City of Columbia

701 East Broadway, Columbia, Missouri 65201

Department Source: Public Works
To: City Council
From: City Manager & Staff
Council Meeting Date: August 7, 2017
Re: Setting a Public Hearing for the Forum Boulevard and Green Meadows Road Intersection Improvement Project

Executive Summary

Setting a public hearing for September 5, 2017 for the construction of the Forum Boulevard and Green Meadows Road intersection improvement project. This project was identified in the 10-year plan for the 0.25 percent Capital Improvement Sales Tax ballot initiative passed in August of 2015.

A public hearing was held on September 6, 2016, at which time Council directed staff to evaluate additional options for the intersection improvement project and request a recommendation from the Bicycle/Pedestrian Commission. Staff worked with Bartlett & West Engineers to develop additional improvement options, which were provided to the Bicycle/Pedestrian Commission and discussed at their November 16, 2016 meeting. The commission voted to support a roundabout concept. The additional options were also presented at a second IP meeting held on June 27, 2017. Staff recommends construction of a partial double-lane roundabout as the preferred improvement option for the intersection improvement.

Discussion

Project Existing Conditions:

Forum Boulevard is classified as a minor arterial and Green Meadows Road as a major collector in both the Columbia Area Transportation Study Organization (CATSO) 2040 Major Thoroughfare Plan and the City Major Roadway Plan. Forum is a four-lane divided road and Green Meadows is a two-lane road. Currently, an all-way stop is present at this intersection. A site location map of the intersection is attached as Exhibit A, and a layout of the existing intersection is attached as Exhibit B.

This intersection was identified for improvement due to both safety and traffic congestion concerns prior to the 2015 CIP Sales Tax Ballot Initiative. The existing layout of the intersection with four-lanes verses two-lanes can be confusing for drivers. It is difficult to know which vehicle has the right of way to enter the intersection when multiple vehicles stop at the same time, causing delay, confusion and increasing the potential for collisions. Staff has received many complaints that drivers do not come to a complete stop in order to "beat" the other vehicles into the intersection. In addition, the intersection is difficult and dangerous for pedestrians to cross. Finally, during daytime peak traffic, the intersection becomes a bottleneck as vehicles queue behind the stop signs in a stop and go situation. This is expected to worsen as improvement projects along Nifong are under construction and as the City continues to grow to the south and southwest.

To summarize collision and traffic data collected at the intersection, there were 14 collisions reported at the intersection between January 2011 and April 2017 (7 right-angle collisions, 2 rear-end collisions and 5 left-turn collisions). This data consists of recorded police reports indicating that the collisions were significant in nature. Collisions that are minor in nature, like a fender-bender, usually do not result in a police report; therefore, minor accidents are not captured in our data. Traffic counts were taken at the intersection on January 21, 2016 from 7:00 a.m. to 7:00 p.m. A total of 14,772 vehicles went through the intersection in the 12-hour period, with 1,754 vehicles counted during the peak hour of 4:45 p.m. to 5:45 p.m.

Public Involvement and Design Options:

The initial Interested Parties (IP) meeting for the project was held April 28, 2016, and a public hearing was held on September 6, 2016. Staff's recommended at that time was to construct a 150-foot diameter partial double-lane roundabout. There was opposition to the proposed roundabout by residents of the Country Club Villas; thus, Council directed staff to evaluate additional options to improve the intersection. Council also directed the Bicycle/Pedestrian Commission to review the information and make a recommendation.

Staff has been working with Bartlett and West Consulting Engineers on both the initial design of the roundabout and the additional options to improve the intersection. A total of five options have been developed which include: a full signal, a reduced signal, a J-turn, a J-turn with a pedestrian signal, and a roundabout as summarized below. The total estimated concept project cost includes construction, utility relocation, easement acquisition, and design. A layout of each option is attached as Exhibit C.

1. **Full Signal**
   - Full length right turn and left turn lanes for vehicle storage at each leg of the intersection.
   - Dual through lanes on Forum.
   - Bike lanes at each leg of the intersection.
   - Islands at each leg of the intersection for pedestrian crossing havens.
   - Total estimated concept project cost is $914,700.

2. **Reduced Signal**
   - Right turn lane storage on the east leg of Green Meadows was reduced in length.
   - Right turn lane and a pedestrian island at the preschool were removed.
   - Pedestrian islands remain on the northeast, southeast, and northwest corners.
   - Bike lanes at each leg of the intersection.
   - Total estimated concept project cost is $868,900.

3. **J Turn**
   - Eliminates the Green Meadows left turn movements at the intersection.
   - Left turns are still allowed off of Forum Blvd.
   - U-turn areas are located farther down Forum for the Green Meadows left turn movements.

- Scottson Way will be made into a cul-de-sac.
- Bike lanes are included on Forum.
- No pedestrian crossing facilities are included with this option.
- Total estimated concept project cost is $1,208,200.

4. J Turn with Ped Signal

- Left turn movement for both Forum and Green Meadows have been removed.
- Crosswalk and pedestrian actuated signal have been included at the intersection.
- Left turn movements for both Forum and Green Meadows will need to utilize the U-turn movement farther down on Forum.
- Bike lanes are included along Forum.
- Scottson Way will be made into a cul-de-sac.
- Total estimated concept project cost is $1,248,700.

5. Roundabout

- Splitter islands are included at each leg of the intersection for pedestrian crossing havens.
- Crosswalks are set back from the intersection to allow vehicles more time to react before merging in and out of traffic.
- Left turn movement is eliminated thus eliminating collisions and delay caused by left turn movement.
- Bicyclists can choose to ride through the roundabout with traffic or use the sidewalk/pedestrian crosswalk. Vehicles speeds will be slower in the roundabout as compared to a signal for bikes riding with traffic.
- Total estimated concept project cost is $1,166.500.

Per Council direction, staff provided the Bicycle/Pedestrian Commission a copy of the council memo prepared for the September 6, 2016 public hearing and the additional improvement options that were designed by Bartlett and West. This information was discussed at the Bicycle/Pedestrian Commission's November 16, 2016 meeting, and the Commission voted to support a roundabout concept.

Staff prepared a report and presented the four additional intersection improvement options to Council at their January 17, 2017 meeting. Council directed staff to hold a second IP meeting and set another public hearing to present all five of the improvement options.

The second IP meeting was held on June 27, 2017. A total of 88 people signed in at the meeting, and 55 comments received. Of those 55 comments, attached as Exhibit D, 27 were in favor of the roundabout, 21 were in favor of a signal option, and 7 did not state a definite preferred option. Nine (9) of the comments received were from Canterbury Drive residents, who requested speed humps or some other traffic calming measures be included in the project for Canterbury Drive, in order to minimize cut-through traffic. As part of this

project, traffic calming measure such as speed bumps will be considered for both Canterbury Drive and Scottson Way.

Staff Recommendation:
The Forum and Green Meadows intersection was identified for improvement due to both safety and traffic congestion concerns. Based on the analysis of the additional intersection improvement options, the recommendation from the Bicycle/Pedestrian Commission and the adoption of Vision Zero by Council, staff recommends the roundabout as the best solution for this intersection improvement project.

The roundabout is considered overall the safest improvement for the intersection for all modes of transportation (motorized and non-motorized). For the following **safety** reasons, staff recommends a roundabout over the signal options and the J-turn options:

- The partial double-lane roundabout has 62% fewer vehicle conflict points compared to a signalized intersection. The severity of a collision is determined largely by the speed and angle of impact. A roundabout changes the geometry of the roadway in a way that forces drivers to slow down and alter their direction. This results in fewer and less severe collisions. Signalization relies on driver's obedience of traffic control devices to eliminate right-angle collisions. The most severe collisions at signalized intersections occur when there is a violation of the traffic control device designed to separate conflicts by time. Also, the rear-end collision rate may increase with a traffic signal given the historical trends of signalizing intersections due to queues at the light. With roundabouts the most severe types of crashes (right-angle, left-turn, and head-on) are unlikely to occur. The conflict diagram (Exhibit E) graphically shows the conflict locations for vehicles for both an all-way stop and a roundabout.
- A pedestrian crossing a double-lane signalized intersection faces seven potential vehicular conflicts, each coming from a different direction. A pedestrian crossing the partial double-lane roundabout will face four potential vehicular conflicts. The first two potential conflicts will both be coming from the left, with a refuge on the median island, before facing the other two potential conflicts, which will both be coming from the right. The intersection conflict diagram (Exhibit E), graphically shows the conflict locations for pedestrians.
- In a study completed by the Transportation Research Board (TRB), it was found that following the conversion of 23 intersections from either a stop sign or a traffic signal to a roundabout, there was approximately a 40% decrease in crashes of all severities, 80% reduction of injury crashes, and approximately 90% reduction of fatal and incapacitating injury crashes. An abstract of this paper is attached as Exhibit F. Ongoing research by the Federal Highway Administration (FHWA), the National Highway Traffic Safety Administration (NHTSA), TRB, the Insurance Institute for Highway Safety (IIHS), and other industry sources continues to indicate roundabouts are one of the safest types of intersection control (see Exhibit G for a list of papers). Improvements have been made to some specific elements of roundabout design over the years, but the principle of providing physical deflection in order to reduce speeds remains a key component for driver, pedestrian and cyclist safety.

- Vehicular speeds are lower in a roundabout allowing more time for vehicles and pedestrians to react, which reduces the consequences of error. Also, the crosswalks are set back at the roundabout to allow drivers more time to react to pedestrians while merging into or out of the roundabout.
- For both the signal and the J-turn options, vehicles on Forum will not need to stop or slow down at the intersection unless making a left turn or stopping for a red light; thus, resulting in higher vehicle speeds at the intersection for through traffic. Whereas, the geometry (layout and islands) of the roundabout forces drivers to slow down to 15-20 mph as one approaches and drives through the roundabout.

Exhibit H "Safety Benefits of Modern Single-Lane Roundabouts" identifies the safety benefits of a roundabout. Although the document is written to address signal-lane roundabouts, most of the discussion applies to partial double-lane roundabouts as well.

For the following **traffic flow and maintenance** reasons, staff recommends a roundabout over the signal options at this intersection:

- Roundabouts bring conflicting traffic streams into a steady flow and allow vehicles to merge without the stop-and-go conditions. Roundabouts provide greater traffic flow benefits by reducing average vehicle delay and vehicle queuing compared to a signal.
- Roundabouts eliminate left turns thus eliminating the delays caused by left-turning vehicles.
- A roundabout would keep traffic flowing even during non-peak periods since vehicles would not have to wait at a red light when little or no traffic is coming from the conflicting direction.
- Long-term maintenance costs are lower for a roundabout than a signal due to the electrical and operation/maintenance costs of a signal.
- A roundabout could potentially have as many as seven landscaped Adopt-A-Spots. A signalized intersection would potentially have four Adopt-A-Spots.

Public Comments and Responses:
Following are concerns residents have voiced about the proposed roundabout, and staff responses:

Concern: Drivers on the southwest leg of Green Meadows won't be able to enter the roundabout during peak traffic times because there will be a steady stream of vehicles on the north leg of Forum entering the roundabout to go south.
Response: The vehicles on the north leg of Forum will need to yield to vehicles already in the roundabout, such as vehicles entering from the south leg of Forum to go west on Green Meadows, and vehicles entering from the east leg of Green Meadows to go south on Forum. Southbound vehicles will need to yield to this traffic and a gap will be created in the roundabout for vehicles entering from the west leg of Green Meadows. These gaps in traffic are typically created due to slow approach speeds and drivers on other legs needing to

yield to the circulating traffic. It is possible that the vehicle on the west leg of Green Meadows may have to occasionally wait a little longer than the current all-way stop configuration. However, that seems unlikely, or will be minor, given the fact that drivers currently have to come to a full stop at the intersection to proceed. Overall delay will be reduced since other movements will not all have to stop, and instead proceed into the circulating roadway after yielding. There has been some feedback that a signal would allow for a dedicated 'turn' for the west leg movement. While this is true, it should be noted that at a signalized location, that leg would have to wait at a red light for a longer period of time than at a roundabout or all-way stop.

Concern: The Insurance Institute of Highway Safety (IIHS) states that roundabouts should not be used at intersections with highly unbalanced traffic flows i.e. very high traffic volumes on the main street and very light traffic on the side streets.
Response: An intersection with a highly unbalanced traffic flow is where an all-way stop would not be warranted to begin with such as the intersection of Green Meadows Road and Doral Drive/Canterbury Drive, located just north of the intersection of Forum and Green Meadows. The significant imbalance that residents referred to is not present at Forum and Green Meadows, where some form of major intersection control is warranted and there are significant left turn movements from the main line and entry movements from the east leg of the intersection. Exhibit I provides the full IIHS study. It should be noted that the name of the IIHS study is: *Continued Reliance on Traffic Signals: The Cost of Missed Opportunities to Improve Traffic Flow and Safety at Urban Intersections".* Page 11 of the study's conclusion, states, "Despite their benefits, roundabouts may not be the best solution at all locations. Roundabouts may not be feasible at locations where topographic or site constraints limit the ability to provide appropriate geometry. Also, intersections with very unbalanced traffic flows (i.e. very high traffic volumes on the main street and very light traffic on the side street) may preclude roundabouts for reasons of traffic flow. However, as the proportion of minor street traffic volumes increase, roundabouts typically become more feasible and provide greater reductions in vehicle delays compared with traffic signals." Staff concurs with the study's conclusion that sometimes roundabouts are not the best option, but that is not the case at this location.

Concern: There are no other double-lane roundabouts in Columbia and drivers will not know how to maneuver through the roundabout.
Response: MoDOT constructed two double-lane roundabouts in Columbia, 1) the intersection of Rangeline Road with I-70 Interstate access ramps, and 2) the intersection of Creasy Springs, I-70 Drive, and the I-70 access ramps. Also, a partial double-lane roundabout has been constructed at Highway WW and Rolling Hills Road, which is very similar to the proposed roundabout at Forum & Green Meadows. The signing and pavement markings used at the roundabouts, along with the splitter islands, direct drivers to the correct lane and use of the roundabout. It should also be noted that the Forum and Green Meadows roundabout will not be a true double-lane roundabout with two circulating lanes. Two lanes are only designed on the northbound and southbound legs of the roundabout. The eastbound and westbound legs are single lanes. While full double-lane roundabouts can be

more difficult to navigate, this hybrid style roundabout is generally perceived to be very user friendly since the number of potential vehicle conflicts is reduced. There is not a need to move from the inner to outer lane of the roundabout. The City's consultant, Bartlett and West has been involved in several successful implementations of this style of roundabout.

Concern: The roundabout will not be safe for pedestrians.
Response: In most studies it has been determined that roundabouts are actually safer for pedestrians than an all-way stop or a signal. A pedestrian crossing a double-lane signalized intersection or an all-way stop faces seven potential vehicular conflicts, each coming from a different direction, when trying to cross from one side of the road to another. A pedestrian crossing the double-lane of the roundabout will face four potential vehicular conflicts. The first two potential conflicts will both be coming from the left, with a refuge on the median island before facing the other two potential conflicts, with both coming from the right. In addition, the vehicle speed going through a green light or running a red light can be much faster than the speed of a vehicle traversing the roundabout because the islands/design of the roundabout forces the vehicle to slow down, which allows drivers and pedestrians both more time to react. This subsequently reduces the consequence of any errors and accidents tend to be less severe. The crosswalks are set back in a roundabout to allow the drivers more time to react before merging into or out of traffic. Ongoing research is being pursued by the Federal Highway Administration (FHWA), Transportation Research Board (TRB), and the National Highway Transportation Safety Administration (NHTSA) to improve roundabouts for all modes, but results consistently indicate that roundabouts are one of the safest forms of intersection control and produce consistently safer results than signalized intersections. Collisions at roundabouts can and do occur; however, they generally occur less often and are less severe. The Bicycle/Pedestrian Commission voted to support the roundabout as the best option.

Concern: The roundabout will not be safe for bicyclists.
Response: Bicyclists can choose to ride through a roundabout with traffic or walk their bicycles through the pedestrian crosswalks; much like a bicyclist would at other intersections. If navigating the roundabout with traffic, cyclists must obey the rules of the roundabout as they proceed through the intersection, but the speed of the vehicles are slower in the roundabout than vehicle speeds passing through a signalized intersection. The slower speed makes it easier for a bicyclist to ride with the traffic. In addition, the sidewalk can be designed with bike ramps to allow the bicyclist access to the sidewalk once the bike lane ends, should the bicyclist choose to use the sidewalk instead. The Bicycle/Pedestrian Commission voted to support the roundabout as the best option.

Concern: The intersection improvement project is not necessary.
Response: The Highway Capacity Manual (HCM) is a publication of the Transportation Research Board (TRB) and is used by engineers to assess roadway capacity and quality of service. It contains concepts, guidelines, and procedures for determining capacity and quality of service for various roadway types including roundabouts, signalized, and un-signalized intersections. From the 2000 version of the HCM, the Intersection Control Type and Peak-Hour Volumes graph (Exhibit J) can be used as guidance to visually determine the type

of control warranted for the intersection. From the graph it can be determined that with the peak-hour traffic counts, the intersection warrants a roundabout or a traffic signal control. In addition, this intersection improvement project was identified in the list of needed capital street improvement projects included in the August 2015 sales tax renewal ballot initiative, and discussed and voted on by Council on May 18, 2015. The intersection is located in Ward 5, with1,036 Ward 5 residents voting in favor of the sales tax renewal and 374 Ward 5 residents opposed the sales tax renewal. Improving this intersection would be consistent with goals and principles of the CATSO 2040 Long Range Transportation.

Concern: The amount of delay at the intersection is not enough to warrant the improvement.
Response: Staff utilized an industry standard software program called Synchro/SimTraffic to analyze and estimate the vehicle delay time at the intersection during the peak hour (Exhibit K). Synchro utilizes the Highway Capacity Manual for modeling signalized and un-signalized intersections. The traffic counts collected in January of 2016 were used in the model to calculate the delay during the peak afternoon traffic. The southbound legs of Forum had the longest delay time with an average of 75 seconds per vehicle for both lanes and 107 seconds per vehicle for the inside lane. The Forum southbound inside lane is utilized by drivers for both through and left turn movements. The average overall delay time for the entire intersection during the peak time was 46 seconds per vehicle. This average delay time includes all legs of the intersection. Overt delay causes issues with driver frustration, delivery of goods and services, lost time, impacts to transit routes, and greater fuel consumption.

Concern: The section of Forum between Nifong and Green Meadows is two lanes.
Response: No matter which intersection improvement is selected, if funding is available, staff recommends coordinating design and construction for widening Forum to a four-lane section between Green Meadows and Nifong, with the Nifong Improvement project planned for the year 2020. Without this additional widening, traffic will continue to be forced to transition between four lanes and two lanes. This merging maneuver may lead to imbalanced lane usage with one lane taking the bulk of the traffic in each direction, as it currently exists.

Conclusion:
The intersection's current configuration presents a legitimate safety concern that will only get worse as future pressure is placed on the intersection due to road construction and growth in the south and southwest. As stated by many of the citizens, the layout of the existing all-way stop is confusing since there are the additional lanes on Forum in comparison to a traditional four-way stop, where there is just one lane of traffic on each leg. Also, drivers will roll through the intersection instead of coming to a complete stop in order to beat vehicles into the intersection. In addition, there were 14 collisions over a five-year period where police collected collision data. From a traffic perspective, there is a large traffic volume at this intersection with 1,754 vehicles passing through the intersection during the peak hour (4:45-5:45 pm), causing vehicles to back up on each leg due to limited capacity of the all-way stop and conflicting movements. The number of vehicles that pass through the intersection

is expected to increase during the construction of improvements along Nifong Boulevard, and as Columbia's population continues to grow. Staff is trying to be proactive by improving the intersection now to lessen the impact to the intersection during construction of roadway improvements to the south.

The Forum and Green Meadows intersection was identified for improvement due to both safety and traffic congestion concerns. Based on the analysis of the additional intersection improvement options, the recommendation from the Bicycle/Pedestrian Commission and the adoption of Vision Zero by Council, staff recommends construction of a partial double-lane roundabout as the preferred improvement option for the intersection improvement project.

Fiscal Impact

Short-Term Impact: The estimated total projects cost for the proposed roundabout is $1,166,500 (design, right of way, utilities, and construction). Funding for the project will be from the 0.25% Capital Improvement Sales Tax.
Long-Term Impact: Routine maintenance for a roundabout is estimated at $2,000 per year.

Vision & Strategic Plan Impact

Vision Impacts:
Primary Impact: Transportation, Secondary Impact: Tertiary Impact: Environment
Strategic Plan Impacts:
Primary Impact: Infrastructure, Secondary Impact: Public Safety, Tertiary Impact:
Comprehensive Plan Impacts:
Primary Impact: Infrastructure, Secondary Impact: Mobility, Connectivity, and Accessibility, Tertiary Impact: Not Applicable

Legislative History

Date	Action
04/28/2016	Interested Parties meeting held
08/01/2016	R103-16 Setting a public hearing for September 6, 2016
09/06/2016	PH30-16 Public hearing held
01/17/2017	REP3-17 Council Report with additional improvement options for the intersection
06/27/2017	Interested Parties meeting held

Suggested Council Action

Adopt the resolution setting a public hearing for September 5, 2017 for the Forum Boulevard and Green Meadows Road intersection improvement project.