenario 1 | 455 | 282.4 | 134.4 | 22 | C | 195 | 324.3 | 176.4 | 21.6 | C |
| | | | 2-Way Scenario 2 | 416 | 276.0 | 129.9 | 21.3 | C | 264 | 309.4 | 163.3 | 20.8 | C |
| | 3rd Street | 8644 | Existing | N/A | N/A | N/A | N/A | N/A | 865 | 276.1 | 129.4 | 22.2 | C |
| | | | 2-Way Scenario 1 | 158 | 856.5 | 710.5 | 15.5 | E | 765 | 377.0 | 231.1 | 17.1 | D |
| | | | 2-Way Scenario 2 | 246 | 436.7 | 292.5 | 19.9 | D | 764 | 340.0 | 195.8 | 17.8 | D |

Based on the results of this analysis, the two-way conversions of 2nd Street and 3rd Street should operate at acceptable levels with Two-way Conversion Scenario 2.

# 4 Implementation Plan

## 4.1 Design Concept

The two-way conversion of the 2nd Street and 3rd Street corridors between Cardinal Boulevard and Broadway presented in Scenario 2 can be completed within the existing curb limits. Traffic signals, roadway signs, and pavement markings will require removal, replacement, and/or modification for the conversion. The addition of turn lanes which are needed for acceptable operation will require the removal of some on-street parking spaces.

## 4.2 Impacts to Traffic Control Devices

### 4.2.1 Traffic Signals

The KYTC has requested complete rebuilds for all signals along the corridors. One exception may be considered for 3rd Street at Broadway which may only need the addition of a mast arm for the northbound approach. Another exception could also be made for 2nd Street at Broadway which may only need heads adjusted or exchanged.

Protective/permissive phasing for left-turns is recommended at the 2nd Street and 3rd Street intersections with Broadway and Cardinal Boulevard.

Consideration could be given to coordination of 2nd Street and 3rd Street instead of the east-west routes along these corridors. However, the signalized intersection spacing along the east-west routes in this area is shorter and more consistent than the signalized intersection spacing along 2nd Street and 3rd Street. This makes coordination more critical for queue storage and easier along the east-west routes.

### 4.2.2 Signs

The two-way conversion will require the removal of the north-south one-way and no-turn signs for the side streets at the intersections. The new direction on each route will require placement of parking restriction, snow emergency route, school crossing, and speed limit signs as well as one-way and no-left-turn signs at the intersecting one-way streets. No-right-turn-on-red restriction signs may also be needed where sight distance is obstructed as noted in the field inventory. Two school zone speed limit flashing assemblies and one static school zone speed limit sign will be required for southbound 2nd Street as well as end school zone signs. Additional signs which may be considered for the new direction on each route include block watch neighborhood and historic preservation district signs.

### 4.2.3 Pavement Markings

The centerline of each converted route will be a double yellow. Pedestrian crosswalks including enhanced crosswalks can remain unchanged with two-way operation on each route. With a few exceptions as noted in section 4.5.2, bike lane markings can also remain unchanged. Shared lane markings could be

considered on 2nd Street from Cardinal Boulevard to Oak Street. The turn lanes will include turn lane arrow markings.

## 4.3 Phasing and MOT Plan

The conversion to two-way operation could be coordinated with a resurfacing project to simplify the maintenance of traffic and revised pavement markings. Traffic signal and sign installation will need to be completed before the resurfacing and conversion to two-way operation can be completed. New signs and signal heads facing the new direction of travel shall remain covered until pavement resurfacing and marking are completed.

The maintenance of traffic (MOT) plan should be very similar to most resurfacing projects. Each phase of construction should be able to be completed with short-term lane closures which will not require long term detours. All vehicles parked on the left side of the one-way corridors will be required to be moved by owners prior to conversion since they would be facing the wrong direction after conversion to two-way. Any vehicles that are not moved by owners will need to be towed. During installation of the permanent yellow centerline marking, covers can be removed from new signs and signals and old signs, which are no longer applicable, can be removed or covered for removal later. Final marking of turn lanes, bike lanes, and crosswalks can complete the implementation. After conversion is complete, it is recommended that changeable message signs be installed at strategic locations to remind motorists who routinely traverse the corridor that the traffic pattern has changed. The changeable message signs should remain in place until such time that motorists become accustomed to the two-way operation.

## 4.4 Impacts to Parking

To accommodate the additional turn lanes, some on-street parking will need to be prohibited. On the 36-foot-wide sections of 2nd Steet, parking will be removed on both sides to accommodate three 12-foot lanes. On the 42-foot-wide sections of 2nd Street and 3rd Street, parking will be removed on both sides to accommodate three 12-foot lanes and a six-foot-wide bike lane. The length of the parking removal will include the length of the turn lane and a taper for the through lane shift to accommodate left-turn lanes. The Manual on Uniform Traffic Control Devices (MUTCD) recommends the taper length for lateral shifts for posted speeds less than 45 mph should be calculated according to the formula $L=WS^2/60$, where L = length of taper (ft), W = width of shift (ft), and S = speed limit (mph). With 12-foot-wide left-turn lanes, the width of the shift can be 6 feet for each direction of travel resulting in a taper length of 122.5 feet (rounded up to 125 feet). **Table 14** shows the parking impacts for each turn lane.

**Table 14: Turn Lane Impacts**

| Turn Lane | Parking Spaces | Current Usage | Off-street Alternatives |
|---|---|---|---|
| 300' NB left - 2nd at Broadway | 16 | Low | Lots east and west sides by permit |
| 100' SB left - 2nd at Kentucky | 16 | Moderate | Alley west side, Lots east side |
| 100' NB left - 2nd at St. Catherine | 19 | High | Alley east side, Lot west side |
| 75' SB left - 2nd at Hill | 20 | High | Alleys east and west sides |
| 75' NB left - 2nd at Hill | 12 | Low | Alley west side, Lot east side |
| 125' SB left and right - 2nd at Cardinal | 19 | High | Alley west side by permit, duPont HS permit |
| | | | |
| 150' NB left and right - 3rd at Broadway | 15 | Moderate | Public parking west side |
| 100' SB left - 3rd at Kentucky | 8 | Moderate | Lots east and west sides |
| 100' NB right - 3rd at Kentucky | 3 | Moderate | Alleys east and west sides, Lots by permit |
| 100' NB left - 3rd at St. Catherine | 19 | Moderate | Alleys east and west sides |
| 75' SB left - 3rd at Hill | 17 | High | Alleys east and west sides |
| 75' NB left - 3rd at Hill | 20 | High | Alleys east and west sides |
| 125' SB left - 3rd at Cardinal | 19 | High | Alleys/Lots east and west side by permit |
| 125' NB left - 3rd at Cardinal | 15 | High | UL parking |

## 4.5 Multi-modal Impacts

### 4.5.1 Ped Crossings

Except for vehicular traffic approaching from additional directions, pedestrian crossings will not be affected. Assuming the conversion to two-way operation is completed with a resurfacing project, sidewalk ramp replacements on 3rd Street to meet ADA guidelines should be included, which is standard practice for resurfacing projects.

### 4.5.2 Bike Routes

As long as parking is restricted on both sides of the 42-foot wide roadways where turn lanes are added, bike lanes can be accommodated. If parking is only restricted on one side, bike lanes would have to be ended and resumed on the other side of the intersection. Shared lane marking can be considered along 2nd Street where it is not wide enough to accommodate a bike lane.

### 4.5.3 Transit

Converting 2nd Street and 3rd Street to two-way operation would allow TARC to revise routes to keep the 2nd Street route on 2nd Street in both directions or convert it to a 3rd Street route with both directions on 3rd Street. This would include the electric bus charging station south of York Street. Regardless of the route, opposing traffic will make passing a stopped bus more difficult. TARC stops with frequent usage may require removal of on-street parking to accommodate bus loading zones.

## 4.6 Policy Changes

There may be policy changes necessary for the conversion of 2nd Street and 3rd Street to two-way operation. State and local officials will determine what, if any, steps are warranted for approval. This may include transferring ownership and maintenance responsibilities for one of the two routes from KYTC to Louisville Metro.

The additional direction of traffic will make enforcement of parking restrictions even more critical. Current Louisville Metro ordinance prohibits vehicles from parking within 30 feet of an intersection to accommodate the turning radius of larger vehicles and to ensure adequate sight distance.

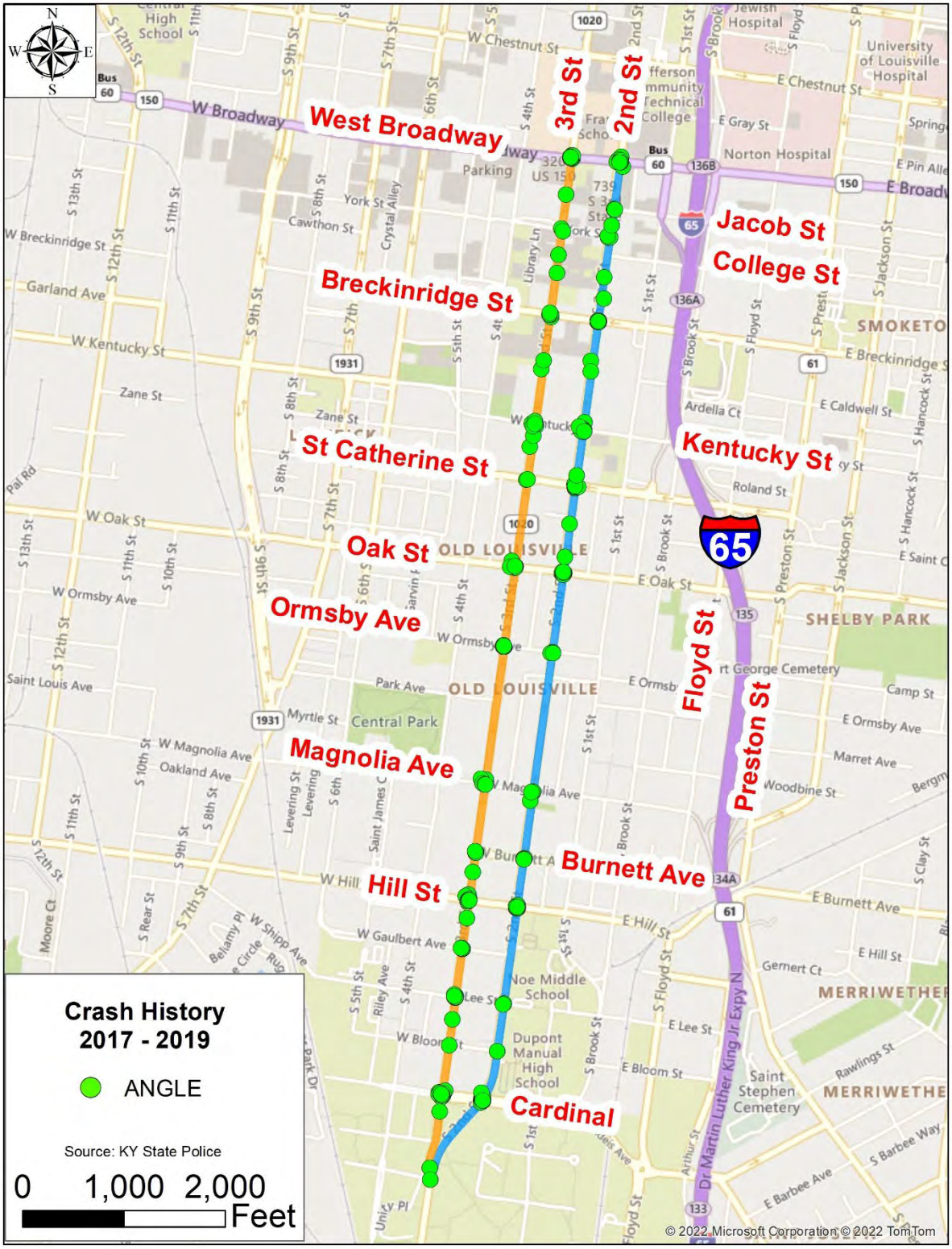
# 5 Opinion of Probable Cost Estimate

The opinion of probable cost estimate shown in **Table 15** is based on experience with similar projects or project components, estimated planning level quantities, and average unit bid prices from KYTC. The traffic signals on both corridors are assumed to be completely rebuilt with mast arms except for the decorative signals on Broadway which are assumed to be modified as noted in section 4.2.1. Signing includes removal of signs which are no longer applicable or facing the wrong direction and replacement with new signs as needed and discussed in section 4.2.2. Signing also includes two school zone flashing beacons for southbound 2nd Street. Marking includes double yellow centerline striping for both corridors, bike lane and shared lane markings, turn lane arrows, and intersection markings discussed in section 4.2.3. Resurfacing includes milling and texturing and new asphalt surface. Pavement repairs including full depth removal and replacement are typically needed in multiple locations on resurfacing projects and can constitute a significant portion of the paving budget. Sidewalk ramps include removal and replacement of existing sidewalk ramps and curb with new ADA compliant ramps with detectable warnings. A 30 percent contingency is included in this planning level estimate.

**Table 15: Opinion of Probable Cost Estimate**

| Item | Estimated Cost |
|---|---|
| Signals | $ 3,360,000.00 |
| Signal Modification | $ 50,000.00 |
| Signing | $ 124,000.00 |
| Marking | $ 222,000.00 |
| Re-surfacing | $ 743,000.00 |
| Pavement Repairs | $ 400,000.00 |
| Sidewalk Ramps | $ 176,800.00 |
| 30% Contingency | $ 1,530,000.00 |
| | $ 6,605,800.00 |

# Appendix A: Crash Maps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Magnolia Ave
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Crash History
2017 - 2019
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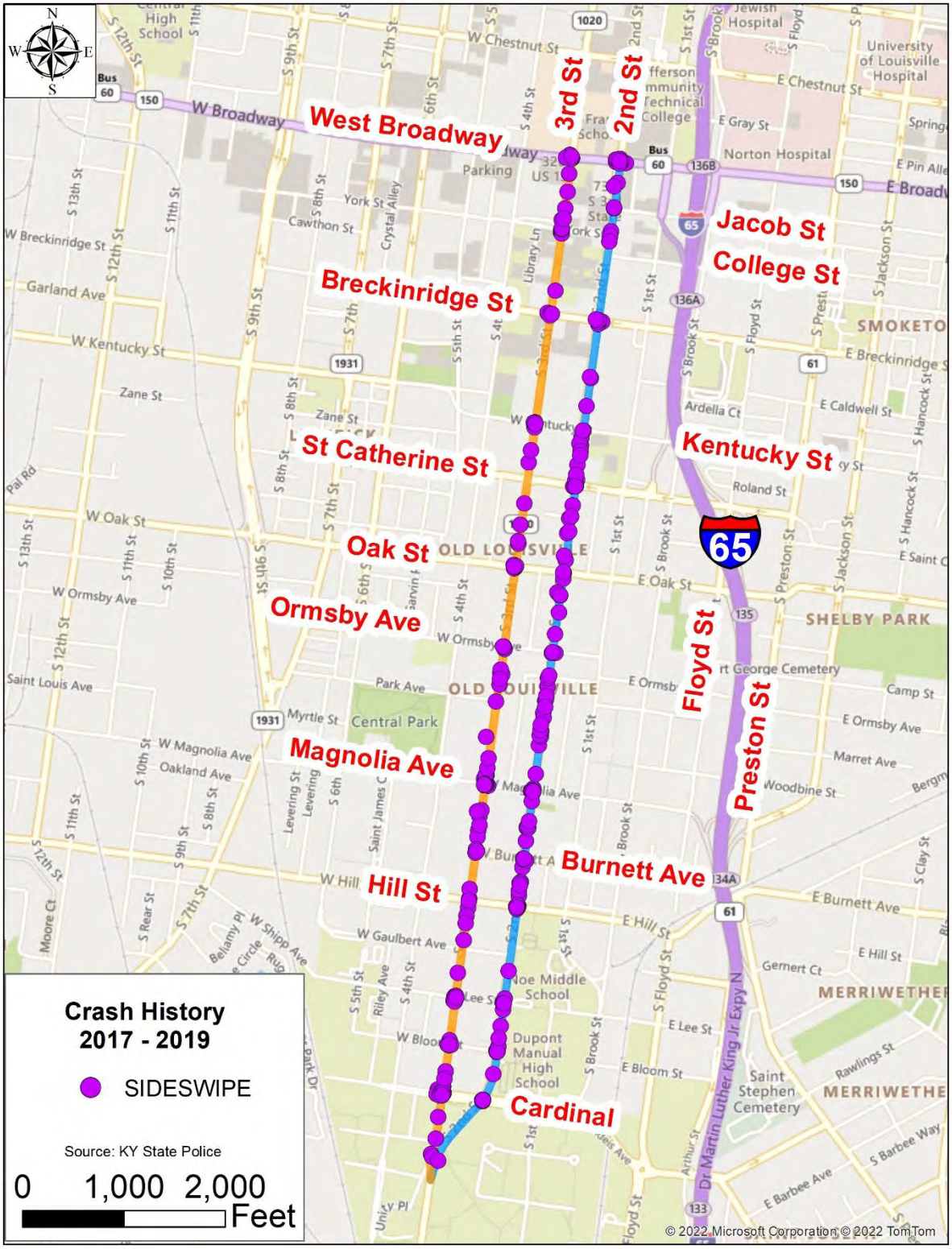
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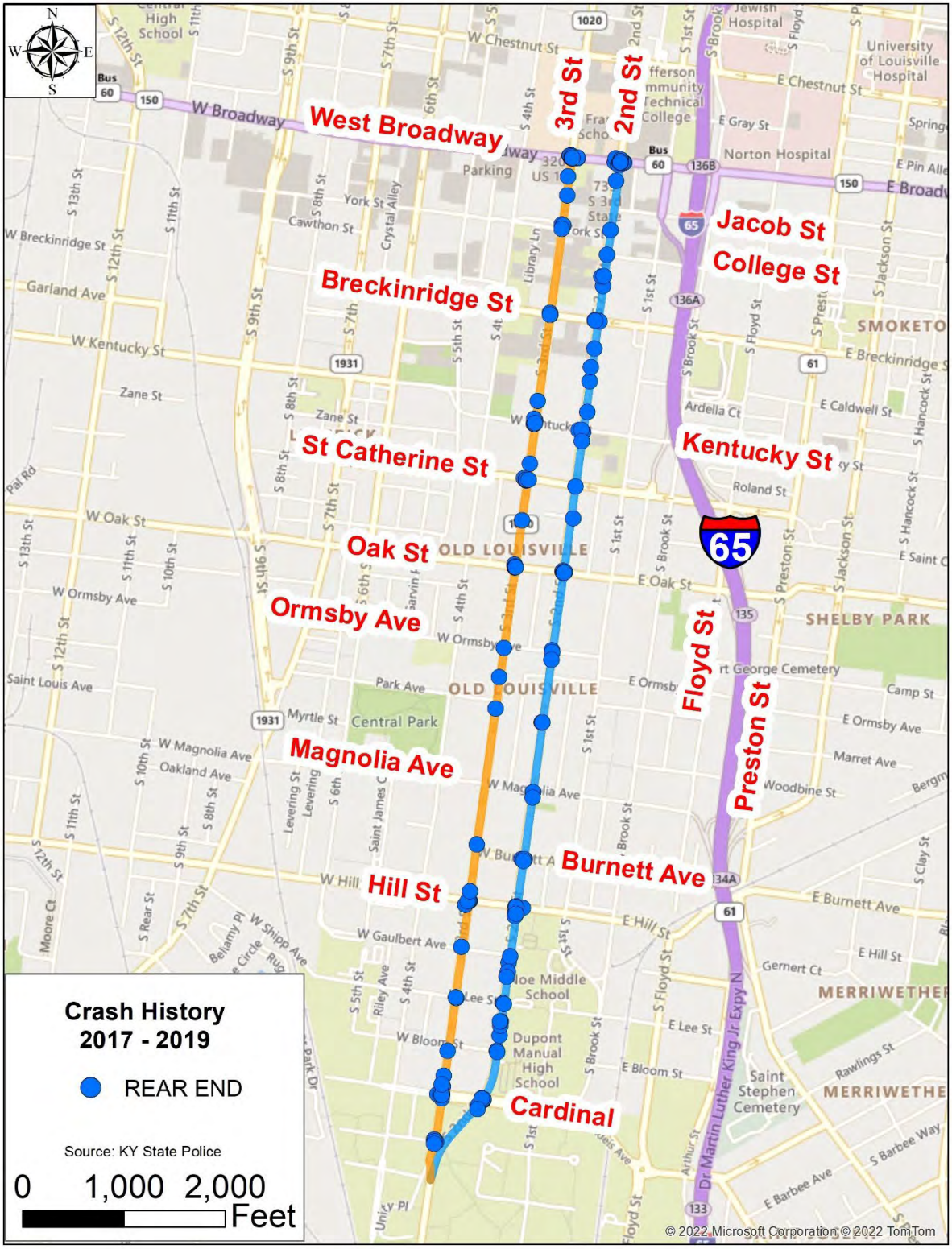
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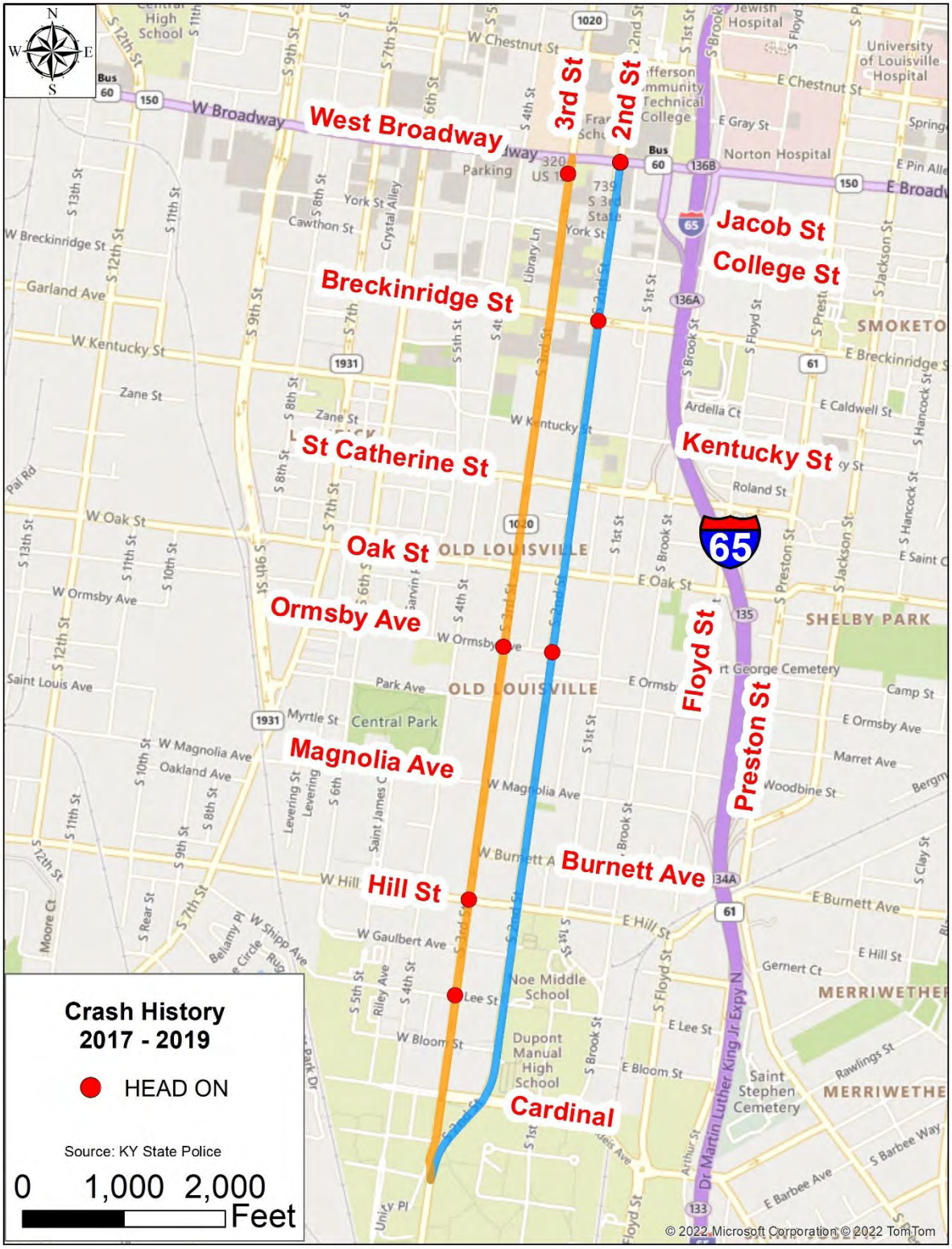
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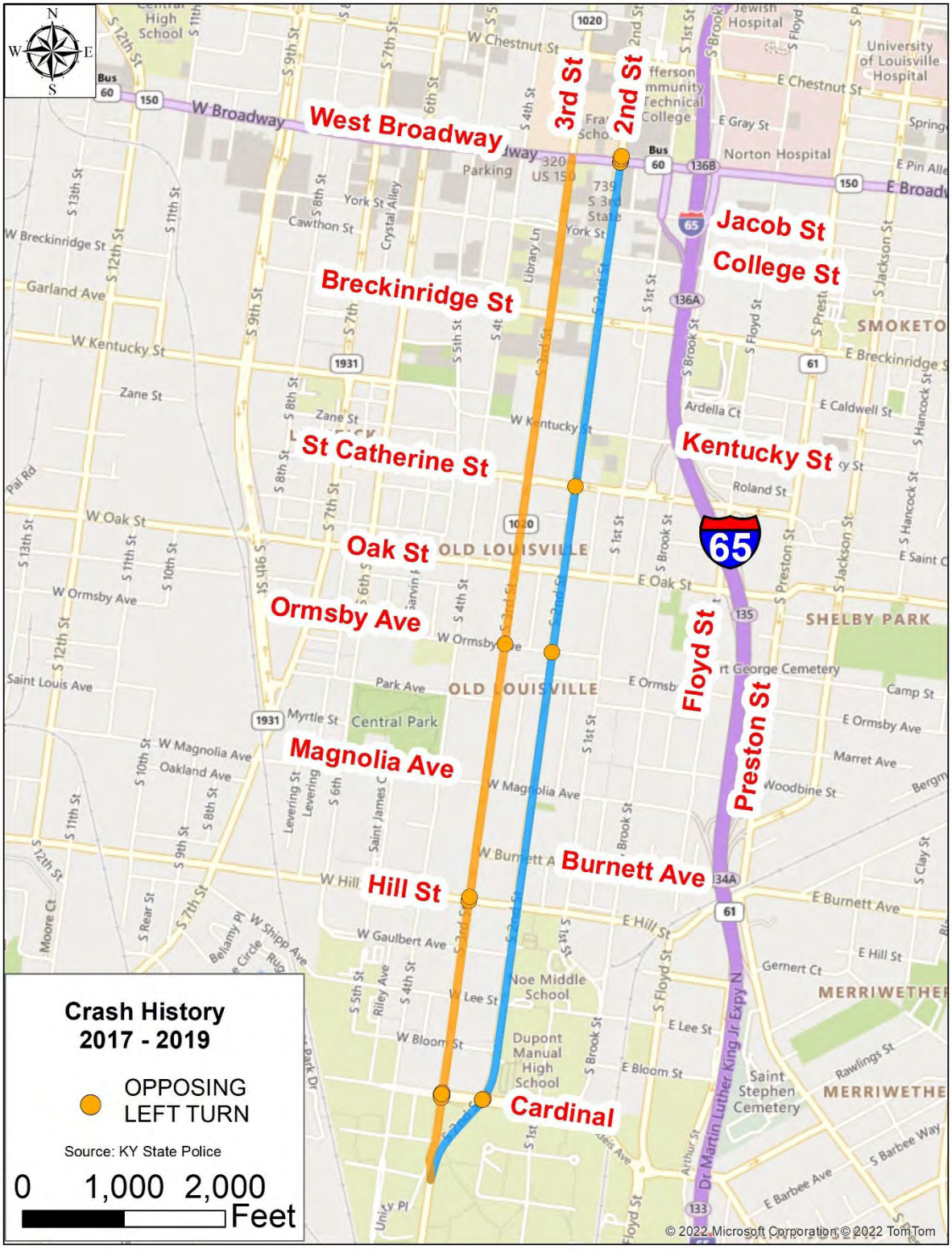
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Burnett Ave
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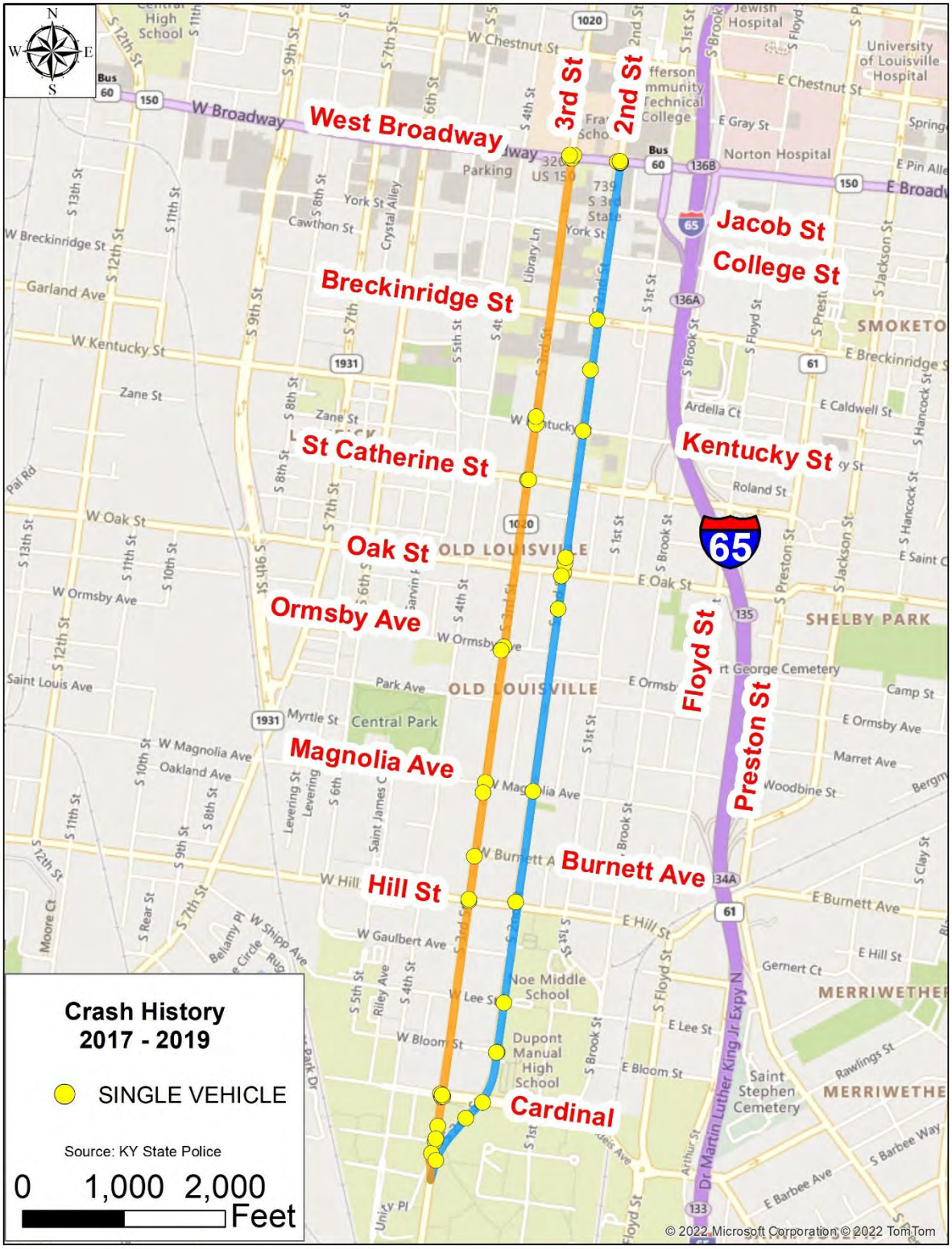
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Crash History
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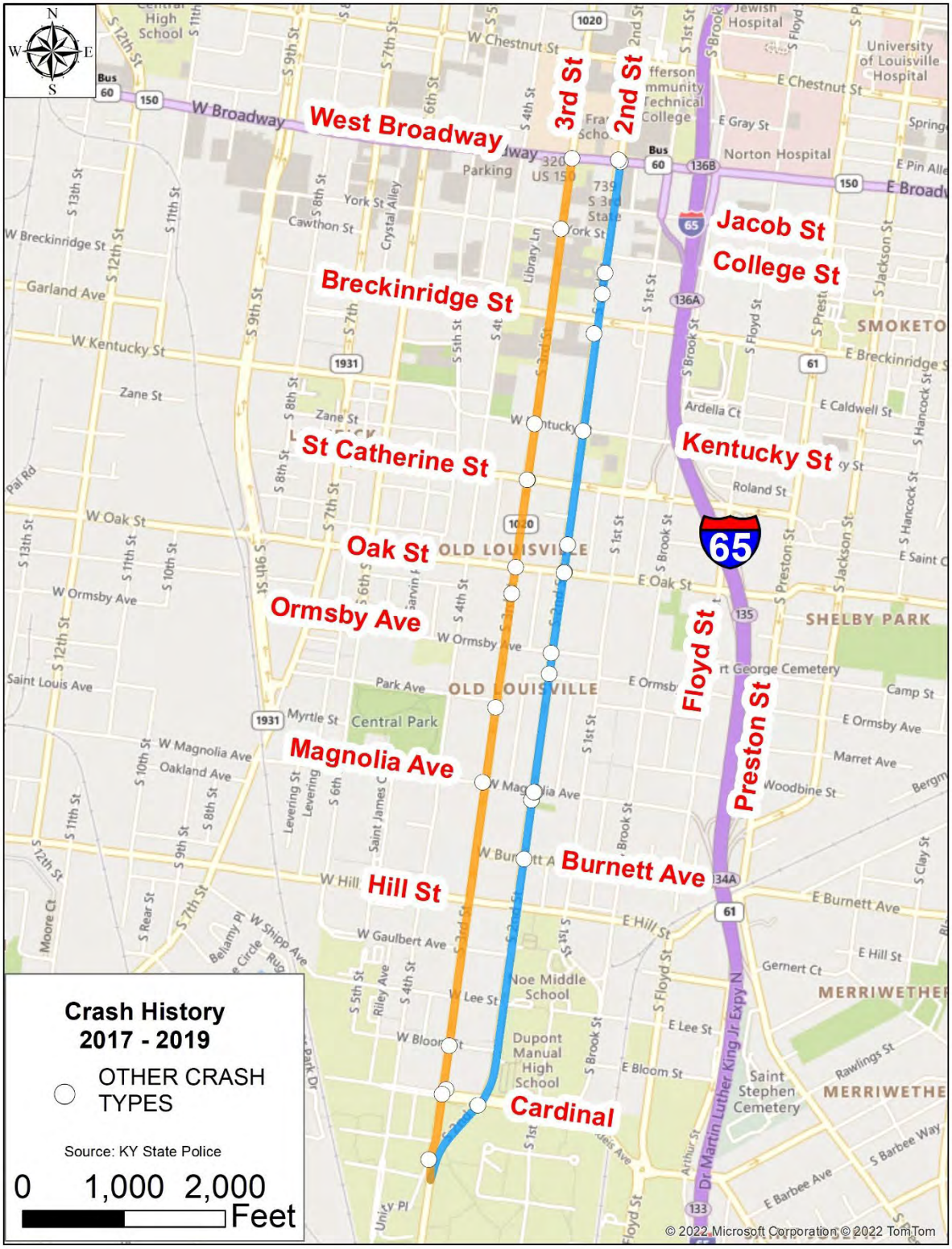
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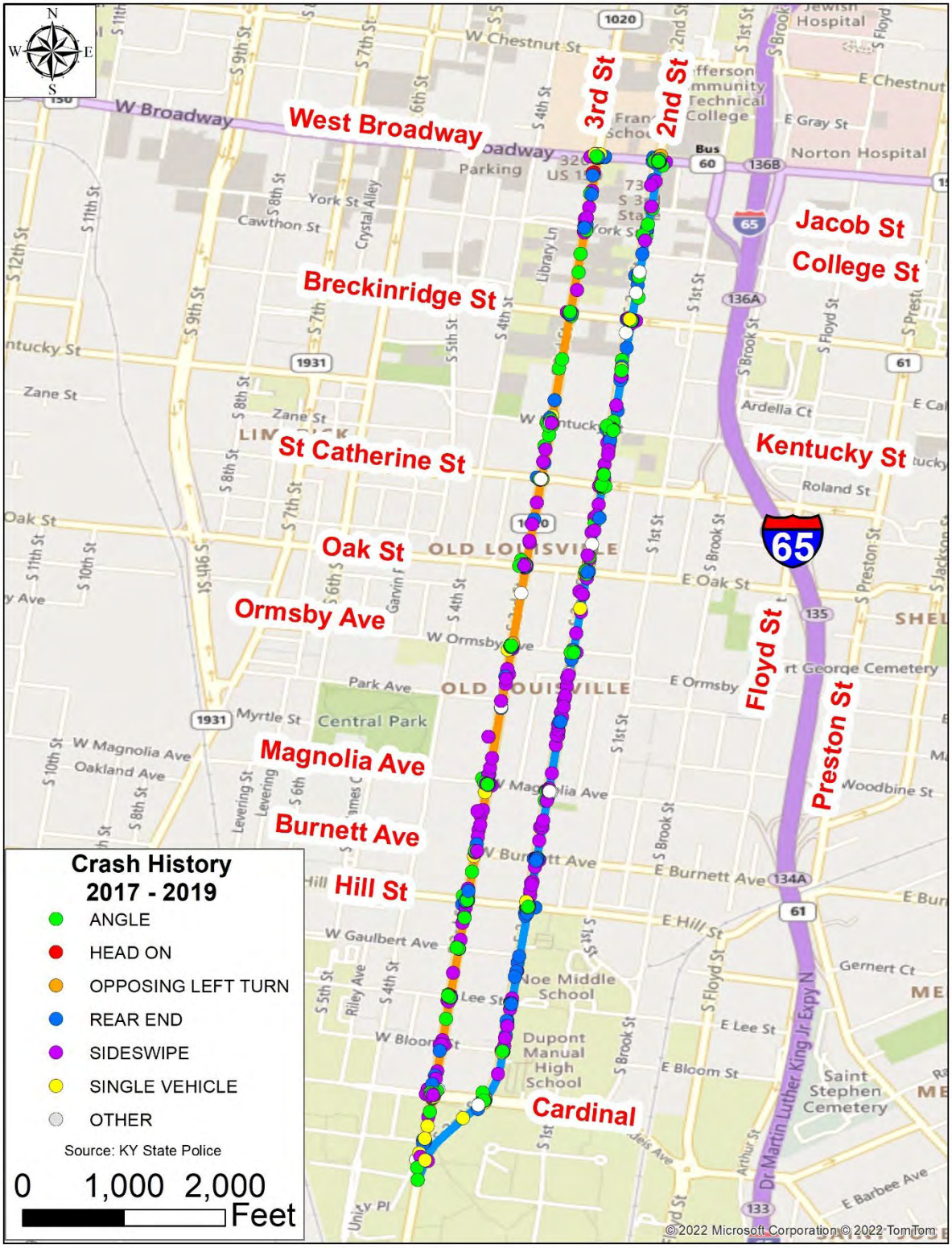
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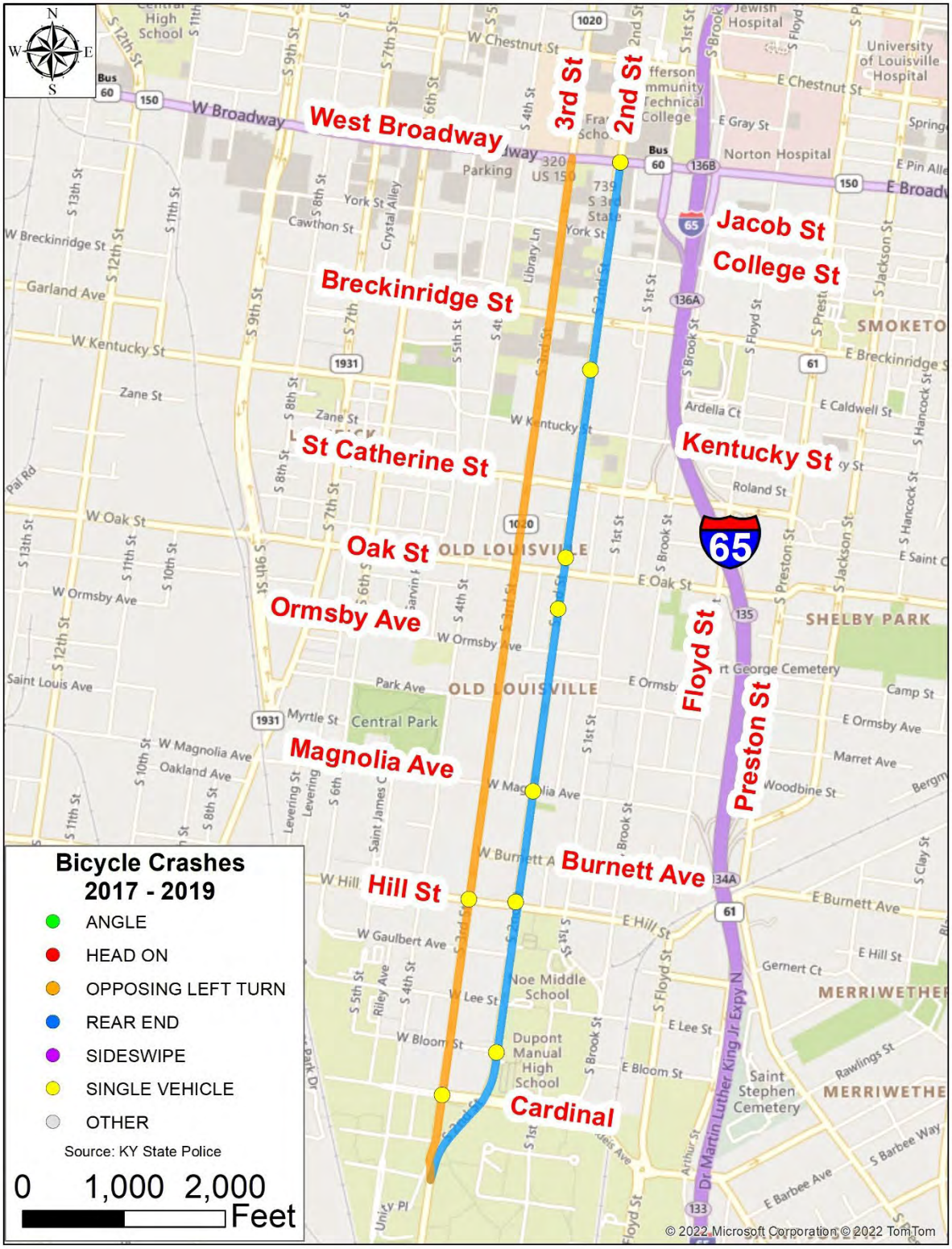
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West Broadway
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Pedestrian Crashes
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SINGLE VEHICLE
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# Appendix B: Field Inventory

| 2nd Street | Unity-Brandeis | Brandeis-Cardinal | Cardinal-Bloom | Bloom-Lee | Lee-Gaulbert | Gaulbert-Hill |
|---|---|---|---|---|---|---|
| **Roadway geometrics** | | | | | | |
| **Width** | 28 | 28 | 36 | 36 | 36 | 36 |
| **Curb bumpouts** | No | No | No | No | No | No |
| **Parking** | No | No | Permit west, 2 Hr Limit East | Permit west, 2 Hr Limit East | Permit west, 2 Hr Limit East | Permit west, 2 Hr Limit East |
| **Topographic features** | | | | | | |
| **Sight distance obs.** | | | Curve on 2nd | NW | | |
| **Other** | | | | | | |
| **Traffic signal infrastructure** | | Ped signal | | | | |
| **Arms or Span** | N/A | Arms | Arms | Bloom Stop | Arms | Gaulbert Stop |
| **Turn signals** | N/A | N/A | No | N/A | No | N/A |
| **Ped detection** | N/A | Audible | Audible | N/A | No | N/A |
| **Ped signals** | N/A | Yes | Yes | N/A | Yes | N/A |
| **Pavement markings** | | | | | | |
| **Parking lane marking** | N/A | N/A | No | No | No | No |
| **Turn lanes** | No | N/A | NB Rt, EB Lt | No | No | No |
| **Crosswalk** | N/A | Brick pavers | Enhanced | No | Yes | No |
| **Hatch** | No | No | No | No | No | No |
| **Existing signing** | | | | | | |
| **Regulatory** | No Left Turn NB | 25 MPH School Zone Flasher | No Turn on Red WB,<br>No parking 8-6 w/o permit | 35 MPH | No Turn on Red NB,<br>25 MPH School Zone Flasher,<br>No Trucks on Lee EB and WB | |
| **Warning** | Crosswalk | | | | Adv School | |
| **Guidance** | | | | | | |
| **Service** | | | | | | |
| **Pedestrian accomodations** | | | | | | |
| **ADA ramps** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Sidewalk width** | 6' East with buffer in front of Speed Museum | 8' East, 5' West with buffer | 8' with 4' buffer East and West | 8' with 4' buffer East and West | 5' with 7' buffer West,<br>7' with 5' buffer East | 6' with 6' buffer East and West |
| **Bicycle accomodations** | | | | | | |
| **Bike lanes** | No | No | No | No | No | No |
| **Sharrows** | No | No | No | No | No | No |
| **Bike racks** | No | Rental | No | No | No | No |
| **Transit accomodations** | | | | | | |
| **Bus route** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Bus shelter** | Yes | No | No | No | No | No |
| **Bus stop** | Yes | No | Yes | Yes | No | No |
| **Major drainage** | | | | | | |
| **Curb box inlets** | Corners and midblock | Corners and midblock | Corners and midblock | Corners and midblock | Corners and midblock | Corners |
| **Major utilities** | | | | | | |
| **Overhead / Poles** | No | No | No | No | No | No |
| **Hydrants** | No | No | East | East | East | East |

| 2nd Street | Hill-Burnett | Burnett-Magnolia | Magnolia-Ormsby | Ormsby-Oak | Oak-Catherine (WB) | St Catherine (WB)-Kentucky (EB) |
|---|---|---|---|---|---|---|
| **Roadway geometrics** | | | | | | |
| **Width** | 36 | 36 | 36 | 36 | 42 | 42 |
| **Curb bumpouts** | No | No | No | No | No | No |
| **Parking** | Unmetered | Unmetered | Unmetered | Unmetered | Unmetered | Unmetered |
| **Topographic features** | | | | | | |
| **Sight distance obs.** | NW | | NW | NW | NE, SE, SW | NE, SE |
| **Other** | | | | | | |
| **Traffic signal infrastructure** | | | | | | |
| **Arms or Span** | Diagonal | Diagonal | Diagonal | Diagonal | Diagonal | Diagonal |
| **Turn signals** | No | No | No | No | No | No |
| **Ped detection** | No | No | No | No | Audible | No |
| **Ped signals** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Pavement markings** | | | | | | |
| **Parking lane marking** | No | No | No | No | No | No |
| **Turn lanes** | No | No | No | No | No | WB Rt |
| **Crosswalk** | Yes | Yes | Yes | Yes | Enhanced | Yes |
| **Hatch** | No | No | No | No | No | No |
| **Existing signing** | | | | | | |
| **Regulatory** | 35 MPH,<br>No Turn on Red WB | | 35 MPH | | No Turn on Red NB and WB,<br>25 MPH School Zone (static),<br>School Crossing at St Catherine | No Turn on Red NB |
| **Warning** | | | | | | |
| **Guidance** | | | | | | |
| **Service** | Handicap On-Street | | | | | |
| **Pedestrian accomodations** | | | | | | |
| **ADA ramps** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Sidewalk width** | 8' with 4' buffer East and West | 8' with 4' buffer East and West | 8' with 4' buffer East and West | 8' with 4' buffer East and West | 8' West, 8' East | 8' West, 8' East |
| **Bicycle accomodations** | | | | | | |
| **Bike lanes** | No | No | No | No | Yes | Yes |
| **Sharrows** | No | No | No | No | No | No |
| **Bike racks** | No | No | No | No | No | Yes |
| **Transit accomodations** | | | | | | |
| **Bus route** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Bus shelter** | No | No | No | No | No | No |
| **Bus stop** | No | Yes | Yes | Yes | No | Yes |
| **Major drainage** | | | | | | |
| **Curb box inlets** | Corners | Corners and midblock | Corners and midblock | Corners and midblock | Corners | Corners |
| **Major utilities** | | | | | | |
| **Overhead / Poles** | East | East | East | East | East | East |
| **Hydrants** | No | East | East | East | East | East |

| 2nd Street | Kentucky (EB)-Breckinridge (WB) | Breckinridge (WB)-York | York-Broadway | Broadway |
|---|---|---|---|---|
| **Roadway geometrics** | | | | |
| **Width** | 42 | 42 | 42 @ Jacob, 50 at Broadway | 52 |
| **Curb bumpouts** | No | No | No | No |
| **Parking** | Unmetered | Unmetered | Metered | No |
| **Topographic features** | | | | |
| **Sight distance obs.** | SE | | NW | |
| **Other** | | Stop on College | | |
| **Traffic signal infrastructure** | | | Heads facing non existent WB approach | |
| **Arms or Span** | Diagonal | Box | Arms (old) | Arms |
| **Turn signals** | No | No | No | NB Lt and SB Lt Prot/Perm, EB Lt Protected Lagging, WB Lt Prohibited (keep) |
| **Ped detection** | No | No | No | Audible |
| **Ped signals** | Yes | Yes | Yes | Yes |
| **Pavement markings** | | | | |
| **Parking lane marking** | No | No | Yes | No |
| **Turn lanes** | NB Rt, EB Lt | No | No | NB Rt, NB Lt, SB Rt, SB Lt |
| **Crosswalk** | Yes | Yes | Across 2nd St | Enhanced |
| **Hatch** | No | No | No | No |
| **Existing signing** | | | | |
| **Regulatory** | End School Zone, 35 MPH | | | No Left Turn WB, 25 MPH |
| **Warning** | | | Two Way Traffic Ahead | |
| **Guidance** | | | To South 65 right on Jacob | |
| **Service** | | Hanicap On-street | | |
| **Pedestrian accomodations** | | | | |
| **ADA ramps** | Yes | Yes | Yes | Yes |
| **Sidewalk width** | 8' with planters East and West | 8' with planters East and West | 8' with planters East and West | 8' with planters East and West |
| **Bicycle accomodations** | | | | |
| **Bike lanes** | Yes | Ending | No | No |
| **Sharrows** | No | No | No | No |
| **Bike racks** | No | No | No | On Broadway |
| **Transit accomodations** | | | | |
| **Bus route** | Yes | Yes | Yes | Yes |
| **Bus shelter** | No | No | No | No |
| **Bus stop** | Yes | No | Yes | No |
| **Major drainage** | | | | |
| **Curb box inlets** | Corners and midblock | Corners and midblock | Corners and midblock | Corners and midblock |
| **Major utilities** | | | | |
| **Overhead / Poles** | East | East | East | No |
| **Hydrants** | East | East | East | West |

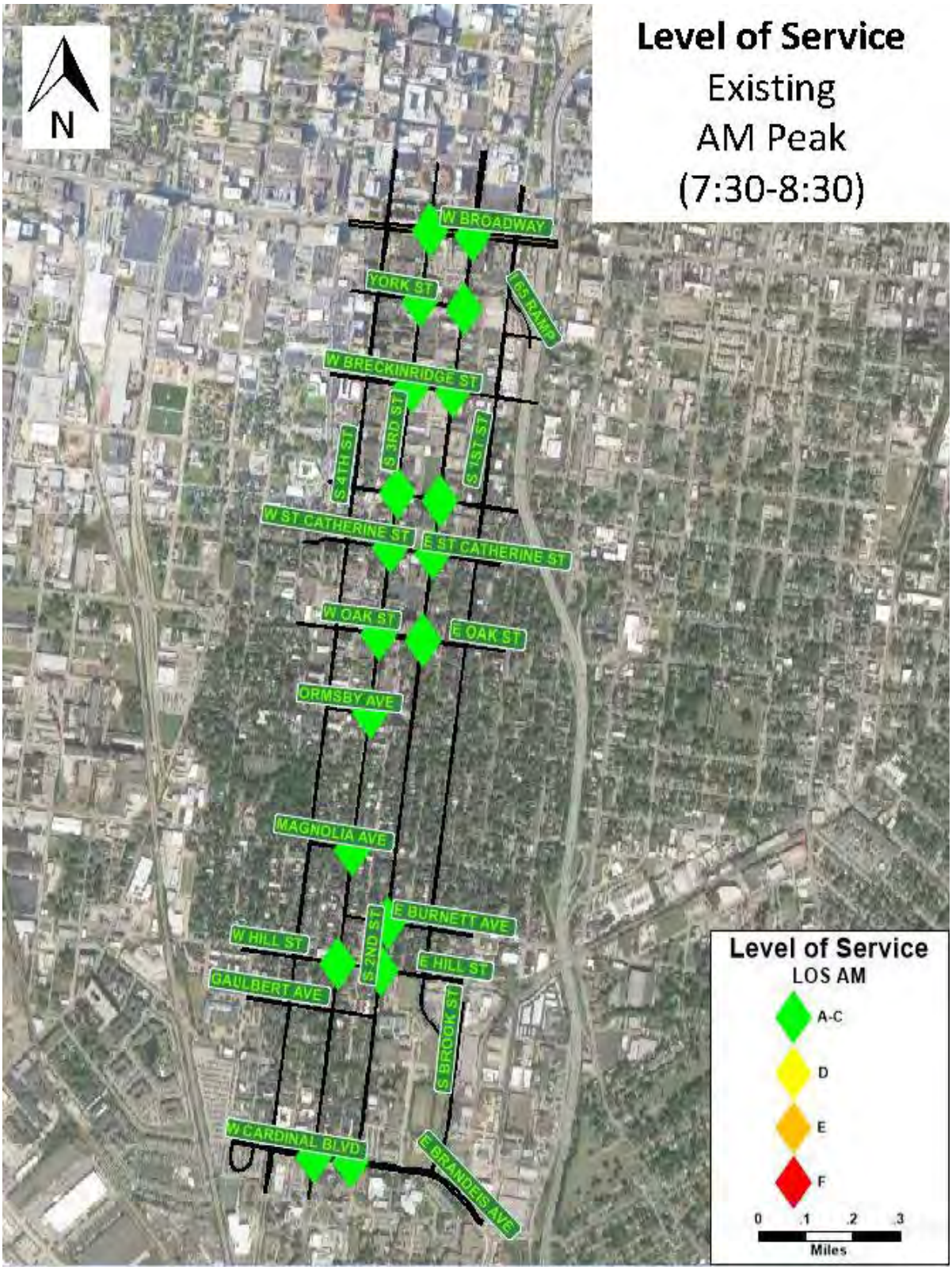
| 3rd Street | | Broadway-York | York-Breckinridge (WB) | Breckinridge (WB)-Kentucky (EB) | Kentucky (EB)-<br>St Catherine (WB) | St Catherine (WB)-Oak | Oak-Ormsby |
|---|---|---|---|---|---|---|---|
| Roadway geometrics | | | | | | | |
| | Width | 42 | 42 | 42 | 42 | 42 | 42 |
| | Curb bumpouts | No | No | No | No | At Oak west side | No |
| | Parking | Metered | Metered (south of bus on west) | Metered (south of Spalding) | Unmetered | Unmetered | Metered and Unmetered |
| Topographic features | | | | | | | |
| | Sight distance obs. | NE, NW, SE | SE | NE, NW, SE | NE, NW, SE | SW, SE | |
| | Other | | West approach divided | | | | |
| Traffic signal infrastructure | | Rebuild or add NB arm? | | | | | |
| | Arms or Span | Arms | Arms (old) | Diagonal | Box | Diagonal | Diagonal |
| | Turn signals | WB Lt Protected Lagging, EB Lt Prohibited | No | No | No | No | No |
| | Ped detection | Audible | No | No | No | No | Audible |
| | Ped signals | Yes | Audible | Yes | Yes | Yes | Yes |
| Pavement markings | | | | | | | |
| | Parking lane marking | No | No | No | No | No | No |
| | Turn lanes | SB Rt (2018), SB Lt | No | WB Lt | No | WB Lt | No |
| | Crosswalk | Enhanced | Yes | Yes | Enhanced | Yes | Enhanced |
| | Hatch | No | No | No | No | No | No |
| Existing signing | | | | | | | |
| | Regulatory | | 35 MPH | | | | |
| | Warning | | | | | | |
| | Guidance | | | | | | |
| | Service | Handicap On-street | | | | | |
| Pedestrian accomodations | | | | | | | |
| | ADA ramps | Yes | NW, SW | Yes | SW only | No | NW, SW |
| | Sidewalk width | 8' East, 8' West | 8' East, 8' West | 8' East, 8' West, 10' West at Spalding | 10' with 18' buffer East and West | 10' with 18' buffer East and West | 10' with 18' buffer East and West |
| Bicycle accomodations | | | | | | | |
| | Bike lanes | Yes | South of bus stop | Yes | Yes | Yes | Yes |
| | Sharrows | No | No | No | No | No | No |
| | Bike racks | SE | No | No | No | No | No |
| Transit accomodations | | | | | | | |
| | Bus route | No | No | No | No | No | No |
| | Bus shelter | On Broadway NE, SE | No | No | No | No | No |
| | Bus stop | No | Electric Bus Charging Station | No | No | No | No |
| Major drainage | | | | | | | |
| | Curb box inlets | Corners and midblock | None south of York | Corners and midblock | Corners and midblock | Corners | Corners and midblock |
| Major utilities | | | | | | | |
| | Overhead / Poles | No | West | West | West | West | West |
| | Hydrants | West | West | West | East | East | West |

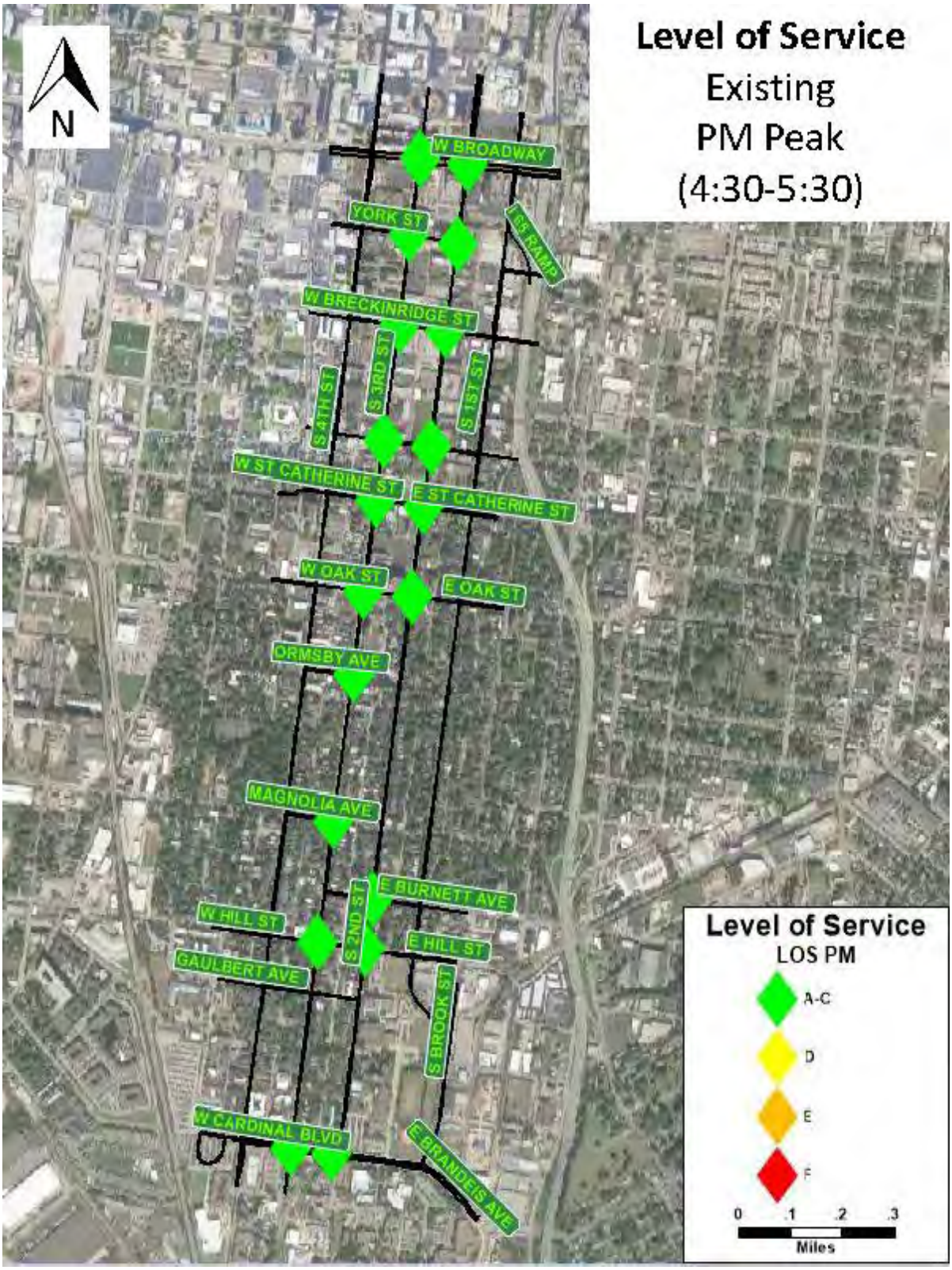
| 3rd Street | | Ormsby-Magnolia | Magnolia-Burnett | Burnett-Hill | Hill-Gaulbert | Gaulbert-Lee | Lee-Bloom |
|---|---|---|---|---|---|---|---|
| Roadway geometrics | | | | | | | |
| | Width | 42 | 42 | 42 | 42 | 42 | 42 |
| | Curb bumpouts | No | No | No | No | No | No |
| | Parking | Unmetered | Unmetered | Unmetered | Unmetered | Unmetered | Unmetered |
| Topographic features | | | | | | | |
| | Sight distance obs. | | | Need parking restriction NB approach | | SE, Need parking restriction NB approach | |
| | Other | Stop sign on Park Ave | Magnolia offset | | | | |
| Traffic signal infrastructure | | | | | | | |
| | Arms or Span | Diagonal | Box | Burnett Stop | Box | Gaulbert Stop | Arms |
| | Turn signals | No | No | N/A | No | N/A | No |
| | Ped detection | No | No | N/A | No | N/A | No |
| | Ped signals | Yes | Yes | N/A | Yes | N/A | Yes |
| Pavement markings | | | | | | | |
| | Parking lane marking | No | No | No | No | No | No |
| | Turn lanes | No | No | No | Not marked (see sign below)? | No | No |
| | Crosswalk | Yes | Yes | No | Yes | Across Gaulbert, not 3rd | Yes |
| | Hatch | No | No | No | No | No | No |
| Existing signing | | | | | | | |
| | Regulatory | | | | Right Lane Must Turn Right SB?, No Turn on Red SB | No parking 8-4 w/o permit | 35 MPH, No parking 8-4 w/o permit, No Trucks WB Lee |
| | Warning | | | Adv School | | | |
| | Guidance | | | | | | |
| | Service | | | | | | |
| Pedestrian accomodations | | | | | | | |
| | ADA ramps | No | Partial NE, SE | NE, SE | Yes | No | No |
| | Sidewalk width | 10' with 18' buffer East and West | 10' with 18' buffer East and West | 6' with 19' buffer East, 10' with 18' buffer West | 6' with 19' buffer East, 10' with 18' buffer West | 8-10' with 18-20' buffer East and West | 8-10' with 18-20' buffer East and West |
| Bicycle accomodations | | | | | | | |
| | Bike lanes | Yes | Yes | Yes | Yes | Yes | Yes |
| | Sharrows | No | No | No | No | No | No |
| | Bike racks | No | No | No | NW on Hill | No | No |
| Transit accomodations | | | | | | | |
| | Bus route | No | No | No | No | Yes | Yes |
| | Bus shelter | No | No | No | No | No | No |
| | Bus stop | No | No | No | No | Yes | No |
| Major drainage | | | | | | | |
| | Curb box inlets | Corners and midblock | Corners and midblock | Corners | Corners and midblock | Corners and midblock | Corners and midblock |
| Major utilities | | | | | | | |
| | Overhead / Poles | West | West | West | West | West | West |
| | Hydrants | West | West | No | No | West | West |

| 3rd Street | | Bloom-Cardinal | Cardinal-Brandeis | Brandeis-Unity | Unity |
|---|---|---|---|---|---|
| **Roadway geometrics** | | | | | |
| | **Width** | 42 | 42 | Varies | 42 |
| | **Curb bumpouts** | No | No | No | No |
| | **Parking** | Unmetered | Metered | No | No |
| **Topographic features** | | | | | |
| | **Sight distance obs.** | Need parking restriction NB approach | NW | SW | |
| | **Other** | | | | |
| **Traffic signal infrastructure** | | | | | |
| | **Arms or Span** | Bloom Stop | Arms | Arms | N/A |
| | **Turn signals** | N/A | No | No | N/A |
| | **Ped detection** | N/A | No | Audible | N/A |
| | **Ped signals** | N/A | Yes | Yes | N/A |
| **Pavement markings** | | | | | |
| | **Parking lane marking** | No | Yes | N/A | N/A |
| | **Turn lanes** | No | SB Rt, WB Lt | SB Lt to Speed Museum | No |
| | **Crosswalk** | No | Enhanced | Brick pavers | N/A |
| | **Hatch** | No | No Parking at Brandeis | Channelizing at Unity | No |
| **Existing signing** | | | | | |
| | **Regulatory** | No parking 8-6 w/o permit | 35 MPH,<br>Not Turn on Red EB | No Turn on Red EB and SB,<br>No Right Turn SB? | No Left Turn NB |
| | **Warning** | Adv School | | | Adv Ped |
| | **Guidance** | | | | |
| | **Service** | | | | |
| **Pedestrian accomodations** | | | | | |
| | **ADA ramps** | No | Yes | Yes | N/A |
| | **Sidewalk width** | 8-10' with 18-20' buffer East and West | 10' with 18' buffer East and West | 7' West | 6' with buffer East and West |
| **Bicycle accomodations** | | | | | |
| | **Bike lanes** | Yes | Yes | No | No |
| | **Sharrows** | No | No | No | No |
| | **Bike racks** | No | At Cardinal | Rental | No |
| **Transit accomodations** | | | | | |
| | **Bus route** | Yes | Yes | Yes | Yes |
| | **Bus shelter** | No | No | No | No |
| | **Bus stop** | Yes | No | Yes | No |
| **Major drainage** | | | | | |
| | **Curb box inlets** | Corners and midblock | Corners | Corners and midblock | Corners and midblock |
| **Major utilities** | | | | | |
| | **Overhead / Poles** | West | West | No | No |
| | **Hydrants** | West | West | West | West |

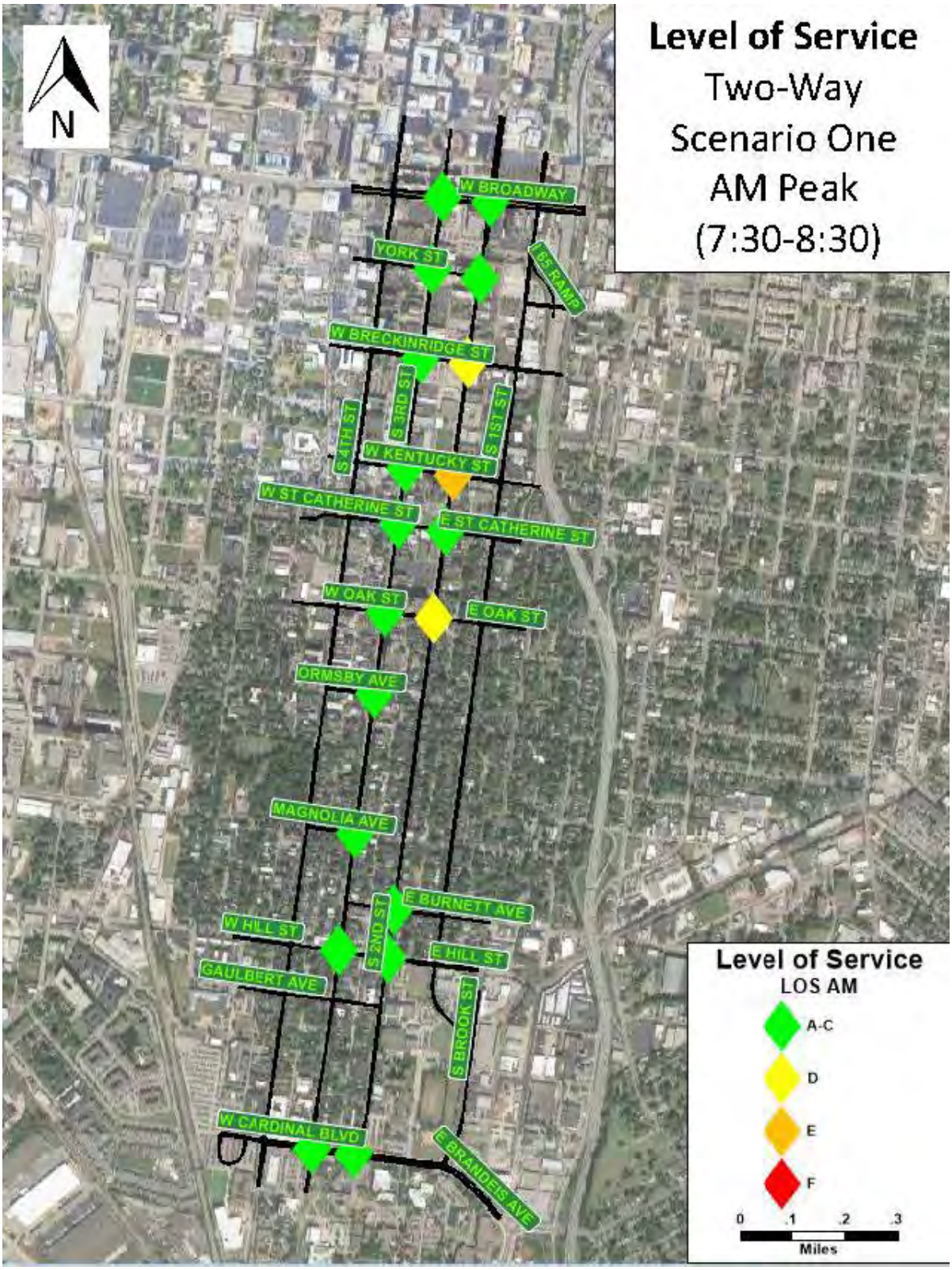
# Appendix C: Signalized Intersection Level of Service Maps

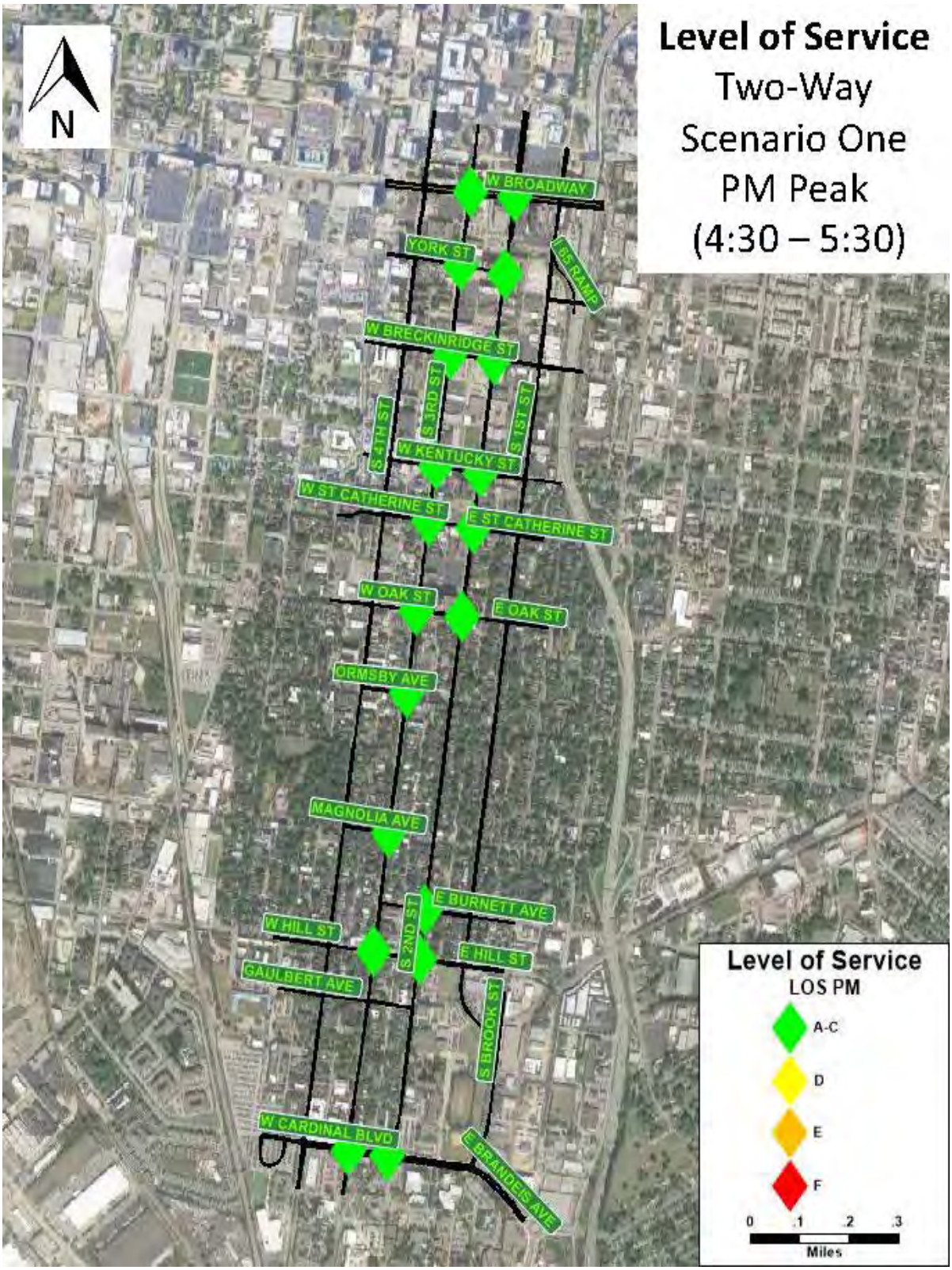
# C.1 Existing


Level of Service
Existing
AM Peak
(7:30-8:30)
N
W BROADWAY
YORK ST
65 RAMP
W BRECKINRIDGE ST
S 4TH ST
S 3RD ST
S 1ST ST
W ST CATHERINE ST
E ST CATHERINE ST
W OAK ST
E OAK ST
ORMSBY AVE
MAGNOLIA AVE
E BURNETT AVE
W HILL ST
S 2ND ST
E HILL ST
GAULBERT AVE
S BROOK ST
W CARDINAL BLVD
E BRANDEIS AVE
Level of Service
LOS AM
A-C
D
E
F
0 .1 .2 .3
Miles

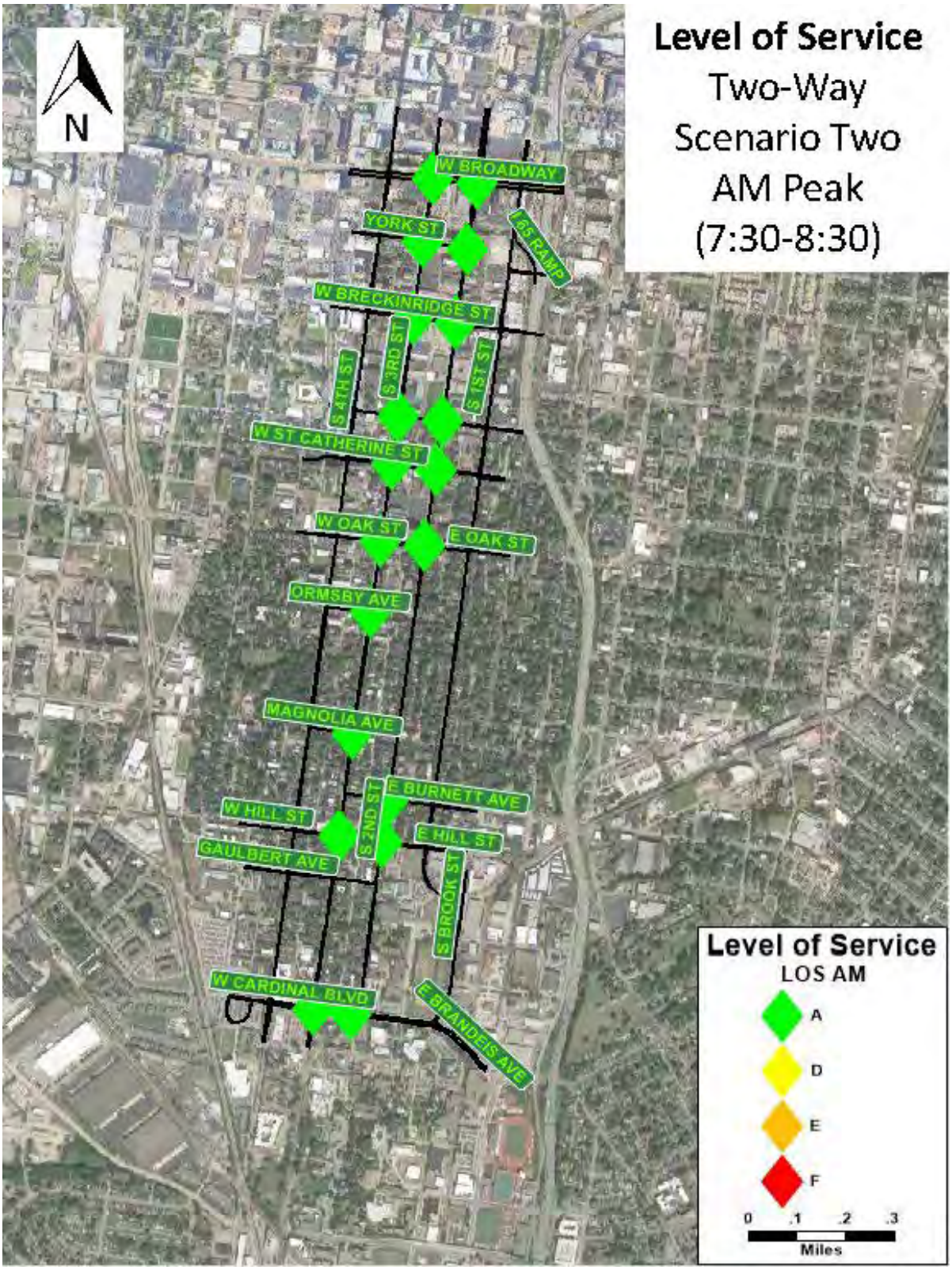

Level of Service
Existing
PM Peak
(4:30-5:30)
N
W BROADWAY
YORK ST
I-65 RAMP
W BRECKINRIDGE ST
S 4TH ST
S 3RD ST
S 1ST ST
W ST CATHERINE ST
E ST CATHERINE ST
W OAK ST
E OAK ST
ORMSBY AVE
MAGNOLIA AVE
E BURNETT AVE
S 2ND ST
W HILL ST
E HILL ST
GAULBERT AVE
S BROOK ST
W CARDINAL BLVD
E BRANDEIS AVE
Level of Service
LOS PM
A-C
D
E
F
0 .1 .2 .3
Miles

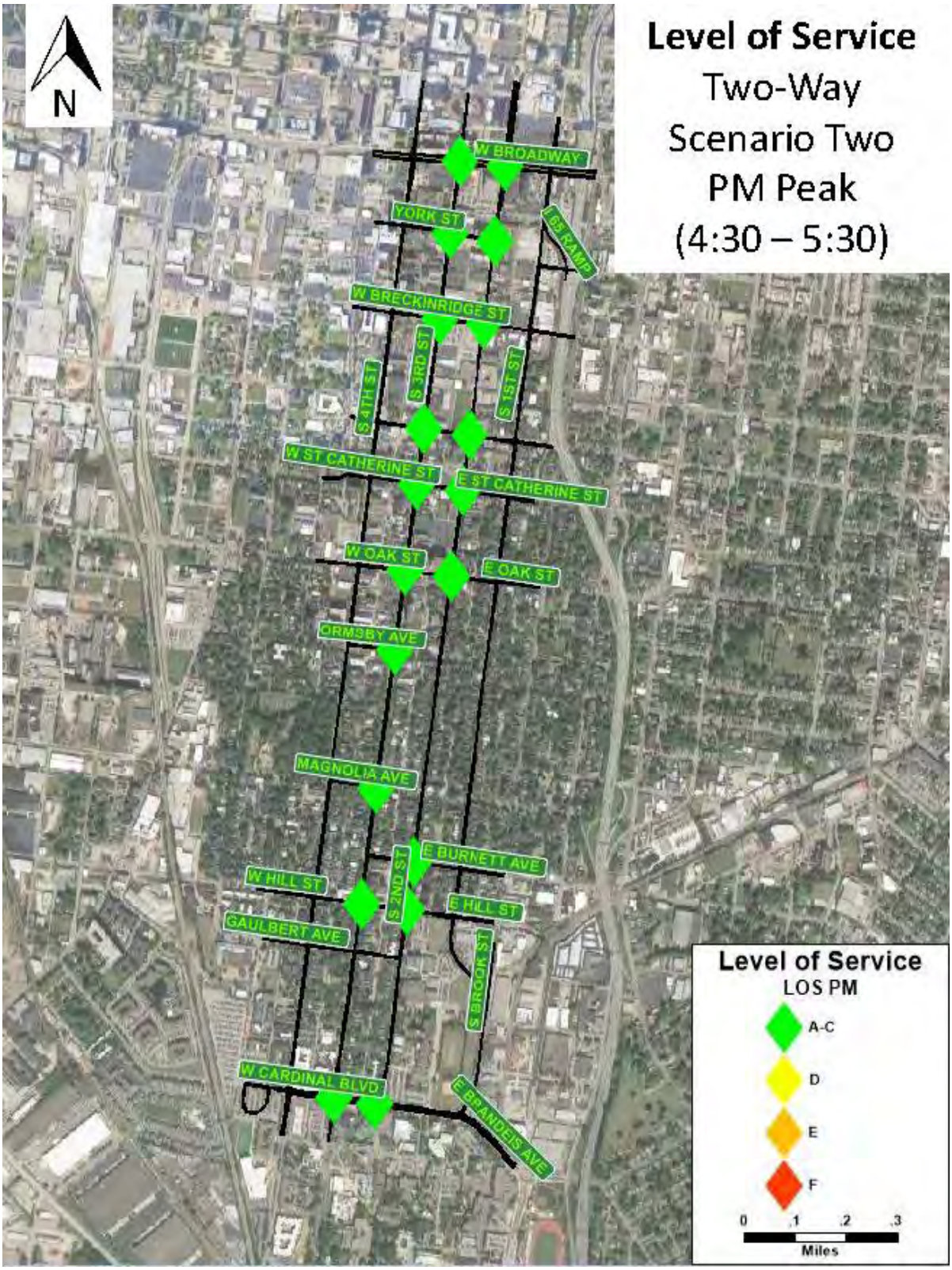
## C.2 Two-way Scenario 1


Level of Service
Two-Way
Scenario One
AM Peak
(7:30-8:30)
N
W BROADWAY
YORK ST
I-5 RAMP
W BRECKINRIDGE ST
S 4TH ST
S 3RD ST
S 1ST ST
W KENTUCKY ST
W ST CATHERINE ST
E ST CATHERINE ST
W OAK ST
E OAK ST
ORMSBY AVE
MAGNOLIA AVE
E BURNETT AVE
W HILL ST
S 2ND ST
E HILL ST
GAULBERT AVE
S BROOK ST
W CARDINAL BLVD
E BRANDEIS AVE
Level of Service
LOS AM
A-C
D
E
F
0 .1 .2 .3
Miles


Level of Service
Two-Way
Scenario One
PM Peak
(4:30 – 5:30)
N
W BROADWAY
YORK ST
65 RAMP
W BRECKINRIDGE ST
S 4TH ST
S 3RD ST
S 1ST ST
W KENTUCKY ST
W ST CATHERINE ST
E ST CATHERINE ST
W OAK ST
E OAK ST
ORMSBY AVE
MAGNOLIA AVE
E BURNETT AVE
W HILL ST
S 2ND ST
E HILL ST
GAULBERT AVE
S BROOK ST
W CARDINAL BLVD
E BRANDEIS AVE
Level of Service
LOS PM
A-C
D
E
F
0 .1 .2 .3
Miles

## C.3 Two-way Scenario 2


Level of Service
Two-Way
Scenario Two
AM Peak
(7:30-8:30)
N
W BROADWAY
YORK ST
I-65 RAMP
W BRECKINRIDGE ST
S 3RD ST
S 4TH ST
S 1ST ST
W ST CATHERINE ST
W OAK ST
E OAK ST
ORMSBY AVE
MAGNOLIA AVE
E BURNETT AVE
W HILL ST
S 2ND ST
E HILL ST
GAULBERT AVE
S BROOK ST
W CARDINAL BLVD
E BRANDEIS AVE
Level of Service
LOS AM
A
D
E
F
0 .1 .2 .3
Miles


Level of Service
Two-Way
Scenario Two
PM Peak
(4:30 – 5:30)
N
W BROADWAY
YORK ST
65 RAMP
W BRECKINRIDGE ST
S 4TH ST
S 3RD ST
S 1ST ST
W ST CATHERINE ST
E ST CATHERINE ST
W OAK ST
E OAK ST
ORMSBY AVE
MAGNOLIA AVE
W HILL ST
S 2ND ST
E BURNETT AVE
E HILL ST
GAULBERT AVE
S BROOK ST
W CARDINAL BLVD
E BRANDEIS AVE
Level of Service
LOS PM
A-C
D
E
F
0 .1 .2 .3
Miles