AGENDA

- Overview
- Study Process
  - Step 1 – Data Collection
  - Step 2 – Assess Existing Conditions/Problem ID
  - Step 3 – Develop and Evaluate Options
- Next Steps
  - Step 4 – Outreach, Education, Design/Approvals
Overview

- Intersection is a known bottleneck
- Intersection is a significant transition point for N. Pleasant Street – lack of a “gateway”
- Utility construction presented opportunity to address the mobility problems
- Explored the most efficient configuration for the intersection once the construction is complete:
  - No Action (status quo, return to prior state)
  - Enhanced signal
  - Roundabout

Pre-construction Condition
Current Condition

Step 1 – Data Collection
N. Pleasant St / Governors Dr / Eastman Ln Intersection Enhancement

Traffic Demands

Vehicles per Hour

- 1. N. Pleasant St. NB (3,600 vpd)
- 2. N. Pleasant St. SB (5,400 vpd)
- 3. Governors Dr. EB (4,300 vpd)
- 4. Eastman Ln. WB (1,200 vpd)
- Total Entering Volume (1+2+3+4 = 16,500 vpd)

Traffic Demands

<table>
<thead>
<tr>
<th>Location</th>
<th>Daily Volume</th>
<th>% c</th>
<th>Dir. Dist. d</th>
<th>Weekly Volume</th>
<th>%</th>
<th>Dir. Dist.</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Pleasant Street, North of Governors Drive/Eastman Lane</td>
<td>10,200</td>
<td>600</td>
<td>5.9%</td>
<td>830</td>
<td>8.1%</td>
<td>51% SB</td>
</tr>
<tr>
<td>North Pleasant Street, South of Governors Drive/Eastman Lane</td>
<td>7,500</td>
<td>300</td>
<td>5.2%</td>
<td>600</td>
<td>8.0%</td>
<td>52% SB</td>
</tr>
<tr>
<td>Governors Drive, West of North Pleasant Street</td>
<td>8,700</td>
<td>620</td>
<td>7.1%</td>
<td>730</td>
<td>8.4%</td>
<td>60% EB</td>
</tr>
<tr>
<td>Eastman Lane, East of North Pleasant Street</td>
<td>6,000</td>
<td>440</td>
<td>7.0%</td>
<td>560</td>
<td>8.8%</td>
<td>50% WE</td>
</tr>
</tbody>
</table>
Pedestrian/Bike Volumes & Desire Lines

LEGEND
AM (PM)
Primary
Secondary
Minor
### Step 2 – Assess Existing Condition / Problem ID

#### No Action – Traffic Operations

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Approach / Lane Group</th>
<th>2009 Volumes on Existing Geometry (before construction activity)</th>
<th>2010 Volumes on Existing Geometry (before construction activity)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Morning Peak Hour</td>
<td>Afternoon Peak Hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Delay</td>
<td>LOS</td>
</tr>
<tr>
<td>North Pleasant Street at</td>
<td>Governors Drive EB</td>
<td>17</td>
<td>B</td>
</tr>
<tr>
<td>Governors Drive / Eastman Lane</td>
<td>Eastman Lane WB/LT</td>
<td>17</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Eastman Lane WB/R</td>
<td>14</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>North Pleasant Street NB</td>
<td>16</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>North Pleasant Street SB</td>
<td>24</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Overall Intersection</td>
<td>20</td>
<td>C</td>
</tr>
</tbody>
</table>

Delay: 100 ft (4 veh) 161 ft (7 veh) 25 ft (3 veh) 89 ft (4 veh) 390 ft (16 veh) 390 ft (16 veh)
LOS: A, B, C
Q: 4 veh, 6 veh, 2 veh, 9 veh, 13 veh, 16 veh
Step 3 – Develop and Evaluate Options

Options Evaluated

- No Action (status quo, return to prior state) - discarded
- Enhanced signal
- Roundabout

Side-by-side comparison initiated
N. Pleasant St / Governors Dr / Eastman Ln Intersection Enhancement

Upgraded Signal

Roundabout (layout as of April 2010)
Roundabout vs. Current Condition

What is a Roundabout?

- It is not a rotary/traffic circle
- A circular intersection
- Entering traffic yields to circulating traffic
- Design features ensure slow entering and circulating vehicle speeds

Over 2,300 roundabouts in the US (as of December 2009)
What is a Roundabout?

Walk around the outside; don’t cross through the middle

Ride your bike as a vehicle or walk your bike as a pedestrian

Measures of Effectiveness

1. Traffic operations – LOS, Queues, Delays
2. Truck operations – truck, bus, FD maneuvering
3. Mobility and safety
4. Environment

Right-of-way and costs are comparable
### 1. Traffic Operations - LOS

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Approach/Lane Group</th>
<th>Morning Peak Hour</th>
<th>Afternoon Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Delay</td>
<td>LOS</td>
</tr>
<tr>
<td>UPGRADED TRAFFIC SIGNAL (optimized timings, added turning lanes EB and SB approaches):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Pleasant Street at Governors Drive EB L</td>
<td>22</td>
<td>B</td>
<td>50 ft (2 veh)</td>
</tr>
<tr>
<td>Governors Drive EB T/R</td>
<td>17</td>
<td>B</td>
<td>74 ft (3 veh)</td>
</tr>
<tr>
<td>Governors Drive / Eastman Lane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastman Lane WB L/T</td>
<td>24</td>
<td>C</td>
<td>186 ft (7 veh)</td>
</tr>
<tr>
<td>Eastman Lane WB R</td>
<td>11</td>
<td>B</td>
<td>19 ft (1 veh)</td>
</tr>
<tr>
<td>North Pleasant Street NB</td>
<td>12</td>
<td>B</td>
<td>88 ft (4 veh)</td>
</tr>
<tr>
<td>North Pleasant Street SB L/T</td>
<td>15</td>
<td>B</td>
<td>182 ft (7 veh)</td>
</tr>
<tr>
<td>North Pleasant Street SB R</td>
<td>3</td>
<td>B</td>
<td>42 ft (2 veh)</td>
</tr>
<tr>
<td>Overall Intersection</td>
<td>16</td>
<td>B</td>
<td>18</td>
</tr>
</tbody>
</table>

ROUNDABOUT (1-LANE):

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Approach/Lane Group</th>
<th>Morning Peak Hour</th>
<th>Afternoon Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Delay</td>
<td>LOS</td>
</tr>
<tr>
<td>North Pleasant Street at Governors Drive EB</td>
<td>8</td>
<td>A</td>
<td>51 ft (2 veh)</td>
</tr>
<tr>
<td>Governors Drive / Eastman Lane</td>
<td>6</td>
<td>A</td>
<td>62 ft (3 veh)</td>
</tr>
<tr>
<td>Eastman Lane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Pleasant Street NB</td>
<td>7</td>
<td>A</td>
<td>37 ft (2 veh)</td>
</tr>
<tr>
<td>North Pleasant Street SB</td>
<td>7</td>
<td>A</td>
<td>163 ft (6 veh)</td>
</tr>
<tr>
<td>Overall Roundabout</td>
<td>7</td>
<td>A</td>
<td>9</td>
</tr>
</tbody>
</table>

### 1. Traffic Operations - Queues

Both enhanced signal and roundabout significantly reduce the critical queues.
National studies have shown significant delay reductions with a roundabout.

Peak hour turning volumes are well suited for a roundabout.
1. Traffic Operations - Roundabout Capacity

National research suggests that the roundabout would operate at about 65% of capacity.
Generally, a one-lane roundabout can handle approximately 25,000 vpd.

16,500 vpd ~ 65%

N. Pleasant St / Governors Dr / Eastman Ln Intersection Enhancement

N. Pleasant Street / Governors Drive / Eastman Lane Intersection Enhancement

Existing Geometry

Enhanced Signal

AM Peak Hour
AM Peak Hour: VISSIM Simulation

Existing Geometry

Roundabout

N. Pleasant Street / Governors Drive / Eastman Lane Intersection Enhancement

Existing Geometry

Enhanced Signal

PM Peak Hour
PM Peak Hour: VISSIM Simulation

Existing Geometry    Roundabout

2. Truck Operations - Maneuvering
- Semi tractor-trailer (WB-50)
- PVTA Bus (with bike rack)
- Amherst Fire Truck (Ladder 1)

Fewer areas of encroachment under a roundabout configuration; truck apron is critical
2. Truck Operations - Maneuvering

3. Safety – Vehicle Conflict Points

- Crossing (32)
- Diverging (8)
- Converging (8)

- Crossing (3)
- Diverging (4)
- Converging (4)
3. Safety - Pedestrian Conflict Points

16

- Crossing (16)

8

- Crossing (8)

3. Safety - Pedestrian Awareness

SPLITTER ISLANDS ARE THEN ADDED WITH THE OPPPOSITE DIAMETER.
S-11A IN THE APPROACH LANE.
L-103 IN THE EXIT LANE. NOT ON THE TRAVEL LANE.
3. Safety - Pedestrian Benefits

1. Drivers and pedestrians pay more attention to the environment at roundabouts than at traffic signals (no false protection)
2. Very low vehicle speeds due to deflection
3. Gaps in the traffic stream are easier to gauge and determine
4. Vehicles are only coming from one direction (no red light running)
5. Shorter crossing/fewer lanes to cross with splitter islands providing refuge areas

National studies show decreased pedestrian wait time at roundabouts vs. signals (2.1 sec vs. 10.7 secs.)

3. Safety - Pedestrian Benefits

Smart Investment and Smart Design

“The safest metro areas are already making smart investments to make roads safer and more inviting for pedestrians. Tools from policy guidelines to engineering adjustments are available, with plenty of on-the-ground examples to work from. All that is required is the courage to depart from business-as-usual highway planning that focuses on vehicles, not people. These techniques include traffic calming, road diets, roundabouts, sidewalks and crosswalks and prioritized investments in pedestrian safety projects such as Safe Routes to School and Complete Streets.”
3. Safety - Pedestrian Benefits

www.iihs.org

...on average, converting conventional intersections to roundabouts can reduce pedestrian crashes by about 75 percent. Single-lane roundabouts, in particular, have been reported to involve substantially lower pedestrian crash rates than comparable intersections with traffic signals.

FHWA Office of Safety

http://safety.fhwa.dot.gov/intersection/roundabouts/

Roundabouts are a proven safety solution that prevent and reduce the severity of intersection crashes. Roundabouts are designed to meet the needs of all road users—drivers, pedestrians, pedestrians with disabilities, and bicyclists.
3. Safety - Bicycle Conflict Points

24

12

3. Safety – Bicycle Considerations

- Most challenging design element of all modes
- Give the option of operating as a vehicle or as a pedestrian
- Bicycle speeds similar to vehicle speeds
3. Safety – Bicycle Considerations

Figure 9C-9. Shared Lane Marking
3. Safety – Bicycle Considerations
3. Safety – Bicycle Considerations
3. Safety – Bicycle Considerations
3. Safety – Crash Reduction - FHWA

<table>
<thead>
<tr>
<th>Type of roundabout</th>
<th>Sites</th>
<th>Before roundabout</th>
<th>Roundabout</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Inj.</td>
<td>PDO</td>
</tr>
<tr>
<td>Single-Lane²</td>
<td>8</td>
<td>4.8</td>
<td>2.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Multilane²</td>
<td>3</td>
<td>21.5</td>
<td>5.8</td>
<td>15.7</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>9.3</td>
<td>3.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

National before-after studies:
51% reduction (all crashes)
73% reduction (injury crashes)

3. Safety – Crash Reduction – Insurance Institute for Hwy Safety

<table>
<thead>
<tr>
<th>Group Characteristic</th>
<th>Conversion</th>
<th>Count of Crashes</th>
<th>Crashes Expected</th>
<th>Index of Effectiveness</th>
<th>Percent Reduction in Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DURING CONVERSION</td>
<td>AFTER CONVERSION</td>
<td>Without Conversion</td>
<td>(Standard Deviation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All</td>
<td>408 (7.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injury</td>
<td>521 (7.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All</td>
<td>4.8 (1.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injury</td>
<td>105.7 (10.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All</td>
<td>478.2 (20.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injury</td>
<td>6.61 (0.04)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All</td>
<td>292 (14)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injury</td>
<td>478.2 (20.7)</td>
</tr>
</tbody>
</table>

National studies:
32% reduction (all crashes)
68% reduction (injury crashes)
75% reduction (pedestrian crashes)
3. Safety – Crash Reduction – Transportation Research Board (www.trb.org)

A December 2002 study of 15 single-lane roundabouts in Maryland showed a 60-percent decrease in total crash rates, an 82-percent reduction in injury crash rates, a 100-percent decrease in the fatal crash rate, and a 27-percent reduction in property-damage-only (PDO) crash rates.
4. Environment – Vehicle emissions/delays/noise (Idling time)

Because roundabouts reduce vehicle stop-and-start cycles, they also reduce vehicle emissions, noise pollution, and fuel consumption.

Noise reduction measurements vary from 1 dBA to 5 dBA.

4. Environment - Annual delay reduction

Annual delay reduction of ~4,000 vehicle-hours per year.

Greenhouse Gas Reductions:
- 21% CO2
- 16% NOx
- 19% CO
- 26% HC

Less pavement = 10 to 15% more pervious area
Measures of Effectiveness - Summary

<table>
<thead>
<tr>
<th>Measure</th>
<th>Signal</th>
<th>Roundabout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Traffic operations – LOS, Queues, Delays</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2. Truck operations – truck, bus, FD</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3. Mobility and safety</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>4. Environment (emissions, noise, fuel consumption, aesthetics, pervious area)</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

Overview of Roundabout Benefits

- Improved and balanced mobility (vehicles, pedestrians, bikes)
- Slower speeds, traffic calming
- Crash reduction and severity, fewer conflict points
- Gateway creation, aesthetics, wayfinding
- Environmental benefits (lower delays, reduced emissions, less noise, less impervious paved area)
- Ease of maintenance
Step 4 – Outreach, Education, Design/Approvals

Outreach and Education

- Initial resistance is common (confusion of roundabout with rotary)
- US Experience:
  - Before: 3 to 2 against
  - After: 4 to 1 in favor
Salt Lake City transportation official Tim Harpst likes the fact that traffic keeps flowing through roundabouts without a lot of stopping and starting. “They are not air-pollution causing. And you don’t have a traffic signal you have to maintain.”

The Salt Lake Tribune, December 26, 2002
WHY ROUNDABOUTS?

- Safer than signalized intersections: Modern roundabouts greatly reduce the potential for high-speed, right-angle, side, and self-induced collisions. In traditional four-way traffic intersections, there are 21 types of crashes involving two vehicles, and 21 types of crashes involving three vehicles. At roundabouts, the crashes are only as a result of traffic from other left or right (or left and right) turn movements and not pedestrian or bicycle movements.
- Reduces frequency and severity of crashes: A study in California Transportation Research Board compared three 5-year intervals during which the U.S. traffic signal network was roundabout, reducing injury crashes by 69 percent, and reducing all crashes by 40 percent, in those areas.
- Reduces traffic delays: Increases traffic capacity: Traditional four-way traffic signals result in stop-and-go directions of traffic at one time. In roundabouts, all directions of traffic are open at once, eliminating the need for traffic signals.
- Reduces long-term operational costs: With reduced or no signalized costs, and fewer maintenance costs, operational savings from roundabouts have been estimated at an average of $10,000 per year.
- More environmentally-friendly than traditional intersections due to less vehicle maintenance, fuel use and more.
- Reduced noise levels: Reduce vehicle speeds, delays, and impacts, which translates to reduced noise pollution, as well as fuel consumption.
- More aesthetically pleasing: The circular shape of many U.S. roundabouts provides a visual reminder for drivers, making it easier to identify the location of the roundabout.

ROUNDABOUT BASICS

Entering a roundabout requires many of the same skills as making a right-turn, with some differences in the procedure. For pedestrians and bicyclists, have clear path for traffic, from the left. Wait for a suitable gap in traffic, and proceed into the roundabout.

TRAFFIC

SAFE TO ENTER

4 WEST

SAFE TO EXIT

1 EAST

SAFE TO ENTER

3 EAST

SAFE TO EXIT

2 EAST

LEFT TURN

RIGHT TURN

SAFE TO ENTER

1 WEST

SAFE TO EXIT

3 WEST

SAFE TO ENTER

2 WEST

SAFE TO EXIT

1 WEST

ROUNDABOUTS: The first modern U.S. traffic roundabout was constructed in Las Vegas, Nevada in 1990. Thousands of modern roundabouts can now be found throughout the U.S., ranging from 2,000 to 5,000 roundabouts in future plans for U.S. cities.

WHAT ARE ROUNDABOUTS?

Roundabouts are a type of circular intersection in which traffic flows around a central island without the use of traffic signals.

Because roundabout traffic flows in a clockwise direction, every vehicle must yield to the vehicle entering the roundabout at the roundabout. Roundabouts are sometimes referred to as "traffic circles" or "traffic circles" in some jurisdictions.

CIRCULAR ROADWAY

CENTRAL ISLAND

PEDESTRIAN/ GEOMARKER

PEDESTRIAN/ GEOMARKER

ROUNDABOUTS WITH MULTIPLE LANES

- Select your lane before entering a roundabout intersection. Use the right lane if you are making a right turn or to proceed through the roundabout.
- Do not overtake other vehicles or bicycles in a roundabout.
- Never travel in a commercial truck or other large vehicle in a multi-lane roundabout.
- Do not exit the roundabout if there is a vehicle traveling in your lane.
- Improper turns or roundabout entries are not practiced in a roundabout.

PEDESTRIANS/BICYCLISTS IN ROUNDABOUTS

PEDESTRIANS

- Obey the same requirements as in signalized intersections.
- Use the appropriate lane and cross the roadway at the appropriate place.
- Enter the roundabout at a safe speed and make eye contact with the driver as you cross.
- Look back before crossing the roadway.

BICYCLISTS

- Use the appropriate lane and follow the rules of the road.
- Do not overtake other vehicles or bicycles in a roundabout.
- Use the appropriate lane and follow the rules of the road.
- Enter the roundabout at a safe speed and make eye contact with the driver as you cross.
- Look back before crossing the roadway.

WALKING/BICYCLING IN A ROUNDABOUT

PEDESTRIANS

- Obey the same requirements as in signalized intersections.
- Use the appropriate lane and cross the roadway at the appropriate place.
- Enter the roundabout at a safe speed and make eye contact with the driver as you cross.
- Look back before crossing the roadway.

BICYCLISTS

- Use the appropriate lane and follow the rules of the road.
- Do not overtake other vehicles or bicycles in a roundabout.
- Use the appropriate lane and follow the rules of the road.
- Enter the roundabout at a safe speed and make eye contact with the driver as you cross.
- Look back before crossing the roadway.

TRUCKS/LARGE VEHICLES

Many roundabouts provide access between the roadway and the central island over which the large trucks and other vehicles can safely go. The area is known as a truck turn, and is often designated with a different type of roadway surface.
Not a Roundabout… (Bourne, MA)

Not a Roundabout…. (Medford, MA)
Not a Roundabout….(Johnson City, NY)

Not a Roundabout…. (E. Longmeadow, MA)
Not a Roundabout….(Worcester, MA)
Not a Roundabout… (Belmont, MA)

Not a Roundabout… (Worcester, MA)…yet
Roundabout....(Worcester, MA)

Roundabouts....(Concord NH)
Roundabout….(Montpelier VT)

Around 300’ from a school

- 600 children per day
- 800 pedestrians per day
- 13,000 vehicles per day

Only 4 reportable crashes in 10 years – injury accidents down 69%

There are now over 40 roundabouts near schools

Roundabout (under construction)....

Figure 2

Kingston Roundabout, New York
During Construction

Source: New York State Department of Transportation
Roundabout...(Fitchburg, Route 12/31)

Roundabout...(Nantucket, Sparks Ave)
N. Pleasant St / Governors Dr / Eastman Ln Intersection Enhancement

Roundabout....(Waltham, Bentley/Lyman/Beaver)

Roundabout....(Belmont, Prospect/Park)
N. Pleasant St / Governors Dr / Eastman Ln Intersection Enhancement

Roundabout…..(Belmont, Washington St)

Roundabout – Norfolk (Route 115)
Roundabout – Dedham (Needham St)

Roundabout….(Arlington, Mystic Valley Pkwy)
Roundabout….(FL)

Roundabout….(North Haven NY)
Roundabout….(Duke)

Roundabout….(Univ of Utah)
N. Pleasant Street / Governors Drive / Eastman Lane Intersection Enhancement

AGENDA

- Overview
- Study Process
  - Step 1 – Data Collection
  - Step 2 – Assess Existing Conditions/Problem ID
  - Step 3 – Develop and Evaluate Options
- Next Steps
  - Step 4 – Outreach, Education, Design/Approvals

Questions?

May 4, 2010
Potential Pervious Areas

+10 to 15% more pervious area
Roadway Crossing
(Socket distance across splitter islands)

Parallel Desire Line

[Diagram showing measurements and layout details]
Diagonal Desire Line

240 ft (+30 ft)