Treating Potential "Back-of-Queue" Safety Hazards

Developed By:
Module Objectives

- Discuss the hazards associated with queuing caused by work zones
- Describe steps to quantify work zone impacts, determine when and where queues are likely to occur, and ascertain how long they might be
- Discuss strategies that can mitigate potential back-of-queue hazards
What is a Queue?

“A line of vehicles waiting their turn”
Where are Queues Likely to Occur?

- In the advance warning area
- Upstream of the advance warning area (more dangerous)
- In the traffic space near the work area itself
Back-of-Queue Issues

- Increased crash risk, particularly rear-end crashes
- Potentially large variability in speeds between approaching traffic and queued traffic
- Impacts on driver expectations
  - They may be accustomed to unencumbered travel and may have a slower perception-reaction time
Back-of-Queue Issues

- Geometry of roadway
  - Limited sight distance to the back-of-queue due to curvature
- Impacts from recurring congestion
- Multiple public access points
- Impacts near work vehicle access/egress points
Why Should We Analyze Queues?

Analysis can provide valuable insights into the anticipated:

- Length of queue
- Time when queues may occur
- Location of queue
- Variability in traffic speeds

Analysis helps determine potential treatments for the problem.
Analyzing Potential Queues

When the volume to capacity ratio exceeds one, a queue forms.

[Graph showing flow rate and data collection time period]
Example: V/C Estimate

<table>
<thead>
<tr>
<th>AADT</th>
<th>Directional Split</th>
<th>Peak Direction</th>
<th>Peak Hour Volume</th>
<th>Capacity</th>
<th>V/C Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>15000</td>
<td>0.6</td>
<td>9000</td>
<td>900</td>
<td>1500</td>
<td>0.60</td>
</tr>
<tr>
<td>25000</td>
<td>0.6</td>
<td>15000</td>
<td>1500</td>
<td>1500</td>
<td>1.00</td>
</tr>
<tr>
<td>35000</td>
<td>0.6</td>
<td>21000</td>
<td>2100</td>
<td>1500</td>
<td>1.40</td>
</tr>
<tr>
<td>55000</td>
<td>0.6</td>
<td>33000</td>
<td>3300</td>
<td>1500</td>
<td>2.20</td>
</tr>
</tbody>
</table>

This is a rough estimate of the potential for queuing if no other data are available.
# Measured Average Work Zone Capacities for Freeways

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>Normal</th>
<th>Open</th>
<th>Avg. Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>vph</td>
<td>vphpl</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1,170</td>
<td>1,170</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1,550*</td>
<td>1,550*</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2,740</td>
<td>1,370</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2,960</td>
<td>1,480</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3,720*</td>
<td>1,860*</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4,560</td>
<td>1,520</td>
<td></td>
</tr>
</tbody>
</table>

*Source: TRB, “HCM, Special Report 209” (1985)*

*HCM (2000)
## Ohio-DOT PLCS

<table>
<thead>
<tr>
<th>Ratio of Lanes: 2:1</th>
<th>Traffic Volume per open lane</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Construction Mon-Fri</td>
</tr>
<tr>
<td><strong>Season</strong></td>
<td><strong>Weekday</strong></td>
</tr>
<tr>
<td>1-2PM</td>
<td>1156</td>
</tr>
<tr>
<td>2-3PM</td>
<td>1407</td>
</tr>
<tr>
<td>3-4PM</td>
<td><em>1983</em></td>
</tr>
<tr>
<td>4-5PM</td>
<td><em>2366</em></td>
</tr>
<tr>
<td>5-6PM</td>
<td><em>2278</em></td>
</tr>
<tr>
<td>6-7PM</td>
<td><em>1595</em></td>
</tr>
<tr>
<td>7-8PM</td>
<td>935</td>
</tr>
</tbody>
</table>
Traffic Analysis Considerations

- Seasonal variation
- Demand fluctuation
- Fluctuation within the peak hours or peak periods
- Data accuracy
A Process-Oriented Approach

- Detailed Analysis
- Comparison of Alternatives
- Design
Choosing Mitigation Strategies

Once potential impacts are understood, appropriate strategies can be designed.

Analyzing impacts can help determine the need for strategies.

Design solutions that are tailored to solve a specific problem.
Types of Strategies

- Reducing/eliminating the end of queue
- Strategies to treat the end of the queue
- Communications techniques to improve awareness of impacts for enhanced trip planning
Queue Reduction/Elimination - Nighttime Construction

- Becoming more common
- Minimizes traffic impacts
- May reduce or eliminate a queue that would normally occur during the day
End of Queue Treatment - Proper TTC Setup

- Important for alerting motorists of any potential hazards
- Use appropriate devices and possibly law enforcement personnel for visibility
End of Queue Treatment - Use of Law Enforcement Personnel

1. Advance Warning Area
2. Transition Area
3. Activity Area
4. Termination Area

Component Parts of a TTCZ

Traffic Space

NOT TO SCALE
End of Queue Treatment – Intelligent Transportation Systems
End of Queue Treatment – Dynamic Lane Merge System
End of Queue Treatment – An Example From South Carolina

- Some projects require truck-mounted PCMS to display queue warnings.
- Required when development of a lane closure-induced queue is evident.
- Truck/TMA with operator shall be placed on the shoulder; PCMS shall be 2,000 feet in advance of queue.
End of Queue Monitoring – Portable or Permanent Cameras
Public Information and Outreach

- Project flyers
- Websites
- Marketing Materials
- Signs
- Alternate Route Information
- Traveler Information
- Traffic Reports
Work Zone Inspection – An Example from Maryland

- Includes multiple aspects of work zone operations (temporary traffic control devices as well as queuing)
- Maryland SHA has a checklist that includes work zone impacts, ITS, traffic operations strategies, etc.
Module Recap

- Name two potential hazards associated with the back-of-queue.
- How do you determine the hourly volume using only AADT?
- Why is it important to locate the back-of-queue and how do we estimate it?
- Name various mitigation treatments for back-of-queue issues.