

D2  
Show Me the Impacts!

TRAFFIC OPERATIONS & SAFETY IMPROVEMENT STUDY FOR THE GIANT CITY ROAD  
CORRIDOR IN CARBONDALE, ILLINOIS

Dustin B. Riechmann, PE, PTOE  
Lochmueller Group  
1928 SrA Bradley Smith Drive  
Troy, Illinois 62294  
618-667-1411  
[driechmann@lochgroup.com](mailto:driechmann@lochgroup.com)

Carbondale, Illinois is a diverse community of approximately 26,000 that is located 96 miles southeast of St. Louis and is home to Southern Illinois University. The newly formed Southern Illinois Metropolitan Planning Organization (SIMPO) chose to partner with the City and fund a study to improve traffic operations and safety within the Giant City Road corridor.

This stretch of road was consistently rated as the top source of driver frustration during public involvement completed for the MPO's first Long-Range Transportation Plan. It is also the highest crash rate location in the entire MPO with 92 crashes reported over the most recent three-year period. The existing congestion, traffic spillbacks and safety problems are expected to be greatly exacerbated as traffic continues to grow in the corridor. By 2040, it is anticipated that volumes on the major crossroad (IL Route 13) will increase by 35% while traffic on Giant City Road will increase by nearly 80%.

The purpose of the study was to develop improvement options for the corridor that would result in more efficient, safer traffic flow and accommodate all users. At the core of this analysis was the use of micro-simulation traffic modeling, which also facilitated the development of demonstration videos. These videos depicting the various alternatives and their true impact on traffic operations were key to the selection of a preferred alternative through interaction with stakeholders, public officials and area residents.

After extensive evaluation, a series of improvements were recommended to correct the existing deficiencies and accommodate future growth in a manner that accommodates multi-modal use, including:

- Roundabout intersections in both traditional applications as well as "turnaround" points when raised medians are implemented to enforce access management
- Intersection capacity improvements at several key locations
- Traffic signal operational improvements, including modified phasing, sequencing and progressive timing
- Relocation of a frontage road with accommodations to enhance access to adjacent development parcels
- The continued development of frontage road systems and cross-access along each side of the corridor
- Integration of the sidewalks within the corridor with a planned adjacent multi-use path
- Dedicated transit service locations with proper accommodations

Upon implementation, it is anticipated that the prescribed improvements will significantly reduce delays and queuing as well as eliminate 60-80% of crashes within the corridor.

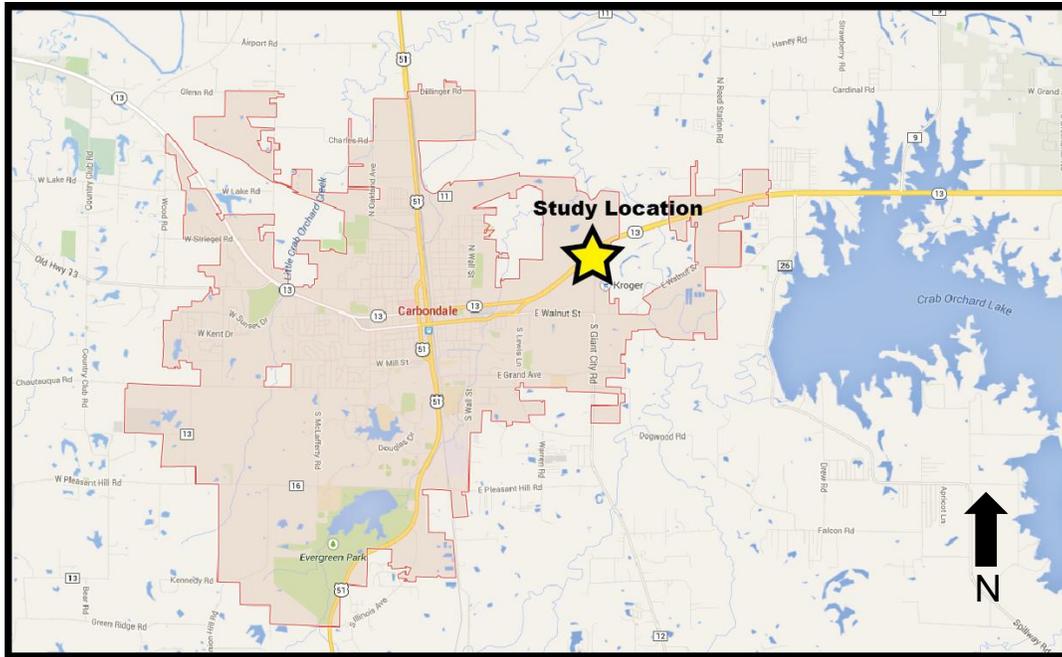
The constraints present along the Giant City Road corridor are common to many small and medium sized communities. The road network is often planned for rural conditions, but as development continues on the edges of town, problems develop as a result of closely-spaced intersections and an outdated approach to access management.

This study demonstrates how state-of-the art operational analysis tools can be leveraged to not only develop innovative solutions to these often complex problems, but interact with the public and local stakeholders to facilitate consensus. This project also provides a valuable case study regarding a small MPO's role in improving quality of life by partnering with its member communities to provide funding for special studies.

## TRAFFIC OPERATIONS & SAFETY IMPROVEMENT STUDY FOR THE GIANT CITY ROAD CORRIDOR IN CARBONDALE, ILLINOIS

On behalf of the Southern Illinois Metropolitan Planning Organization (SIMPO) and in conjunction with IDOT and the City of Carbondale, Lochmueller Group prepared a traffic and access management study for the nearly one-mile section of the Giant City Road corridor from north of Illinois Route 13 (IL 13) to just north of East Walnut Street/Old IL 13. The location of the study corridor in relation to the City of Carbondale is shown in **Figure 1** and an overview of local features is shown in **Figure 2**.

**Figure 1: Regional Study Location**



This corridor carries heavy commuter traffic in addition to serving as a primary means of access to many large-scale commercial uses as well as Southern Illinois University (SIU). The resulting mix of drivers seeking both mobility and access, coupled with the proximity to IL 13 and the prevalence of closely-spaced access points, has created a corridor known as one of the most congested and frustrating in the region.

The purpose of this study was to develop conceptual improvement options for the corridor that would result in more efficient, safer traffic flow and address the needs of all users. To that end, the focus of the analysis was on operational enhancements, crash reduction and access management.

The primary study intersections were Giant City Road with North Frontage Road, IL 13, South Frontage Road, East Mall Drive and various commercial access drives within the corridor.

### EXISTING CONDITIONS

As an initial step in quantifying existing traffic conditions within the study area, turning movement counts were performed at all of the study intersections. Based on these counts, it was determined that the peak hours of traffic flow are 4:30 to 5:30 p.m. during a weekday afternoon and 1:30-2:30 p.m. on Saturday.

In addition to traffic counts, extensive observations were performed by traffic engineers during peak periods to note areas of congestion, spillbacks and driver behavior within the study area. In addition, video footage collected in conjunction with the traffic counts was reviewed in detail.

The observations revealed driver confusion and frustration at both frontage road intersections with Giant City Road, including several “near misses” where crashes were narrowly avoided. Frequent red-light running was observed at the signalized intersection with IL 13, presumably due in part to congestion and long delays, particularly for motorists arriving from the frontage roads. On Saturday, lengthy queues developed along both frontage roads and extended back along Giant City Road as well.

In order to gain specific input from those that use the study roadways on a regular basis, an initial public meeting was held in Carbondale in February 2015 where business owners, residents, public officials and other stakeholders shared their experiences using the corridor. The public input received was consistent with the study team’s own observations as well as the results of subsequent technical analysis. In addition, valuable input was provided by stakeholders regarding preferences for possible solutions to evaluate.

#### *Traffic Analysis Methodology*

Traffic operating conditions at the study intersections were evaluated using VISSIM 7.0 microsimulation modeling software. This software is often applied to analyze corridors with queuing interaction between intersections, complex or saturated operations and/or unorthodox traffic control. The VISSIM results were then used to quantify conditions based upon methodologies outlined in the “Highway Capacity Manual” (HCM), published in 2010 by the Transportation Research Board.

The use of VISSIM also provided a valuable visual tool that aided in the evaluation of alternative improvement options and produced videos for use in public involvement interactions.

#### *Existing Safety Conditions*

In order to quantify safety conditions within the study corridor, file crash data for the years 2011, 2012 and 2013 was reviewed at the intersections of Giant City Road with IL 13, North Frontage Road and South Frontage. The crash data was summarized in the form of crash diagrams.

The intersection of IL 13 and Giant City Road had a total of 58 crashes over the three-year period, including two that resulted in serious injuries. The majority of these crashes were rear-end, which is typical at high-volume signalized intersections. However, a significant number of left-turn and right-angle crashes were also recorded, which could be an indication of failure to yield and red-light running.

At the North Frontage Road intersection, a total of 17 crashes were reported with one severe injury. The large majority of these crashes were right-angle and left-turn, which is indicative of the observed confusion and frustration with the unorthodox three-way stop control and congestion at this location. A total of 17 crashes were also reported at the South Frontage Road intersection, and again most were right-angle and left-turn collisions, likely for the same reasons noted at the North Frontage Road.

A disproportionate number of crashes occurred wherein southbound vehicles on Giant City Road hit westbound vehicles crossing the intersection, which is a relatively low-volume movement. This pattern could be attributed to sight distance restrictions for westbound motorists who cannot see through standing vehicular queues to determine if a safe gap exists in southbound traffic (which is not required to stop).

## 2040 NO-BUILD CONDITIONS

To ensure that any improvement plans satisfactorily accommodate future growth, the year 2040 was chosen as the design horizon. Traffic forecasts were developed for this horizon, and operations within the corridor under the resulting demand were quantified to establish a baseline condition if no improvements are implemented.

### *Anticipated Traffic Increase By 2040*

Traffic volumes within the study corridor are expected to increase substantially over time as overall population in the region grows and additional development occurs within the immediate area. Background traffic growth (independent of any local development) was estimated based on historic growth along the IL 13 and Giant City Road corridors.

The impact of local development was estimated based on the assumed build-out of developable properties adjacent to the Giant City Road corridor. A summary of the available acreage along with assumed land uses and building coverage rates is provided in **Figure 2**.

**Figure 2: Overview of Future Local Development (Study Corridor Highlighted)**



These land use assumptions were based on current zoning and coordination with City of Carbondale planning staff. As shown, significant acreage remains available for development within the study area, particularly along the west side of the corridor.

The trip generation resulting from future development was estimated based upon data provided in the "Trip Generation Manual", Ninth Edition, published by the Institute of Transportation Engineers (ITE). The development trips as well as the background growth were added to the existing traffic resulting in a 2040

traffic forecast. A significant amount of growth is anticipated over the next 25 years. In fact, **overall peak hour traffic volumes are expected to increase by approximately 35% on IL 13 and nearly 80% on Giant City Road.**

#### *2040 No-Build Forecasted Operating Conditions*

The operating conditions for the study intersections were analyzed using the forecasted traffic volumes to quantify the impact of projected growth. The results are summarized in **Table 1**.

**Table 1: 2040 No-Build Operating Conditions**

<b>Intersection/Approach</b>	<b>Weekday PM Peak Hour</b>	<b>Saturday Midday Peak Hour</b>
<b>Giant City Road and North Frontage Road (unsignalized)</b>		
Eastbound Approach	F (77.4)	F (114.6)
Westbound Approach	F (>200)	F (>200)
Southbound Approach	E (39.6)	F (121.9)
<b>Giant City Road and IL 13 (signalized)*</b>		
Eastbound Approach	C (27.6)	C (22.6)
Westbound Approach	C (33.6)	C (28.6)
Northbound Approach	C (28.1)	C (22.1)
Southbound Approach	D (41.0)	D (50.2)
<b>Overall Intersection</b>	<b>C (32.1)</b>	<b>C (28.8)</b>
<b>Giant City Road and South Frontage Road (unsignalized)</b>		
Eastbound Approach	F (172.1)	F (181.2)
Westbound Approach	F (54.1)	E (39.0)
Northbound Approach	F (165.5)	F (129.2)
<b>Giant City Road and East Mall Drive/ East Sunny Acres Road (unsignalized)</b>		
Eastbound Approach	F (104.8)	F (>200)
Westbound Approach	F (>200)	F (>200)

X (XX.X) – Level of Service (Average vehicular delay in seconds per vehicle)

*\*Actual operating conditions at this location are not accurately captured due to upstream congestion limiting access to the intersection; as a result the total demand volume is not reflected in the analysis.*

As shown, the significant growth expected along the corridor would have major impacts on operations at every study location. **Without improvements, the frontage road intersections would be effectively gridlocked during peak periods**, resulting in failing Level of Service (LOS) for most movements. In fact, congestion would be so heavy that some traffic (up to 40% of those arriving from Giant City Road) would be “held back” and unable to access the signal at IL 13 within the peak hour, which results in artificially favorable LOS at that location in Table 1.

In addition, as traffic grows on Giant City Road and the number of available gaps decreases, unsignalized side-street left turns will become difficult during peak periods. This is evident by the failing LOS shown at East Mall Drive during both peak hours under the No-Build condition.

The visual simulation of conditions produced by VISSIM confirmed these constraints. The screenshot shown in **Figure 3** captures p.m. peak period conditions under the No Build scenario, including long queues on northbound Giant City Road and along both frontage roads.

#### RECOMMENDED IMPROVEMENTS

Based on the evaluation of 2040 No Build conditions, it is evident that substantial improvements are necessary to accommodate future growth. Without changes, gridlock conditions are anticipated with significant increases in congestion and further degradation of safety.

**Figure 3: VISSIM Screenshot of 2040 No Build Conditions**



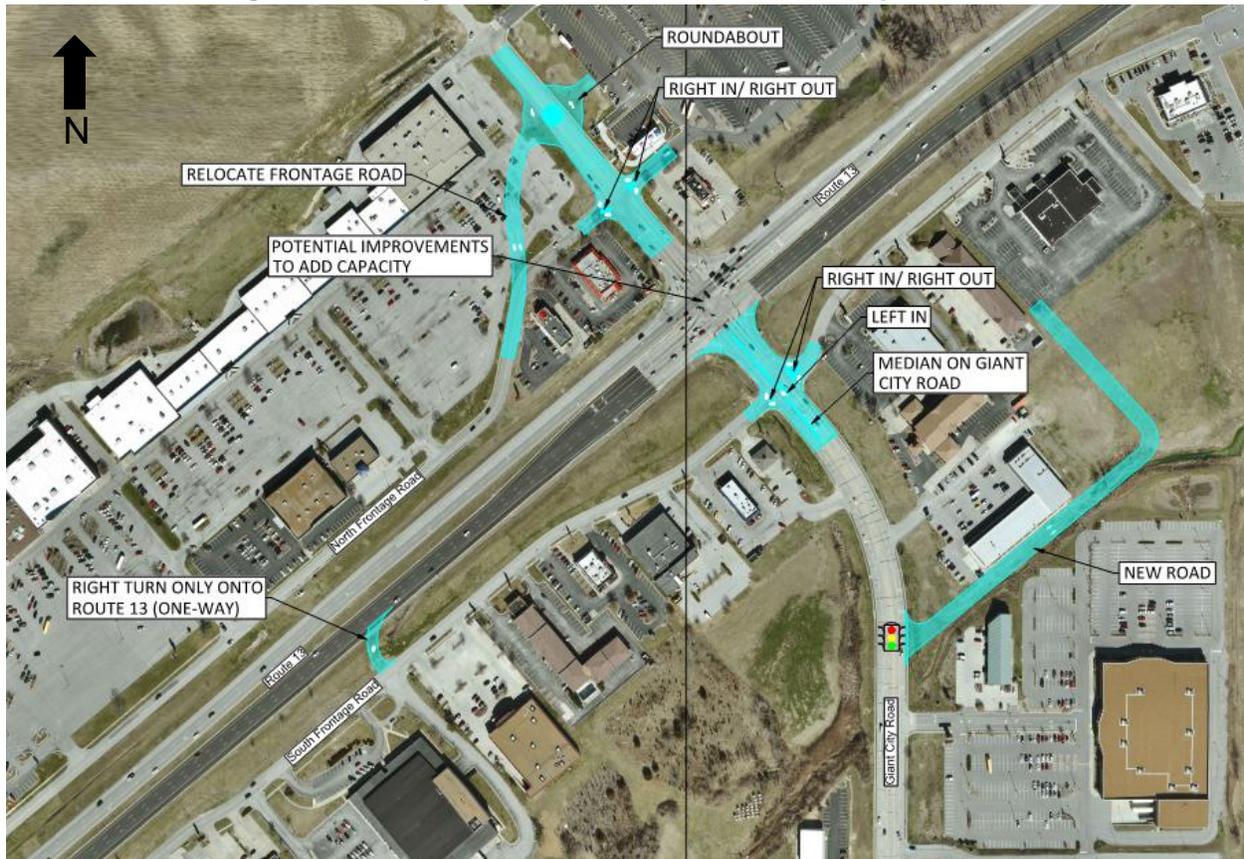
A wide variety of improvement options were considered, including those suggested by stakeholders during the first public meeting. However, based on initial evaluations, numerous ideas (such as significant widening at the signalized intersection, four-way stop or signal control at the outer roads, or complete closure to individual business access) were deemed infeasible or ineffective because they did not address the core issues or adequately support future growth. Three main alternatives were developed that used different access configurations and had varying degrees of impact on existing businesses. However, for brevity, this report focuses on the preferred concept, which was deemed by both stakeholders and the review agencies as best balancing the needs of commercial access vs. traffic mobility.

A second public meeting was held in April 2015 to share preliminary findings and provide an overview of the improvement options under consideration. VISSIM traffic simulation videos were also presented to aid in the public's understanding of the anticipated constraints in 2040 alongside potential solutions to those problems.

The impacts and benefits of various modifications were discussed in detail, and the resulting dialogue helped to further refine the alternatives. Following this meeting, the final detailed analyses of the options was completed to quantify their traffic operations and safety implications.

After extensive operational analysis and with consideration of engineering and environment constraints, a set of recommended improvements were developed, as shown conceptually in **Figure 4**.

**Figure 4: Conceptual Overview of Recommended Improvements**



*2040 Build Forecasted Operating Conditions*

**Illinois Route 13 at Giant City Road**

The following improvements are recommended at the intersection of Illinois Route 13 and Giant City Road:

- Add a separate southbound right-turn lane
- Add a second northbound left-turn lane
- Modify signal phasing, sequencing and timing

These improvements would significantly increase the capacity of the intersection and reduce delays, particularly for motorists on Giant City Road. The resulting conditions are summarized in **Table 2**.

**Table 2: 2040 Build Operating Conditions at Giant City Road & IL 13**

Intersection/Approach	Weekday PM Peak Hour	Saturday Midday Peak Hour
<b>Giant City Road and IL 13 (signalized)</b>		

Eastbound Approach	C (23.8)	C (31.8)
Westbound Approach	D (36.2)	C (31.7)
Northbound Approach	C (34.4)	C (34.3)
Southbound Approach	D (36.7)	D (39.3)
<b>Overall Intersection</b>	<b>C (31.6)</b>	<b>C (33.4)</b>

X (XX.X) – Level of Service (Average vehicular delay in seconds per vehicle)

As shown, these improvements would result in satisfactory conditions despite the major increase in traffic anticipated by 2040. It should be noted that the results in Table 4 do not differ greatly from those reported in the No Build scenario; however, in this case the intersection is serving the full 2040 demand, while volumes on Giant City Road were reduced by as much as 40% due to upstream congestion (gridlock at the frontage roads) in the No Build scenario.

### North Side of Illinois Route 13

On the north side of IL 13, the improvements would include the following:

- Relocate the North Frontage Road approximately 300 feet further to the north
- Install a roundabout at the new intersection with Giant City Road.
  - The roundabout could also serve Wal-Mart directly with parking lot modifications.
  - The roundabout would need two circulating lanes on the east side (to accommodate two northbound through lanes) but only one lane on the west side.
- Retain the existing frontage road but restrict to right-in/right-out movements only.

The operating conditions with the modifications in place are summarized in **Table 3**.

**Table 3: 2040 Build North Side Operating Conditions**

Intersection/Approach	Weekday PM Peak Hour	Saturday Midday Peak Hour
<b>Giant City Road and Proposed North Roundabout</b>		
Eastbound Approach	A (7.5)	A (8.8)
Westbound Approach	B (12.7)	D (33.3)
Northbound Approach	A (2.8)	A (4.0)
Southbound Approach	B (14.8)	D (27.9)
<b>Overall Intersection</b>	<b>A (7.0)</b>	<b>B (11.4)</b>
<b>Giant City Road and North Frontage Road (right-in/right-out)</b>		
Eastbound Right Turn	C (22.3)	D (31.5)
Westbound Right Turn	C (16.9)	D (31.5)

X (XX.X) – Level of Service (Average vehicular delay in seconds per vehicle)

Furthermore, traffic queues along Giant City Road and the North Frontage Road would be dissipated greatly as compared to the No Build condition. As shown in **Figure 5**, VISSIM modeling confirms that no significant spillbacks would be anticipated with the implementation of these improvements.

### South Side of Illinois Route 13

The improvements would include the following:

- Modify the west leg of the existing South Frontage Road so its intersection with Giant City accommodates inbound left and right turns and outbound right turns, but prohibits outbound (eastbound) left turns.
- Provide a direct right-on-only connection to eastbound IL 13 to the west of Giant City Road.

- Provide a new signalized intersection on Giant City Road approximately 650-850 feet south of the existing South Frontage Road.
  - A new roadway connection to the east would be provided as well as a fourth leg to serve properties on the west side of Giant City.
  - The new roadway should connect to adjoining properties to facilitate cross-access.
- Restrict the east side of the existing South Frontage Road intersection to right-in/right-out movements only.

**Figure 5: VISSIM Screenshot of 2040 Build Conditions North of IL 13**



The resulting operating conditions with in place are summarized in **Table 4**. As shown, favorable conditions are expected at both intersections with Giant City Road as well as the right turn onto eastbound IL 13.

**Table 4: 2040 Build South Side Operating Conditions**

Intersection/Approach	Weekday PM Peak Hour	Saturday Midday Peak Hour
<b>Giant City Road and South Frontage Road (right-in/right-out)</b>		
Eastbound Right Turn	A (7.0)	A (6.8)
Westbound Right Turn	E (63.3)	D (52.0)
<b>Giant City Road and Proposed New Access (signalized)</b>		
Westbound Approach	C (22.2)	C (22.5)
Northbound Approach	A (3.1)	A (4.4)
Southbound Approach	A (2.5)	A (5.2)
<b>Overall Intersection</b>	<b>A (3.5)</b>	<b>A (5.5)</b>
<b>Proposed Right Turn onto Eastbound IL 13</b>		
Northbound Approach	C (17.4)	B (12.3)

X (XX.X) – Level of Service (Average vehicular delay in seconds per vehicle)

Traffic queues along Giant City Road and the South Frontage Road would also be dissipated greatly under this option. As shown in **Figure 6**, VISSIM modeling confirms that no significant spillbacks would be anticipated with the implementation of these improvements.

**Figure 6: VISSIM Screenshot of 2040 Build Conditions South of IL 13**



**Additional Roadway Improvement Recommendations**

With the large increase in traffic expected on Giant City Road, it is important that proper access management policies be instituted as development continues. The following recommendations are provided for the corridor between the South Frontage Road and East Walnut Street:

- Install a traffic signal at the intersection of East Mall Drive and Giant City Road.
- Continue the development of frontage roads along Giant City Road, and require cross-access between all developments with frontage on this section of Giant City Road so that all parcels have indirect access to a signalized intersection.
- Restrict access drives in close proximity to signalized intersections and instead provide connections to the frontage roads along either side of Giant City.

As previously noted, unsignalized left turns from side streets will become increasingly difficult during peak times. With the installation of a signal at East Mall Drive, conditions would be improved significantly, as shown in **Table 5**.

**Table 5: 2040 Build Operating Conditions at East Mall Drive**

Intersection/Approach	Weekday PM Peak Hour	Saturday Midday Peak Hour
Giant City Road and East Mall Drive/ East Sunny Acres Road (signalized)		

Eastbound Approach	C (30.8)	D (52.0)
Westbound Approach	C (21.1)	B (18.3)
Northbound Approach	A (9.0)	B (15.7)
Southbound Approach	A (6.3)	A (8.4)
<b>Overall Intersection</b>	<b>A (10.0)</b>	<b>B (16.3)</b>

X (XX.X) – Level of Service (Average vehicular delay in seconds per vehicle)

### Bicycle & Pedestrian Improvement Recommendations

It is important that any project undertaken within the SIMPO planning area be multi-modal in nature. While the study corridor is dominated by heavy vehicular demands, there are opportunities to improve the experience for pedestrians and cyclists.

IDOT currently has a project underway to construct an off-street multi-use trail on the south side of IL 13 from Lewis Lane to Giant City Road. This project will include improved crossings at IL 13's intersections with McKinney Avenue and Lewis Lane.

Sidewalks are already in place along Giant City Road between East Walnut Street and South Frontage Road. It is recommended that the sidewalk be connected to the planned IDOT path. The proposed new signal on Giant City Road at the relocated south frontage road should accommodate pedestrian crossings. This will provide a safer crossing of Giant City as compared to the existing South Frontage Road intersection.

It is recommended that consideration be given to converting the sidewalk on one side of Giant City Road to a multi-use path to accommodate cyclists, if feasible. This would connect Carbondale High School and East Walnut Street to IDOT's planned path and ultimately could provide safe access to a future off-street path along IL 13 to the east.

It is our understanding that IDOT has deemed the IL 13/Giant City Road intersection as too large and complex to accommodate crosswalks. Given that this intersection is going to get larger and significantly busier in the future, this position is appropriate.

Nevertheless, better connections could be provided within the northern portion of the study area. Sidewalks are currently provided along the east side of Giant City to the north of IL 13 and along the north side of the North Frontage Road. The proposed roundabout should be designed to accommodate pedestrian crossings and connections to both existing sidewalk systems.

### *Anticipated Safety Benefits of Proposed Improvements*

Given the complex nature of this project, it is difficult to quantify all of the associated safety benefits. However, there are clear and readily identifiable safety improvements expected at the problematic frontage road locations.

As previously noted, a total of 17 crashes were recorded at each of the frontage road intersections with Giant City Road over the most recent three-year reporting period. With the elimination of left-turn and crossing maneuvers as well as reduced congestion, it is anticipated that the following safety improvements would be realized through the implementation of the recommended modifications:

- At the North Frontage Road's intersection with Giant City Road, the 10 angle and left-turn crashes experienced between 2011-2013 would have been eliminated under the proposed configuration, which represents a **reduction of nearly 60% of total crashes** at the intersection.

The severe injury crash at this location was also a right-angle collision involving an eastbound crossing maneuver that would be eliminated.

- Similarly, at the South Frontage Road, the 14 angle and left-turn crashes experienced in 2011-2013 would have been eliminated, which represents a **reduction of over 80% of total crashes** at the intersection.

It is difficult to quantify the crash reduction benefits at the intersection of IL 13 and Giant City Road since all movements would remain. However, the significant reduction in delay at the intersection as well as reductions in spillbacks and delays approaching the intersection from Giant City Road would be expected to reduce driver frustration and hopefully lessen the incidence of red-right running.

## CONCLUSION

Based on the preceding discussion, the following may be concluded regarding the Giant City Road corridor:

1. Public input, peak period observations and engineering analyses all confirmed a high level of driver frustration within the corridor. This was particularly prevalent at the frontage road intersections with Giant City Road, which have unorthodox traffic control and long delays.
2. The existing congestion, traffic spillbacks and safety problems will be greatly exacerbated as traffic continues to grow in the corridor. By 2040, it is anticipated that volumes on IL 13 will increase 35% while traffic on Giant City Road will increase by nearly 80%.
3. In order to address existing constraints and accommodate future growth, many options were considered to improve conditions within the corridor. After gaining input from the public and conducting initial engineering screenings, a core set of improvement options were evaluated in detail using VISSIM traffic microsimulation modeling.
4. The preferred alternative utilizes a combination of upgraded traffic control, frontage road relocations and enhanced access management to achieve substantially improved operating conditions.
5. It is important that any project undertaken within the SIMPO planning area be multi-modal in nature. While the study corridor is dominated by heavy vehicular demands, there are opportunities to improve the experience for pedestrians and cyclists. The preferred alternative includes accommodations for pedestrians, cyclists and transit.
6. A total of 17 crashes were recorded at each of the frontage road intersections with Giant City Road over the most recent three-year reporting period (2011-2013), and 58 crashes were recorded at the intersection of IL 13 and Giant City Road during this time.

Based on crash types, it is anticipated that the proposed improvements would reduce nearly 60% of crashes at the North Frontage Road and over 80% of crashes at the South Frontage Road. Given these are right-angle and left-turn crashes, they also tend to be the most severe crash types.

It is difficult to quantify the crash reduction benefits at the intersection of IL 13 and Giant City Road since all movements would remain. However, the significant reduction in delay at the intersection as well as reductions in spillbacks and delays approaching the intersection from Giant City Road would be expected to reduce driver frustration and hopefully lessen the incidence of red-right running.

7. Overall, the recommended improvement plan would resolve significant existing constraints within the corridor and accommodate extensive traffic growth expected through 2040.

The constraints present along the Giant City Road corridor are common to many small and medium sized communities. The road network is often planned for rural conditions, but as development continues on the edges of town, problems develop as a result of closely-spaced intersections and an outdated approach to access management.

This study demonstrates how state-of-the art operational analysis tools can be leveraged to not only develop innovative solutions to these often complex problems, but interact with the public and local stakeholders to facilitate consensus. This project also provides a valuable case study regarding a small MPO's role in improving quality of life by partnering with its member communities to provide funding for special studies.