City of Columbia

701 East Broadway, Columbia, Missouri 65201

Department Source: Public Works
To: City Council
From: City Manager & Staff
Council Meeting Date: September 6, 2016
Re: Public Hearing – Forum and Green Meadows Intersection Improvement Project

Executive Summary

The Forum Boulevard and Green Meadows Road intersection improvement project was identified in the 10-year plan for the 0.25 percent Capital Improvement Sales Tax ballot initiative passed in August of 2015. Staff is recommending construction of a partial double-lane roundabout; however, a traffic signal would also be an option for the intersection improvement. An Interested Parties (IP) meeting for the project was held April 28, 2016. Adjacent property owners have been contacted by engineering staff concerning this public hearing.

Discussion

Summary of Project Design/Project Data:
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 confusion and increasing the potential for accidents. 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, when there are six vehicles at the intersection at the same time, it's difficult and dangerous for pedestrians to cross. During daytime peak traffic, the intersection becomes a bottleneck as vehicles queue behind the stop signs in a stop and go situation. This situation is expected to worsen as improvement projects along Nifong are under construction, and as the City continues to grow to the south and southwest

Staff's recommendation for improvement to this intersection consists of a 150-foot diameter partial double-lane roundabout that is situated generally within the existing intersection. A similar diameter roundabout is located at Vandiver Drive and Highway 63 interchange. This design includes splitter islands and 5-foot wide sidewalks. The roundabout would be designed to accommodate commercial vehicles and school busses, as well as installation of street lighting. The improvement for this intersection is being designed by Bartlett and West of Jefferson City, Missouri. The proposed layout for the roundabout is attached as Exhibit C.

While analyzing this intersection, traffic counts (Exhibit D) were manually taken on January 21, 2016, between 7:00 a.m. and 7:00 p.m. A total of 14,772 vehicles passed through the intersection during the 12-hour period. During the peak hour (4:45 p.m. - 5:45 p.m.), a total of 1,754 vehicles passed through the intersection. Of these 1,754 vehicles, 782 vehicles were southbound on Forum, 522 vehicles northbound on Forum, 368 vehicles westbound on Green Meadows, and 77 vehicles eastbound on Green Meadows.

Collision data (Exhibit E) was also collected for the period between January of 2011 and December of 2015. The data consisted of recorded police reports indicating that the collisions were more significate in nature. Collisions that are minor in nature, like a fender-bender, usually do not result in a police report. Due to how the Police Department collects and reports data, minor accidents are not captured in our data. During this time period, 13 collisions were reported, with seven right-angle collisions, two rear-end collisions, and four left-turn collisions. There were three injury collisions at the location during this timeframe.

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 F) 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.

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 G). 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, which indicated the average delay time for the existing intersection during the peak hour was 46 seconds per vehicle. This average delay time includes all legs of the intersection. Overt delay causes issues with delivery of goods and services, lost time, impacts to transit routes and greater fuel consumption. Staff also utilized a program called Vissim to analyze the intersection. Although the Synchro/Simtraffic program is better suited to simulate stop and go conditions, Vissim tends to reflect a better model of how drivers use yield type maneuvers, such as those at a roundabout. Vissim also provides a good graphical representation of a proposed condition, such as the proposed roundabout at Forum and Green Meadows. Staff will provide a model of the proposed roundabout at the September 6, 2016 public hearing.

Finally, staff proposes to widen the two-lane section of Forum between Green Meadows and Nifong. 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. Therefore, 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.

Public Involvement/Public Comments:
An Interested Parties (IP) meeting was held on April 28th, with a total of 33 citizens signed in and 10 written comments received (see attached Exhibit H). Four of the comments were in favor of the roundabout citing that the intersection is frustrating and that a roundabout is the preferred intersection improvement. The six comments not in favor of the roundabout cited cost, the intersection is not a problem, roundabouts are dangerous for pedestrians, and that it will be hard for traffic on Green Meadows to enter the roundabout.

A petition (Exhibit J) was received at the June 6th Council meeting in opposition of the development and installation of a roundabout at this intersection. The petition was signed by 94 Country Club Villa residents and 46 Green Meadows preschool clients. Mr. Tim Vicente, representing those who signed the petition, commented at the meeting that the group's opposition against the roundabout was because drivers will have difficultly navigating the double-lane roundabout since there are no other double-lane roundabouts in Columbia; a roundabout will be less safe for pedestrians and bikers; and since most of the residents living in the Country Club Villas are over the age of 60, they will have trouble entering and navigating the roundabout. He stated that the money should be used for another project.

Property owners of each parcel adjacent to the intersection were contacted about the project, and informed that permanent street easements and temporary construction easements are anticipated to be acquired from them. The property owners located on the northwest corner, the northeast corner, and the southeast corner were all in favor of the roundabout. The property owner located on the southwest corner (Green Meadows Preschool) was in favor of the roundabout, but did have concerns about right of way impacts. E-mails outlining their concerns are included in Exhibit H. The contact log summarizing the discussion with each property owner is attached as Exhibit I.

Response to Public Comments:
Following are concerns voiced by many Country Club Villa residents and staff responses:
Concern: They 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 with the current all-way stop configuration. However, that seems unlikely given the fact that drivers currently have to 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 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 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 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.

Concern: There are no other double-lane roundabouts in Columbia and drivers will not know how to maneuver through the roundabout.
Response: MoDOT has recently 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. A third partial two-lane roundabout is being constructed at Highway WW and Rolling Hills Road. The signage 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/Green Meadows roundabout will not be a true double-lane roundabout with two circulating lanes. Two lanes are only present on the northbound and southbound side of the roundabout. The eastbound and westbound sides 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 never a need to move from the inner to outer lane of the roundabout and there is not the concern of having to cross over a conflicting traffic movement. The City's consultant, Bartlett and West has been involved in several successful implementations of this style of roundabout.

Concern: Roundabout will not be safe for pedestrians.
Response: in most studies it has been determined that roundabouts are actually safer 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 a 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, 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. The intersection conflict diagram (Exhibit K), graphically shows the conflict locations for pedestrians for both an all-way stop and a roundabout. On-going 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.

Concern: 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 lower 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 crosswalks instead.

Concern: The project isn't necessary.
Response: 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. Exhibit L includes minutes from that Council meeting, a ballot fact sheet distributed to the public, and election results. The intersection is located in Ward 5, with 1,036 residents voting in favor of the sales tax renewal and 374 residents opposed the sales tax renewal.

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 future growth. As stated by many of the citizens at the IP meeting, 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. As previously stated, there were 13 collisions over a four-year period, where police collected collision data which included three injury accidents. 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, 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 of roadway construction to the south.

Concern: Cost of the project.
Response: The estimated construction cost for the roundabout is $957,900 and would be paid from the 0.25% Capital Improvement Sales Tax renewal initiative approved by voters.

Proposed Intersection Improvement: Roundabout or Traffic Signal:

Many verbal comments received at the IP meeting conjectured that residents from Country Club Villas would have difficulty entering the roundabout during peak traffic times and requested a signal at the intersection instead. A signal would also work at this intersection because the terrain is relatively flat and the sight distance is sufficient for either a roundabout or a signal. In addition, a roundabout or a signal would require similar additional right-of-way acquisition. A signal would provide residents of Country Club Villas a dedicated phase to enter the intersection by allocating time to that movement and delaying other movements. There was indication that many residents are over 60 years of age and do not feel that they would be able to navigate the roundabout during peak hour traffic. During construction, traffic control and constructability of the signal may be easier than the roundabout since some of the pavement may be able to remain in place. The estimated signal construction cost is $775,700. A drawing of the proposed signal layout is attached as Exhibit M.

Staff's opinion is that a roundabout is preferable over a signal at this intersection primarily for safety, but also for the following reasons:

- The 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 K) graphically shows the conflict locations for vehicles for both an all-way stop and a roundabout.
- In a study completed by the Transportation Research Board, 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, about an 80% reduction of injury crashes, and about a 90% reduction of fatal and incapacitating injury crashes. An abstract of this paper is attached as Exhibit N.
- A pedestrian crossing a double-lane signalized intersection faces seven potential vehicular conflicts, each coming from a different direction. A pedestrian crossing a 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. Pedestrians crossing the double-lanes in either scenario can be obscured from approaching vehicles in adjacent lanes if vehicles in the nearest lane yield to

them. The intersection conflict diagram (Exhibit J), graphically shows the conflict locations for pedestrians.

- Vehicular speeds are lower in a roundabout allowing more time for vehicles and pedestrians to react, which reduces the consequences of error.
- 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.
- Long-term maintenance costs are lower for a roundabout than a signal due to the electrical cost and operation/maintenance cost 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.
- 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.
- Roundabouts provide greater traffic flow benefits by reducing average vehicle delay and vehicle queuing compared to a signal.
- Roundabouts bring conflicting traffic streams into a steady flow and allow vehicles to merge without the stop-and-go conditions.
- Roundabouts eliminate left turns thus eliminating the delays caused by left-turning vehicles and the collisions caused by left-turn movements.

Exhibit O "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 double-lane roundabouts as well.

Fiscal Impact

Short-Term Impact: The estimated construction cost for the proposed roundabout is $957,900 and funding from 0.25% Capital Improvement Sales Tax. The estimated signal cost is 775,700.

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
08/01/2016	R103-16-Setting a public hearing for 9/6/16 for construction of the Forum & Green Meadows intersection improvement project.
04/28/2016	Interested Parties meeting

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Suggested Council Action

Following public input and Council discussion at the public hearing, Council should determine if a roundabout or signal should be constructed at the intersection and make a motion directing staff to proceed with final plans and specifications for the Green Meadows Road & Forum Boulevard intersection improvement project.