Instructing the Implementing Safe Work Zone Operations Strategies Training Course

Handout

FHWA Grant Agreement DTFH6116RA00018 “2016 Work Zone and Guardrail Safety Training Grants”
Acknowledgements

We would like to thank the following individuals, organizations and programs for their support in the development of this course. Their expertise, advice and materials were critical in developing a practical, implementable course to simplify the application of engineering judgment and necessary plan modification in the field. The strategies detailed in this course are intended to improve the safety, effectiveness and efficiency of Temporary Traffic Control; reducing the number and severity of incidents for both workers and road users.

Oklahoma State University College of Engineering, Architecture and Technology:
Engineering Extension

Center for Local Government Technology

Oklahoma Local Technical Assistance Program

Transportation Training Institute, LLC

Anaya Echo-Hawk LaMarr

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– Steve Allen, Oklahoma Turnpike Authority
– Jeff Beaty, C-Tech Corporation
– Eric Ferron, FHWA
– Jeff Henry, Kansas DOT
– Angelo Lombardo, City of Norman, Oklahoma
– Jerry, Ullman, Texas Transportation Institute, Texas A&M University
– Bill Williams, Formerly Monroe County Indiana

FHWA and the Work Zone Safety Grantees, State DOTs and others that supported this project; specifically, we want to recognize the following organizations and their materials:
– American Road and Transportation Builders Association
– American Traffic Safety Services Association
– Michigan Road Builders Association
– Wayne State University
Disclaimer

The course materials for this training are based upon work supported by the Federal Highway Administration under Grant Agreement DTFH6116RA00018, “2016 Work Zone and Guardrail Safety Training Grants.”

Any opinions, findings, conclusions or recommendations expressed in this course are those of the trainer and the grantee and do not necessarily reflect the view of the Federal Highway Administration; nor does the Federal Highway Administration warrant or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed. The mention of trade names, commercial products, or organizations does not imply endorsement by the U. S. Government. This course does not constitute a national standard, specification or regulation.

This course provides training to assist the participants in meeting the objectives identified. Basic principles and discussions of industry practice are intended to assist practitioners in the planning and implementation of their temporary traffic control operations; planned using the appropriate Manual on Uniform Traffic Control Devices, engineering judgment and jurisdictional requirements for the location the work is being performed. Due to the multitude of situations in which these principles can be applied, the coursework only provides the basic foundation on which decisions should be made.

The employee and their employer are responsible and assume the liability for their comprehension of the principles, review and implementation of the information provided in this training as well as the applicable laws and regulations associated with the location of the work.

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Some of the language used here is directly from the US Department of Transportation, Federal Highway Administration and the US Department of Labor, Occupational Safety and Health Administration’s Susan Harwood Grant Program; modified for the specific use of this project.
Instructions and Agenda

This course is eligible for 5 contact hours of continuing education. The following paperwork must be completed and turned in during the class to have your credit logged in the Oklahoma Local Technical Assistance Program database at Oklahoma State University.

- Name, Signature and Organization on the Sign In Sheet
- Registration Information
- Evaluation (Please provide written comments on the course)

These documents can be found at the back of your handout.

Instructing the Implementing Safe Work Zone Operations Strategies Training Course

8:00 to 9:10 Introduction, The Learner and The Environment
9:10 to 9:20 Break
9:20 to 10:20 Adult Learning: The Instructor
10:20 to 10:30 Break
10:30 to 11:30 Adult Learning: Teaching Tools
11:30 to 12:30 Lunch
12:30 to 1:20 Adult Learning: The Lesson
1:20 to 1:30 Break
1:30 to 2:20 Course Delivery and Teach Backs
2:20 to 2:30 Break
2:30 to 3:30 Teach Backs
3:30 to 4:00 Final Evaluations and Closing

The times listed are approximate. The course is intended to be interactive and flexible to allow discussion on particular areas of interest of the participants. The complete set of slides and links to references to allow further investigation of content not covered or of particular interest to the participants are included.
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### Acronyms Used in this Course

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>AASHTO</td>
<td>American Association of State and Highway Transportation Officials</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ARTBA</td>
<td>American Road and Transportation Builders Association</td>
</tr>
<tr>
<td>ATSSA</td>
<td>American Traffic Safety Services Association</td>
</tr>
<tr>
<td>CDC</td>
<td>Center for Disease Control</td>
</tr>
<tr>
<td>CEAT</td>
<td>College of Engineering Architecture and Technology at Oklahoma State University</td>
</tr>
<tr>
<td>CLGT</td>
<td>Center for Local Government Technology at Oklahoma State University</td>
</tr>
<tr>
<td>CO</td>
<td>Colorado</td>
</tr>
<tr>
<td>DHHS</td>
<td>US Department of Health and Human Services</td>
</tr>
<tr>
<td>DOT</td>
<td>Department of Transportation</td>
</tr>
<tr>
<td>EREF</td>
<td>Environmental Research &amp; Education Foundation</td>
</tr>
<tr>
<td>FHWA</td>
<td>US Department of Transportation, Federal Highway Administration</td>
</tr>
<tr>
<td>FL</td>
<td>Florida</td>
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<tr>
<td>IA</td>
<td>Iowa</td>
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<tr>
<td>IL</td>
<td>Illinois</td>
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<tr>
<td>IN</td>
<td>Indiana</td>
</tr>
<tr>
<td>ISEA</td>
<td>International Safety Equipment Association</td>
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<tr>
<td>LTAP</td>
<td>Local Technical Assistance Program</td>
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<tr>
<td>MI</td>
<td>Michigan</td>
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<td>MN</td>
<td>Minnesota</td>
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<tr>
<td>MO</td>
<td>Missouri</td>
</tr>
<tr>
<td>MRBA</td>
<td>Michigan Road Builders Association</td>
</tr>
<tr>
<td>MUTCD</td>
<td>Manual on Uniform Traffic Control Devices</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>NIOSH</td>
<td>National Institute of Occupational Safety and Health</td>
</tr>
<tr>
<td>NWRA</td>
<td>National Waste &amp; Recycling Association</td>
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<tr>
<td>NYS</td>
<td>New York State</td>
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<tr>
<td>OK</td>
<td>Oklahoma</td>
</tr>
<tr>
<td>OR</td>
<td>Oregon</td>
</tr>
<tr>
<td>OSHA</td>
<td>US Department of Labor, Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>OSU</td>
<td>Oklahoma State University</td>
</tr>
<tr>
<td>SIC</td>
<td>Standard Industrial Code (SIC) 1611 - Highway and Street Construction, No Elevated Highways</td>
</tr>
<tr>
<td>TA</td>
<td>Typical Application</td>
</tr>
<tr>
<td>TTC</td>
<td>Temporary Traffic Control</td>
</tr>
<tr>
<td>TTC</td>
<td>Temporary Traffic Control Devices</td>
</tr>
<tr>
<td>TTI-LLC</td>
<td>Transportation Training Institute, LLC</td>
</tr>
<tr>
<td>TTI-TAMU</td>
<td>Texas Transportation Institute, Texas A&amp;M University</td>
</tr>
<tr>
<td>VA</td>
<td>Virginia</td>
</tr>
<tr>
<td>WIIFM</td>
<td>What’s In It for Me</td>
</tr>
<tr>
<td>WZ</td>
<td>Work Zone</td>
</tr>
</tbody>
</table>

Where MUTCD is used in this course, it refers to the 2009 National Manual on Uniform Traffic Control Devices with Revisions 1 and 2.
Credits and Resources (Adult Education)

- Dynamic Test Center, Crash Test Videos, https://www.dtc-ag.ch/
- Energy Absorption Systems, Trinity Highway Products, “Truck Mounted Crash Attenuator Hit – Video,” Dallas, Texas
- Growth Engineering, “Why you should make online learning fun,” http://www.growthengineering.co.uk/why-you-should-make-online-learning-fun/
- Humphreys, Jack and Sullivan, TD, “Guidelines for the Use of Truck Mounted Attenuators in Work Zones,” Transportation Research Record 1304
Credits and Resources
(Adult Education)


• Turning Technologies, https://www.turningtechnologies.com/


• US Department of Labor, Occupational Safety and Health Administration (OSHA), Directorate of Training and Education, Course 502: “Update for Construction Industry Outreach Trainers”


Credits and Resources

Many documents, resources and contacts are identified in this course. The most current information can be found on-line by entering the title or other information in your search engine of preference. The links listed below can also be used to access the associated information.

- American Association of State Highway and Transportation Officials (AASHTO) “Roadside Design Guide”
- American Road and Transportation Builders Association (ARTBA) Video Screenshot, “Playing it safe with PPE.”
  - [https://www.workzonesafety.org/files/documents/training/fhwa_wz_grant/shad_veh_final.pdf](https://www.workzonesafety.org/files/documents/training/fhwa_wz_grant/shad_veh_final.pdf)
  - [https://www.workzonesafety.org/files/documents/training/fhwa_wz_grant/atssa_pedestrian_work_zones.pdf](https://www.workzonesafety.org/files/documents/training/fhwa_wz_grant/atssa_pedestrian_work_zones.pdf)
- American Traffic Safety Services Association (ATSSA) Training Page
  - [http://www.atssa.com/Training](http://www.atssa.com/Training)
  - [https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/traffic-engineering-safety/trafficmanagementmanual](https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/traffic-engineering-safety/trafficmanagementmanual)
- City of Stillwater, Oklahoma, “Be Informed Stillwater,”
- Federal Highway Administration: Manual on Uniform Traffic Control Devices Adoption Map
  - [https://mutcd.fhwa.dot.gov/resources/state_info/index.htm](https://mutcd.fhwa.dot.gov/resources/state_info/index.htm)
- Federal Highway Administration: Manual on Uniform Traffic Control Devices
  - [https://mutcd.fhwa.dot.gov/](https://mutcd.fhwa.dot.gov/)
- Federal Highway Administration: Work Zone Training List
- Florida Department of Transportation, Approved Product List, Truck Mounted Changeable Message Sign
  - [https://fdotws1.dot.state.fl.us/ApprovedProductList/Products/Index/4264](https://fdotws1.dot.state.fl.us/ApprovedProductList/Products/Index/4264)
- Indiana Department of Transportation, Standard Drawings
  - [https://www.in.gov/dot/div/contracts/standards/drawings/](https://www.in.gov/dot/div/contracts/standards/drawings/)
- Iowa Department of Transportation “Standard Road Plan“
  - [https://iowadot.gov/design/standard-road-plans](https://iowadot.gov/design/standard-road-plans)
- “Iowa Work Zone Safety Guidelines for Utilities,” Iowa DOT, 2000
  - [https://www.iowadot.gov/pdf_files/work_zone_utilities.pdf](https://www.iowadot.gov/pdf_files/work_zone_utilities.pdf)
Credits and Resources


• Michigan DOT Maintenance Work Zone Traffic Control Guidelines,” 2007

• Minnesota Temporary Traffic Control Field Manual,” Minnesota DOT, 2018
  – http://www.dot.state.mn.us/trafficeng/publ/fieldmanual/fieldmanual.pdf


• Oklahoma Local Technical Assistance Program (OKLTAP)
  – http://ltap.okstate.edu/

• Quality Standards for Temporary Traffic Control Devices, 2013. Missouri Department of Transportation (MODOT)

• Safely Regulating Traffic in Michigan,” video. Produced by the Michigan Department of Transportation (MIODOT) and the Michigan Road Builders Association (MRBA)
  – https://michiganltap.org/videos/safely-regulating-traffic-michigan

• Texas Transportation Institute, The Texas A&M University, “EVALUATION OF INNOVATIVE DEVICES TO CONTROL TRAFFIC ENTERING FROM LOW-VOLUME ACCESS POINTS WITHIN A LANE CLOSURE,” September 2013, Melisa D. Finley, Praprut Songchitruksa, and Srinivasa R. Sunkari

• Texas Transportation Institute, The Texas A&M University, “IDENTIFICATION OF HAZARDS ASSOCIATED WITH MOBILE AND SHORT DURATION WORK ZONES,” September 2003, Brooke R. Ullman, Melisa D. Finley, and Nada D.

• Transportation Training Institute, LLC (TTI-LLC), https://www.transportationtraininginstitute.com/

• US Department of Labor, Occupational Safety and Health Administration (OSHA), Interpretation Letter # 20080829-8611


• Wayne State University, “A Guide to Short-Term Stationary, Short-Duration, and Mobile Work Zone Traffic Control”, 2016

• Work Zone Safety Clearinghouse
  – https://www.workzonesafety.org/
Solid Waste Resources

- National Waste & Recycling Association (NWRA) and Environmental Research & Education Foundation (EREF) have released the revised Manual of Recommended Safety Practices, https://wasterecycling.org/safety/safety-materials
- NIOSH Fact Sheet, https://www.cdc.gov/niosh/docs/2012-140/pdfs/2012-140.pdf
- NIOSH Alert, “Preventing Worker Injuries and Deaths From Moving Refuse Collection Vehicles,”

Standard Operating Procedure Development Resources

Instructing the Implementing Safe Work Zone Operations Strategies Training Course

Instructor Module 1
Intro, The Learner and The Environment

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How important can a lesson be?

Source: Energy Absorption Systems, Trinity Highway Products
An effective lesson can change lives
The study of adult learning is important because...

*It makes teaching effective*
Instructing the Implementing Safe Work Zone Operations Strategies Training Course

Objective

Improve understanding of

- Critical elements for teaching adults
- Focal points for teaching the ISWZOS (Day 1) course
- Best practices for manager course delivery
Before We Get Started

• In case of an emergency
• Facilities
• Breaks
• Please set your cell phone to silent
  – If you need to take a call, just step out of class

Please give us your thoughts and participate

Source: Pixabay – Creative Commons
Paperwork

- Sign In
- Registration Form
- Afternoon Teach Back
- Evaluations

Your opinion matters.
Give us your thoughts on the evaluation.
Agenda

8:00 to 9:10 Introduction, The Learner and The Environment
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2:30 to 3:30 Teach Backs
3:30 to 4:00 Final Evaluations and Closing
Five Elements of Teaching Adults

Source: TTI-LLC

How to engage learners
At the end of this lesson...

You will be able to:

❑ Identify the needs of adult learners
❑ Create a supportive learning environment
❑ Know the role as an instructor
❑ Use effective teaching tools
❑ Make a lesson using the teaching tools
What effects adult learning?

- The Learner
- The Environment
- The Instructor
- The Teaching Tools
- The Lesson

Source: TTI-LLC
The Five Elements of Teaching Adults

1. The Learner
2. The Environment
3. The Instructor
4. The Teaching Tools
5. The Lesson
#1 The Learner

who are you teaching and why should they care?

Source: Pixabay Creative Commons
Adult Learners as Individuals

Also their responsibilities – Do they vary in the same room?

Source: Pixabay – Creative Commons
Adult learners...

• Expect a lesson to help solve their problems

• Are motivated to actively learn

• Want new info to connect to their own knowledge and experience

• Want info to be relevant to their own life

• Want to know ‘What’s in it for ME?’ - WIIFM

• Are all unique in their learning styles
Emphasize

The training is likely something that could save a life - outside of work too ...

Source: https://www.dtc-ag.ch/ Dynamic Test Center
Learning Styles

V  Visual: observing, PowerPoint's,

A  Auditory: listening, speaking, radio, lecture

K  Kinesthetic (Tactile): practicing, touching, moving
Key to Learning Style?

Combine training methods for Active Learning

See it (visual)

Hear it (auditory)

Do it (kinesthetic)
The Retention Curve
(Understanding/Remembering)

Source: OSHA Training Techniques
Active Learning

Key to an Adult Learner
Practices lesson

Engaged in Learning Process

Active Learning

Contributes to Lesson

Higher Level of Thought
Active Learning Techniques

Vary teaching methods:

- Discussions
- Exercises
- Activities

Long Lectures
‘What’s in it for ME?’

• Start the lesson with WIIFM?
• Adults learn best when lesson relates to their work or will help them reach a goal.
‘What’s in it for ME?’

Emphasize the benefit of the lesson:

• Have learner make their own personal goals
• Encourage learner to write down how they will use the lesson in their life
Adult Learners as a Group

*Individuals coming together with a common goal*

Source: Pixabay Creative Commons
Adult Learners as a Group

Stage One: Strangers

- Learners are reluctant to talk
- Learners are forming impressions of:
  - Instructor
  - Other learners

Source: Pixabay Creative Commons
Adult Learners as a Group

Stage Two: Coming Together

• Begin working together
• Begin communicating
• Recognize common goals
• Start to feel apart of the group

Source: TTI-LLC
Adult Learners as a Group

Stage Three: an Effective Group

- Learners feel safe to participate
- Learners trust the group

*How do we reach this stage?*
Becoming an Effective Group

- Ask get to know you and other questions
  - Have everyone respond
- Make sure learners understand goal of lesson
- Encourage learners to create their own goals
- Use brainstorming and Q & As
- Use and respect learner’s experience

Source: Pixabay Creative Commons
Disruptive Behavior

What do you do when a learner is distracting themself or the class?
The Distraction

Quiet/Uninvolved

The Clown/Joking Around

The Solution

Encourage participation, Talk to them

Redirect their humor Learning should be fun!

Try to resolve behavior, but avoid fixating on it

Source: Institute of Education Sciences https://eric.ed.gov/
Handling Offensive Behavior

- Ignoring offensive behavior sends message that it’s acceptable

- Calling out a student could prevent them from learning

- Be firm but fair:
  
  “This is a safe environment, let's be considerate & not put others down”

#2 The Environment

How do you set up the room?
The Five Elements of Teaching Adults

1. The Learner
2. The Environment
3. The Instructor
4. The Teaching Tools
5. The Lesson
Room Arrangement should...

- Fit the room
- Fit the number of participants comfortably (Elbow Room)
- Preferably tables with desk space for each person
- Make sure all participants can see, hear & do
  - Enough room for planned activities
Room Arrangement should...

- Encourage discussion
- Allow space for instructor to move around
- Make instructor clearly visible
  - Raised stool/higher seat
  - Closer to presentation/front of the room

Source: TTI-LLC
Common
Set up

Source: OSHA Susan Harwood Adult Learning and TTI-LLC
Example #1

Avoid seating learners where they can’t see past instructor

Source: OSHA Susan Harwood Adult Learning and TTI-LLC
Example

#2

Source: OSHA Susan Harwood Adult Learning and TTI-LLC
Example

#3

Source: OSHA Susan Harwood Adult Learning and TTI-LLC
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End Instructor Module 1
Intro, The Learner and The Environment

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Instructing the Implementing Safe Work Zone Operations Strategies Training Course

Instructor Module 2
The Instructor

FHWA Grant Agreement DTFH6116RA00018 “2016 Work Zone and Guardrail Safety Training Grants”
The Five Elements of Teaching Adults

1. The Learner
2. The Environment
3. The Instructor
4. The Teaching Tools
5. The Lesson
#3 The Instructor

What can you do to be an effective teacher?
Duties as an Instructor:

• Plan, prepare, & practice
• Communicate with the learners
• Creating an encouraging atmosphere
• Recognize your own limitations
• Be an available resource for learners
Plan, Prepare, & Practice
Planning for the Audience

Consider the audiences’:
- experience
- skills
- age
- training needs
- education
- job/position

Customize the lesson for the target audience

May be “on the fly” if necessary
The Learner’s Needs

• Leave out unrelated info
• Include definitions (Acronyms) as needed
• Plan presentation for best learning potential
• Plan to include all learning styles
  (See it, Hear it, Do it)
Preparing for Q & A

• What possible questions could your audience have? (FAQs)

• How would you answer that question?

• Are you saving time for a Q & A session?

• Re-direct questions you are unsure of
  • It is ok to say you do not know – Don’t Guess

*Boost your confidence, plan your answers*
Preparations for the Presentation

• Know the facility contact (Cell)
  - Gate, building / room may be locked
• Arrive early
• Check seating arrangements
• Check A/V
• Know the facility
  - Location of the thermostat
  - Restrooms, break rooms, vending
  - Exits, Smoking Rules
  - Safe rooms (tornado), evacuation procedures
Preparations for the Presentation

• Have enough supplies for a back up
  - Extension cords and power strips
  - Long HDMI, VGA-Audio cables
  - Spare equipment
    (Projector, Bulbs, Laptop, Speakers ...)

• Cover cords for safety
  - Blue painters tape
  - Rug
  - “Gaffers” Tape $$

Source: TTI-LLC
Preparations for the Presentation

- Room temperature
  - Keep it below 71º
- Have handouts laid out (if applicable)
  - Layout 1st for early arrivals
- Telephones set to vibrate
  - Step out of class to take a call
Practice

• Practice to be comfortable with the presentation
  • Even if you are familiar with the material
• Practice for improvement
• Practice timing
  • How long do you spend per slide?
    
    30 Seconds per slide?
    1 Minute per slide?
    2 Minutes per slide?
Time Management

• How long will the presentation be?
• Consider time per slide?
• Do you tell long stories?
• Participants typically need a break every hour
• Learners appreciate sticking to a planned schedule
  - Use slides to stay on message

Source: Stocksnap
Save Time for:

• Questions
• Discussions
• Responses
Communicating with your Learners
How do we communicate effectively?

Facial Expressions

Body Language

Voice

Listening Skills

Source: TTI-LLC
Learners react to facial expression & respond with the emotion they SEE
Facial Expression

- Friendly
- Enthusiastic
- Engaged

- Be aware of your ‘thinking face’
- May come off as bored or unapproachable

Source: Pixabay
Use Body Language

• Maintain posture
• Gesture hands naturally
• Avoid pointing at the audience, gesture towards the audience
• Move around the room
  – Provides variety
  – Can be more comfortable
  – Alternate between sitting & moving

Source: TTI-LLC
Eye Contact

- Make eye contact with every learner
  - Gradually throughout lesson
- Avoid ‘reading the lesson’
  - Use less info per slide
  - More slides if necessary
Eye Contact

- If you are less familiar with the content ...
  - Bring up the next slide
  - Look up at the screen
  - Point to the words with the pointer
  - Read the words
  - Then *look back* and explain / give an example
Eye Contact
It is ok to look at the screen

Just don’t turn your back on the audience

Source: TTI-LLC
Eye Contact

Other tips

• Use your laptop as a teleprompter
  • Have it in a convenient place to glance back and forth
• A monitor can be placed on the projector cart
  • Especially in large rooms with multiple screens
Use your voice

• Show enthusiasm
• Project your voice so everyone can hear you
• Use a friendly tone
• Vary your pace to keep it interesting
• Encourage participants
• Provide positive feedback
Tips for a nervous speaker

• Plan to be nervous beforehand, it’s okay
• Being prepared gives you more confidence
• Use tools to help: PowerPoint (Screen / Laptop), Handouts, Discussion
• Learning should be a discussion, encourage interaction between group

75% of people experience speaking anxiety
It’s Ok to Move and Use your Handout
Use Listening Skills

• Allow time for participants to ask questions or respond

• Discussion is the overall goal of learning

• Use Learners knowledge to your advantage
Listen to what participants say

- Do they need more explanation?
- Are there concerns?
- What do your participants need?
- What experience can they share?
- What do THEY want to learn?
Listen to the Learner

“We do it by…”

“We don’t have…”

Ok how about …
Create Opportunities for you to Listen

• Use a “get-to-know-you” exercise

• Ask learners to share what they want from the course

• Talk to them individually, during breaks, before training starts, etc.

• Save time in lesson for discussion

*Depends on how many people are in class*
Creating an Encouraging Atmosphere
# Lead by Example...

<table>
<thead>
<tr>
<th>Thoughtful</th>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Audience Awareness</td>
<td>- Encourage others’ input</td>
</tr>
<tr>
<td>- Literacy Levels</td>
<td>- Connect emotionally</td>
</tr>
<tr>
<td></td>
<td>- Group &amp; Individual Involvement</td>
</tr>
<tr>
<td>Friendly</td>
<td>Passionate</td>
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<tr>
<td>- Non-threatening</td>
<td>- Fun</td>
</tr>
<tr>
<td></td>
<td>- Enthusiastic</td>
</tr>
</tbody>
</table>
Audience Awareness

• Allows us to learn and understand people different than ourselves
• Respect and negotiate differences
• *Remember*, how we communicate can mean different things to different learners:
  – Gestures
  – Phrases
  – Humor/jokes
  – Personal space
Literacy Levels
(the audience’s reading/writing ability)

Keeping that in mind, instructors can:
✓ Read aloud instructions or questions
✓ Include visual aids & props
✓ Have evaluations to make sure learners are understanding the material
✓ Explain new & difficult to understand terms
Encourage & Connect

• Lessons that connect to learners’ emotions are more likely to be remembered

• Always be patient, ensure learners that mistakes are part of learning process

• Make sure YOU are involved

Any participation should be encouraged!

Source: Pixabay – Creative Commons
“I was made to feel that there were no dumb questions”
Learning Should Be Fun

• Adults like to laugh

• Adults are motivated by fun

• Humor should be:
  • Inclusive
  • Non-offensive
  • Non-threatening
Be Passionate about Learning

• Instructor should be passionate
  • Encourages learners to care
  • Creates positive learning environment
• Teaching should be fun for the instructor
Let them know you are learning *WITH* them
Be Relatable

• Be yourself

• Try to understand the learners’ point of view

• Interact on a one on one basis

• Foster group participation by allowing group to answer questions,
  
  – Example: Say, “That’s a great question, does anyone know the answer to that?”
Use Real Life Example

• Stories are more interesting than just explaining an idea

• Good stories are real, relevant & recent

• Best stories are drawn from your own experience

Source: Pixabay Creative Commons
Don’t ‘Play Expert’

- It's okay to say “I don’t know”
- Learner’s have valuable knowledge
- Learner’s have real life experience

Source: Pixabay Creative Commons
Always Avoid

• Unenthusiastic delivery
• Not covering promised objectives
• Not involving learners
• Being unprofessional:
  • inappropriate behavior/ humor
  • inappropriate attire
  • poor grammar speaking
  • being late
  • being unprepared

Source: Pixabay Creative Commons
Instructing the Implementing Safe Work Zone Operations Strategies Training Course

End Instructor Module 2

The Instructor

FHWA Grant Agreement DTFH6116RA00018
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Instructing the Implementing Safe Work Zone Operations Strategies Training Course

Instructor Module 3
Teaching Tools

FHWA Grant Agreement DTFH6116RA00018 “2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Remember …

The Five Elements of Teaching Adults

1. The Learner
2. The Environment
3. The Instructor
4. The Teaching Tools
5. The Lesson
#4 The Teaching Tools

What methods can you use to engage your learners?

Source: TTI-LLC

Simplified Hands On Exercises
Teaching Tools

- Question/answer
- Energizers
- Scenarios
- Brainstorm
- Structured note-taking
- Pretests/Post tests
- Visual Aids

Have them spend a few minutes reviewing the handout

“Write down a few things that get your attention”

After 10 minutes or so, ask “what got your attention?”

Can ask everyone in a small class.
Questions

Ask questions as a review,
Can emphasize difficult ideas,
Encourage input & repeat key concepts

Source: Pixabay Creative Commons
Types of Questions

Close-ended
Open-ended
Probing
Close-ended Questions

• Does not encourage a discussion
• Limits how a participant could reply
• Generates a yes/no answer
• Conclusive
Open-ended Questions

• Encourages a discussion
• Promotes sharing experiences and personal knowledge
• Generates descriptive answers

Source: Pixabay Creative Commons
Probing Questions

• Encourages participants to go into further detail
• Promotes deeper thought
• Generates additional discussion
When a Question is met with Silence

• Maintain silence

• Repeat or rephrase the question

• Use body language/eye contact

• Encourage any form of an answer
  “Come on. Somebody knows …”

• Give an example

• Answer yourself
Always avoid putting someone on the spot
Pre-Test/Post-test

Gauging your audience’s knowledge

Allows for “on the fly” course customization

Gauges retention

Evaluates delivery & the instructor
Pre-Test

- Understand what learner already knows
- Understand what learner still needs to learn

It’s a Course Preview

*Discussing answers opens up the room for learners to participate*
Post Test

- Did the learners understand the lesson?
- Are there any problems with the lesson that can be fine tuned?
- How will the learner use this lesson in their job?

Example: In what ways could active learning effect your teaching style?
Scenarios

- Adult learners are problem-centered
- Learners use new skill/knowledge in the lesson
- Makes them think how they will apply lesson to their own life
- ‘What would you do?’

Source: Pixabay Creative Commons
Remember this scenario from Day 1?

SPEED LIMIT 45

MOWING AHEAD

Cover with a roll up mowing sign in passing zones

Source: TTI-LLC, Modified

How about this?
Energizers

Fun activities to mix it up
## Types of Energizers

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Gets participants up and moving, regains energy and attention</td>
</tr>
<tr>
<td>Team Building</td>
<td>Builds relationships between participants</td>
</tr>
<tr>
<td>Types of Energizers</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Educational</td>
<td>Reinforces main ideas and gauges where everyone is in the learning process</td>
</tr>
<tr>
<td>Mental</td>
<td>Problem-solving encourages active learning</td>
</tr>
<tr>
<td>Fun</td>
<td>Highlights new skill or info</td>
</tr>
</tbody>
</table>
When Including Energizers...

Consider:

- Cultural/organizational context
- Training goals
- Time management
- Room layout
- Size of the group
- Learners’ background
Visual Aids

Improve retention, vary the presentation & make it interesting
Visual Aids

Source: TTI-LLC

Improve retention by 38%
Types of Visual Aids

• Videos/DVDs
• Easel pads
• Overhead projector
• White boards
• Slideshows
• Mock ups
But, ... Ask yourself

Is this visual readable?
White boards/chalkboards
Handwriting

Should we handwrite in this room?
But, ... Ask yourself

Is this visual relevant?
Related to the content
Is this visual interesting?
Use real life examples

Think of a shadow vehicle being struck

Source: Dynamic Test Center, https://www.dtc-ag.ch/
PowerPoint

- One concept per slide
- Keep it simple & easy to follow
- Don’t crowd the text
- Practice with the slides
- Use PowerPoint to stay on message

*Using PowerPoint to type group discussions involves the learners
(They can also see the comments)*
What concerns you about the video?

- Discussion
  - How far the shadow vehicle moved
  - The driver of the impacting truck
  - The driver of the shadow vehicle

Source: Dynamic Test Center, https://www.dte-ag.ch/
Is there anything wrong with this picture?

Discussion

- Driver outside truck
- Not facing traffic
- Vest?
- Near centerline
- On a hill
- Where is the mowing sign?
- Is the truck too close to the tractor?
- Strobes?
Audience Response Systems

- Allows learners to assess the lesson in real time
- Helps instructor gauge audience’s knowledge

Source: Turning Technologies
Example:

“How familiar are you with the MUTCD?”

1 Not Familiar
2 Minor Familiarity
3 Somewhat Familiar
4 Familiar
5 Very Familiar

Source: TTI-LLC & Turning Technologies
Responses displayed for discussion

Source: TTI-LLC & Turning Technologies
Structured Note Taking

• Provide an outline or handout

• Can be helpful to leave out definitions of key terms
  – Allow learner to define it in their own words

Source: TTI-LLC
Example Problems

- You have about 200 feet of guardrail to repair,
- The work will take a few hours,
- You have 2 – 11’ asphalt lanes and a 2’ gravel shoulder
- There is room to pull off the road on the North side,
- No vertical curves exist in this section
- Use Typical Application 10
- Mark where your signs, flaggers, buffer spaces, taper, tangent and termination are located.
- Calculate the number of cones you plan to use for this operation.
- Indicate what spacing you will use for the cones on the taper and the tangent. Why are you using these spacings?
- The posted speed limit is 45 mph approaching the curves
- Weather: Dry, High 75, Low 62

Guardrail Repair

Wooded Area

Situation 3

- A hilly / curvy section of road, 18’ Wide
- There are typically only a couple of vehicles per hour
- Mowing brush at the edge of the road
- Work will take a couple hours over the entire section of road.

Source: TTI-LLC
Instructing the Implementing Safe Work Zone Operations Strategies Training Course

End Instructor Module 3

Teaching Tools

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Instructing the Implementing Safe Work Zone Operations Strategies Training Course

Instructor Module 4
The Lesson

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
Remember ...
The Five Elements of Teaching Adults

1. The Learner
2. The Environment
3. The Instructor
4. The Teaching Tools
5. The Lesson
#5 The Lesson

HOW TO STRUCTURE THE LEARNING
REMEMBER ...

Only 30% of students are listening at any given time during a lecture.

Source: TTI-LLC
Repeat main ideas for retention

Tell them what you’re going to teach them

Teach them

Tell them what you’ve taught them

Source: Freelmages Creative Commons
The Lesson

- The Opening
- The Body
- The Conclusion
- The Feedback
- The Evaluation
The Opening

• Figure out where the learners “are”
• Determine where the learners will “be”

For this course:

“Learners are somewhat familiar with adult learning

By the end of the lesson

Learners will be able to implement the five parts of adult learning”
The Opening

- Addresses “What’s in it for me?”
- Attention grabbing
- Has a Learning Objective

Source: Energy Absorption Systems, Trinity Highway Products
The Learning Objective will guide:

– The content of the lesson
– How to instruct the lesson
– How to evaluate the lesson
Creating a Learning Objective

Ask yourself:

✓ Who needs to be taught?
✓ What needs to be taught?
✓ How long should the presentation be?
✓ What type of approach would be appropriate?
✓ What kind of knowledge does your audience already have?
Be **SMART** about your Objective

**S**pecific: Objective should be straight-forward

**M**easurable: Objective should give definition of success

**A**chievable: Objective should be doable

**R**elevant: Objective should be related to the lesson

**T**ime-Sensitive: Objective should have a time frame
The Body

- Present each major point that supports objective
- Provide details and research for each major point
- Use pictures, examples, videos, scenarios

**TABLE 5  ROLL-AHEAD DISTANCE FOR BARRIER VEHICLES**

<table>
<thead>
<tr>
<th>Weight of Barrier Vehicle (stationary)</th>
<th>Prevailing Speed (mph)</th>
<th>Weight of Impacting Vehicle to be Contained $^a$</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td>4,500 lbs</td>
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<td>10,000 lbs</td>
<td>60-65</td>
<td>50 ft</td>
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<td>50-55</td>
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<td>$\leq$45</td>
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<td>15,000 lbs</td>
<td>60-65</td>
<td>25 ft</td>
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<td>25 ft</td>
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</table>

Source: “Guidelines for the Use of Truck Mounted Attenuators in Work Zones, Jack Humphreys and T. Darcy Sullivan, Transportation Research Record 1304
The Close

• Summarize your major points
• Include evaluation & feedback
• Give them action items
  • Remind them how they can use this tomorrow
• One last chance to get their attention

Example Closing
Remember
You can save lives using these strategies

Video
What happens when a flagger is struck by a motorist?

Source: TTI-LLC & Dynamic Test Center
Post Test, Feedback & Evaluation
Helps trainee understand material and encourage them by allowing constructive comments
Post Test, Feedback & Evaluation

• Shows the level of understanding
• Shows what can be different
• Helps instructor improve their teaching

Grades the lesson, **NOT** the Learner
Key Questions for Evaluating

• Did the lesson accomplish the learning objective?
• Was the instructor effective?
• What did you like?
Key Questions for Evaluating

- Was the lesson practical?
- How well do you understand the lesson?
- How much will the lesson benefit you?
- What can be improved?
Tell me and I’ll forget
Show me and I may remember
Involve me and I learn

-Benjamin Franklin
Tell me and I’ll forget
Show me and I may remember
Involve me and I learn

-Benjamin Franklin
Instructing the Implementing Safe Work Zone Operations Strategies Training Course

End Instructor Module 4

The Lesson

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Instructing the Implementing Safe Work Zone Operations Strategies Training Course

Instructor Module 5
Delivery and Focal Points

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
Delivering the ISWZOS Class

• Disclaimer (Handout and Slides)
• Acknowledgements in the Handout
• Discuss the Table of Contents
• Emphasize
  – Acronyms for Attendees with Less Experience
  – The Resources
  – Quick Reference Tables
  – Example Pages
  – National MUTCD CHs 1 and 6
  – “Managing Flagging Operations …” Guidance
  – Example SOP Manual Excepts
• Recordkeeping
Disclaimer

The course materials for this training are based upon work supported by the Federal Highway Administration (FHWA) under Grant Agreement DTFH6116RA00018, “2016 Work Zone and Guardrail Safety Training Grants.”

Any opinions, findings, conclusions or recommendations expressed in this course are those of the trainer and the grantee and do not necessarily reflect the view of the Federal Highway Administration. This course does not constitute a national standard, specification or regulation.
Disclaimer

This course provides training to assist the participants in meeting the objectives identified. Basic principles and discussions of industry practice are intended to assist practitioners in the planning and implementation of their temporary traffic control operations; planned using the appropriate Manual on Uniform Traffic Control Devices (MUTCD), engineering judgment and jurisdictional requirements for the location the work is being performed. Due to the multitude of situations in which these principles can be applied, the coursework only provides the basic foundation on which decisions should be made.

The employee and their employer are responsible and assume the liability for their comprehension of the principles, review and implementation of the information provided in this training as well as the application laws and regulations associated with the location of the work.
# Recordkeeping
(Sign in Sheet)

## Sign-In Sheet

<table>
<thead>
<tr>
<th>Instructor Name: __________________________</th>
<th>Instructor Signature: __________________________</th>
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<tbody>
<tr>
<td>Class Date: __________________________</td>
<td>Class Location: __________________________</td>
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<td>Class Sponsor: __________________________</td>
<td>Class Title: __________________________</td>
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</table>

Please Print Clearly

<table>
<thead>
<tr>
<th>Name (Include Middle Initial)</th>
<th>Signature</th>
<th>Employer (City, State)</th>
<th>Device ID (If Used)</th>
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Please PRINT Clearly
Recordkeeping
(Registration)

Enter your personal information (not work) for transferability

Name: ________________________________

(Include Middle Initial)

Home Address: _______________________

____________________________________

____________________________________

Cell Phone: __________________________

Email: _______________________________

ID Number: __________________________

ID Type: ____________________________

(Drivers License, State ID... No Social Security Numbers)
Recordkeeping
(Registration)

Employer: __________________________________________

Employer City & State: __________________________________________

Position: __________________________________________

Today’s Date: __________________________________________

Class Sponsor: __________________________________________

Class Location: __________________________________________

Class Title: __________________________________________

Instructor’s Name: __________________________________________
# Recordkeeping

**Pre-Test, Post-Test, Module Exercises**

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<th>Name (w/MI)</th>
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<th>Answer</th>
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Score (# Correct) __________

# Recordkeeping

**Pre-Test, Post-Test, Module Exercises**

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Score (# Correct) __________
Recordkeeping
Evaluations

Name (w/ MI): _____________________________ Signature _____________________________

We strive to offer the best training available and your feedback helps us to continually improve. Please take a few minutes to answer the questions and provide your feedback.

Your opinion matters.

How would you rate the following:

1. Your understanding of the topic before the course
   Fair Neutral Good
   1    2    3    4    5

2. Your understanding of the topic after the course
   Fair Neutral Good
   1    2    3    4    5

Other comments, observations, suggestions:

Pre-Test Score: ______
Post-Test Score: ______
Your Initials: ______

Instructor: _____________________________ Instructor’s Signature: _____________________________

2 Pages
Includes Written Comments Scores, and Instructor Review / Signature
Copyright and Future Course Delivery

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Some of the language used herein comes directly from the US Department of Transportation, Federal Highway Administration and the US Department of Labor, Occupational Safety and Health Administration’s Susan Harwood Grant Program; modified for the specific use of this project.
Teach Back

• 1 Focal Point Per Person
• 5 Minute Presentation
• 2 Minute Speaker Evaluation and Next Speaker Prep.
• 1 to 3 Slides Per Person
• 1 to 2 Minutes Comments
• Give the evaluation sheet to the speaker

(Time flexibility will depend on class numbers)
Worker / Motorist Protection Focus
Implementing Safe Work Zone Operations Strategies

Intro Video

Source: Energy Absorption Systems, Trinity Highway Products

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
What if your workers were on the road when that SUV came through?

Source: TTI-LLC
Goals of this Training

- Reduce the number and severity of work zone incidents
- Protect
  - Workers
  - Road Users
  - Stakeholders
  - Public and Private Assets at Risk

Ambulance Image Source: “Safely Regulating Traffic in Michigan,” video. Produced by the Michigan Department of Transportation (MIDOT) and the Michigan Road Builders Association (MRBA)

Source: Neal Carboneau, JTRP
Use of available resources focus
What should you take away?

• A confidence in using the MUTCD
• Knowledge that there are a lot of resources and research to supplement the MUTCD
• See examples of common problems and solutions
Implementation Focus
Common Hazards and Countermeasures – Standard Operating Procedures to Implement
Implementing Safe Work Zone Operations Strategies

Objectives
How will we improve operational understanding, planning and implementation?

- identifying
  - common site related hazards and
  - strategies that can be used as countermeasures to those hazards

Source: TTI-LLC
Implementing Safe Work Zone Operations Strategies

Objectives

How will we improve operational understanding, planning and implementation?

- allowing for planning and implementation through the use of
  - standard operating procedures (SOPs)
  - training
  - assessments
  - updates

Source: Report No. FHWA-SA-09-025
Visibility Focus
Changing Conditions and Quality Devices
Implementing Safe Work Zone Operations Strategies

Objectives

How will we improve operational understanding, planning, and implementation?

• emphasizing
  – awareness of changing conditions and
  – the necessity for on-site plan adjustments

• assigning
  – responsibility for quality operations, devices and control

Source: TTI-LLC

Source: Quality Standards for Temporary Traffic Control Devices, July 2013. Missouri DOT (MODOT)
Jurisdictional Responsibility Focus
Importance of Understanding the MUTCD, Traffic Control Devices (TCDs), & Temporary Traffic Control (TTC) Zones

“Responsibility for design, placement, operation, maintenance, and uniformity of traffic control devices shall rest with the public agency or official having jurisdiction...”

-MUTCD (1A.07)

Traffic Control Devices (TCDs) on all streets, highways, bikeways and private roads open to public travel must be in substantial conformance with standards issued or endorsed by the Federal Highway Administrator

MUTCD is the national standard for all traffic control devices
Engineering Judgment Focus
Applying the Principles in the MUTCD

Engineering Judgment

Section 1A.09

• Application of traffic control devices
• Not a legal requirement (Adopted by the State)
• Decision to use a particular device at a particular location ... the application of engineering judgment
• Manual provides Standards, Guidance, and Options
• not ... a substitute for engineering judgment
• Jurisdictions, or owners of private roads open to public travel ... who do not have engineers on their staffs who are trained and/or experienced in traffic control devices should seek engineering assistance from others

Source: FHWA
Applying the Principles in the MUTCD

Engineering Judgment

Section 1A.13 #64

... the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device.

Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer.
Operational Duration and Incident Management Overlap Focus
The focus of this training

Operations without typical design drawings

Section 6G.02 Temporary Traffic Control Activities

Mobile: Moves **intermittently** or **continuously**

Short Duration: Up to 1 hour

Short Term: > 1 hour in a single daytime period

Intermediate: > 1 Daylight Period to 3 Days (Night > 1 Hour)

Section 6I.01 Incident Management

Minor: < 30 minutes

Intermediate: 30 minutes to 2 hours

Often 1 Hr and less treated as short duration

Major: > 2 hours

An Excellent Resource Beyond this Course is the “Guide to Short-Term Stationary, Short-Duration, and Mobile Work Zone Traffic Control” by Wayne State University.
Minimum Requirements for Mobile Operations and Short Duration Activity Focus
Let’s look at the specific language

Other notes on implementation based on duration

Section 6G.02 Temporary Traffic Control (TTC) Activities

¶ 11 Vehicles with ... strobe lights may be used in place of signs and channelizing devices for short-duration or mobile operations... they may be augmented with signs or arrow boards.

¶ 14 Mobile operations often involve frequent short stops for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations.

Source: TTI-LLC
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control (TTC) Activities ¶ 12-13

• During short-duration work, it often takes longer to set up and remove the TTC zone than to perform the work.

• Workers face hazards in setting up and taking down the Temporary Traffic Control zone... delays affecting road users are significantly increased.

• Considering these factors, simplified control procedures may be warranted for short-duration work.

• A reduction in the number of devices may be offset by the use of other more dominant devices such as ... strobe lights on work vehicles.

Source: TTI-LLC
Flagging for Mobile Operations Focus
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control Activities ¶ 17

• Flaggers may be used for mobile operations that often involve frequent short stops.

Source: TTI-LLC, Modified
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control Activities

¶ 19 When mobile operations are being performed, a shadow vehicle equipped with an arrow board or a sign should follow the work vehicle ... Where feasible, warning signs should be placed along the roadway and moved periodically as work progresses.

¶ 20 Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.

¶ 21 If there are mobile operations on a high-speed travel lane of a multi-lane divided highway, arrow boards should be used.

Source: TTI-LLC, Modified
Shadow Vehicle Use Focus
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control Activities ¶ 17

- Flaggers may be used for mobile operations that often involve frequent short stops.

How about this?

Source: TTI-LLC, Modified

Cover with a roll up mowing sign in passing zones
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control Activities

¶ 19 When mobile operations are being performed, a shadow vehicle equipped with an arrow board or a sign should follow the work vehicle ... Where feasible, warning signs should be placed along the roadway and moved periodically as work progresses.

¶ 20 Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.

¶ 21 If there are mobile operations on a high-speed travel lane of a multi-lane divided highway, arrow boards should be used.
## AASHTO Roadside Design Guide Shadow Vehicle Positioning

**Could Add Cones Along the Centerline for Visibility**

**Can Turn Wheels to The Curb or Shoulder**

<table>
<thead>
<tr>
<th>Shadow Vehicles Weighing 22,000 lbs or More</th>
<th>Operating Speed Limit</th>
<th>Stationary</th>
<th>Moving &lt; 15.5 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥ 55 MPH</td>
<td>150 Feet</td>
<td>172 Feet</td>
</tr>
<tr>
<td></td>
<td>45 - 50 MPH</td>
<td>100 Feet</td>
<td>150 Feet</td>
</tr>
<tr>
<td></td>
<td>&lt; 45 MPH</td>
<td>74 Feet</td>
<td>100 Feet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shadow Vehicles Weighing 9,900 lbs to 22,000 lbs</th>
<th>Operating Speed Limit</th>
<th>Stationary</th>
<th>Moving &lt; 15.5 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥ 55 MPH</td>
<td>172 Feet</td>
<td>222 Feet</td>
</tr>
<tr>
<td></td>
<td>45 - 50 MPH</td>
<td>123 Feet</td>
<td>172 Feet</td>
</tr>
<tr>
<td></td>
<td>&lt; 45 MPH</td>
<td>100 Feet</td>
<td>100 Feet</td>
</tr>
</tbody>
</table>

Graphic Source: ARTBA and TTI-LLC
### AASHTO Roadside Design Guide Shadow Vehicle Use

<table>
<thead>
<tr>
<th>If the type of activity involves:</th>
<th>The priority for use of shadow vehicles is:</th>
<th>And, if the speed is:</th>
<th>The priority for use of a TMA on the vehicle is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed personnel – crack pouring, patching, utility work, striping, coning (No Stationary Lane Closure)</td>
<td>Very highly recommended</td>
<td>50 mph</td>
<td>Highly recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 mph or less</td>
<td>Desirable</td>
</tr>
<tr>
<td>Exposed personnel – pavement repair, pavement marking, delineator repair (No Stationary Shoulder Closures)</td>
<td>Highly recommended</td>
<td>50 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td>Recommended</td>
<td>45 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td>Recommended</td>
<td>40 mph or less</td>
<td>Recommended</td>
</tr>
<tr>
<td>No exposed personnel – sweeping, chemical spraying (No Stationary Lane Closure)</td>
<td>May be justified based on the specific project need if it would lessen impacts</td>
<td>50 mph</td>
<td>Highly recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 mph or less</td>
<td>Desirable</td>
</tr>
</tbody>
</table>

Example of use from the American Traffic Safety Services Association’s “Field guide for the use and placement of shadow vehicles in work zones.” Mobile Non-Freeway Application
Gaining Motorist Attention Focus
Public Information
Implementing the MUTCD

Addressing Site Conditions

• 6A.01 ¶ 8

Improved road user performance might be realized through a well-prepared public relations effort.

Source: Stillwater News Press
Gaining Motorist Attention Focus Speed
Implementing the MUTCD

Addressing Site Conditions

• 6C.01 Temporary Traffic Control (TTC) Plans
  – ¶ 12, 13, 14 Speed Reduction

10 Miles Per Hour (MPH) - Change

>10 MPH Encroachment?

Source: FHWA, Texas A&M. Modified, “IDENTIFICATION OF HAZARDS ASSOCIATED WITH MOBILE AND SHORT DURATION WORK ZONES,” Modified

Source: Neal Carboneau, JTRP, Cropped
Video

Speed Sign Gets Driver’s Attention

Source: TTI-LLC

So does the work ...
Adjusting Sign Distances for Field Conditions Focus
Implementing the MUTCD

Addressing Site Conditions

• 6C.04 Advance Warning ¶ 3, 4, 5, 6

... placement of advance warning signs on freeways and expressways should be longer ... should extend on these facilities as far as 1/2 mile or more.

On urban streets, the effective placement of the first warning sign in feet should range from 4 to 8 times the speed limit in mph ... can be as short as 100 feet ... on higher-speed streets, such as major arterials, the advance warning area should extend a greater distance (see Table 6C-1).

... rural highways ... the effective placement of the first warning sign in feet should be substantially longer—from 8 to 12 times the speed limit in mph.

The distances contained in Table 6C-1 are approximate, are intended for guidance purposes only, and should be applied with engineering judgment. These distances should be adjusted for field conditions, if necessary, by increasing or decreasing the recommended distances.
## Advance Warning

**Sign Placement**

<table>
<thead>
<tr>
<th>Speed in Miles Per Hour</th>
<th>Distance Between Signs**</th>
<th>Buffer Space Stopping Sight Distance in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 x Speed Limit Urban Min</td>
<td>8 x Speed Limit Urban Max Rural Min</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>160</td>
</tr>
<tr>
<td>25</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>30</td>
<td>120</td>
<td>240</td>
</tr>
<tr>
<td>35</td>
<td>140</td>
<td>280</td>
</tr>
<tr>
<td>40</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>45</td>
<td>180</td>
<td>360</td>
</tr>
<tr>
<td>50</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>55</td>
<td>220</td>
<td>440</td>
</tr>
<tr>
<td>60</td>
<td>240</td>
<td>480</td>
</tr>
<tr>
<td>65</td>
<td></td>
<td>520</td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>560</td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>600</td>
</tr>
</tbody>
</table>

Source: TTI-LLC, Calculated from the MUTCD
Advance Warning
Sign Placement

Merging Taper Length (L)

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Distance Between Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Urban (Low Speed)</td>
<td>100</td>
</tr>
<tr>
<td>Urban (High Speed)</td>
<td>350</td>
</tr>
<tr>
<td>Rural</td>
<td>500</td>
</tr>
<tr>
<td>Expressway/Freeway*</td>
<td>1000</td>
</tr>
</tbody>
</table>

... should be adjusted for field conditions ...

Approx. 1 Mile
“½ mile or more”

Source: Table 6C-1 2009 National MUTCD
Image Source: ARTBA, TTI-LLC
Inclement Weather and Operational Adjustment Focus
Implementing the MUTCD

Addressing Site Conditions

• 6C.04 Advance Warning ¶ 7

The need to provide additional reaction time for a condition is one example of justification for increasing the sign spacing.

Conversely, decreasing the sign spacing might be justified in order to place a sign immediately downstream of an intersection.
Buffer Space Focus
Implementing the MUTCD

Addressing Site Conditions

• 6C.06 Activity Area

¶ 6 The buffer space is a lateral and/or longitudinal area that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle.

Neither work activity nor storage of equipment, vehicles, or material should occur within a buffer space.

Source: ARTBA, TTI-LLC
Look at Figure 6C-2

Source: MUTCD

Source: TTI-LLC

Lateral Buffer Space

Work on the lane line typically requires an additional lane or “encroachment” for improved safety.
Look at Table 6C-2

Table 6C-2. Stopping Sight Distance as a Function of Speed

<table>
<thead>
<tr>
<th>Speed*</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mph</td>
<td>115 feet</td>
</tr>
<tr>
<td>25 mph</td>
<td>155 feet</td>
</tr>
<tr>
<td>30 mph</td>
<td>200 feet</td>
</tr>
<tr>
<td>35 mph</td>
<td>250 feet</td>
</tr>
<tr>
<td>40 mph</td>
<td>305 feet</td>
</tr>
<tr>
<td>45 mph</td>
<td>360 feet</td>
</tr>
<tr>
<td>50 mph</td>
<td>425 feet</td>
</tr>
<tr>
<td>55 mph</td>
<td>495 feet</td>
</tr>
<tr>
<td>60 mph</td>
<td>570 feet</td>
</tr>
<tr>
<td>65 mph</td>
<td>645 feet</td>
</tr>
<tr>
<td>70 mph</td>
<td>730 feet</td>
</tr>
<tr>
<td>75 mph</td>
<td>820 feet</td>
</tr>
</tbody>
</table>

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed

Source: MUTCD

Posted Speed, 85th Percentile... anticipated operating speed

Use caution selecting the distance.
Distance = Longitudinal Buffer Space & Stopping Sight Distance
Identifying the end of the mobile operation focus
Image Source: For construction pros: Modified
Let’s modify our previous patching image

Source: TTI-LLC
Modified
Self Regulating TTC Zone Focus
¶ 5 “If the work space on a low-volume street or road is short and road users from both directions are able to see the traffic approaching from the opposite direction through and beyond the work site, the movement of traffic through a one-lane, two-way constriction may be self-regulating.”

TA-11 Applicability Notes
A. Vehicular traffic volume is such that sufficient gaps exist for vehicular traffic that must yield.
B. ... and have sufficient visibility of approaching vehicles.

If conditions change flaggers may need to be added.
Some states have additional guidance for use of self regulating TTC zones. Here is an excerpt from “Managing Flagging Operations on Low Volume Roads.”

- When planning a self regulating Temporary Traffic Control (TTC) Operation
  - Consult local jurisdictional requirements
  - Conduct a field investigation to assess sight distance
  - Assess traffic volumes
  - Monitor volumes during the work
  - Cease operations or add flaggers and appropriate signing if sufficient gaps no longer exist

- Example Specific State Department of Transportation (DOT) Constraints

<table>
<thead>
<tr>
<th>Type</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume</strong></td>
<td>Less Than 2000 Vehicles Per Day</td>
</tr>
<tr>
<td><strong>Work Space</strong></td>
<td>250’ or Less, 350’ Maximum from the beginning of the taper to the end of the termination</td>
</tr>
<tr>
<td><strong>Sight Distance</strong></td>
<td>Do not use if a no passing zone exists between the start of the taper and end of the termination</td>
</tr>
</tbody>
</table>

Iowa

<table>
<thead>
<tr>
<th>Type</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td>Short-term or Intermediate (3 days or less)</td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td>Less Than 400 Average Daily Traffic</td>
</tr>
<tr>
<td><strong>Work Space</strong></td>
<td>Less than 200 Feet</td>
</tr>
<tr>
<td><strong>Sight Distance</strong></td>
<td>More than 750 Feet at Each End</td>
</tr>
<tr>
<td><strong>Speed Limit</strong></td>
<td>40 Miles Per Hour and Below</td>
</tr>
</tbody>
</table>

Oregon
Look at Typical Application 18

TA-18 Applicability Notes

1. This TTC plan shall be used only for low-speed facilities having low traffic volumes.
   (< 40 Miles Per Hour?)

2. Where the work space is short, where road users can see the roadway beyond, and where volume is low, vehicular traffic may be self-regulating.

3. Where vehicular traffic cannot effectively self-regulate, one or two flaggers shall be used as illustrated If conditions change flaggers may need to be added.
Single Flagger Focus
Implementing the MUTCD

Addressing Site Conditions

• 6C.10 One-Lane, Two-Way Traffic Control

¶ 1 ... when traffic in both directions must use a single lane for a limited distance, movements from each end shall be coordinated. P05 “If the work space on a low-volume street or road is short and road users from both directions are able to see the traffic approaching from the opposite direction through and beyond the worksite, the movement of traffic through a one-lane, two-way constriction may be self-regulating.”

¶ 2 “When a one-lane, two-way TTC zone is short enough to allow a flagger to see from one end of the zone to the other, traffic may be controlled by either a single flagger or by a flagger at each end of the section.”
“Managing Flagging Operations ...” Example

6C.11 Flagger Method

¶ 3 “When a single flagger is used, the flagger should be stationed on the shoulder opposite the constriction or work space, or in a position where good visibility and traffic control can be maintained at all times.”

Source: TTI-LLC

Modified to Represent Single Flagger Control
“Wait for Pilot Car” Sign
Considerations for Driveways and Low Volume Roads Focus
Pilot Vehicle Considerations

• Over extended lengths of road with hills and curves
  – A pilot vehicle may be necessary to control the motorists’ speed
  – Intersections may require flaggers
    – If not using a pilot vehicle
    – or high volumes exist
  – In some cases driveway and intersection traffic can be controlled with signage

Source: Texas Transportation Institute, Texas A&M University (TTI-TAMU) & Transportation Training Institute, LLC (TTI-LLC)

Source: Virginia DOT, Flagger Training Video, Cropped

Source: MIDOT & MRBA, Cropped
Low-Volume Access Point Considerations

“Evaluation of innovative devices to control traffic entering from low-volume access points.”

Texas Transportation Institute, Texas A & M University, (TTI-TAMU) 2014

By Melisa Finley, Praprut Songchitruksa and Srinivasa Sunkari

Describes methods to address intersecting roadways and driveways including the following:

- Use “barricades and cones to close low-volume access points;”
- “Visit property owners and residents to notify them of the changes in traffic control and what they should do when exiting their driveway;”
- Station “flaggers at all access points;” and
- Hold traffic at the access point until the pilot vehicle arrives.
Operational Assistance for Pedestrians and Pedestrians with Disabilities Focus
Implementing the MUTCD

Addressing Site Conditions

• 6D.01 Pedestrian Considerations

• ¶ 5 “If establishing or maintaining an alternate pedestrian route is not feasible during the project, an alternate means of providing for pedestrians may be used, such as adding free bus service around the project or assigning someone the responsibility to assist pedestrians with disabilities through the project limits.”

Look through ¶ 6-12, but these relate to longer term work

Source: Stomp, Sim
Solid Waste Pickup Operational Similarities Focus
Portable Changeable Message Signs and Light Bar Considerations
Changeable Message Signs

Source: TTI-LLC
Implementing the MUTCD

Addressing Site Conditions

- Section 6F.60 Portable Changeable Message Signs (PCMSs)

¶ 15 ... Shorter letter sizes may also be used on a portable changeable message sign used on low speed facilities (<40MPH) provided that the message is legible from at least 650 feet.

¶ 16 The portable changeable message sign may vary in size.

<table>
<thead>
<tr>
<th>Series Model Number</th>
<th>Cabinet Dimensions</th>
<th>Character Height</th>
<th>Display Matrix</th>
<th>No. of Lines</th>
<th>No. of Chars./Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>1020A-4</td>
<td>75”x31”x5”</td>
<td>10”</td>
<td>Character</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>1020F-4</td>
<td>75”x31”x5”</td>
<td>10”</td>
<td>Full</td>
<td>1-2</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: FDOT / Litesys - Modified

Source: Florida DOT, Approved Product List & Litesys.com
Implementing the MUTCD

Typical Application 17

Source: FHWA, MUTCD

Source: FDOT, Approved Product List & Litesys.com
Modified
Light Bars

1. At least one of the following three modes shall be provided:
   - Flashing Arrow
     - Move/Merge Right
   - Sequential Arrow
     - Move/Merge Right
   - Sequential Chevron
     - Move/Merge Right

2. The following mode shall be provided:
   - Flashing Double Arrow
     - Move/Merge Right or Left

3. At least one of the following three modes shall be provided:
   - Flashing Four Corners
   - Flashing Bar
   - Alternating Flashing Diamonds
     - Caution

<table>
<thead>
<tr>
<th>Panel Type</th>
<th>Minimum Size (inches)</th>
<th>Minimum Legibility Distance (miles)</th>
<th>Minimum Number of Elements</th>
<th>Recommended Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>48 x 24</td>
<td>0.50</td>
<td>12</td>
<td>Low Speed Streets</td>
</tr>
<tr>
<td>B</td>
<td>60 x 30</td>
<td>0.75</td>
<td>13</td>
<td>Anything not covered in A or C</td>
</tr>
<tr>
<td>C</td>
<td>96 x 48</td>
<td>1.00</td>
<td>15</td>
<td>Freeways and Expressways</td>
</tr>
</tbody>
</table>

Arrow Stick

Arrow Sticks may supplement other TTC devices, but shall not be used in place of arrow boards.

Advance Warning Arrow Board Specification
Figure 6K-6

Source: TTI-LLC
High Visibility Apparel / Visibility Focus
Implementing the MUTCD

Addressing Site Conditions

- 6D.03 Worker Safety Considerations (Visibility) ¶ 4

All workers, including emergency responders, within the right-of-way who are exposed either to Traffic ... or to work vehicles and construction equipment within the TTC zone shall wear high-visibility (Hi-Vis) safety apparel that meets the Performance Class 2 or 3 requirements of the American National Standards Institute and the International Safety Equipment Association (ANSI/ISEA) Standard 107–2004 ... or equivalent revisions, and labeled ... except as provided in ¶ 5”
Implementing the MUTCD

Addressing Site Conditions

• 6D.03 Worker Safety Considerations (Visibility)

¶ 6 When uniformed law enforcement personnel are used to direct traffic, to investigate crashes, or to handle lane closures, obstructed roadways, and disasters, high-visibility safety apparel as described in this Section shall be worn by the law enforcement personnel.

¶ 7 Except as provided in Paragraph 8, firefighters or other emergency responders working within the right-of-way shall wear high-visibility safety apparel as described in this Section.

¶ 8 Firefighters or other emergency responders working within the right-of-way and engaged in emergency operations that directly expose them to flame, fire, heat, and/or hazardous materials may wear retroreflective turnout gear that is specified and regulated by other organizations, such as the National Fire Protection Association (NFPA).
Notice the contrasting colors and retroreflective striping on the fireman’s pants.
“... high-visibility apparel is required under the General Duty Clause to protect employees exposed to the danger of being struck by public and construction traffic while working in highway/road construction work zones. Typically, workers in a highway/road work zone are exposed to that hazard most of the time.” Richard E. Fairfax, Acting Director, Directorate of Construction, OSHA
Notice even on a building construction site that High Visibility (Hi-Vis) apparel is worn.

The runover / backover hazard even exists here with forklifts, concrete trucks etc.

Source: Pixabay, Creative Commons, Michael Gaida
Flagger Protection Focus
What to do after stopping traffic ...
Implementing the MUTCD

Addressing Site Conditions

What happens between stop and proceed?

• Have body face the stop slow paddle.
• Watch both directions for traffic, driveways, pedestrians.

Does this give us flexibility?

Turn face to face traffic for stop or proceed signals.

Google Dictionary

“verb, 1. be positioned with the face or front toward (someone or something).”

Source: TTI-LLC
Motorist / Operational Protection Focus
Avoiding Conflicting Signals
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.05 Regulatory Sign Authority

¶ 1 Regulatory signs such as those shown in Figure 6F-3 inform road users of traffic laws ...

¶ 2 Regulatory signs shall be authorized by the public agency or official having jurisdiction ...

• Section 6F.07 Regulatory Sign Applications

¶ 1 If a TTC zone requires regulatory measures different from those existing, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary regulatory signs. This change shall be made in compliance with applicable ordinances or statutes of the jurisdiction.

• Section 4D.01 General

¶ 1 When a traffic control signal is not in operation, such as before it is placed in service, during seasonal shutdowns, or when it is not desirable to operate the traffic control signal, the signal faces shall be covered, turned, or taken down to clearly indicate that the traffic control signal is not in operation.
Implementing the MUTCD

Addressing Site Conditions

Source: TTI-LLC

Source: MIDOT & MRBA
Use of Additional Signs Focus
To provide additional warning and direction.
A. Additional devices:
1. Signs
2. Arrow boards

We saw in Module 4 the need for additional signs beyond the minimum in the TA.

Source: FDOT, Approved Product List & Litesys.com Modified

We saw how arrow boards in caution mode can improve the visibility of operations.

Another Commonly Added Sign
A. Additional devices: (Signs)

How can a flagger help a motorist understand where to stop?

There are a multitude of ways additional devices can improve both operation and safety.
Use of Additional Devices Focus
To provide additional warning and direction.
A. Additional devices:

3. More channelizing devices at closer spacing

There are a multitude of ways additional devices can improve both operation and safety.
Section 6: Traffic Control Layouts – General Instructions

Centre line delineation can prevent cars from moving into the oncoming lane too early.

Cars move over too early.
Use of Additional Devices Focus
To provide additional warning and direction during mobile operations.
A. Additional devices:

3. More channelizing devices at closer spacing

A. Additional devices:

3. More channelizing devices at closer spacing
Use of Lighting Focus
Caution with amount and glare.
E. Lighting:
1. Temporary roadway lighting
2. Steady-burn lights used with channelizing devices
3. Flashing lights for isolated hazards
4. Illuminated signs
5. Floodlights

These strategies relate to night time operations as well as emergency operations that must be performed during inclement weather.

Use caution with lighting at night as glare from headlights, artificial lighting and even too many strobes can blind and distract motorists.
Be cautious of too much lighting at a flagger station. The flagger here is becoming hard to see.
Encroachment Focus
Proper Use of Encroachment
Implementing the MUTCD

Addressing Site Conditions

- Section 6G.08 Work on the Shoulder with Minor Encroachment
  
  ¶ 2 When work takes up part of a lane, vehicular traffic volumes, vehicle mix (buses, trucks, cars, and bicycles), speed, and capacity should be analyzed to determine whether the affected lane should be closed. Unless the lane encroachment permits a remaining lane width of 10 feet, the lane should be closed.

  ¶ 3 Truck off-tracking should be considered when determining whether the minimum lane width of 10 feet is adequate.

  ¶ 4 A lane width of 9 feet may be used for short-term stationary work on low-volume, low-speed roadways when vehicular traffic does not include longer and wider heavy commercial vehicles.
Figure 6H-6. Shoulder Work with Minor Encroachment (TA-6)

Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.
Guidance:

1. All lanes should be a minimum of 10 feet in width as measured to the near face of the channelizing devices.

2. The treatment shown should be used on a minor road having low speeds. For higher-speed traffic conditions, a lane closure should be used.

Option:

3. For short-term use on low-volume, low-speed roadways with vehicular traffic that does not include longer and wider heavy commercial vehicles, a minimum lane width of 9 feet may be used.

4. Where the opposite shoulder is suitable for carrying vehicular traffic and of adequate width, lanes may be shifted by use of closely-spaced channelizing devices, provided that the minimum lane width of 10 feet is maintained.

5. Additional advance warning may be appropriate, such as a ROAD NARROWING sign.

6. Temporary traffic barriers may be used along the work space.

7. The shadow vehicle may be omitted if a taper and channelizing devices are used.

8. A truck-mounted attenuator may be used on the shadow vehicle.

9. For short-duration work, the taper and channelizing devices may be omitted if a shadow vehicle with activated high-intensity rotating, flashing, oscillating, or strobe lights is used.

10. Vehicle hazard warning signals may be used to supplement high-intensity rotating, flashing, oscillating, or strobe lights.

Standard:

11. Vehicle-mounted signs shall be mounted in a manner such that they are not obscured by equipment or supplies. Sign legends on vehicle-mounted signs shall be covered or turned from view when work is not in progress.

12. Shadow and work vehicles shall display high-intensity rotating, flashing, oscillating, or strobe lights.

13. Vehicle hazard warning signals shall not be used instead of the vehicle’s high-intensity rotating, flashing, oscillating, or strobe lights.
Urban Intersection Focus
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.11 Work Within the Traveled Way of an Urban Street

¶ 7 Worksites within the intersection should be protected against inadvertent pedestrian incursion by providing detectable channelizing devices.

¶ 8 Utility work takes place both within and outside the roadway to construct and maintain services such as power, gas, light, water, or telecommunications. Operations often involve intersections, since that is where many of the network junctions occur. The work force is usually small, only a few vehicles are involved, and the number and types of TTC devices placed in the TTC zone is usually minimal.

¶ 10 As discussed under short-duration projects, however, the reduced number of devices in utility work zones should be offset by the use of high-visibility devices, such as ... strobe lights on work vehicles or high-level warning devices.
Implementing the MUTCD

Addressing Site Conditions

- Section 6G.13 Work Within the Traveled Way at an Intersection

  ¶ 5 When work will occur near an intersection where operational, capacity, or pedestrian accessibility problems are anticipated, the highway agency having jurisdiction shall be contacted.

  ¶ 6 For work at an intersection, advance warning signs, devices, and markings should be used on all cross streets, as appropriate. The typical applications depict urban intersections on arterial streets. Where the posted speed limit, the off-peak 85th-percentile speed prior to the work starting, or the anticipated speed exceeds 40 mph, additional warning signs should be used in the advance warning area.
Implementing the MUTCD

Addressing Site Conditions

- **Section 6G.13 Work Within the Traveled Way at an Intersection**
  
  ¶ 9 When near-side work spaces are used, an exclusive turn lane may be used for through vehicular traffic.
  
  ¶ 10 Where space is restricted in advance of near-side work spaces, as with short block spacings, two warning signs may be used in the advance warning area, and a third action-type warning or a regulatory sign (such as Keep Left) may be placed within the transition area.
Standard Operating Procedure
Definition and Use
Module Outline

- Principles of Standard Operating Procedures, SOPs
- Developing an SOP for TTC Zones
- Examine existing SOPs
- Modify SOPs, tailoring it to your individual work
- Developing a Manual
Benefits of Standard Operating Procedures

• Communicates intent to entire unit of workers
• Helps guides workers with consistent leadership
• Represents desired end state of work
• Allows subordinate employees to use discretion if decisions need to be made
• Identifies needed change:
  • Implement agency policy, enhance training, & evaluation of operations
Standard Operating Procedure
Implementation Questions
Questions to Ask During Development

• Is this proposed procedure realistic?
• Can the procedure be implemented given the current resources?
• Will training be required?
• Must equipment be procured?
• Does the procedure comply with agency policy & guidelines?
• How will this procedure impact individual crewmembers?
• Will the procedure survive outside scrutiny?
Standard Operating Procedure
Training Preparation
Preparing for Training

• Gather training materials
• Find qualified/knowledgeable instructor
• Organize needed facilities, equipment and supplies
• Schedule a timeframe for initial training & refresher training
• Can training be combined with other training or activities?
• Determine what records need to be kept
  • What kind of reports will this training require?
Standard Operating Procedure
Manual Index Considerations
Application Index Examples

Basic Example:

<table>
<thead>
<tr>
<th>Typical Application Description</th>
<th>Typical Application Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Outside of the Shoulder (see Section 6G.06)</td>
<td>TA-1</td>
</tr>
<tr>
<td>Work Beyond the Shoulder</td>
<td>TA-2</td>
</tr>
<tr>
<td>Delineating Zone</td>
<td>TA-3</td>
</tr>
<tr>
<td>Work on the Shoulder (see Sections 6G.07 and 6G.08)</td>
<td>TA-4</td>
</tr>
<tr>
<td>Work on the Shoulders</td>
<td>TA-5</td>
</tr>
<tr>
<td>Short Duration or Mobile Operation on a Shoulder</td>
<td>TA-6</td>
</tr>
<tr>
<td>Shoulder Closure on a Freeway</td>
<td>TA-7</td>
</tr>
<tr>
<td>Shoulder Work with Minor Encroachment</td>
<td>TA-8</td>
</tr>
<tr>
<td>Work Within the Travelled Way of a Two-Lane Highway (see Section 6G.10)</td>
<td>TA-9</td>
</tr>
<tr>
<td>Road Closed with a Detour</td>
<td>TA-10</td>
</tr>
<tr>
<td>Roads Closed with an Off-Site Detour</td>
<td>TA-11</td>
</tr>
<tr>
<td>Overlapping Routes with a Detour</td>
<td>TA-12</td>
</tr>
<tr>
<td>Lane Closure on a Two-Lane Road Using Flaggers</td>
<td>TA-13</td>
</tr>
<tr>
<td>Lane Closure on a Two-Lane Road with Low Traffic Volumes</td>
<td>TA-14</td>
</tr>
<tr>
<td>Lane Closure on a Two-Lane Road Using Traffic Control Signals</td>
<td>TA-15</td>
</tr>
<tr>
<td>Temporary Road Closure</td>
<td>TA-16</td>
</tr>
<tr>
<td>Haul Road Crossing</td>
<td>TA-17</td>
</tr>
<tr>
<td>Work in the Center of a Road with Low Traffic Volumes</td>
<td>TA-18</td>
</tr>
<tr>
<td>Surveying Along the Center Line of a Road with Low Traffic Volumes</td>
<td>TA-19</td>
</tr>
<tr>
<td>Mobile Operations on a Two-Lane Road</td>
<td>TA-20</td>
</tr>
</tbody>
</table>

Better Example:

<table>
<thead>
<tr>
<th>Typical Application No.</th>
<th>Title</th>
<th>Roadway Type</th>
<th>Issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAG-CE1</td>
<td>Work Beyond the Shoulder</td>
<td>All Roadway Types</td>
<td>October 2008</td>
</tr>
<tr>
<td>TAG-C1</td>
<td>Mowing - Work Beyond the Shoulder</td>
<td>Conventional Highway</td>
<td>December 2008</td>
</tr>
<tr>
<td>TAG-C2</td>
<td>Mowing - Shoulder Encroachment</td>
<td>Conventional Highway</td>
<td>December 2008</td>
</tr>
<tr>
<td>TAG-C3</td>
<td>Mowing - Lane Encroachment</td>
<td>Conventional Highway</td>
<td>December 2008</td>
</tr>
<tr>
<td>TAG-C4</td>
<td>Mulching / Herbicide</td>
<td>Conventional Highway</td>
<td>December 2008</td>
</tr>
<tr>
<td>TAG-E1</td>
<td>Mowing - Work Beyond Shoulder</td>
<td>Freeway or Expressway</td>
<td>December 2008</td>
</tr>
<tr>
<td>TAG-E2</td>
<td>Mowing - Shoulder Encroachment</td>
<td>Freeway or Expressway</td>
<td>December 2008</td>
</tr>
<tr>
<td>TAG-E3</td>
<td>Mowing - Lane Encroachment</td>
<td>Freeway or Expressway</td>
<td>December 2008</td>
</tr>
<tr>
<td>TAG-E4</td>
<td>Mulching / Herbicide</td>
<td>Freeway or Expressway</td>
<td>December 2008</td>
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</tbody>
</table>

MUTCD 6H

NYS DOT (26)

A detailed index can be a decision making tool
End of the Teach Back.
Instructor Course
Final Evaluations & Closing
With the course materials and training ...

You should be able to:

- Identify the needs of adult learners
- Create a supportive learning environment
- Know the role as an instructor
- Use effective teaching tools
- Make a lesson using the teaching tools

Review this information before you start. Make checklists as reminders.
Remember ...
The Five Elements of Teaching Adults

1. The Learner
2. The Environment
3. The Instructor
4. The Teaching Tools
5. The Lesson
Remember

Tell me and I’ll forget
Show me and I may remember
Involve me and I learn

-Benjamin Franklin
Instructing the Implementing Safe Work Zone Operations Strategies Training Course

End Instructor Module 5

Thanks for Attending and Good Luck with Your Training

FHWA Grant Agreement DTFH6116RA00018 “2016 Work Zone and Guardrail Safety Training Grants”
Implementing Safe Work Zone Operations Strategies

Source: Transportation Training Institute, LLC (TTI-LLC)

Instruction Documents

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
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ISWZOS (Day 1)
Statement on Class Size and Continuing Education

Class Size

The FHWA Work Zone Safety Classes offered under the grant have had size limitations from 15 to 40 or more participants. The low end was to insure economical delivery of the course. The OSHA 10 Hour courses offered through this grant had an absolute maximum of 40 as stipulated by OSHA.

The intent is to allow for participation by the attendees and provide time for questions and answers. For any non-OSHA courses, the instructor should use their judgment as to how many to schedule for each offering of the course. Audience response systems can allow for accommodation of more participants, simpler administration by the instructor and accelerated course delivery allowing more time for participation of additional students.

Often, participants show up for class when they have not registered. The intent of class sizes is not to turn participants away, but to allow for effective delivery of the course. Un-registered arrivals becomes more problematic when it is a significant number. In this case, it is worth taking time to discuss an alternate date and have the un-registered participants come to the added class date.

Continuing Education

Continuing education credit often has differing requirements in each State. This course was developed following typical standards for continuing education delivery and documentation. The instructor should emphasize that the participants are responsible for insuring the acceptance of the continuing education credit from this course with their local governing body.

Documentation and recordkeeping for continuing education are the responsibility of the instructor and the organization they represent. Copies of the course materials, objectives, sign in sheets, tests and evaluations can all be submitted as a part of credit verification.
ISWZOS (Day 1) – Instructor’s Guidance

Introduction

• Introduce yourself
• Indicate the course was developed under a FHWA Work Zone Safety Grant
• Mention the Acknowledgements in the Handout
  – As well as the effort developing the material
• A helpful exercise can be to give the class 10 minutes to look through the entire handout.
  – Have them look at every page quickly just to see what is there.
  – Have them write down a few items that get their attention.
  – You may want them to skip or quickly page through the MUTCD re-print.
• Provide a brief overview of the course:
  – Assist in implementing the MUTCD in the field using engineering judgment through standard operating procedures
  – Allow for field modification based on site conditions
• Emphasize
  – Language in the disclaimer
  – Facility information
  – Course documentation and need for continuing education credit
  – Participation: Everyone learns more discussing actual experiences
  – The tests are to
    • Identify key points from the course
      – The first of several repetitions
      – Remind them the repetition is on purpose
      – To help reinforce those main points
    • Help participants identify what they have not seen
    • Help the instructor know what to emphasize in the class
• Hand out the sign in sheets and pre-tests (Ask the class not to write on the question sheets)
  – Provide 10 to 15 minutes to complete based on time available
  – Mention the tests are open book, but “don’t spend a lot of time looking up the answers”
  – The pre-test is an introduction. We will show them where to find the information during the course.
  – We don’t intend on them remembering all of the information, just where to find it when they need it.
• Following the pre-test
  – Read the answers and indicate we will discuss where the answers are found as we go
  – Have the class grade their own tests. They should enter the number of correct answers at the bottom of the test block and on their evaluations
  – Pick up the test question handouts and pass out the module question sheets.
  – Ask the class not to work ahead, wait until the end of each module to complete the exercises.
# Sign-In Sheet

**Instructor Name:** __________________________  
**Instructor Signature:** __________________________

**Class Date:** __________________________  
**Class Location:** __________________________

**Class Sponsor:** __________________________  
**Class Title:** __________________________

**Please Print Clearly**

<table>
<thead>
<tr>
<th>Name (Include Middle Initial)</th>
<th>Signature</th>
<th>Employer (City, State)</th>
<th>Device ID (If Used)</th>
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</thead>
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</table>
Registration

(Please Print Clearly)

Enter your personal information (not work) for transferability

Name: ______________________________________________
(Include Middle Initial)

Home Address: ______________________________________________
________________________________________________________________
________________________________________________________________

Cell Phone: ______________________________________________

Email: ______________________________________________

ID Number: ______________________________________________

ID Type: ______________________________________________
(Drivers License, State ID... No Social Security Numbers)

Employer: ______________________________________________

Employer City & State: ______________________________________________

Position: ______________________________________________

Today’s Date: ______________________________________________

Class Sponsor: ______________________________________________

Class Location: ______________________________________________

Class Title: ______________________________________________

Instructor’s Name: ______________________________________________
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<table>
<thead>
<tr>
<th>Activity:</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
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<td>19.</td>
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<td>20.</td>
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</tbody>
</table>

Score (# Correct) ___________
We strive to offer the best training available and your feedback helps us to continually improve. Please take a few minutes to answer the questions and provide your feedback.

Your opinion matters.

<table>
<thead>
<tr>
<th>How would you rate the following:</th>
<th>Fair</th>
<th>Neutral</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your understanding of the topic before the course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Your understanding of the topic after the course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. The trainer’s understanding of the topic</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. How interactive the trainer was with the class</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. The time available for questions and comments</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. The quality of the answers to the questions</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. The quality of the overall course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. How practical the course is</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. The quality of the handouts</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Usefulness of the materials for future reference</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>11. The quality of the facilities</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>12. The quality of the course administration</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13. How much you feel this training will benefit you</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. Likelihood you will implement these strategies</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15. Would you recommend this training to others</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Length of the Training:
- [ ] Too Short
- [ ] Short
- [ ] Just Right
- [ ] Long
- [ ] Too Long

Difficulty of the Training:
- [ ] Too Simple
- [ ] Simple
- [ ] Just Right
- [ ] Challenging
- [ ] Too Challenging

How this course compares to other similar courses you have taken:
- [ ] Much Worse
- [ ] Worse
- [ ] Similar
- [ ] Better
- [ ] Much Better

Please write a few comments on the next page.
Comments

What were some of the most helpful topics in the training?

What would you change about the training? (Instruction, PowerPoints, Handouts, Facilities, Administration ...)

What other training do you feel would be helpful?

Other comments, observations, suggestions:

Pre-Test Score ______
Post-Test Score ______

Instructor: _______________________________ Instructor’s Signature: _______________________________
Implementing Safe Work Zone Operations Strategies

Pre-Test

1. Temporary Traffic Control (TTC) plans and devices are the responsibility of the authority of a public body or official with jurisdiction.
   a. True
   b. False

2. Temporary traffic control planning should include:
   a. A site condition assessment
   b. Planning based on engineering judgment
   c. Site condition monitoring and adjustment during operations
   d. All of the above
   e. None of the above

3. Incident scenes with a duration of less than 1 hour are handled like a short duration operation.
   a. True
   b. False

4. Reducing the number of devices shown in the Typical Applications of the National MUTCD is not allowed.
   a. True
   b. False

5. Engineering judgment is necessary when deciding mobile operations for which a shadow vehicle is not necessary.
   a. True
   b. False

6. Public relations efforts can improve awareness of temporary traffic control operations and potentially reduce the volume of traffic in the area of the operation.
   a. True
   b. False

7. The National Manual on Uniform Traffic Control Devices (MUTCD) identifies self regulating Temporary Traffic Control (TTC) zones that allow motorists to decide when to pass the work space.
   a. True
   b. False

8. On urban and high speed streets, the distance between the signs is required to be 350’
   a. True
   b. False

   a. True
   b. False

10. Which of the following could be used to control road users at a low volume driveway when a pilot vehicle is being used?
    a. A flagger
    b. Notification of the resident
    c. A sign indicating, “Turning Traffic Follow Pilot Car”
    d. All the above
    e. None of the above
Implementing Safe Work Zone Operations Strategies
Pre-Test
(Continued)

11. The US Dept. of Labor, Occupational Safety and Health Administration (OSHA), considers being struck by construction traffic a worker hazard.
   a. True
   b. False

12. A good practice for flaggers is to have their body towards the stop slow paddle allowing them to watch both directions for traffic, driveways and pedestrians.
   a. True
   b. False

13. Covering an existing stop sign adjacent to a flagger at an intersection is not necessary.
   a. True
   b. False

14. Truck mounted changeable message signs with arrow capabilities provide flexibility for meeting site condition needs.
   a. True
   b. False

15. Temporary traffic control operations never occur when roads are icy or snow covered.
   a. True
   b. False

16. Cones down the centerline of the road upstream of the flagger station can improve the safety and operation of the Temporary Traffic Control zone.
   a. True
   b. False

17. Effective standard operating procedures are written based on input from personnel with field experience.
   a. True
   b. False

18. Training on how to use standard operating procedures is not necessary.
   a. True
   b. False

19. Standard operating procedures can allow for proper application of engineering judgment in the field.
   a. True
   b. False

20. Many states have their own Manual on Uniform Traffic Control Devices.
   a. True
   b. False
Implementing Safe Work Zone Operations Strategies

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(Continued)

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   a. True
   b. False
19. Standard operating procedures can allow for proper application of engineering judgment in the field.
   a. True
   b. False
20. Many states have their own Manual on Uniform Traffic Control Devices.
   a. True
   b. False
Module 1

1. The distance a parked shadow vehicle weighing 25,000 lbs should be positioned behind the work being protected on a road with a speed limit of 45 MPH is _____ feet.
   a. 50
   b. 100
   c. 123
   d. 150
   e. 172

2. The distance a shadow vehicle, moving at 5 mph in a mobile operation and weighing 12,000 lbs, should be positioned behind the work being protected on a road with a speed limit of 35 MPH is _____ feet.
   a. 50
   b. 100
   c. 123
   d. 150
   e. 172

3. The American Traffic Safety Services Association’s shadow vehicle guide indicates that a shadow vehicle may be justified for a sweeping operation when workers are not on the road, but the road has a speed of 45 MPH.
   a. True
   b. False

4. Statutory authority is needed to implement and enforce a work zone speed limit.
   a. True
   b. False

5. Adoption of the National Manual on Uniform Traffic Control Devices (MUTCD) or equivalent by a State Legislature and signed into law by the Governor makes the language State law.
   a. True
   b. False

6. The National Manual on Uniform Traffic Control Devices (MUTCD) indicates that to be effective, a traffic control device should meet which of the following basic requirements:
   a. Easy to install
   b. Command attention
   c. Preferred by the field personnel
   d. All the above
   e. None of the above

7. The National MUTCD does not allow vehicles with strobe lights to be used in place of signs and channelizing devices for short-duration or mobile operations.
   a. True
   b. False
Module Questions and Exercises (Continued)

Module 2

1. A work zone speed limit is acceptable to be used with a mobile operation.
   a. True
   b. False

2. The distance between the signs shown in the National MUTCD on an urban high speed road is ____ feet.
   a. 100
   b. 250
   c. 350
   d. 500

3. The stopping sight distance on a road with a speed limit of 40 miles per hour is ____ feet.
   a. 100
   b. 200
   c. 305
   d. 320
   e. 360

4. The buffer space for a road with a speed limit of 35 miles per hour is 250 feet.
   a. True
   b. False

5. A taper length of 100 feet is acceptable for a one-lane, two-way traffic control zone set up.
   a. True
   b. False

6. The taper length (L) for a merging taper on a 12’ wide lane with a speed limit of 30 miles per hour is ____ feet.
   a. 60
   b. 90
   c. 180
   d. 200
   e. 245

7. Iowa allows the use of a 50’ downstream taper at intersections within the activity area of the Temporary Traffic Control zone.
   a. True
   b. False
Module 3

1. Oregon requires a minimum of _____ feet of sight distance at each end of a self regulating TTC zone.
   a. 100
   b. 350
   c. 750
   d. 2640
   e. 5280

2. If a heavy rain shower moves through the project the self regulating Temporary Traffic Control (TTC) zone should be
   a. Modified by adding flaggers for the duration of the reduced visibility.
   b. Removed and resumed when proper visibility exists.
   c. Both A and B
   d. None of the above.

3. Short intermittent segments of temporary traffic barrier are acceptable for use along the road adjacent to a building project.
   a. True
   b. False

4. Assigning someone the responsibility to assist pedestrians is an acceptable method according to the National Manual on Uniform Traffic Control Devices (MUTCD) of accommodating pedestrian traffic through the Temporary Traffic Control zone.
   a. True
   b. False

5. Personnel performing solid waste collection can be subjected to the same hazards as workers covered by Chapter 6 of the National MUTCD.
   a. True
   b. False

6. The American Traffic Safety Services Association’s shadow vehicle guidance recommends a shadow vehicle any time workers are exposed to vehicular traffic.
   a. True
   b. False

7. Based on the Virginia Work Area Protection Manual, at 55 MPH, the maximum distance between the first and last portable rumble strip in a set would be _____ Feet.
   a. 8
   b. 10
   c. 15
   d. 16
   e. 24
Implementing Safe Work Zone Operations Strategies

Module Questions and Exercises
(Continued)

Module 4

1. A good practice for flaggers is to have their body towards the stop slow paddle allowing them to easily watch both directions for traffic, driveways and pedestrians.
   a. True
   b. False

2. Covering an existing stop sign that conflicts with the flagger’s slow sign is necessary for flagging at an intersection.
   a. True
   b. False

3. Truck mounted changeable message signs with arrow capabilities provides flexibility for meeting site condition needs.
   a. True
   b. False

4. Temporary traffic control operations never occur when roads are icy or snow covered.
   a. True
   b. False

5. Stopping sight distance would not be impacted by the existence of a snow covered road.
   a. True
   b. False

Module 5

Review of Typical Applications

Module 6

Review of Example SOPs and Manuals
Module Questions and Exercises

Module 1

1. The distance a parked shadow vehicle weighing 25,000 lbs should be positioned behind the work being protected on a road with a speed limit of 45 MPH is _____ feet.
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   b. False

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Implementing Safe Work Zone Operations Strategies

Module Questions and Exercises
(Continued)

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   b. False

Module 5

Review of Typical Applications

Module 6

Review of Example SOPs and Manuals
Implementing Safe Work Zone Operations Strategies

Post-Test

1. The National Manual on Uniform Traffic Control Devices (MUTCD) is required to be used by all states.
   a. True
   b. False
2. The National MUTCD indicates that low speed is 45 MPH and below.
   a. True
   b. False
3. Incident scenes with a duration of less than 2 hours are handled like a short duration operation.
   a. True
   b. False
4. Temporary Traffic Control plans and devices are the responsibility of the authority of a public body or
   official with jurisdiction.
   a. True
   b. False
5. Temporary traffic control planning is based on engineering judgment and guidance.
   a. True
   b. False
6. The National MUTCD indicates in TA-10, “Lane Closure on a Two-Lane Road Using Flaggers,” that for
   short duration activities the Road Work Ahead and End Road Work Signs are not required.
   a. True
   b. False
7. Engineering judgment is necessary when deciding mobile operations for which a shadow vehicle is not
   necessary.
   a. True
   b. False
8. Public relations efforts can improve awareness of temporary traffic control operations and potentially
   reduce the volume of traffic in the area of the operation.
   a. True
   b. False
9. The National MUTCD has a typical application that allows self regulating Temporary Traffic Control
   zones which allows motorists to decide when to pass the work space.
   a. True
   b. False
10. On urban streets the effective placement of the first warning sign in feet should range from 4 to 8
    times the speed limit in mph
    a. True
    b. False
Implementing Safe Work Zone Operations Strategies
Post-Test
(Continued)

11. A sign indicating, "Turning Traffic Follow Pilot Car" could be used to control road users at a low volume driveway when a pilot vehicle is being used.
   - True
   - False

12. Construction vehicles and equipment pose a hazard to workers.
   - True
   - False

13. It is acceptable for a flagger to have their back towards on-coming traffic.
   - True
   - False

14. Covering an existing stop sign adjacent to a flagger at an intersection is important in avoiding road user confusion.
   - True
   - False

15. Truck mounted changeable message signs with arrow capabilities provide flexibility for meeting site condition needs.
   - True
   - False

16. Temporary traffic control operations require special care in inclement weather.
   - True
   - False

17. Cones down the centerline of the road upstream of the flagger station can improve the safety and operation of the Temporary Traffic Control zone.
   - True
   - False

18. Training on the use standard operating procedures assists in effective application of the procedures.
   - True
   - False

19. Effective standard operating procedures are written based on input from personnel with field experience.
   - True
   - False

20. Standard operating procedures can allow for proper application of engineering judgment in the field.
   - True
   - False
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   a. True
   b. False
Module 1
Introduction
Definitions and Descriptions of Durations

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
Disclaimer

The course materials for this training are based upon work supported by the Federal Highway Administration (FHWA) under Grant Agreement DTFH6116RA00018, “2016 Work Zone and Guardrail Safety Training Grants.”

Any opinions, findings, conclusions or recommendations expressed in this course are those of the trainer and the grantee and do not necessarily reflect the view of the Federal Highway Administration. This course does not constitute a national standard, specification or regulation.
Disclaimer

This course provides training to assist the participants in meeting the objectives identified. Basic principles and discussions of industry practice are intended to assist practitioners in the planning and implementation of their temporary traffic control operations; planned using the appropriate Manual on Uniform Traffic Control Devices (MUTCD), engineering judgment and jurisdictional requirements for the location the work is being performed. Due to the multitude of situations in which these principles can be applied, the coursework only provides the basic foundation on which decisions should be made.

The employee and their employer are responsible and assume the liability for their comprehension of the principles, review and implementation of the information provided in this training as well as the application laws and regulations associated with the location of the work.
Before We Get Started

• In case of an emergency
• Facilities
• Breaks
• Please set your cell phone to silent
  – If you need to take a call, just step out of class

Please give us your thoughts and participate

Source: Pixabay – Creative Commons
Paperwork

- Sign In
- Registration Form
- Exercises
- Pre and Post Tests
- Evaluation

Please PRINT Clearly

Course Instructions and Documentation in Your Handout

Your opinion matters.
Give us your thoughts on the evaluation.

Source: Pixabay – Creative Commons
Pre-Test

- Tests are open book
  Don’t spend a lot of time looking up the answers
- The pre-test is an introduction to:
  - See the key points from the course
  - Show what you need is in the handout
  - Remind you that you don’t have to remember everything … Just where to find it.
- During the pre-test
  - Please answer on your remote
  - Fill in the space on your answer sheet
  - Grade the answers as we go.
  - Record the number you get correct on your bubble sheet and page 2 of the course evaluation
- Please do not write on the test or module exercise pages
  Also, please do not to work ahead on the module exercises

(Document in the Instructor’s Handout)
Implementing Safe Work Zone Operations Strategies

Source: Energy Absorption Systems, Trinity Highway Products

Intro Video

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
Notes

• Video Source: Energy Absorption Systems, Permission from Trinity Highway Products, Dallas, Texas

• This video demonstrates the necessity for a shadow vehicle. It shows a mobile operation during which traffic is merging into the lane adjacent to the operation. A sports utility vehicle is seen approaching the shadow vehicle and not slowing down or merging. The SUV strikes the truck mounted attenuator on the shadow vehicle and pushes the shadow vehicle between 160 and 180 feet based on the number of skip lines the truck rolls past after being impacted. At the end of the video, it indicates that the driver of the SUV had a laptop next to him in the SUV and was not watching the road.
What if your workers were on the road when that SUV came through?

Source: TTI-LLC
Goals of this Training

• Reduce the number and severity of work zone incidents
• Protect
  – Workers
  – Road Users
  – Stakeholders
  – Public and Private Assets at Risk

Source: TTI-LLC

Ambulance Image Source: Source: “Safely Regulating Traffic in Michigan,” video. Produced by the Michigan Department of Transportation (MIDOT) and the Michigan Road Builders Association (MRBA)

Source: Neal Carboneau, JTRP
What should you take away?

• A confidence in using the MUTCD
• Knowledge that there are a lot of resources and research to supplement the MUTCD
• See examples of common problems and solutions
Project Goals

FHWA Grant Agreement DTFH6116RA00018 “2016 Work Zone and Guardrail Safety Training Grants”

- Provide “training to enhance highway work zone safety”
- Implement “products already completed”
- Strategic extension on provision of existing training
- Continued identification of gaps and solutions

The goals for the project and this training will be achieved through the objectives of this and the follow up instructor's course.
Implementing Safe Work Zone Operations Strategies

Objectives

Improve operational understanding, planning and implementation for

- flagged
- mobile
- short duration
- short term and
- incident management

Source: TTI-LLC

Source: TTI-LLC

Ditching Image Source: George Armstrong, Federal Emergency Management Agency, Cropped

Source: TTI-LLC
Implementing Safe Work Zone Operations Strategies

Objectives

How will we improve operational understanding, planning and implementation?

- by
  - expanding on basic language in the MUTCD
  - allowing for appropriate use of engineering judgment
  - supplementing existing guidance & training with specific strategies

Source: TTI-LLC
Implementing Safe Work Zone Operations Strategies

Objectives

How will we improve operational understanding, planning, and implementation?

- identifying
  - common site-related hazards and
  - strategies that can be used as countermeasures to those hazards

Source: TTI-LLC
Implementing Safe Work Zone Operations Strategies

Objectives

How will we improve operational understanding, planning and implementation?

• allowing for planning and implementation through the use of
  – standard operating procedures (SOPs)
  – training
  – assessments
  – updates

Source: Report No. FHWA-SA-09-025
Implementing Safe Work Zone Operations Strategies

Objectives

How will we improve operational understanding, planning and implementation?

• emphasizing
  – awareness of changing conditions and
  – the necessity for on-site plan adjustments

• assigning
  – responsibility for quality operations, devices and control

Source: TTI-LLC

Source: Quality Standards for Temporary Traffic Control Devices, July 2013. Missouri DOT (MODOT)
Notes

• Source: Quality Standards for Temporary Traffic Control Devices, July 2013. Missouri Department of Transportation (MODOT)
• Mention poor quality sign, maintaining cones, improper flagging and inattention
• Missouri has an excellent guide on evaluating the condition of devices. They also have a supplemental inspection sheet that is very detailed. It has been created for Temporary Traffic Control (TTC) zone audits, but is an extensive tool for any evaluation.
• Insurers in attendance could use this resource for audits of their clients’ TTC.
• Kansas DOT (KSDOT) has a brief one page review sheet better suited for the installation personnel to verify the adequacy of their installation. It is included in the handout.
Importance of Understanding the MUTCD, Traffic Control Devices (TCDs), & Temporary Traffic Control (TTC) Zones

“Responsibility for design, placement, operation, maintenance, and uniformity of traffic control devices shall rest with the public agency or official having jurisdiction...”

-MUTCD (1A.07)

Traffic Control Devices (TCDs) on all streets, highways, bikeways and private roads open to public travel must be in substantial conformance with standards issued or endorsed by the Federal Highway Administrator

MUTCD is the national standard for all traffic control devices
Notes

• May need to indicate Traffic Control Devices (TDCs) is the acronym used commonly for traffic control devices and Temporary Traffic Control (TTC) is the acronym for temporary traffic control used throughout the course. Some participants may be new to the information. Possibly insurance personnel, etc.
Importance of Understanding the MUTCD, TCDs, & TTC Zones

• The National MUTCD has the force and full effect of law (1A.07)
• All state manuals are reviewed for specific provisions relating to that state (1A.07)
• The National MUTCD has also been adopted by the National Park Service, U.S. Forest service, U.S. Military Command, Bureau of Indian Affairs, Bureau of Land Management and the U.S. Fish and Wildlife Services (1A.07)
Notes

• Note the “full force and effect of law” is based on the specific state law that adopts the national manual or equivalent state version.
Note: The Manual on Uniform Traffic Control Devices (MUTCD) describes the application of Traffic Control Devices (TCDs) but is not a legal requirement for their installation (1A.09)
Notes

• Discuss how the National MUTCD is not the legal requirement. The individual State’s adoption in their code is the legal requirement; except for Federal agencies governed by the Code of Federal Regulations.
Adoption of the National MUTCD

Be sure to check your state and local jurisdictional requirements.

Source: FHWA

- Red: Adopted the national MUTCD
- Blue: Adopted the national MUTCD with a State Supplement(s)
- Green: Adopted a State MUTCD
Authority for Placement of TCDs (1A.08)

**Standard:**

- Street or Highway
- Private Road
- Public Agency or Official w/ jurisdiction
- Private Owner/Official

Given proper authority, contractors or public utility company are permitted to install Temporary Traffic Control Devices (TTCDs) in Temporary Traffic Control (TTC) zones complying with the standards of the Manual on Uniform Traffic Control Devices (MUTCD)

All regulatory Traffic Control Devices are supported by laws, ordinances, or regulations
Authority for Placement of TTC Zones (1A.01)

- Temporary Traffic Control plans and devices are the responsibility of the authority of a public body or official with jurisdiction.
- Statutory authority is needed to implement and enforce:
  - regulations, parking controls, speed zoning, and management of traffic incidents.

There is a certain flexibility in the application of Temporary Traffic Control to meet the needs of changing conditions in a TTC Zone.
Understanding the Manual on Uniform Traffic Control Devices (MUTCD), Traffic Control Devices (TCDs) and Temporary Traffic Control (TTC) Zones allows professionals to provide a safe, regulated, and effective work zone.
Throughout this course ...

We will be primarily using Chapters 1 and 6 of the 2009 National Manual on Uniform Traffic Control Devices with Revisions 1 and 2 dated May 2012.

Each section will be called out with the following format:   Section 6G.02 ¶ 11

Which indicates that we will be looking at Chapter 6G, Section 2 Paragraph (¶) 11

Other resources referenced on a slide will be called out specifically by title. The handout has links to the documents for further reference.

Source: FHWA
Applying the Principles in the MUTCD

Engineering Judgment

Section 1A.09

• Application of traffic control devices
• Not a legal requirement (Adopted by the State)
• Decision to use a particular device at a particular location ... the application of engineering judgment
• Manual provides Standards, Guidance, and Options
• not ... a substitute for engineering judgment
• Jurisdictions, or owners of private roads open to public travel ... who do not have engineers on their staffs who are trained and/or experienced in traffic control devices should seek engineering assistance from others

Source: FHWA
Notes

• Open the MUTCD handout to the applicable section and show them where to find the specific language.

• The intent for this course will be using the MUTCD handout throughout the course to help the audience realize that most of the information they need is in the MUTCD and not very hard to find as we will demonstrate by going through it and marking it.

• We will also discuss other resources they can use to supplement the MUTCD.
Applying the Principles in the MUTCD

Engineering Judgment

Section 1A.13 #64

... the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device.

Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer.

Standard Operating Procedures Developed using Engineering Judgment

Source: TTI-LLC
Principles of Traffic Control Devices
(1A.02)

To be effective, a traffic control device should meet five basic requirements:

1. Fulfill a need
2. Command attention
3. Convey a clear, simple meaning
4. Command respect from road users
5. Give adequate time for proper response

Source: “Safely Regulating Traffic in Michigan,” video. Produced by the Michigan Department of Transportation (MIDOT) and the Michigan Road Builders Association (MRBA)
The focus of this training

Operations without typical design drawings

Section 6G.02 Temporary Traffic Control Activities

Mobile: Moves intermittently or continuously

Short Duration: Up to 1 hour

Short Term: > 1 hour in a single daytime period

Intermediate: > 1 Daylight Period to 3 Days (Night > 1 Hour)

Section 6I.01 Incident Management

Minor: < 30 minutes

Intermediate: 30 minutes to 2 hours

Often 1 Hr and less treated as short duration

Major: > 2 hours

An Excellent Resource Beyond this Course is the “Guide to Short-Term Stationary, Short-Duration, and Mobile Work Zone Traffic Control” by Wayne State University.
Notes

• The focus of this course is implementation. The language in this section is often overlooked and provides important information regarding flexibility in operational requirements based on the duration; more specifically, relating to mobile operations.

• The next few slides emphasize specific considerations for mobile operations.

• Wayne State University, “A Guide to Short-Term Stationary, Short-Duration, and Mobile Work Zone Traffic Control”, 2016

• http://workzone.eng.wayne.edu/GuidetoSTSDMWorkZoneTrafficControl.pdf
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control (TTC) Activities

¶ 7 Retroreflective Devices for nighttime operations (Intermediate)

¶ 9 Signs mounted on trucks – allowable

Object Markers?

Source: TTI-LLC
Notes

• Later in the course, cropping of signs is discussed and the language allowing it is detailed in the slides. This sign could have been cropped at the top to avoid as much overlapping the arrow board.

• There is no clear definition in the MUTCD regarding marking for attenuators, but the language on the following slide indicates that this is the proper marking for an object within the limits of the pavement.
CHAPTER 2C. WARNING SIGNS AND OBJECT MARKERS

Section 2C.63 Object Marker Design and Placement Height

¶ 1 Type ... 3 object markers ... mark obstructions within or adjacent to the roadway.

Section 2C.64 Object Markers for Obstructions Within the Roadway

¶ 3 To provide additional emphasis, large surfaces such as bridge piers may be painted with diagonal stripes ... similar in design to the Type 3 object marker.

Section 6F.02 General Characteristics of Signs

¶ 2 ... Warning signs in TTC zones shall have a black legend and border on an orange background

¶ 5 Existing warning signs that are still applicable may remain in place.

Notes for Figure 6H-17—Typical Application 17

¶ 6 The shadow vehicles should also be equipped with two high-intensity flashing lights mounted on the rear, adjacent to the sign.
Notes

• Chapter 2 of the MUTCD is not included in the handout, so this language will only be available on the screen.
• Language for barricades indicates one to three rails that are orange and white, so it would not relate to object markers.
• The red and white is not uncommon. Many states have this coloration on their attenuators. Some even have different patterns.
• It is worth discussing as administrators, managers and engineers will be present, and a change to procedures could remedy the situation.
Let’s look at the specific language

Other notes on implementation based on duration

Section 6G.02 Temporary Traffic Control (TTC) Activities

¶ 11. Vehicles with ... strobe lights may be used in place of signs and channelizing devices for short-duration or mobile operations... they may be augmented with signs or arrow boards.

¶ 14. Mobile operations often involve frequent short stops for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations.

Source: TTI-LLC
Notes

• Emphasize ¶ 10 that safety in short-duration or mobile operations should not be compromised by using fewer devices simply because the operation will frequently change its location.
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control (TTC) Activities ¶ 12-13

• During short-duration work, it often takes longer to set up and remove the TTC zone than to perform the work.

• Workers face hazards in setting up and taking down the Temporary Traffic Control zone... delays affecting road users are significantly increased.

• Considering these factors, simplified control procedures may be warranted for short-duration work.

• A reduction in the number of devices may be offset by the use of other more dominant devices such as ... strobe lights on work vehicles.

Source: TTI-LLC
Notes

• Can reiterate the duration definitions: Short duration $< 1$ hour ... intermediate incident management $< 1$ hour would be similar

• Also indicate that delays / queues can cause incidents (back of queue), rear end crashes, so evaluating the risk to the workers and the road users is a necessary component of the plan or standard operating procedure development.
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control Activities ¶ 17

- Flaggers may be used for mobile operations that often involve frequent short stops.

Source: TTI-LLC, Modified

Cover with a roll up mowing sign in passing zones.
Let’s look at the specific language

Notes on implementation based on duration

Section 6G.02 Temporary Traffic Control Activities

¶ 19 When mobile operations are being performed, a shadow vehicle equipped with an arrow board or a sign should follow the work vehicle ... Where feasible, warning signs should be placed along the roadway and moved periodically as work progresses.

¶ 20 Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.

¶ 21 If there are mobile operations on a high-speed travel lane of a multi-lane divided highway, arrow boards should be used.

Source: TTI-LLC, Modified
• The next slide reminds the audience that “should” means “deviations are allowed if engineering judgment ... indicates the deviation to be appropriate .“

• How does an engineer determine when shadow vehicles are necessary? The slide following the definitions will provide a resource.
Let’s step back for a second

A reminder on the definitions of Shall, Should and May

Section 1A.13 Definitions Temporary Traffic Control Activities ¶ 1

A. Standard ... required ... verb “shall” is typically used.

B. Guidance ... deviations allowed if engineering judgment ... indicates the deviation to be appropriate ... “should” is typically used.

C. Option ... statement of practice that is a permissive condition and carries no requirement or recommendation ... the verb “may” is typically used.
Where is the guidance for shadow vehicles?

American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide

American Traffic Safety Services Association (ATSSA) has provided an overview in their shadow vehicle guidance document, “Field guide for the use and placement of shadow vehicles in work zones.”

The Transportation Research Board (TRB) research that the AASHTO language was derived from is detailed in “Guidelines for the use of truck-mounted attenuators in work zones,” by Humphreys and Sullivan.

PDF’s for both documents can be found by entering the title in your browser’s search engine.

Source: ATSSA – workzonesafety.org
Notes

• American Traffic Safety Services Association (ATSSA) “Field guide for the use and placement of shadow vehicles in work zones.”

• https://www.workzonesafety.org/files/documents/training/fhwa_wz_grant/shad_veh_final.pdf

• American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide


• May indicate that most of the guidance documents mentioned in this course are available at WorkZoneSafety.org
## AASHTO Roadside Design Guide: Shadow Vehicle Positioning

- Could Add Cones Along the Centerline for Visibility
- Can Turn Wheels to The Curb or Shoulder

### Shadow Vehicles Weighing 22,000 lbs or More

<table>
<thead>
<tr>
<th>Operating Speed Limit</th>
<th>Stationary</th>
<th>Moving &lt; 15.5 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 55 MPH</td>
<td>150 Feet</td>
<td>172 Feet</td>
</tr>
<tr>
<td>45 - 50 MPH</td>
<td>100 Feet</td>
<td>150 Feet</td>
</tr>
<tr>
<td>&lt; 45 MPH</td>
<td>74 Feet</td>
<td>100 Feet</td>
</tr>
</tbody>
</table>

### Shadow Vehicles Weighing 9,900 lbs to 22,000 lbs

<table>
<thead>
<tr>
<th>Operating Speed Limit</th>
<th>Stationary</th>
<th>Moving &lt; 15.5 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 55 MPH</td>
<td>172 Feet</td>
<td>222 Feet</td>
</tr>
<tr>
<td>45 - 50 MPH</td>
<td>123 Feet</td>
<td>172 Feet</td>
</tr>
<tr>
<td>&lt; 45 MPH</td>
<td>100 Feet</td>
<td>100 Feet</td>
</tr>
</tbody>
</table>

Graphics Source: ARTBA & TTI-LLC
<table>
<thead>
<tr>
<th>If the type of activity involves:</th>
<th>The priority for use of shadow vehicles is:</th>
<th>And, if the speed is:</th>
<th>The priority for use of a TMA on the vehicle is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed personnel – crack pouring, patching, utility work, striping, coning (No Stationary Lane Closure)</td>
<td>Very highly recommended</td>
<td>50 mph</td>
<td>Highly recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 mph or less</td>
<td>Desirable</td>
</tr>
<tr>
<td>Exposed personnel – pavement repair, pavement marking, delineator repair (No Stationary Shoulder Closures)</td>
<td>Highly recommended</td>
<td>50 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td>Recommended</td>
<td>45 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td>Recommended</td>
<td>40 mph or less</td>
<td>Recommended</td>
</tr>
<tr>
<td>No exposed personnel – sweeping, chemical spraying (No Stationary Lane Closure)</td>
<td>May be justified based on the specific project need if it would lessen impacts</td>
<td>50 mph</td>
<td>Highly recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 mph</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 mph or less</td>
<td>Desirable</td>
</tr>
</tbody>
</table>

Example of use from the American Traffic Safety Services Association’s “Field guide for the use and placement of shadow vehicles in work zones.”

Mobile Non-Freeway Application
Let’s work a few problems

• The exercises are open book
• Following the exercises
  • We will go through the answers
  • Grade your own exercises
  • Record the number you get correct on your bubble sheet
• Please do not write on the module exercise pages
  Also, please do not work ahead on the other module exercises

(In the Instructor’s Handout)
Agenda

Addressing Site Related Conditions with the MUTCD

8:00 to 9:00  Intro, Pre-Test, Understanding the MUTCD
Module 1 Definitions and Descriptions of Durations

9:00 to 9:10  Break

9:10 to 10:10 Module 2 Fundamental Principles, Speeds & Dimensions
10:10 to 10:20 Break

10:20 to 11:20 Module 3 One Lane – Two Way, Pedestrians & Worker Safety

11:20 to 12:20 Lunch

12:20 to 1:20 Module 4 Flagging & Device Usage
1:20 to 1:30  Break

1:30 to 2:30 Module 5 Modifications, Operations and Typical Applications
2:30 to 2:40 Break

2:40 to 3:40 Module 6 Developing a Manual of Standard Operating Procedures
3:40 to 4:00  Post-Test and Evaluation
Implementing Safe Work Zone Operations Strategies

End of Module 1

Introduction

Definitions and Descriptions of Durations

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Implementing Safe Work Zone Operations Strategies

Module 2
Implementing the MUTCD & Addressing Site Conditions
Fundamental Principles, Speeds & Dimensions

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Let’s start with a few definitions

Sections 1A.13

• Average Daily Traffic (ADT): the average 24 hour volume, being the total volume during a stated period divided by the number of days in that period. Normally, this would be periodic daily traffic volumes over several days

• Expressway: a divided highway with partial control of access

• Highway: a general term for denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way

Source: TTI-LLC
Let’s start with a few definitions

Sections 1A.13

- **Conventional Road:** a street or highway other than a low-volume road, expressway or freeway

Source: Flickr – Oregon DOT (ORDOT)

(Discussion Point: The flagger is positioned beyond the curve)
Let’s start with a few definitions

Sections 1A.13

Speed: defined based on the following classifications:

A. Average Speed- the summation of the instantaneous or spot-measured speeds at a specific location of vehicles divided by the number of vehicles observed

B. Design Speed- a selected speed used to determine the various geometric design features of a roadway

C. 85th Percentile Speed- the speed at or below which 85 percent of the motor vehicles travel

D. Operating Speed- a speed at which a typical vehicle or the overall traffic operates. Operating speed might be defined with speed values such as the average, pace, or 85th percentile speeds

E. Pace- the 10 mph speed range representing the speeds of the largest percentage of vehicles in the traffic stream
Let’s get comfortable with the MUTCD

We will step through CH 6 as well as other pertinent sections. Focus on implementation and modification relating to site conditions.

Let’s open up to 6A.01

Source: FHWA
Implementing the MUTCD

Addressing Site Conditions

• 6A.01 ¶ 2

Needs and control of all road users

¶ 10, 13, 14 Covers Jurisdictional Requirements & Flexibility

Discussed Earlier

Source: TTI-LLC

Source: ATSSA “Guidance Sheet - Temporary Traffic Control Zone Pedestrian Access Considerations”
Notes

• Discuss (Remind) that legal requirements are the jurisdiction’s responsibility. Look at ¶ 10 ... shall be adequate statutory authority for the implementation and enforcement ... Such statutes shall provide sufficient flexibility in the application of TTC to meet the needs of changing conditions in the TTC zone.
• Emphasize the jurisdictions responsibility and flexibility based on engineering judgment, MUTCD language and associated minimums
• ¶ 13 ... plans may deviate from the typical applications ... to allow for conditions and requirements of a particular site or jurisdiction.
• ¶ 14 Describes urban and rural as well as traffic volumes.
• Flexibility is underlined above since this is a critical component of this training. Identifying gaps in current guidance or training. This training specifically identifies the flexibility allowed when engineering judgment is used to customize plans for site conditions.
• Can discuss the improper use of devices and lack of detour for this sidewalk closure.
Implementing the MUTCD

Addressing Site Conditions

• 6A.01 ¶ 8

Improved road user performance might be realized through a well-prepared public relations effort.

Source: Stillwater News Press

Source: Stillwater, Ok - Facebook
Implementing the MUTCD

Addressing Site Conditions

• 6B.01 Fundamental Principles

Understanding this section is critical to customizing TTC Plans and addressing specific situations

¶ 2 Transit, Emergency Response, Railroads

¶ 3 Customized Detours (Large Vehicles)

Combine over the curb to miss barrels

Source: MUTCD Typical Application 46 (TA-46)

Source: TTI-LLC
Notes

• This is the first location a Typical Application is referenced. Would be helpful to turn to that Typical Application and indicate that TA is a common acronym for the Typical Applications (TAs). Also, saying Typical Application instead of TA would also be helpful throughout.

• Emphasize self study and review of the information from this training
Implementing the MUTCD

Addressing Site Conditions

• 6B.01 Fundamental Principles

¶ 7 Fundamental Principles

1. Provide safety for everyone involved
2. Inhibit road users as little as practical
3. Guide in a clear positive manner
4. Provide acceptable operation
   (Modify as necessary)
5. Maintain roadside safety
6. Each person ... should receive training
7. Maintain good Public Relations

Source: MUTCD TA-6

Source: TTI-LLC

¶ 7
Notes

• Encroachment provides lateral buffer space, but need to weigh the safety of an extra lane for workers near traffic.

• Queues and rear end crashes are the risk being weighed. What is the proximity to lane line of the workers and how much room is there to encroach
Implementing the MUTCD

Addressing Site Conditions

- 6C.01 Temporary Traffic Control (TTC) Plans
  
  ¶ 2 ... very detailed to simply referencing typical drawings ..., standard approved highway agency drawings and manuals ...

Source: Indiana DOT
Standard Drawings

Modifies MUTCD TA-10
Double Signing
Additional Advance Warning
Notes

• Shows a customized plan based on a specific State’s preferences. Higher speed and volume.

• A standard operating procedure manual is the focus of this training. Many exist and are online for example. Many Local Technical Assistance Programs (LTAPs) have developed one for their state. http://www.nltapa.org/
Implementing the MUTCD

Addressing Site Conditions

• 6C.01 Temporary Traffic Control (TTC) Plans

¶ 4 Coordinate with overlapping projects

Source: TTI-LLC
Implementing the MUTCD

Addressing Site Conditions

• 6C.01 Temporary Traffic Control (TTC) Plans
  – ¶ 8, 9 Changed Condition Language
    SOPs with modifications under specific circumstances will allow field adjustment

Example Standard Operating Procedure (SOP) Modification
(Use MUTCD TA-10)

“At curves or hills lengthen the activity area to position flaggers on opposite sides of the hill or curve.”

Activity Area

Source: MUTCD TA-10
Notes

• Notes for TA-10 ¶ 4 The buffer space should be extended so that the two-way traffic taper is placed before a horizontal (or crest vertical) curve to provide adequate sight distance for the flagger and a queue of stopped vehicles.
Implementing the MUTCD

Addressing Site Conditions

• 6C.01 Temporary Traffic Control (TTC) Plans
  – ¶ 12, 13, 14 Speed Reduction

  10 Miles Per Hour (MPH) - Change

  >10 MPH Encroachment?

Source: FHWA, Texas A&M. Modified, “IDENTIFICATION OF HAZARDS ASSOCIATED WITH MOBILE AND SHORT DURATION WORK ZONES,” Modified

Source: Neal Carboneau, JTRP, Cropped
Notes

• Main points from ¶ 12, 13, 14

• Reduced speed limits should be used only where it is needed in a zone
• Avoid frequent changes in speed limits
• Goal is to keep limit reduction no more than 10 mph
• Reducing speed should be avoided if practical- drivers will only reduce speed if they see a clearly perceived reason to
• A reduction of more than 10 mph in speed limit should be used only:
  – When required by restrictive features in TTC zone (Encroachment?)
  – Additional driver notification required
  – Additional TTC devices required before reaching location requiring the lowest speed
Video
Speed Sign Gets Driver’s Attention

Source: TTI-LLC

So does the work ...
Notes

• If time permits, the video can be shown. It is best to have the media player set for replay on this video.

• The space bar can be used during the video to stop at these images for emphasis.

• Can discuss how the work can distract road users. Excessive use of strobes can be a contributing factor to this distraction.
Implementing the MUTCD

Addressing Site Conditions

• 6C.02 TTC Zones (Types)
  – Work Zone
    • Construction
    • Maintenance
    • Utility
  – Incident Zone
  – Special Events

Source: TTI-LLC
Notes

• Discuss entire section
• Clearly defines TTC, WZ ...
• Can discuss the images. Proper flagging practices and training, sweeping operations – location, protection... Additional encroachment if possible as outrigger for truck is at the lane line.
• Indicates the beginning and ending of the zone with associated flexibility
• “Sign,” “strobe,” ... “last TTC device.”
• If questions arise regarding sweeping ... can discuss AASHTO Shadow Vehicle Use Recommendations
• The research language discusses reducing the severity of the incident for the drivers. Would a shadow vehicle do this?
• Not necessarily for this sweeper ...
• A comment may arise regarding 360 degree visibility of strobes on the sweeper.
Implementing the MUTCD

Addressing Site Conditions

• 6C.04 Advance Warning
  – ¶ 2 The advance warning area may vary from a single sign or ... strobe ... on a vehicle to a series of signs in advance of the TTC zone activity area.

Source: MUTCD TA18

Source: TTI-LLC
Notes

• This image, the need for the sign, and placement (offset and distance) can all be discussed as time permits.

• Can expand on the discussion relating to placement of signs in parking areas, in lanes ... based on language in the MUTCD
Implementing the MUTCD

Addressing Site Conditions

• 6C.04 Advance Warning ¶ 3, 4, 5, 6

... placement of advance warning signs on freeways and expressways should be longer ... should extend on these facilities as far as 1/2 mile or more.

On urban streets, the effective placement of the first warning sign in feet should range from 4 to 8 times the speed limit in mph ... can be as short as 100 feet ... on higher-speed streets, such as major arterials, the advance warning area should extend a greater distance (see Table 6C-1).

... rural highways ... the effective placement of the first warning sign in feet should be substantially longer—from 8 to 12 times the speed limit in mph.

The distances contained in Table 6C-1 are approximate, are intended for guidance purposes only, and should be applied with engineering judgment. These distances should be adjusted for field conditions, if necessary, by increasing or decreasing the recommended distances.
Notes

- This is an important concept to discuss. The distances in 6C-1 are commonly known and guidance “should”, but that is where the engineering judgment is applied in the field. If site conditions do not allow for the prescribed distances, the table on the following page can be used to customize the site for the conditions.
- Also, the choice of speed limits is not always based on the data; the reason for the discussion of the definitions.
- The speeds with associated sign distances can be used to help an agency determine the speed categories associated with Table 6C-1 in the MUTCD. Language in Chapter 5 and Figure 6F-7 can also be used as an example; where 45 mph and above is considered high speed for 28” cones and 40 mph and below is considered low speed for 18” cones.
- Can also discuss the relationship between stopping sight distance and the sign distances. IE 360’ is the stopping sight distance at 45 mph, high speed, 350’ sign distance from Table 6C-1. The minimum sign distance is 100’, and the stopping sight distance at 20 mph is 115’.
## Advance Warning

### Sign Placement

<table>
<thead>
<tr>
<th>Speed in Miles Per Hour</th>
<th>Distance Between Signs**</th>
<th>Buffer Space Stopping Sight Distance in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 x Speed Limit Urban Min</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>115</td>
</tr>
<tr>
<td>25</td>
<td>100</td>
<td>155</td>
</tr>
<tr>
<td>30</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>35</td>
<td>140</td>
<td>250</td>
</tr>
<tr>
<td>40</td>
<td>160</td>
<td>305</td>
</tr>
<tr>
<td>45</td>
<td>180</td>
<td>360</td>
</tr>
<tr>
<td>50</td>
<td>200</td>
<td>425</td>
</tr>
<tr>
<td>55</td>
<td>220</td>
<td>495</td>
</tr>
<tr>
<td>60</td>
<td>240</td>
<td>570</td>
</tr>
<tr>
<td>65</td>
<td>240</td>
<td>645</td>
</tr>
<tr>
<td>70</td>
<td>240</td>
<td>730</td>
</tr>
<tr>
<td>75</td>
<td>240</td>
<td>820</td>
</tr>
</tbody>
</table>

|                         | 8 x Speed Limit Urban Max |                                             |
| 20                      | 160                      | 115                                         |
| 25                      | 200                      | 155                                         |
| 30                      | 240                      | 200                                         |
| 35                      | 280                      | 250                                         |
| 40                      | 320                      | 305                                         |
| 45                      | 360                      | 360                                         |
| 50                      | 400                      | 425                                         |
| 55                      | 440                      | 495                                         |
| 60                      | 480                      | 570                                         |
| 65                      | 520                      | 645                                         |
| 70                      | 560                      | 730                                         |
| 75                      | 600                      | 820                                         |

|                         | 12 x Speed Limit Rural Min |                                             |
| 20                      | 240                      | 115                                         |
| 25                      | 300                      | 155                                         |
| 30                      | 360                      | 200                                         |
| 35                      | 420                      | 250                                         |
| 40                      | 480                      | 305                                         |
| 45                      | 540                      | 360                                         |
| 50                      | 600                      | 425                                         |
| 55                      | 660                      | 495                                         |
| 60                      | 720                      | 570                                         |
| 65                      | 780                      | 645                                         |
| 70                      | 840                      | 730                                         |
| 75                      | 900                      | 820                                         |

**Source:** TTI-LLC, Calculated from the MUTCD
Advance Warning
Sign Placement

Merging Taper Length (L)

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Distance Between Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Urban (Low Speed)</td>
<td>100</td>
</tr>
<tr>
<td>Urban (High Speed)</td>
<td>350</td>
</tr>
<tr>
<td>Rural</td>
<td>500</td>
</tr>
<tr>
<td>Expressway/Freeway*</td>
<td>1000</td>
</tr>
</tbody>
</table>

... should be adjusted for field conditions ...

Approx. 1 Mile
“½ mile or more”

Source: Table 6C-1 2009 National MUTCD

Image Source: ARTBA, TTI-LLC
Implementing the MUTCD

Addressing Site Conditions

• 6C.04 Advance Warning ¶ 7

The need to provide additional reaction time for a condition is one example of justification for increasing the sign spacing.

Conversely, decreasing the sign spacing might be justified in order to place a sign immediately downstream of an intersection.

Source: TTI-LLC
Implementing the MUTCD

Addressing Site Conditions

- 6C.05 Transition Area

When redirection of the road users’ normal path is required, they shall be directed from the normal path to a new path.

¶ 3 ... impractical in mobile operations ... arrow boards ... message signs ... strobe lights

Source: TTI-LLC
Notes

• Emphasize paragraph 3. Taper of cones with no arrow board are used, strobes on a shadow vehicle in a passing zone ... are all allowable within the language of the MUTCD when being applied with engineering judgment. The key to this training is using engineering judgment to develop standard operating procedures which detail under what conditions the engineer allows specified activities.

• Proper use and visibility of strobes is often problematic when used in conjunction with arrow boards and crash attenuators. Training programs should discuss these issues.
Implementing the MUTCD

Addressing Site Conditions

• 6C.06 Activity Area

¶ 2 The work space is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream.

Source: TTI-LLC
Notes

• The fire truck is being used as a blocking vehicle in this incident scene.

• Notice how it is angled away from traffic. If struck it will roll into the guardrail, and not back into traffic.

• Wheels can also be turned towards the shoulder – guardrail to reduce roll ahead distance.

• Also notice how personnel are sitting on the guardrail near the front of the blocking vehicle.

• Someone may notice the law enforcement not wearing high-visibility apparel.
Implementing the MUTCD

Addressing Site Conditions

• 6C.06 Activity Area

¶ 6 The buffer space is a lateral and/or longitudinal area that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle.

¶ 7 Neither work activity nor storage of equipment, vehicles, or material should occur within a buffer space.

Source: ARTBA, TTI-LLC
Notes

• Emphasize that nothing should be in the buffer space. It is for vehicle recovery. The term should is also used. A shadow vehicle in lieu of buffer space may be an acceptable option depending on the field conditions: Lack of adequate distance to establish a buffer space. More commonly seen in urban settings. A shadow vehicle in the work space (hatched area) is also a good practice for road users that lose control of their vehicle.
Look at Figure 6C-2

Source: MUTCD

Source: TTI-LLC

Lateral Buffer Space

Work on the lane line typically requires an additional lane or “encroachment” for improved safety.
Notes

• Look at Figure 6C-2 in the National MUTCD
• Further Explain Longitudinal Buffer Space. Considering taking additional room for further separation of traffic and work.
• Broken debris is crossing the lane line and creates risk for the road users. Roadway pavement marker work at the lane line is an activity that has a high amount of risk for the worker.
• Indicate that tapers and termination are upcoming topics and identify them this Figure.
• Indicate that lane shifts are not defined in the National MUTCD beyond this Figure, but are an important option for work zones.
Look at Table 6C-2

Table 6C-2. Stopping Sight Distance as a Function of Speed

<table>
<thead>
<tr>
<th>Speed*</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mph</td>
<td>115 feet</td>
</tr>
<tr>
<td>25 mph</td>
<td>155 feet</td>
</tr>
<tr>
<td>30 mph</td>
<td>200 feet</td>
</tr>
<tr>
<td>35 mph</td>
<td>250 feet</td>
</tr>
<tr>
<td>40 mph</td>
<td>305 feet</td>
</tr>
<tr>
<td>45 mph</td>
<td>360 feet</td>
</tr>
<tr>
<td>50 mph</td>
<td>425 feet</td>
</tr>
<tr>
<td>55 mph</td>
<td>495 feet</td>
</tr>
<tr>
<td>60 mph</td>
<td>570 feet</td>
</tr>
<tr>
<td>65 mph</td>
<td>645 feet</td>
</tr>
<tr>
<td>70 mph</td>
<td>730 feet</td>
</tr>
<tr>
<td>75 mph</td>
<td>820 feet</td>
</tr>
</tbody>
</table>

posted speed, 85th percentile ... anticipated operating speed

Use caution selecting the distance.
Distance = Longitudinal Buffer Space & Stopping Sight Distance

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed

Source: MUTCD
Notes

• Look at Table 6C-2 in the National MUTCD
• Design speed, speed limit, 85th percentile ... are not applied consistently. Using engineering judgment, clearly defining the speed to be used as well as training on use is critical to appropriate field application.
# Minnesota Decision Sight Distance

## Temporary Traffic Control Distance Charts

<table>
<thead>
<tr>
<th>Posted Speed Limit Prior to Work Starting (mph)</th>
<th>Advance Warning Sign Spacing (A) feet</th>
<th>Decision Sight Distance (D) feet</th>
<th>Taper Length (12 ft lane) (L) feet</th>
<th>Shifting Taper (12 ft lane) (L/2) feet</th>
<th>Typical Shoulder Taper (L/3) feet</th>
<th>Buffer Space (B) feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30</td>
<td>100</td>
<td>550</td>
<td>200</td>
<td>100</td>
<td>75</td>
<td>200</td>
</tr>
<tr>
<td>35-40</td>
<td>325</td>
<td>700</td>
<td>325</td>
<td>175</td>
<td>125</td>
<td>305</td>
</tr>
<tr>
<td>45-50</td>
<td>600</td>
<td>900</td>
<td>600</td>
<td>300</td>
<td>200</td>
<td>425</td>
</tr>
<tr>
<td>55</td>
<td>750</td>
<td>1200</td>
<td>700</td>
<td>350</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>60-65</td>
<td>1000</td>
<td>1400</td>
<td>800</td>
<td>400</td>
<td>275</td>
<td>650</td>
</tr>
<tr>
<td>70-75</td>
<td>1200</td>
<td>1600</td>
<td>900</td>
<td>450</td>
<td>300</td>
<td>820</td>
</tr>
</tbody>
</table>

**Source:** Minnesota Temporary Traffic Control Field Manual, 2018

**Note:**
- G=25’ for 0 to 20 mph not 1x
- G=50’ for 45 mph not 1x – could use 20’ and 40’ to match skips
NOTE:
EXERCISE CARE WHEN PLACING "LIGHTED ARROW" ON VERTICAL OR HORIZONTAL CURVES. ADJUST ALIGNMENT OF "LIGHTED ARROW" TO ALLOW MAIN BEAM OF LAMPS TO BE SEEN BY DRIVER FOR MAXIMUM EFFECTIVENESS.

USE OF LIGHTED ARROW ON A HILL OR CURVE

Source: Michigan DOT Maintenance Work Zone Traffic Control Guidelines 2007
NOTE:
EXERCISE CARE WHEN PLACING "LIGHTED ARROW" ON VERTICAL OR HORIZONTAL CURVES. ADJUST ALIGNMENT OF "LIGHTED ARROW" TO ALLOW MAIN BEAM OF LAMPS TO BE SEEN BY DRIVER FOR MAXIMUM EFFECTIVENESS.

Source: Michigan DOT Maintenance Work Zone Traffic Control Guidelines 2007
This table is a useful inclusion in a SOP Manual

<table>
<thead>
<tr>
<th>Speed in Miles Per Hour</th>
<th>Distance Between Signs**</th>
<th>Buffer Space Stopping Sight Distance in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 x Speed Limit Urban Min</td>
<td>8 x Speed Limit Urban Max Rural Min</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>160</td>
</tr>
<tr>
<td>25</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>30</td>
<td>120</td>
<td>240</td>
</tr>
<tr>
<td>35</td>
<td>140</td>
<td>280</td>
</tr>
<tr>
<td>40</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>45</td>
<td>180</td>
<td>360</td>
</tr>
<tr>
<td>50</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>55</td>
<td>220</td>
<td>440</td>
</tr>
<tr>
<td>60</td>
<td>240</td>
<td>480</td>
</tr>
<tr>
<td>65</td>
<td></td>
<td>520</td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>560</td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>600</td>
</tr>
</tbody>
</table>

Source: TTI-LLC, Calculated from the MUTCD
Implementing the MUTCD

Addressing Site Conditions

• 6C.07 Termination Area

¶ 2 “An END ROAD WORK sign, ... may be used to inform road users that they can resume normal operations.”
Notes

• Emphasize how delineating the end of work can help improve respect for the work zone and associated speeds.
• We discussed earlier how increased signing increases risk for the workers and balancing that risk is an important consideration.
• With that said, improving road user respect for TTC could be improved using end work signs; especially, if work zone speed limits are established.
• School zone speed limits and associated signing are an example of this concept.
Image Source: For construction pros: Modified
Notes

• Note the end painting sign is on the lead vehicle in the convoy, so once the road user passes this vehicle, the work has ended.

• This is an excellent method to incorporate the end road work sign in a mobile operation.
Let’s modify our previous patching image

Source: TTI-LLC
Modified
Notes

• Here is another example of a method to help road users understand where the work is being performed and when they are past it.

• Some of the images show blue strobes to the rear. Some states have modified their code to allow use of colors other than amber in these situations.
Implementing the MUTCD

Addressing Site Conditions

- 6C.08 Tapers (Figure 6C-2 Shows the Types)

¶1 Whenever tapers are to be used in close proximity to an interchange ramp, crossroads, curves or other influencing factors, the length of the tapers may be adjusted.

Notes

• Example public road approach work zone closure, “Work Zone Traffic Control,” 2009, NYSDOT, TAST-C8UL

• Discuss NYSDOT SOP showing cones closing off the activity area.

• These cones serve multiple purposes. To keep the motorists turning from the crossroad from entering the activity area as well as notifying a motorist that has inadvertently entered the activity area that that area is closed off.

• Many jurisdictions add devices across the activity area specifically for the purpose of notifying an errant vehicle they are in the wrong space.
NYSDOT
WORK ZONE TRAFFIC CONTROL

SHORT-TERM STATIONARY OPERATION INVOLVING RIGHT LANE CLOSURE THRU INTERSECTION (CURBED OR NO SHOULDER) ON LOW SPEED URBAN (30-40 mph) ONE-WAY CONVENTIONAL HIGHWAY

FEBRUARY 2009 TAST-C8UL
Notes

• Example public road approach work zone closure, “Work Zone Traffic Control,” 2009, NYSDOT, TAST-C8UL

• Note “Low Speed Urban (30-40mph)” is the NYSDOT designation.

• NYSDOT also shows 200’ as the minimum sign distance here.
“Downstream Taper”
Notes

• Iowa DOT Standard Road Plan TC-418  Lane Closure on Divided Highway

• “Downstream taper” per Iowa Standard, minimum of 5 devices.

• Downstream tapers have a allowable length between 50’ and 100’ per the MUTCD.
Implementing the MUTCD

Addressing Site Conditions

• 6C.08 Tapers

¶ 3 Longer tapers are not necessarily better than shorter tapers (particularly in urban areas with characteristics such as short block lengths or driveways) because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily

... observe driver performance

Source: TTI-LLC
Implementing the MUTCD

Addressing Site Conditions

• 6C.08 Tapers

4 The appropriate taper length \((L)\) should be determined using the criteria shown in Tables 6C-3 and 6C-4.

Table 6C-3. Taper Length Criteria for Temporary Traffic Control Zones

<table>
<thead>
<tr>
<th>Type of Taper</th>
<th>Taper Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merging Taper</td>
<td>at least (L)</td>
</tr>
<tr>
<td>Shifting Taper</td>
<td>at least 0.5 (L)</td>
</tr>
<tr>
<td>Shoulder Taper</td>
<td>at least 0.33 (L)</td>
</tr>
<tr>
<td>One-Lane, Two-Way Traffic Taper</td>
<td>50 feet minimum, 100 feet maximum</td>
</tr>
<tr>
<td>Downstream Taper</td>
<td>50 feet minimum, 100 feet maximum</td>
</tr>
</tbody>
</table>

Note: Use Table 6C-4 to calculate \(L\)

Table 6C-4. Formulas for Determining Taper Length

<table>
<thead>
<tr>
<th>Speed ((S))</th>
<th>Taper Length ((L)) in feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mph or less</td>
<td>(L = \frac{WS^2}{60})</td>
</tr>
<tr>
<td>45 mph or more</td>
<td>(L = WS)</td>
</tr>
</tbody>
</table>

Where: \(L\) = taper length in feet
\(W\) = width of offset in feet
\(S\) = posted speed limit, or off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in mph
Implementing the MUTCD

Addressing Site Conditions

• 6C.08 Tapers

¶ 6 A merging taper requires the longest distance because drivers are required to merge into common road space

Source: ARTBA, TTI-LLC
Implementing the MUTCD

Addressing Site Conditions

• 6C.08 Tapers

  ¶ 5 The maximum distance in feet between devices in a taper should not exceed 1.0 times the speed limit in mph.

• Section 6F.63 Channelizing Devices

  ¶ 8 The spacing between cones ... should not exceed a distance in feet equal to 1.0 times the speed limit in mph when used for taper channelization, and a distance in feet equal to 2.0 times the speed limit in mph when used for tangent channelization.

Source: TTI-LLC
Notes

• Since the device spacing is the maximum, devices at any speed above 40 mph could be spaced as shown for ease of installation.

• Additional devices can be added to improve safety and reduce the probability of an intrusion. As queues build and traffic slows, additional devices will assist in the channelization.
# Example SOP Inclusion

<table>
<thead>
<tr>
<th>Speed in Miles Per Hour</th>
<th>Distance Between Cones - Max. Taper 1 x Speed Limit Max.</th>
<th>Tangent 2 x Speed Limit Max.</th>
<th>12' Lane Example Merging Taper Length (L) in Feet</th>
<th>Shifting Taper Length (.5L) in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
<td>40</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>50</td>
<td>125</td>
<td>63</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>60</td>
<td>180</td>
<td>90</td>
</tr>
<tr>
<td>35</td>
<td>35</td>
<td>70</td>
<td>245</td>
<td>123</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>80</td>
<td>320</td>
<td>160</td>
</tr>
<tr>
<td>45</td>
<td>45</td>
<td>90</td>
<td>540</td>
<td>270</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>100</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td>55</td>
<td>55</td>
<td>110</td>
<td>660</td>
<td>330</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
<td>120</td>
<td>720</td>
<td>360</td>
</tr>
<tr>
<td>65</td>
<td>65</td>
<td>130</td>
<td>780</td>
<td>390</td>
</tr>
<tr>
<td>70</td>
<td>70</td>
<td>140</td>
<td>840</td>
<td>420</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
<td>150</td>
<td>900</td>
<td>450</td>
</tr>
</tbody>
</table>

Typical One-Lane Two-Way (Flagger) Taper 50' Min to 100' Max

Source: TTI-LLC

(Note: Some states cap the maximum at 50’ and 100’.)
### Example State Manual with Calculated Taper Table

Table 2. Taper Lengths

<table>
<thead>
<tr>
<th>Offset / Lane Width (ft)</th>
<th>Taper Length, L (ft)</th>
<th>Posted Speed Limit, mph (Prior to Work Zone)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>146</td>
</tr>
</tbody>
</table>

Providing examples & equations in a SOP allows flexibility in the field.

<table>
<thead>
<tr>
<th>Speed in Miles Per Hour</th>
<th>Distance Between Cones - Max.</th>
<th>12' Lane Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Taper 1 x Speed Limit Max.</td>
<td>Merging Taper Length (L) in Feet</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
<td>180</td>
</tr>
<tr>
<td>35</td>
<td>35</td>
<td>245</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>320</td>
</tr>
<tr>
<td>45</td>
<td>45</td>
<td>540</td>
</tr>
<tr>
<td>50</td>
<td>50</td>
<td>600</td>
</tr>
<tr>
<td>55</td>
<td>55</td>
<td>660</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
<td>720</td>
</tr>
<tr>
<td>65</td>
<td>65</td>
<td>780</td>
</tr>
<tr>
<td>70</td>
<td>70</td>
<td>840</td>
</tr>
<tr>
<td>75</td>
<td>75</td>
<td>900</td>
</tr>
</tbody>
</table>

Note: Use Table 6C-4 to calculate L.

Typical One-Lane Two-Way (Flagger) Taper 50' Min to 100' Max

Source: TTI-LLC

### Table 6C-3. Taper Length Criteria for Temporary Traffic Control Zones

<table>
<thead>
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<th>Type of Taper</th>
<th>Taper Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merging Taper</td>
<td>at least L</td>
</tr>
<tr>
<td>Shifting Taper</td>
<td>at least 0.5 L</td>
</tr>
<tr>
<td>Shoulder Taper</td>
<td>at least 0.33 L</td>
</tr>
<tr>
<td>One-Lane, Two-Way Traffic Taper</td>
<td>50 feet minimum, 100 feet maximum</td>
</tr>
<tr>
<td>Downstream Taper</td>
<td>50 feet minimum, 100 feet maximum</td>
</tr>
</tbody>
</table>

### Table 6C-4. Formulas for Determining Taper Length

<table>
<thead>
<tr>
<th>Speed (S)</th>
<th>Taper Length (L) in feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mph or less</td>
<td>L = (\frac{WS^2}{60})</td>
</tr>
<tr>
<td>45 mph or more</td>
<td>L = WS</td>
</tr>
</tbody>
</table>

Where:
- L = taper length in feet
- W = width of offset in feet
- S = posted speed limit, or off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed in mph

Source: FHWA, MUTCD
Implementing the MUTCD

Addressing Site Conditions

• 6C.08 Tapers

¶ 12 A downstream taper might be useful in termination areas to provide a visual cue to the driver that access is available back into the original lane ...

¶ 13 If used, a downstream taper should have a minimum length of 50 feet and a maximum length of 100 feet with devices spaced at a spacing of approximately 20 feet.

Remember ... these can help with long term deference
Let’s work a few problems

• The exercises are open book
• During the exercises
  • Please answer on your remote
  • Fill in the space on your answer sheet
  • Grade the answers as we go
  • Record your score at the bottom of the answer sheet
• Please do not write on the module exercise pages
  Also, please do not to work ahead on the other module exercises

(In the Instructor’s Documents)
Implementing Safe Work Zone Operations Strategies

End Module 2
Implementing the MUTCD & Addressing Site Conditions
Fundamental Principles, Speeds & Dimensions

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Implementing Safe Work Zone Operations Strategies

Module 3
Implementing the MUTCD & Addressing Site Conditions
One Lane – Two Way, Pedestrians & Worker Safety

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Addressing Site Conditions

- 6C.08 Tapers (Continued)

¶ 14 The one-lane, two-way taper is used in advance of an activity area that occupies part of a two-way roadway in such a way that a portion of the road is used alternately by traffic in each direction.

¶ 15 Traffic should be controlled by a flagger, Typical Application 10 (TA-10), temporary traffic control signal (if sight distance is limited) (TA-12), or a STOP or YIELD sign (TA-11).

A short taper having a minimum length of 50 feet and a maximum length of 100 feet with channelizing devices at approximately 20-foot spacing should be used to guide traffic into the one-lane section, and a downstream taper should be used to guide traffic back into their original lane.

See Figure 6C-3
Notes

• If time permits, look at Typical Applications 10, 11 and 12 in the MUTCD and discuss the differences and uses.
• Did anyone in the room know that TA-11 existed?
• Is anyone in the room comfortable using TA-11?
• Colorado DOT (CODOT) does not have TA-11 in their TTC guidelines, but both Iowa (IADOT) and Oregon DOTs (ORDOT) not only have the typical application, but their provide specific guidelines for its use which provides an excellent resource for the course participants to use in applying this Typical Application.
Figure 6C-3

Source: FHWA, MUTCD
“If the work space on a low-volume street or road is short and road users from both directions are able to see the traffic approaching from the opposite direction through and beyond the worksite, the movement of traffic through a one-lane, two-way constriction may be self-regulating.”

TA-11 Applicability Notes
A. Vehicular traffic volume is such that sufficient gaps exist for vehicular traffic that must yield.
B. ... and have sufficient visibility of approaching vehicles.

If conditions change flaggers may need to be added.
Notes

• Could discuss the benefits of using a yield sign.
• Getting flaggers off the road when conditions warrant.
• Freeing up personnel for other activities.
• Balancing risks.
Some states have additional guidance for use of self-regulating TTC zones. Here is an excerpt from “Managing Flagging Operations on Low Volume Roads.”

- When planning a self-regulating Temporary Traffic Control (TTC) Operation
  - Consult local jurisdictional requirements
  - Conduct a field investigation to assess sight distance
  - Assess traffic volumes
  - Monitor volumes during the work
  - Cease operations or add flaggers and appropriate signing if sufficient gaps no longer exist

- Example Specific State Department of Transportation (DOT) Constraints

<table>
<thead>
<tr>
<th>Iowa</th>
<th>Oregon</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td><strong>Limit</strong></td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td>Less Than 2000 Vehicles Per Day</td>
</tr>
<tr>
<td><strong>Work Space</strong></td>
<td>250’ or Less, 350’ Maximum from the beginning of the taper to the end of the termination</td>
</tr>
<tr>
<td><strong>Sight Distance</strong></td>
<td>Do not use if a no passing zone exists between the start of the taper and end of the termination</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>Short-term or Intermediate (3 days or less)</td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td>Less Than 400 Average Daily Traffic</td>
</tr>
<tr>
<td><strong>Work Space</strong></td>
<td>Less than 200 Feet</td>
</tr>
<tr>
<td><strong>Sight Distance</strong></td>
<td>More than 750 Feet at Each End</td>
</tr>
<tr>
<td><strong>Speed Limit</strong></td>
<td>40 Miles Per Hour and Below</td>
</tr>
</tbody>
</table>
Look at Typical Application 18

TA-18 Applicability Notes

1. This TTC plan shall be used only for low-speed facilities having low traffic volumes.

(< 40 Miles Per Hour?)

2. Where the work space is short, where road users can see the roadway beyond, and where volume is low, vehicular traffic may be self-regulating.

3. Where vehicular traffic cannot effectively self-regulate, one or two flaggers shall be used as illustrated.

If conditions change flaggers may need to be added.
Implementing the MUTCD

Addressing Site Conditions

• 6C.10 One-Lane, Two-Way Traffic Control

¶ 1 ... when traffic in both directions must use a single lane for a limited distance, movements from each end shall be coordinated. P05 “If the work space on a low-volume street or road is short and road users from both directions are able to see the traffic approaching from the opposite direction through and beyond the worksite, the movement of traffic through a one-lane, two-way constriction may be self-regulating.”

¶ 2 “When a one-lane, two-way TTC zone is short enough to allow a flagger to see from one end of the zone to the other, traffic may be controlled by either a single flagger or by a flagger at each end of the section.”
"Managing Flagging Operations ..." Example

6C.11 Flagger Method

¶ 3 “When a single flagger is used, the flagger should be stationed on the shoulder opposite the constriction or work space, or in a position where good visibility and traffic control can be maintained at all times.”

Source: TTI-LLC

Modified to Represent Single Flagger Control
Other considerations for engineers during plan development

MUTCD TA-10 modified to show single flagger

Provide specific instructions for use on horizontal or vertical curves
Notes

• Discuss language in the notes for TA-10 ... site distance, visibility of the flagger to traffic and of traffic to the flagger. Is the roadway straight from the flagger each direction to allow for adequate visibility and control.

• ¶ 1 For low-volume situations with short work zones on straight roadways where the flagger is visible to road users approaching from both directions, a single flagger, positioned to be visible to road users approaching from both directions, may be used (see Chapter 6E).
A flagger may be placed at a blind curve, crest of a hill, or other site obstruction where traffic might enter from other driveways or entrances to warn the Pilot Car that there may be oncoming traffic. When used, the flagger:

- Shall be located to clearly see traffic from both directions,
- Shall not be positioned in the open traffic lane,
- Shall have 2-way communications with the Pilot Car,
- Shall have a flagger paddle; and
- Should have a means to warn an errant driver such as an air horn.

4. **Consider distributing brochures to local businesses and residents detailing Pilot Car operations.**
Notes

• An example where a single flagger is used to supplement the plan at hills and curves.
• Notice the sign at the local access road that indicates that “Turning Traffic Follow Pilot Car” with no flagger. The MNDOT plan and notes have the entire drawing and complete set of notes. This is mentioned in the handout “Managing Flagging Operations on Low Volume Roads.”
What's wrong with this picture?

Source: TTI-LLC
Notes

• Discuss alternatives for handling this situation.
• If the signal changes to red on the main line, traffic turning right from the side road would be heading into traffic.
• Possibly close the side road as this town had easy access to the ends of the TTC zone where the flaggers were stationed.
• Is there enough room for two way traffic and no flaggers?
Implementing the MUTCD

Addressing Site Conditions

• Section 6C.12 Flag Transfer Method

  ¶ 2 The flag transfer method should be employed ... short length of a road ... 1 Mile or less

• Section 6C.13 Pilot Car Method

  ¶ 3 The PILOT CAR FOLLOW ME (G20-4) sign shall be mounted on the rear of the pilot vehicle.
  ¶ 4 A flagger shall be stationed on the approach to the activity area to control vehicular traffic until the pilot vehicle is available.

Image Source: MNDOT, “Minnesota Temporary Traffic Control Field Manual,” 2018
Pilot Vehicle Considerations

- Over extended lengths of road with hills and curves
  - A pilot vehicle may be necessary to control the motorists’ speed
  - Intersections may require flaggers
    - If not using a pilot vehicle
    - Or high volumes exist
  - In some cases, driveway and intersection traffic can be controlled with signage

Source: Texas Transportation Institute, Texas A&M University (TTI-TAMU) & Transportation Training Institute, LLC (TTI-LLC)

Source: Virginia DOT, Flagger Training Video, Cropped

Source: MIDOT & MRBA, Cropped
Low-Volume Access Point Considerations

“Evaluation of innovative devices to control traffic entering from low-volume access points.”

Texas Transportation Institute, Texas A & M University, (TTI-TAMU) 2014
By Melisa Finley, Praprut Songchitruksa and Srinivasa Sunkari

Describes methods to address intersecting roadways and driveways including the following:

- Use “barricades and cones to close low-volume access points;”
- “Visit property owners and residents to notify them of the changes in traffic control and what they should do when exiting their driveway;”
- Station “flaggers at all access points;” and
- Hold traffic at the access point until the pilot vehicle arrives.
Commonly Overlooked Language

Specific Reminders

• 6C15 Stop or Yield Control Method

¶ 2 “If the STOP or YIELD sign is installed for only one direction, then the STOP or YIELD sign should face road users who are driving on the side of the roadway that is closed for the work activity area.”

Source: “Quality Standards for Temporary Traffic Control Devices,” July 2013. Missouri DOT (MODOT), Modified
Implementing the MUTCD
Addressing Site Conditions

• 6D.01 & 6D.02 Pedestrian / Accessibility Considerations

¶ 3 “Advance notification of sidewalk closures shall be provided by the maintaining agency.”

¶ 4 “If the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.

Source: Pixabay, Creative Commons
Notes

• Notice the pedestrians looking down at their cameras and phones. Pedestrian distraction is another growing problem that needs consideration.
6D.01 Pedestrian Considerations - Detectable

Temporary truncated domes, optional based upon usage of cross-street.

Bypass width of 60 inches is preferred. If width is 48 inches, then at least one 60 x 60 inch passing space is required for every 200 feet.

Temporary curb ramp providing 12:1 (8%) slope or flatter and non-slip treatment added.

Ramp landing area providing 48 x 48 inch minimum area and 2% or flatter cross-slope.

5 device taper 25 feet long (1 stall), recommended when the closed area was used as an intermittent traffic lane or bypass lane.

Additional audible message devices may be needed for route information.
Notes

• This is an example of a longer term solution. Can discuss options for intermediate term such as curing a section of sidewalk or new curb ramp.

• A sidewalk detour may be a better intermediate term solution.
Implementing the MUTCD

Addressing Site Conditions

• 6D.01 Pedestrian Considerations

• ¶ 5 “If establishing or maintaining an alternate pedestrian route is not feasible during the project, an alternate means of providing for pedestrians may be used, such as adding free bus service around the project or assigning someone the responsibility to assist pedestrians with disabilities through the project limits.”

Look through ¶ 6-12, but these relate to longer term work.
Notes

• This is likely the best method for course participants to handle short duration, mobile and even short term TTC plans that impact pedestrians and pedestrians with disabilities; possibly event transit stops.
Implementing the MUTCD
Addressing Site Conditions (Building Const. in your Jurisdiction)

• 6D.01 Pedestrian Considerations

¶ 13 “Fencing should not create sight distance restrictions for road users. Fences should not be constructed of materials that would be hazardous if impacted by vehicles. Wooden railing, fencing, and similar systems placed immediately adjacent to motor vehicle traffic should not be used as substitutes for crashworthy temporary traffic barriers.”

Source: TTI-LLC
Notes

- THE FHWA website page regarding work zone devices provides additional information regarding the implementation of the MASH standards.
- The FHWA and AASHTO published a memorandum regarding the joint implementation of the Manual for Assessing Safety Hardware (MASH).
  - [https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/docs/memo_joint_implementation_agmt.pdf](https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/docs/memo_joint_implementation_agmt.pdf)

The following are key points from the mentioned memorandum:

- Agencies are urged to establish a process to replace existing highway safety hardware that has not been successfully tested to NCHRP Report 350 or later criteria.
- Agencies are encouraged to upgrade existing highway safety hardware to comply with the 2016 edition of MASH either when it becomes damaged beyond repair, or when an individual agency's policies require an upgrade to the safety hardware.
- For contracts on the National Highway System with a letting date after the dates below, only safety hardware evaluated using the 2016 edition of MASH criteria will be allowed for new permanent installations and full replacements:
  - December 31, 2017: w-beam barriers and cast-in-place concrete barriers
  - June 30, 2018: w-beam terminals
  - December 31, 2018: cable barriers, cable barrier terminals, and crash cushions
  - December 31, 2019: bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, and all other breakaway hardware
- Temporary work zone devices, including portable barriers, manufactured after December 31, 2019, must have been successfully tested to the 2016 edition of MASH. Such devices manufactured on or before this date, and successfully tested to NCHRP Report 350 or the 2009 edition of MASH, may continue to be used throughout their normal service lives.
- Regarding the federal-aid eligibility of highway safety hardware, after December 31, 2016:
  - FHWA will no longer issue eligibility letters for highway safety hardware that has not been successfully crash tested to the 2016 edition of MASH.
  - Modifications of eligible highway safety hardware must utilize criteria in the 2016 edition of MASH for re-evaluation and/or retesting.
  - Non-significant modifications of eligible hardware that have a positive or inconsequential effect on safety performance may continue to be evaluated using finite element analysis.
- Division Offices should discuss the MASH implementation agreement with state transportation agency partners and monitor the actions taken and progress towards the dates established in the agreement.
Implementing the MUTCD

Addressing Site Conditions (Building Const. in your Jurisdiction)

• 6D.01 Pedestrian Considerations

¶ 22 “Short intermittent segments of temporary traffic barrier shall not be used because they nullify the containment and redirective capabilities of the temporary traffic barrier ...
Implementing the MUTCD

Addressing Site Conditions

• 6D.01 Pedestrian Considerations

¶ 15 Movement by work vehicles and equipment across designated pedestrian paths should be minimized ...

¶ 16 Access to the work space by workers and equipment across pedestrian walkways should be minimized ... pedestrians will tend to avoid these areas by attempting non-intersection crossings where no curb ramps are available.

Source: Pixabay, Creative Commons, Skeeze
Implementing the MUTCD

Addressing Site Conditions

• 6D.03 Worker Safety Considerations (Key Elements) ¶ 3
  
  – Training ... all workers trained how to work next to vehicle traffic, trained in Temporary Traffic Control techniques, device usage, and placement
  
  – Temporary Traffic Barriers
  
  – Speed Reduction ... reducing speed of vehicular traffic-regulatory speed zoning, funneling, lane reduction, or law enforcement
  
  – Activity Area ... planned internal work activity are to minimize backing-up maneuvers ...

Preventing Runovers and Backovers – Training American Road and Transportation Builders Association (ARTBA) WorkZoneSafety.org
Notes

• We discussed training, barriers and speed reduction, but preventing runovers and backovers has been an area of focus for recent training.

• Being struck by an employer’s vehicle is the #1 killer of workers in work zones.

• Go through this section in detail. It is the foundation for many of the topics of discussion in this course.
Heavy and Highway Fatalities

Standard Industrial Code (SIC) 1611
Highway and Street Construction, Except Elevated Highways

Employer’s Vehicle Inside Work Area

- 40.7%
- 22.5%
- 17.8%
- 19.1%
- Other

Vehicle Entered Work Area

Other Traffic Crash

At 6:00 a.m. on April 14, 2017, an employee was riding on the back of a garbage truck. The employee jumped off the truck, slipped, and was run over by the garbage truck's tires.

Source: KSDOT “Behind the Vest”

Source: LaCrosse Tribune, Anne Jungen, 2014

Source: OSHA.gov
Notes

- Solid waste operations have different standards, but agencies and insurers attending may also be responsible for personnel in these situations. Having internal discussions relating to sanitation worker safety relating to both equipment and road users is also necessary.
- FHWA has similar statistics with breakdowns in different categories.
- The main point is that the #1 killer of workers is being struck by the employers equipment or vehicles.
- The #2 killer of workers is being struck by a road user.
- The #3 killer is a transportation incident (crash) which is also the #1 killer of workers in all industries nationally.

Worker Fatalities

- The following facts and statistics were obtained using data from a presentation on Injury Hazards in Road and Bridge Construction (PDF 12.4MB), Fatal Occupational Injuries at Road Construction Sites (PDF 413KB), and Census of Fatal Occupational Injuries, unless otherwise noted.
- Fatality Causes: The primary causes of worker fatalities in recent years were:
  - Runovers/backovers (often by dump trucks): 48%
  - Collision Between Vehicles/Mobile Equipment: 14%
  - Caught in Between/Struck by Construction Equipment and Objects: 14%
- Runovers/Backovers: Nearly half of worker fatalities are caused when workers are run over or backed over by vehicles or mobile equipment. More than half of these fatalities were workers struck by construction vehicles.
  - Between 2005 and 2010 runovers/backovers were the cause of an average of 48% of worker fatalities. In 2010 runovers/backovers were the cause of 43% of worker fatalities, a slight decline from 2009 (46%).
  - For these types of fatalities, between 2003 and 2007, more workers were struck and killed by construction vehicles (38%) than by cars, vans, and tractor-trailers (33%).
- Vehicle Collisions: The second most common cause of worker fatalities are collisions between vehicles/mobile equipment.
  - Between 2005 and 2010 this was the cause of an average of 14% of worker fatalities each year. In 2010 this was the cause of 19% of worker fatalities. This is a slight increase from 2009 (16%).
- Caught in Between or Struck by Object: The third most common cause of worker fatalities are workers caught between or struck by construction equipment and objects.
  - Between 2005 and 2010 this was the cause of an average of 14% of worker fatalities. In 2010 this was the cause of 8% of worker fatalities. This is a decline from 2009 (16%) and the lowest reported number in recent years.
Solid Waste Resources


- National Waste & Recycling Association (NWRA) and Environmental Research & Education Foundation (EREF) have released the revised Manual of Recommended Safety Practices, https://wasterecycling.org/safety/safety-materials


- National Waste & Recycling Association and EREF have released the revised Manual of Recommended Safety Practices

- NIOSH Fact Sheet, https://www.cdc.gov/niosh/docs/2012-140/pdfs/2012-140.pdf

- NIOSH Alert, “Preventing Worker Injuries and Deaths From Moving Refuse Collection Vehicles,”


You can use your browser’s search engine to find these resources as well.
Notes

Since agencies and insurers attending may also be responsible for personnel in solid waste operations, this slide was included as a reference for further study by interested participants.

• Solid Waste Collection Resources including Runover and Backover Information
  – National Waste & Recycling Association and EREF have released the revised Manual of Recommended Safety Practices
  – NIOSH Fact Sheet, https://www.cdc.gov/niosh/docs/2012-140/pdfs/2012-140.pdf
  – NIOSH Alert, “Preventing Worker Injuries and Deaths From Moving Refuse Collection Vehicles,”
Notes

• Discuss the situation and alternatives. What if it was 45 MPH?

• Urban multi-lane roads can have speeds of 50, 55 and 60 MPH.

• Discussions with cities regarding best practices for this situation include use of shadow vehicles in these locations and self loading equipment.
How about this one?
Implementing the MUTCD

Addressing Site Conditions

• 6D.03 Worker Safety Considerations (Key Elements) ¶ 9

... additional elements ... that may be considered to improve worker safety:

- Shadow Vehicle
- Road Closure
- Law Enforcement Use
- Lighting
- Special Devices
  - Rumble strips
  - Changeable message signs
  - Hazard identification beacons
  - Flags
  - Warning lights
  - Intrusion warning devices

Misuse or overuse of special devices ... might lessen their effectiveness.
Notes

• The American Traffic Safety Services Association (ATSSA) has extensive guidelines available at WorkZoneSafety.org regarding the use of law enforcement in work zones.
Light Bars

1. At least one of the following three modes shall be provided:
   - **Flashing Arrow**: Move/Merge Right
   - **Sequential Arrow**: Move/Merge Right
   - **Sequential Chevron**: Move/Merge Right

2. The following mode shall be provided:
   - **Flashing Double Arrow**: Move/Merge Right or Left

3. At least one of the following three modes shall be provided:
   - **Flashing Four Corners**
   - **Flashing Bar**
   - **Alternating Flashing Diamonds**: Caution

---

**Panel Display**
(Element layout for Type C panel shown.)

**Panel Type** | Minimum Size (inches) | Minimum Legibility Distance (miles) | Minimum Number of Elements | Recommended Usage
--- | --- | --- | --- | ---
A | 48 x 24 | 0.50 | 12 | Low Speed Streets
B | 60 x 30 | 0.75 | 13 | Anything not covered in A or C
C | 96 x 48 | 1.00 | 15 | Freeways and Expressways

**Advance Warning Arrow Board Specification**
Figure 6K-6

**Arrow Stick**
Arrow Sticks may supplement other TTC devices, but shall not be used in place of arrow boards.

Source: TTI-LLC
Notes

• The “Minnesota Temporary Traffic Control Field Manual” indicates that the light bars are not to be used in place of an arrow board where required, but to supplement other devices.

• It time permits, discuss the effectiveness of light bars. Law enforcement use, tow truck use, fire truck use and when they would not be appropriate. IE, when required; but, the MUTCD provides a lot of flexibility based on durations, speed of traffic, volumes etc which would allow for a wide usage of light bars for some agencies and organizations.
Typical Traffic Control
Lane Closure on a Two-Lane Roadway Using Flaggers
(Figure TTC-23.1)

NOTES

Virginia Work Area Protection Manual
(Excerpt)

Standard:

14. When approved for use, three portable temporary rumble (PTRS) strips shall be installed across the entire travel lane adjacent to the BE PREPARED TO STOP (W3-4) sign. The portable temporary rumble strips shall be monitored and adjusted as necessary during the work shift to ensure proper placement on the roadway. When the PTRS are installed, the RUMBLE STRIPS AHEAD (W20-V26) sign shall also be utilized.

<table>
<thead>
<tr>
<th>Posted Speed</th>
<th>0 – 35 mph</th>
<th>36 – 55 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTRS Spacing (Center to Center)</td>
<td>5 Feet</td>
<td>8 Feet</td>
</tr>
</tbody>
</table>
Implementing the MUTCD

Addressing Site Conditions

• 6D.03 Worker Safety Considerations (Visibility) ¶ 4

All workers, including emergency responders, within the right-of-way who are exposed either to Traffic ... or to work vehicles and construction equipment within the TTC zone shall wear high-visibility (Hi-Vis) safety apparel that meets the Performance Class 2 or 3 requirements of the American National Standards Institute and the International Safety Equipment Association (ANSI/ISEA) Standard 107–2004 ... or equivalent revisions, and labeled ... except as provided in ¶ 5”
Notes

• Contrasting colors is also an important component of visibility.
Implementing the MUTCD

Addressing Site Conditions

• 6D.03 Worker Safety Considerations (Visibility)

¶ 6 When uniformed law enforcement personnel are used to direct traffic, to investigate crashes, or to handle lane closures, obstructed roadways, and disasters, high-visibility safety apparel as described in this Section shall be worn by the law enforcement personnel.

¶ 7 Except as provided in Paragraph 8, firefighters or other emergency responders working within the right-of-way shall wear high-visibility safety apparel as described in this Section.

¶ 8 Firefighters or other emergency responders working within the right-of-way and engaged in emergency operations that directly expose them to flame, fire, heat, and/or hazardous materials may wear retroreflective turnout gear that is specified and regulated by other organizations, such as the National Fire Protection Association (NFPA).
Notes

• We discussed training, barriers and speed reduction, but preventing runovers and backovers has been an area of focus for recent training.

• Being struck by an employer’s vehicle is the #1 killer of workers in work zones.

• Go through this section in detail. It is the foundation for many of the topics of discussion in this course.
Notice the contrasting colors and retroreflective striping on the fireman’s pants.
US Department of Labor, Occupational Safety and Health Administration (OSHA) Interpretation Letter # 20080829-8611

“... high-visibility apparel is required under the General Duty Clause to protect employees exposed to the danger of being struck by public and construction traffic while working in highway/road construction work zones. Typically, workers in a highway/road work zone are exposed to that hazard most of the time.” Richard E. Fairfax, Acting Director, Directorate of Construction, OSHA

Source: https://www.osha.gov/laws-regas/standardinterpretations/2009-08-05
Notice even on a building construction site that High Visibility (Hi-Vis) apparel is worn.

The runover / backover hazard even exists here with forklifts, concrete trucks etc.

Source: Pixabay, Creative Commons, Michael Gaida
Let’s work a few problems

- The exercises are open book
- During the exercises
  - Please answer on your remote
  - Fill in the space on your answer sheet
  - Grade the answers as we go
  - Record your score at the bottom of the answer sheet
- Please do not write on the module exercise pages
  Also, please do not to work ahead on the other module exercises
Implementing Safe Work Zone Operations Strategies

End Module 3
Implementing the MUTCD & Addressing Site Conditions
One Lane – Two Way, Pedestrians & Worker Safety

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Implementing Safe Work Zone Operations Strategies

Module 4
Implementing the MUTCD & Addressing Site Conditions
Flagging & Device Usage

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Flagger Control and TTC Devices

- Chapters 6E and F contain detailed information regarding flagger control and TTC devices.
  - Much of this information is covered in traditional MUTCD training.
  - The American Traffic Safety Services Association has developed training in flagging and responsibilities of temporary traffic control technicians and supervisors. Training in these topics is supported by the 2016 FHWA Work Zone Safety grant.

- This module focuses on details not often covered in traditional MUTCD training and will assist in implementing the language detailed in these sections as well as modifying operations to meet the specific needs of the site.
Implementing the MUTCD

Addressing Site Conditions

• Section 6E.03 Hand-Signaling Devices

¶ 1 The STOP/SLOW paddle should be the primary and preferred hand-signaling device because the STOP/SLOW paddle gives road users more positive guidance than red flags. Use of flags should be limited to emergency situations.
Implementing the MUTCD

Addressing Site Conditions

• Section 6E.03 Hand-Signaling Devices

¶ 5 The STOP/SLOW paddle may be modified to improve conspicuity by incorporating either white or red flashing lights on the STOP face, and either white or yellow flashing lights on the SLOW face.
Implementing the MUTCD

Addressing Site Conditions

- Section 6E.07 Flagger Procedures
  
  1. The use of paddles and flags by flaggers is illustrated in Figure 6E-3.
  
  2. Flaggers shall use a STOP/SLOW paddle, a flag, or an Automated Flagger Assistance Device (AFAD) to control road users approaching a TTC zone. The use of hand movements alone without a paddle, flag, or AFAD to control road users shall be prohibited except for law enforcement personnel or emergency responders at incident scenes as described in Section 6I.01.

Incident scene exemption
Implementing the MUTCD

Addressing Site Conditions

• Section 6E.07 Flagger Procedures ¶ 3

A. To stop road users, the flagger shall face road users and aim the STOP paddle face toward road users in a stationary position with the arm extended horizontally away from the body. The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.
Notes

• This and the following two slides discuss the flagger’s position. The MUTCD language indicates that the flagger should face traffic. The definition of “to face” indicates that the face is looking at the traffic being stopped. Best practices and written guidance in the British Columbia Traffic Management Manual indicate that the best position for the flagger is to have the body facing the centerline allowing the face to turn from facing stopped traffic to facing on-coming traffic from the opposite direction as well as the work zone and potential pedestrians, driveways, etc in the area of the work zone.
Implementing the MUTCD

Addressing Site Conditions

What happens between stop and proceed?

• Have body face the stop slow paddle.
• Watch both directions for traffic, driveways, pedestrians.

Does this give us flexibility?

Turn face to face traffic for stop or proceed signals.

Google Dictionary

“verb, 1. be positioned with the face or front toward (someone or something).”
Section 5: Traffic Control Persons (TCPs)

5.6.5 TCP Signals

TCP signals shall comply with the specifications described and illustrated in Part 18 of WorkSafeBC’s Occupational Health and Safety Regulation:

http://www2.worksafebc.com/publications/ohsregulation/part18.asp

1. Signal for Stopping Traffic

1. Position yourself in a safe position. See 5.6.2 Positioning Rules for TCPs.

2. Stand on the roadway shoulder, with toes pointing towards the centre of the road, and hold the paddle out to stop the first vehicle. Always display the paddle in a static manner. Move to the centreline only if necessary, and hold the paddle so that it is visible to traffic.

3. Stand where you can see, and be seen by, approaching drivers from a sufficient distance to stop safely (at least 150 metres).
What about a single flagger in an emergency situation

Get traffic stopped

Source: TTI-LLC
How do you alternate directions with a flag?

- Make sure they stay stopped.
- Keep the flag displayed.
- Wave through the other direction.

Source: TTI-LLC
To switch directions:
- Hold the flag straight out and stop traffic.
- Make sure they stay stopped.
- Switch hands and keep the flag displayed to the stopped traffic.
- Wave through the waiting traffic.
Implementing the MUTCD

Addressing Site Conditions

- Section 6E.08 Flagger Stations

¶ 1 Flagger stations shall be located such that approaching road users will have sufficient distance to stop at an intended stopping point.

... stopping sight distance as a function of speed, may be used for the location of a flagger station.

Table 6E-1. Stopping Sight Distance as a Function of Speed

<table>
<thead>
<tr>
<th>Speed*</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mph</td>
<td>115 feet</td>
</tr>
<tr>
<td>25 mph</td>
<td>155 feet</td>
</tr>
<tr>
<td>30 mph</td>
<td>200 feet</td>
</tr>
<tr>
<td>35 mph</td>
<td>250 feet</td>
</tr>
<tr>
<td>40 mph</td>
<td>305 feet</td>
</tr>
<tr>
<td>45 mph</td>
<td>360 feet</td>
</tr>
<tr>
<td>50 mph</td>
<td>425 feet</td>
</tr>
<tr>
<td>55 mph</td>
<td>495 feet</td>
</tr>
<tr>
<td>60 mph</td>
<td>570 feet</td>
</tr>
<tr>
<td>65 mph</td>
<td>645 feet</td>
</tr>
<tr>
<td>70 mph</td>
<td>730 feet</td>
</tr>
<tr>
<td>75 mph</td>
<td>820 feet</td>
</tr>
</tbody>
</table>

* Posted speed, off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed

Source: FHWA, MUTCD
Implementing the MUTCD

Addressing Site Conditions

• Section 6E.08 Flagger Stations

¶ 3 Flagger stations should be located such that an errant vehicle has additional space to stop without entering the work space. The flagger should identify an escape route that can be used to avoid being struck by an errant vehicle.
Implementing the MUTCD

Addressing Site Conditions

• Section 6E.08 Flagger Stations

¶ 4 Except in emergency situations, flagger stations shall be preceded by an advance warning sign or signs.

Except in emergency situations, flagger stations shall be illuminated at night.

Source: ARTBA
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.05 Regulatory Sign Authority

  ¶ 1 Regulatory signs such as those shown in Figure 6F-3 inform road users of traffic laws ...
  ¶ 2 Regulatory signs shall be authorized by the public agency or official having jurisdiction ...

• Section 6F.07 Regulatory Sign Applications

  ¶ 1 If a TTC zone requires regulatory measures different from those existing, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary regulatory signs. This change shall be made in compliance with applicable ordinances or statutes of the jurisdiction.

• Section 4D.01 General

  ¶ 1 When a traffic control signal is not in operation, such as before it is placed in service, during seasonal shutdowns, or when it is not desirable to operate the traffic control signal, the signal faces shall be covered, turned, or taken down to clearly indicate that the traffic control signal is not in operation.
Notes

• Additional MUTCD language regarding failure of a signal.

Section 4D.02 Responsibility for Operation and Maintenance
¶ 1 Provide for alternate operation of the traffic control signal during a period of failure, using flashing mode or manual control, or manual traffic direction by proper authorities as might be required by traffic volumes or congestion, or by erecting other traffic control devices;
Implementing the MUTCD

Addressing Site Conditions

Source: TTI-LLC

Source: MIDOT & MRBA
Commentary on covering signals:

- **Short duration and mobile:**
  - Law enforcement can direct traffic through the intersection; although, there is risk for the officer, workers and motorists regarding conflicting signals, operational signal heads and advance warning.
  - FHWA interpretation reminds operational planners that law enforcement are not flaggers and flaggers do not have the flexibility or authority of law enforcement.
  - The MUTCD indicates heads shall be covered when switched off. Flaggers in most cases are not allowed to flag motorists past an existing regulatory device; although, flaggers could stop traffic for the operation and release traffic to then be controlled by the regulatory device.
    - Best Practice: Turn signals to red flash which means stop, so the signal is not switched off.
    - Stop traffic prior to the intersection with flaggers, once the operation is complete, release the traffic. May need to move off, allow traffic through and move back out depending on duration and scope of activities.
  - Remember that the MUTCD allows reduced numbers of devices and effort if strobes are used to minimize worker exposure for short duration and mobile operations.
  - Switching off the signal heads and bagging for a short duration or mobile operation would cause more exposure to workers, thus would not be recommended.

- **Intermediate and long duration operations:** Cover the signal heads

- **Short term:**
  - The MUTCD indicates heads shall be covered when switched off. Flaggers in most cases are not allowed to flag motorists past an existing regulatory device; although, flaggers could stop traffic for the operation and release traffic to then be controlled by the regulatory device.
    - IE Turn signals to red flash which means stop.
    - Stop traffic prior to the intersection with flaggers, once the operation is complete, release the traffic. May need to move off, allow traffic through and move back out depending on duration and scope of activities.
  - Remember that the MUTCD allows reduced numbers of devices and effort if strobes are used to minimize worker exposure for short duration and mobile operations.
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.16 Warning Sign Function, Design, and Application

4 Mounting or space considerations may justify a change from the standard diamond shape.
Implementing the MUTCD

Addressing Site Conditions

- Section 6F.16 Warning Sign Function, Design, and Application

¶ 3 Warning signs used for TTC incident management situations may have a black legend and border on a fluorescent pink background.

¶ 5 In emergencies, available warning signs having yellow backgrounds may be used if signs with orange or fluorescent pink backgrounds are not at hand.
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.17 Position of Advance Warning Signs

¶ 2 Where multiple advance warning signs are needed on the approach to a TTC zone, the ROAD WORK AHEAD (W20-1) sign should be the first advance warning sign encountered by road users.

¶ 3 Various conditions, such as limited sight distance or obstructions that might require a driver to reduce speed or stop, might require additional advance warning signs.

¶ 4 As an alternative to a specific distance on advance warning signs, the word AHEAD may be used.
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.17 Position of Advance Warning Signs

¶ 5 At TTC zones on lightly-traveled roads, all of the advance warning signs prescribed for major construction might not be needed.

¶ 6 Utility work, maintenance, or minor construction can occur within the TTC zone limits of a major construction project, and additional warning signs may be needed.

¶ 7 Utility, maintenance, and minor construction signing and TTC should be coordinated with appropriate authorities so that road users are not confused or misled by the additional TTC devices.
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.60 Portable Changeable Message Signs (PCMSs)
  ¶ 11 Portable changeable message signs (PCMS) should be visible from 1/2 mile under both day and night conditions.
  ¶ 15 For portable changeable message signs mounted on service patrol trucks or other incident response vehicles, a letter height as short as 10 inches may be used.
  ¶ 16 The portable changeable message sign may vary in size.

• Section 6F.61 Arrow Boards
  ¶ 26 A portable changeable message sign may be used to simulate an arrow board display.

Source: TTI-LLC
Notes

• This section is called out because of the importance of portable changeable message signs. It details the minimum requirements for truck mounted portable changeable message signs (PCMSs) which may be a consideration for course participants.
Implementing the MUTCD

Addressing Site Conditions

- Section 6F.60 Portable Changeable Message Signs (PCMSs)

¶ 15 ... Shorter letter sizes may also be used on a portable changeable message sign used on low speed facilities (<40MPH) provided that the message is legible from at least 650 feet.

¶ 16 The portable changeable message sign may vary in size.

<table>
<thead>
<tr>
<th>Series Model Number</th>
<th>Cabinet Dimensions</th>
<th>Character Height</th>
<th>Display Matrix</th>
<th>No. of Lines</th>
<th>No. of Chars./Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>1020A-4</td>
<td>75”x31”x5”</td>
<td>10”</td>
<td>Character</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>1020F-4</td>
<td>75”x31”x5”</td>
<td>10”</td>
<td>Full</td>
<td>1-2</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: Florida DOT, Approved Product List & Litesys.com
Implementing the MUTCD

Source: FHWA, MUTCD
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.61 Arrow Boards

¶ 2 An arrow board in the arrow or chevron mode should be used to advise approaching traffic of a lane closure along major multi-lane roadways in situations involving heavy traffic volumes, high speeds, and/or limited sight distances, or at other locations and under other conditions where road users are less likely to expect such lane closures.

¶ 3 If used, an arrow board should be used in combination with appropriate signs, channelizing devices, or other TTC devices.

Source: FHWA, MUTCD
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.61 Arrow Boards

¶ 4 An arrow board should be placed on the shoulder of the roadway or, if practical, farther from the traveled lane. It should be delineated with retroreflective TTC devices.

¶ 20 Where the shoulder is narrow, the arrow board should be located in the closed lane.

Let’s look at 2 more slides & discuss this situation
Notes

• What’s wrong with this picture?
• What is the speed limit?
• The merge sign is too close to the arrow board.
• The taper is not long enough for a merging taper at any speed.
• The arrow board should have cones around it.
• There is a vehicle leaving the parking lot on the right with no way into the traffic lane.
Looking South
607’ S. of Intersection to the end of the taper.
Notes

• The speed limit is 45 MPH. That means a taper of 540’.

• The high speed urban sign spacing is 350’.
What options do we have here?

45 MPH, High Speed, 540’ Taper, 180’ to 360’ Sign Spacing,
Short term, but If a short day, could avoid rush hour and high volumes.

Source: Google Maps, 2018 and TTI-LLC
Notes

• Remember that the MUTCD allows signs to be spaced from 4x to 8x the speed limit for urban roads.
• The arrow board could still be set in the closed lane for more visibility. Remember to place cones around it.
• With 600’ from the intersection to the end of the taper, we can fit the 540’ taper for 45 MPH.
• We can add a merge sign just downstream of the intersection for turning traffic. They will be stopped or low speed turning.
• There is another 600 feet from the intersection upstream to the first driveway. We could set the 3 sign sequence with a 200’ spacing to exceed the minimum and give motorists time to merge prior to the intersection.
• Might also discuss cones for driveway access.
What about something like this?

Source: FHWA, MUTCD
Implementing the MUTCD

Addressing Site Conditions

- Section 6F.03 Sign Placement

¶ 1 Signs should be located on the right-hand side of the roadway unless otherwise provided in this Manual.

¶ 2 Where special emphasis is needed, signs may be placed on both the left-hand and right-hand sides of the roadway.

Signs mounted on portable supports may be placed within the roadway itself.

Remember, with limited right of way, signs can be placed in the lane.

¶ 8 Neither portable nor permanent sign supports should be located on sidewalks, bicycle facilities, or areas designated for pedestrian or bicycle traffic. (But, if mounted at the proper height and not restricting the useful width, could be considered with engineering judgment.)
Implementing the MUTCD

Addressing Site Conditions

- Section 6G.07 Work on the Shoulder with No Encroachment

¶ 8 When used for shoulder work, arrow boards shall operate only in the caution mode.

Lets talk through another one.

Flashlight Caution or Flashlight Caution or Alternating Diamond Caution

Guardrail Repair

>8’? Taper
Notes

• Some agencies do not allow the “straight bar” caution because it can be confused with an arrow. What about here?
TA-5 Shoulder Closure on a Freeway
(Barrier is optional)

Source: FHWA, MUTCD
What about taking a lane for safety?
(Transverse Buffer Space)

Source: TTI-LLC

Source: FHWA, MUTCD
Implementing the MUTCD

Addressing Site Conditions

• Section 6F.61 Arrow Boards

¶ 24 A vehicle displaying an arrow board shall be equipped with ... strobe lights.

Source: TTI-LLC
Implementing the MUTCD

Addressing Site Conditions

- Section 6F.63 Channelizing Devices
  ¶ 10 Warning lights (see Section 6F.83) may be added to channelizing devices in areas with frequent fog, snow, or severe roadway curvature, or where visual distractions are present.
Implementing the MUTCD

Addressing Site Conditions

- Section 6F.64 Cones

**Figure 6F-7. Channelizing Devices**

High Speed 45 and above
Low Speed 40 mph and below

Source: FHWA, MUTCD
Implementing the MUTCD

Addressing Site Conditions

- Section 6F.64 Cones

¶ 5 Steps should be taken to minimize the possibility of cones being blown over or displaced by wind or moving vehicular traffic.

¶ 6 Cones may be doubled up to increase their weight.
Implementing the MUTCD

Addressing Site Conditions

Do you have any work through the winter?
Let’s work a few problems

- The exercises are open book
- During the exercises
  - Please answer on your remote
  - Fill in the space on your answer sheet
  - Grade the answers as we go
  - Record your score at the bottom of the answer sheet
- Please do not write on the module exercise pages

(Information is in the Instructor’s Handout)
Implementing Safe Work Zone Operations Strategies

End Module 4
Implementing the MUTCD & Addressing Site Conditions
Flagging & Device Usage

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
Implementing Safe Work Zone Operations Strategies

Module 5
Implementing the MUTCD & Addressing Site Conditions Modifications, Mobile Ops and TAs

FHWA Grant Agreement DTFH6116RA00018 “2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.03 Location of Work ¶ 3

When the work space is within the traveled way, except for short-duration and mobile operations, advance warning shall provide a general message that work is taking place and shall supply information about highway conditions. TTC devices shall indicate how vehicular traffic can move through the TTC zone.

We have seen various durations for a stopped mobile operation, but appropriate TTC in accordance with this statement provides flexibility to appropriately handle mobile operations that may be stopped for longer durations.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.04 Modifications To Fulfill Special Needs

   2 Other devices may be added to supplement the devices provided in the typical applications, and device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.
Notes

- Section 6G.04 is critical for safe operations, modified to meet specific sight conditions. Used in conjunction with a standard operating procedure developed based on the fundamental principles in Section 6B.01, engineering judgment, the appropriate MUTCD and the resources identified in this training, will allow field personnel to appropriately implement and customize the plans necessary for their operations in accordance with the MUTCD and field conditions.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.04 Modifications To Fulfill Special Needs

¶ 3 When conditions are more complex, typical applications should be modified by giving particular attention to the provisions set forth in Chapter 6B and by incorporating appropriate devices and practices from the following list:

A. Additional devices
B. Upgrading of devices
C. Improved geometrics at detours or crossovers
D. Increased distances
E. Lighting
F. Pedestrian routes and temporary facilities
G. Bicycle diversions and temporary facilities
A. Additional devices:

1. Signs
2. Arrow boards

We saw in Module 4 the need for additional signs beyond the minimum in the TA.

Source: FDOT, Approved Product List & Litesys.com Modified

We saw how arrow boards in caution mode can improve the visibility of operations.

Another Commonly Added Sign
A. Additional devices: (Signs)

How can a flagger help a motorist understand where to stop?

There are a multitude of ways additional devices can improve both operation and safety.
A. Additional devices:

3. More channelizing devices at closer spacing (see Section 6F.74 for information regarding detectable edging for pedestrians)

There are a multitude of ways additional devices can better separate road users, pedestrians, bicycles and workers
A. Additional devices:

3. More channelizing devices at closer spacing

There are a multitude of ways additional devices can improve both operation and safety.

Source: MNDOT, “Minnesota Temporary Traffic Control Field Manual,” 2018

Source: TTI-LLC
Section 6: Traffic Control Layouts – General Instructions

Centre line delineation can prevent cars from moving into the oncoming lane too early.

Cars move over too early.

25-35m
A. Additional devices:

3. More channelizing devices at closer spacing
A. Additional devices:
3. More channelizing devices at closer spacing
A. Additional devices:

4. Temporary raised pavement markers
5. High-level warning devices

Figure 4.27: Pair of Flags on Sign

Remember that sign supports “shall be crashworthy,”
Section 6F.03 Sign Placement ¶ 15

Some tri-pod sign supports exist that have met crash testing requirements. Be sure to verify that any supports being used meet the crashworthiness requirements.
The FHWA website page regarding work zone devices provides additional information regarding the implementation of the MASH standards.

• https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/listing.cfm?code=workzone

The FHWA and AASHTO published a memorandum regarding the joint implementation of the Manual for Assessing Safety Hardware (MASH).

• https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/docs/memo_joint_implementation_agmt.pdf

The following are key points from the mentioned memorandum:

• Agencies are urged to establish a process to replace existing highway safety hardware that has not been successfully tested to NCHRP Report 350 or later criteria.

• Agencies are encouraged to upgrade existing highway safety hardware to comply with the 2016 edition of MASH either when it becomes damaged beyond repair, or when an individual agency’s policies require an upgrade to the safety hardware.

• For contracts on the National Highway System with a letting date after the dates below, only safety hardware evaluated using the 2016 edition of MASH criteria will be allowed for new permanent installations and full replacements:
  • December 31, 2017: w-beam barriers and cast-in-place concrete barriers
  • June 30, 2018: w-beam terminals
  • December 31, 2018: cable barriers, cable barrier terminals, and crash cushions
  • December 31, 2019: bridge rails, transitions, all other longitudinal barriers (including portable barriers installed permanently), all other terminals, sign supports, and all other breakaway hardware

• Temporary work zone devices, including portable barriers, manufactured after December 31, 2019, must have been successfully tested to the 2016 edition of MASH. Such devices manufactured on or before this date, and successfully tested to NCHRP Report 350 or the 2009 edition of MASH, may continue to be used throughout their normal service lives.

• Regarding the federal-aid eligibility of highway safety hardware, after December 31, 2016:
  • FHWA will no longer issue eligibility letters for highway safety hardware that has not been successfully crash tested to the 2016 edition of MASH.
  • Modifications of eligible highway safety hardware must utilize criteria in the 2016 edition of MASH for re-evaluation and/or retesting.
  • Non-significant modifications of eligible hardware that have a positive or inconsequential effect on safety performance may continue to be evaluated using finite element analysis.

• Division Offices should discuss the MASH implementation agreement with state transportation agency partners and monitor the actions taken and progress towards the dates established in the agreement.
A. Additional devices:

6. Portable changeable message signs

Source: FDOT, Approved Product List & Litesys.com Modified

Source: FDOT / Litesys - Modified

Source: FDOT, Approved Product List & Litesys.com Modified

Source: TTI-LLC
A. Additional devices:

7. Temporary traffic control signals (including pedestrian signals and accessible pedestrian signals)

6D.01 Pedestrian Considerations - Detectable
MN TTC Field Manual 2018
A. Additional devices:

7. Temporary traffic control signals (including pedestrian signals and accessible pedestrian signals)

Source: TTI-LLC

Source: FHWA, MUTCD

Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.
A. Additional devices:

7. Temporary traffic control signals (including pedestrian signals and accessible pedestrian signals)
A. Additional devices:

8. Temporary traffic barriers

Source: Wiki Creative Commons

Source: TTI-LLC
A. Additional devices:

9. Crash cushions

Source: TTI-LLC

Source: TTI-LLC

Source: Neal Carboneau, JTRP Modified
A. Additional devices:
10. Screens
11. Rumble strips
12. More delineation

Virginia Work Area Protection Manual
TTC 23.1

Source: Plastic Safety Systems
B. Upgrading of devices:
1. A full complement of standard pavement markings
2. Brighter and/or wider pavement markings
3. Larger and/or brighter signs
4. Channelizing devices with greater conspicuity
5. Temporary traffic barriers in place of channelizing devices

These are longer term solutions, but larger, brighter signs (fluorescent diamond grade) and larger cones (36”, 42” Grabber Cones) can improve visibility and compliance.
C. Improved geometrics at detours or crossovers

Detours are often safer than maintaining traffic and should be considered with difficult site conditions.

Source: FHWA, MUTCD
D. Increased distances: *(Base on operating speeds)*

1. Longer advance warning area
2. Longer tapers

<table>
<thead>
<tr>
<th>Speed in Miles Per Hour</th>
<th>Distance Between Signs**</th>
<th>Buffer Space Stopping Sight Distance in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 x Speed Limit Urban Min</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>100</td>
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<td>560</td>
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<tr>
<td>75</td>
<td>600</td>
<td></td>
</tr>
</tbody>
</table>

**Source: TTI-LLC, Calculated from the MUTCD**
E. Lighting:
1. Temporary roadway lighting
2. Steady-burn lights used with channelizing devices
3. Flashing lights for isolated hazards
4. Illuminated signs
5. Floodlights

*These strategies relate to night time operations as well as emergency operations that must be performed during inclement weather.*

*Use caution with lighting at night as glare from headlights, artificial lighting and even too many strobes can blind and distract motorists.*
Be cautious of too much lighting at a flagger station. The flagger here is becoming hard to see.
Notes

• Can remind the participants that arrow boards have daytime and nighttime settings. The arrow board shown has not switched to nighttime setting and is too bright for nighttime operations.

• Glare can impact both road users and workers. Caution should be used with artificial lighting, vehicle and equipment headlights as well as the number and intensity of strobes being used in nighttime operations.
F. Pedestrian routes and temporary facilities

The resources identified in the following course has excellent guidance for appropriately handling pedestrians and pedestrians with disabilities within the TTC zone should that be necessary.

Pedestrian Safety and Accessibility in Work Zones

American Traffic Safety Services Association (ATSSA)
G. Bicycle diversions and temporary facilities

The Minnesota Temporary Traffic Control (TTC) Field Manual is another excellent resource for pedestrian and bicycle accommodation should that be necessary for the operations being addressed.
Section 6G – H Review

The following slides contain content within section 6G that applies to the operations and topics discussed in this course.

When reviewing those sections, pay particular attention to the paragraphs called out here.
Notes

• The following slides are intended to emphasize language in Section 6G that corresponds with associated Typical Application. Notes in the Typical Applications should also be reviewed along with the language in Section 6G. If time is short, a few specific examples can be used and emphasis made to the group of the importance of the notes in application of the Typical Applications in the field.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.05 Work Affecting Pedestrian and Bicycle Facilities

Except for short duration and mobile operations, when a highway shoulder is occupied, a SHOULDER WORK (W21-5) sign should be placed in advance of the activity area. When work is performed on a paved shoulder 8 feet or more in width, channelizing devices should be placed on a taper having a length that conforms to the requirements of a shoulder taper. (Section 6G.07 Work on the Shoulder with No Encroachment)

Signs should be placed such that they do not narrow any existing pedestrian passages to less than 48 inches.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.06 Work Outside of the Shoulder
  ¶ 6 A general warning sign like ROAD MACHINERY AHEAD (W21-3) should be used if workers and equipment must occasionally move onto the shoulder.

  Typically for mowing operations, but for operations outside the shoulder with vehicles parked on the shoulder, the methods identified for < 8’ and 8’ and over would be appropriate.
Addressing Site Conditions

• Section 6G.08 Work on the Shoulder with Minor Encroachment

¶ 2 When work takes up part of a lane, vehicular traffic volumes, vehicle mix (buses, trucks, cars, and bicycles), speed, and capacity should be analyzed to determine whether the affected lane should be closed. Unless the lane encroachment permits a remaining lane width of 10 feet, the lane should be closed.

¶ 3 Truck off-tracking should be considered when determining whether the minimum lane width of 10 feet is adequate.

¶ 4 A lane width of 9 feet may be used for short-term stationary work on low-volume, low-speed roadways when vehicular traffic does not include longer and wider heavy commercial vehicles.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.10 Work Within the Traveled Way of a Two-Lane Highway

¶ 4 When an entire roadway is closed, as illustrated in Figure 6H-8, a detour should be provided and road users should be warned in advance of the closure, which in this example is a closure 10 miles from the intersection. If local road users are allowed to use the roadway up to the closure, the ROAD CLOSED AHEAD, LOCAL TRAFFIC ONLY (R11-3a) sign should be used. The portion of the road open to local road users should have adequate signing, marking, and delineation.

¶ 5 Detours should be signed so that road users will be able to traverse the entire detour route and back to the original roadway as shown in Figure 6H-9.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.11 Work Within the Traveled Way of an Urban Street

¶ 3 Pedestrian traffic needs separate attention
¶ 4 If the TTC zone affects the movement of bicyclists, adequate access to the roadway or shared-use paths shall be provided (see Part 9).
¶ 5 Where transit stops are affected or relocated because of work activity, both pedestrian and vehicular access to the affected or relocated transit stops shall be provided.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.11 Work Within the Traveled Way of an Urban Street

¶ 7 Worksites within the intersection should be protected against inadvertent pedestrian incursion by providing detectable channelizing devices.

¶ 8 Utility work takes place both within and outside the roadway to construct and maintain services such as power, gas, light, water, or telecommunications. Operations often involve intersections, since that is where many of the network junctions occur. The work force is usually small, only a few vehicles are involved, and the number and types of TTC devices placed in the TTC zone is usually minimal.

¶ 10 As discussed under short-duration projects, however, the reduced number of devices in utility work zones should be offset by the use of high-visibility devices, such as ... strobe lights on work vehicles or high-level warning devices.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.12 Work Within the Traveled Way of a Multi-Lane, Non-Access Controlled Highway

¶ 3 When a lane is closed on a multi-lane road for other than a mobile operation, a transition area containing a merging taper shall be used.

This is where the difference between short duration and mobile is important since the taper is required in other than mobile.

¶ 6 When the right lane is closed, TTC similar to that shown in Figure 6H-33 may be used for undivided or divided four-lane roads.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.12 Work Within the Traveled Way of a Multi-Lane, Non-Access Controlled Highway

¶ 7 If morning and evening peak hour vehicular traffic volumes in the two directions are uneven and the greater volume is on the side where the work is being done in the right-hand lane, consideration should be given to closing the inside lane for opposing vehicular traffic and making the lane available to the side with heavier vehicular traffic, as shown in Figure 6H-31.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.12 Work Within the Traveled Way of a Multi-Lane, Non-Access Controlled Highway

¶ 10 When only the left lane is closed on undivided roads, channelizing devices shall be placed along the center line as well as along the adjacent lane.

¶ 11 When an interior lane is closed, an adjacent lane should also be considered for closure to provide additional space for vehicles and materials and to facilitate the movement of equipment within the work space.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.13 Work Within the Traveled Way at an Intersection

¶ 3 TTC zones in the vicinity of intersections might block movements and interfere with normal road user flows. Such conflicts frequently occur at more complex signalized intersections having such features as traffic signal heads over particular lanes, lanes allocated to specific movements, multiple signal phases, signal detectors for actuated control, and accessible pedestrian signals and detectors.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.13 Work Within the Traveled Way at an Intersection

¶ 5 When work will occur near an intersection where operational, capacity, or pedestrian accessibility problems are anticipated, the highway agency having jurisdiction shall be contacted.

¶ 6 For work at an intersection, advance warning signs, devices, and markings should be used on all cross streets, as appropriate. The typical applications depict urban intersections on arterial streets. Where the posted speed limit, the off-peak 85th-percentile speed prior to the work starting, or the anticipated speed exceeds 40 mph, additional warning signs should be used in the advance warning area.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.13 Work Within the Traveled Way at an Intersection
  ¶ 9 When near-side work spaces are used, an exclusive turn lane may be used for through vehicular traffic.
  ¶ 10 Where space is restricted in advance of near-side work spaces, as with short block spacings, two warning signs may be used in the advance warning area, and a third action-type warning or a regulatory sign (such as Keep Left) may be placed within the transition area.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.14 Work Within the Traveled Way of a Freeway or Expressway

¶ 1 ... TTC zones on high-speed, high-volume roadways. Although the general principles outlined in the previous Sections of this Manual are applicable to all types of highways, high-speed, access controlled highways need special attention in order to accommodate vehicular traffic while also protecting road users and workers. The road user volumes, road vehicle mix (buses, trucks, cars, and bicycles, if permitted), and speed of vehicles on these facilities require that careful TTC procedures be implemented ... 

Other conditions exist where work must be limited to night hours, thereby necessitating increased use of warning lights, illumination of work spaces, and advance warning systems.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.14 Work Within the Traveled Way of a Freeway or Expressway

¶ 3 TTC for a typical lane closure on a divided highway is shown in Figure 6H-33. Temporary traffic controls for short duration and mobile operations on freeways are shown in Figure 6H-35.
Implementing the MUTCD

Addressing Site Conditions

- Section 6G.17 Interchanges

¶ 1 Access to interchange ramps on limited-access highways should be maintained even if the work space is in the lane adjacent to the ramps. Access to exit ramps should be clearly marked and delineated with channelizing devices.

Do you double the signs for short term operations?

What about short duration / mobile?
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.18 Work in the Vicinity of a Grade Crossing

¶ 1 When grade crossings exist either within or in the vicinity of a TTC zone, lane restrictions, flagging, or other operations shall not create conditions where vehicles can be queued across the tracks. If the queuing of vehicles across the tracks cannot be avoided, a uniformed law enforcement officer or flagger shall be provided at the crossing to prevent vehicles from stopping on the tracks, even if automatic warning devices are in place.

Early coordination with the railroad company or light rail transit agency should occur before work starts.
Implementing the MUTCD

Addressing Site Conditions

• Section 6G.19 Temporary Traffic Control During Nighttime Hours
• Section 6I.05 Use of Emergency-Vehicle Lighting

Review in depth if considering night time operations
Implementing Safe Work Zone Operations Strategies

End Module 5
Implementing the MUTCD & Addressing Site Conditions Modifications, Mobile Ops and TAs

FHWA Grant Agreement DTFH6116RA00018 “2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
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Implementing Safe Work Zone Operations Strategies

Module 6
Implementing the MUTCD & Addressing Site Conditions
Standard Operating Procedure & Manual Development

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”

Source: Transportation Training Institute, LLC (TTI-LLC)
Developing a Personalized Standard Operating Procedure (SOP) for Temporary Traffic Control (TTC) Zones

Principles of Standard Operating Procedures (SOPs), examining existing SOPs, & modifying SOPs for a tailored manual

Source: Transportation Training Institute, LLC (TTI-LLC)
Notes

- Additional information regarding the following slides can be found at:
Module Outline

- Principles of Standard Operating Procedures, SOPs
- Developing an SOP for TTC Zones
- Examine existing SOPs
- Modify SOPs, tailoring it to your individual work
- Developing a Manual
Benefits of Standard Operating Procedures

• Communicates intent to entire unit of workers
• Helps guides workers with consistent leadership
• Represents desired end state of work
• Allows subordinate employees to use discretion if decisions need to be made
• Identifies needed change:
  • Implement agency policy, enhance training, & evaluation of operations
Why Develop your own SOPs?

• SOPs are developed for tasks in an operating work zone
• Learning to develop your own detailed/personalized SOPs will:
  • Enable you to personalize expectations of work
  • Provide safety measures custom to job site
  • Allow you to design a manual to suit the needs of your workers, your goals, & the work activity

Source: Pixabay.com
Seven Principles of SOPs

1. Task Analysis
2. Developing SOP
3. Writing the SOP
4. Implementing SOP
5. Training Needs Assessment
6. Training Scheduling and Administration
7. Evaluation
Task Analysis

• Begin by asking basic questions about unit/crew
  • What areas of my work need SOPs?
  • What types of situations need to be clarified?
  • What process do I want my crew to use in ___situation?

• List factors that will influence your SOPs

Think of what influences the work zone
What factors could influence your SOPs?

• Discussion • Discussion
Notes

• Work activity
• Crew size
• Administrative hierarchy
• Weather
• Type of road
• Location (what’s near it)
• What obstacles could crew face during work
Steps to Developing the SOPs

1. Find knowledgeable individuals for development team
2. Provide organizational support
3. Establish team procedures
4. Gather information & identify alternatives
5. Analyze & select alternatives
6. Write the SOPs
7. Review & test
8. Ratify & approve
Notes

• Information from the following slides can be found in these resources:


• “Developing Standard Operating Procedures in Wildland Fire Management, “2003, Leadership Committee NWCG,
  • https://www.nwcg.gov/sites/default/files/wfldp/docs/sop-workbook.pdf

The Development Team

• May be a single person or more
• Usually includes members of overhead structure from crew
• Consider their/your knowledge:
  • Are you qualified to write this?
  • Do you know process details?
  • How could procedure go wrong?
  • How do you make SOP as safe as possible?
Analysis & Picking Alternatives

• Identify alternative procedures and select which is best for SOPs
• Most commonly used methods may not be necessarily best
• Consult your peers & crew for their valuable info
  • How did they handle specific situations
  • Share your SOPs with them

Source: Pixabay.com
Analysis & Picking Alternatives (cont.)

- Interview personnel for realistic information
  - Avoids inaccurate/unrealistic SOPs
  - Avoids discrediting the crew’s valuable knowledge
  - Ask how they execute the task
  - Can improve time, efficiency, & safety

Source: Pixabay.com
Questions to Ask During Development

• Is this proposed procedure realistic?
• Can the procedure be implemented given the current resources?
• Will training be required?
• Must equipment be procured?
• Does the procedure comply with agency policy & guidelines?
• How will this procedure impact individual crewmembers?
• Will the procedure survive outside scrutiny?
Writing the SOP

• Individual SOPs should be bound in a comprehensive manual

• Include:
  • **Numbering system:** Important for reference, usability, and integrating SOPs into a manual
  • **Effective date:** date SOP was officially adopted for use in field
  • **Expiration/Review Date:** important for ensuring the SOPs stay current and are periodically reviewed for any revision needed
  • **Title**

*Set a standardized format*
Choosing a Standardized Format

A Simple Steps Format:

ideal for routine, short procedures that have a limited number of outcomes. Essentially a bullet list of simple sentences explaining what to do.

Choosing a Standardized Format

A Hierarchal Format:

ideal for long procedures, (more than ten steps) involving decision making, clarification & terminology. Usually a list of steps with sub-steps to clarify
Choosing a Standardized Format

A Flowchart Format:
Ideal for a procedure more like a map, with infinite number of possible outcomes. Format best for unpredictable procedure results.
Writing the SOP (cont.)

• **Statement of Purpose**: why is the SOP needed and what is intended to be accomplished by it

• **Authority Signature(s)**: proves the SOP was properly created, reviewed, and approved by crew leader (or proper authority)

• **Scope**: Describes situations for which the SOP was created and the intended audience

**VIRGINIA WORK AREA PROTECTION MANUAL**

**INTRODUCTION**

Standard:

11. Traffic control devices shall be defined as all signs, signals, markings, and other devices used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, pedestrian facility, bikeway, or private road open to public travel (see definition in Section 1A.13 of the Virginia Supplement to the 2009 MUTCD) by authority of a public agency or official having jurisdiction, or, in the case of a private road, by authority of the private owner or private official having jurisdiction.
Writing the SOP (cont.)

- **General Procedures**: the main part of SOP should be setting broad guidelines for procedural operations

- **Specific procedures**: Specific actions needed under the SOP to safely handle a situation

- **References**: the sources used to create the SOP, also useful in future evaluations of SOP

Source:

Consider the Intended Audience

• Prior knowledge: Determine how familiar they are with existing procedure and terminology. Match your language & level of depth to their knowledge

• Language ability: Some members of the crew may not speak same language you’re writing in. Add lots of annotated pictures and diagrams

• Size: If a large group is reading SOP, write each role in a detailed and orderly fashion to represent their role as a integral cog in a machine

  • User 1: completes an action
  • User 2: follows User 1

Language Ability of Audience

- Breaking down text & including a picture can clarify complex ideas

- Intimidating ideas can be made easier to follow with the use of diagrams, flowcharts & examples

Source: 2009 MUTCD, FHWA
Source: Pixabay.com
The Procedure Itself: Scope/Capability

• Describe the purpose of the process, limits, & how it’s used
• Regulatory requirements, roles & responsibilities
• List all steps with any needed details
  • Equipment needed
• Address the “what ifs”
• Possible interferences
• Health & Safety steps- *Important to go into detail*

The Procedure Itself: Additional Information

• Clarify any acronyms, abbreviations, & phrases that aren’t common

• List any equipment & supplies needed
  • Where do you get equipment/supplies, standards for equipment/supplies

• A troubleshooting section, what could go wrong & how to deal with interference, what to look out for
  • Each topic should have own section

Test the SOPs

• Before implementing test out the SOPs
• Have a range of individuals test out procedure
• Different individuals can find different issues/responses
• Have individuals who will be doing the procedure test it out
  • Important to have their input
  • Will encourage them to accept the SOP when implemented
• Have a novice individual test SOPs to check validity/clarity
  • People with prior experience may rely on that & not SOPs

Proper Review of SOPs

• Reviewed by advisor, quality assurance team, or proper authority within organization
• Ensures SOPs meets formatting requirements
• Proper protocol needed to make SOPs official
• Use document management systems to ensure audit trails of approvals
• Proper signatures will be needed in most organizations

Remember to focus on SOPs target/purpose during development

- Ensure compliance standards are met
- Maximize production
- Ensure safety
- Ensure everything stays on schedule
- Ensure there are no adverse impacts on environment

Notes

• The information in next several slides are from the following resources:
  • “Developing Standard Operating Procedures in Wildland Fire Management, “2003, Leadership Committee NWCG,
  • https://www.nwcg.gov/sites/default/files/wfldp/docs/sop-workbook.pdf
Implementing the SOP

• Introducing the SOP to the user should ensure that:
  • Everyone is informed about new/modified SOP
  • Copies of SOP are distributed
  • Readily accessible to potential users
  • Personnel understand their roles
  • Personnel have knowledge & skills needed to carry out the SOP safely & effectively
    • Including understanding of consequences for failing to comply
  • A mechanism will:
    • Monitor performance, identify potential problems, & provide support
Training Needs Assessment

Consider the following:

• Who needs to be trained in the new/revised SOP?
• What content needs to be covered?
• What training methods will work best?
• Would a crew meeting suffice?

• How will understanding be evaluated?
• How long should training sessions last?
• How will training sessions be scheduled/administered?
Training Scheduling & Administration

- Training is most important part of implementation
- Level of depth depends on procedure
- Crew must understand SOPs
  - Can be dangerous or ineffective if under-trained
Preparing for Training

• Gather training materials

• Find qualified/knowledgeable instructor

• Organize needed facilities, equipment and supplies

• Schedule a timeframe for initial training & refresher training

• Can training be combined with other training or activities?

• Determine what records need to be kept
  • What kind of reports will this training require?
Evaluation

• Every SOP needs to be periodically reviewed

• More evaluations may be needed at the beginning

• Goal is to assess results of SOP
Assessing the New SOP

• What were employees behaviors/actions before the SOP was implemented?
• What administrative or operation problem was intended to be resolved by SOP?
• Was the SOP fully implemented or were there barriers to fulfilling implementation?
• How did employee behaviors/actions change after SOP?
• Where these changes intended?
• Was the purpose of the SOP accomplished?
• Is this SOP still currently needed?
SOP Examples:

Let’s look at and discuss the example manuals
Building the Ideal Manual

Standard operating procedures, important information, tables, & diagrams
Manuals Typically Include:

• **Title Page:** usually states organization, date of issue/revision, signatures of proper authority & general statement about manual’s purpose

• **Table of Contents:** Only required if manual is lengthy, allows for easy reference

• **Quality Assurance/quality control:** the mark of a good procedure is that it can be checked for quality. Includes descriptions of desired result of procedure

• **References/Resource Page:** a list of all cited work

Work Zone Traffic Control
New York State (NYS) DOT

A. The purpose of work zone traffic control is to provide a safe work area for workers within the roadway, while facilitating the safe and orderly flow of all road users (motorists, bicyclists and pedestrians including persons with disabilities in accordance with the Americans with Disabilities Act of 1990) through the work zone.

B. This manual is intended to provide New York State Department of Transportation (NYSDOT) employees, utility companies, municipalities, and contractors who are involved with the design, set-up and maintenance of highway work zones, or anyone working within the state right-of-way, with the basic principles and elements constituting a safe work zone. The information presented in this manual is based on the requirements set forth in the National Manual of Uniform Traffic Control Devices and the NYS Supplement, review of work zone manuals from a selection of state and federal agencies, and discussions with members of the NYSDOT Work Zone Traffic Control Committee.

C. This manual includes basic information on work zone traffic control, including a description of traffic control devices, illustrations of acceptable, commonly used devices, and the proper flagger attire and methods. Color diagrams depicting typical traffic control set-ups for two-lane and multilane highways are intended to provide guidance concerning the minimum requirements for a safe work zone set-up. Additional traffic control or protection can be added for situations that require additional measures such as high traffic or pedestrian volume, high speeds, restricted sight distance, poor or confusing alignment.

D. This is a “living document” that will evolve as recommendations are received from the Regions. Work zone traffic control typicals will be added, and deleted, as necessary, and all will be posted on the NYSDOT internet site (Work Zone Traffic Control Manual).

D. Please address any questions, comments, and/or recommendations regarding this manual to Charles Riedel, Deb Hartman or Lori Abeel, Office of Traffic Safety & Mobility, 518-457-3537.

Further information may be included as seen fit.
Table of Contents

• Only required if manual is lengthy
• Organization can help personnel find needed procedures
• Can help overall sequence of procedures

Source: National MUTCD
References Page

- List sources of information used in manual
- Can be a good resource for personnel
- (where to find more info)
- Typically written alphabetically by author/organization

Include:
- Author/Organization
- Publisher location
- Publication date
- Further contact info

Reference Source:
https://www.wikihow.com/Write-a-Works-Cited-Page
Difference in Resources

• Use multiple sources for a well-rounded manual
• Different states & organizations may have differences in:
  • Citing
  • Phrasing
  • Organization
  • Procedure
How to Write in the Manual

Source: https://www.wikihow.com/Write-a-Manual

• Write procedures & information in a sequence that makes sense
  • What will personnel need to know/do first?
  • Can be helpful to perform task to figure out logical sequence

• Write in a concise, but detailed manner
  • Pages should be easy to follow but include needed information
The principles listed below provide a guiding philosophy of good temporary traffic control and enhance the safety of motorists, pedestrians and workers near temporary traffic control zones.

- Make traffic safety and temporary traffic control an integral and high-priority element of every project from planning through design, construction, and maintenance.
- Inhibit traffic movement as little as possible.
- Provide clear and positive guidance to drivers and pedestrians as they approach and travel through the temporary traffic control zone.
- Inspect traffic control elements routinely and modify when necessary.
- Pay increased attention to roadside safety near temporary traffic control.
- Train all persons that select, place and maintain temporary traffic control devices.
- Establish proper legislative authority to implement and enforce needed traffic regulations, speed zoning, parking controls, and incident management.
- Keep the public well informed.
- If there is a side road intersection/driveway or ramp within the work area, additional traffic control, such as flaggers and appropriate signs, may be needed on the side road/driveway approaches or ramps.

Source: NYSDOT
Visualization in Manual

• Visuals, diagrams, & pictures aid comprehension of complex information

• Give personnel a helpful set up guide for signs, placement, etc.

• Make sure visuals are relevant, easy to read/follow

Reminder: Manual may be written in different language than personnel’s primary language, visual aids will improve their retention

NYS DOT
A detailed index can be a decision making tool
Manual Defines the Work Zone


• First advance warning sign & the point beyond work activity where traffic is no longer affected

• Traffic is moved from normal path by transition area

• Buffer space separates traffic from workers (no equipment, vehicles, or material shall be placed here)

• Protection vehicle area provides temporary barrier for worker safety

• Work area is set aside for workers, equipment, & material storage

• Taper areas allow traffic to transition gradually
Defining the Work Zone (cont.)

• Diagrams can be a useful mechanism
• Include all aspects of work zone
• Especially ones that will be affected by procedures
Flaggers

Flaggers must be trained in safe traffic control practices & public contact techniques

Flaggers need to:

• Receive and communicate specific instructions clearly, firmly & courteously
• Move & maneuver quickly in order to avoid danger from errant vehicles
• Control signaling devices to provide clear guidance to drivers approaching TTC zone
• Understand & apply safe traffic control practices, in stressful or emergency situations
• Recognize dangerous traffic situations & warn workers in time to avoid injury

Source: National MUTCD
How to Place Flaggers
(Typical Application Lane Closure on a Two-Lane Road)

- Single flagger may be used when visible to road users from both directions
- Flagger stations must be illuminated at night for visibility
- “Be Prepared to Stop” sign must be placed between flagger & “ONE LANE ROAD” sign
- Buffer space should be extended so two-way traffic taper is placed before any type of curve in road

Source: 2009 MUTCD, FHWA
How to Place Flaggers

*(Typical Application Lane Closure on a Two-Lane Road)*

- Flagger should be stationed on the shoulder opposite the construction or work zone where they have good visibility at all times.
- If good visibility cannot be maintained, one flagger should be placed at each end of work zone.
- One flagger should be designated as coordinator/lead.
- Flaggers must be able to communicate orally, electronically or with manual signals (not mistaken as flagging signals to traffic).


Source: Flicker.com
How to be a Flagger

- Certified (& up to date) in accordance with the American Traffic Safety Services Association
- Dress according to safety standards & high-visibility standards
- STOP/SLOW paddle will be primary hand-signaling device

Source: Virginia Work Area Protection Manual
W20-8 (V) 24"

TO LET TRAFFIC PROCEED

TO ALERT AND SLOW TRAFFIC

Source: Virginia Work Area Protection Manual
Shadow Vehicle Roll Ahead Distance

AASHTO Roadside Design Guide Shadow Vehicle Positioning

Could Add Cones Along the Centerline for Visibility

Can Turn Wheels to The Curb or Shoulder

<table>
<thead>
<tr>
<th>Shadow Vehicles Weighing 22,000 lbs or More</th>
<th>Operating Speed Limit</th>
<th>Stationary</th>
<th>Moving &lt; 15.5 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥ 55 MPH</td>
<td>150 Feet</td>
<td>172 Feet</td>
</tr>
<tr>
<td></td>
<td>45 - 50 MPH</td>
<td>100 Feet</td>
<td>150 Feet</td>
</tr>
<tr>
<td></td>
<td>&lt; 45 MPH</td>
<td>74 Feet</td>
<td>100 Feet</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Shadow Vehicles Weighing 9,900 lbs to 22,000 lbs</th>
<th>Operating Speed Limit</th>
<th>Stationary</th>
<th>Moving &lt; 15.5 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥ 55 MPH</td>
<td>172 Feet</td>
<td>222 Feet</td>
</tr>
<tr>
<td></td>
<td>45 - 50 MPH</td>
<td>123 Feet</td>
<td>172 Feet</td>
</tr>
<tr>
<td></td>
<td>&lt; 45 MPH</td>
<td>100 Feet</td>
<td>100 Feet</td>
</tr>
</tbody>
</table>

Graphics Source: ARTBA & TTI-LLC
Mobile and Short Duration Work

Rural or Urban Highway

• Short duration work
• Safety should not be compromised using fewer vehicles due to frequent location changes
• No vehicle, equipment, or workers should be in the buffer space/roll ahead distance
• Barrier vehicle shall be unoccupied dump truck with parking brake set & front wheels facing away from employees

• Example Language from the NYSDOT Manual

Mobile and Short Duration Work

Rural or Urban Highway

• Short duration work
• Safety should not be compromised using fewer vehicles due to frequent location changes
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• Barrier vehicle shall be unoccupied dump truck with parking brake set & front wheels facing away from employees
• Example Language from the NYSDOT Manual

Shadow Vehicles

High Speed Urban Highways (45-55 mph)

- No vehicle, equipment, or workers should be in the buffer space/roll ahead distance
- Barrier vehicle shall be unoccupied dump truck with parking brake set & front wheels facing away from employees
- In urban conditions warning signs may be reduced to 100ft. minimum

Shadow Vehicles
Freeway or Expressway Paved Shoulder Less than 8 Ft.

- No vehicle, equipment, or workers should be in the buffer space/roll ahead distance
- Shadow vehicle shall be unoccupied dump truck with parking brake set & front wheels facing away from employees

Conventional Roadway

- Mobile work is continuously moving or stopped for a brief period of time (less than 15 min)

- Mowing operations shall be scheduled & completed during daylight work shifts & have little interference with traffic

- Suspended under poor visibility or weather

- Mowers must have rotating amber beacon operating at all times

- Hard hat, eye protections, approved vests, shirts, or jackets, hearing protection & seat belts shall be worn at all times

- Advanced Warning Vehicle cannot encroach into travel lane

Proper Notation

Each page should have:
- Short title
- ID #
- Revision number
- Date
- Page # of #
- May or may not require footnote

Example: Oklahoma Forestry Services SOPs

By learning to create your own SOPs & Manual you are improving your work zone’s:

Safety
Effectiveness
Efficiency

Let’s Look Through the Examples in Your Handout
Post Test and Evaluation

- The test is open book
- During the post-test
  - Please answer on your remote
  - Fill in the space on your answer sheet
  - Grade the answers as we go.
  - Record the number you get correct on your bubble sheet and page 2 of the course evaluation
- Please do not write on the test pages
- Complete your evaluation
  - Please make a few comments on the 2nd page
  - We would like your opinion on the course
  - It will help us improve the course for future attendees
- Leave the following documents:
  - Post Test
  - Module Exercise Pages
  - Your 2 Answer Sheets
  - Your Evaluation
Evaluation

• During the evaluation
  • Please answer on your remote
  • Mark the answer on your evaluation
• Please comment on the written questions

The Post Test and Evaluations are in the Instructor’s Handout
Implementing Safe Work Zone Operations Strategies

Thank You for Being Here
and Good Luck with Your Implementation

FHWA Grant Agreement DTFH6116RA00018
“2016 Work Zone and Guardrail Safety Training Grants”
This Page Left Blank
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Course Instructions

• Sign In
  – In the morning

• Registration Form
  – Turn in at lunch

• Teach Back
  – Complete a teach back evaluation for each speaker and give it to them when they have finished
  – When you speak, the instructor will provide you an evaluation that gets recorded in the course records
  – Your name is not necessary on the participant evaluations

• Evaluation
  – Turn in your course evaluation at the end of the day
  – Please include comments on page 2
  – Your opinion is important to us

• At the end of the class
  – Turn in the course evaluation
Registration

(Please Print Clearly)

Enter your personal information (not work) for transferability

Name: ______________________________________________ (Include Middle Initial)

Home Address: ______________________________________________

____________________________________________

____________________________________________

Cell Phone: ______________________________________________

Email: ______________________________________________

ID Number: ______________________________________________

ID Type: ______________________________________________ (Drivers License, State ID... No Social Security Numbers)

Employer: ______________________________________________

Employer City & State: ______________________________________________

Position: ______________________________________________

Today’s Date: ______________________________________________

Class Sponsor: ______________________________________________

Class Location: ______________________________________________

Class Title: ______________________________________________

Instructor’s Name: ______________________________________________
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We strive to offer the best training available and your feedback helps us to continually improve.
Please take a few minutes to answer the questions and provide your feedback.

Your opinion matters.

<table>
<thead>
<tr>
<th>How would you rate the following:</th>
<th>Fair</th>
<th>Neutral</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your understanding of the topic before the course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Your understanding of the topic after the course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. The Trainer’s Understanding of the Topic</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. How interactive the trainer was with the class</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. The time available for questions and comments</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. The quality of the answers to the questions</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. The quality of the overall course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. How practical the course is</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. The quality of the handouts</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Usefulness of the materials for future reference</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. The quality of the facilities</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. The quality of the course administration</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13. How much you feel this training will benefit you</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. Likelihood you will implement these strategies</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15. Would you recommend this training to others</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Length of the Training:
- Too Short
- Short
- Just Right
- Long
- Too Long

Difficulty of the Training:
- Too Simple
- Simple
- Just Right
- Challenging
- Too Challenging

How this course compares to other similar courses you have taken:
- Much Worse
- Worse
- Similar
- Better
- Much Better

Please write a few comments on the next page.
Comments

What were some of the most helpful topics in the training?

What would you change about the training? (Instruction, PowerPoints, Handouts, Facilities, Administration ...)

What other training do you feel would be helpful?

Other comments, observations, suggestions:

Your Initials:  ________

Instructor: _______________________________    Instructor’s Signature:_____________________________