# Walnut Lane Traffic Circle Retrofit

By

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**ABSTRACT**

The Walnut Lane Traffic Circle was built in the early 20th Century in Philadelphia. The intersection was originally had a mix of stop-controlled and free-flowing movements. It was converted into roundabout control (yield-on-entry) around 2005, but no geometric changes were made. Geometric deficiencies with the current design include large curvature on some approaches and a lack of deflection, a circulatory roadway wider than one lane in some places, no truck apron, no crosswalks on intersection legs, no splitter island on one approach, and bicycle lanes on the circulatory roadway. At the request of the surrounding community, PennDOT developed improvement plans for the traffic circle and plans to construct them as part of a nearby bridge rehabilitation project.

The Walnut Lane Traffic Circle at the intersection of Walnut Lane and Park Line Drive was built in the early 20th Century in the Blue Bell Hill neighborhood in the City of Philadelphia. The circle borders a residential neighborhood to the east and a forested area to the west. Southwest of the traffic circle is Wissahickon Valley Park. Johnson Street, a residential westbound one-way street, intersects with the westbound approach 45 feet beyond the intersection. There is also a westbound bus stop on the approach. The eastbound and westbound approaches on Walnut Lane have posted speed limits of 30 mph; the southbound approach on Park Line Drive has a speed limit of 25 mph. The site location is shown in Figure 1.

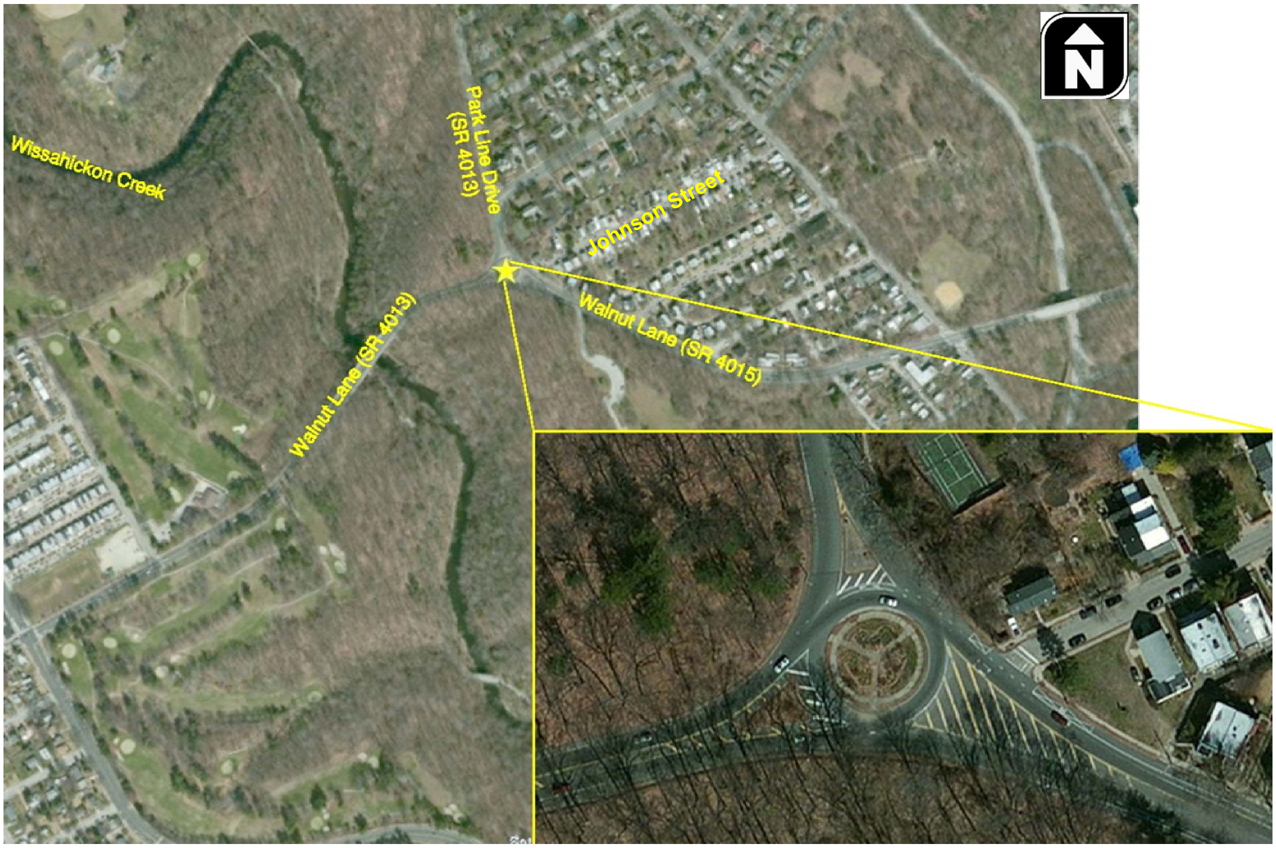


**Figure 1: Site Vicinity**

The intersection was originally a traffic circle with stop-control for Park Line Drive and free through movement on Walnut Lane. This control is shown in Figure 2. It was converted into roundabout control (yield-on-entry) around 2005, and the current geometry and pavement markings are shown in Figure 3.


**Figure 2: Stop-Controlled and Free-flowing approaches to traffic circle prior to 2005. (© Google Earth)**

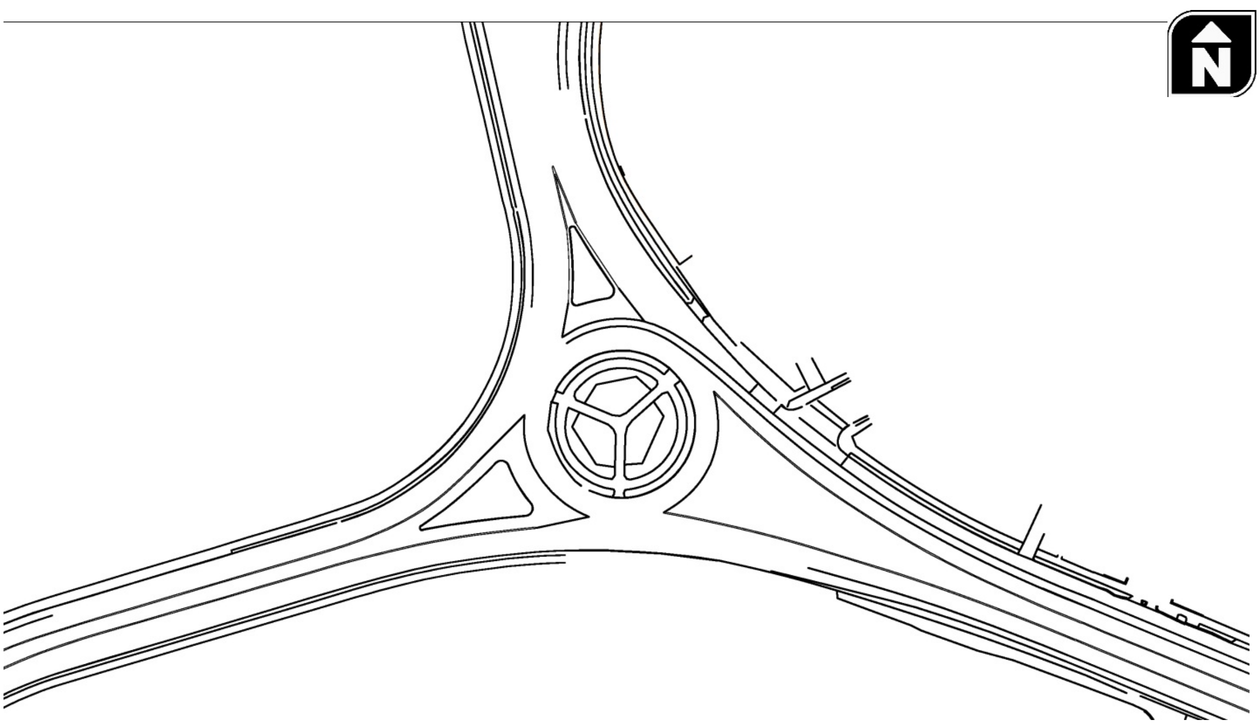


**Figure 3: Current circle configuration**

Although traffic control devices are now consistent with a roundabout, the geometry remains inconsistent with modern roundabout principles documented in *NCHRP Report 672 - Roundabouts: An Informational Guide, 2nd Edition*. Deficiencies include the following:

- The large radii of roadway curvature of some approaches and lack of deflection, as shown in Figure 4, allows vehicles to make through movements with little or no deflection or speed reduction. Fastest path speeds exceed the NCHRP Report 672 recommended threshold of 25 miles per hour for a single-lane roundabout
- The circulatory roadway is wider than one lane in some places despite all entries/exits having only one lane. As shown in Figure 5, this can confuse vehicle priority.
- There are no crosswalks on the intersection legs, and pedestrians are directed into the central island.
- The east leg, shown in Figure 6, does not have a splitter island. The roadway widens to approximately 100 feet near the traffic circle, making it difficult for pedestrians to cross this leg and travel between the residential area to the north and the park to the south. If a splitter island existed on this leg, it would restrict access from Johnson Street. Johnson Street is one-way southbound (towards the circle area), and left and right turns from Johnson Street to Walnut Lane are currently permitted.
- The bicycle lane on Walnut Lane continues into the circle between the westbound approach and the southbound approach. Bike lanes are not recommended in the circulatory roadway at roundabouts, because it encourages bicyclists to ride at the outside of the circulatory roadway where they are at greater risk of being struck by entering or existing vehicles. If bicyclists remain in the roadway at a roundabout, NCHRP Report 672 recommends they be directed to operate and travel like a vehicle, or that they dismount and use the sidewalk.
- Large vehicles appear to off-track into the central island. Damaged central island curb is shown in Figure 7.

These deficiencies make it challenging for pedestrians to cross roadways in vicinity of the circle, and have created maintenance issues.


**Figure 4: Lack of deflection on west leg entry**


**Figure 5: Wide lanes confuse priority**

**Figure 6: Wide roadway and lack of splitter island on east leg**

**Figure 7: Damaged central island curb**

PennDOT District 6-0 initiated design activities for rehabilitation of the historic Walnut Lane bridge over Wissahickon Creek in Philadelphia, and held a public meeting in the Blue Bill Hill neighborhood. At the meeting, residents expressed a desire for improvements to the traffic circle to be made in conjunction with rehabilitation of the bridge, and PennDOT agreed. Proposed improvements to the circle, described later in this paper, address the issues identified above.

## TRAFFIC VOLUME AND ANALYSIS

Recent and historical average daily traffic (ADT) for Walnut Lane indicated growth between the late-1970s and mid-1990s, and little change between the mid-1990s and the present. The most recent ADT and heavy vehicle percentages available for Walnut Lane are shown in Table 1. ADT for Park Line Drive was not available.

**Table 1: Average Daily Traffic and Heavy Vehicle Percentages**

| Leg | ADT | Heavy Vehicle Percentage | Year |
|---|---|---|---|
| Walnut Lane East of Circle | 8,300 | 7% | 2009 |
| Walnut Lane West of Circle | 17,300 | 4% | 2011 |
| Park Line Drive | Unavailable | | |

Turning movement counts were collected on a mid-week day in June, 2013 when City of Philadelphia schools were in session. The peak hour turning movement counts are shown in Figure 8.

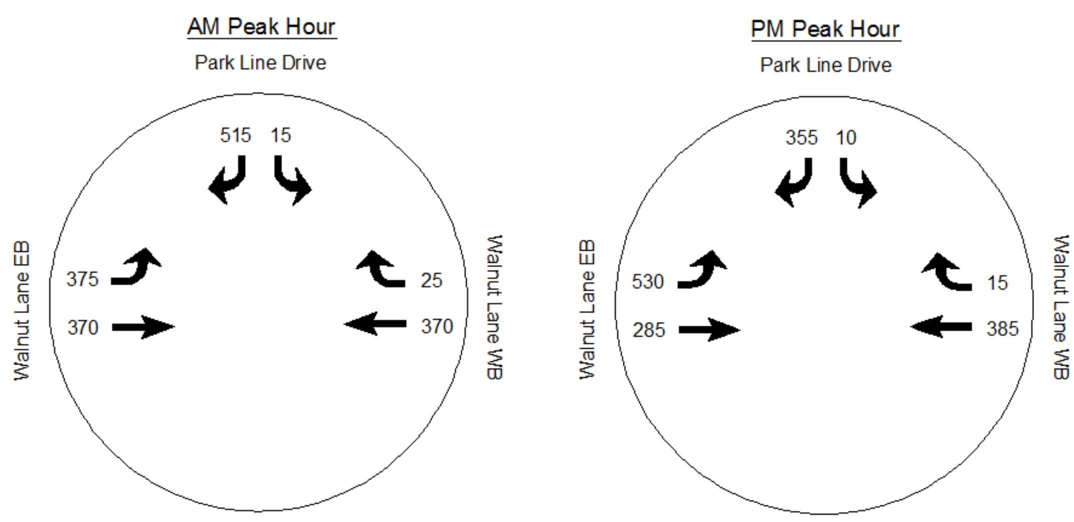


**Figure 8: Existing Turning Movement Counts**

HCS 2010 software was used to assess operations of a single-lane roundabout. Although the circle lacks many design features of a modern roundabout, it operates like one from a traffic analysis perspective due to the yield-on-entry control. Roundabouts are generally considered to operate acceptably if the volume-to-capacity (v/c) ratio of each entering leg is 0.85 or less. LOS, delay and v/c are shown in Table 2.

**Table 2: Performance Measures for Single-Lane Roundabout**

| Time Period | Approach | V/C | LOS | Delay |
|---|---|---|---|---|
| AM Peak | SB | .80 | D | 26.3 |
| | WB | .60 | C | 15.4 |
| | EB | .76 | C | 16.9 |
| PM Peak | SB | .50 | B | 12.0 |
| | WB | .64 | C | 18.2 |
| | EB | .76 | C | 16.5 |

As shown in Table 2, a single-lane roundabout operates acceptably under current traffic volumes. Little to no growth in traffic volume is anticipated. The intersection is located in a built-out, urban area and a review of historical tube counts on Walnut Lane indicates very little growth in the last 15 years. Therefore, a single-lane roundabout is expected to operate acceptably for the design life of any proposed improvements.

## CRASH HISTORY AND SAFETY ANALYSIS

In the years 2009 to 2012, four crashes occurred in the traffic circle area. Three were fixed object crashes, and one was a rear-end crash. Two crashes were property damage only, one crash was a moderate injury, and one was an unknown injury. It is expected that the proposed geometric improvements, which will result in the slowing of vehicles, will improve safety in the traffic circle. Construction of curbs will also decrease the frequency at which vehicles leave the roadway. The crashes are summarized in Table 3, and depicted in Figure 9.

**Table 3: Traffic Circle Crash History, 2009 - 2012**

| ID | Date & Time | Light | Road Surface | Severity | Type | Driver Actions |
|---|---|---|---|---|---|---|
| 1 | Sunday 6/7/2009 3:59 a.m. | Street Lights | Dry | PDO | Fixed Object (utility pole) | Distracted |
| 2 | Thursday 10/1/2009 12:00 p.m. | Daylight | Dry | Moderate Injury | Fixed Object (guard rail) | Unknown |
| 3 | Tuesday 12/6/2011 4:20 p.m. | Daylight | Wet | PDO | Fixed Object (barrier) | Too fast for conditions |
| 4 | Monday 3/12/2012 | Street Lights | Dry | Unknown if Injured | Rear End | 1) Other improper actions , 2) distracted |

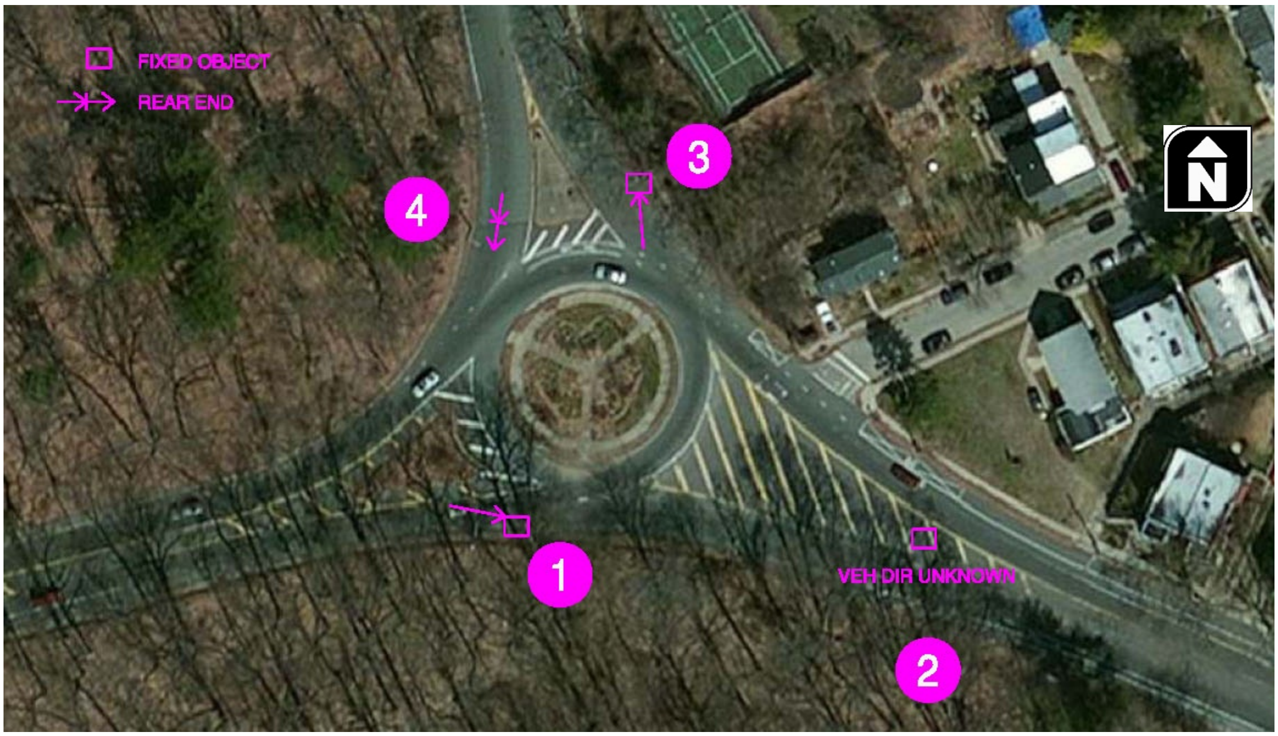


**Figure 9: Diagram of Crashes, 2009-2012**

Note: Numbers correspond to “ID” values in Table 3.

The crash rate for the roadways passing through the traffic circle is several times lower than the statewide average crash rate for roadways with the same functional classification. While data does not indicate a poor safety performance, the community identified safety as a concern at the start of the project. Specifically, the current circle is uncomfortable for pedestrians and bicyclists, and discourages travel by these modes.

Fastest paths approximate the centerline of a vehicle traveling through a roundabout in the absence of other traffic to estimate the fastest speeds that drivers could achieve. They serve as a surrogate safety measure for roundabouts. The fastest paths were drawn for the existing design and are summarized in Table 4. The recommended maximum speed at a single-lane roundabout per NCHRP Report 672 is 25 miles per hour.

**Table 4: Fastest Paths of Existing Traffic Circle**

| Approach | Curve | Radius (feet) | Speed (mph) |
|---|---|---|---|
| Eastbound | R1 | 900 | **>34** |
| | R4 | 50 | 16 |
| | R5 | 800 | **>34** |
| Westbound | R1 | 700 | **>34** |
| | R2 | 80 | 19 |
| | R3 | 220 | **28** |
| | R5 | 700 | **>34** |
| Southbound | R1 | 300 | **31** |
| | R4 | 50 | 16 |
| | R5 | 220 | **28** |

**BOLD** indicates speeds higher than limit of 25 mph

As shown in Table 4, all but three of the fastest path speeds in the existing traffic circle exceed the recommended 25 mph threshold. The only speeds that are acceptable are circulating speeds; all of the entry speeds exceed 30 mph. As such, there is a high speed differential between circulating vehicle and entering vehicles.

## PROPOSED IMPROVEMENTS

A concept improvement plan was developed to address the deficiencies with existing traffic circle noted at the start of this memo. Key elements of the proposed improvements include the following:

- Outside curbs on the entries and exits are moved in to narrow lane widths, increase deflection, provide speed control, and shorten pedestrian crossing distances.
- The splitter island on the west leg is relocated to increase deflection and provide speed control.
- A splitter island is added on the east leg.
- The bicycle lane is removed from the roundabout, and striping directs bicyclists to ride in travel lanes within the roundabout.
- Pedestrian crossings and curb ramps are added on each leg.
- A truck apron is added to the central island. The inside edge of the truck apron is located at the current inside edge of pavement of the sidewalk. The truck apron will accommodate WB-67s and removal of the sidewalk will discourage pedestrians from using the central island.
- Bus stops were moved outside of the circle
- Johnson Street, which is currently one-way southwestbound, is converted to right-out access.

These improvements are shown in Figure 10.

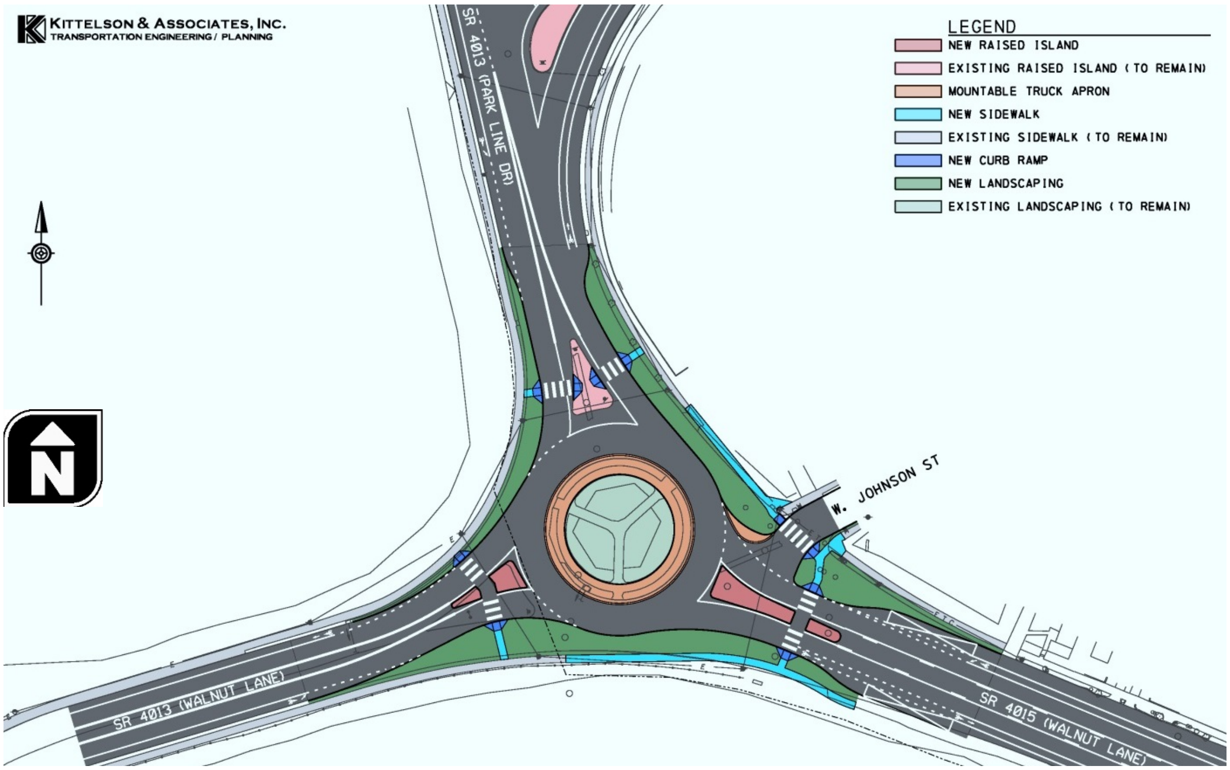


**Figure 10: Concept Improvements**

The concept plan shown in Figure 10 was presented to the Blue Bill Hill Civic Association in October 2013. Residents of Johnson Street raised several concerns related to emergency vehicle access and traffic flow in the event of a broken down vehicle within the circulatory roadway. In response to these concerns, the splitter island on the east leg (in front of Johnson Street) was changed to a mountable design to allow left-turns by emergency vehicles.

Final design of these improvements is currently underway, and construction is planned to occur concurrently with the Wissahickon Creek bridge rehabilitation.

**ACKNOWLEDGEMENT**

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**REFERENCES**

Transportation Research Board. *NCHRP Report 672: Roundabouts: An Informational Guide*. 2nd Ed. Transportation Research Board, National Research Council: Washington, DC, 2010.