Treating Potential "Back-of-Queue" Safety Hazards

Developed By:

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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

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What is a Queue?

- "A line of vehicles waiting their turn"

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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

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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

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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

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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

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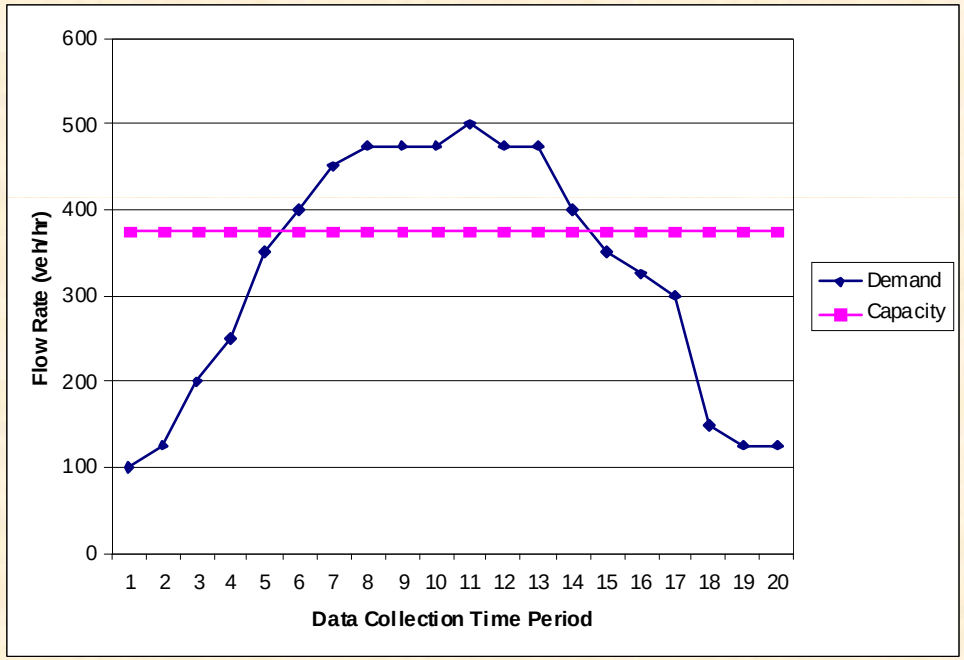
Analyzing Potential Queues

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



Example: V/C Estimate

AADT	Directional Split	Peak Direction	Peak Hour Volume	Capacity	V/C Ratio
15000	0.6	9000	900	1500	0.60
25000	0.6	15000	1500	1500	1.00
35000	0.6	21000	2100	1500	1.40
55000	0.6	33000	3300	1500	2.20

This is a rough estimate of the potential for queuing if no other data are available

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Measured Average Work Zone Capacities for Freeways

Number of Lanes		Avg. Capacity	
Normal	**Open**	**vph**	**vphpl**
3	**1**	**1,170**	**1,170**
2	**1**	**1,550***	**1,550***
5	**2**	**2,740**	**1,370**
4	**2**	**2,960**	**1,480**
3	**2**	**3,720***	**1,860***
4	**3**	**4,560**	**1,520**

Source: TRB, "HCM, Special Report 209" (1985)
**HCM (2000)*

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Ohio-DOT PLCS

Ratio of Lanes	2:1	Traffic Volume per open lane		
Season	Construction Weekday	Construction Weekend	Non-Const., Weekday	Non-Const., Weekend
Hour of the Day	Mon-Fri	Sat-Sun	Mon-Fri	Sat-Sun
1-2PM	1156	1140	1048	1058
2-3PM	1407	1211	1379	1073
3-4PM	* 1983	1161	* 1920	1115
4-5PM	* 2366	1125	* 2019	1096
5-6PM	* 2278	1107	* 2112	1012
6-7PM	* 1595	850	1433	908
7-8PM	935	713	845	745

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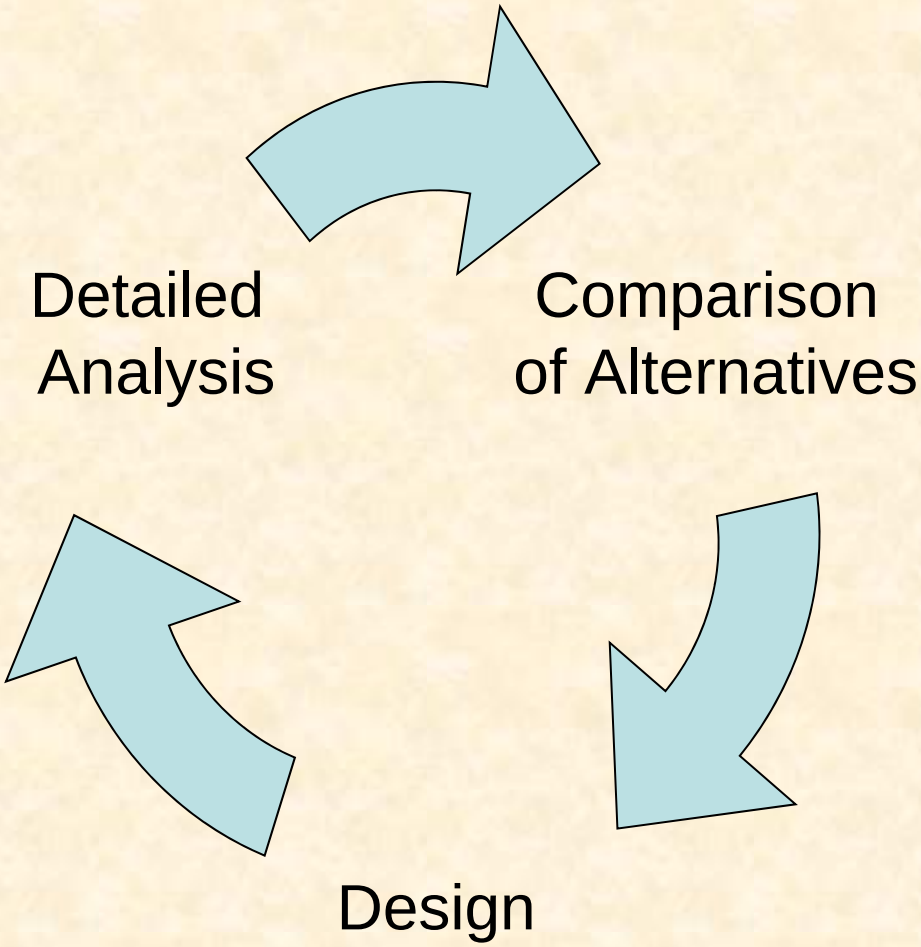
Traffic Analysis Considerations

- Seasonal variation
- Demand fluctuation
- Fluctuation within the peak hours or peak periods
- Data accuracy

A Process-Oriented Approach



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

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Types of Strategies

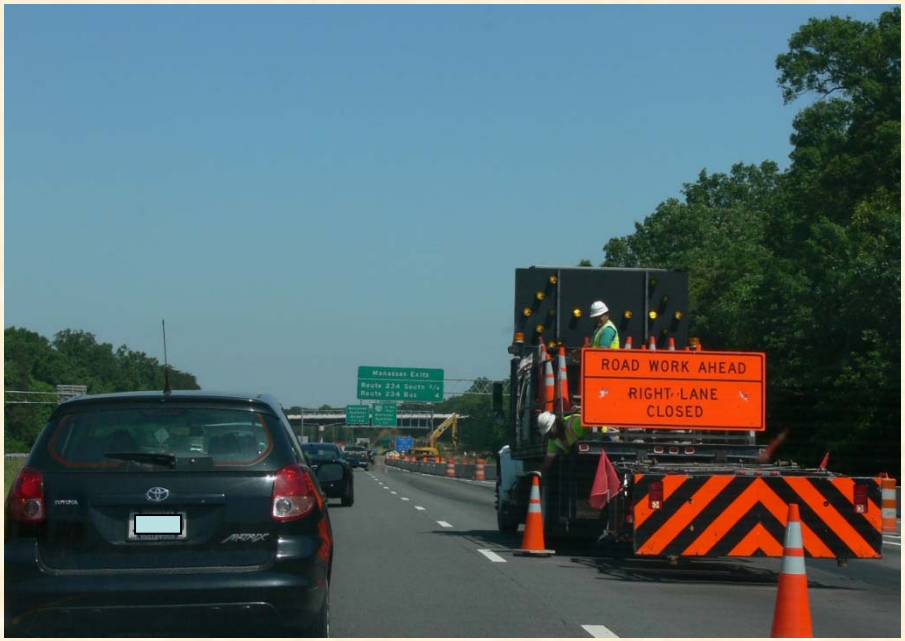
- Reducing/eliminating the end of queue
- Strategies to treat the end of the queue
- Communications techniques to improve awareness of impacts for enhanced trip planning

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



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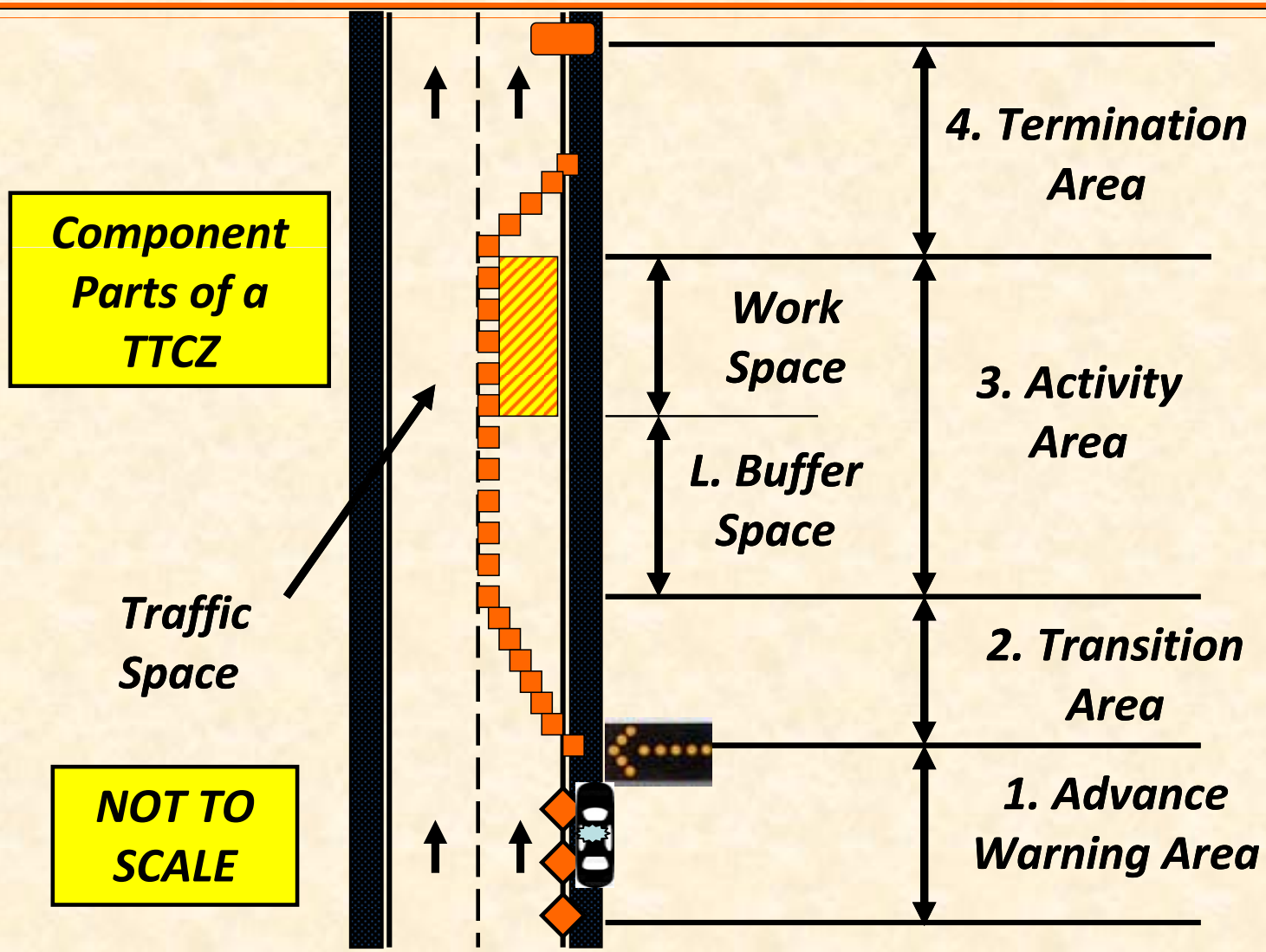
End of Queue Treatment - Use of Law Enforcement Personnel



End of Queue Treatment – Intelligent Transportation Systems

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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

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Public Information and Outreach

- Project flyers
- Websites
- Marketing Materials
- Signs
- Alternate Route Information
- Traveler Information
- Traffic Reports

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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.

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