
**SCAN TEAM REPORT**

NCHRP Project 20-68, Scan 23-01

# Experiences in the Use of Mini and Modular Roundabouts by Highway Agencies

*Supported by the*

National Cooperative Highway Research Program

The information contained in this report was prepared as part of NCHRP Project 20-68 U.S. Domestic Scan, National Cooperative Highway Research Program.

# Acknowledgments

The work described in this document was conducted as part of NCHRP Project 20-68, the U.S. Domestic Scan program. This program was requested by the American Association of State Highway and Transportation Officials (AASHTO), with funding provided through the National Cooperative Highway Research Program (NCHRP). The NCHRP is supported by annual voluntary contributions from state Departments of Transportation. Additional support for selected scans is provided by the U.S. Federal Highway Administration and other agencies.

The purpose of each scan, and of Project 20-68, is to accelerate beneficial innovation by facilitating information sharing and technology exchange among the states and other transportation agencies and identifying actionable items of common interest. Experience has shown that personal contact with new ideas and their application is a particularly valuable means for such sharing and exchange. A scan entails peer-to-peer discussions between practitioners who have implemented new practices and others who are able to disseminate knowledge of these new practices and their possible benefits to a broad audience of other users. Each scan addresses a single technical topic selected by AASHTO and the NCHRP 20-68 Project Panel. Further information on the NCHRP 20-68 U.S. Domestic Scan program is available at https://www.trb.org/NCHRP/USDomesticScanProgram.aspx

This report was prepared by the scan team for *Domestic Scan 23-01: Experiences in the Use of Mini and Modular Roundabouts by Highway Agencies*, whose members are listed below. Scan planning and logistics are managed by Arora and Associates, P.C.; Harry Capers is the Principal Investigator. NCHRP 20-68 is guided by a technical project panel and managed by Sid Mohan, NCHRP Program Officer. As subject matter expert, Zachary Bugg was assisted by other members of Kittelson & Associates, Inc. in reviewing the desk scan. These included Andy Duerr, Justin Bansen, and Lee Rodegerdts.

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# Disclaimer

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# Scan 23-01

## Experiences in the Use of Mini and Modular Roundabouts by Highway Agencies

**REQUESTED BY THE**

**American Association of State Highway and Transportation Officials**

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**February 2025**

The information contained in this report was prepared as part of NCHRP Project 20 68 U.S. Domestic Scan, National Cooperative Highway Research Program.

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# Abbreviations and Acronyms

| | |
|---|---|
| **AADT** | Annual Average Daily Traffic |
| **AASHTO** | American Association of State Highway Transportation Officials |
| **ACEC** | American Council of Engineering Companies |
| **AMPO** | Association of Metropolitan Planning Organizations |
| **DOT** | Department of Transportation |
| **FHWA** | Federal Highway Administration |
| **GDOT** | Georgia Department of Transportation |
| **ICD** | Inscribed Circle Diameter |
| **ITE** | Institute of Transportation Engineers |
| **MnDOT** | Minnesota Department of Transportation |
| **NCDOT** | North Carolina Department of Transportation |
| **NCHRP** | National Cooperative Highway Research Program |
| **ROW** | Right of Way |
| **SS4A** | Safe Streets and Roads for All |
| **SWM** | Storm Water Management |
| **TRB** | Transportation Research Board |
| **VDOT** | Virginia Department of Transportation |
| **WCRC** | Washtenaw County Road Commission |
| **WSDOT** | Washington State Department of Transportation |

# Executive Summary

While roundabouts continue to be a proven solution for addressing safety and efficiency at intersections in the U.S., the increasing costs of construction and right-of-way needs for conventional roundabouts have increased momentum of the mini roundabout as a viable option in favor of the traditional roundabout. By definition, a mini roundabout is a type of roundabout in which the central island is fully traversable and intended to be utilized by trucks or other large vehicles. This reduces the footprint of the intersection, and mini roundabouts can often be retrofitted within existing intersection footprints. Approximately 300 mini roundabouts with fully traversable central islands have successfully been constructed in the U.S., and states with eight or more mini roundabouts include Washington, Minnesota, North Carolina, Texas, Maryland, Michigan, Kentucky, Georgia, Ohio, Colorado, Arkansas, and Oregon. These states' general experiences with mini roundabouts have been overwhelmingly positive.

A modular roundabout is a specialized roundabout that incorporates prefabricated materials to reduce excavation, paving and drainage work, environmental impacts, utility and right-of-way impacts, construction duration, and ultimately, cost. The modular material is typically used for the central island and splitter islands but may also be used for outside curbing. The material is glued or anchored on top of existing pavement. In addition to these custom-made materials, modular roundabouts employ striping and may include quick-build curbs and flex-posts to delineate vehicle paths. Modular roundabouts are less common in the U.S., but several have been constructed in California, Georgia, North Carolina, Virginia, and Wisconsin. Most modular roundabouts have been received positively by agency staff and the public.

The objective of the domestic scan was to identify leading states and describe the experiences and lessons learned that may be valuable to others who may be considering using mini or modular roundabouts. The scope of the scan included a range of topics for each form of roundabout, including the following:

- Capacity and traffic efficiency data,
- Crash history (before and after),
- Design and performance checks,
- Construction costs,
- Installation and construction timeline,
- Maintenance, and
- Public/community acceptance.

This scan consisted of two phases. In the first phase, a desk scan was prepared to identify municipal, state, and federal agencies that have experience with mini or modular roundabouts. During this phase, the scan team prepared a set of amplifying questions for invited agencies to help structure their responses. The second phase included a four-day virtual workshop with the invited agencies. A total of nine agencies participated in the scan and were invited to not only give presentations of their experiences but also to join roundtable discussions with the scan team members. At the end of each day of the virtual workshop, the scan team met to debrief the day's activities and identify key themes and findings. After the four-day workshop was completed, the scan team met to recap the entire workshop and compile a summary of thoughts.

Table ES-1 provides a summary of the key findings and recommendations for mini roundabouts, and Table ES-2 provides a summary of the key findings and recommendations for modular roundabouts.

| | Key Findings | Recommendations |
|---|---|---|
| General | Mini roundabouts have been successfully applied across the United States by various agencies and should continue to be considered when costs or right-of-way constraints rule out larger roundabouts.<br>"Compact" roundabouts have reemerged as a promising type of roundabout for some agencies. These generally have an inscribed circle diameter between 65 and 120 feet, with a portion of the central island being non-traversable. Mini roundabouts with diameters generally under 90 feet and with entirely traversable central islands can be considered a subset of compact roundabouts. | More specific design guidance, strategies, and performance reviews for "compact" roundabouts are needed. |
| Capacity | Although a range of capacity models are used to evaluate mini roundabouts, there was a general conjecture that mini roundabouts have a lower capacity than larger single-lane roundabouts due to their small size, which limits the ability of an entering driver to find an acceptable gap in circulating traffic. | Updated capacity models for mini roundabouts are needed.<br>Additional guidance on intersection control evaluation is needed. |
| Crash History | Mini roundabouts have reduced fatal and severe injury crashes, as well as angle crashes, compared to two-way stop control, but not as effectively as conventional single-lane roundabouts. The documented safety performance of mini roundabouts relative to all-way stop control is limited, but mini roundabouts have generally experienced more crashes than all-way stop control intersections across a range of severities and locations. | While the crash performance of mini roundabouts is well documented, additional before and after data and studies for mini roundabouts will continue to help support their consideration as a viable alternative in certain circumstances. |

| | Key Findings | Recommendations |
|---|---|---|
| Design and Performance Checks | Entry fastest path speeds generally fell between 20 and 25 mph, with some agencies willing to accept higher speeds to avoid increasing the footprint of the intersection.<br>The use of a 75- to 90-foot inscribed circle diameter can accommodate a wide range of vehicles without making splitter islands mountable or having vehicle cabs mount the central island.<br>Mini roundabouts have been applied broadly in both urban low-speed environments and on rural/suburban high-speed roadways. | Mini roundabouts have generally performed well for pedestrian and bicyclists if the design guidance and best practices for conventional roundabouts are applied.<br>General post-construction observations or "in-service review" results could be shared between agencies to help document performance and changes that were made to keep mini roundabouts effective. |
| Cost | Mini roundabouts are almost always less expensive than larger roundabouts. Costs range from $100,000 to $400,000 if the footprint of the intersection can be minimized, and $350,000 to $1,400,000 if right-of-way and utilities are impacted, which is still generally less than half the cost of a larger conventional roundabout. | More detailed cost information, including breakdowns by design and construction, is needed. |
| Installation and Construction Timeline | Mini roundabouts can reduce the design and construction timeline due to their simplified design and fewer impacts.<br>For retrofit applications, it is preferable to close the intersection completely during construction. | |
| Maintenance | Agencies from snow-prone climates indicated mini roundabouts perform well under winter weather so long as smaller plowing equipment was available to remove snow.<br>Lower-profile (less than three inches) central islands may be less visible to snow plow operators and present an obstacle during snow removal. | Design guidance for mini roundabout sizing for winter maintenance is needed. |
| Public and Agency Response | Most public reactions were positive, especially due to the lower cost and shorter implementation timeframe for mini roundabouts.<br>Most negative feedback was related to the visibility of the central island, especially at night. | Design guidelines for mini roundabouts should be updated to include recommended treatments for providing visibility of the central island. |

*Table ES-1: Mini roundabout key findings and recommendations*

| | Key Findings | Recommendations |
|---|---|---|
| General | Modular roundabouts are a promising emerging treatment that have been constructed in at least five states, and they should be considered when costs or construction timelines rule out more permanent conventional designs.<br>Two agencies took a programmatic approach toward screening and installing modular roundabouts, with the benefit of building modular roundabouts in batch installments (multiple locations at a time).<br>To date, modular roundabout applications in the U.S. have been built as retrofits within the existing intersection footprint by reducing the number of lanes and/or reducing outside curb radii. | Additional research on prioritization is needed, especially when a modular roundabout is constructed as an interim solution but results in the project no longer scoring well for permanent installation. |
| Crash History | The general safety benefits of modular roundabouts are likely similar to mini roundabouts.<br>Before and after crash data has been mixed or limited, with two installations experiencing similar crash trends to two-way stop control, one installation experiencing no crashes after one year, and one installation experiencing no crashes after four years. | As reported crash data become available for modular roundabouts, before and after data for should be compared for any emerging trends. |
| Design and Performance Checks | Entry fastest path speeds generally fell between 20 and 25 mph, with some agencies willing to accept higher speeds to avoid increasing the intersection footprint.<br>Design vehicles ranged from city buses to WB-67 trucks for major routes, with modular elements rated for 80,000 pounds.<br>Modular roundabouts function similarly to mini roundabouts or compact roundabouts, where large trucks roll over either all or a portion of the central island. | General post-construction observations or “in-service review” results could be shared between agencies to help document performance and changes that were made to keep modular roundabouts effective. |

| | Key Findings | Recommendations |
|---|---|---|
| Cost | Year 2020-2023 costs ranged from $30,000 to $500,000 (including design and construction) if no permanent materials are used and impacts can be limited to the existing curb space of the intersection.<br>One concern for some agencies was that there appears to be only one viable vendor for modular roundabout materials, which may create challenges with procurement. | More detailed cost information including breakdowns by design and construction is needed.<br>There is a need to identify additional vendors for modular roundabout elements. |
| Installation and Construction Timeline | Modular materials may require several months from order to delivery from a vendor.<br>Construction timelines have ranged from two to five days if impacts are limited, with other locations taking one to four weeks to construct.<br>Incorporating preliminary engineering and design time, the project development timeline can be reduced by 50% or more compared to conventional permanent roundabouts. | |
| Maintenance | Modular materials have stood up well to truck traffic and can easily be replaced along the outside of truck aprons or splitter islands if damaged.<br>Winter maintenance was a concern raised by agencies who have not yet implemented modular roundabouts, as there has been limited documented experience with snow removal. | More applications and design guidance for modular roundabout installation and maintenance in snow-prone climates are needed.<br>Agencies may want to consider procuring additional replacement parts as spares that can be used to address damaged modular roundabout pieces over time. |
| Public and Agency Response | Most modular roundabouts have been installed in communities where the public already supports roundabouts.<br>Most negative public feedback has been related to the small size, lack of landscaping, and general lesser aesthetic of the modular roundabout elements compared with more permanent materials.<br>The public has raised concerns over the visibility of the central island, especially at night. | |

*Table ES-2: Modular roundabout key findings and recommendations*

# Introduction

While roundabouts continue to be a proven solution for addressing safety and efficiency at intersections in the U.S., the increasing costs of construction and right-of-way have increased momentum of the mini roundabout as a viable option in favor of the traditional roundabout. The Federal Highway Administration defines a mini roundabout **(Figure 1-1)** as a type of roundabout in which the central island is fully traversable and intended to be utilized by trucks or other large vehicles, with an Inscribed Circle Diameter (ICD) at or below 90 feet[1]. Mini roundabouts can often be constructed within existing intersection footprints. Approximately 300 mini roundabouts with a fully traversable central island have been constructed in the U.S., and states with eight or more mini roundabouts include Washington, Minnesota, North Carolina, Texas, Maryland, Michigan, Kentucky, Georgia, Ohio, Colorado, Arkansas, and Oregon[2].


*Figure 1-1. Mini roundabout in Benson, North Carolina (Source: NCDOT Division 4)*

A modular roundabout (**Figure 1-2**) is a specialized roundabout that incorporates prefabricated materials to reduce excavation, paving and drainage work, environmental impacts, utility and right-of-way impacts, construction duration, and ultimately, cost. The modular material is typically used for the central island and splitter islands but may also include outside curbing. The material is glued or anchored on top of existing pavement. In addition to these custom-made materials, modular roundabouts employ striping and may include quick-build curbs and flex-posts to delineate vehicle paths. Modular roundabouts are less common in the U.S., but several have been constructed in California, Georgia, North Carolina, Virginia, and Wisconsin.

1 Guide for Roundabouts | The National Academies Press

2 http://roundabouts.kittelson.com


*Figure 1-2. Former modular roundabout in Jackson, Georgia (Source: GDOT)*

The objective of the scan is to identify leading states and describe the experiences and lessons learned that may be valuable to others who may be considering using mini or modular roundabouts.

## Scan Focus Areas

The scope of the scan included a range of topics for each form of roundabout, including the following:

- Capacity and traffic efficiency data,
- Crash history (before and after),
- Design and performance checks,
- Construction costs,
- Installation and construction timeline,
- Maintenance, and
- Public/community acceptance.

## Desk Scan

This scan consisted of two phases. In the first phase, a desk scan was prepared to identify municipal, state, and federal agencies that have experience with mini or modular roundabouts. During this phase, the scan team prepared a set of amplifying questions for invited agencies to help structure their responses. The final list of amplifying questions is provided in **Appendix C**, and the Desk Scan document is provided in **Appendix D**.

## Invited Scan Agencies

The second phase included a four-day virtual workshop with the invited agencies. A total of nine agencies participated in the scan and were invited to not only give presentations of their experiences but also to listen and join roundtable discussions with the scan team members. At the end of each day of the virtual workshop, the scan team met to debrief the day's activities and identify key themes and findings. After the four-day workshop was completed, the scan team met to recap the entire workshop and compile a summary of thoughts.

The agencies interviewed in the scan included the following:

- City of McKinney, Texas
- City of San Diego, California
- Federal Highway Administration
- Georgia Department of Transportation
- Minnesota Department of Transportation
- North Carolina Department of Transportation
- Virginia Department of Transportation
- Washington State Department of Transportation
- Washtenaw County, Michigan

The host agency contact information is provided in Appendix E.

## Scan Team

A 10-member scan team from six state departments of transportation (DOTs), the Federal Highway Administration (FHWA), and Kittelson & Associates, Inc. participated in the domestic scan effort. The team members included the following:

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- Anyesha Mookherjee, FHWA Office of Safety
- Zachary Bugg, PhD, PE, Kittelson & Associates, Inc., Subject Matter Expert

**Appendix A** contains the contact information for the scan team members, and Appendix B provides biographical sketches for the scan team. **Figure 1-3** illustrates the range of states represented by scan team members and invited scan host agencies.

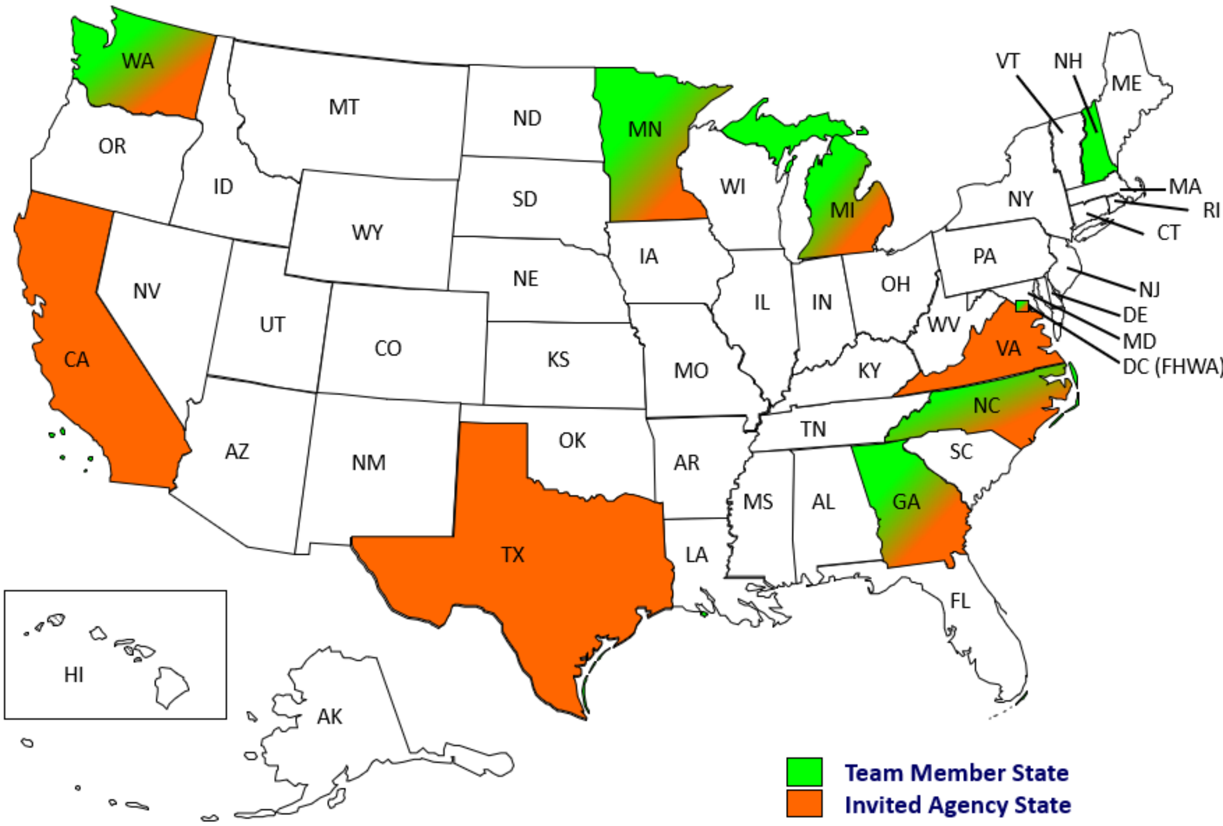


*Figure 1-3. States represented by scan team members and host agencies*

# Summary of Information

This chapter provides a summary of each agency interviewed during the virtual workshop. While not all agencies responded to all amplifying questions in writing, the scan team was attentive to whether each question had been answered during the virtual workshop and recorded diligent notes. The following summaries for each agency are organized by roundabout type (mini roundabout or modular roundabout, with some agencies covering both) and provides a general overview of the organization and their key successes and lessons learned. A more general summary of key findings across all agencies is provided in **Chapter 3**.

## Mini Roundabouts

### City of McKinney, Texas

The City of McKinney has recently experienced an explosion in population and currently has approximately 220,000 residents, with expected population growth to nearly 300,000 by the year 2040. The City began experimenting with mini roundabouts in 2013/2014 and created their first "Residential Mini/Traffic Circle" standard detail in 2016. City leaders have identified the roundabout, including mini roundabouts, as an effective solution to enhance traffic calming and safety in residential communities of the city while preserving aesthetics, and they have been successful in implementing roundabouts through private development. The City currently has 24 single-lane and two multilane conventional roundabouts, as well as 10 mini roundabouts, with many more in design or construction. While the City does not yet have a "roundabout-first" intersection control evaluation policy, the City has its own engineering standards and specifications for mini roundabouts included in their Engineering Design Manual that are intended to support implementation.

Some of the lessons the City has learned with mini roundabouts include the following:

- The central island profiles of many of the existing mini roundabouts are too low (three-inch curb with one percent slope) to be visible. Some passenger vehicles such as pick-up trucks have even driven straight over the central island due to the limited vertical deflection.
- It is critical to have the support of local emergency responders. Each fire station has its own design vehicle and the City has supported a multitude of testing of those design vehicles within both the design and the construction phases of roundabout implementation.
- Educational activity books have proven successful for public engagement and have garnered statewide attention. The City provides all materials in both English and Spanish. While these materials were not developed specifically for mini roundabouts, their use in conjunction with the City's mini roundabout program has helped generate public support.
- Roundabouts can be viewed as unfriendly by developers due to the additional design time, construction time, and cost, so it is important to continually emphasize the benefits of roundabouts over what may be less expensive but less effective alternatives.

## Federal Highway Administration

FHWA provided an overview of mini roundabout installation and national guidance. Nationwide, over 300 mini roundabouts with fully traversable islands have been installed, with large growth in the past 10 to 12 years as an outcome of positive performance. The first FHWA roundabout guide described multiple roundabout types and distinguished between mini, urban compact, and urban single-lane roundabouts, with a range of daily design volume for each. The second FHWA roundabout guide, NCHRP Report 672, combined mini and compact roundabouts into a single design form. Published in 2023, NCHRP Report 1043 reintroduced the distinction between mini and compact roundabouts.

FHWA developed the most widely used capacity model for mini roundabouts, which was based on microsimulation [3]. In 2016, FHWA prepared a case study synthesis of 15 mini roundabouts, with all sites constructed between 2011 and 2015 and ICDs ranging from 40 to 90. At the time, most sites could be constructed for under $100,000 each [4].

At the conclusion of the presentation, FHWA highlighted a series of research needs to consider:

- The safety of mini roundabouts (or compact roundabouts) compared to two-way stop control or all-way stop control.
- Capacity model updates for mini and compact roundabouts.
- Design guidance updates for mini roundabouts focusing on curb dimensions.
- Additional best practices and guidance on “right-sizing” projects.
- Updated comprehensive cost information for roundabouts.
- How to address approach speeds with geometry and to enhance visibility via lighting, signing, and marking.
- A comparative analysis of two-way stop control, all-way stop control, traffic signal, and roundabout cost and performance in various locations.
- Additional design vehicle guidance and applications or tools specific to mini roundabouts.
- Techniques or best practices for communicating the benefits of mini roundabouts to the public.

## Georgia Department of Transportation

GDOT has completed 13 mini roundabout projects on state routes, with one in project development. An additional five sites have been implemented as part of their quick-response program, which is capped at a $500,000 cost for implementation in 90 days. The GDOT roundabout design guide defines a mini roundabout typical size as 70- to 90-foot ICD with a fully mountable central island (**Figure 2-1**).

3 They’re Small But Powerful | FHWA

4 FHWA Mini Roundabout Case Study (2010-2016)

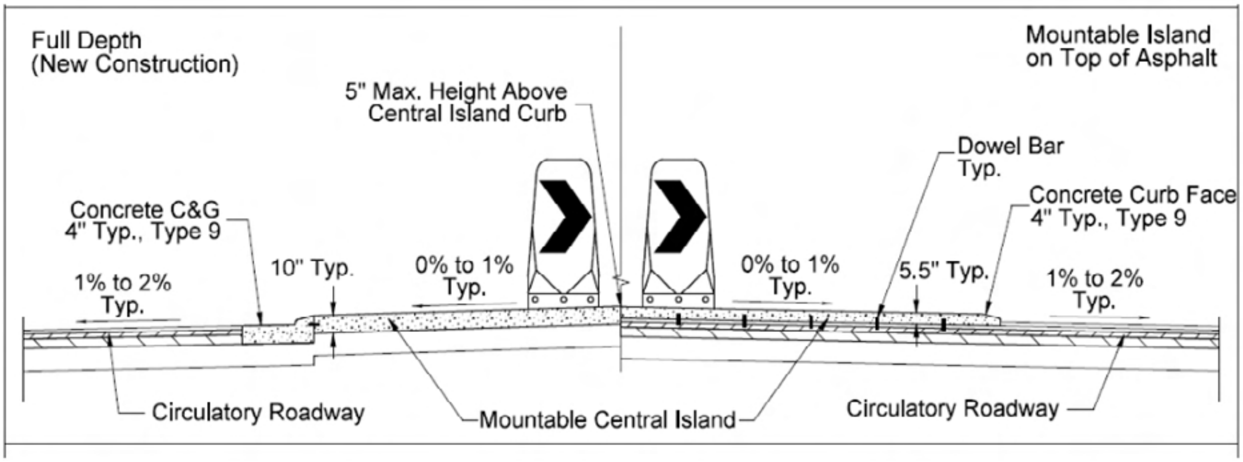


*Figure 2-1. Mountable apron at mini roundabouts, shown with bollards (Source: GDOT Roundabout Design Guide)*

Alternatively, compact roundabouts in Georgia generally have an ICD between 85 and 120 feet, with a 12-14 foot truck apron and a portion of the central island being non-traversable. The presentation described a series of mini roundabout installations within GDOT's quick-response program with relevant sizing, posted speed, and traffic volume information (see **Table 2-3**).

| Intersection | County | ICD | Posted Speeds | Cost | Total entering vehicles per day | Notes / Context |
|---|---|---|---|---|---|---|
| SR 81 at Snapping Shoals Road | Henry | 85' | 55 mph / 45 mph | $ 200,000.00 | 8,500 | Converted from AWSC after severe crashes persisted |
| SR 33 Business at 4th Ave | Colquitt | 90' | 35 mph / 30 mph | $ 460,000.00 | 2,700 | Mixed use commercial context |
| Monroe Dr at Armour Dr | Fulton | 78' | 35 mph / 30 mph | $ 630,000.00 | 23,000 | Urban mixed-use / commercial context |
| Flat Shoals Ave at McPherson Ave | Fulton | 47' | 25 mph / 25 mph | $ 100,000.00 | 8,400 | Urban commercial context |
| SR 14 at Hal Jones Rd | Coweta | 90' | 35 mph / 30 mph | $ 200,000.00 | 15,000 | Rural commercial context |
| SR 14 at Green Top Rd | Coweta | 90' | 35 mph / 30 mph | $ 200,000.00 | 15,000 | Rural commercial context |
| SR 138 at Moseley Dr | Henry | 70' | 55 mph / 35 mph | $ 400,000.00 | 13,000 | Later converted to compact roundabout |

*Table 2-3: GDOT Quick-Response Mini Roundabouts (Source: GDOT)*

The following are key lessons learned from GDOT:

- Mini roundabouts can be constructed on high-speed roads with the correct combination of mitigations to slow vehicles down in advance of the roundabout.
- In-service reviews are useful to examine before and after crash history and identify safety issues, as well as possible failing level of service or capacity issues.
- During construction phasing it is important to define edge lines using hard/curb materials on entries and exits rather than painted treatments to help reinforce the intended vehicle path.
- GDOT has balanced practical design with context sensitivity by not requiring sidewalk at all sites—instead, these pedestrian treatments should be evaluated/validated with pedestrian origin-destination paths in mind prior to deciding not to provide them.
- Mini roundabouts can be used as an interim project solution until a more expensive project (like a larger conventional single-lane roundabout) can be funded to replace it, if deemed necessary.

## Minnesota Department of Transportation

MnDOT considers mini roundabouts when larger conventional roundabouts do not fit within existing right-of-way or constraints. The state currently maintains nine mini roundabouts, with an additional site under construction, and there are a total of 33 mini roundabouts in Minnesota that were designed and maintained by local agencies, dating back to 2013. The following are the findings from the interview with MnDOT, of which they consider the most important as visibility and snow removal:

- MnDOT has had success with installing mini roundabouts in urban or small town center contexts with low speeds and pedestrian activity.
- Snow removal can be problematic for underplows (Figure 2-2), but, in general, all traversable central islands are a maximum of three inches height. This creates a tradeoff with visibility for drivers, particularly in non-urban settings. To address this, the state has experimented with painting the central island yellow.
- MnDOT utilizes a range of capacity models for mini roundabouts, including the Highway Capacity Manual (HCM), CAP-X, and Rodel, with an emphasis on peak hour traffic volumes over daily volumes.
- Overall, the state has seen an increase in total crashes after mini roundabout installation but a decrease in injuries compared with the previous control, which was two-way stop control for approximately half the sites, all-way stop control for approximately 25% of the sites, and signal control for approximately 25% of the sites. MnDOT published a roundabout traffic safety report in 2017[5].

5 Safety - Roundabouts in Minnesota

*Figure 2-2. Snow removal at min roundabouts (Source: MnDOT)*

## North Carolina Department of Transportation

NCDOT staff from Divisions 4 and 10, representing the eastern and west-central parts of the state, respectively, presented at the virtual workshop and described a range of mini roundabout sites that have been implemented on state-maintained roadways.

The following were themes from the presentations:

- Mini roundabouts have proven successful as a long-term solution in suburban communities where traffic growth is expected and as an alternative when all-way stop control would become over-capacity.
- Costs have increased significantly in recent years, but mini roundabouts have been an effective way to limit cost escalation compared to conventional roundabouts. In 2024, a mini roundabout was successfully implemented in Benson, NC in a small town core at the junction of two regional arterials for a cost below $1.5 million.
- NCDOT also aims to illuminate mini roundabouts to mitigate drivers from inadvertently mounting the central island.
- Mini roundabouts have worked well on high-speed roadways in rural areas using advance signage and reverse curvature, as well as placement of a yellow stripe around the central island.
- Installing all-way stop control as an interim configuration before roundabout installation is a best practice to help drivers prepare for conversion and to limit crashes until the roundabout can be installed.

In addition to these individual sites, NCDOT highlighted a safety analysis of mini roundabouts prepared by the University of North Carolina-Charlotte in 2021, which compared before and after crash trends of 25 retrofits from either two-way or all-way stop control and generated a range of crash modification factors (CMFs) for mini roundabouts [6]. The total and injury Crash Modification Factors (CMFs) for converting from two-way stop control to mini roundabouts were under 1.0 (indicating crash reductions), while the CMFs for converting from all-way stop control to mini roundabouts were over 1.0 (indicating crash increases).

6 RP2020-32_Final Report.pdf

## Washington State Department of Transportation

In Washington State, it is more common to see the use of "compact" roundabouts instead of mini roundabouts. Compact roundabouts differ from mini roundabouts in that they tend to be larger (65- to 120- foot ICD, according to FHWA) and may have a portion of the central island that is not mountable or is used for signing. The state began installing compact roundabouts in 2010 and has a robust intersection control evaluation (ICE) policy, with broad geographic applications across the state.

In addition to an overview of their roundabout program, WSDOT provided a detailed description of approximately a dozen compact roundabout installations, including location, context/neighboring land uses, traffic volume, cost, year of construction, and unique design applications. The table below provides a list of the sites that were discussed.

| Intersection | Year Constructed | ICD | Installation Cost | Total entering vehicles per day | Context | Additional Notes |
|---|---|---|---|---|---|---|
| SR 546 at Northwood | 2016 | 85' | $350,000.00 | 11,000 | Rural/urban transition | Constructed in 12 working days |
| SR 548 at Kickerville | 2018 | 115' | $1,300,000.00 | 6,000 | Rural/ industrial | |
| SR 902 at Craig Rd | 2018 | 95' | $2,000,000.00 | 11,000 | Rural | Spokane Tribe contributed funding |
| US 395 at Loon Lake | 2022 | 103' | $700,000.00 | 17,000 | Rural/small town | Incorporated into a larger pavement rehabilitation project |
| SR 282 in Ephrata | 2019 | 112'x88' | $120,000.00 | 10,000 | Small town | Elliptical design |
| I-90 in Ellensburg | 2021 | 116'x100' | $670,000.00 | 10,000 | Rural | Interchange ramp; elliptical design |
| I-5 in Kelso | 2015 | 106' | $400,000.00 | 12,000 | Rural | Interchange ramp (closed during construction) |
| SR 500 at 182nd Ave | 2022 | 90' | $1,400,000.00 | 12,000 | Rural | Closed completely during construction |
| SR 503 at NE Rock Creek | 2024 | 96' | $2,300,000.00 | 8,000 | Suburban | |
| SR 20 in Port Townsend | 2024 | 90'x75' | $2,600,000.00 | 18,000 | Tourist area | Elliptical design, includes speed cushion on SR 20 approaches |
| SR 203 at High Rock Rd | 2024 | | $2,800,000.00 | 12,000 | Rural | Double roundabout design |

*Table 2-4: Select Compact Roundabouts in Washington (Source: WSDOT)*

WSDOT has had a positive experience with compact roundabout implementation. Some keys to implementation along with challenges and lessons learned are as follows:

- WSDOT is working to harden edges more with curbing or raised shoulders to improve speed control and separation of vehicles from non-motorized users, although this has led to increased cost.
- WSDOT is now providing full illumination in all corners for compact roundabouts to enhance visibility. This also increases costs.
- WSDOT primarily uses rolled mountable curbing for splitter islands as well as outside curbing to provide more flexibility in accommodating large vehicles at mini roundabouts.
- While public skepticism and agency practices can be hard to overcome, it is important to educate staff, recruit future champions, and plan for staff turnover and retirement. One of WSDOT's strongest champions for roundabouts has recently retired. However, the many champions created across WSDOT continue the department's commitment to roundabouts and other innovative intersections.
- WSDOT's project delivery process includes a multidisciplinary peer review for all roundabouts on state highways. This not only serves as an educational opportunity but allows innovative concepts to be considered and promotes design consistency across the state.

### Washtenaw County, Michigan

The Washtenaw County Road Commission (WCRC) encompasses the City of Ann Arbor and surrounding suburban and rural areas, and they are committed to maintaining 598 lane-miles of roadway. The County has been utilizing the roundabout as a successful intersection safety and operations treatment since 2002 and has particularly found roundabouts to be successful near schools due to their traffic calming benefit and flexibility with school ingress/egress volumes. The first mini roundabout installations in the County were along Textile Road in 2015. While the County favored mini roundabouts at first, they have since built many more compact roundabouts. Figure 2-3 displays a compact roundabout with a portion of non-traversable central island.

*Figure 2-3. Compact roundabout on Baker Road in Washtenaw County, Michigan (Source: WCRC)*

The County has had a positive experience with mini roundabouts in winter maintenance, and they have been received positively by both the public and the trucking community. Some of their specific strategies include the following:

- The County contracts with a subject matter expert consultant to review all engineering plans for roundabouts and to conduct an operational analysis, prepare an initial geometric layout, and identify right-of-way needs.
- Roundabouts have been a successful replacement for all-way stop control intersections between two-lane primary routes.
- An ICD between 110 and 120 feet has been identified as a “sweet spot” to provide cost savings, limit ROW needs, facilitate snow plows, and provide a balance between speed control and driver comfort.

## Modular Roundabouts

### City of San Diego, California

The City of San Diego has had success with roundabouts and has taken an aggressive approach toward roundabout implementation as part of its Vision Zero plan, given that half of all fatal crashes within the City occur at traffic signals. As traditional roundabout design and construction have become cost-prohibitive, the City has leaned toward an alternative approach: the modular roundabout. The City has planned and implemented modular roundabouts in batch installations based on a screening method that prioritizes retrofits of locations having all three of the following conditions: four-lane crossing two-lane intersections, transit routes, and locations with three or more injury crashes in the past 10 years. The program favors unsignalized intersections with street lighting and without on-street parking near the intersection. Approximately 500 intersections met all three of these criteria. The City has found it helpful to engage with community members as each batch of installations is identified within a specific region. The batch approach also leads to efficiency with procurement and installation.

Each of the City's modular roundabouts is within the range of typical sizes of a mini roundabout, with an ICD below 90 feet. The City has altered its approach to standard roundabout design to help lower costs and speed implementation. This includes concentrating on key conflict areas such as roundabout entries, keeping side street splitter islands short, and avoiding survey if no excavation is needed. The City's design process continues to prioritize multimodal access at modular roundabouts, including separated bike lanes outside the circulatory roadway when bike lanes are planned, and crosswalks are always included. Costs for modular roundabouts have evened out at approximately one-tenth of the cost for traditional roundabout construction.

The following have been keys to the success of the City's program:

- The flexibility and relatively easy removal of modular roundabouts has been an advantage for making them feasible on roadways with a range of traffic demand. Instead of needing to design for future traffic, the City allows existing traffic volumes to be used for the capacity analysis of modular roundabout projects, which helps avoid unnecessary lanes.
- The City avoids filling in splitter islands and central islands so that the perimeter of the roundabouts can be identical, which greatly simplifies manufacturing and installation. It also allows stockpiling for immediate installation in the future.
- The City's Climate Action Plan requires roundabouts and a roundabout master plan.
- The Mayor and City Council have committed to achieving safety / Vision Zero goals.
- The City has a local success story to point to (the roundabout corridor and road diet in La Jolla), and people across the City request roundabouts regularly.

### Georgia Department of Transportation

GDOT shared their experience for a one modular roundabout application at SR 36 at Keys Ferry Road/Barnetts Bridge Road, which was opened to traffic in 2017. The total construction cost for the roundabout was approximately $27,500 and was sponsored as an experimental installation by FHWA. While the roundabout was generally successful as a pilot project, some of the post-construction issues experienced included the durability of the materials, which required replacement of bolts, "mushroom" washers, reinstalling outside boards, and adding metal straps to keep panels from popping out. These maintenance needs were related to the roundabout being located on a heavy truck route. The modular roundabout was replaced with a permanent compact roundabout with a landscaped central island in 2021.

## North Carolina Department of Transportation

NCDOT provided an overview of a modular roundabout installation in Burlington, NC that was constructed in 2023 as a safety improvement to address limited intersection sight distance at a three-legged minor road stop-controlled intersection with a total entering volume of 7,500 vehicles per day. The roundabout functions as a mini roundabout and has an ICD of 75 feet. While a permanent mini roundabout was expected to cost over $600,000, the cost was reduced by 60% with a modular roundabout. The site was constructed in 10 days without having to completely close the intersection. The following are the key lessons learned from design and implementation:

- NCDOT found only a single vendor for modular roundabouts, which made it more difficult to procure a bid.
- Materials arrived in multiple shipments and needed many staff to install.
- It was valuable to have a preconstruction meeting with the vendor to prepare for installation.
- The site has performed well as a safety improvement, with local criticism limited to concerns about aesthetics.

## Virginia Department of Transportation

While roundabouts are widely supported in Virigina due to their safety performance, traffic performance, and cost-effectiveness, they present challenges with additional ROW needs, higher construction cost, and longer design/construction timeline compared to other types of intersection traffic control. VDOT identified the modular roundabout as a method to mitigate these challenges and worked through a district-wide screening to select three sites for implementation.

VDOT staff presented on three successful modular roundabout installations in the greater Richmond area installed in July-September 2020. The sites included two two-way stop control locations and one all-way stop control intersection on four-lane arterials where traffic demand was well below capacity. These intersections experienced safety and speeding issues, and the modular roundabout was considered because of its potential for quick removal in the event traffic volumes grow to the point where four lanes would be needed on the arterial. An example is shown in Figure 2-4—this design had its central island constructed in a "donut" shape, with a portion of the center remaining open to existing pavement. The ICD of this modular roundabout is 120 feet and is larger than most other installations due to the available footprint of the four-lane arterial.

*Figure 2-4. Modular roundabout in Richmond District, Virginia (Source: VDOT)*

The following were key findings from VDOT's experience with modular roundabouts:

- During public engagement it was critical to communicate the visual elements of modular roundabouts so that the community could weigh in on colors and other aesthetic treatments.
- There was a learning curve for construction crews, and it would eventually save construction time to have a crew trained especially for modular roundabout installation.
- Pedestrian access and location of splitter islands and crosswalks should line up with existing ramp locations to avoid impacting longer-term solutions.
- VDOT's Smart Scale statewide prioritization program does not have a specific method for scoring interim to full configuration locations such as modular roundabouts. This could lead to a scenario where a modular roundabout is installed to address safety and operational issues, but after crashes decrease and conditions improve, the intersection no longer scores well in the statewide prioritization framework.

# Key Findings

## Mini Roundabouts

### General

Several of the agencies in the workshop supported the assertion that mini roundabouts are a cost-effective alternative to conventional single-lane roundabouts, evidenced by positive safety performance and reception from agency staff and the public. While mini roundabouts have previously been predominantly planned in low-volume / less than 15,000 AADT (Annual Average Daily Traffic), low-speed contexts (i.e. posted speeds below 30 mph), with a niche within downtowns and small town centers, they are increasingly becoming viable alternatives on higher-speed, more rural roadways. Another important theme from the workshop was the high number of mini roundabout installations near schools—in addition to traffic calming, mini roundabouts can process the sharp peaks of school ingress and egress traffic more efficiently than some other forms of traffic control.

One major outcome of the agency workshop was highlighting that mini roundabouts are not limited to a 90-foot ICD or less so long as they have a fully traversable central island. Another finding was the relationship between mini roundabouts and "compact" roundabouts. Compact roundabouts typically have a central island that is partially non-traversable but are generally smaller than conventional single-lane roundabouts. Compact roundabouts typically have an inscribed circle diameter (ICD) between 65 and 120 feet per NCHRP Report 1043, which begins to overlap with the size range for several of the mini roundabout applications discussed during the workshop. Most of the compact roundabout examples discussed in the workshop ranged from an 80 to 100 feet ICD. Two of the agencies noted that they are mostly or exclusively using compact roundabouts instead of mini roundabouts and that they preferred them over mini roundabouts due to better speed/truck performance. While the scope of this Domestic Scan was limited to mini and modular roundabouts, it will be useful for a later effort to explore agency experiences with compact roundabouts and their benefits and tradeoffs relative to other sizes of single-lane roundabouts.

### Capacity

Most of the agencies reviewed reference the Highway Capacity Manual (HCM) as the required procedure for analyzing the capacity of roundabouts, regardless of software tool utilized [7]. Currently, the HCM roundabout capacity models are based solely upon lane assignment and conflicting flow within the roundabout and do not distinguish between mini and full-size single-lane roundabouts, nor do they account for roundabout dimensions such as ICD or entry width. These capacity models were developed based on data collected at roundabouts in 2013-2014 and reflect a range of sizes and contexts across the United States. While not specific to mini roundabouts, some agencies require the use of the SIDRA Standard Model for roundabout capacity analysis, with the Environmental Factor

7 Highway Capacity Manual 7th Edition: A Guide for Multimodal Mobility Analysis | The National Academies Press

(EF) as a function of site location and/or design year. Both the SIDRA Standard Model and the British model RODEL are based upon the size of the roundabout, with larger dimensions generally tied to greater capacity. Another agency performed capacity analysis using Arcady software. Some agencies referenced the mini roundabout models in the Capacity Analysis for Planning of Junctions (CAP-X) tool, which is a spreadsheet-based analysis tool developed by FHWA. CAP-X relies upon a capacity model for mini roundabouts that was developed based on microsimulation rather than empirical data.

Overall, there was a general conjecture that mini roundabouts have a lower capacity than single-lane roundabouts due to their small size, which limits the ability of an entering driver to find an acceptable gap in circulating traffic. Drivers may be hesitant to enter the mini roundabout despite the adequate headway because of the excessive sight distance or perceived lack of gap if there is traffic entering from directly across the roundabout (180 degrees away), given the short distance to the potential conflict area and the ability to see over the central island. A possible research need is to perform an updated data collection and capacity model calibration experiment at mini roundabouts like the approach used to develop the latest HCM roundabout capacity models. One of the participating agencies (NCDOT) has just commissioned a research project to develop a capacity model for mini roundabouts. For optimal data collection, it will be necessary to identify mini roundabouts that experience demand at or over capacity during a portion of the day, which may be limited at this time. It is notable that some agencies are implementing mini roundabouts at intersections with greater than 15,000 AADT, approximately the demand level where all-way stop control begins to produce long queues. These intersections may be good candidates for capacity model development and/or calibration.

The design year for intersection control evaluation can also vary by agency. The longstanding convention of using 20 to 25 years as the design year for intersection improvements has resulted in overbuilding, but this can be detrimental to roundabout implementation due to higher cost and speed performance due to additional lanes. Some agencies intentionally use a nearer-term design year such as 10 years for roundabout-specific analyses, or even existing traffic volumes, to avoid overdesigning the roundabout. For planning-level analyses, agencies noted they generally utilize a mix of daily (AADT) and peak-hour volume-based rules of thumb to identify promising sites for mini roundabouts.

## Safety

Several agencies provided before and after crash data at a range of mini roundabout installations. Mini roundabouts were observed to reduce fatal and severe injury crashes, as well as angle crashes, compared to two-way stop control, but at a smaller scale than conventional single lane roundabouts. The documented safety performance of mini roundabouts relative to all-way stop control is limited, but mini roundabouts have been shown to generally increase crashes across a range of severities in rural, suburban, and urban areas compared to all-way stop control.

## Design and Performance Checks

Fastest path speed performance generally conformed with other single-lane roundabouts, with a maximum desired entry fastest path speed between 15 and 25 mph. Recently, some jurisdictions have implemented mini roundabouts on higher-speed roadways (50 mph or higher posted speed) with enhanced speed control on the approaches such as extended non-traversable splitter islands, curb-and-gutter, and reverse curvature when possible. Other agencies have implemented mini roundabouts in series (along with other traffic calming measures) to implement corridor-wide speed control. Two agencies noted that they have been willing to increase acceptable fastest path speeds to keep costs and/or right-of-way (ROW) impacts below their threshold for project programming/procurement, but other agencies provided examples where the desired safety performance was not achieved when proper horizontal deflection and speed control was not provided.

Mini roundabouts are typically designed so that passenger cars and buses can complete all movements without running over the mountable central island, while larger vehicles such as tractor-trailers will sweep over the entire central island (and potentially splitter islands as well). At locations without ROW constraints, the use of 75- to 90-foot ICDs can accommodate a wide range of vehicles without making splitter islands mountable or having vehicle cabs mounting the central island.

There was generally limited guidance or experience with bicycle/pedestrian treatments at mini roundabouts above and beyond the typical practices for single lane roundabouts. Some customized designs have incorporated special treatments for crosswalks and bicycle facilities, especially for retrofit applications where curb-to-curb space may be limited. Often, crosswalks may be placed closer to the yield line than at conventional roundabouts, and splitter islands may be painted or too narrow to incorporate standard pedestrian refuge areas. Raised crosswalks may help to control speeds and provide better bicyclist/pedestrian access.

## Cost

Most agencies noted that mini roundabouts are almost always less expensive to implement than full-size single lane roundabouts due to their small footprint. Costs typically ranged from $100,000 to $400,000 if the footprint of the intersection can be minimized, but as much as $350,000 to $1,400,000 if ROW and utilities were impacted. Compact roundabouts have had much greater costs than mini roundabouts due to their larger size. Quantifying individual project costs has been challenging, as mini roundabouts were often incorporated into longer corridor or complete streets projects. Mini roundabouts were often planned to retrofit two-way or all-way stop-controlled intersections and designed within existing curb lines. Designing within existing curb lines has also been used to minimize environmental, utility, and ROW impacts.

While it is intuitive that ROW costs would also be lower for mini roundabouts, some agencies have limited their mini roundabout programs to sites with large areas of existing pavement or available ROW to eliminate ROW or drainage costs, so this comparison to single lane roundabout costs may not always be appropriate.

Several agencies have leveraged alternative funding sources to help implement their mini roundabout programs and offset engineering and/or construction costs. These include Safe Streets and Roads for All (SS4A) and other FHWA grants.

## Installation and Construction Timeline

Stamped asphalt and concrete are the most common construction materials for mini roundabout central islands and splitter islands. At least one agency is utilizing permeable concrete pavers to further reduce impacts by minimizing or eliminating drainage and Storm Water Management (SWM) provisions. Several agencies also mentioned that mini roundabouts were much easier to design and construct than conventional single lane roundabouts due to fewer necessary plan sheets and shorter construction duration time. In urban areas, the ability to close the intersection completely during construction, thereby eliminating the need for maintaining traffic during construction, also reduced construction timelines, although this may not be possible in rural areas where a detour route is not available.

## Maintenance

There were limited maintenance issues raised about mini roundabouts, as they have generally stood up to truck traffic other than clipping signs on the roundabout entries. Agencies from snow-prone climates indicated that mini roundabouts perform well under winter weather and can be maintained with their standard snow plow fleet, with a few exceptions. Common issues included larger snow plow vehicles becoming stuck or having to stop and back up to complete turning movements at some of the smallest mini roundabout designs because of the large turning radius of the plow. Smaller equipment is needed to remove snow from the central island. Lower-profile (< two inches) central islands may also be less visible to snow plow operators when covered with snow, increasing the risk of scraping the central island with the plow. The use of a domed central island, as displayed in NCHRP Report 1043, Exhibit 11.13, may also help enhance snow removal while preserving visibility.

## Public Reaction

The public is generally aware of the benefits of roundabouts and appeared to support roundabout implementation in most communities so long as multiple lanes were not needed. Nonetheless, it is important to identify local champions for mini roundabout projects and programs to communicate proactively and gain public support. An indirect benefit of mini roundabouts toward public acceptance has been the ability to implement the mini roundabout quickly and inexpensively, which can help satisfy the public demand for progress.

Most of the negative feedback received from the public was related to the visibility of the central island, especially at night. Some agencies have addressed this concern by striping the outline of the central island, placing striping and/or raised pavement markers along the outside of the central island, placing signage (roundabout circulation arrows) directly in the middle of the central island, utilizing contrasting or more reflective construction materials within the central island, and/or installing lighting.

Some public criticism or skepticism has also related to the small size of the roundabout, whereby the public sees the term “mini” and interprets it as “less.” Improved messaging and public education continue to be important as more agencies program mini roundabouts. It was also noted that highlighting mini roundabout success stories (preferably local installations) continues to be a very effective strategy toward improving public acceptance.

# Modular Roundabouts

## General

Modular roundabouts have been successfully designed and installed in at least five states, with positive outcomes. They are typically considered in low-volume locations (below 15,000 AADT) with operational and/or safety issues at a minor road stop or all-way stop control installation. For retrofits, the modular roundabout becomes more competitive with other intersection improvement alternatives when it can be constructed fully within the paved area of the existing intersection, for an ICD of approximately 70 to 100 feet. Modular roundabouts can take the form of mini roundabouts, where trucks are anticipated to sweep over the entire central island, or larger roundabouts where trucks do not drive over the central island, and several installations have been larger depending on the existing footprint of the intersection. Modular roundabouts are much less common than mini roundabouts, with fewer than 10 known installations in the United States. However, there are several more in development. A related treatment is the "quick build" or "temporary" roundabout, which incorporates low-cost materials such as temporary curb, bollards or flex posts, and striping, but not necessarily modular central island materials.

Two agencies took a programmatic approach toward screening and installing modular roundabouts. One of these agencies embedded their modular roundabout screening within their municipal Vision Zero program and targeted intersections between four-lane and two-lane streets, including a transit route, and/or having three or more injury crashes in the past 10 years. Another agency explored several modular roundabout implementation locations at one time by identifying intersections with a large footprint, existing crash issues (especially angle crashes), multiple stop-controlled approach lanes, and traffic volumes well below the capacity of a roundabout. By collectively organizing a batch of multiple modular roundabout sites for implementation, these agencies were able to expedite procurement and delivery as well as mitigate the learning curve associated with modular roundabout construction (discussed later in this summary). Modular roundabouts were also notable for their flexibility and ability to be modified as future changes in the roadway lane configuration may be needed.

One concern raised throughout the workshop is that there appears to be a single viable vendor for the supply of modular roundabouts, which could create issues with project bid advertisement or even intellectual property. One municipal agency had overcome this by soliciting vendors for a modular roundabout program and then selecting one vendor to move forward with the program for a set length of time. Another concern related to project funding and prioritization. Several sites have been constructed at high-crash locations and performed well, but after local communities expressed a desire to convert to non-modular designs, the increased safety performance of the intersections during the modular roundabout phase has resulted in a low benefit-cost ratio for a potential upgrade during project prioritization.

## Safety

The general safety benefits of modular roundabouts are believed to be like mini roundabouts. Before and after crash data at modular roundabouts has been mixed, with two installations experiencing similar crash trends to two-way stop control in the four years after construction and one installation experiencing no crashes in four years after construction. Other locations have no conclusive safety results due to recent construction. As reported crash data become available, before and after data should be compared for any emerging trends.

## Design and Performance Checks

At least one site has installed–and other locations have considered building–only the outer portion of the central island to create a "donut"-shaped design to save cost. This helps reinforce circulation and speed control without the need to construct the entire central island. In addition to cost savings, this treatment may also help facilitate "batch"-style improvements due to less customization in the design of one modular roundabout to another, allowing materials to be stockpiled for immediate installation in the future.

Like mini roundabouts, the desired fastest path speeds for modular roundabouts are generally between 20 and 25 mph. One agency has incorporated more offset-left alignment at modular roundabouts to reduce impacts on the roundabout exits, so long as speed performance goals were achieved at critical areas such as the roundabout entrances.

Design vehicles ranged from city buses to WB-67 trucks for major routes. Buses were generally kept from driving onto the modular roundabout elements, while larger trucks usually need to drive over the center island like mini roundabouts.

Crosswalks and splitter island cut-throughs have generally been provided at modular roundabout installations, with no specific treatments beyond those for mini roundabouts.

## Cost

Costs have ranged from $30,000 to $500,000 (including design and construction) if only modular materials are used and impacts can be limited to the existing curb space of the intersection. Much of the cost savings afforded by modular roundabouts have been related to reduced labor and construction time. One agency noted that modular materials required several months to procure from a vendor. Construction schedules should include buffer time for materials arriving in multiple shipments, as was the experience described by one agency.

## Installation and Construction Timeline

Most modular roundabouts were installed by the maintaining agency rather than an independent vendor. Several agencies noted that installation presented a significant challenge for their construction staff. Drilling of modular materials into existing pavement may require specialized or different equipment (drill bits, portable power source, shop-vac for excavation) than what is typically utilized at state and municipal DOTs. One or more pre-construction meetings with the vendor and construction management team may be necessary. Some designs have taken up to several weeks to construct, especially if existing permanent medians or other materials are demolished, but several others have been substantially completed within two to five days.

Preliminary engineering and design time has been substantially reduced for modular roundabouts compared to conventional single lane roundabouts. One agency noted they could reduce their project development timeline to 17 months (excluding construction time), whereas other roundabouts take two to five years to fund and implement.

## Maintenance

Generally, modular roundabout materials have stood up to truck traffic, with occasional replacements or re-installation of modular components near the outer edges of the central island or splitter islands. One agency noted that the modular roundabout materials were rated for 50 years by the vendor, with an 80,000 pound weight limit. Another agency ordered a batch of modular roundabout materials that could be readily available for replacements to avoid future deliveries. One agency noted that the modular roundabout materials could easily be cut or reconfigured as necessary.

For resurfacing applications, milling should be truncated outside of the modular materials. There were mixed opinions among the participating agencies about whether pavement resurfacing was needed before modular roundabout construction or not.

Winter maintenance was a concern raised by agencies who have not yet applied modular roundabouts, as there has been limited documented experience with modular roundabouts during snow removal.

## Public Reaction

In communities where modular roundabouts have been installed, the public and elected officials generally already provided support for roundabouts as a safety/Vision Zero treatment. Agencies noted that individual public meetings for each roundabout were no longer necessary for their communities. One agency that utilized a batch installation program noted that they first identified a community in need of modular roundabouts and then performed a single engagement touchpoint with that community ahead of approximately 10 intersection installations. One agency noted positive feedback from cyclists.

While most modular roundabout applications have not been installed for a long time, most of the negative feedback received from the public was related to the small size and lack of landscaping within the roundabout. One agency has utilized green modular materials to simulate grass to respond to this public concern. It was noted that some colors may be more expensive than the standard black or grey modular components.

Similarly to the mini roundabout, the public has raised concerns over the visibility of the central island, especially at night. This has been addressed by utilizing lighter-color modular materials, including yellow in the outermost components of the central island to increase visibility. Other notable visibility treatments included striping the outline of the central island, increasing the size of the splitter islands, and prioritizing visibility at locations in a sag curve and installing lighting.

# Recommendations

The scan team developed a broad range of recommendations based on the findings from the virtual workshop. These recommendations are intended to be applied in the practical sense, including additional guidelines, reference points, and best practices. Additional research is also needed across a range of areas to support further and more widespread understanding of the benefits and tradeoffs of mini and modular roundabouts. The following includes a brief narrative under each recommendation, with the intent to support further expanded research needs statement development within each topic.

## General

Mini and modular roundabouts have been demonstrated as successful, cost-effective intersection control under a range of contexts and conditions, including urban, suburban, and rural areas, near schools, in areas with heavy truck traffic, and as retrofits. Roundabouts have proven safety benefits, and mini and modular roundabouts have expanded the applicability of roundabouts to additional sites due to their cost savings over full size roundabouts. Mini and modular roundabouts should be strongly considered and implemented under the right conditions.

## Mini Roundabout Capacity Models

Updated capacity models for mini roundabouts are needed. As noted in Chapter 2, there is funded research underway to address this need, but more research might be needed to supplement those findings. Existing mini roundabout capacity models are available but are primarily based on simulation rather than empirical data.

## Intersection Control Evaluation Support

While not specific to mini and modular roundabouts, it was noted that there continues to be a gap in available resources to support decision making around roundabouts as an alternative within intersection control evaluation. Mini and modular roundabouts tend to be most viable when two two-lane roadways intersect, demand is above the level that can be processed efficiently by all-way stop control but below the capacity of a roundabout (using the latest available mini roundabout capacity models), and funding, right-of-way availability, or other constraints prevent the installation of a full-size roundabout.

## Before and After Crash Data

To date, one before and after crash study of mini roundabouts has been published, and additional before and after crash data should be compiled and compared for existing sites to build upon these results. Currently, the safety benefits and tradeoffs of mini roundabouts versus all-way stop control are unclear, and there is little documented before and after crash data for three-leg sites. Additional before and after crash data are also needed for modular roundabouts due to the low number of installations and newness of most installations.

## Post-Construction Analysis

General post-construction observations or "in service review" results have been invaluable toward helping to document performance and changes that were made to keep mini and modular roundabouts effective. More such post-construction operations should be recorded and shared between agencies.

## Compact Roundabout Design Guidance

The "compact" roundabout has reemerged as a separate design treatment from mini roundabouts. According to FHWA, compact roundabouts have an ICD between 65 and 120 feet with a central island that may be traversable. Compact roundabouts have been applied widely in Washington State, Georgia, and other jurisdictions. More specific design guidance, strategies, and performance for compact roundabouts are desired, and they should be considered as a viable treatment alongside mini roundabouts.

## Bike/Ped Design Guidance

While the FHWA Roundabout Guide provides a comprehensive reference for the design of bicyclist and pedestrian facilities at roundabouts, more specific multimodal design emphasis, experience, and guidance for mini and modular roundabouts is needed, including for visually impaired pedestrians.

## Prioritization Strategies

Prioritization guidance would be helpful, especially when a modular or quick-build roundabout has performed well but no longer scores highly for conversion to permanent installation. This was particularly important for states like North Carolina and Virginia that have large state-maintained road systems and centralized prioritization frameworks.

## Winter Maintenance

Additional design guidance for mini and modular roundabout sizing for winter maintenance is needed.

## Modular Roundabout Vendors

As there appears to be only a single viable vendor available for modular roundabouts, additional vendors or procurement advice for modular roundabouts should be identified.

# Implementation Strategy

The scan team met at the end of the virtual workshop to identify several implementation strategies to help disseminate the information from the domestic scan and advance the scan recommendations. These included professional organizations, presentation venues, workshops, publications, online materials, webinars, pilot projects, and peer exchanges. As the scan team is well connected to many outlets for disseminating the results of the scan, the list of strategies below is a partial list that is intended to be continually updated as new ideas and opportunities become available.

## Presentation Venues and Ideas

The presentation venues identified by the scan team were classified as either national/international or statewide/regional. Upcoming national conferences and workshops include the following:

- MassDOT Regional Innovation Conference, May 6-7, 2025, Worcester, MA
- American Council of Engineering Companies (ACEC) Annual Convention, May 18-21, 2025, Washington, DC
- National Association of City Transportation Officials (NACTO) Annual Meeting, May 20-21, 2025, Washington, DC
- New York State Association of Transportation Engineers Conference, May 27-30, 2025, Saratoga Springs, NC
- 2025 International Conference on Roundabouts and Geometric Design, June 8-12, 2025, Atlanta, GA
- AASHTO Committee on Traffic Engineering Annual Meeting, June 8-12, 2025, Des Moines, IA
- ITE International Annual Meeting, August 10-14, 2025, Orlando, FL
- National Association of Metropolitan Planning Organizations (AMPO) Annual Conference, September 15-19, 2025, Providence, RI
- ACEC/NCDOT Joint Transportation Conference, September 25, Raleigh, NC
- AASHTO Safety Summit
- AASHTO Committee on Design

The following are statewide or regional conferences and presentation venues identified by the scan team members:

- Ohio Annual Roundabout Conference, December 11, 2024, Toledo, OH
- North Carolina Association of Metropolitan Planning Organizations (NCAMPO), April 15-17, 2025, Wilmington, NC
- ITE Northeastern District Annual Meeting, May 14-16, 2025, Buffalo, NY

### Articles and Papers

The scan team identified the following professional journals for submitting articles and papers for publication:

- *Public Roads*
- *ITE Journal*
- *Transportation Research Record*

In addition to these, many of the national conferences listed in the previous section publish submitted abstracts and papers within the conference proceedings.

### Webinars and Online Materials

The scan team identified the following online methods for hosting and disseminating the scan findings:

- Domestic Scan Website
- Updates to Kittelson roundabout website (roundabouts.kittelson.com)
- ITE webinar(s)
- FHWA co-sponsored webinar(s)
- TRB webinar (co-sponsored by AKD80 – Standing Committee on Roundabouts and Other Intersection Design and Control Strategies)

## Additional Communication and Outreach

The following are additional communication and outreach activities identified by the scan team:

- National Safety Roundtable (FHWA peer exchange)
- New Hampshire DOT ACEC Technical Exchange
- Pilot projects or case studies through the Safe Streets and Roads for All (SS4A) program

# Appendix A:
## Scan Team Contact Information

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# Appendix B:
# Scan Team Biographical Sketches

**JOSEPH E. HUMMER, PhD, PE** (CHAIR) is the State Traffic Management Engineer with the North Carolina DOT Mobility and Safety Division. He specializes in alternative intersection and interchange designs and recently developed an interest in automated vehicles. He began researching alternative designs in 1990, has published numerous articles about them, and has invented several new designs. On automated vehicles, he is the author of the 2020 book Driverless America that forecasts life after widespread deployment. Joe spent most of his career as a Professor at North Carolina State before serving as Chair of Civil Engineering at Wayne State. He returned to North Carolina and joined the NCDOT in 2016 to work on the implementation of new ideas.

**WILLIAM R. LAMBERT** is currently the State Highway Safety/Active Transportation Administrator at the New Hampshire Department of Transportation and has been with NHDOT since 1993, having previously served as the State Traffic Engineer. A native of Rumford, Maine, Bill holds a BSCE from Worcester Polytechnic Institute and worked as a consultant for seven years prior to joining NHDOT. Bill is the current Vice Chair of the National Committee on Uniform Traffic Control Devices (NUTCD) and is a past president of the New Hampshire Section of the American Society of Civil Engineers.

**OLADIMEJI ONABANJO, PE** is the State Traffic Operations Managers for Georgia DOT and is managing the RAID Team and Plan Review programs for State Traffic Operations. Ola graduated from Florida A & M University with a B.S. in civil engineering. Ola is a registered Professional Engineer in the State of Georgia. Ola's career with GDOT started in District 7 Construction (Atlanta), District 7 Preconstruction. Ola joined State Traffic Operations RAID (Roundabouts and Alternative Intersection Design) Team in 2015 and joined the State Signal Maintenance Office.

**LAURA D. NESBITT** specializes in Roundabout and Alternative Intersection Design. She earned her bachelor's degree in civil engineering from Kennesaw State University. Currently, she is employed at Jacobs as a Highway Engineering Professional on the Roundabouts Team. Previously, she spent four years with GDOT on the Roundabout & Alternative Design Team. Laura is also a registered Engineer in Training in Georgia. Her objectives include promoting awareness of roundabouts and alternative intersection designs and their benefits to the public.

**GARRETT DAWE, PE** graduated from Michigan Technological University in 2004 with a B.S. in civil engineering and has been working for the Michigan Department of Transportation since that time, primarily in the areas of road design and traffic safety. In February 2024, he became the Engineer of Traffic & Safety for the department and continues to serve in that role. Garrett lives in Gaylord, Michigan with his wife, Lindsay, and three sons and enjoys coaching youth basketball and experiencing the outdoors.

**GWEN MEI** is the Assistant State Geometrics Engineer at Minnesota DOT. Gwen graduated from the University of Minnesota with a bachelor's degree in civil engineering, with emphasis in transportation. She began her career at the Minnesota Department of Transportation (MnDOT) as a Graduate Engineer Trainee, where she gained experience in environmental stewardship, state aid, hydraulics, roadway design, and construction during a two-year rotation. She then spent three years in the Environmental Modelling and Testing Unit where she had an oversight role in air quality and traffic noise modeling. Over the past seven years, Gwen has served as the Assistant State Geometrics Engineer in the Geometric Design Support Unit in MnDOT's Central Office. She has served as a Project Manager of a partnership agreement with multiple state agencies to develop a web-based Geometric Design training video series. This training series is part of Minnesota's technical training and is widely used by partner states and agencies.

**MARK A. GAINES** has worked for the Washington State Department of Transportation for 25 years and currently serves as the State Design Engineer. He holds bachelor's and master's degrees from the University of Washington.

**HILLARY ISEBRANDS** has thrived in the transportation profession for over 29 years. Hillary has expertise as a roadway design and safety engineer, leader, facilitator, and teacher. She is a Team Leader and Senior Roadway Safety Engineer with the Federal Highway Administration (FHWA) Resource Center – National Safety and Design Team. She specializes in providing training and technical assistance on roadway safety and design, including modern roundabouts and innovative intersections, and local and rural roadways. Prior to FHWA, Hillary worked as a researcher at the Iowa State University, Center for Transportation Research and Education and was a highway designer and project manager at an engineering consulting firm in Wisconsin. She strives every day to empower transportation agencies and stakeholders to help people get home safely.

Hillary is a Professional Engineer in Iowa and Wisconsin, a National Highway Institute (NHI) Certified Instructor, and the 2019 FHWA Engineer of the Year. She is the Chair of the Transportation Research Board (TRB) Standing Committee on Roundabouts and Other Intersection Strategies, and a Member of the TRB Rural Transportation Issues Coordinating Council.

**ANYESHA MOOKHERJEE** is a Transportation Specialist at the Federal Highway Administration Office of Safety and develops and delivers programs to reduce fatal and injury crashes on the nation's transportation systems. Prior to joining FHWA in 2020, she spent five years as a transportation consultant before working for the Maryland State Highway Admininistration for nine years. Anyesha holds a Bachelor of Engineering from Birla Institute of Technology and Science in Pilani, India and a Master of Science in Civil Engineering from the University of Massachusetts Amherst.

**ZACHARY BUGG, PhD** (SUBJECT MATTER EXPERT) is an associate engineer at Kittelson & Associates based in Wilmington, North Carolina and has over 14 years of progressive transportation experience in the areas of roundabout planning and design, traffic engineering and simulation, and context-based multimodal design. Zach thrives at the intersection of planning and engineering and continually aims to advance the transportation profession by applying engineering skills to corridor and long-range planning projects. He has worked with federal, state, and local agencies to deliver solutions to a range of complex transportation projects across the nation. Zach holds a PhD in Civil Engineering from North Carolina State University, B.S. degrees in Civil Engineering and Mathematics from Mississippi State University, and a professional engineering license in North Carolina, Virginia, and Maryland.

# Appendix C
# Amplifying Questions

# Mini Roundabouts

A. General

1. How many mini roundabouts has your agency opened to traffic?
2. How many mini roundabouts does your agency have in the preconstruction or construction phase?
3. What are the general sizes (Inscribed Circle Diameter) of mini roundabouts in your agency?
4. In what types of locations do you install mini roundabouts?
5. Do you have criteria or guidelines on the choice to consider a mini roundabout instead of a conventional roundabout with a non-traversable island?
6. How else has your agency decided on a mini roundabout instead of a full sized roundabout?
7. Have you considered using a mini roundabout as an interim treatment until a larger roundabout or different design could be constructed?

B. Capacity

8. During planning / pre-design, did you conduct a traffic analysis for the roundabout? Why did you/didn't you conduct a traffic analysis? If you used a capacity model, why did you choose it?
9. Did your agency calibrate the capacity model to mini roundabout conditions before use?
10. Are actual traffic operations close to the expected model predictions?
11. Did you select a mini roundabout as a treatment for any particular traffic pattern, such as low truck demand?
12. What data can you provide for vehicle throughput before and after construction of the mini roundabout?

C. Safety

13. During planning and pre-design, did you conduct a predictive safety analysis using a safety performance function (SPF) or crash modification factor (CMF)? If so, which one?
14. Do you have (and would be willing to share) detailed crash data (especially before/after crash data for retrofits), including severe crashes and ped/bike crash data, or have you conducted crash analysis for any mini roundabouts within your agency?
15. What has been your experience regarding the safety effects of mini roundabouts?
16. Do vehicles generally drive within the mini roundabouts as intended? Has speed control performance been achieved?

17. Have you heard any experiences from pedestrians or bicyclists at mini roundabouts?
18. What has been the experience of large trucks and buses at your mini roundabouts?
19. How (if present) are oversized vehicles navigating your mini roundabouts?
20. Has the visibility of the central island (during day or night) been an issue, and, if so, how has this been addressed?

D. Design, Cost, and Construction

21. Generally, what materials have you used within the central island?
22. Do you typically provide lighting at mini roundabouts?
23. What design vehicle do you typically use at mini roundabouts? What check vehicle (control vehicle) do you typically use at mini roundabouts?
24. What are other key design features of your mini roundabouts?
25. Do you typically need to purchase right-of-way to construct a mini roundabout?
26. Do you typically need to relocate utilities to install a mini roundabout?
27. Do you typically require access control around a mini roundabout, and if so, what is the minimum distance from the circulatory roadway to the nearest driveway or on-street parking?
28. Could you provide itemized construction costs for your mini roundabouts?
29. Comparing full sized roundabouts with mini roundabouts, what is the approximate cost savings you have experienced with mini roundabouts?
30. Do you have any programmatic constraints to the maximum cost of installing mini roundabouts?
31. What is the typical time to construct a mini roundabout?
32. What is the typical maintenance of traffic stages during the construction of a mini roundabout?
33. Do you use traversable (raised) splitter islands, painted splitter islands only, or some other treatment?
34. How are WB-62/67 truck movements accommodated within your mini roundabouts (do the truck cabs mount the central island, or just the trailers)? Do you allow encroachments into opposing traffic? Are trucks expected to mount the splitter island on the approach/receiving legs?
35. Are light trucks and buses accommodated within the flush pavements of your mini roundabouts without having to mount the central island or splitter islands?

36. What is the design of your mountable curbs at central islands/splitter islands for mini roundabouts?
37. How are emergency vehicles accommodated within your mini roundabouts?
38. How have you considered pedestrians and bicyclists in the design of mini roundabouts?
39. Have you placed the crosswalks at a different location than 20-30 feet beyond the circulatory roadway at mini roundabouts?
40. What is the maximum fastest path speed you have designed your mini roundabouts for?
41. What treatments have you used to help control speeds at mini roundabouts on roadways with design speeds greater than 30 mph?

E. Maintenance

42. What are the primary maintenance needs at mini roundabouts, and are these different from full sized roundabouts?
43. What is the typical budget for mini roundabout maintenance?
44. Are winter maintenance needs (including plowing) at a mini roundabout different than full-sized roundabouts?

F. Public Reaction

45. How positive is the feeling about mini roundabouts among staff in your agency in general?
46. What are some current perspectives about mini roundabouts among elected officials/other community leaders/project partners?
47. What have the professional media and social media stories and comments generally looked like regarding mini roundabouts?
48. Was there significant public opposition to mini roundabouts during planning / construction / after construction? If so, was that reaction likely greater than a full-sized roundabout would have seen? What were generally the areas of concern for the opponents?
49. Based on your experiences to-date with mini roundabouts, what is your long-term outlook / do you expect the use of these within your system to continue to expand?

## Modular Roundabouts

A. General

1. How many modular roundabouts has your agency opened to traffic?
2. How many modular roundabouts does your agency have in the planning, pre-design, or construction phase?

3. What are the general sizes (Inscribed Circle Diameter) of modular roundabouts in your agency?
4. In what types of locations do you install modular roundabouts?
5. Do you have criteria or guidelines on the choice to consider a modular roundabout instead of a conventional roundabout with permanent materials?
6. How else has your agency decided on a modular roundabout instead of a conventional (permanent) roundabout?
7. Have you considered using a modular roundabout as an interim treatment until a larger roundabout, permanent roundabout, or different design could be constructed?

B. Safety

8. During planning / pre-design, how did you consider the safety of the modular roundabout relative to other intersection control types (including mini roundabouts and conventional roundabouts)?
9. Do you have (and would be willing to share) detailed crash data (especially before/after crash data for retrofits), including severe crashes and ped/bike crash data, or have you conducted crash analysis for any modular roundabouts within your agency?
10. What has been your experience regarding the safety effects of modular roundabouts?
11. Do vehicles generally drive within the modular roundabouts as intended? Has speed control performance been achieved?
12. Have you heard any experiences from pedestrians or bicyclists at modular roundabouts?
13. What has been the experience of large trucks and buses at your modular roundabouts?
14. How (if present) are oversized vehicles navigating your modular roundabouts?
15. 15. Has the visibility of the central island (during day or night) been an issue, and, if so, how has this been addressed?

C. Design, Cost, and Construction

16. Generally, what materials (or vendors) have you used within the central island?
17. What materials (or vendors) have you used for splitter islands?
18. What materials (or vendors) have you used for other areas within the roundabout, such as outside edges?
19. Do you typically provide lighting at modular roundabouts?
20. What design vehicle do you typically use at modular roundabouts? What check vehicle (control vehicle) do you typically use at modular roundabouts?

21. What are other key design features of your modular roundabouts?
22. For modular roundabouts, do you typically stay within the existing footprint of the intersection, and if not, are there typically any ROW or utility impacts?
23. Do you typically require access control around a modular roundabout, and, if so, what is the minimum distance from the circulatory roadway?
24. What have your experiences been with the color of modular roundabout materials?
25. Could you provide itemized construction costs for your modular roundabouts?
26. Comparing full-sized roundabouts with modular roundabouts, what is the approximate cost savings you have experienced with modular roundabouts?
27. Do you have a maximum cost you typically aim for with modular roundabouts?
28. What is the typical time to construct a modular roundabout? How much of the project timeline has been dedicated to design and materials procurement/shipping?
29. What is the typical maintenance of traffic stages during the construction of a modular roundabout?
30. How are WB-62/67 truck movements accommodated within your modular roundabouts? Do you allow encroachments into opposing traffic? Are trucks expected to mount the splitter island on the approach/receiving legs?
31. Are light trucks and buses accommodated within the flush pavements of your mini roundabouts without having to mount the central island or splitter islands?
32. How are emergency vehicles accommodated within your modular roundabouts?
33. How are pedestrians and bicyclists designed for at your modular roundabouts?
34. Have you placed the crosswalks at a different location than 20-30 feet beyond the circulatory roadway at modular roundabouts?
35. What is the maximum fastest path speed you have designed your modular roundabouts for?
36. What treatments have you used to help control speeds at modular roundabouts on roadways with design speeds greater than 30 mph?
37. What is the intended design life of your modular roundabouts? What (if any) is the ultimate configuration?
38. Have you had any difficulty with purchasing or obtaining (due to product availability) the modular roundabout materials?
39. Have you had any difficulty installing the modular roundabout materials?

D. Maintenance

40. What are the primary maintenance needs at modular roundabouts, and are these different from full sized roundabouts?
41. What is the typical budget for modular roundabout maintenance?
42. Are winter maintenance (including plowing) needs at modular roundabouts different than full-sized roundabouts?
43. How long have the materials (central island, splitter island, outside temporary curb, or others) lasted at modular roundabouts before needing replacement, and how did you address or mitigate this? Did you order extra/replacement materials prior to construction?
44. Did maintenance/construction staff require any additional training for installation/repair of modular roundabout materials?

# Appendix D:
# Desk Scan

# Background

## Scope of Desk Scan

While roundabouts continue to be a proven solution for addressing safety and efficiency at intersections in the U.S., the increasing costs of construction and right-of-way have reinvigorated the mini roundabout as a viable option in favor of the traditional roundabout. By definition, a mini roundabout is a special type of roundabout in which the central island is fully traversable and intended to be utilized by trucks or other large vehicles. This technique reduces the footprint of the intersection, and mini roundabouts can often be retrofitted within existing intersection footprints. Approximately 300 mini roundabouts have been constructed in the U.S., and states with eight or more mini roundabouts include Washington, Minnesota, North Carolina, Texas, Maryland, Michigan, Kentucky, Georgia, Ohio, Colorado, Arkansas, and Oregon.

Like a mini roundabout, a modular roundabout is a specialized roundabout that incorporates prefabricated materials to reduce excavation, paving and drainage, environmental, utility and right-of-way impacts, construction duration, and ultimately, cost. The modular material is typically used for the central island and splitter islands but may also include outside curbing. The material is glued or anchored on top of existing pavement. In addition to these custom-made materials, modular roundabouts employ striping and may include quick-build curbs and flex-posts to delineate vehicle paths. Modular roundabouts are less common in the U.S., but several have been constructed in California, Georgia, North Carolina, Virginia, and Wisconsin.

The objective of the domestic scan is to identify leading states and describe the experiences and lessons learned that may be valuable to others who may be considering using mini or modular roundabouts. The scan team will meet with innovative agencies that have utilized mini- and/or modular roundabouts and discuss their experiences in design, construction, operation, and maintenance, including as the following:

- Installation costs,
- Maintenance needs,
- Temporary and permanent traffic control measures,
- Usage on higher-speed roadways,
- Crash history,
- Capacity and traffic efficiency data,
- Truck and bus performance,
- Return on investment, and
- Public/community leader acceptance.

## Methodology

To prepare the Desk Scan, several known sources of mini roundabout research and best practices were consulted and listed in Attachment A. While there has been some published guidance and findings on mini roundabout design and implementation, little to no research has been conducted on modular roundabouts in the U.S. due to the limited number of applications. Best practices from modular roundabout design and implementation have been taken from the personal experience of the Subject Matter Expert and from agency interviews listed in Attachment B.

## Results

### Best Practices and Innovations – Mini roundabouts

The following are best practices and innovations associated with mini roundabouts:

- **Applicability.** While mini roundabouts have been predominantly planned in low-volume, low-speed contexts (i.e. posted speeds below 30 mph), they are increasingly becoming explored as viable alternatives on higher-speed, state-maintained roadways.
- **Cost.** Typically below the cost of conventional roundabouts ($60,000 - $200,000), especially if the footprint of the intersection can be minimized. Mini roundabouts are often planned to retrofit two-way or all-way stop-controlled intersections and designed within existing curb lines. This technique can also minimize environmental, utility, and right-of-way (ROW) impacts.
- **Traffic Operations.** Mini roundabouts have previously been thought to have lower capacity than conventional single-lane roundabouts due to slower speeds and turning movements, but with limited operational verification. This is because most mini roundabouts are installed in locations with volumes well under capacity.
- **Speed Control.** Mini roundabouts have typically been limited to low-speed roadways (i.e., 30 mph and less). Recently, some jurisdictions have implemented minis on higher-speed roadways with enhanced speed control on the approaches. Other agencies have implemented mini roundabouts in series (along with other traffic calming measures) to implement corridor-wide speed control.
- **Design Vehicle.** Mini roundabouts are typically designed so that passenger cars and buses can complete all movements without running over the central island, while larger vehicles such as tractor-trailers and fire trucks will sweep over the entire central island (and potentially splitter islands as well). The use of an 80- to 90-foot Inscribed Circle Diameter (ICD) can accommodate a wide range of vehicles without making splitter islands mountable or having vehicle cabs mounting the central island.
- **Pavement Materials.** Stamped asphalt or concrete are the most common construction materials. At least one agency is utilizing permeable concrete pavers to further reduce impacts by minimizing or eliminating drainage and SWM provisions.
- **Quick-build materials.** Like modular roundabouts, mini roundabouts can be constructed using low-cost, quick-build materials such as temporary curbs, flex posts, raised domes, and pavement markings.

- **Color and Visibility.** Without the vertical height of landscaping within the central islands, visibility of the central island can sometimes become an issue with mini roundabouts. Some agencies use a very small, landscaped area to increase visibility or provide flexible bollards in the very center to increase visibility and reinforce directional circulation.
- **Multimodal Design.** Customized designs have incorporated special treatments for crosswalks and bicycle facilities, especially for retrofit applications where curb-to-curb space may be limited. Often, crosswalks may be placed closer to the yield line than at conventional intersections, and splitter islands may be painted or too narrow to incorporate typical pedestrian refuge areas. Raised crosswalks may help to control speeds and provide better bicyclist/pedestrian access.

### Best Practices and Innovations – Modular Roundabouts

The following are several highlights and lessons learned from the researched experiences with modular roundabouts:

- **Applicability.** Like mini roundabouts, modular roundabouts are typically considered in low-volume locations where traffic signal warrants are not met, but with speed/safety issues. For retrofits, the modular roundabout becomes more competitive with other intersection improvement alternatives when it can be constructed fully within the paved area of the existing intersection, for an ICD of approximately 70 to 100 feet. Several installations have been larger depending on the existing footprint of the intersection.
- **Design Techniques.** At least one site has installed, and other locations have considered, building only the outer portion of the central island to create a "donut"-shaped design to save cost. This helps reinforce circulation and speed control without the need to construct the entire central island.
- **Cost.** Typically $300,000 to $500,000 (including design and construction) if no permanent materials are used and impacts can be limited to the existing curb space of the intersection.
- **Construction Timeline.** Some designs have taken up to several weeks to construct, but several others have been substantially completed within two to five days.
- **Materials Availability.** Modular materials are less prevalent than typical construction materials and may require several months to procure from the vendor. Construction schedules should include buffer time for materials arriving in multiple shipments.
- **Installation.** Drilling of modular materials into existing pavement may require specialized or lower-duty equipment (drill bits, portable power source, shop-vac for excavation) than what is typically utilized at state and municipal DOTs. One or more pre-construction meetings with the vendor and construction management team may be necessary.
- **Color and Visibility.** Like mini roundabouts, the lack of signage and landscaping within the central island creates additional challenges for visibility of the roundabout. A conspicuous color such as yellow should be used instead of grey or black. Colors other than black may be several times more expensive.

- **Maintenance.** Materials typically hold up well under single-unit trucks and light vehicle trailers. For resurfacing applications, milling should be truncated outside of the modular materials, and good practice has been to resurface the intersection prior to construction of the modular materials so that they can be bolted into fresh pavement. Modular roundabouts may be less durable with snowplowing, but not enough have been installed in locations with heavy snow to have reliable information on performance.
- **Conversion to Permanent Installation.** Several sites have been constructed at high-crash locations and performed well, but after local communities expressed a desire to convert to permanent designs, the increased safety performance of the intersections during the modular roundabout phase has resulted in a low benefit-cost ratio for project prioritization.

### Overlap with Previous Scans

The following domestic scans have covered related topics to the issues raised in the Draft Amplifying Questions:

- Scan 07-02 – *Best Practices in Accelerated Construction Techniques*
- Scan 07-03 – *Best Practices in Winter Maintenance*
- Scan 12-03 – *Advances in Safety Program Practices in "Zero-Fatalities" States*
- Scan 17-02 – *Successful Approaches to Accommodate Additional Modes and Services in Existing Right of Way*

None of the above have included specific applications to roundabouts. Therefore, there is minimal overlap with previous scans.

## Recommendation

Based on the prevalence of mini roundabouts (Attachment C), we propose to interview the following agencies on their experience with mini roundabouts:

*Higher Priority:*

- Georgia DOT
- Howard County, MD
- Washtenaw County, MI
- Minnesota DOT
- North Carolina DOT
- Washington State DOT
- FHWA

*Lower Priority:*

- City of Harrisburg, PA
- City of McKinney, TX

We propose to interview the following agencies on their experience with modular roundabouts:

*Higher Priority:*

- Georgia DOT
- North Carolina DOT
- Virginia DOT

Lower Priority:

- City of San Diego, CA

The list of amplifying questions for the agency interviews is contained in Attachment D.

## Attachments

A. Bibliography

B. List of contacts consulted

C. Summary of known mini- and modular roundabout installations in the United States

D. List of amplifying questions for Domestic Scan

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10. Road Commission for Oakland County. "Compact (or Mini) Roundabouts." <https://www.rcocweb.org/519/Compact-or-mini-Roundabouts>. Accessed 3-29-2024.

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## ATTACHMENT C – SUMMARY OF KNOWN MINI AND MODULAR ROUNDABOUTS IN THE U.S.

| State | Number of Mini Roundabouts |
|---|---|
| Washington | 64 |
| Minnesota | 34 |
| North Carolina | 17 |
| Texas | 16 |
| Maryland | 12 |
| Michigan | 12 |
| Kentucky | 11 |
| Georgia | 10 |
| Ohio | 10 |
| Colorado | 9 |
| Arkansas | 8 |
| Oregon | 8 |
| California | 7 |
| Massachusetts | 7 |
| New York | 7 |
| Virginia | 7 |
| Florida | 6 |
| Nebraska | 6 |

| State | Number of Mini Roundabouts |
|---|---|
| Pennsylvania | 6 |
| Idaho | 5 |
| Missouri | 5 |
| Arizona | 4 |
| Iowa | 4 |
| Montana | 4 |
| Mississippi | 3 |
| Connecticut | 2 |
| Delaware | 2 |
| New Jersey | 2 |
| South Carolina | 2 |
| Tennessee | 2 |
| Utah | 2 |
| Wisconsin | 2 |
| Alaska | 1 |
| Illinois | 1 |
| Kansas | 1 |
| Rhode Island | 1 |
| Vermont | 1 |

Source: roundabouts.kittelson.com

# Appendix E: Host Agency Key Contacts

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