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**Title:** Maryland Roundabout History

**Submission Date:** March 26, 2008

**Word Count:** 4,534

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## Abstract

The Maryland State Highway Administration was the first state in the United States to adopt a roundabout program at a statewide level. The purpose of this paper will be to identify the activities that occurred in the early years, including the early activities and projects. We will then discuss how the program has grown in subsequent years in terms of the number and locations of roundabouts. We will also discuss the results from an operational and safety perspective of those sites for which we have data. Additionally, we will discuss lessons learned and projects for which we have had to make modifications to improve operations or safety.

# Formation and Establishment of the Maryland Roundabout Program

The Maryland State Highway Administration (SHA) was the first state in the United States to adopt a roundabout program at a statewide level. In the late 1980's, Ken Todd, a British expatriate who had experienced roundabouts while living in the United Kingdom, would frequent public meetings for transportation projects in the Washington D.C. area and encourage SHA to look at roundabouts.

In 1990, SHA began analyzing the feasibility of a roundabout at the ramp termini for a new interchange at a grade separation of I-95 (Capitol Beltway) and Ritchie-Marlboro Road. Upon completion of the roundabout analysis for the ramp termini roundabouts at I-95 (Capitol Beltway) and Ritchie-Marlboro Road, SHA was confident that a roundabout was an appropriate solution. However, due to the very high volume at this location, SHA wanted to ensure their first roundabout was successfully implemented, and decided to cut their teeth on something a little less risky. To that end, SHA formed a Roundabout Task Force.

The SHA Roundabout Task Force included members from several departments within SHA, and traffic engineers from several counties in the Baltimore-Washington region. The goals of the task force were to continue research on the use of roundabouts, develop a videotape for use in public meetings, identify candidate locations where a roundabout may solve a particular problem, and develop guidelines for the use of roundabouts.

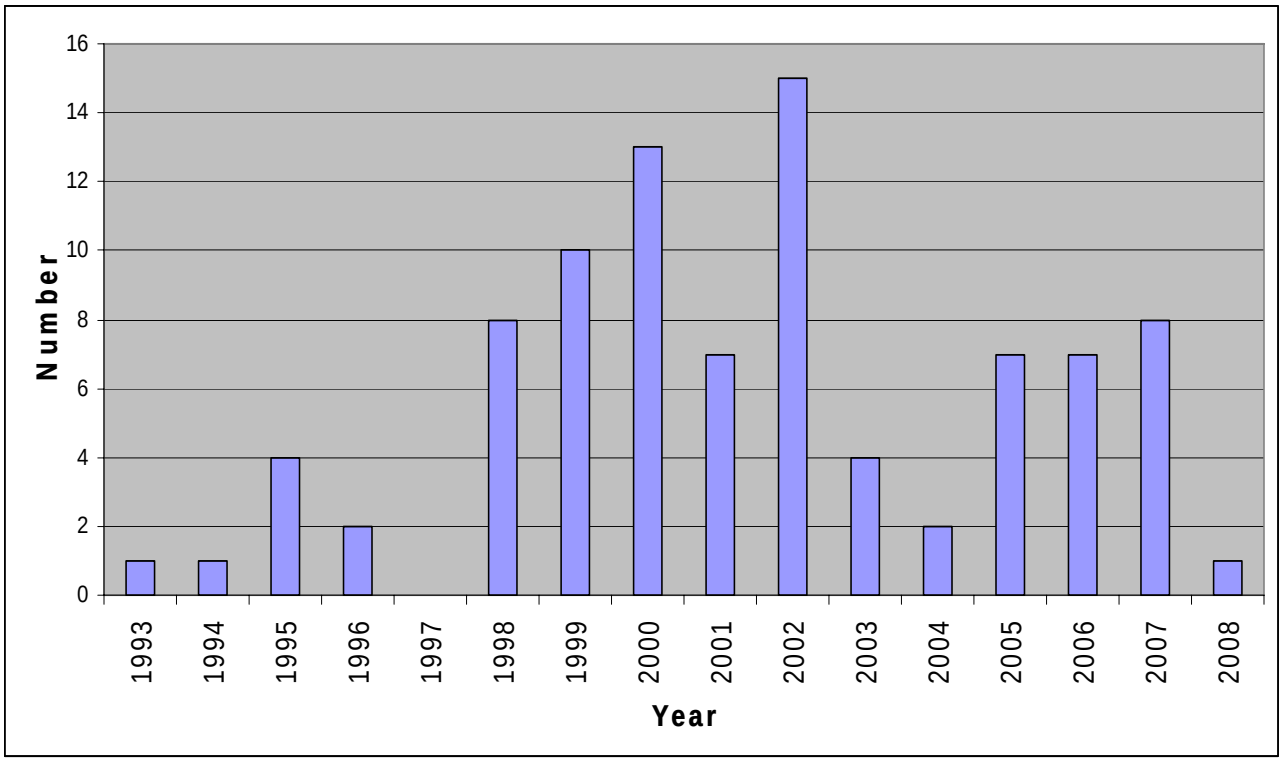
Most of the first roundabouts constructed by SHA were low to medium-volume sites with a high crash experience. All of these initial roundabouts are still in place today and have a very low crash rate. Since that time SHA has constructed roundabouts in a variety of settings ranging from low volume to high volume, and in rural, suburban and urban settings.

SHA has adopted a policy that roundabouts will be considered at all intersections where improvements are being considered. This policy has lead to one of the highest number of roundabouts constructed on a state system in the country.

# Roundabouts in Maryland

Information was collected from the Kittelson & Associates, Inc. roundabout database, county engineers in Maryland, and the state of Maryland in order to review the number of roundabouts by jurisdiction, the number of roundabouts constructed each year, as well as operations and safety information for roundabouts in Maryland. Currently there are at least 158 roundabouts in the state of Maryland, with more than 65 roundabouts in operation at State maintained intersections (Reference 1). Chart 1 displays the number of roundabouts constructed by year in Maryland.

**Chart 1 Roundabouts Constructed by Year in the State of Maryland**




*Construction date was not found for 68 roundabouts, which are not included in the chart

As seen in Chart 1, after seeing the rate of roundabouts constructed per year increase through the late 1990s the number of roundabouts constructed per year has begun to steady. Roundabouts have become more commonplace in the state of Maryland, and public acceptance is no longer the biggest detriment to the construction of more roundabouts. While SHA would like to see the rate of roundabouts constructed per year continue to increase, however fiscal issues are preventing a greater number from being constructed each year.

Table 1 displays the number of roundabouts located in each county in Maryland.

**Table 1 Location of Roundabouts in Maryland**

| County | Number |
|---|---|
| Anne Arundel | 10 |
| Baltimore County | 3 |
| Calvert | 1 |
| Caroline | 1 |
| Carroll | 4 |
| Cecil | 2 |
| Charles | 3 |
| Frederick | 10 |
| Harford | 20 |
| Howard | 80 |
| Kent | 2 |
| Montgomery | 7 |
| Prince George's | 8 |
| Queen Anne's | 2 |
| St. Mary's | 2 |
| Washington | 2 |
| Wicomico | 1 |
| **Total** | **158** |

As seen in Table 1, the state's 158 roundabouts are located in at least 17 of Maryland's 24 counties. Howard County has the most roundabouts with at least 80, followed by Harford with 20, and Anne Arundel and Frederick with 10 each. While this is partly due to the higher population in each of these three counties, it also shows that as roundabouts gain acceptance in particular areas, they are more welcomed by the public, which in turns allows a greater number to be built. Additionally, local engineers begin to develop roundabout expertise that allows for better design suited to local conditions. Table 2 displays the ownership of roundabouts in Maryland.

**Table 2 Ownership of Roundabouts in Maryland**

| Owner | Number |
|---|---|
| Local | 8 |
| County | 84 |
| Military | 1 |
| State | 65 |
| **Total** | **158** |

As seen in Table 2, local counties have constructed and presently maintain more roundabouts than the State of Maryland. However, local and county roundabouts are predominantly single-

lane roundabouts in low-speed environments. Conversely, there is no one defining characteristic of SHA roundabouts. SHA has constructed and presently maintains roundabouts on state highways in rural, developing, and urban locations.

# Summary of Research

Since the publication of "Modern Roundabouts for Maryland" in 1993, there have been numerous articles, papers, books, reports, design guides, and videos produced documenting roundabouts. Roundabout delay, queues, capacity, safety issues, pedestrian and bicycle usage at roundabouts, and more have been analyzed and reviewed. Additionally, many websites have been created by jurisdictions, consultants, researchers and private citizens with information, graphics, animation, and data related to roundabouts. Research and information on roundabouts is far more available than it was in 1993. Three documents detailing roundabout research: The Maryland Roundabout Design Guide, Federal Highway Administration's (FHWA) Roundabouts: An Informational Guide, and the NCHRP 5-72 report on roundabouts, were chosen to be reviewed for this paper due to there far-reaching impacts for roundabouts in Maryland, as well as nationally.

## MARYLAND ROUNDABOUT GUIDE

In 1995, the Maryland Department of Transportation State Highway Administration (SHA) produced a statewide roundabout guide as an interim document prior to the production of the FHWA Roundabout Guide. Most of the information within the Maryland guide was borrowed from the Australian Design Guide. Where necessary, the design guidelines were slightly altered to conform to standard AASHTO and MUTCD practices, and all units were converted to U.S. standard units and the diagrams inverted to right-side traffic flow; however, the procedures and guidelines were largely the same as those in the Australian guide. Additionally, examples of landscaping designs, truck apron details, typical signing plans for state route and local street roundabouts, construction staging diagrams, and public education suggestions were also included. The appendix included a sample benefit/cost analysis.

At this time, SHA has adopted the FHWA Roundabout Guide, as its standard. In addition, they have created several supplements with regards to signing and pavement marking guidance.

## FHWA ROUNDABOUTS: AN INFORMATIONAL GUIDE

The FHWA roundabout guide was developed based on established international and domestic roundabout practice, and was supplemented by additional research. The guide is intended for both transportation professionals and the public. Consequently, the roundabout guide provides introductory material through design detail. The differences between a roundabout and a traffic circle are discussed, as well as public acceptance and legal issues. The roundabout guide also provides information relating to the planning, operation, design and configuration of modern roundabouts. While the guide was intended to consider all modes, including heavy vehicles,

buses, transit, bicycles, and pedestrians, the discussion on pedestrians and bicycles has been criticized as being inadequate.

### NCHRP 5-72: APPLYING ROUNDABOUTS IN THE UNITED STATES

The objectives of this national research project were to develop methods of estimating the safety and operational impacts of U.S. roundabouts and refine the design criteria used for them. The document describes, analyzes, and critiques pertinent domestic and international operational and safety analysis models and design criteria on the basis of applicability to roundabouts in the United States**.** Additionally, crash prediction models and methods that relate crashes to traffic and geometric characteristics for all roundabout sizes and types was developed and reported. Refined geometric and traffic control design criteria used for roundabouts, including treatments for bicycles and pedestrians (including pedestrians with disabilities and including the impact of accessible pedestrian signals on pedestrian access and vehicle operations) was also included. Lastly, computational procedures to estimate capacity, delay, and queue lengths for approaches to single and multi-lane roundabouts using U.S. data was refined and developed.

## Case Studies

### MD 144/MD 94 INTERSECTION

The MD 144/MD 94 intersection was the first roundabout constructed by the Maryland State Highway Administration. This intersection was experiencing a significant number of crashes, and many of these crashes resulted in injury crashes. Since this was the first roundabout constructed in Maryland, and one of the first constructed in the country, the local residents were very skeptical that this was the right solution in their community and about roundabouts generally. As such, most residents expressed disapproval of the state preferred solution at this intersection. Given that SHA didn't have much experience with roundabouts they agreed to install a temporary roundabout, and that they would remove it if the community did not adjust to the new form of intersection control. To gauge the community's reaction to the roundabout, SHA agreed to meet with a task force of eight citizens on a monthly basis. This group was assured that the roundabout would be removed at any time during the first six months if it wasn't performing as SHA officials anticipated. After the third month, the citizen group agreed that the roundabout was a good solution and that the temporary roundabout should be converted to a permanent roundabout as soon as possible. Figure 1 displays a photo of the permanent roundabout.

About two years later, the community asked SHA to install another roundabout to the north of the original intersection to solve similar, although not as serious problems. This illustrates how the community completely changed their position related to roundabouts. Both of these are still in operation and operating well both from a safety and operations perspective.

**MD 144/MD 94 INTERSECTION**
**PERMANENT ROUNDABOUT**
**HOWARD COUNTY, MARYLAND**

**FIGURE 1**

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### *Towson Roundabout*

The Towson Roundabout became the first two-lane roundabout constructed in Maryland, and the first with any level of pedestrian activity. Prior to the construction of the roundabout, the intersection was controlled by two closely-spaced signals. Not all movements were allowed under this configuration, and the intersection was not pedestrian friendly. The goals of the project were to improve traffic operations and safety, and to improve the intersection aesthetically, as it was the gateway to the central business district of Towson. Additionally, the hope was that the infrastructure improvements would lead to economic development activity. While overall the project was a success and achieved many of the stated goals, it did not meet al of the project goals.

Overall, the intersection is much more aesthetically pleasing than the previous intersection, and most of the buildings are now occupied and others are planned. The traffic operations are slightly better during peak periods and much better in the off-peak periods. However, the intersection has a mixed record with respect to safety. The overall number of crashes has increased while the number of injury crashes has decreased. The intersection has had mixed reviews with respect to pedestrian activities, and while there were not before/after pedestrian counts taken, there does not appear to be less pedestrians than in the previous condition. If anything, because of the new land uses, there are more pedestrians at the intersection. SHA continues to make minor changes to the intersection to improve operations and safety, and the number of crashes has come down in recent years. Figures 2 and 3 display before and after photos of the Towson Roundabout, respectively.

**TOWSON CIRCLE**
**BEFORE ROUNDABOUT**
**TOWSON, MARYLAND**

**FIGURE 2**

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**TOWSON CIRCLE**
**AFTER ROUNDABOUT**
**TOWSON, MARYLAND**

**FIGURE 3**

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## I-95(CAPITAL BELTWAY)/RITCHIE-MARLBORO ROAD INTERCHANGE

This interchange actually marked the first time SHA considered a roundabout as a potential solution. The original planning effort started in the mid 1980's and produced the typical range of intersection solutions including full cloverleaf, partial cloverleaf, and urban diamond interchange forms. SHA was reticent to install a full cloverleaf interchange at this location given their recent experiences with weaving problems on the freeway and the resulting safety concerns. SHA was in the process of adding Collector-Distributor roads to existing full cloverleaf interchanges to mitigate the safety concerns. At the same time, officials within SHA had learned of new advances with roundabouts, and had reviewed some of the safety records from overseas. They asked me to review the applicability of roundabouts at this location. It turned out that roundabouts proved to be the preferred interchange solution and was chosen as the selected alternative. The project was completed around 2000 with a diamond interchange with roundabouts as the intersection treatments. The original interchange consisted of two two-lane roundabouts at the ramp termini. This is illustrated in Figure 4. This interchange will be converted to a three-lane roundabout this year due to development pressure in the area. The three-lane roundabout is shown in Figure 5.

I-95 SOUTHBOUND (CAPITAL BELTWAY)/RITCHIE-MARLBORO ROAD
EXISTING ROUNDABOUT
TOWSON, MARYLAND

FIGURE 4

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I-95 SOUTHBOUND (CAPITAL BELTWAY)/RITCHIE-MARLBORO ROAD
PROPOSED ROUNDABOUT
TOWSON, MARYLAND

FIGURE 5

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# Current State of the Maryland Roundabout Program

## SUCCESSES

A report conducted by SHA in 2006 (Reference 2) on 19 single-lane roundabouts that had been in service for three to five years reported that there had been a 68% decrease in the total accident rate, a 100% decrease in the fatal accident rate, an 86% reduction in the injury accident rate, and a 40% reduction in the property damage-only accident rate. Additionally the report found that for every accident reduced, a total of $16,469 was spent, while the weighted average accident cost was estimated at approximately $100,000. Consequently, a benefit/cost analysis revealed that there is an approximately $13.00 return for every dollar spent on roundabouts.

# Vision for the Future

The 1993 paper completed by the co-author on this subject was written at a time when there were very few roundabouts in the State of Maryland, and less than ten in the nation. Since that time roundabouts have been constructed in at least 44 states, with at least 22 states having adopted some form of statewide program. Nationwide, over 870 roundabouts have been constructed. This number is expected to continue to increase as more states become aware of the safety and operational advantages of this form of traffic control. The pending issue related to pedestrian crossings at roundabout intersections could potentially limit the number of roundabouts depending on the wording of the Access Board recommendations, and the results of on-going research, in particular NCHRP 3-78. Even in spite of this issue, we expect the number of roundabouts to continue to grow exponentially in the coming years due to their safety and operational benefits.

# References

1. Cunningham, Robert B. Maryland's Roundabouts: Accident Experience and Economic Evaluation. Maryland State Highway Administration, Traffic Development & Support Division, Office of Traffic & Safety. 2007.
2. "MDSHA: Traveling Maryland's Roundabouts: Roundabouts on the Maryland State Highway System." Maryland Department of Transportation, State Highway Administration. 2000. Fall 2007 <http://www.sha.state.md.us/safety/oots/roundabouts/location.asp>.
3. Myers, Edward J. Modern Roundabouts for Maryland. ITE Consultants Council, Young Consultants Award. ITE Consultants Council, 1993.