The Future of Roundabouts in Northeast Ohio

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The Future of Roundabouts in Northeast Ohio

Bret David Baker

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Advised by Dr. William Schneider IV
ABSTRACT

Roundabouts are a type of intersection that are growing in popularity in the United States within the Engineering Community. They are used to improve traffic flow, reduce side-impact collisions, and reduce energy-usage by removing the need of a traffic signal. Though they offer benefits in application, the public perception of them is negative. Northeast Ohio has seen an increase in the number of traditional intersections being converted to roundabouts. This research project served to analyze existing roundabouts in the area surrounding the University of Akron and predict whether there will be an increase or decrease in this kind of intersection in the subject area. This project was performed under the supervision of Dr. Schneider of the University of Akron. Photographs were captured of traffic navigating various intersections, and the design components of these roundabouts were examined. These photographs as well as additional information was implemented in potential teaching material for Dr. Schneider’s Highway Design class. In most applications, roundabouts reduce fatal crashes, improve traffic efficiency. From this research project, it is clear to see the benefits to roundabout utilization. Because of these benefits, there will likely be an increase in roundabouts in the Northeast Ohio region as well as greater Ohio.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>2</td>
</tr>
<tr>
<td>Introduction</td>
<td>4-5</td>
</tr>
<tr>
<td>Materials and Methodology</td>
<td>6</td>
</tr>
<tr>
<td>Analysis</td>
<td>7-28</td>
</tr>
<tr>
<td>Conclusions</td>
<td>29-30</td>
</tr>
<tr>
<td>References</td>
<td>31</td>
</tr>
</tbody>
</table>
INTRODUCTION

According to the National Cooperative Highway Research Program Report 672, Roundabouts: An Informational Guide, “a roundabout is a form of circular intersection in which traffic travels counterclockwise, as in the United States and other right-hand traffic countries, around a central island and in which entering traffic must yield to circulating traffic.” (National Cooperative Highway Research Program, 2010). Recently, there have been more and more roundabout intersections constructed not only in Ohio, but in the greater United States (Taub, 2015). There are many positives to roundabouts. They improve safety by reducing collisions, reduce delay and improve traffic flow, less expensive long term, and can sometimes save space for right of way on the approach to an intersection (Washington State Department of Transportation, 2020). Though they provide all these benefits, there are some cons to roundabouts and the public perception of them is dismal to say the least. Few drivers have experience navigating roundabouts. This means that a good driver who would have otherwise navigated a traditional intersection with ease may make a mistake and cause a collision in a roundabout.

Roundabouts also take up more space at the intersection than traditional methods, thereby requiring the taking of right of way. One last con to mention is the upfront cost. When installing a new roundabout, they usually take up more intersection space, therefore more right of way. Maintenance of Traffic during the construction is also more drastic because the intersection can’t be completed in pieces with lanes being open. A roundabout requires a complete detour from the original route.

For this research project and report, seven different roundabout intersections were visited with photographs taken at each location. The intersections of State Route 94 and Granger Road as well as Ridgewood Road and South Hametown Road were visited in the morning on Saturday February 15th. These intersections are in Medina and Copley. The intersections that were visited in Green, Ohio were Greensburg Road and Lauby Road near the Akron-Canton Regional Airport on Monday, February 17th, in the morning. Next, on Tuesday morning, February 18th, the intersections of Campus Center Street and
Johnston Drive that intersect with Summit Street in Kent, Ohio, on the campus of Kent State University were visited. Lastly, the Roundabout on State Route 619 and King Church Avenue was visited in the morning, on Saturday, February 29th, and this roundabout is adjacent to a major trip attracting store called Hartville Hardware and Hartville Kitchen. Each one of these roundabouts provided great design examples of the details of roundabouts. This report aims to highlight and describe the details of these roundabouts.
MATERIALS AND METHODOLOGY

For this project, the only tool that was used was a Canon EOS Digital Rebel XT Camera.

The methodology behind capturing photographs for this project was to capture vehicles of all shapes and sizes navigating through roundabouts and to try to obtain any instances of noncompliance as well as good designs. It was also desired to get a wide range of pictures with diversity in designs, traffic patterns, and settings. The goal was also to attempt to capture photographs during peak hours of the day for the locations. This mostly included weekday morning around rush hour, which is when most drivers are on the road. The only intersection that was not captured on a weekday was the roundabout on State Route 619 and King Church Avenue, which was taken on a Saturday. This however still produced viable photographs due to the proximity to Hartville Hardware and Hartville Kitchen, both of which attract large amounts of traffic on the weekend.

All the photographs taken were used to gain an understanding of how roundabouts work, study the designs of roundabouts in Northeast Ohio, and see how effective these roundabouts have been in performing the way they were designed too. In addition, these photographs will serve a dual purpose not only in this report, but in the future learning of students at the University of Akron as select pictures will be added to Dr. Schneider’s class slides in his Highway Design Class. He will also retain all photographs taken for any future scholarly purposes he sees fit. This amounts to over 600 photographs.
ANALYSIS

Challenges with Roundabouts

When it comes to implementing roundabouts in the United States, generally one of the biggest challenges is the public opinion. People do not like roundabouts. They think they are confusing, take more effort to make left turn movements, and are dangerous, mostly due to not knowing how to drive through them. However, it is often found that once a roundabout is installed and people have driven through them a couple times that they feel less opposed to them.

Another challenge to roundabouts is if the intersection is close to traditional intersections, railroad crossings, and if the approaches do not form close to ninety degrees with the intersecting road. With signalized intersections and railroad tracks, if the roundabout is close to these and they inhibit the flow of traffic, vehicles within the roundabout can back up and this stops all traffic movement within the roundabout. If the approaches do not come together at about ninety degree angles, this might make it hard for a car to make a right turn, or if the angle is obtuse, it enables the car to go through the roundabout too fast.

Lastly, a challenge that affects the implementation of roundabouts, is the amount of Right of Way that is required. They take up a larger footprint at the intersection. This might be a problem if buildings, structures, or other things are on the corners of the intersections.

Design Guides

There are multiple design guides to reference when designing roundabouts. There is the American Association of State Highway Transportation Officials A Policy on Geometric Design of Highways and Streets Book, or more commonly known as the AASHTO Green Book. However, this resource only provides a few pages of guidance in designing a roundabout. Another resource for Design is the Ohio
Department of Transportation Location and Design Manual Volume One. This is more extensive than the AASHTO Green Book and gives more guidance on the design of roundabouts such as position of approaches, inscribed diameter, and performance checks (Ohio Department of Transportation, 2020). This resource draws much of its information from the last, but most extensive resource for roundabouts, the National Cooperative Highway Research Program Report 672, Roundabouts: An informational Guide or NCHRP Report 672. The AASHTO Green book also points readers to this guide as well. This is a very in-depth resource to designing roundabouts and lays out everything from planning to construction of this type of intersection.

**Considering a Roundabout**

When considering putting in a roundabout in place of a traditional intersection, the NCHRP Report 672, lays out the workflow of this process. First, the municipality or engineer should consider the context of this proposed roundabout. Next, he or she must clarify the objectives. Following that, they must determine how many lanes would be required to replace the existing intersection. Then, simultaneously they must check the space requirements and compare alternatives such as adding a lane or retiming a signal. Following that they should assess other impacts and other opportunities. Finally, they draw a conclusion on whether a roundabout is preferred and/or feasible and worthy of advancing for additional analysis and design.

Along with this, the municipality or engineer should perform some calculations or methods to determine the capacity of the roundabout. They can either manually do calculations, use deterministic software methods, or simulation methods. Both the methods listed are based more on foreign countries data and research due to the lack of data in the United States.

**Capacity Calculation**
For calculating the capacity of a proposed roundabout, there can be multiple methods. These methods include manual calculations, deterministic software, or simulation methods. For manual calculations, the designer must make adjustments for vehicle fleet size using the following equation:

\[
v_{i,pe} = \frac{v_i}{f_{iw}}
\]

\[
f_{iw} = \frac{1}{1 + P_T(E_T - 1)}
\]

where
- \(v_{i,pe}\) = demand flow rate for movement \(i\), pc/h;
- \(v_i\) = demand volume for movement \(i\), veh/h;
- \(f_{iw}\) = heavy vehicle adjustment factor;
- \(P_T\) = proportion of demand volume that consists of heavy vehicles; and
- \(E_T\) = passenger car equivalent for heavy vehicles.

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>(E_T)</th>
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</thead>
<tbody>
<tr>
<td>Passenger Car</td>
<td>1.0</td>
</tr>
<tr>
<td>Heavy Vehicle</td>
<td>2.0</td>
</tr>
<tr>
<td>Bicycle</td>
<td>0.5</td>
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</table>

They then must calculate the entry capacity for each leg. This is determined using the following equations:

1 lane entry-1 lane conflicting
\[
c_{c,pe} = 1,130e^{(-1.0 \times 10^{-3})v_{c,pe}}
\]

1 lane entry-2 lanes conflicting
\[
c_{c,pe} = 1,130e^{(-0.7 \times 10^{-3})v_{c,pe}}
\]

2 lanes entry-2 lanes conflicting right lane
\[
c_{c,R,pe} = 1,130e^{(-0.7 \times 10^{-3})v_{c,pe}}
\]

2 lanes entry-2 lanes conflicting left lane
\[
c_{c,L,pe} = 1,130e^{(-0.75 \times 10^{-3})v_{c,pe}}
\]

\(c_{c,pe}\) = lane capacity, adjusted for heavy vehicles, pc/h; and
\(v_{c,pe}\) = conflicting flow, pc/h.

They can also use the following exhibit taken from NCHRP 672:
Designers should also perform calculations to determine the need for a right turn bypass lane which is best explained in the equations and text taken from NCHRP 672:

The capacity for a yielding bypass lane opposed by one exiting lane can be approximated using Equation 4-7.

$$c_{bypass,pe} = 1,130e^{-1.0 \times 10^{-3}p_{ex,pe}}$$

The capacity for a yielding bypass lane opposed by two exiting lanes can be approximated using Equation 4-8.

$$c_{bypass,pe} = 1,130e^{-0.7 \times 10^{-3}p_{ex,pe}}$$

where

- $c_{bypass,pe}$ = capacity of the bypass lane, adjusted for heavy vehicles, pc/h; and
- $p_{ex,pe}$ = conflicting exiting flow, pc/h.

Pedestrians should also be considered by the designer. The designer can use the following figures from NCHRP 672, both detailing out entry capacity adjustments for one lane entry and two lane entry:
Finally, the designer can evaluate the roundabout based on the Volume to Capacity Ratio. This equation is shown below:

$$x = \frac{V}{c}$$

Then they calculate Control delay, which, is shown below:
The volume to capacity ratio along with the control delay help the designer determine the level of service of the roundabout. The criteria taken from NCHRP 672 is shown below:

\[
d = \frac{3,600}{c} + 900T \left[ x - 1 + \sqrt{(x-1)^2 + \frac{3,600}{450T}} \right] + 5 \cdot \min(x, 1)
\]

where:
- \(d\) = average control delay, s/veh;
- \(x\) = volume-to-capacity ratio of the subject lane;
- \(c\) = capacity of subject lane, veh/h; and
- \(T\) = time period, h (\(T = 1\) for a 1-h analysis, \(T = 0.25\) for a 15-min analysis).

The other methods discussed above are used as well, however it should be noted that they are based much on data from countries outside of the United States and require calibration to local driver behavior, effective geometry, and lane use assignment, and they need checked for volume patterns.

**Design Software**

Though there are many different software packages on the market to design roundabouts, the two most common are Bentley OpenRoads Designer, and Autodesk Civil 3D. The Ohio Department of Transportation used Bentley Microstation for all their roadway plans, however they are in the midst of transitioning to Bentley OpenRoads Designer. To layout a Roundabout in this software, the user picks a cell from the library, places it, and then manipulates it to design the intersection. They also can draw the
roundabout by hand. In Autodesk Civil 3D, though ODOT prefers Bentley, some local municipalities will prefer Autodesk Civil 3D plans in Ohio, or other states that have different design standards. The tool to draw a roundabout in the plans for Civil 3D works by the user defining parameters for the roundabout, then selecting the intersecting alignments, then the design software automatically draws it in for the user. If the user wishes to change the roundabout, they can either manually edit the properties, or delete the roundabout and start over.

Goal: Slow Cars Down

There are many goals that roundabouts aim to accomplish, but one design goal is to make vehicles decelerate as they enter the roundabout and keep speed at a minimum while a vehicle is in the roundabout. Both those things are desired while also trying not to limit the efficiency of the flow of traffic. This is accomplished by several ways.

First, signs are used to warn drivers and encourage them to slow down. This can be seen in Figure 1 to the left. In this figure, the roundabout symbol is on a yellow sign with a suggested approach speed of fifteen miles per hour. The yellow catches the eye of the driver and the information is conveyed to the driver is a simple, ODOT standard manner. Another way that deceleration of approach vehicles is accomplished is through flashing lights. This can be LED lights that are inlaid in yield signs, much like red LED lights that surround the border of some stop signs. There are also roundabout signs with flashing yellow light above, below, or both above and below the sign. Lastly, the most common way of helping motorists slow down before they enter a roundabout is the use of lead-in curves. These are curves
designed to force a driver to slow down before they enter the roundabout because they must navigate these reverse curves, as well that these curves help line the driver up to go through the roundabout efficiently. This can be seen in Figures 2 and 3 below.

![Figure 2, State Route 94 and Granger Road](image)

![Figure 3, Greensburg Road and Lauby Road](image)

**Crash Analysis**

One major reason roundabouts are becoming more popular has to do with the aspect of safety. Though it must be conceded that not all intersections would benefit from transitioning a traditional stop sign or traffic signal intersection to a roundabout, most intersections would see a reduction in severe injury or fatal crashes. On average nationally, there was a 35% reduction in all crashes, 76% reduction in
injury/fatal crashes and an 89% reduction in injury/fatal crashes in rural environments at intersections that made the change to a roundabout (National Highway Institute 2017). Safety is also improved with lower speeds while traversing the intersection, fewer contact points, shorter crossing distances, and only one direction of travel at a time (National Highway Institute 2017). It is also estimated based on a study in 2004 that a 10% conversion of signalized intersections in the United States would have prevented approximately 51,000 crashes in 2018 including 231 fatal crashes and about 34,000 crashes involving injuries (Eisenman, et al., 2004).

**Roundabout Noncompliance**

Most noncompliance that comes from roundabouts is the result of drivers that are inexperienced with roundabouts. One type of noncompliance happens when a driver is attempting to make a left turn at an intersection and instead of traveling through the roundabout in a counterclockwise fashion, passing the right leg and through leg, they go clockwise and take the shortest distance to left leg of the intersection. This often only occurs at smaller, single lane roundabouts. Another type of noncompliance is when a vehicle approaching the roundabout does not yield to traffic already in the roundabout. This can result in property damage, however since cars within the roundabout are traveling slower, this rarely results in injury. Lastly, a common form of noncompliance that happens in multilane roundabouts is cars switching lanes while in the roundabout. Roundabout approach lanes are designed to set the driver up for their intended direction of travel. Usually the lane closes to the center of the roundabout is designated for

![Figure 4, State Route 619 and King Church Avenue](image1.png)

![Figure 5, State Route 619 and King Church Avenue](image2.png)
drivers making a left or through movement, whereas the lane further from the center is designated either solely for a right turn, or both a right turn and through movement. It can be seen in Figures 4 and 5 below that a car approaches the roundabout in the right turn only lane, and then progresses into the through lane within the roundabout. This type of noncompliance is dangerous like the other forms and could result in a side collision if another car in the roundabout was trying to go use the leg that the noncompliant car crossed.

**Pedestrians**

Another thing to consider when designing roundabouts is how to move pedestrians through them. Determination of the necessity for crosswalks or other forms of design for pedestrian movement is very similar for roundabouts as with conventional intersections. In the same fashion as few rural conventional intersections include crosswalks, walking beacons, or other tools rural roundabouts often do not include those things either. This can be seen in Figure 6.

Roundabouts can be very beneficial to pedestrians. Roundabouts are designed to slow vehicles down as they approach the intersection. It is also driver expectation to have to yield to traffic within the roundabout. Both these factors reduce the risk for pedestrians. The common design...
and use of islands in roundabouts are also beneficial to pedestrians. With the use of an island, a pedestrian only needs to focus on the direction of traffic to cross to the island, and then look the other way to leave the island. A typical crosswalk design can be seen in Figure 7. This shows a simple design where the cross walk is neither too close nor too far from the intersection. One downside to roundabouts however is the issues they create for blind or disabled pedestrians. Since the intersection usually requires a larger footprint, this creates crosswalks that are longer to traverse. Crosswalks also are slightly more complex than traditional intersection crosswalks that are normally just straight lines perpendicular to the road. Roundabout crosswalks can include slight bends and right angles, which are not typical of what blind pedestrians may be used to. These right angles can be seen in Figure 8 below.
The roundabouts on Kent State’s Campus are unique. With being in close proximity to a college campus,
a location that has large amounts of pedestrian traffic, the engineers knew that having a multilane roundabout would require additional attention to pedestrian design. In order to address this increased traffic they implemented High-Intensity Activated Crosswalk beacons or HAWK beacons. These beacons operate as shown in the following Figures 9-14.

The button that the pedestrian pushes to activate the beacon looks similar to any crosswalk button. There is a sign that informs the pedestrian how to cross. Vehicles then will see a flashing Yellow as shown above. This changes to a solid yellow, then solid double red, then alternating flashing red, to off. During the Flashing yellow, cars may still proceed through the crosswalk. During the solid yellow, cars should prepare to stop, similar to a standard traffic signal. During the double solid red phase, vehicles must stop. This allows eight seconds of time for the pedestrian to cross the road. The next phase is the alternating flashing red lights. During this phase a car may proceed through the crosswalk but must stop for any pedestrian traffic. Lastly, the beacon shuts off and remains off until another pedestrian presses the button to cross. For each button, traffic is only stopped in one direction. This means that if necessary, a pedestrian would have to wait for two different beacons to cross one leg of the intersection. It was observed on the Kent State Campus during the visit, that very few pedestrians used the HAWK beacon. Most did fine by waiting for gaps in traffic and crossing when the opportunity arose (KentStateTV, 2018).
Design for Bicycles

Bicycles are considered vehicles and should be in the road and intersections while sidewalks are meant for pedestrians. This is not what is applied with most roundabouts. Roundabouts often will utilize the
sidewalks surrounding the intersection and force users to dismount from their bicycle. This in turn makes them a normal pedestrian, which can then traverse the roundabout in that fashion. It is also unique to see the small sidewalks put in place to move bicyclists from the bike lane to the normal sidewalk. This can be seen in Figure 15. In this figure, one can see how the bike lane abruptly ends, and diverts the user on a thinner sidewalk, which leads to the main sidewalk. To further encourage bicyclists to dismount from their bike, the sidewalks in the island are jagged with sharp bends and ninety degree angles as observed earlier in Figure 8, as well as shown in Figure 16 to the below.

Curb Issues

The next thing to consider is curb design for roundabouts. Most roundabouts utilize a mountable truck apron on the center island before the curb for trucks and a normal curb on the outside. The goal of the truck apron is to give smaller vehicles boundaries in the roundabout and allow for a smaller roundabout, which is achieved because the apron allows trucks or bigger vehicles to drive up on the apron when needed. This is shown in Figures 17 and 18.
Even with this added area for trucks and trailers, there still are times when vehicles mount the curb. This can be due to oversized loads, faulty maneuvering from drivers, or poor design. Figure 19 shows tire tracks through the center island of a roundabout where the trailer mounted the curb. Figure 20 and 21 show damage caused to curbs, most likely from off track drivers.
Figure 20, Greensburg Road and Lauby Road

Figure 21, Summit Street and Campus Center Street
Landscape Design

Landscape Design around a roundabout is more in depth than traditional intersections due in part to the center island. The center island serves many roles and it is a crucial part of the roundabout. When designing the landscaping for the center of the roundabout, the engineer must account for the possibility of a vehicle driving through the center of the roundabout. There is a great opportunity to turn what would have been a sea of pavement for a traditional intersection into something that aesthetically pleasing to the road. In addition, by the making the landscaping in the center of the roundabout more eye-catching, it shifts the attention of the driver to the left, which is where their eyes need to be to check for oncoming traffic in the roundabout (City of Carmel, 2019). With all this in mind, the engineer is limited in what he should place in the center of the roundabout. Sometimes in design, the enter island landscaping is very minimal, either just grass, mulch, or stone. This increases the driver’s intersection sight distance, is usually easy to maintain or requires no maintenance, and keeps the construction costs down. It also makes the roundabout safe if a driver were to lose control of their vehicle and drive through the center island. When putting in landscaping, any poles, trees, or signs
should have a small diameter and if possible, have a breakaway base. Any flowers or bushes should be short to allow drivers to see across the circle. It can be seen in Figure 22 that there was once a light post in the center island but has broken off. In Figure 23, the landscaping includes trees with small bases, short bushes, and is stoned. This provides a visually appealing design that is safe and low maintenance.

**Drainage Design**

Though all intersections would benefit from being as level as possible, this is not always possible. This is one major setback to roundabouts. They must be as level as possible for easy traversing of traffic, while also providing adequate drainage capabilities. Roundabouts also take up a larger footprint at the intersection. This does not necessarily mean they create more impervious area than a traditional intersection when the center island is pervious, and the legs of the intersection take up less space. This is just something that needs to be considered. Also, some of the roundabout that were observed required large conduits and culverts to divert streams. This is shown in Figures 24 and 25.
Another challenge with drainage is the placement of catch basins. As shown in Figures 26 and 27, some catch basins have been placed on the truck apron, while others are placed in the approach and departure lanes.
Intersection Sight Distance

As mentioned in the landscape design section, intersection sight distance is important in roundabouts, just as with traditional intersections, however with roundabouts it is more important. This is because roundabouts involve continuous flow. Traffic yields to vehicles in the roundabout but does not come to a complete stop. This means that approaching vehicles need to be able to see any vehicles already navigating the roundabout, as well as approaching traffic in the left leg. Some examples of bad intersection sight distance can be found below in Figures 28 and 29. In both figures, though the intersection is visible and the driver has clear sight for the through leg, the right and left legs are blocked by grading or vegetation. Following are some examples of good intersection sight distance in Figures 30 and 31. Both locations have an open view of what is going on in the intersection and the legs entering the roundabout.
Driveways

One other aspect of design that was observed at some of the roundabouts was the placement of driveways. When designing roundabouts, there can be residential, commercial, or emergency response/other types of driveways that each pose unique requirements. Figure 32 shows how special consideration and design was given to a residential driveway. This way the resident could turn both ways out of their drive. If this break in the island wouldn’t have been added, they would have only been able to turn right into their driveway, and turn right to exit their driveway.

Figure 33 is unique in the fact that on the corner of the roundabout is a city of Green fire station. This probably meant that a fire truck was used as one of the design vehicles in this roundabout with both of their driveways being right on legs of the roundabout.

Figure 32, State Route 94 and Granger Road

Figure 33, Massillon Road and Steese Road.
CONCLUSIONS

After performing site visits to several roundabouts in the area surrounding the University of Akron as well as performing research, it can be concluded that roundabouts serve the purpose they were designed for in this part of Northeast Ohio, and will most likely continue to be designed and constructed in the future. They increase safety, efficiency, are a more cost-effective alternative to conventional intersections. It was clear to see how some roundabouts were better designed than others in the site visits, as well as the strengths and limitations of each roundabout. The rural roundabout on State Route 94 and Granger Road was very easy for drivers to maneuver, as well as improved efficiency and safety. The limitation to this roundabout was poor intersection sight distance on the northbound approach. The roundabout on Ridgewood Road and South Hametown Road in Copley was very minimalistic in design, which meant low construction cost and low maintenance, however it was very small and did not include crosswalks. Though there probably are not many tractor-trailers traveling on through this intersection, they probably would have some issues making left turns, as well as the lack of crosswalks seemed problematic with it being in proximity to a housing development as well as other residents close by. The next roundabout that was observed was Massillon Road and Steese Road in Green. This roundabout saw lots of traffic and operated efficiently. The limitation of this roundabout was that the northbound approach was on a steep grade leading to the intersection, which inhibited some visibility for drivers entering the roundabout. Following that roundabout was the intersection of Greensburg Road and Lauby Road in Green. This roundabout included unique traffic and was not designed well. There seemed to be lots of evidence where vehicles or trailers off tracked either into the center island, or outer curbs. This roundabout was adjacent to a large recreational vehicle dealership, close to the Akron-Canton Airport, and seemed to have a large amount of truck traffic, being on the route for vehicles to get on Interstate 77. It also did not have much warning signage to inform drivers that they were approaching a roundabout. The next two roundabout site visits were Summit Street and Campus Center Drive and the
intersection of Summit Street and Johnston Drive. Both roundabouts were special in being on the Campus of Kent State University in Kent, Ohio. With being on a college campus, they were both designed for heavy pedestrian traffic. They were designed very well and worked effectively at not hindering the movement of students getting from parking lots to their classes. The one constraint was the roundabout on Campus Center Drive was that a little over a tenth of a mile away is a traditional intersection with a traffic signal. When traffic was heavy on Summit Street, occasionally traffic would back up and the roundabout would be clogged. Lastly, the roundabout on State Route 619 in Hartville worked well, however it was noticed that cars had noncompliance at this roundabout. A few select cars would switch lanes within the roundabout. This is a new roundabout in terms of installation, so this could have been the result of drivers not being familiar with the intersection, or poor signage leading up to the roundabout. All in all, though, the intersection worked well and included a driveway from the Hartville Hardware store as well as what seemed to be a driveway for the church on the corner that had yet to be installed.

Overall, the roundabouts studied in this project each had their strengths and weaknesses, however they each perform the role they were intended to do. They provide safety, cost savings, and improve the flow of traffic. Due to this, the conclusion can be restated that there will more roundabouts being designed and constructed in Northeast Ohio in the future, as well as other regions in the country.
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