Developing Transportation Management Plans for Work Zones

RULE on WORK ZONE Safety and Mobility

Training Course

Participant Workbook

October 2012

U.S.Department of Transportation
Federal Highway Administration

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Technical Report Documentation Page

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15. Supplementary Notes **FHWA Project Leader-Tracy Scriba** **Ken Wood of FHWA also assisted significantly in the development of the course**		
16. Abstract **This participant workbook is part of the web-based training course "Developing Transportation Management Plans for Work Zones. The training course is intended to assist transportation agencies in developing an effective and complete work zone Transportation Management Plan (TMP). The workbook contains information on the course objectives and general overview of the course. The workbook is designed for note taking and as an additional resource for future use. The primary intended audience for this training is transportation agency staff, including technical staff, (planners, designers, traffic engineers, highway/safety engineers, etc); management and executive-level staff responsible for setting policy and program direction; field staff responsible for building projects and managing work zones; and staff responsible for assessing performance in these areas.**		
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Office of Operations

Table of Contents

I. Training Course Overview

The Work Zone Safety and Mobility Rule (Rule) was published on September 9, 2004 in the Federal Register. All State and local governments that receive Federal-Aid funding were required to comply with the provisions of the rule no later than October 12, 2007. The Rule updated and broadened the former regulation 23 CFR 630, Subpart J. Changes to the regulation encourages broader consideration of safety and mobility impacts of work zones across project development and implementation of strategies that help manage these impacts during project delivery.

The Rule requires State Departments of Transportation (DOT) to develop a Transportation Management Plan (TMP) for all Federal-aid projects. For projects that are considered to be significant, the TMP must include a Temporary Traffic Control Plan (TTC) and must address both Traffic Operations (TO) and Public Information and Outreach (PI&O) components for those projects.

This training course will assist participants in developing an effective and complete TMP including but not limited to; the content of the TMP, roles and responsibilities, work zone impacts assessment, selecting strategies, TMP monitoring, and assessing TMP effectiveness. The web based training course includes:

1. Participant Workbook—the participant workbook contains the course outline and slides for each module.
2. Course with Narration—the training is modular with voiceover narration for guided/ independent learning.

II. Target Audience

The primary intended audience for this training is transportation agency staff, including technical staff, (planners, designers, traffic engineers, highway/safety engineers, etc); management and executive-level staff responsible for setting policy and program direction; field staff responsible for building projects and managing work zones; and staff responsible for assessing performance in these areas.

III. Course Instructions

There are six modules, as well as a Course Overview and a Wrap-up, that are set to advance automatically or can be taken at self-paced speed. You can click on the link for each module to start that module. If you need to stop the training before completion, it is suggested that you at least complete the current module. When you are done with all of the modules, please click on the link for course wrap-up. This includes a general exercise to use your new skills; a post-test to assess how well you understood the material; and a way to provide feedback on the course and your learning experience.

It is recommended that you download and save (or print) a copy of the participant workbook and familiarize yourself with its content. The course will refer to the workbook at various points, including for the course exercises.

IV. Overall Course Outcome

Understand the process involved in developing, implementing, and monitoring TMPs.

V. Course Contents

The course is organized as follows:

Course Overview and Instructions:	General instructions and course outline.
Module 1:	Work Zone Safety and Mobility Rule—Rule overview and provisions.
Module 2:	TMP Basics —what is a TMP; why TMP is needed; TMP process overview including the potential steps to be included in the TMP: examples from various States on TMP process.
Module 3:	TMP Coordination (includes exercise) —coordination during the TMP development and implementation process; stakeholders that should be involved during coordination; coordination issues that need to be considered; ways to achieve coordination while developing TMPs.
Module 4:	Work Zone Impacts Assessment (includes exercise)—overview of work zone impacts assessment; the types of impacts; why and when to assess impacts; a process that can be used for work zone impacts assessment.
Module 5:	TMP Strategies (includes exercise)—how to identify TMP Strategies and examples on possible TMP strategies.
Module 6:	TMP Approval and Implementation—TMP review and approval; TMP implementation and monitoring; TMP revisions; post-project evaluation.
Course Wrap-Up:	General exercise and post course assessment.

Course Overview and Instructions	
Time Allocated	5 minutes
Contents	• Outline for this Course • Course Materials • Course Instructions
Outcome	Participants will be able to: • Understand how the course is presented.
Format	4 slides

Module 1	
Title	Work Zone Safety and Mobility Rule
Time Allocated	10-15 minutes
Contents	• Overview • Provisions • Key Concepts Advocated
Outcome	Participants will be able to: • Understand the Work Zone Safety and Mobility Rule • Understand the significance of the Rule in bringing positive change in work zone management and practices
Format	10 slides

Module 2	
Title	TMP Basics
Time Allocated	25-30 minutes
Contents	• What is a TMP? • Why a TMP is Needed • TMP Benefits • TMPs and Significant Projects • State Examples of Significant Project Criteria • When to Develop a TMP • Who Develops, Approves, and Implements a TMP • TMP Process • TMP Format • TMP Implementation Costs
Outcome	Participants will be able to: • Understand the basics of TMPs • Learn the general steps involved in the TMP process • Develop/modify their own TMP processes based on State/Agency needs
Format	26 slides

Module 3	
Title	TMP Coordination (includes Exercise)
Time Allocated	10-15 minutes + Exercise
Contents	• Stakeholders • Internal Project Coordination • Coordinating Multiple Projects • Interagency Coordination • Roles and Responsibilities • TMP Teams • Exercise
Outcome	Participants will be able to: • Identify stakeholders (Utilities, Emergency providers, etc) • Understand the need for coordination at different levels—within the Agency as well as interagency • Identify the roles and responsibilities of Agency personnel at various stages of TMP development and implementation.
Format	14 slides

Module 4	
Title	Work Zone Impacts Assessment (includes Exercise)
Time Allocated	30-35 minutes + Exercise
Contents	• Overview • Types of Impacts • Why and When Assess Impacts • Work Zone Impacts Assessment Process • Exercise
Outcome	Participants will be able to: • Understand the range of work zone impacts • Learn how to assess the impacts of an upcoming work zone
Format	41 slides

Module 5	
Title	TMP Strategies (includes Exercise)
Time Allocated	25-30 minutes + Exercise

Contents	• Overview
	• Identification of TMP Strategies
	• Possible TMP Strategies
	  • Temporary Traffic Control Plan (TTCP)
	  • Transportation Operations (TO)
	  • Public Information (PI)
	• Tools
	• Exercise

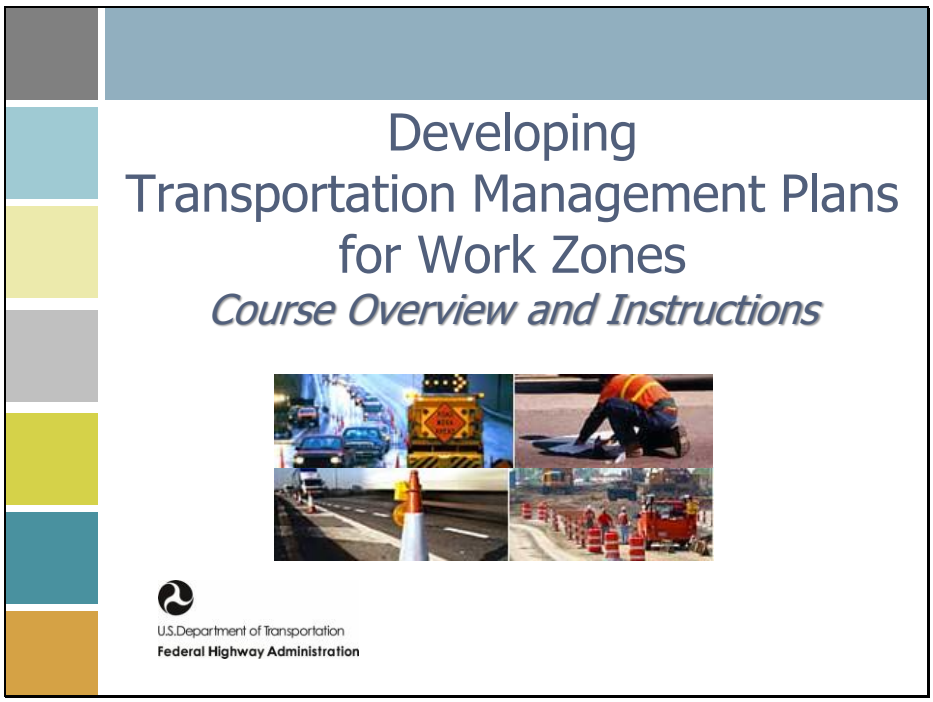
Outcome	Participants will be able to: • Identify strategies to facilitate traffic flow safely through and around work zones • Identify strategies to minimize or mitigate work zone safety and mobility impacts
Format	40 slides

Module 6	
Title	TMP Approval and Implementation (includes Exercise)
Time Allocated	20-25 minutes + Exercise
Contents	• TMP Review and Approval • TMP Implementation and Monitoring • TMP Revisions • Post-Project Evaluation • Exercise
Outcome	Participants will be able to: • Understand the importance of TMP monitoring, revision, and post-project evaluation
Format	26 slides

Course Wrap-Up	
Time Allocated	5-10 minutes + Exercise
Contents	• General Exercise • Post Course Assessment • Course Feedback
Outcome	Participants will be able to: • To assess how well they understand the material that was presented. • Provide feedback on the course and learning experience.
Format	6 slides

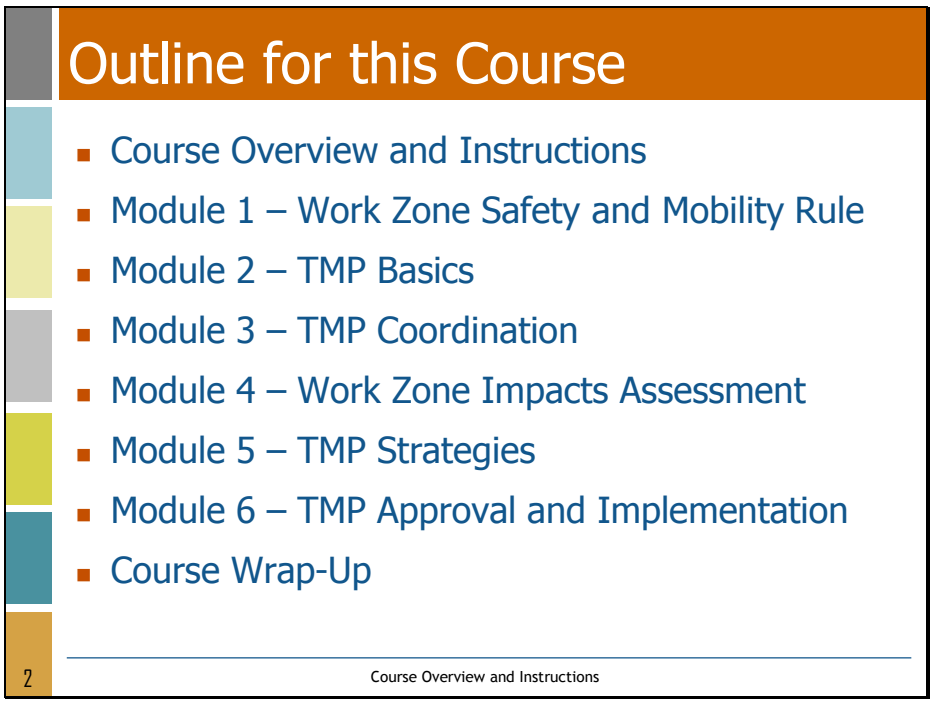
VI. Course Material

Course Overview and Instructions

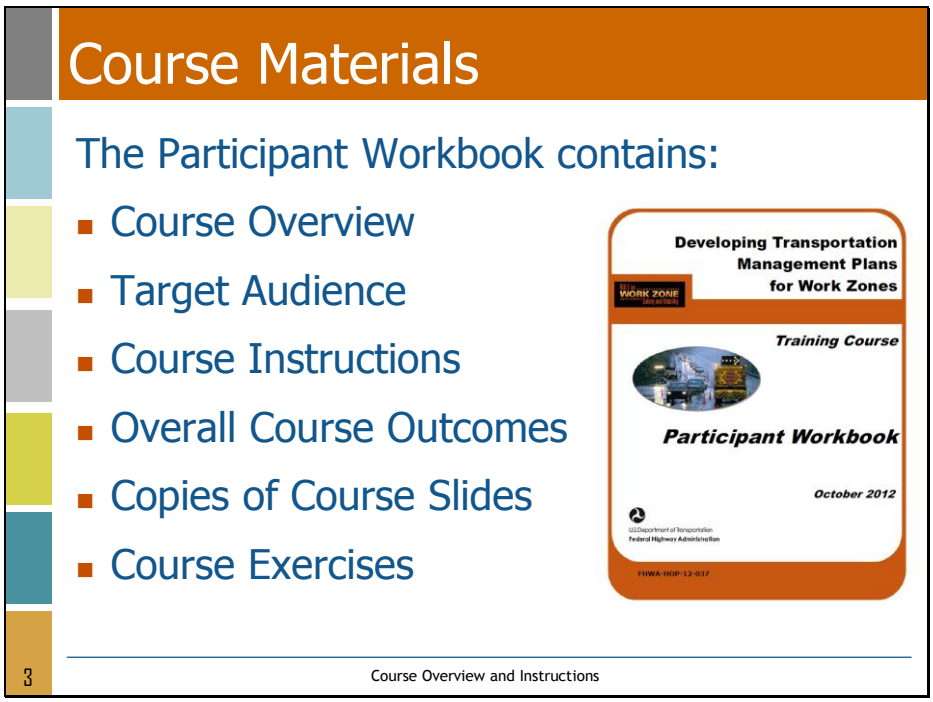


Narrator Notes:
This training course is titled, *Developing Transportation Management Plans for Work Zones*. The course will assist you in understanding and developing effective and complete Transportation Management Plans, or TMPs. Topics discussed in this course include the content of a TMP, roles and responsibilities, work zone impacts assessment, selecting TMP strategies, and TMP implementation.

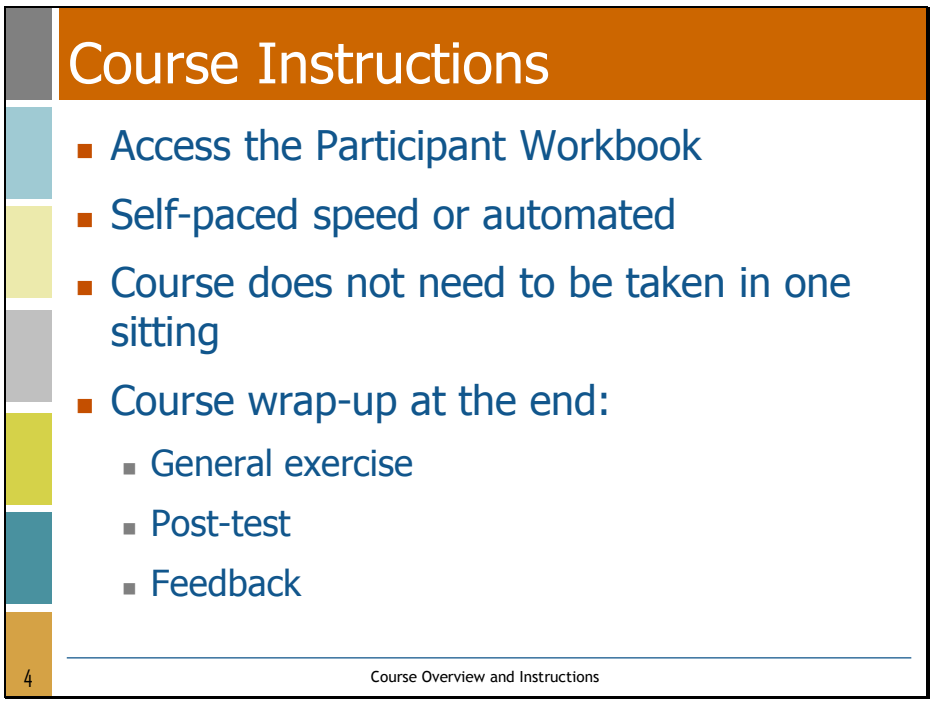
This course is designed for self-paced learning. The training is modular and consists of slides with voiceover narration for guided, independent learning. The course includes exercises to help you apply the concepts you learn throughout the course.



Narrator Notes:
The course contains six modules, as well as the Course Overview and Instructions and Course Wrap-Up. Each module is separate, so all the modules do not have to be taken at once. The modules should be taken in numerical order because the material in each module builds on what is learned in the previous modules.



Narrator Notes:
There is a Participant Workbook for this course. The Workbook contains information on the course objectives, target audience, and intended outcomes, as well as instructions to guide you through the course materials. It also provides a copy of the slides for note taking purposes and future reference, and several exercises for you to complete at various points during the course.



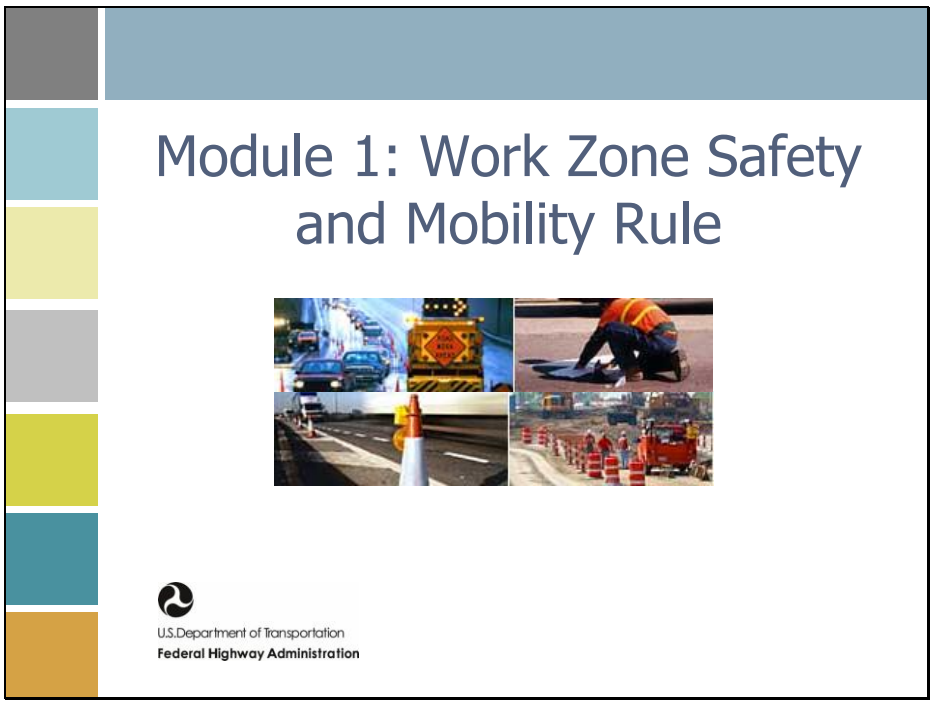
Narrator Notes:
Before beginning Module 1, download a copy of the Participant Workbook and familiarize yourself with its content. The course will refer to the Workbook at various points, including for the course exercises.

The six modules in the course are set up to advance automatically or can be taken at self-paced speed, where you decide when to advance to the next slide. Click on the link for each module to start that module.

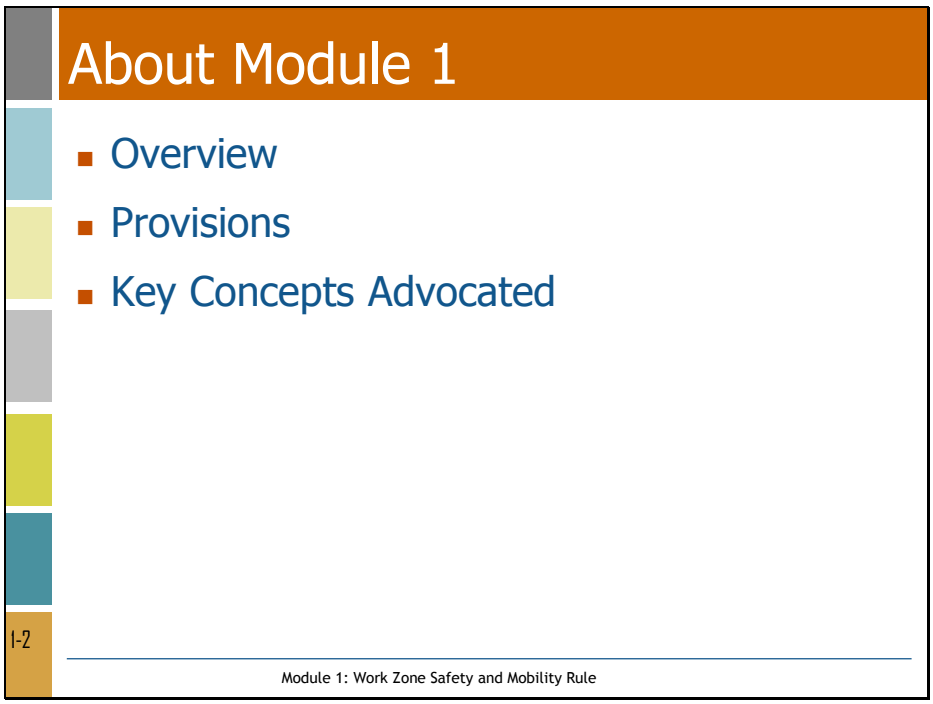
If you need to stop the training before completion, it is suggested that you at least complete the current module.

When you are done with all of the modules, please click on the link for course wrap-up. This includes a general exercise to use your new skills; a post-test to assess how well you understood the material; and a way to provide feedback on the course and your learning experience.

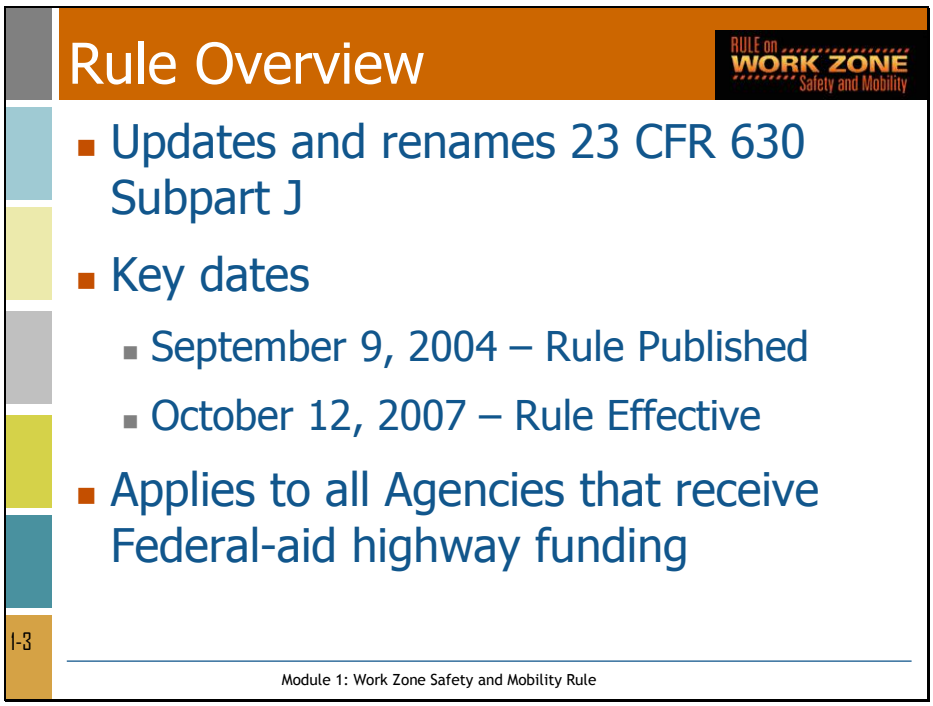
Module 1: Work Zone Safety and Mobility Rule



Narrator Notes:
This module discusses the Work Zone Safety and Mobility Rule, found in the Code of Federal Regulations at 23 CFR 630 Subpart J.



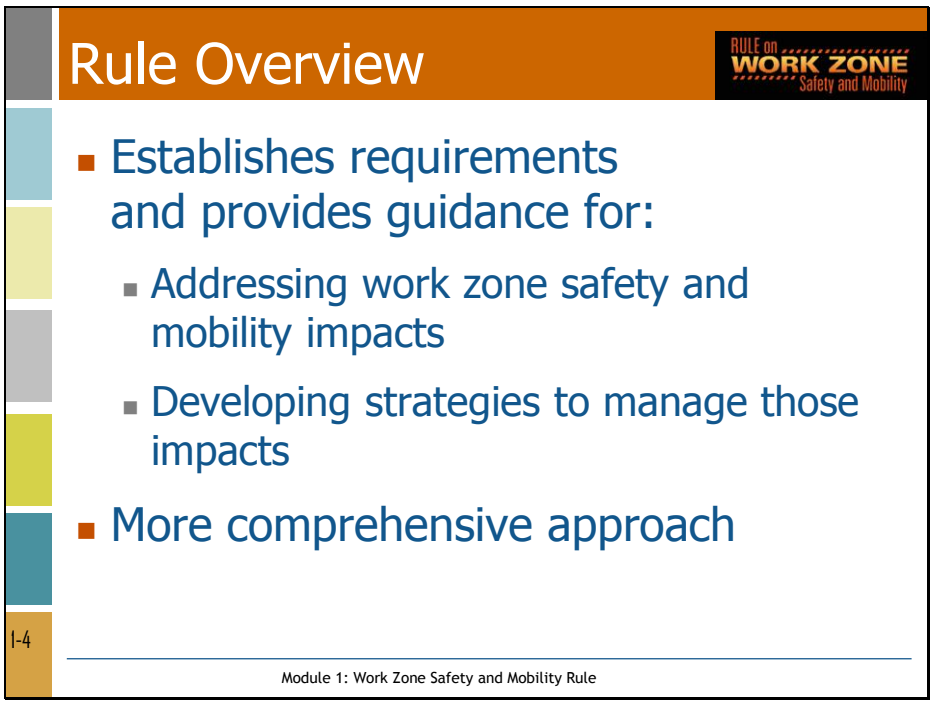
Narrator Notes:
Module 1 provides a brief overview of the Rule, followed by information on the key provisions and concepts advocated by the Rule.



Narrator Notes:
The Work Zone Safety and Mobility Rule updates and renames the former regulation on "Traffic Safety in Highway and Street Work Zones," found in 23 CFR 630 Subpart J.

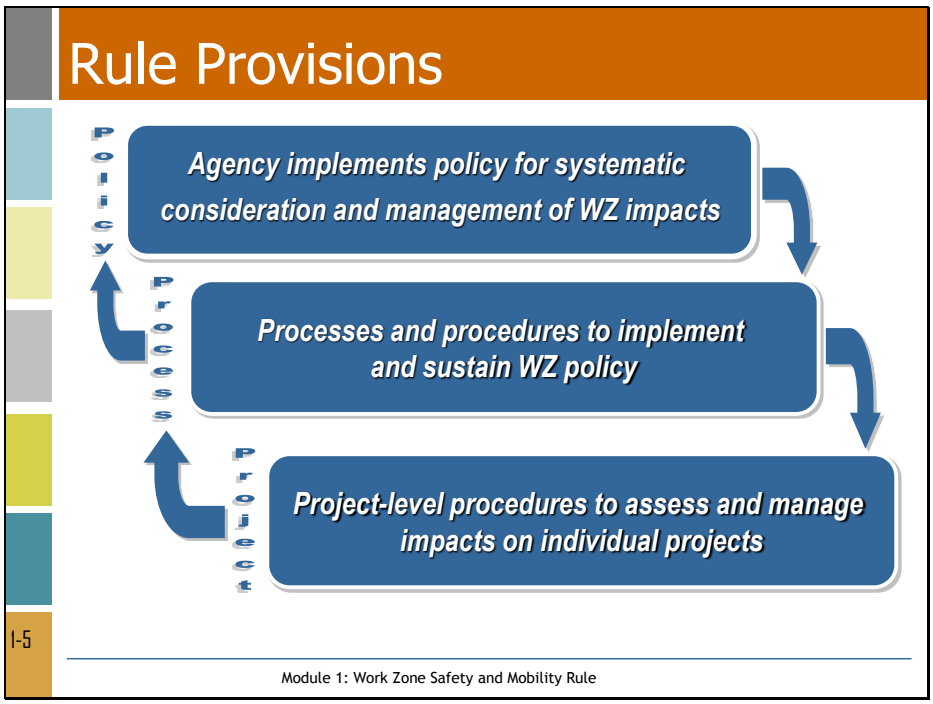
The revised Rule was published in 2004. Transportation Agencies were given just over 3 years, until October 12, 2007, to update their existing practices and policies to comply with the requirements of the revised Rule.

The Rule applies specifically to all Federal-aid highway projects. Agencies are encouraged to apply the good practices that the Rule fosters to other road projects as well, and many DOTs have chosen to do so.



Narrator Notes:
The updated Rule not only emphasizes the importance of safety, but also adds a focus on providing for mobility in and around work zones. It provides for the systematic consideration of work zone impacts during project development. And it provides for the development of an appropriate Transportation Management Plan that contains strategies to help manage those impacts during road work.

The updated Rule fosters a more comprehensive approach to work zone planning, implementation, and management.

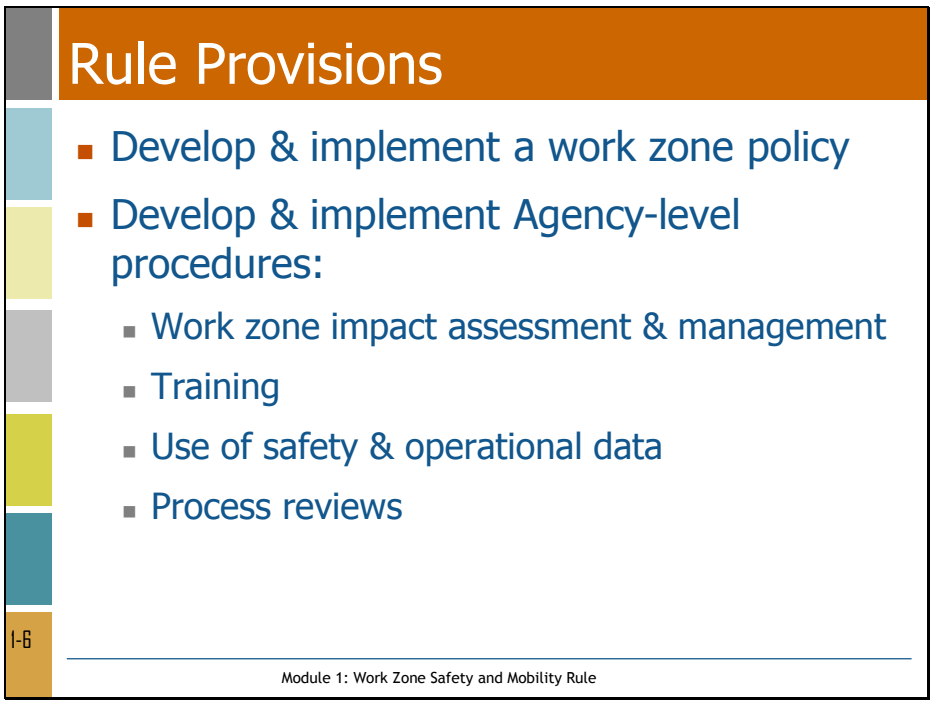


Narrator Notes:
The updated Rule advocates a systematic approach for managing work zone safety and mobility, and has 3 primary components:

- Agency Work zone safety and mobility policy,
- Agency-level processes and procedures, and
- Project-level procedures to address work zone impacts.

For each component, the Rule includes provisions and guidance to help transportation Agencies address work zone considerations, starting early in planning and progressing through design, construction, and post-construction.

The Policy an Agency develops and implements will guide and influence its standard processes and procedures, which in turn will also guide what the Agency does at the project level. In turn, as the DOT sees how certain project-level efforts work in the field, it can use that information over time to refine its work zone policy and higher level processes and procedures.



Narrator Notes:
The Policy imparts the Agency's vision and approach to work zone management and indicates support from Agency leadership. This provision was intended to help Agencies update and enhance their existing policies to meet the intent of the Rule, or create a new policy if needed.

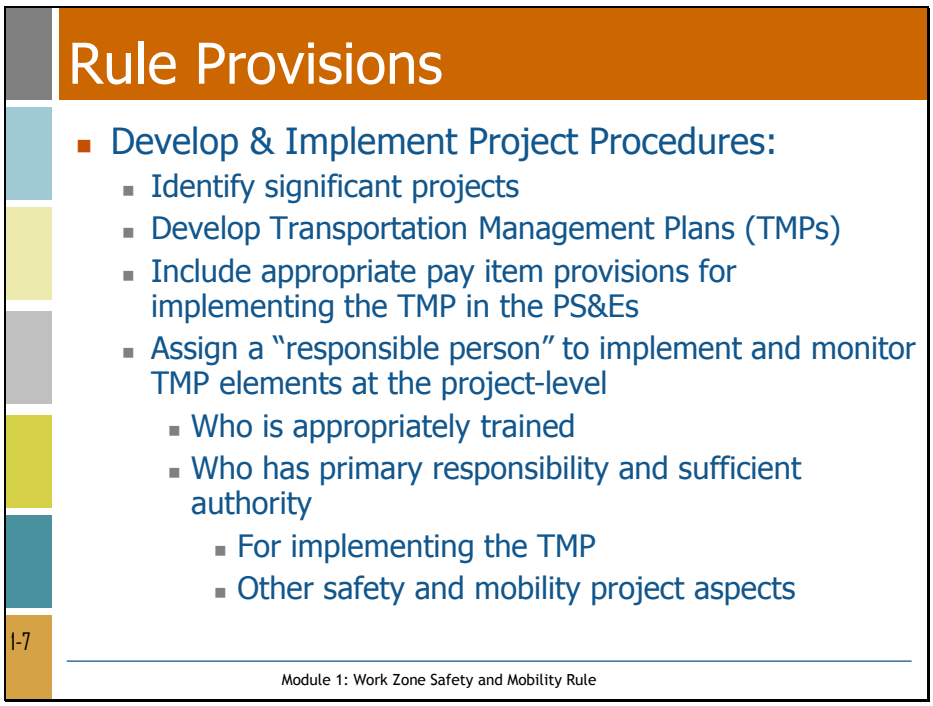
Institutionalizing Agency processes and procedures will help to streamline and standardize work zone practices that support decision-making throughout the project life cycle.

While the Rule encourages Agencies to develop and implement procedures to assess and mitigate work zone impacts, it requires Agency processes and procedures for work zone related training, use of work zone data, and process reviews.

The Rule requires Agencies to provide periodic training for personnel involved in work zone related transportation management and traffic control.

The Rule also requires Agencies to use work zone safety and operational data to manage and improve work zone safety and mobility. This data requirement applies to both current projects in the field, as well as future projects.

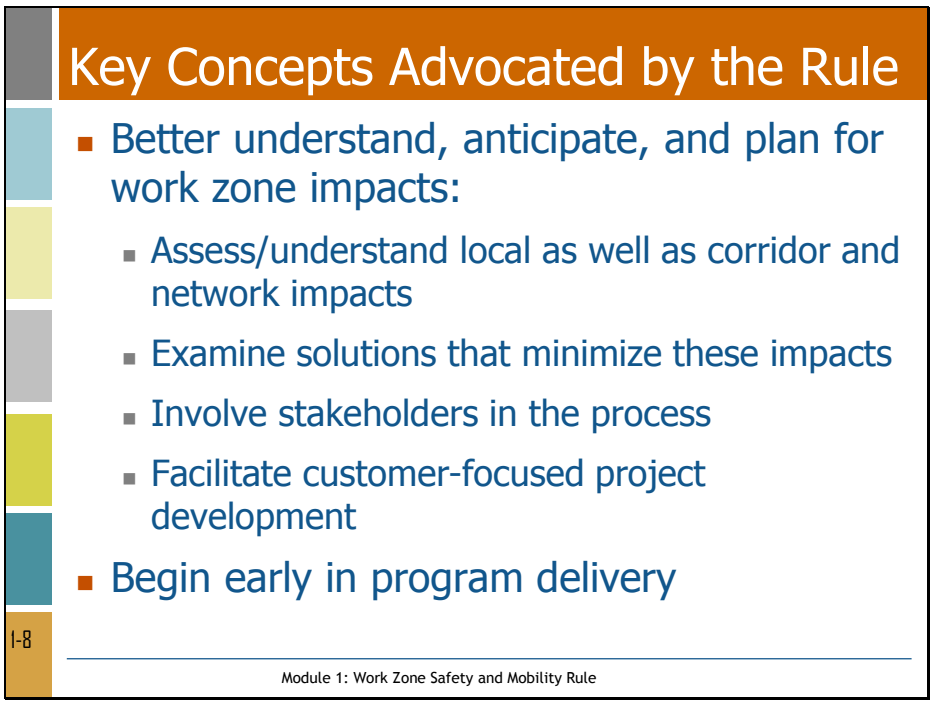
In addition, Agencies are required to assess the effectiveness of their work zone safety and mobility procedures at least every two years by performing a process review.



Narrator Notes:
Agencies are now required to identify future projects with potential for a higher level of disruption. These projects are called, "significant projects." This disruption is also referred to as work zone impacts. The Agency develops mitigation measures to manage those impacts. The TMP is the vehicle through which this information is documented and implemented.

The project's Plans, Specifications, and Estimates, or PS&Es, are required to contain provisions for implementing the applicable elements of a TMP. The TMP is often developed by an Agency before a project goes to bid. However, for some projects the Agency may have the Contractor develop the TMP through the contract. In this case, the Agency would include the TMP development requirement in the PS&Es along with general guidelines for the TMP.

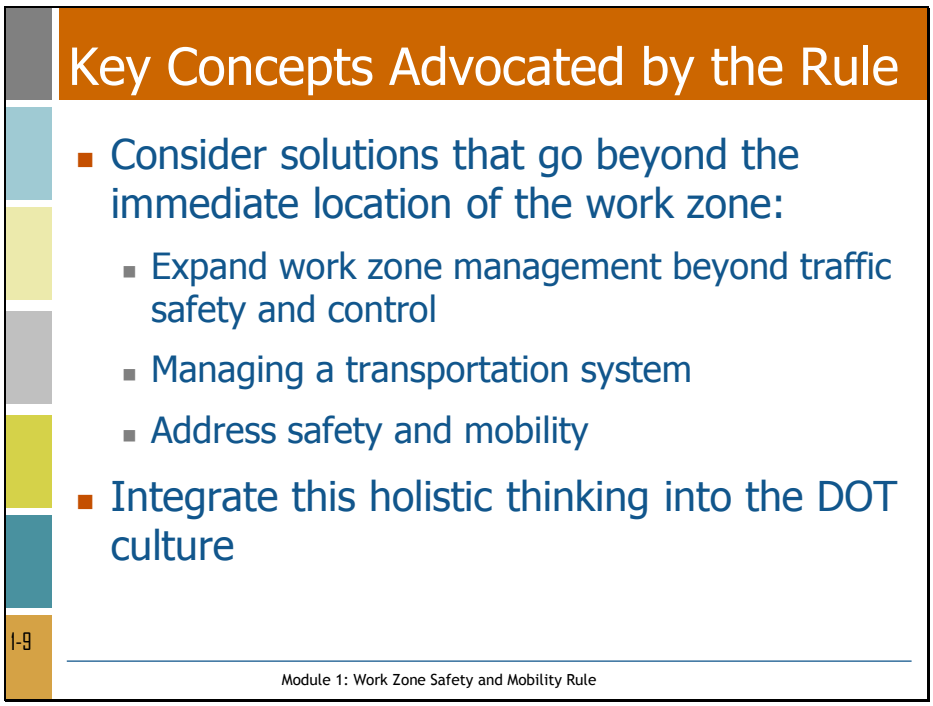
The Rule requires that, the Agency and the Contractor each designate a trained person at the project-level who has the primary responsibility and sufficient authority for implementing the TMP. The designated personnel must be appropriately trained.



Narrator Notes:
The updated Rule advocates a few key concepts to help Agencies be effective in reducing the safety and mobility impacts from work zones.

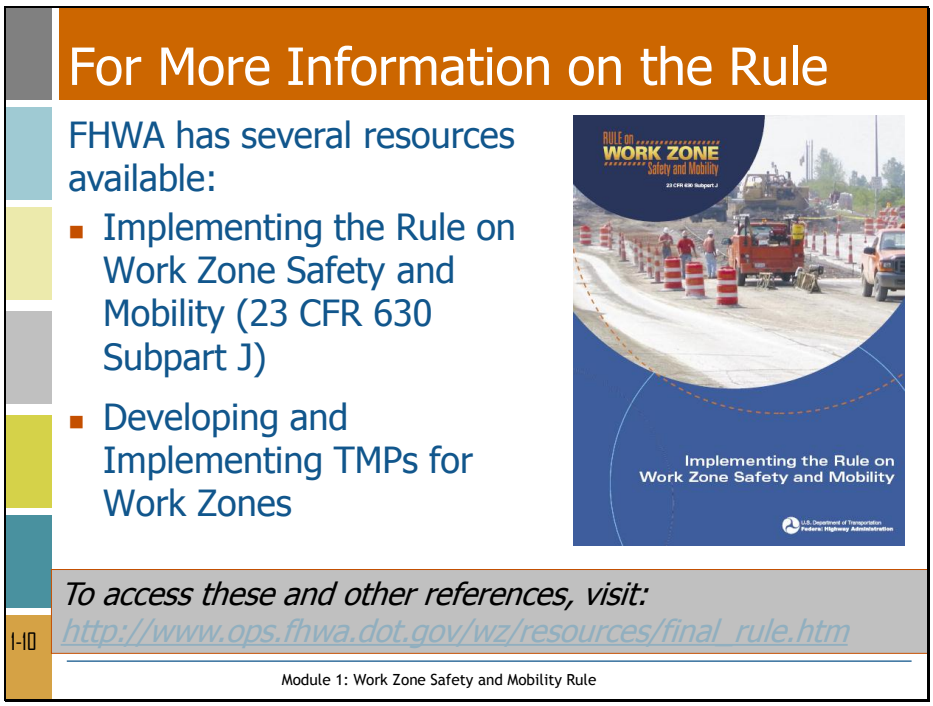
First, the Rule encourages DOTs to actively assess and plan for work zone impacts. This involves looking beyond the immediate location of the work zone to consider the surrounding corridor and the transportation network, and how residents, businesses, commuters, and other stakeholders will be impacted. Once the anticipated impacts are understood, DOTs can examine solutions to reduce and manage those impacts.

These efforts need to begin early in program delivery, so that these considerations can be addressed in budgeting, scheduling, and design.



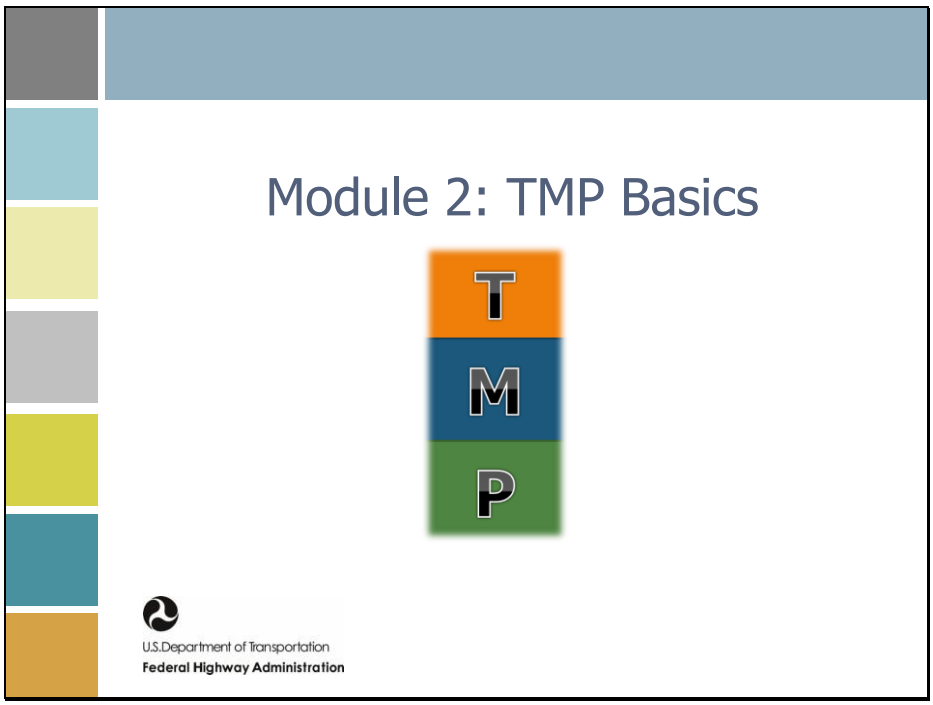
Narrator Notes:
If we view our task as having a transportation system to manage, rather than building a road and guiding traffic through the work zone, many more options become apparent. Options such as the use of alternate routes, transit service enhancements, signal timing adjustments, and travel demand management.

The Rule fosters a new way of thinking as State DOTs consider these safety and mobility impacts from scoping through construction.

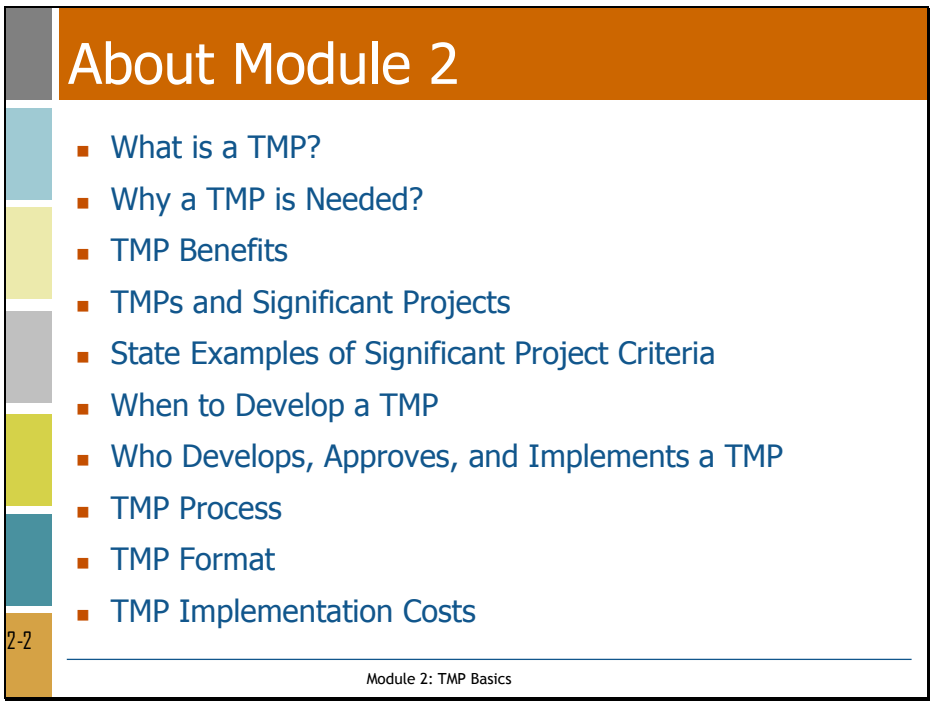


Narrator Notes:
Please visit the website listed on the slide to access FHWA resources and for more information on Rule implementation.

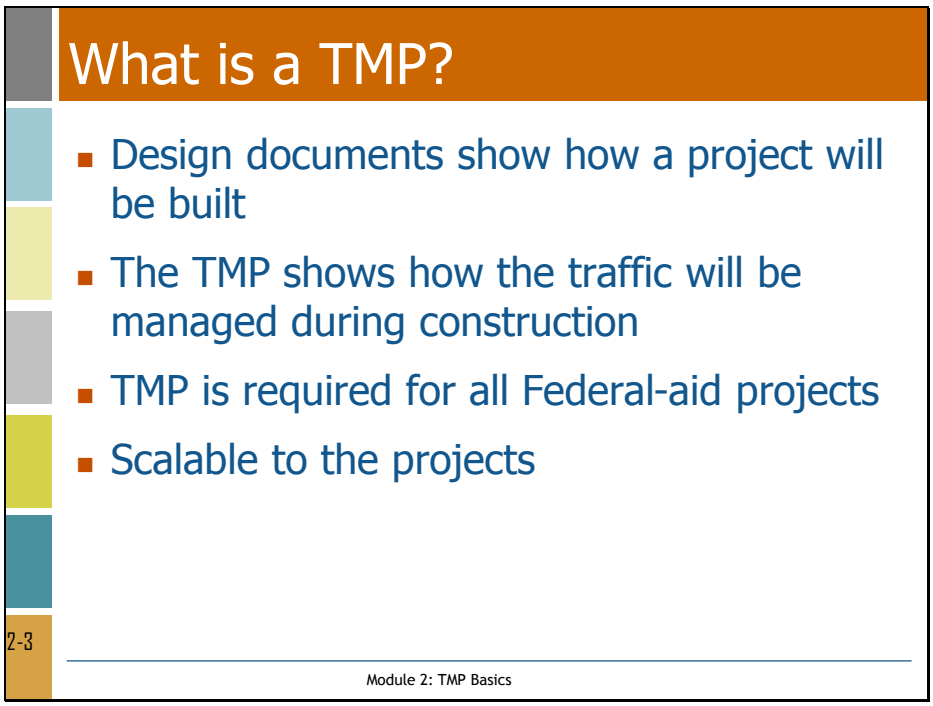
Module 2: TMP Basics



Narrator Notes:
This module discusses the basics of a Transportation Management Plan (TMP)—the what, why, when, and who of TMP development. Examples from various States are used to illustrate a particular concept, but are not the only way the concepts can be implemented.

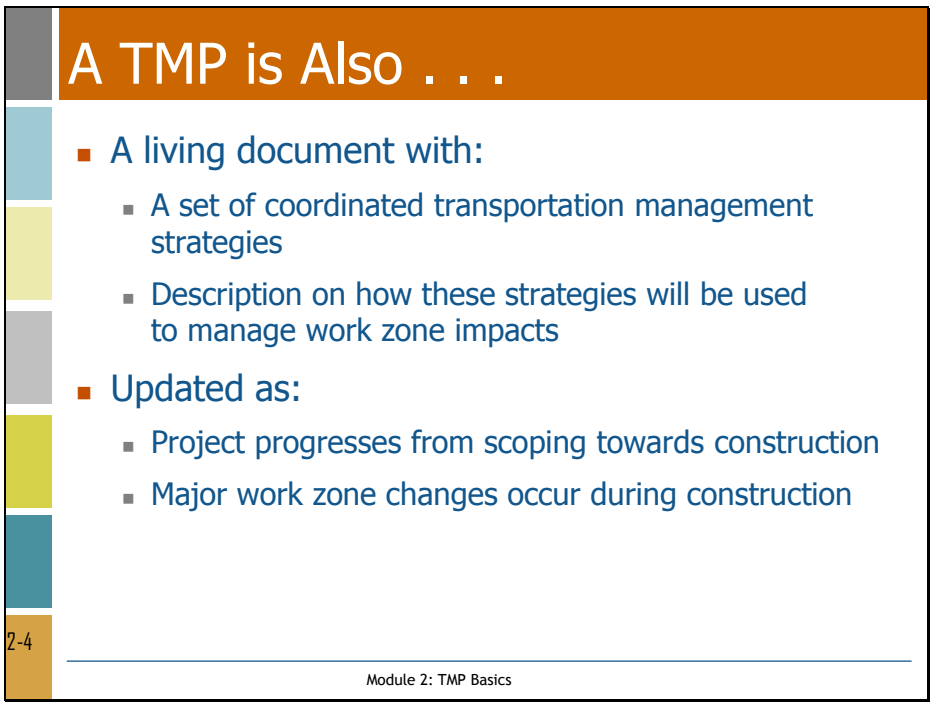


Narrator Notes:
Module 2 starts with a general description of a TMP and explains why a TMP is needed and what benefits it provides. The module then covers how TMP requirements are affected if a project is significant or not and provides some examples of significant project criteria. The module also covers when to develop the TMP, who is involved, and possible processes and formats. The module concludes with a brief discussion on TMP costs.



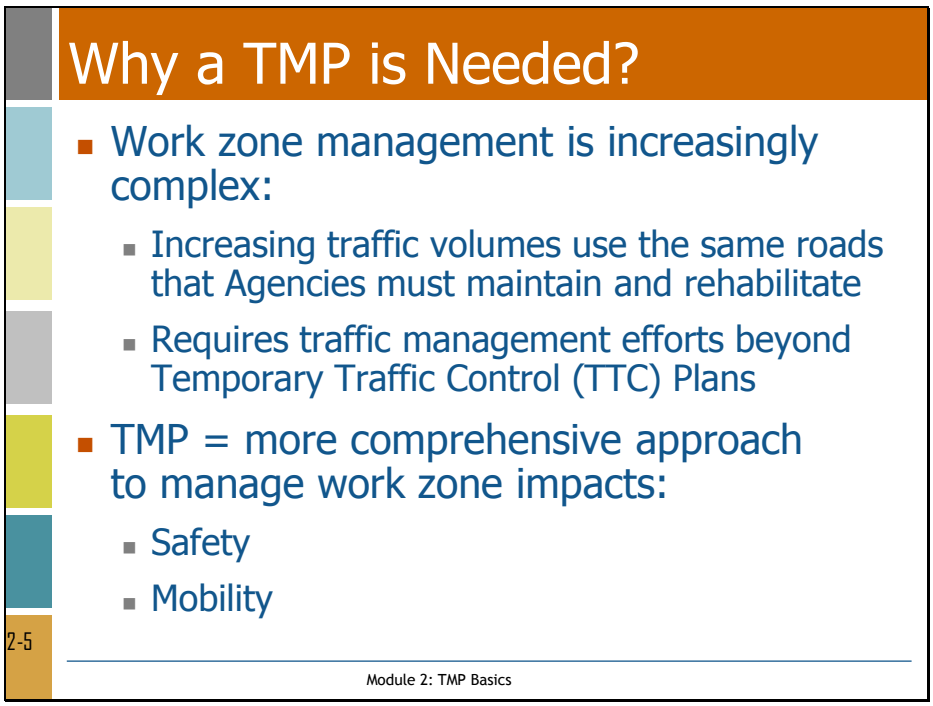
Narrator Notes:
A DOT develops design documents often called "blue prints" for construction. A TMP can be viewed as the "blue print" for managing transportation needs during construction. A TMP is required for all Federal-aid projects.

Just as the design blue prints are more involved for a complex project, the TMP should be more involved for projects with greater transportation needs.



Narrator Notes:
A TMP lays out a set of coordinated transportation management strategies in order to improve safety and mobility in and around a work zone.

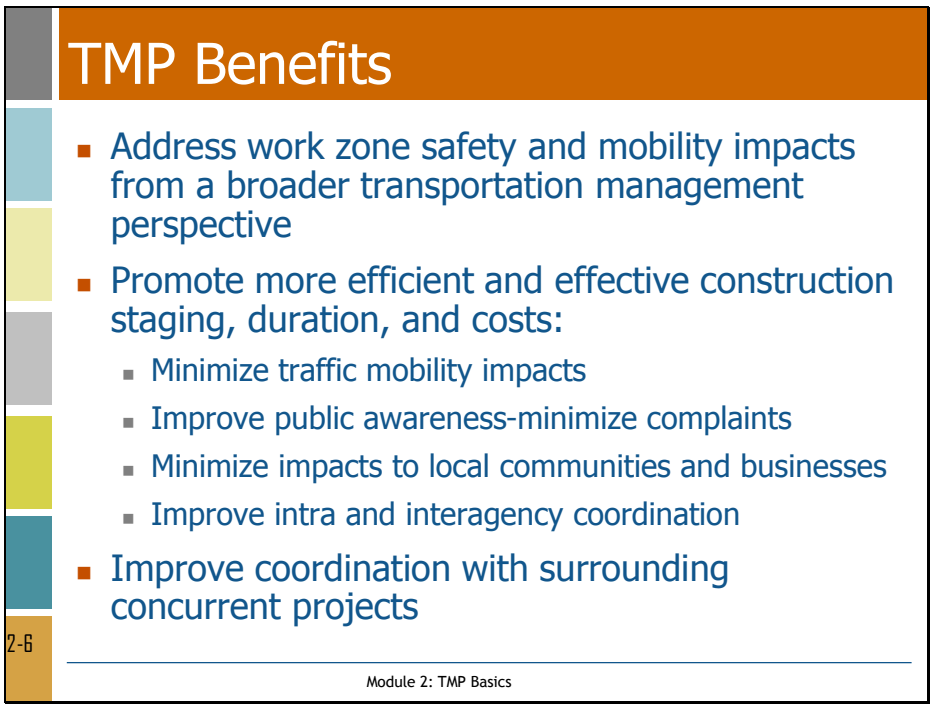
TMP development begins in the early planning stages of the project. The TMP is then updated as the project goes through different stages of planning and design. Once the TMP is implemented during construction, it needs to be monitored. If any major work zone adjustments are needed, the TMP must be revised to reflect the changes. That is why a TMP is also referred to as a "living document".



Narrator Notes:
The TMP provides a holistic way of looking at all the traffic-related impacts from the project and determining what strategies need to be in place to minimize the impacts.

Many urban areas have increasing congestion. In many areas the morning and afternoon peak period lasts several hours, and there may be a mid-day peak. This makes it increasingly challenging for work zone traffic management because a growing portion of road work is maintenance, reconstruction, and improvements to existing roads. These roads already carry traffic and are an important part of the transportation system, so closing lanes and staging construction is challenging.

The TMP provides a strategic approach to estimate traffic impacts for upcoming work zones and plan for and/or mitigate their effects.

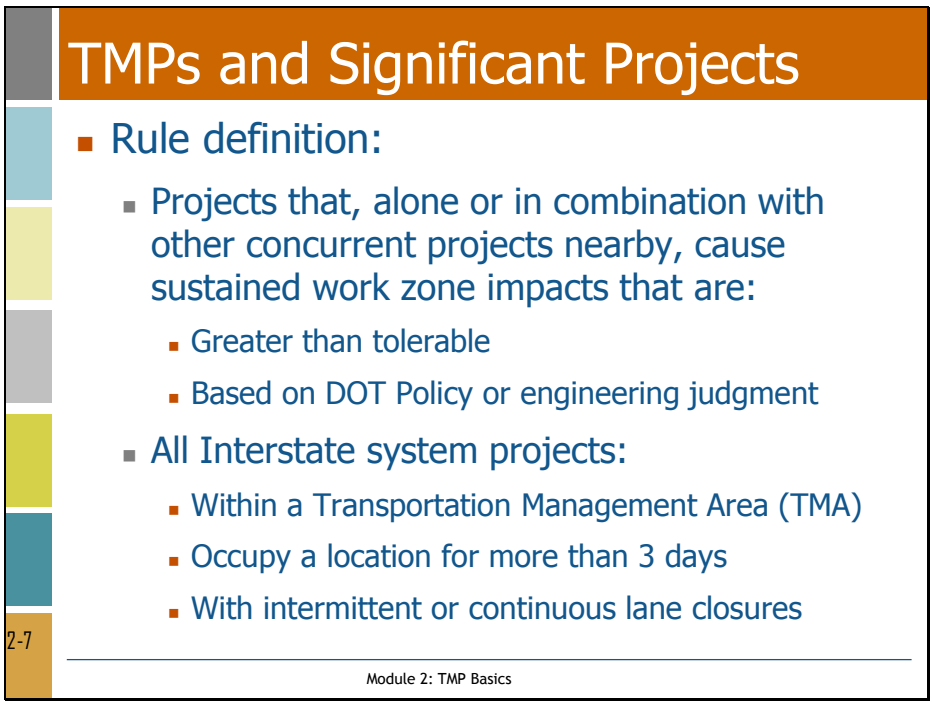


Narrator Notes:
The updated Rule brings a more complete approach to addressing work zone impacts, often resulting in:

- Improved safety,
- Reduced traffic delay/travel time,
- Reduced lane closure hours,
- More satisfied road users, and
- Reduced Agency cost.

The most significant TMP benefits relate to the safety and mobility of the road user and workers. Other key benefits include the efficient sharing of project information with related stakeholders as well as the intra- and inter-agency coordination developed.

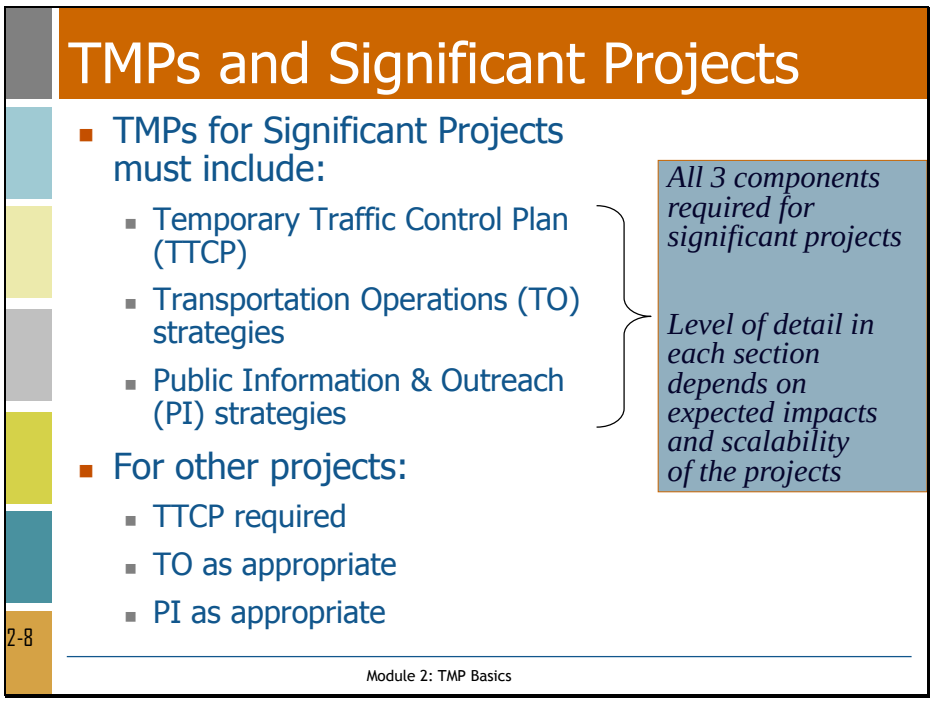
Even if good planning and TMP development is done for a project, unexpected issues can result if traffic diverts to the area as a result of another project nearby. So it is important to consider the impacts of other concurrent construction projects in the area. The TMP process can help foster this coordination by bringing stakeholders together.



Narrator Notes:
We have mentioned the term "Significant Project", but what does that mean? FHWA defines a significant project as one that has the potential to cause sustained work zone impacts that are greater than what is considered tolerable – based on Agency policy or engineering judgment. A project can be significant because it causes these impacts on its own, or in combination with other projects that will occur nearby at the same time.

At a minimum, all Interstate system projects within the boundaries of a designated Transportation Management Area that occupy a location for more than 3 days and have some type of lane closures are to be considered significant projects.

In summary, a significant project is one that is expected to cause a relatively high level of impacts or disruption.



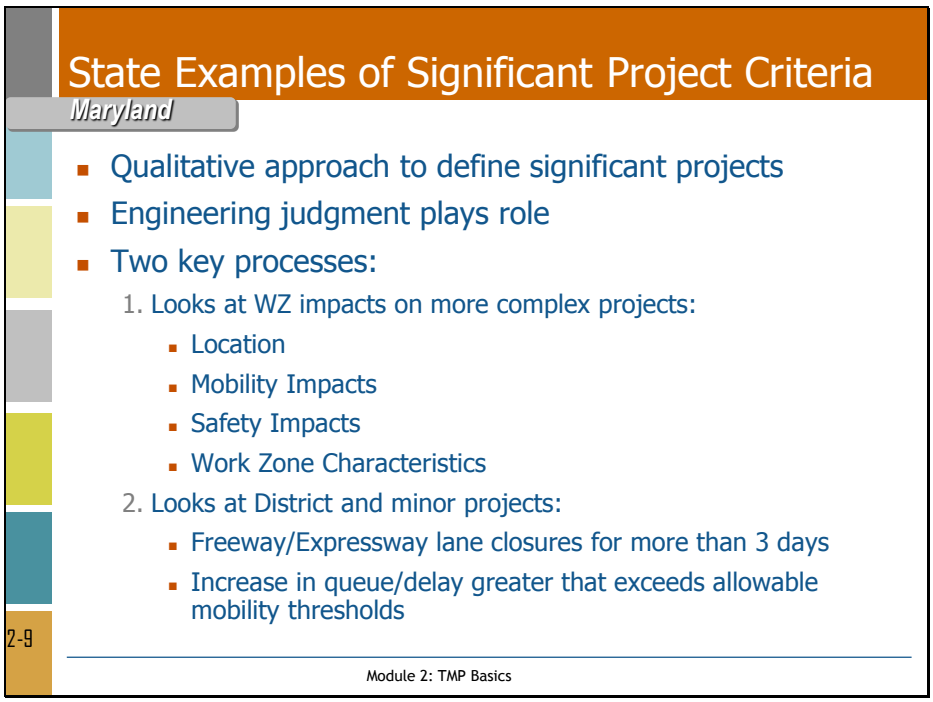
Narrator Notes:
Some road projects lead to more transportation issues than other projects. So the effort to plan for and manage those impacts should be scalable to the project. The scope, content, and level of detail of a TMP will vary based on the project cost and size, the anticipated work zone impacts of the project, as well as the Agency's work zone policy. A project expected to cause more disruption will require a more extensive TMP. The purpose of identifying significant projects is to "flag" higher-impact projects early on so that greater effort is spent on those projects that most need it.

The required components of a TMP depend on whether a project is a significant project. A TMP must always include a Temporary Traffic Control Plan. For significant projects, TMPs must also contain Transportation Operations and Public Information components.

As mentioned, Agencies have some flexibility to determine what impacts are tolerable in their jurisdiction. The following slides are Agency examples of significant project definition. The examples illustrate that States have developed project criteria which varies from relatively simple to quite complex.

Some additional information is available in the Participant Workbook

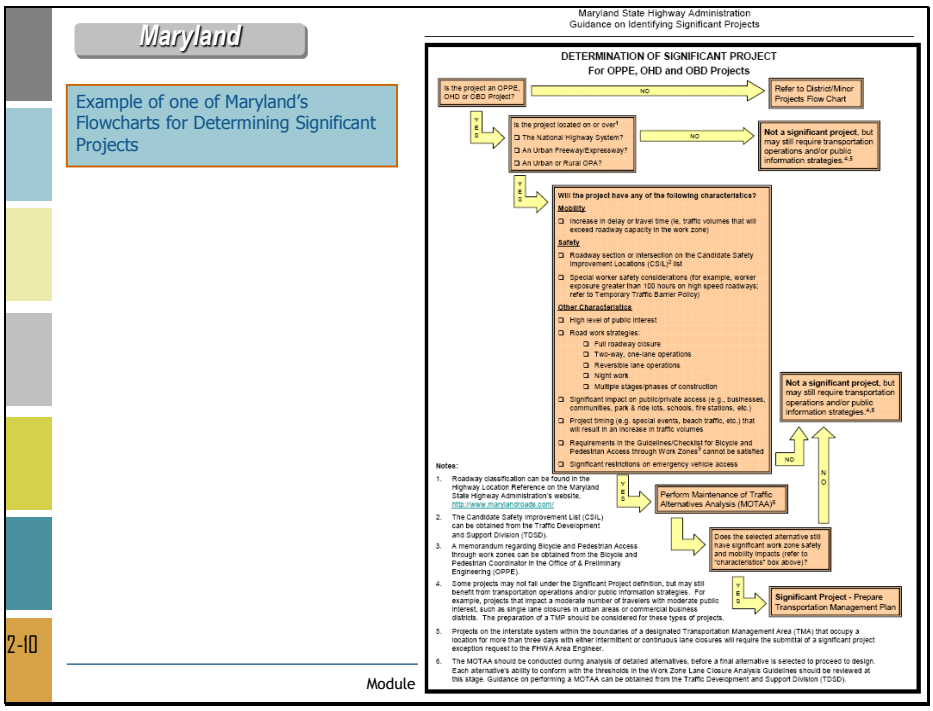
For more information Refer to the FHWA Guide titled, *Implementing the Rule on Work Zone Safety and Mobility* available at
http://www.ops.fhwa.dot.gov/wz/resources/final_rule/guidance.htm



Narrator Notes:
Maryland uses two processes to determine its significant projects.

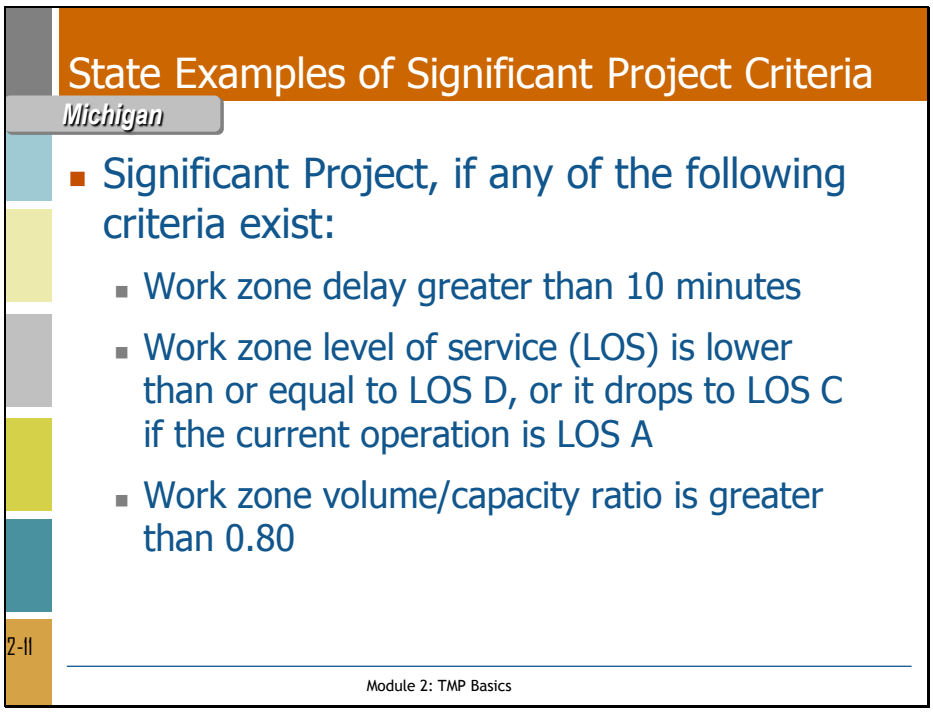
Process one is for projects that fall under the Planning and Design Central Offices, which tend to be larger, more complex projects. The major criteria used are project location, anticipated mobility and safety impacts, and project and/or work zone characteristics. Once deemed significant, the next step is to perform a Maintenance of Traffic Alternative Analysis. If the analysis does not identify a solution that will reduce impacts, traffic operations and public information and outreach strategies must be developed.

Process two is at the District level and relates to minor projects where the work will involve continuous or intermittent lane closures on a freeway/expressway for more than 3 days.



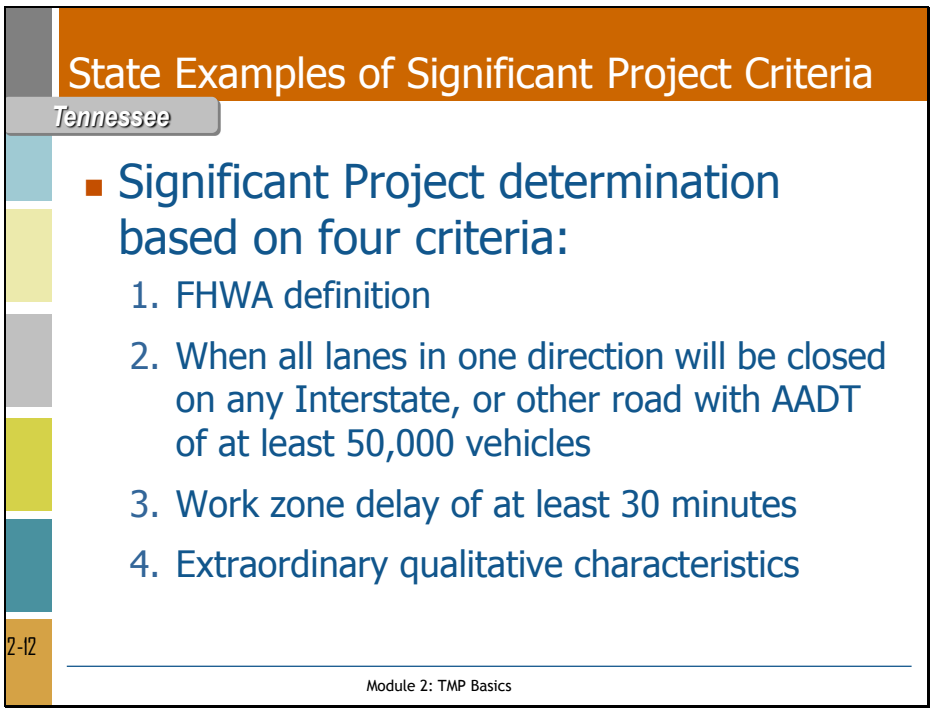
Narrator Notes:
Maryland has developed a flow chart for each of its two processes to help its engineers identify significant projects. This is the flow chart Maryland uses for more complex projects.

You can also refer to Appendix B of the Participant Workbook for a copy of this flowchart and the minor projects flowchart.



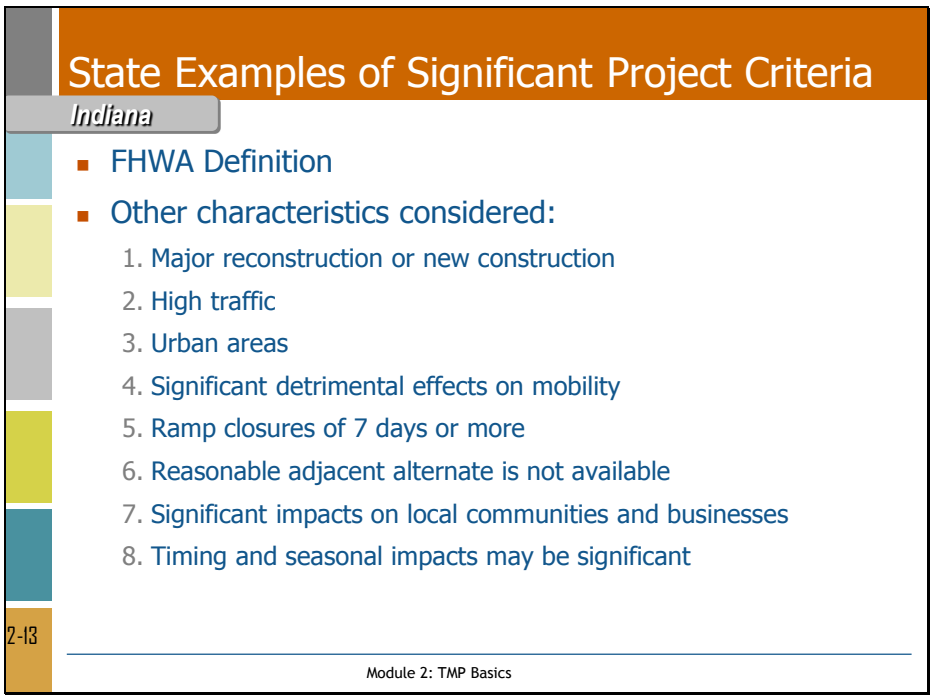
Narrator Notes:
The Michigan Department of Transportation uses three thresholds to determine whether a project is significant. The thresholds are based on delay, level of service, and the ratio of volume to capacity. If one or more of these thresholds are exceeded, then the project is considered significant. For example, if a work zone is expected to cause additional delay of 15 minutes, beyond any pre-existing delay, the project is considered as a significant project in Michigan.

Like a number of other States, Michigan uses a computer program to analyze delay.

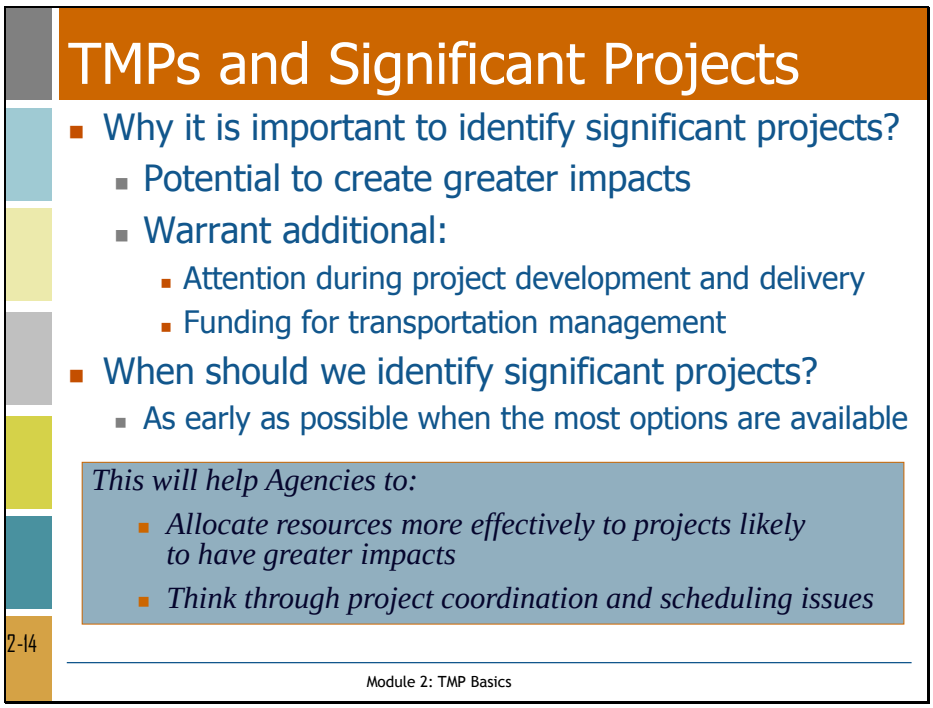


Narrator Notes:
Tennessee uses four criteria to determine if a project is significant. The criteria include the FHWA definition mentioned earlier for Interstate projects, lane closures on major routes, expected extra delay due to the work zone, and extraordinary qualitative characteristics. Examples of these qualitative characteristics include high levels of public interest, business/community impacts, or long work zone duration. Meeting any one of these criteria can result in a project being designated as significant.

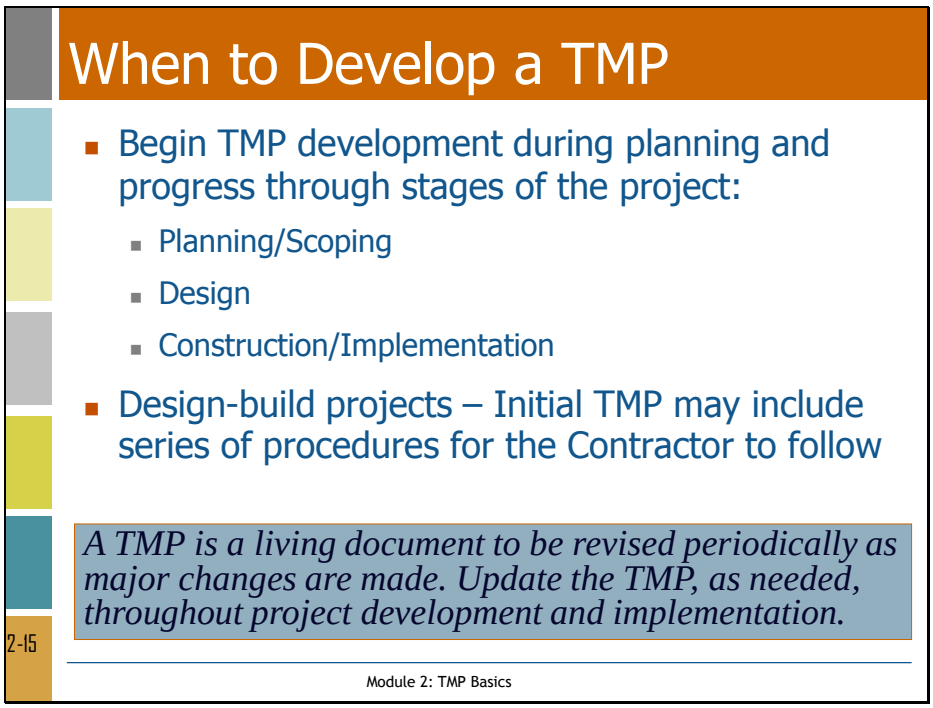
Refer to Appendix B of the Participant Workbook for a sample of the Tennessee flow chart on significant project determination.



Narrator Notes:
In Indiana, a project is considered significant if it meets the FHWA definition mentioned earlier, or if it meets both characteristics 1 and 2 shown on this slide. The project may also be considered significant if it meets either characteristic 1 or 2 and has one or more of the other six characteristics such as being in an urban area or having seasonal impacts.



Narrator Notes:
Identifying significant projects during the early planning stages is critical as they have the potential to cause greater work zone impacts and may also need additional coordination, scheduling, and resources during project planning, design, and implementation. Beginning such efforts early in project development will help the DOT allocate the necessary resources to reduce and manage impacts to the traveling public, community, and businesses, and will allow for better coordination with other projects occurring in the area at the same time.



Narrator Notes:
TMP development begins during project conceptualization or the early planning stages of a project. At this stage of the project, more alternatives and strategies are available for addressing the anticipated work zone impacts. Some feasible alternatives may cause much greater traffic impacts than other alternatives. As the alternatives are being analyzed, work zone impacts should be considered as a factor in the decision-making.

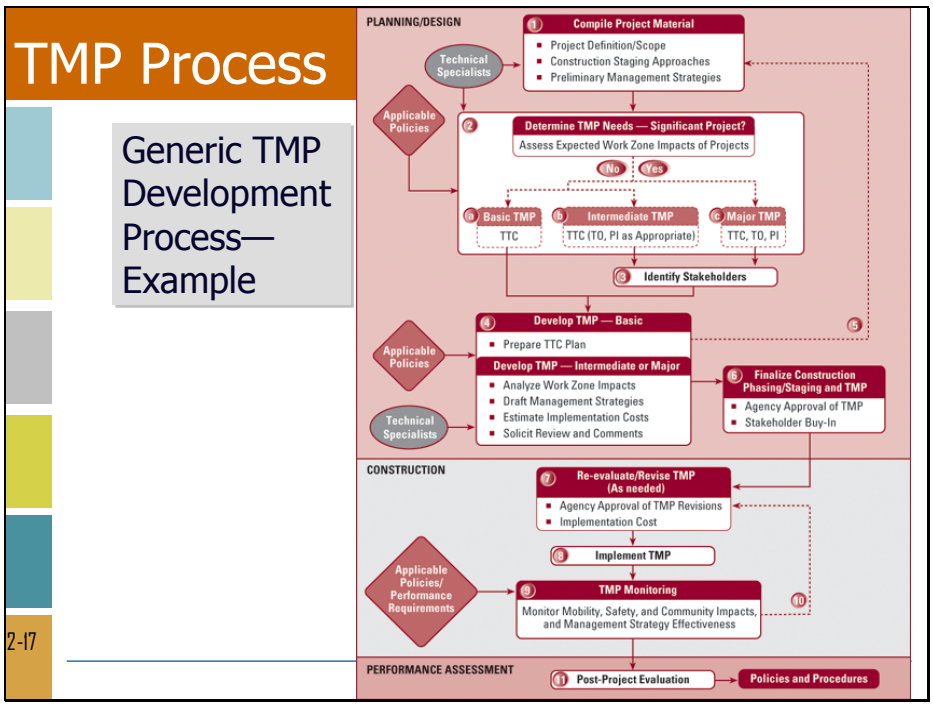
As the project progresses through the different stages of design, the TMP evolves. The strategies selected are reassessed to confirm that work zone impacts are addressed and the TMP is updated as needed. During construction, the TMP is implemented, and if any major work zone adjustments are needed, the TMP is revised to reflect the changes.

In Design/Build projects the construction proceeds along with the design and TMP development. The initial TMP may include a series of procedures that the Contractor must follow, such as for detours, lane closure hours, MOT inspection, and public information. The Contractor would fill in the TMP details as the project design progresses.

The TMP is a living document that needs to be updated regularly throughout the life of the project.

Narrator Notes:
DOTs or their design consultants generally develop the TMP, while the implementation and monitoring is a joint effort between the Contractor and the DOT. The State or local transportation Agency must approve the TMP before it's implemented. However, in some practices like design-build, the Contractor develops the TMP and once approved by the DOT, the Contractor will be responsible for its implementation.

The following slides illustrate a few examples of TMP processes.

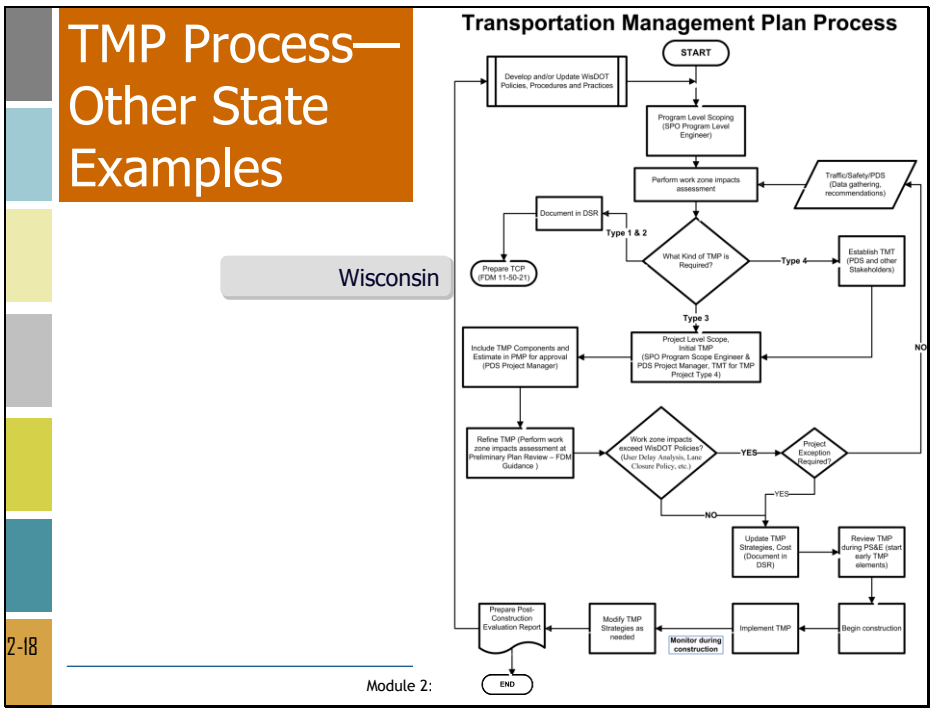


Narrator Notes:
The TMP steps during the three main stages of project delivery are shown in this example, which comes from the FHWA Guide *Developing and Implementing Transportation Management Plans.*

During planning and design the TMP needs are determined and the TMP is developed.

During construction, the TMP is implemented and monitored for impacts and revised as necessary. The TMP may be updated during this time for reasons such as Contractor requested changes to construction phasing or excessive queues at the work zone.

Once the project is completed, a post-project evaluation is conducted to assess TMP performance and lessons learned.



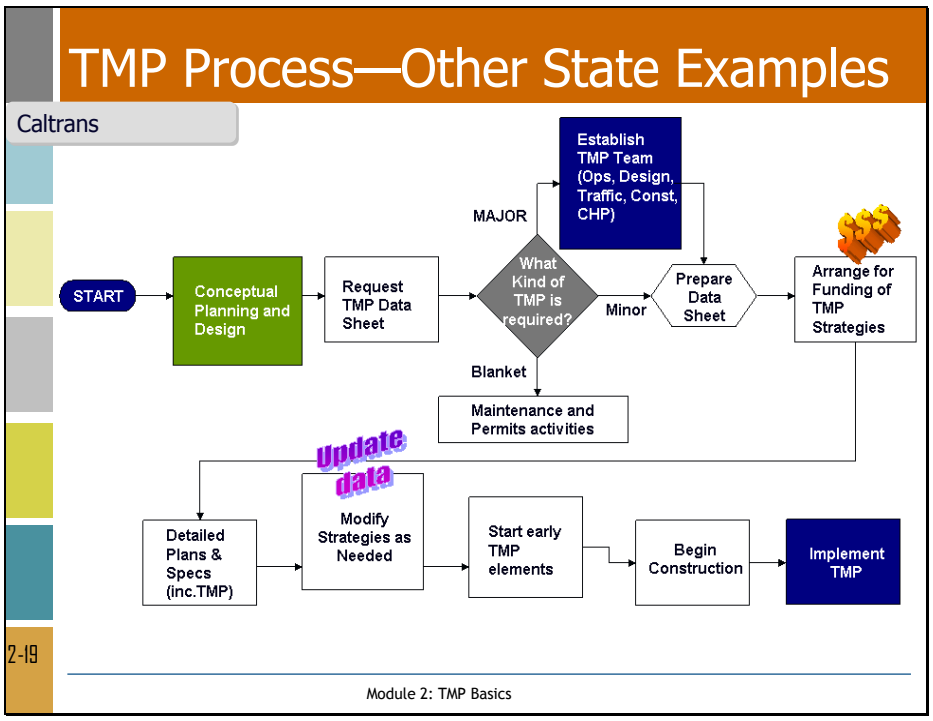
Narrator Notes:
This example illustrates the Wisconsin DOT Transportation Management Plan Process. Wisconsin DOT does a systematic assessment of work zone impacts for construction projects that affect travel lanes. They categorize TMPs into four different types, with types 3 and 4 being significant.

At the program level-scoping phase, a preliminary work zone impact assessment is conducted to determine the type of TMP. A preliminary TMP is prepared at this stage.

During the preliminary plan review stage, work zone impacts are re-assessed for type 3 and type 4 TMPs using formalized guidance called *Lane Closure and Delay Guidelines*. If the impacts are determined to be within Wisconsin DOT policies, TMP update and implementation continues. If the impacts are determined to exceed Wisconsin DOT policies and a project exception is not approved, the TMP strategies are revised and impacts are re-assessed. The goal is to mitigate to the greatest extent possible, safety and mobility impacts to workers and the public.

Some additional information is available in the Participant Workbook

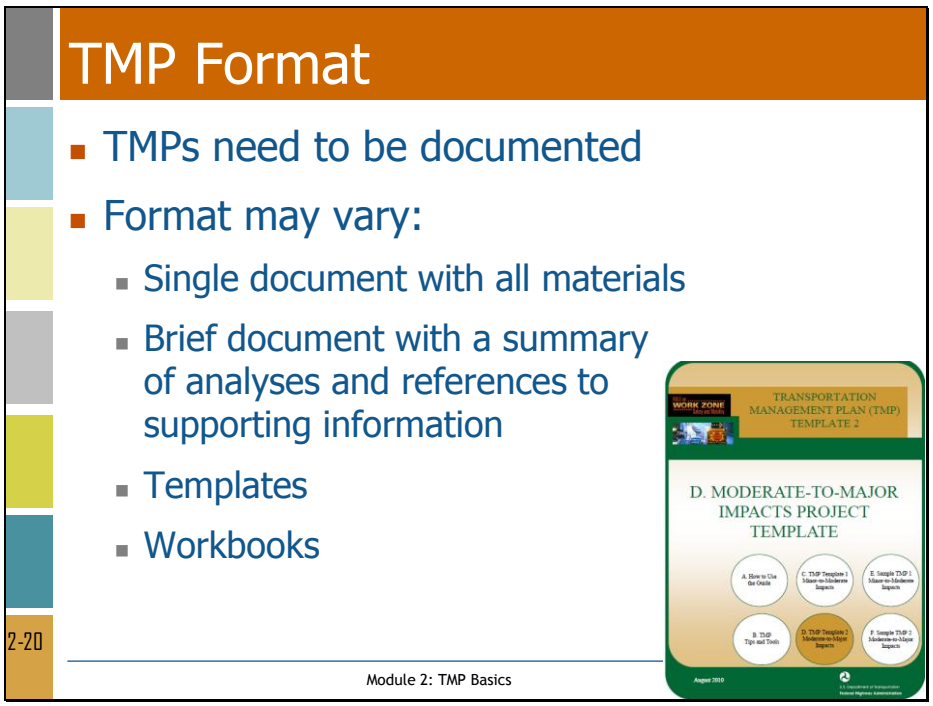
For more information refer to Traffic Analysis Tools Volume IX: *Work Zone Modeling and Simulation Guide for Analysts available at:*
http://ops.fhwa.dot.gov/wz/traffic_analysis/index.htm



Narrator Notes:
This example illustrates the Caltrans TMP Development process.
Caltrans considers the TMP from the conceptual planning and design stages. A TMP datasheet helps to define the project into minor, major, or blanket TMP categories. For all major TMPs, a TMP Team is created to ensure the involvement of key stakeholders in developing the TMP.

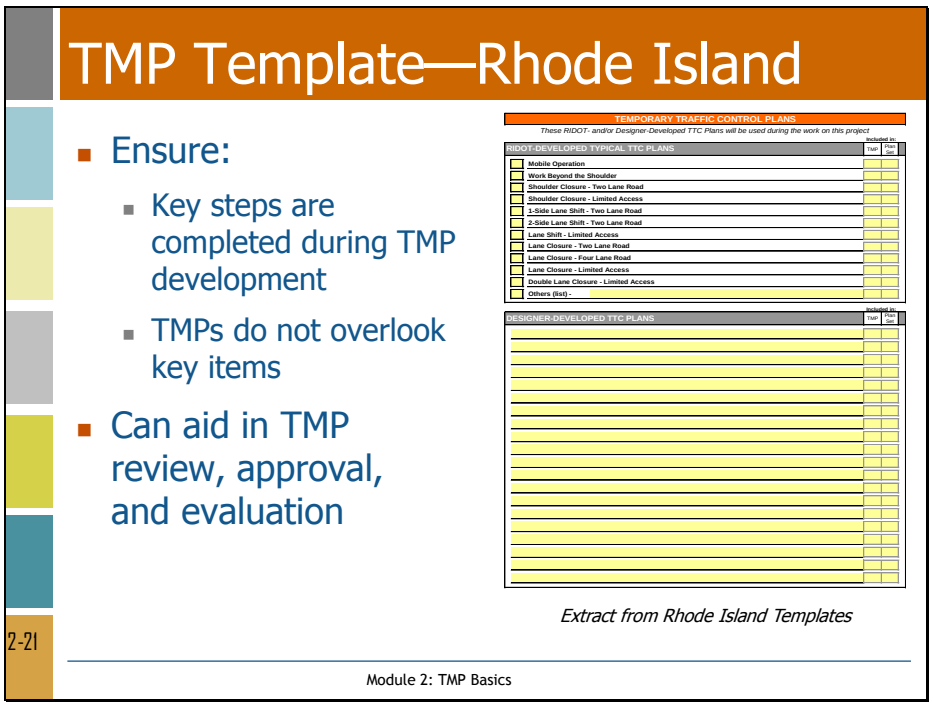
Some additional information is available in the Participant Workbook

Other Information:
From presentation by Traffic Management Branch, Division of Traffic Operations, CALTRANS on Transportation Management Plans - Managing Congestion in Work Zones available at:
http://www.ntoctalks.com/webcast_archive/to_feb_17_05/to_feb_17_05jg.ppt#7



Narrator Notes:
TMPs are a formal plan which can be an all-inclusive document or a summary document with supporting information provided in appendices or project files. The final document format depends on the DOT and its Policy guidelines.

Some States use TMP templates or workbooks to aid staff in developing TMPs. Other States use a typical report format.



Extract from Rhode Island Templates

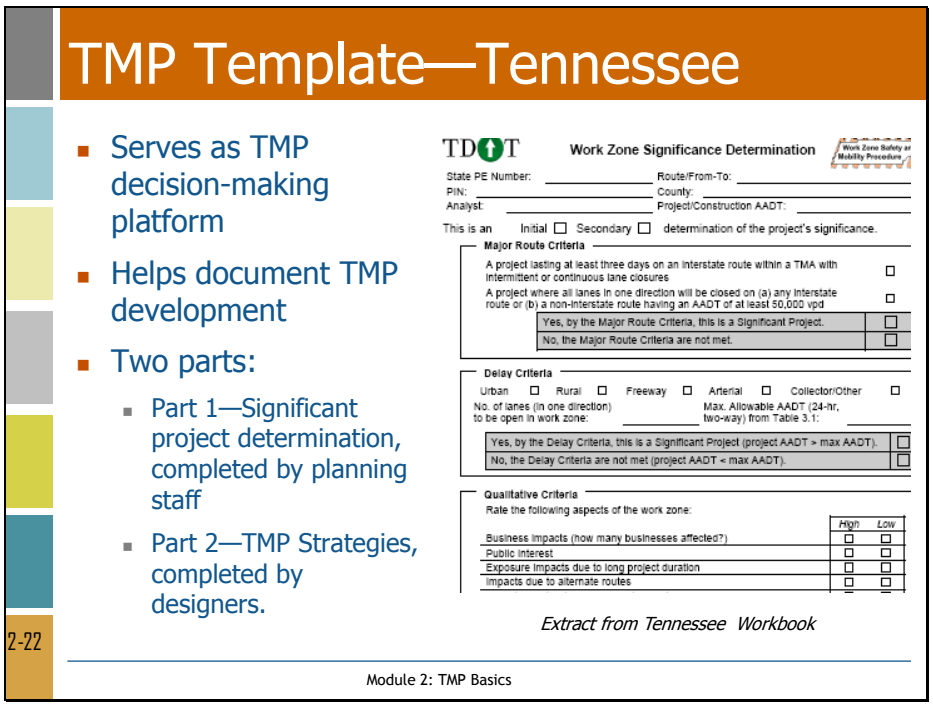
Narrator Notes:
Rhode Island DOT has developed four TMP templates. The template used depends on the impact level of the project, with levels 1 and 2 designated as significant.

Its TMP templates help Rhode Island DOT ensure that key steps are completed during TMP development and that TMPs do not overlook key items. Its templates also help provide some consistency, which can aid in TMP review, approval, and evaluation.

While aiding in consistency, templates can also allow flexibility and vary based on the complexity and level of impacts anticipated for the project.

Some additional information is available in the Participant Workbook

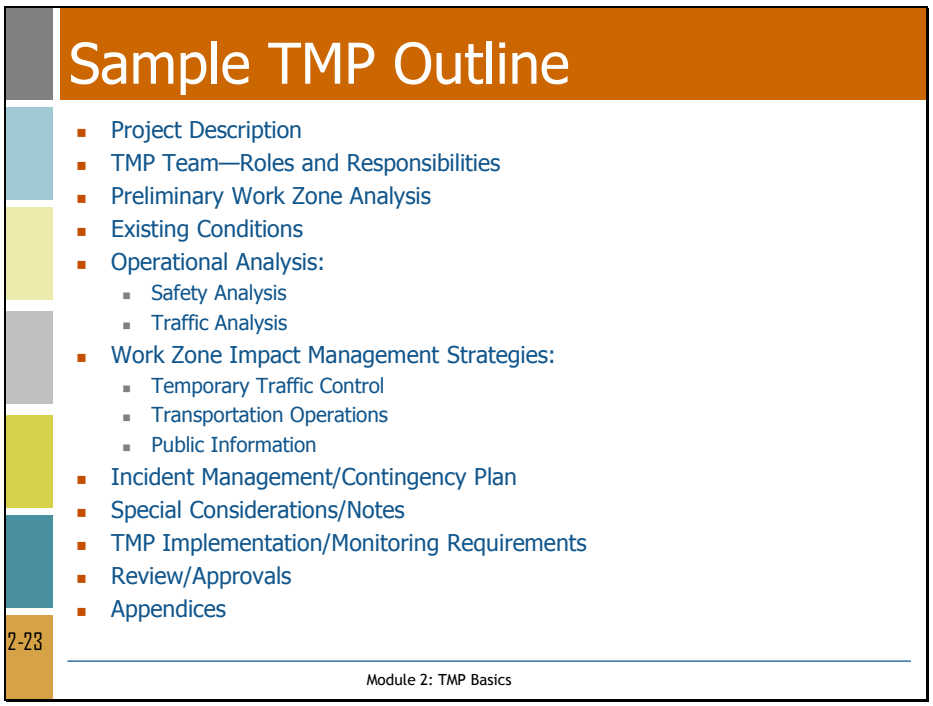
More Information:
For more information on Rhode Island Templates visit:
http://ops.fhwa.dot.gov/wz/resources/final_rule/tmp_examples/ridot_tmps.htm



Narrator Notes:
The Tennessee Department of Transportation developed a TMP Workbook to aid DOT staff in developing TMPs. The Workbook serves as a decision-making platform for the TMP and also helps document TMP development. The first part of the Workbook, Project Significance Determination, is completed by the planning staff, and then the Workbook is passed forward to designers who complete the sections on TMP strategies during project design.

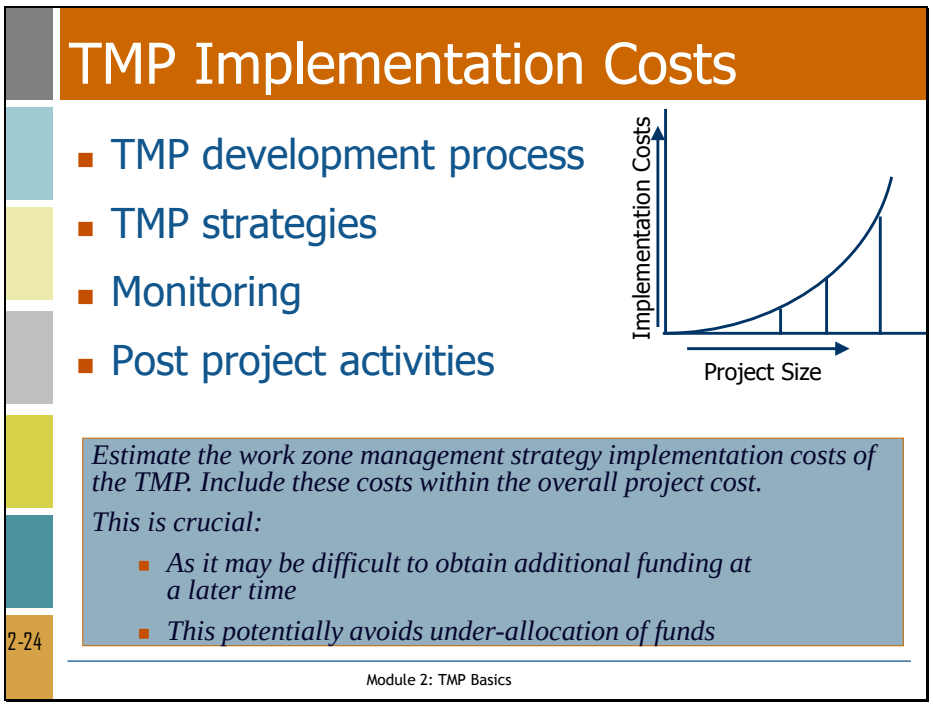
Some additional information is available in the Participant Workbook

More Information:
For more information on Tennessee workbook visit:
http://ops.fhwa.dot.gov/wz/resources/final_rule/tmp_examples/tmp_dev_resources.htm



Narrator Notes:
A typical TMP will contain many of these elements. However, it is important to keep in mind that some TMPs will be relatively simple, while others will be much more involved and detailed. The scope and level of detail depends on a number of factors including whether a project is significant; the potential work zone impacts of the project; and Agency policies, procedures, and guidelines.

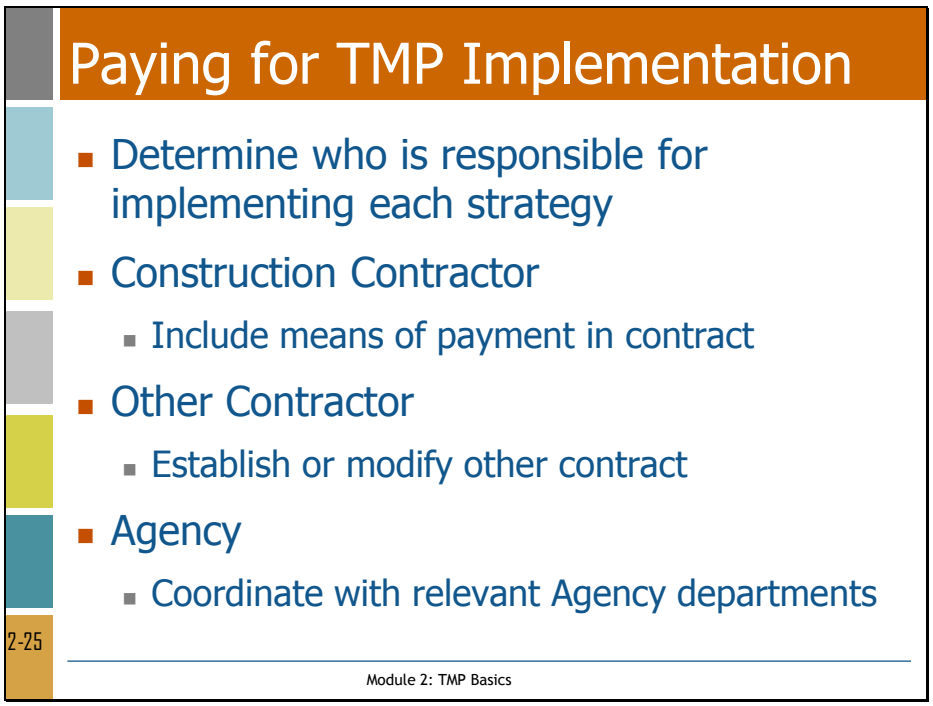
In some States the TMP is a shared responsibility among many Departments. For example, the traffic analysis may be completed by the Safety Office while the traffic control plan may be done by the Traffic Office. This information needs to be conveyed to the TMP developers.



Narrator Notes:
The TMP cost includes the TMP development process, the implementation of the selected strategies, monitoring during construction, and any post project activities. TMP cost will vary based on project size, the extent of project impacts, location, and duration of the project. Generally the larger and more complex a project is, the greater the overall TMP cost.

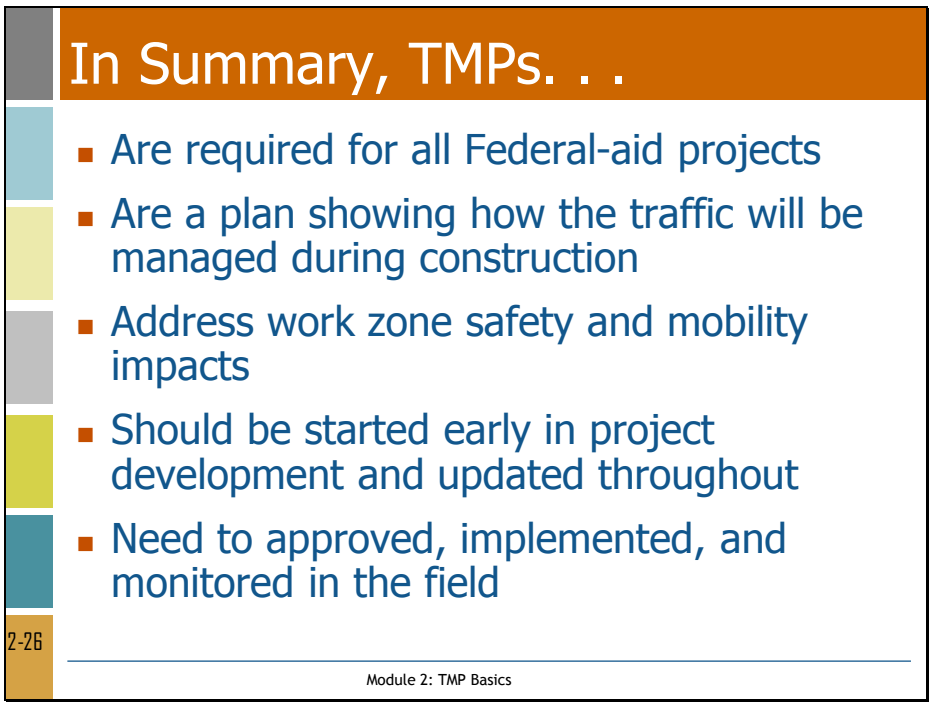
Estimating the costs to implement the TMP and including those costs within the overall project cost is critical, as it may be difficult to obtain additional funding at a later time.

When there is more than one project occurring in an area, it may be possible to share some TMP costs across projects, such as costs for a public outreach campaign or the use of a motorist assist patrol to address disabled vehicles.



Narrator Notes:
Cost estimates for the various TMP strategies should be itemized and documented when feasible, with cost responsibilities, opportunities for sharing or coordinating with other projects, and funding sources specified. TMP strategies can be funded as part of the construction contract, in separate agreements with other Contractors, and within the owner-agency. For example, if one of the TMP strategies is to implement a temporary intelligent transportation system for work zone monitoring and management, the Agency might include that strategy in the construction contract or might implement it through a separate agreement with a consultant or vendor. For public information strategies, an Agency might choose to use a separate consultant contract with a public relations firm or have the outreach strategies done by the Agency's own Public Information Officer.

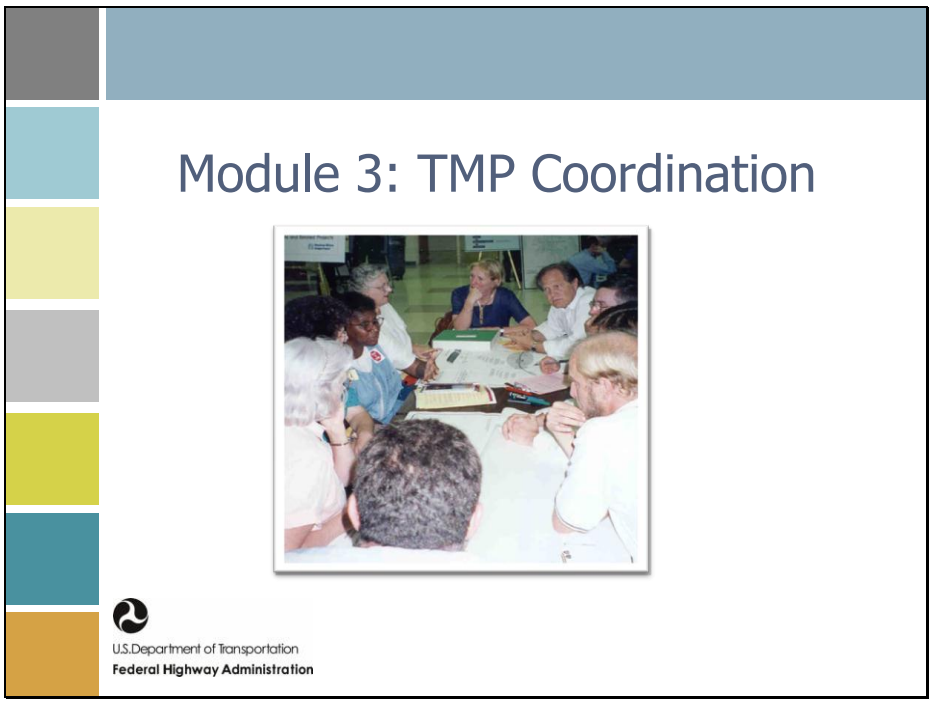
Provisions for a TMP must be included in the project's Plans, Specifications, and Estimates, or PS&Es. The PS&Es must either contain all the elements of an Agency-developed TMP that will be implemented by the construction Contractor, or include provisions for the Contractor to develop and implement a TMP. Specific pay item provisions for the TMP also need to be included. Pay item provisions can be individual pay items, lump sum, or a combination of these methods, or as performance-based specifications that stipulate performance criteria and standards. TMP strategies should not be considered incidental to a contract.



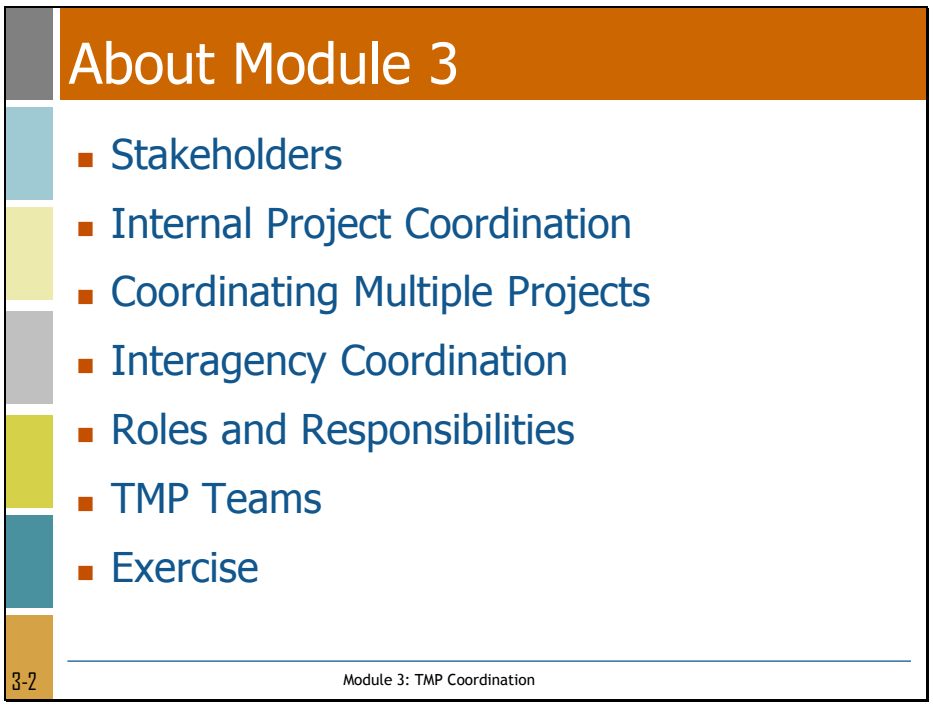
Narrator Notes:
To review what we have learned in this module:

- DOTs must create a TMP for every Federal-aid road project.
- TMPs are a formal plan that shows how traffic will be managed during construction.
- TMPs reduce and manage the safety and mobility impacts of work zones
- Developing an effective TMP is an effort that should be started early in project development, and then updated as the project progresses through preliminary engineering, design, and construction.
- A TMP must be approved by the DOT before implementation. After it is implemented in the field, it needs to be monitored to see if it is effectively managing traffic.

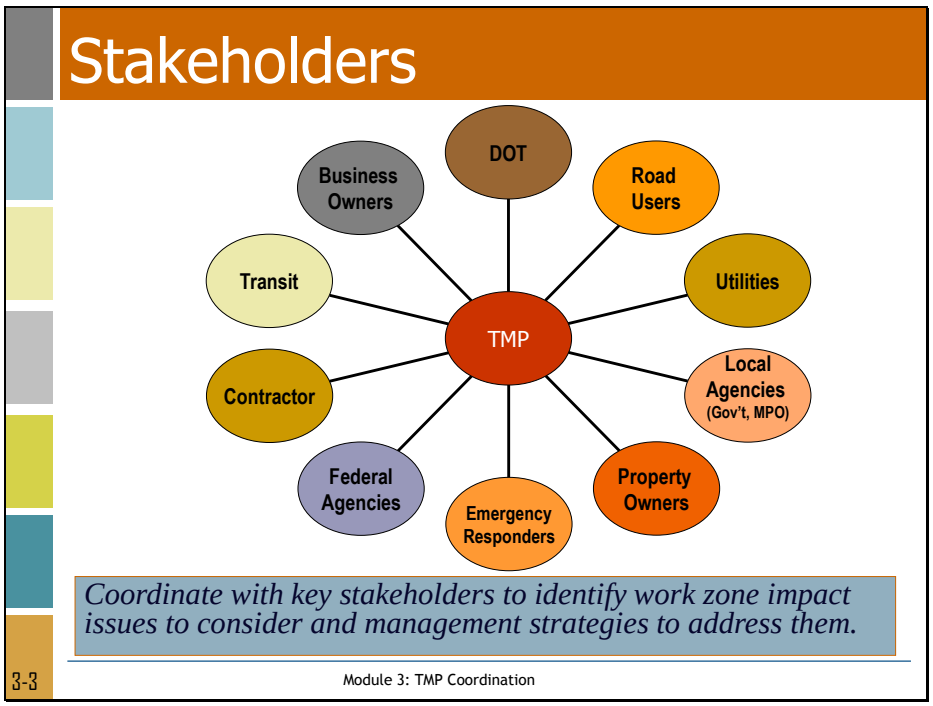
Module 3: TMP Coordination



Narrator Notes:
One important element of an effective TMP is "coordination". This module discusses coordination during the TMP development and implementation process, and the parties that should be involved. The module discusses coordination issues that need to be considered and illustrates ways to achieve coordination while developing TMPs.

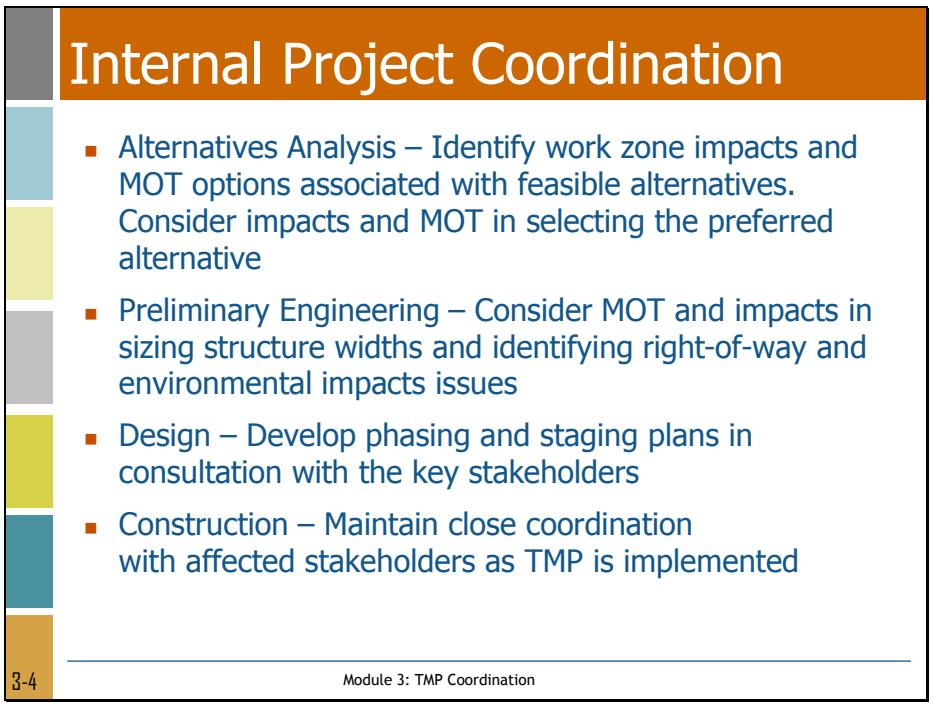


Narrator Notes:
Module 3 discusses stakeholders; internal project coordination; coordinating multiple projects; interagency coordination; roles and responsibilities; and TMP teams. The module concludes with an exercise to help you apply what you have learned.



Narrator Notes:
Coordination within and across Agencies and other stakeholders at different stages of the project is crucial for the successful development and implementation of a TMP. Regular meetings are one way to bring all stakeholders together and share the same information in a timely and accurate manner.

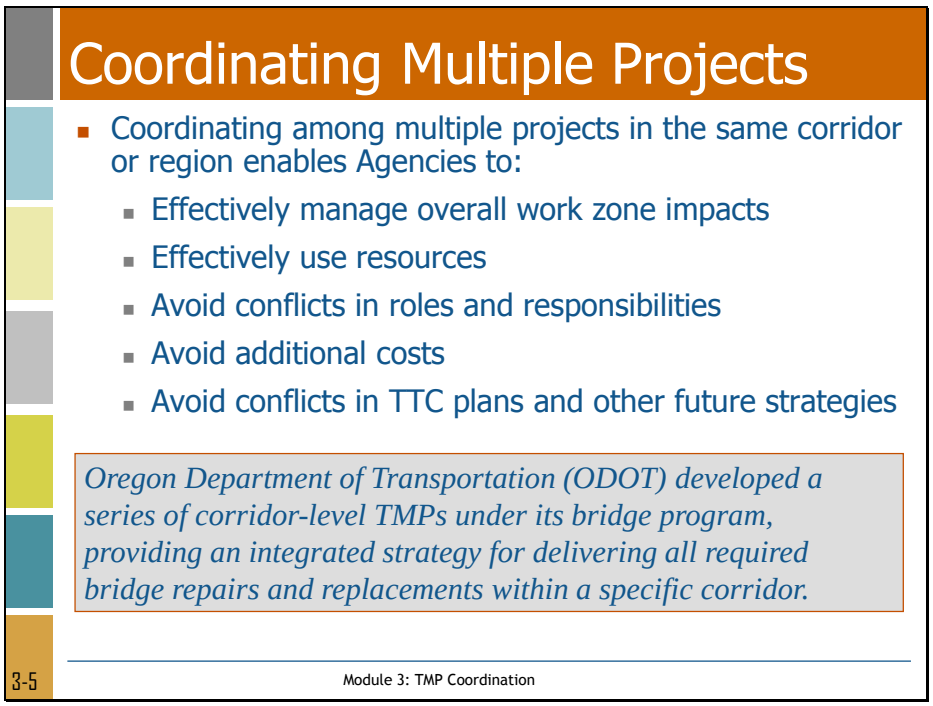
The list of stakeholders needs to be carefully thought out and may include Agencies outside the project jurisdiction. For example, if the project is along an evacuation route, then Federal Agencies like the Department of Homeland Security may need to be notified. Another consideration is emergency response. While coordination with emergency responders is always important, if the project is near a hospital additional stakeholders from EMS need to be at the table. The stakeholders list can be added to as the project progresses and new needs arise.



Narrator Notes:
The TMP is a living document that needs to be developed and adjusted as the project progresses throughout the various phases and even during construction as major changes take place. The more that work zone impacts are considered as project decisions are made through scoping, alternatives analysis, and design, the greater the chance that solutions to traffic issues can be engineered into the design.

In traditional design/bid/build projects, the goal should be to complete most of the TMP by 60% design. The TMP developed needs to be closely coordinated with key stakeholders throughout all stages of design. During construction the TMP manager needs to work closely with the contractor and affected stakeholders as major updates/changes can result due to post design changes.

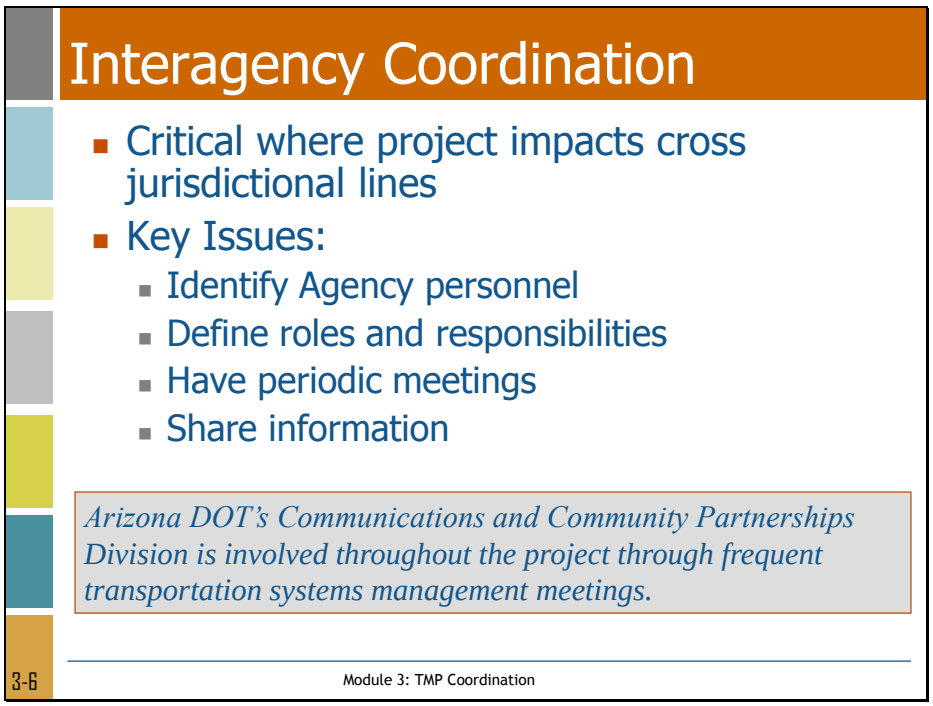
For design-build projects, the TMP should be developed within 30-60 days of notice-to-proceed (NTP) and should lay out the procedures and process to be followed in the future design phases.



Narrator Notes:
Coordination among owners of different road projects that can affect each other is crucial to achieve the objectives of any TMP. Poor coordination can result in significant traffic delays, conflicting messages leading to unsafe driving conditions, and a public relations "nightmare" - things that can be avoided with good, proactive coordination.

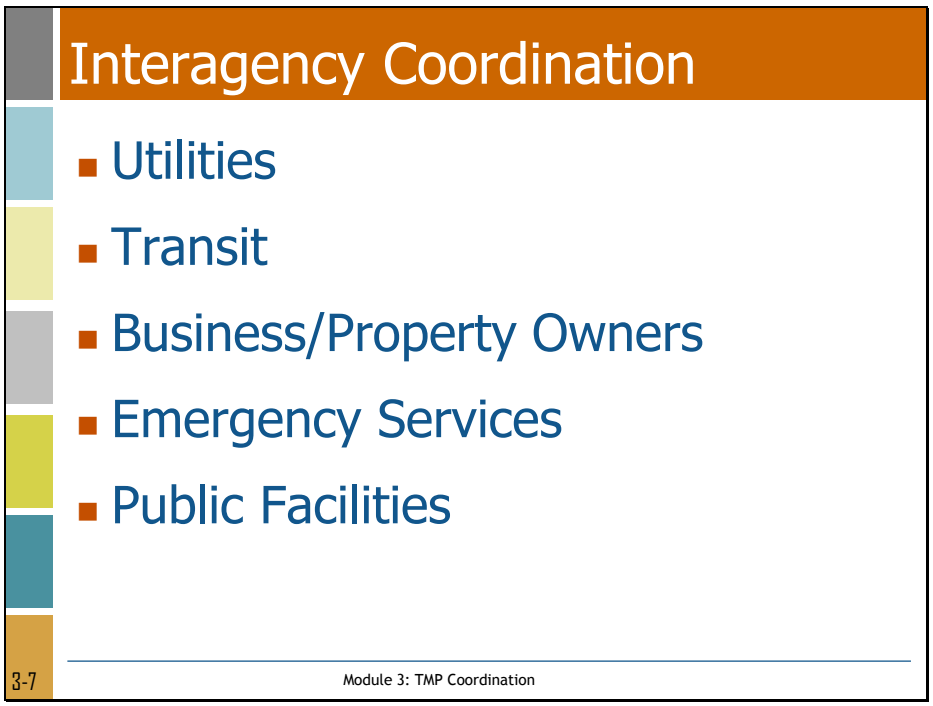
So it is important to consider the impacts of other concurrent construction projects in the area. The TMP process can help foster this coordination by bringing common stakeholders together. Project schedules can be coordinated and public outreach efforts and traffic management efforts can sometimes be shared across projects.

In some cases, Agencies have developed a regional TMP to help coordinate efforts across all the projects in an area or on a corridor. Oregon DOT's corridor level TMP approach ensures that all the projects and their individual project TMPs within the corridor are integrated, resulting in less conflict and more efficient use of resources.

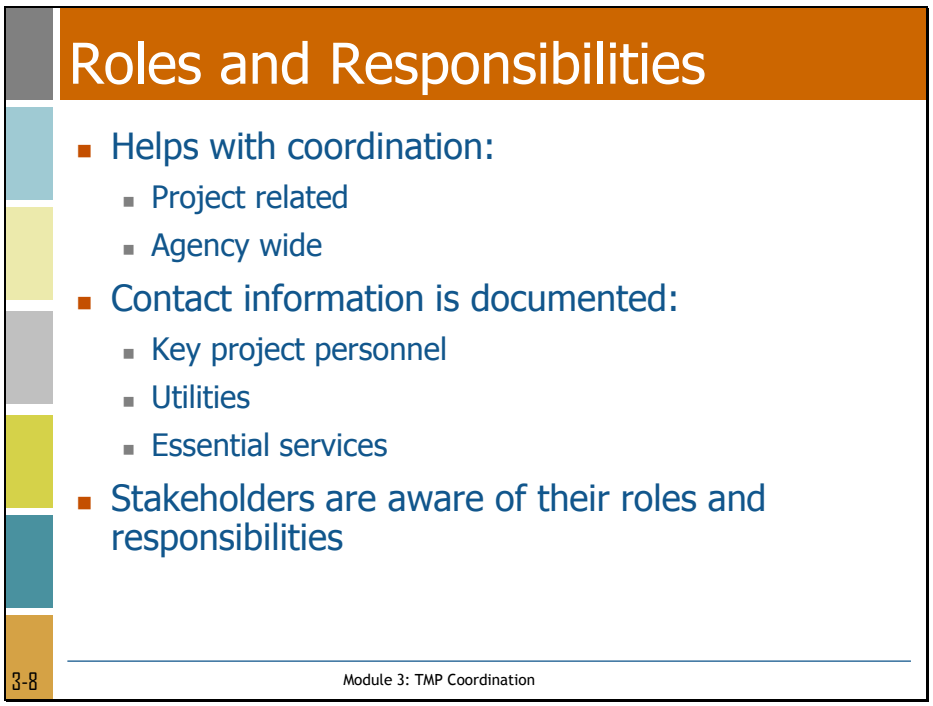


Narrator Notes:
Interagency coordination depends on the project size, area, location, and impacts. Often a significant project that is within 25-50 miles of a State border may affect the adjacent State. In large urban areas, where towns are right next to each other, projects done at the local level and permit projects such as utility work particularly require interagency coordination. Honest and open communication is the key to solicit interagency support.

For example, Arizona DOT's Communication Division has frequent management meetings with all Agencies involved in nearby projects.



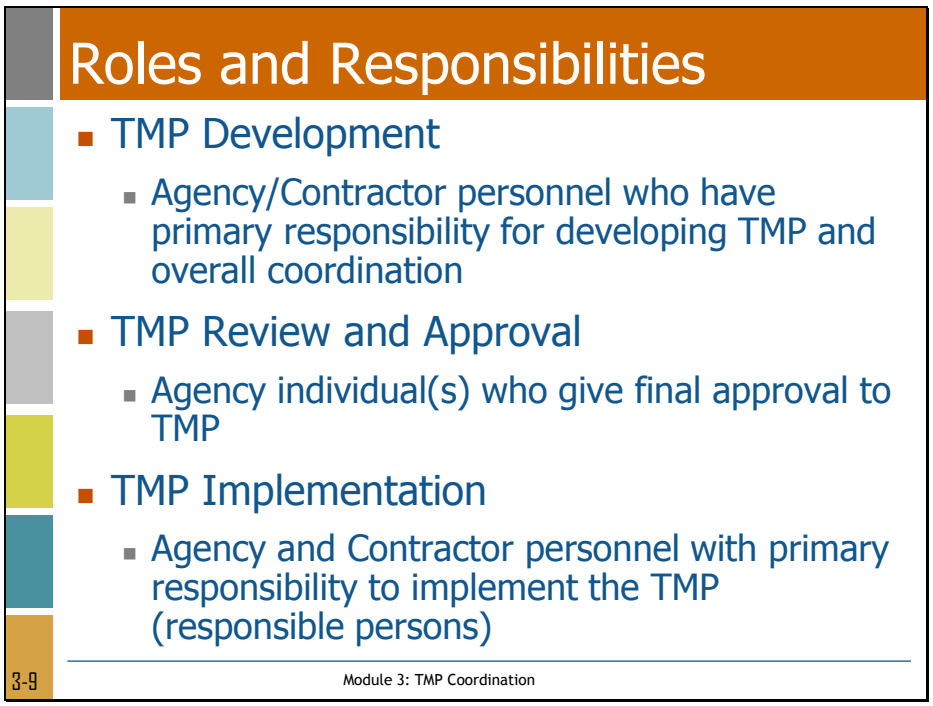
Narrator Notes:
Coordination with other stakeholders can also be critical at various stages of projects. Other stakeholders may include utility companies, transit providers, businesses, emergency services, and large public facilities such as schools and sports stadiums.



Narrator Notes:
Defining roles and responsibilities during TMP development is key to successful project coordination. Roles and responsibilities are defined Agency wide and on a project-by-project basis.

Documenting the contact information and roles and responsibilities in the TMP helps ensure that the stakeholders are aware of their roles and responsibilities. This also helps the TMP Manager or any other TMP-related personnel to easily access the contact information, as needed. This information will also be very helpful in bringing any key project replacement personnel up to date.

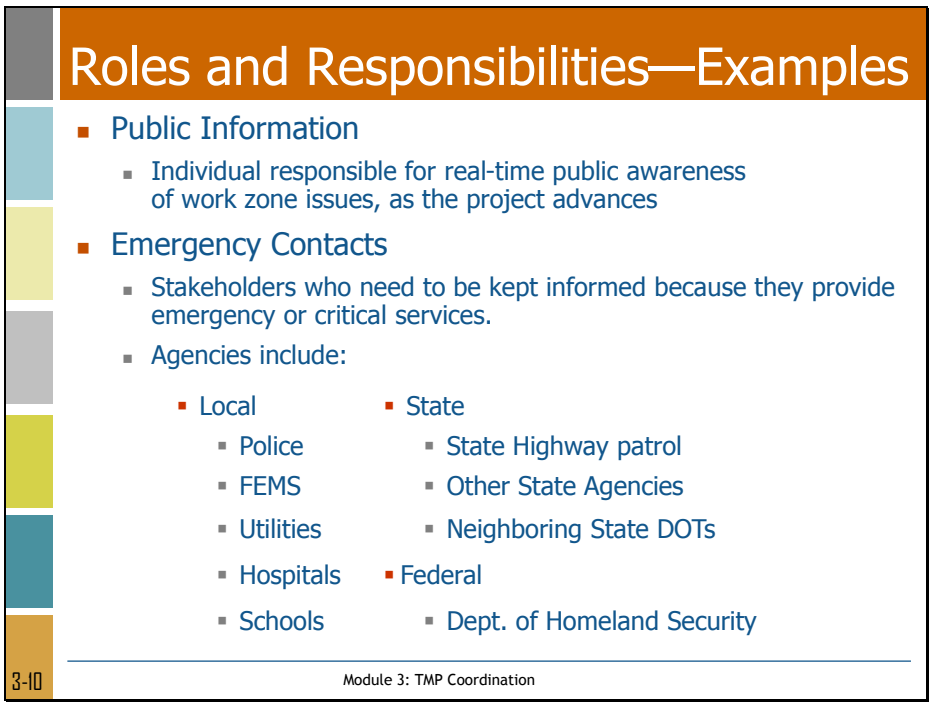
In cases where the roles and responsibilities are not well defined and/or all contact information is not available at the beginning stages of the project, the information can be filled in as the project progresses.



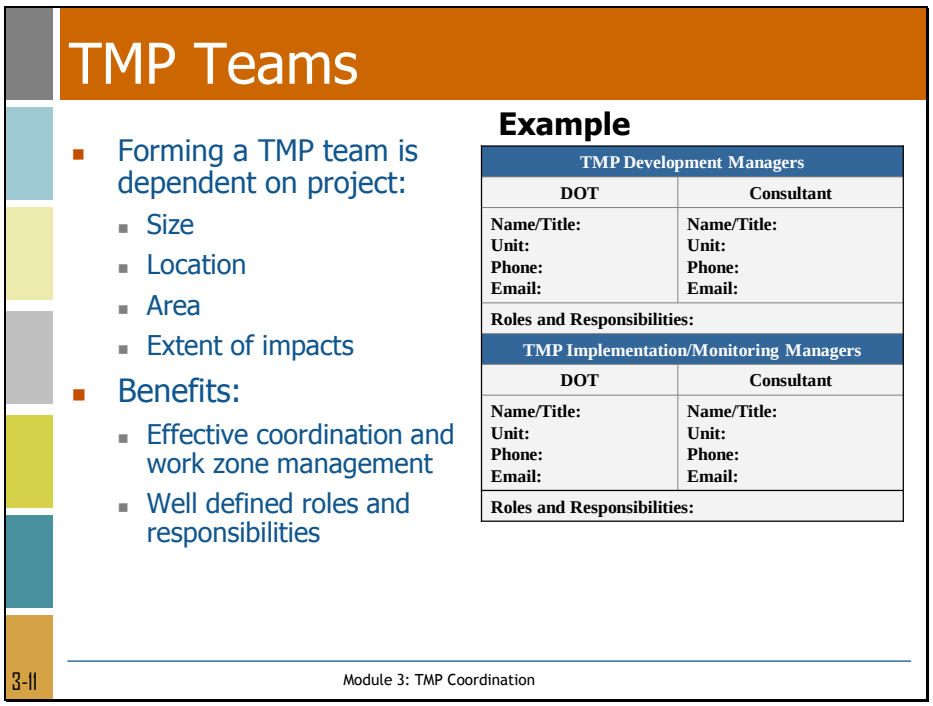
Narrator Notes:
The general roles and responsibilities related to TMPs can be thought of in three categories: development, review and approval, and implementation. The development of a TMP involves steps such as consulting with stakeholders, assessing potential work zone impacts, and identifying strategies to help manage the impacts. TMP development may use a team approach, particularly for larger projects.

All TMPs must be approved before being implemented. DOTs have to determine within their job classification, where these responsibilities should be assigned. In some cases, the same person can be used on multiple roles although this should be minimized to avoid a conflict of interest.

TMP implementation requires trained responsible personnel with sufficient knowledge and authority to implement the various elements of the TMP. Both the Agency and the Contractor are required to designate a "responsible person" for this purpose.



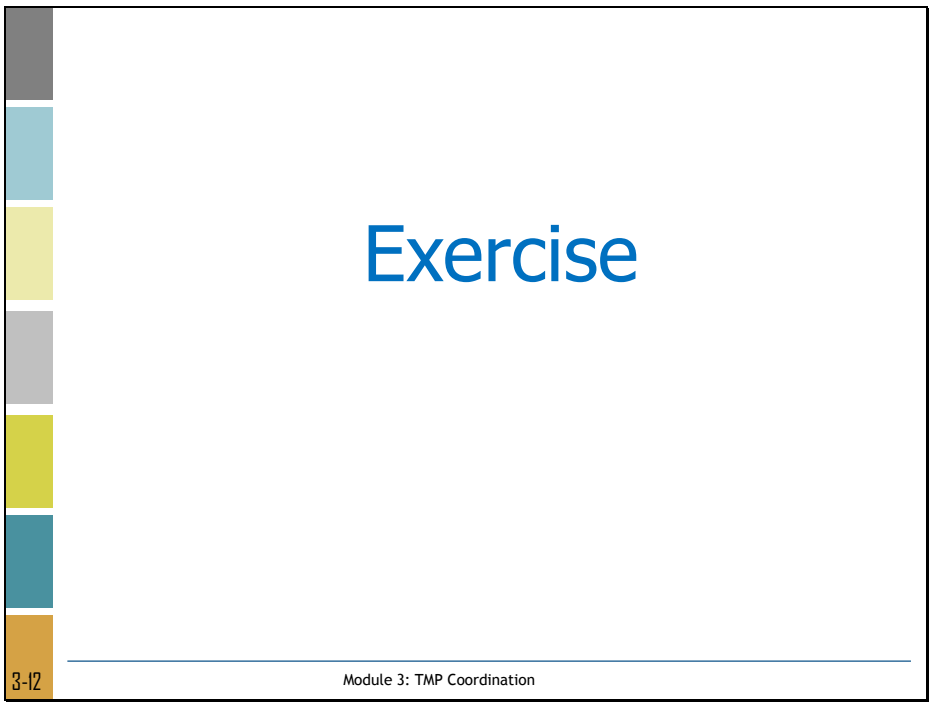
Narrator Notes:
The list of stakeholders affected by a road project can be extensive. Stakeholders may include those who perform public outreach, provide emergency services, and enforce laws, to name a few. Many times key persons are left out. Often engineers think only within their own jurisdictions, while the project impacts can extend to other Agencies, jurisdictions, and even other States. The key stakeholder's roles need to be clearly defined and contact information available for use at a moment's notice.



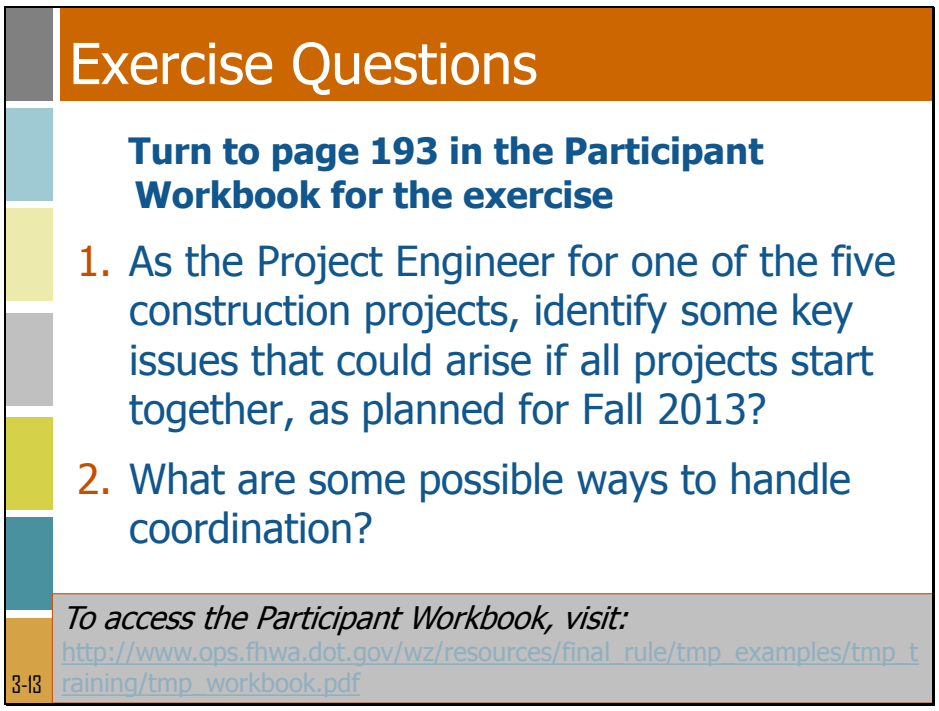
Narrator Notes:
Forming a TMP team to help with TMP development, coordination, review, and implementation can be helpful. Several States use TMP teams, primarily on significant projects.

A well-balanced team includes a range of appropriate stakeholders. Regular team meetings including the project designer, resident engineer, law enforcement officials, contractor, community representatives, and other stakeholders on major projects can help ensure that work zone management will be effective. A preliminary meeting of this type during the early stage of TMP development helps to identify potential work zone issues early in the process, and to clearly define roles and responsibilities.

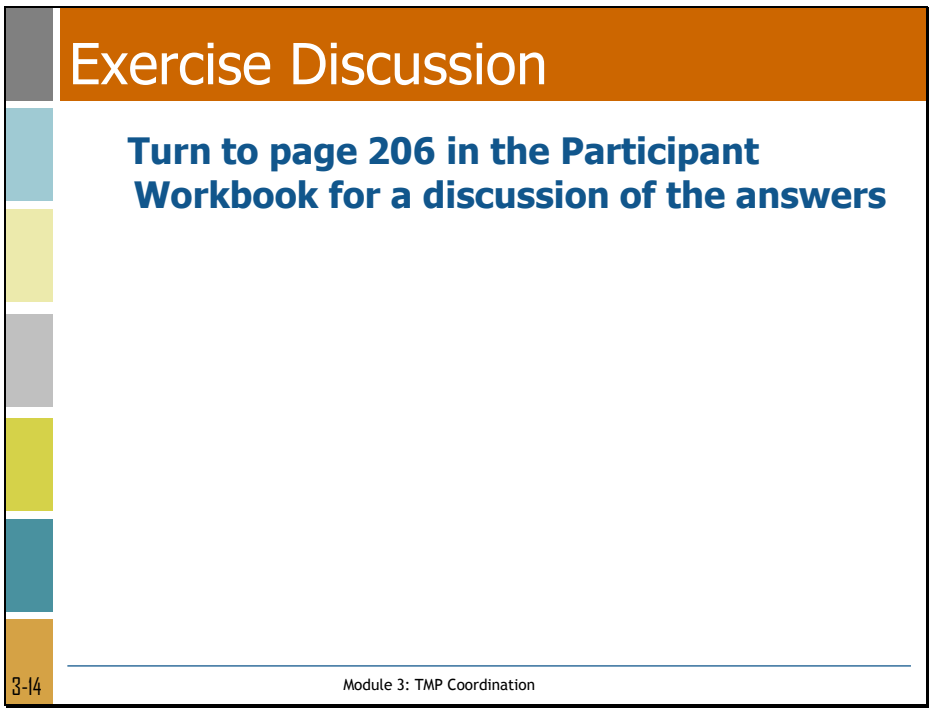
The sample table shown here can be useful for documenting the contact information and roles and responsibilities of TMP team members. The table can be modified as the TMP progresses.



Narrator Notes:
Now that you have completed Module 3, this exercise will provide you with an opportunity to apply what you have learned.

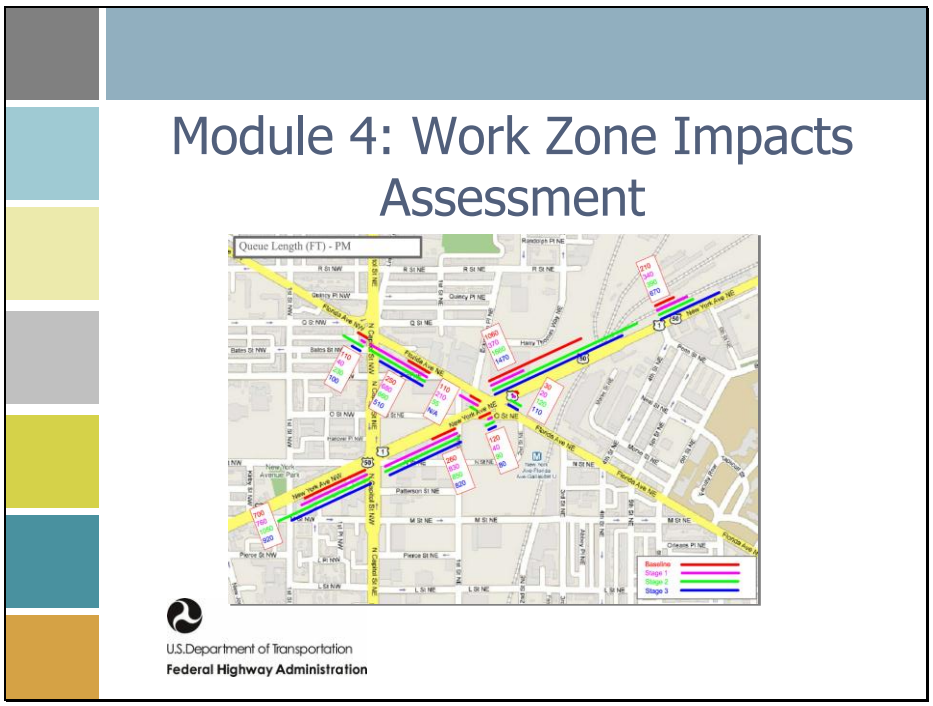


Narrator Notes:
Please turn to page 193 in Appendix C in the Participant Workbook. After reading the exercise, please answer the questions on this slide.

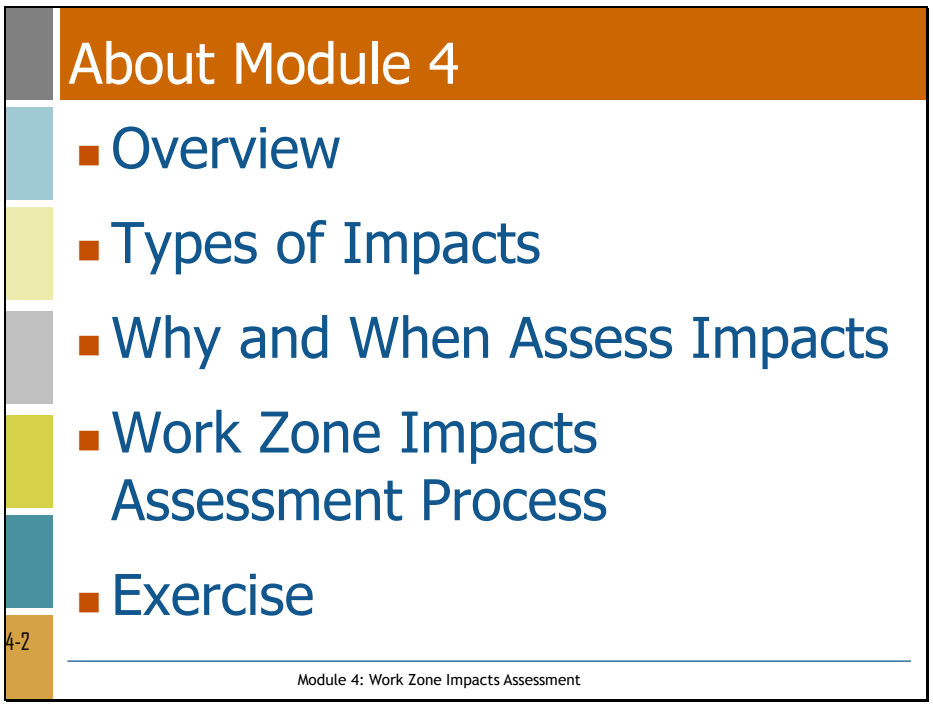


Narrator Notes:
Once you have finished answering the questions, turn to page 206 in the Participant Workbook for a discussion of the exercise answers.

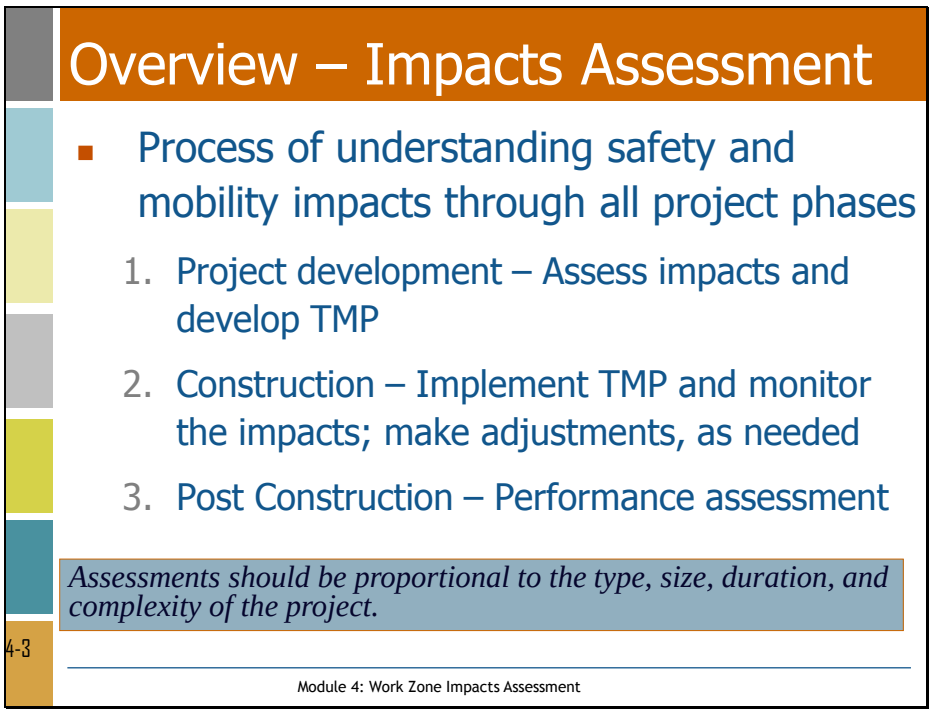
Module 4: Work Zone Impact Assessment



Narrator Notes:
This module focuses on a work zone impacts assessment process and benefits during the project development and delivery stages. An important part of TMP development is having a good understanding of what work zone impacts are likely for an upcoming project. This understanding is critical to identifying what strategies are needed for the TMP.



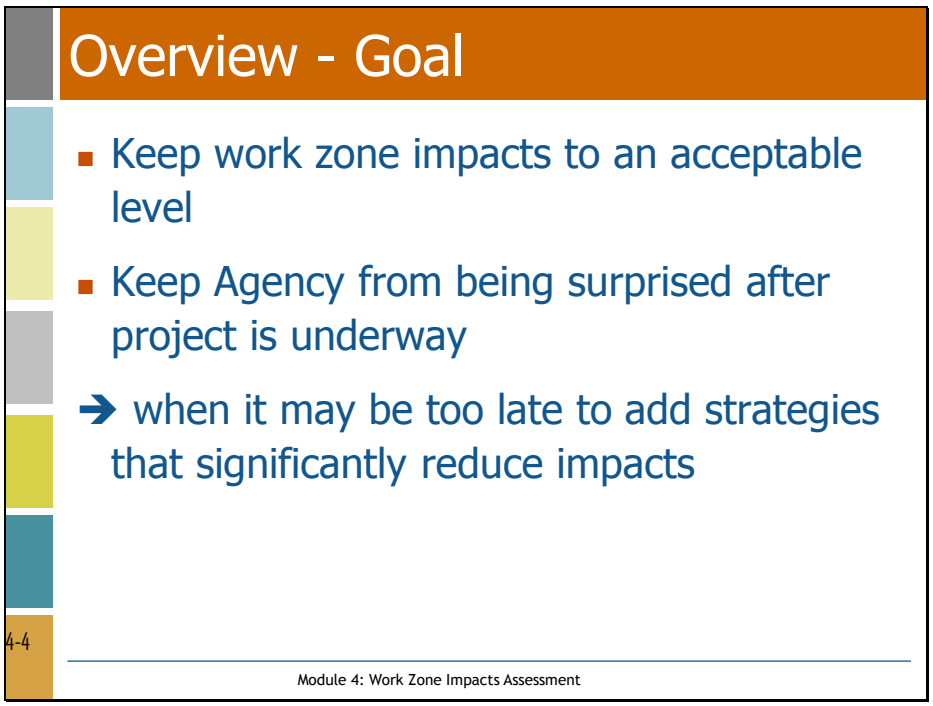
Narrator Notes:
Module 4 provides an overview of work zone impacts assessment, then discusses the types of impacts; why and when to assess impacts; and a process that can be used for work zone impacts assessment. The module will end with an exercise to help you apply what you have learned.



Narrator Notes:
Work zone impacts assessment is the process of understanding the safety and mobility impacts of a road project, whether new construction or a rehabilitation project. This is conducted during three project stages:

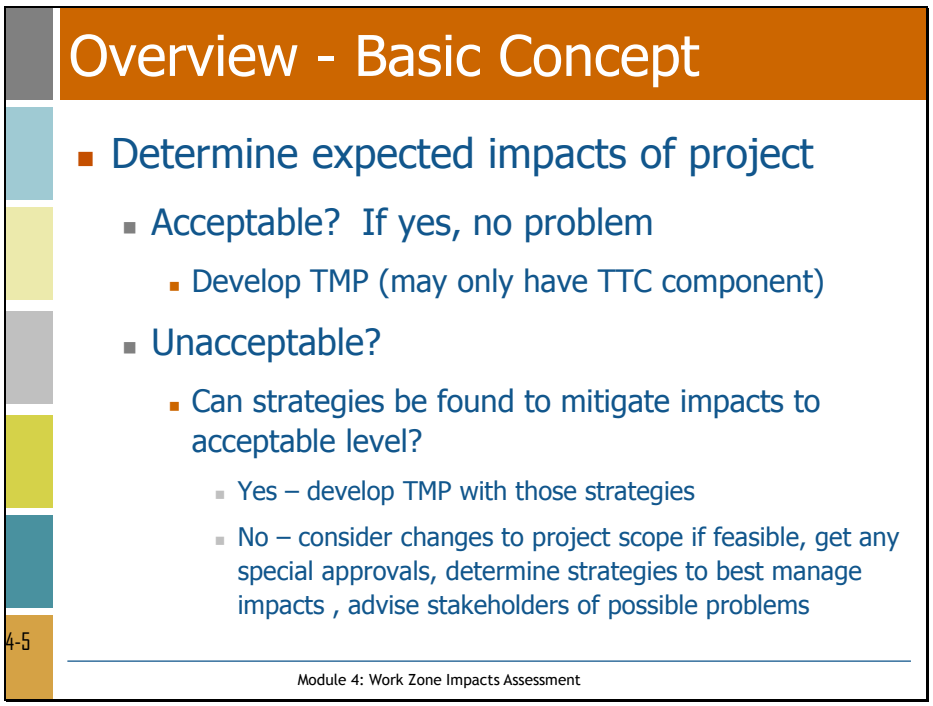
- During project development, the likely work zone impacts are estimated and where possible mitigated.
- During construction, the TMP is implemented and the actual impacts are gauged against what was expected. If actual impacts are greater than allowable, alternative work zone strategies may be implemented.
- Following project completion an assessment is helpful to determine what worked and what did not. The results of the assessment should be used to improve future TMPs.

The idea of conducting a work zone impacts assessment for every alternative may seem daunting. However, the assessment should be proportional to the type, size, duration, and complexity of the project. For many projects a qualitative assessment may be sufficient, with a quick identification and documentation of work zone impacts issues. The screening of small projects or those likely to have minimal impacts could be done with templates or simplified tools so that analysts can concentrate their efforts on projects that are likely to cause greater impacts.

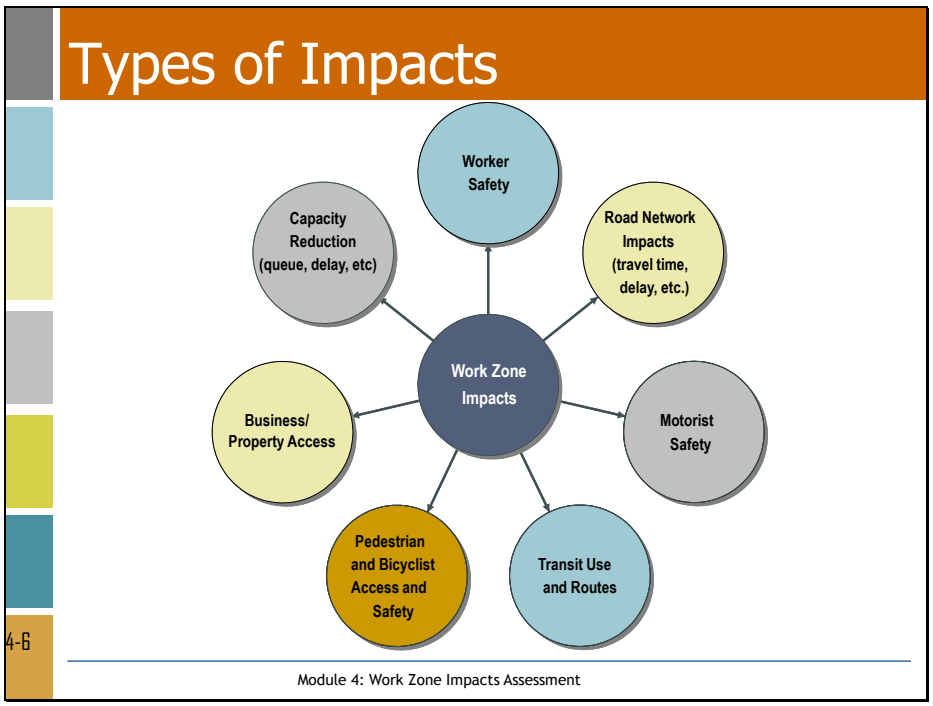


Narrator Notes:
A good impacts assessment will consider potential impacts due to the work zone from the early stages of the project and will develop appropriate strategies to mitigate those impacts or at least keep them within the Agency thresholds.

It will also help keep the Agency from being surprised by unexpected traffic issues after the project is underway. Unexpected traffic issues can put the Agency in the news in undesirable ways, and are usually more difficult to fix once the project is underway.



Narrator Notes:
When the identified impacts are unacceptable, the TMP will be more comprehensive. If the impacts are acceptable, the TMP may only contain the temporary traffic control plan. This is a very basic TMP. When the anticipated impacts exceed acceptable levels or the Agency's thresholds, the design team needs to take additional steps to manage these negative impacts.

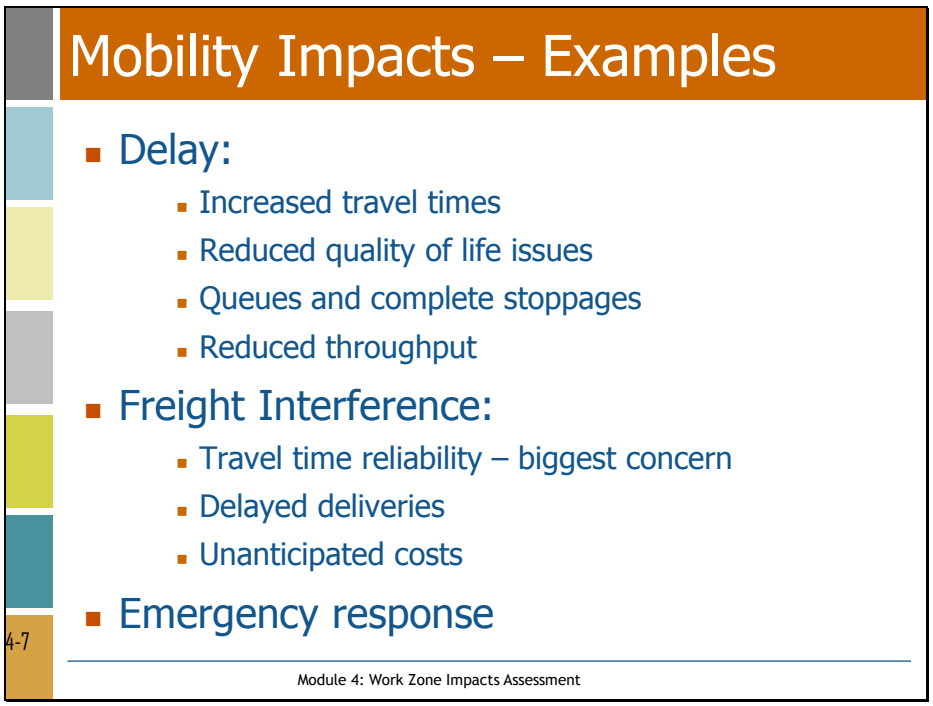


Narrator Notes:
Work zones can cause a variety of impacts that affect different stakeholders.

Worker safety is critical since workers are subject to the direct dangers of moving traffic. Motorist safety is critical as drivers are subjected to unfamiliar driving conditions in work zones. Work zone capacity reductions impact the mobility of traffic, including freight, leading to queues and delays that can reduce mobility.

The transportation network is impacted when a work zone can't serve all the demand, or detours traffic to surrounding roads. Depending on the location, size, and complexity of a project, a work zone can also impact the access, mobility, and safety of pedestrians, bicyclists, transit users, and business and property owners, as well as emergency services.

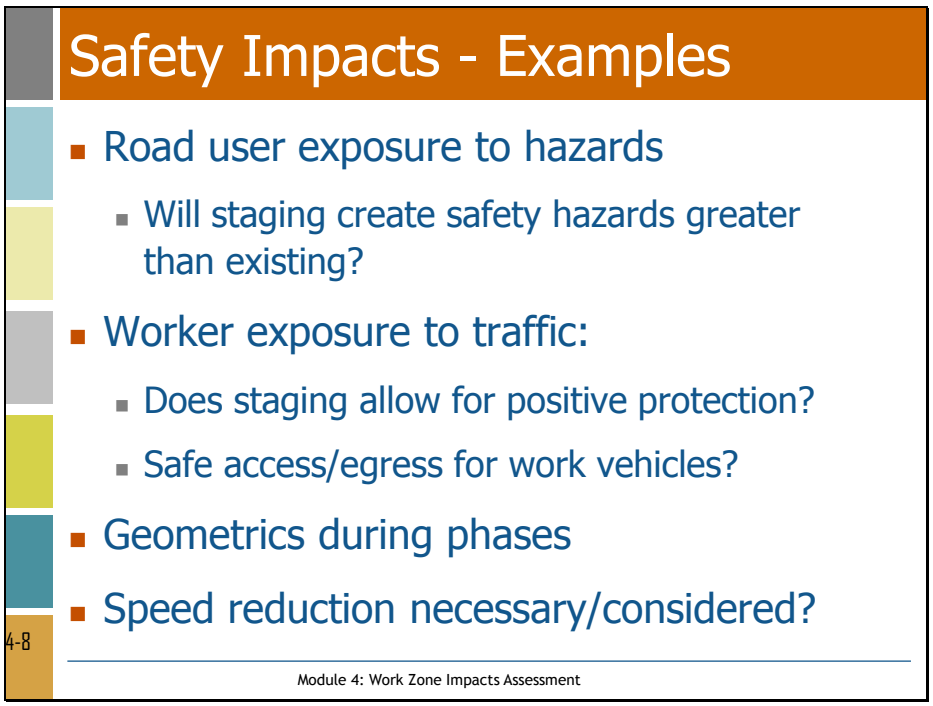
A work zone impacts assessment should consider all the potential impacts.



Narrator Notes:
One of the key concerns of any work zone is the mobility impacts. Traffic delays and queues through a work zone can impact road users in many ways such as:

- Increase travel time for road users
- Increased time for emergency response
- Higher emissions resulting in reduced quality of life, and
- Aggressive driving as a result of longer queues.

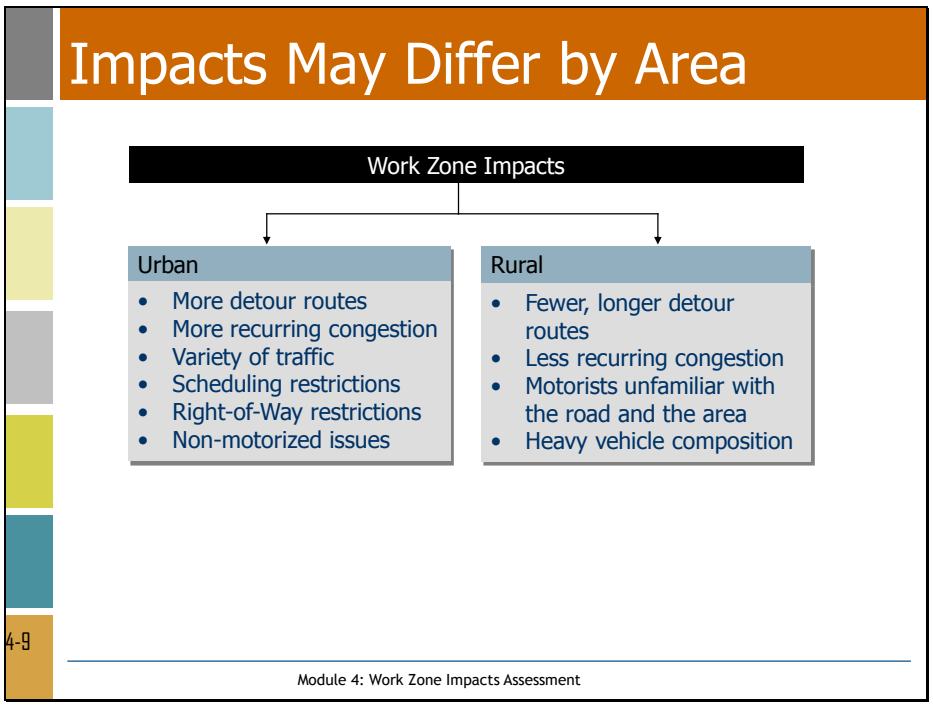
Trucks carrying freight can also be delayed, resulting in delayed deliveries and unanticipated costs. Work zone mobility impacts can also delay construction vehicles trying to reach the job site, delaying delivery of materials and reducing productivity.



Narrator Notes:
Similar to mobility impacts, safety impacts need to be considered and managed or eliminated. Road users may encounter unsafe conditions due to:

- Lack of positive guidance within work zone,
- Signage and sign spacing not suitable to the prevailing speed,
- Sudden lane changes and other geometric changes,
- Inadequate worker protection, and
- Inadequate lighting for night work either for workers or at key driver decision points.

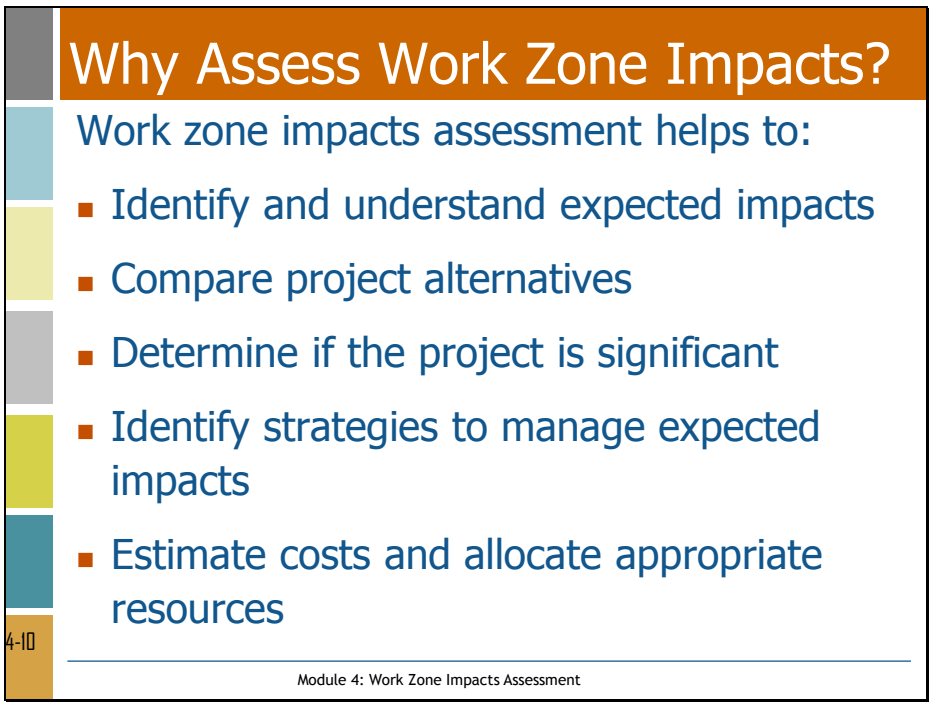
In some situations, such as where geometrics change, the speed limit may need to be reduced and accompanied by visible enforcement.



Narrator Notes:
Work zones in different areas can lead to different impacts and challenges.

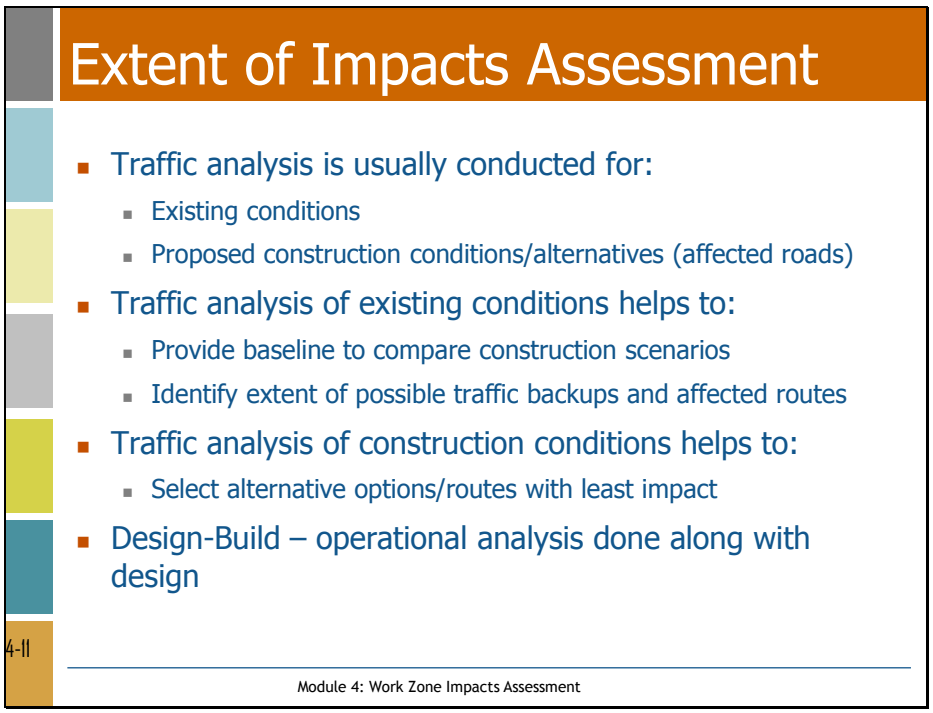
Urban areas have developed networks which may allow traffic to be detoured easier than in rural areas. But urban areas are also more likely to be congested and have more traffic modes such as pedestrians and transit, making the phasing of temporary traffic control a greater challenge.

Rural areas have fewer or longer alternate routes, making it difficult to detour traffic. Also in rural areas, it may be more difficult to inform motorists unfamiliar with the road and the area.



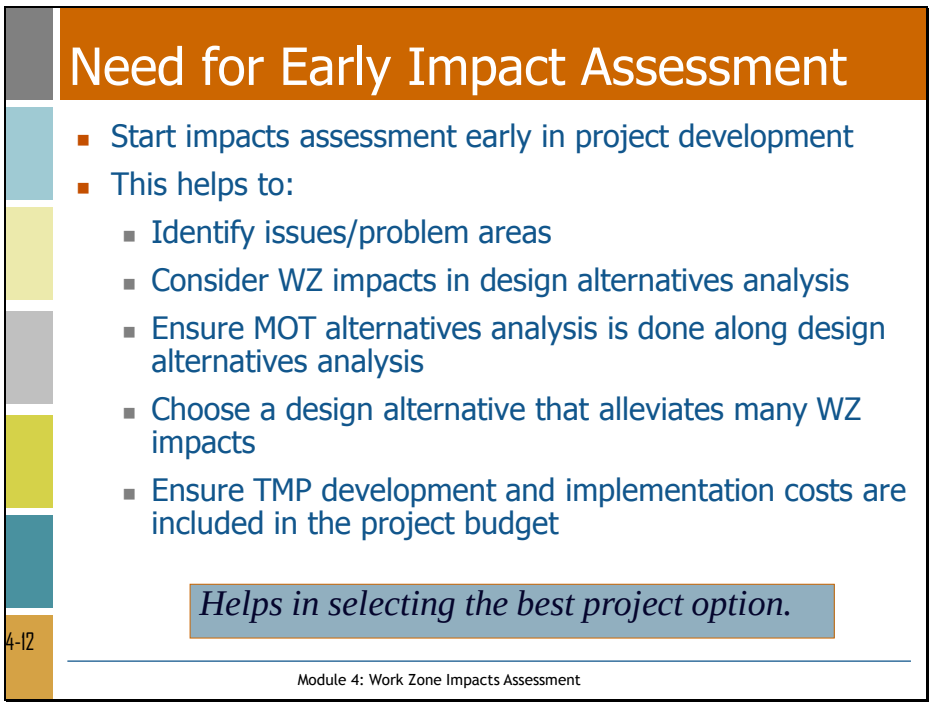
Narrator Notes:
A work zone impacts assessment helps to identify potential work zone issues that could arise due to the proposed project scope and design and brings them to the attention of the Agency, project team, and other stakeholders. The assessment estimates the work zone impacts of various build options so they can be considered during alternatives analysis.

Once an alternative is selected, impacts assessment helps an Agency determine if the project is a significant project and identify strategies to manage the likely impacts. It also provides an opportunity for the Agency to estimate costs early, and thus helps to avoid any under allocation of funds for TMP implementation.



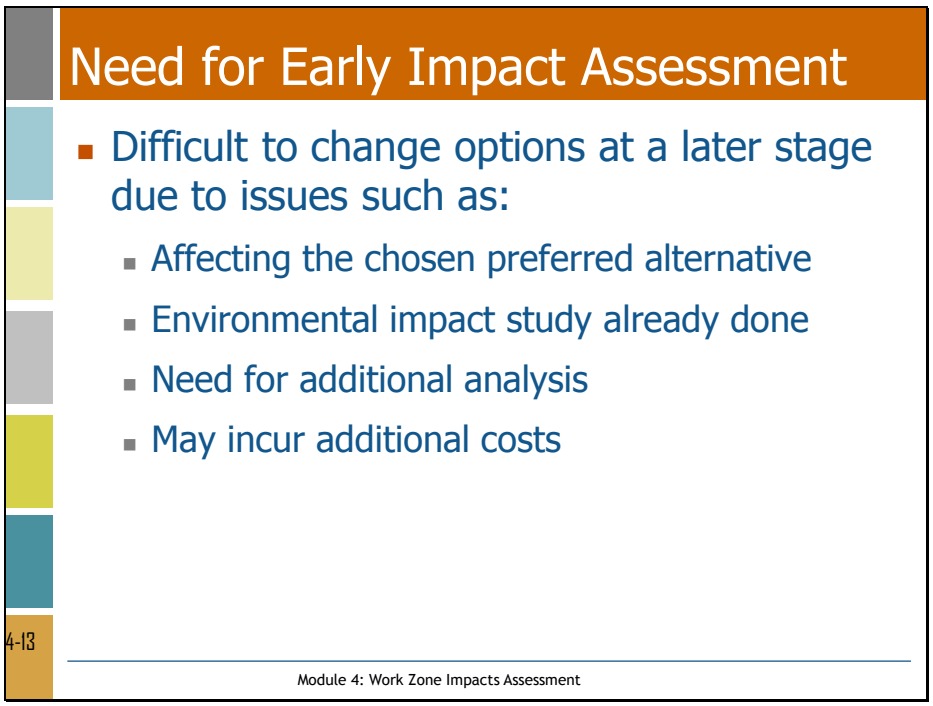
Narrator Notes:
The extent of an impacts assessment is determined by Agency guidelines. A detailed assessment including traffic analysis is more often done for significant projects with moderate-to-major level of impacts. During analysis, existing conditions are compared with proposed work zone alternatives to determine where traffic delays or queuing may occur. This type of analysis allows the work zone designer in modeling his design prior to implementation and so identify the level of impacts on various routes and locations.

In Design-Build projects, the construction proceeds along with the design. In such cases, often the operational analysis is done alongside the design, within a few weeks of actual construction. The inclusion of clear processes and procedures in the contract requirements are needed to ensure that the Contractor undertakes impact assessment, identifies any negative impacts, and implement strategies to alleviate those impacts.

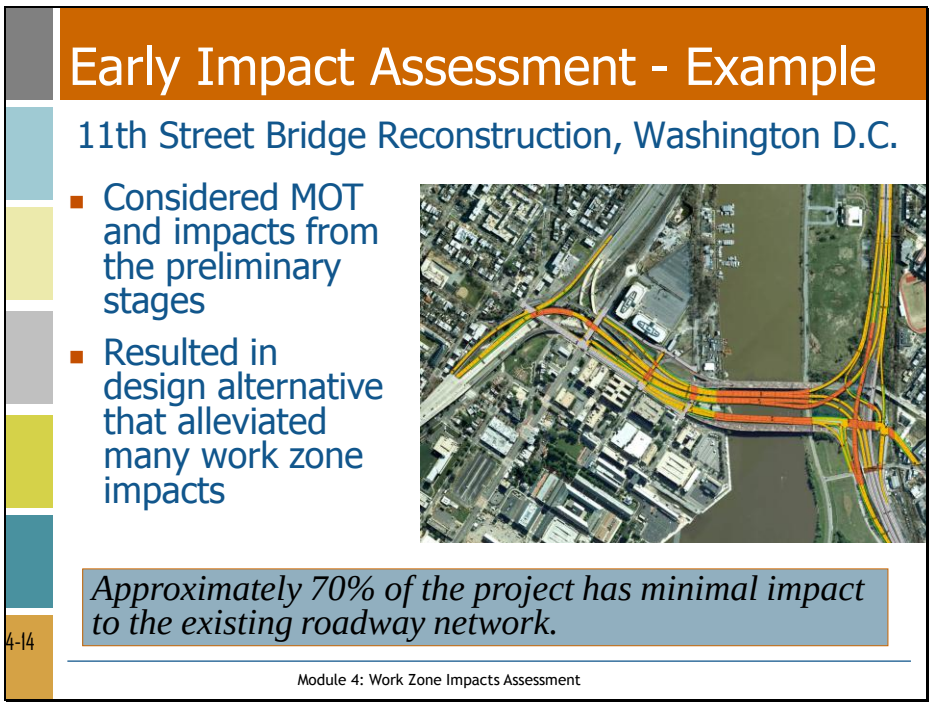


Narrator Notes:
Beginning work zone impacts assessment early in the life of a project can significantly increase the chances of successful traffic management for the project.

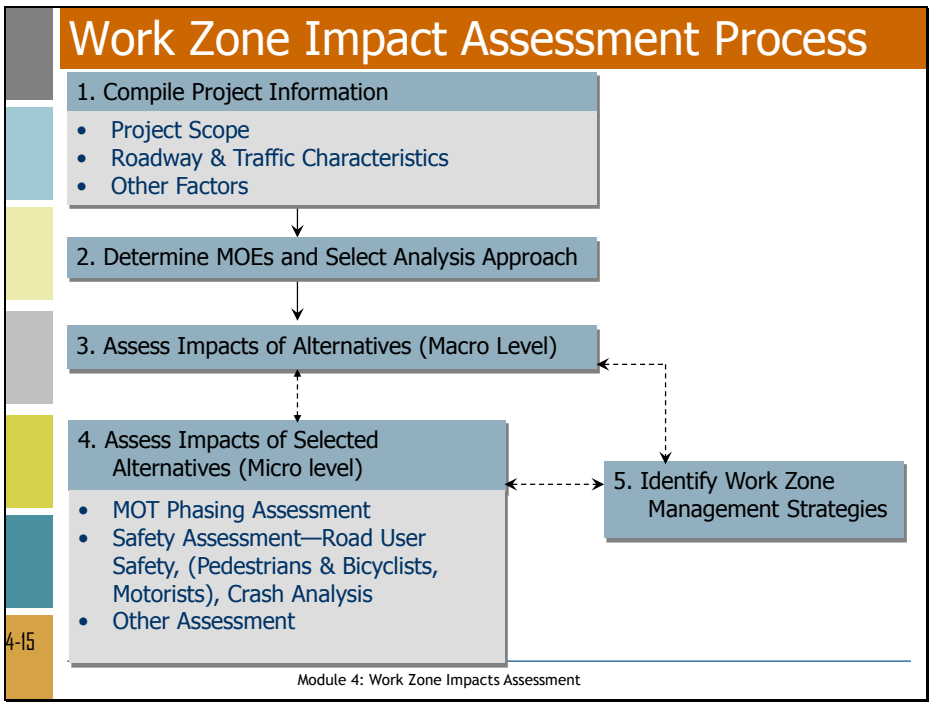
An assessment of work zone impacts during the early planning stages of the project will help identify issues or uncover problem areas that should be considered during project development. This provides the Agency with an opportunity to evaluate the work zone impacts along with the design alternatives analysis, which can lead to the selection of a design alternative that alleviates many of the work zone impacts. This also helps to allocate adequate funding in the project budget for TMP implementation.



Narrator Notes:
Another key reason to consider work zone impacts early is because it enables the project team to include maintenance of traffic in the alternative analysis, when most options are available. If this is not done, and the Agency finds out later that the alternative that was chosen has too many work zone impacts, it will be difficult to change options. Later, time and money may have already been invested in right of way or an environmental impact study, making the Agency reluctant to change alternatives and incur additional delay and cost.

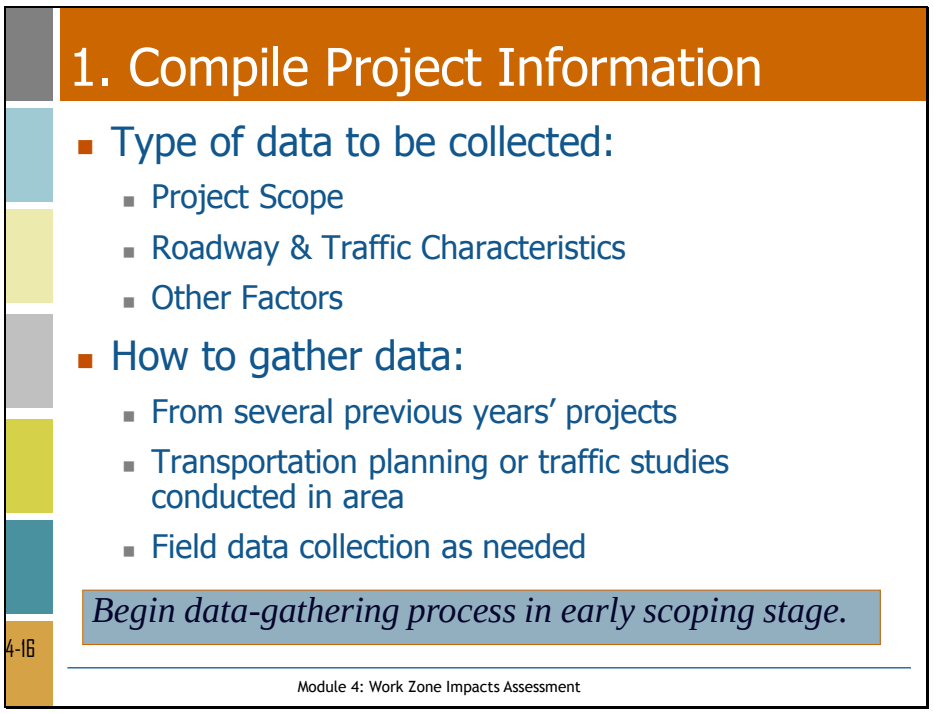


Narrator Notes:
This is an example of a design build project where many of the impacts were eliminated during project development. By considering maintenance of traffic, or MOT, impacts from the preliminary stages, the project team was able to propose a design alternative that alleviated many of the potential work zone impacts. The solution, which builds approximately 70% of the improvements "off-line" and away from traffic, significantly reduced impacts to all stakeholders, including road users, the surrounding community, businesses, and government agencies. This was made possible by considering maintenance of traffic and impacts from the conceptual stages of the project and working with all affected stakeholders.



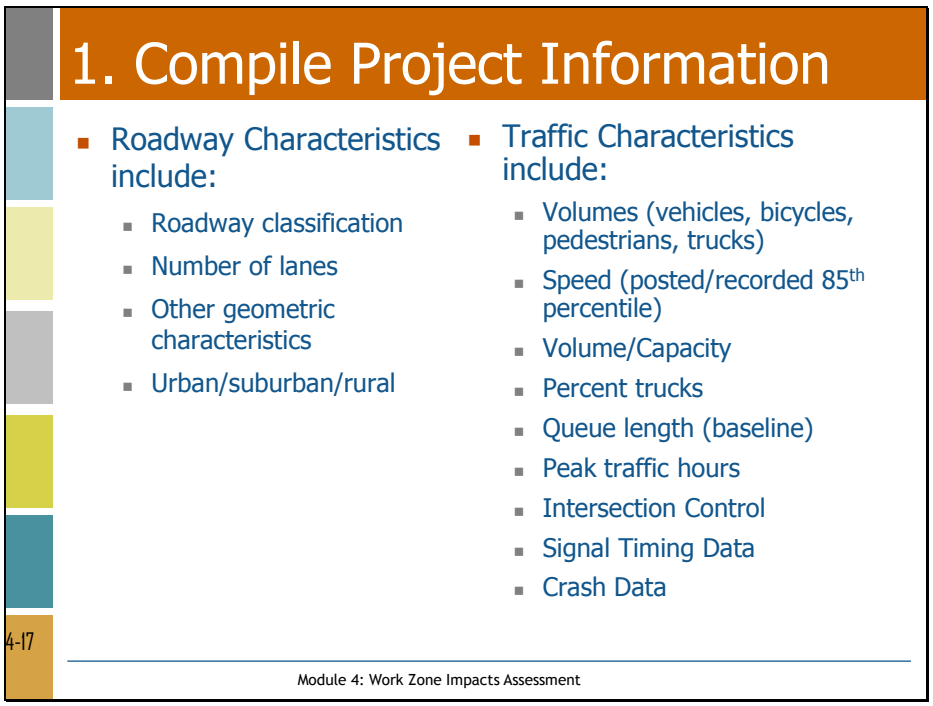
Narrator notes:
There are four general steps in assessing the impacts of work zones during the project development stages. Keep in mind that your Agency may use different terminology or a different number of steps to capture the basic concepts laid out in these four steps. These steps lead to identifying strategies for the TMP. Identification and selection of strategies will be discussed in Module 5.

The following slides expand on each of the four steps of impacts assessment.

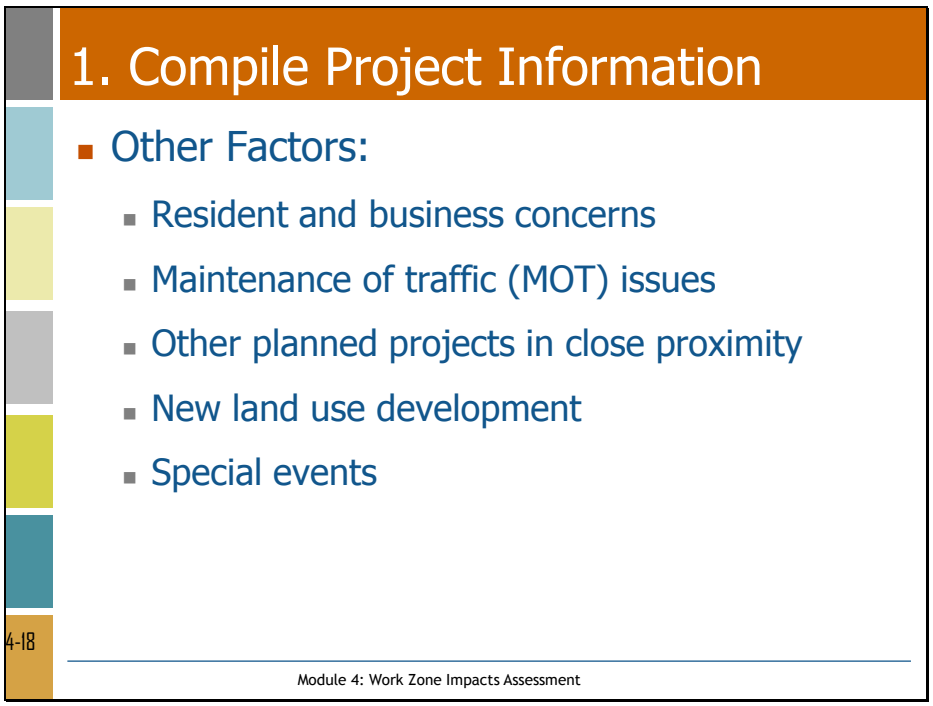


Narrator Notes:
Data gathering is the initial step in the impacts assessment process and should begin in the early scoping stages of the project. Historical data can be used in many cases, such as data from past construction projects or transportation planning or traffic studies. Based on what data is available, additional data collection may be required. This effort should be included in any scope when the contractor or consultant is developing the TMP.

This data is important for establishing a baseline for comparison of future conditions. For example, modeling the future construction conditions may indicate a queue of 2 miles more than non-work zone conditions. This may be unacceptable and lead to looking at alternate strategies.



Narrator Notes:
The extent of the data to be collected depends on the size, location and complexity of the project. Projects in heavily congested urban areas may need the most data gathering parameters. Projects in rural areas with limited access may have fewer parameters.



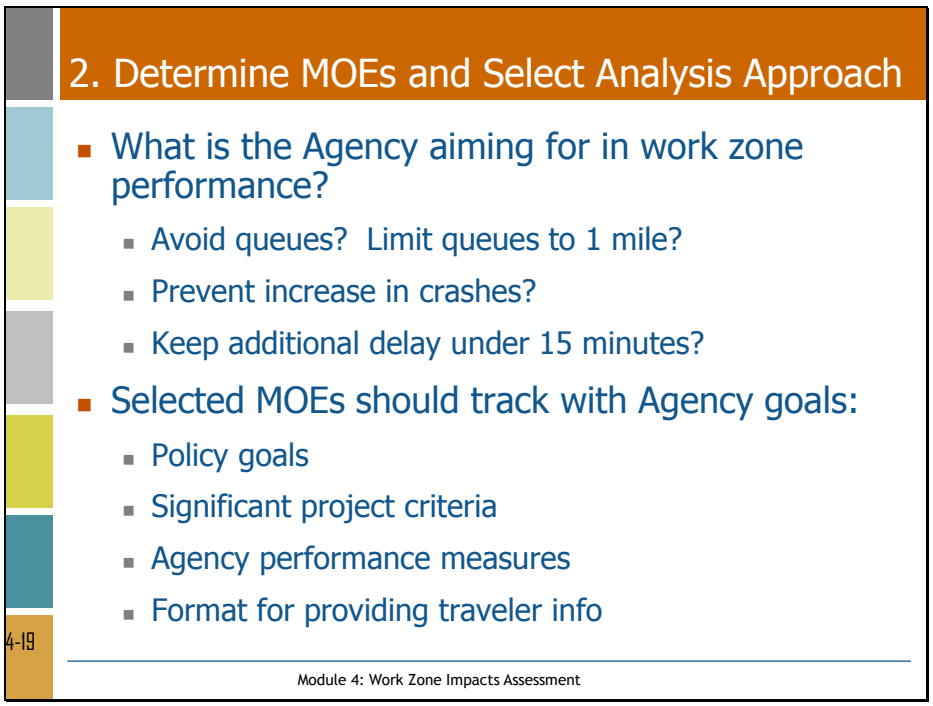
Narrator Notes:
As part of any assessment it is important to identify other factors that can affect the project and traffic management in and around the work zone.

It is crucial to gather resident and business concerns on access issues. A public involvement strategy identified during the preliminary stages of the project will assist in this process.

Identifying any maintenance of traffic issues during the early scoping stages will help to uncover any problem areas and identifying strategies to mitigate those issues.

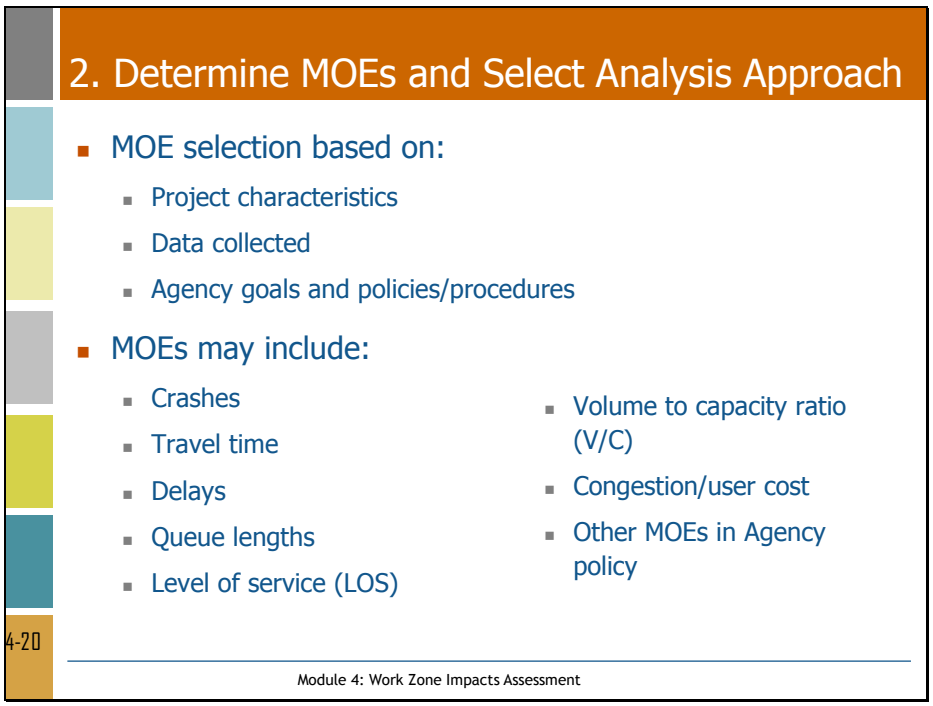
Identifying any planned projects nearby, including utility projects, is vital to avoiding conflicts such as lane closures that affect alternate routes. Failure to identify other planned projects can lead to conflicts in roles and responsibilities, scheduling, and traffic plans.

Depending on the project location, there may be a need to identify special sources of traffic, such as new developments or major events. Significant planned developments like the opening of a hotel or major retail store can create major access issues. Similarly, special events such as a baseball or football game can have 90,000 fans exit the stadium in a short time. These situations can affect project work days and schedule.



Narrator Notes:
The measures of effectiveness, or MOEs, that are important to the Agency should form the basis for what measures are used in impacts assessment. For example, if the Agency's work zone policy limits queues to one mile, then the impacts assessment needs to determine if queues are likely to stay within that 1 mile criteria.

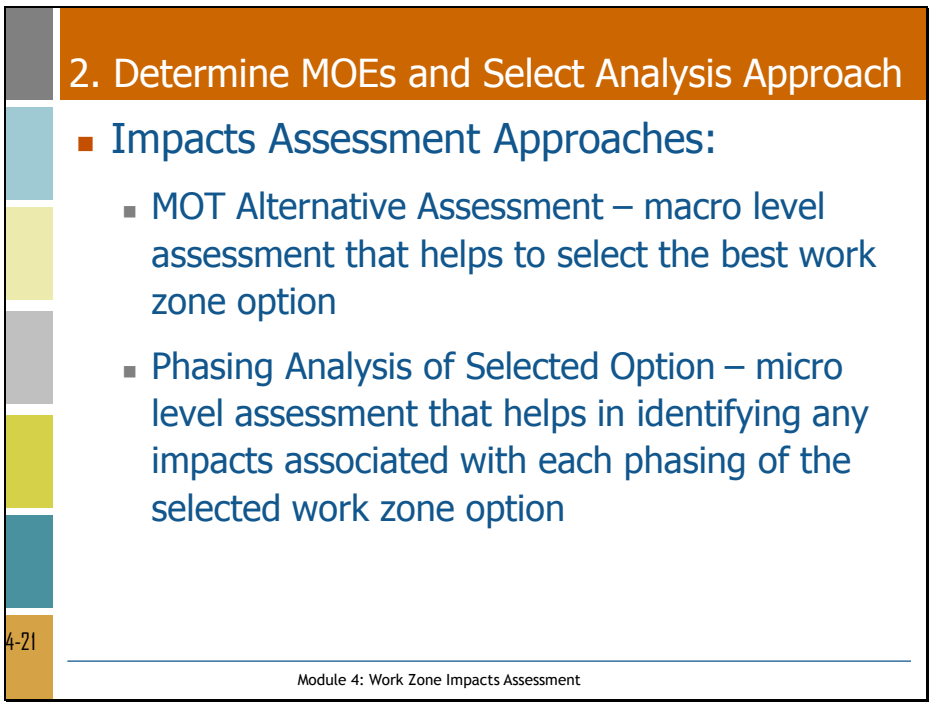
Other sources of MOE are what criteria the Agency uses to define a significant project, or how it reports traveler information. For example, if the Agency reports expected work zone delays through its traffic management center, then it would make sense to generate that estimate of delay during impacts assessment.



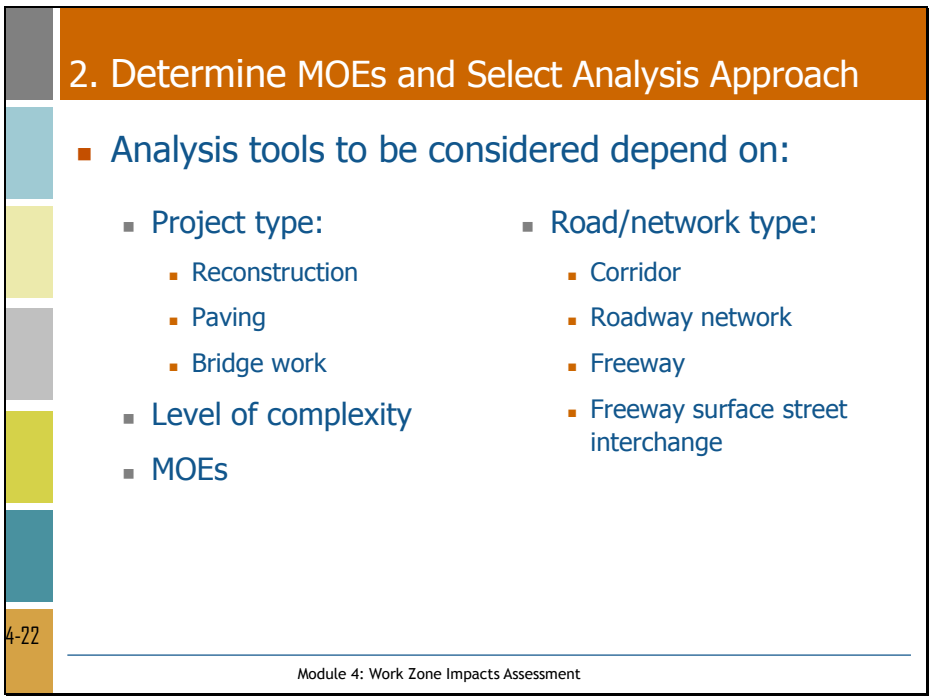
Narrator Notes:
The selection of MOEs and analysis approach generally depend on project characteristics such as the size and duration of a project and whether it is expected to cause major disruption, the available data, and Agency policy and procedures.

Some common MOEs used by Agencies are maximum queue lengths or delays as a mobility goal, and no increase in crashes as a safety goal. To determine if a delay criteria will be met, the analyst would need to assess expected work zone travel time against current or baseline travel time without the work zone. Another commonly used measure is the volume to capacity ratio because this gives the analyst a quick initial idea of whether congestion is likely to be an issue.

It is important to determine as early as possible within the planning stages, what MOEs will be evaluated and the methods and tools that will be used to assist in the assessment.



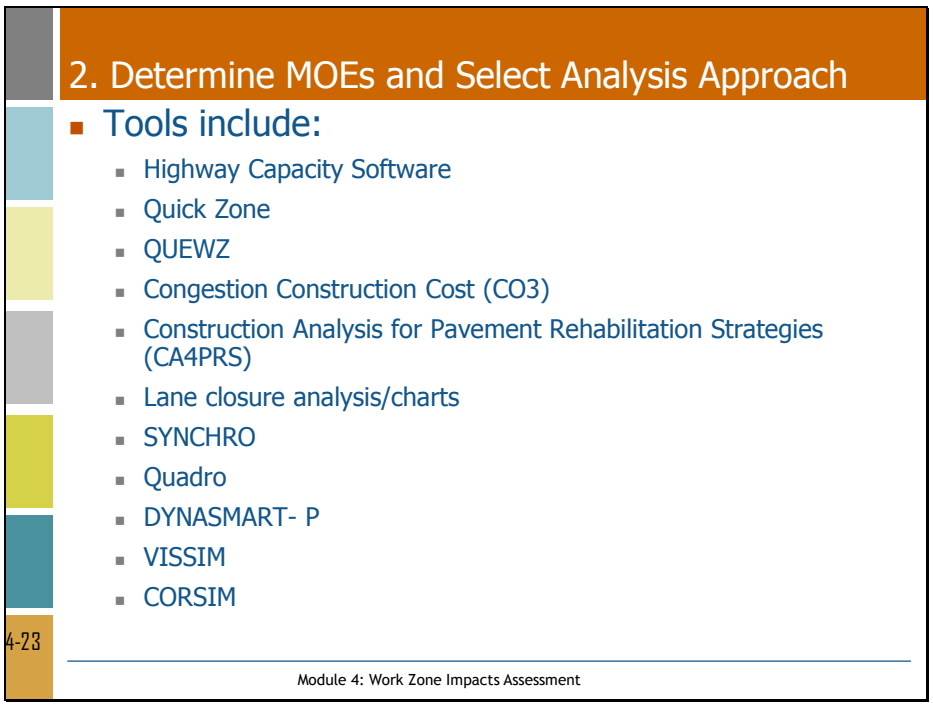
Narrator Notes:
There are basically two impacts assessment approaches, one at a macro level and the other at a micro level. MOT alternative assessment is a macro level analysis which helps to select the best option to go forward with, while the phasing analysis is a micro level analysis which helps to identify the impacts associated with each phasing of the selected work zone option.



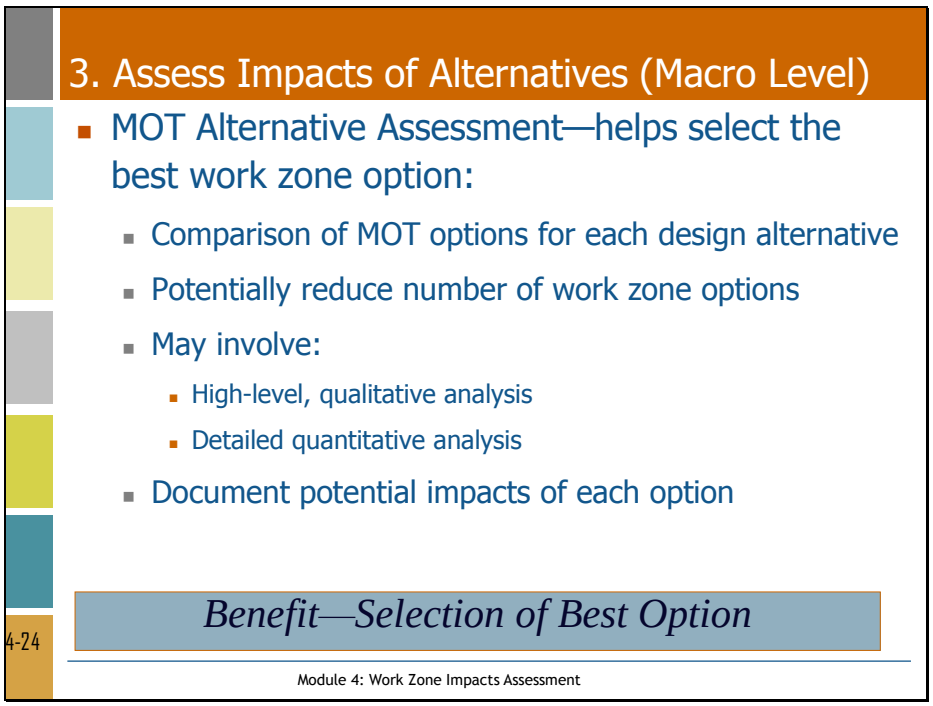
Narrator Notes:
The type of tools to be used for an assessment should always be proportional to the type, size, and complexity of the project, as well as the type of roadway and the chosen MOEs.

For many small projects with minimal expected disruption, a qualitative assessment of impacts may be sufficient. For significant projects an Agency may use decision support tools, such as modeling programs, while for less complex projects it may have developed checklists and flowcharts to assist in the analysis and decision making process. Some Agencies use a simple spreadsheet tool that performs volume to capacity calculations to provide an initial or macro assessment of likely impacts. The results of that initial assessment may determine if an Agency performs a more detailed assessment.

Ultimately, Agency guidelines govern how extensive an assessment should be for a project.



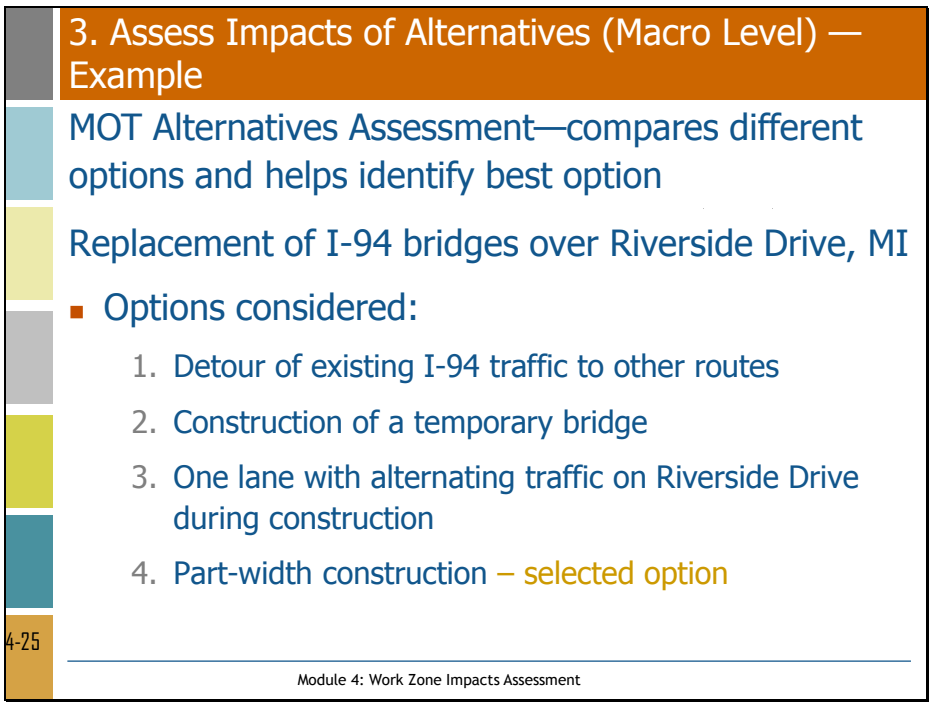
Narrator Notes:
When using analysis tools, projects on major corridors may require more complex tools like CORSIM or VISSIM to accurately assess impacts. Various States have also developed their own unique work zone tools. For example, Michigan uses the Construction, Congestion, Cost tool and California uses the Construction Analysis for Pavement Rehabilitation Strategies tool.



Narrator Notes:
The objective of this step is to get a first-hand understanding of the potential work zone impacts of each design alternative. The assessment can be quantitative or qualitative, based on the project. Screening of small projects or those likely to have minimal impacts could be done with templates or simplified tools or charts so that more detailed analyses can focus on projects that are likely to cause greater impacts. A comparison with lane closure charts developed by the Agency or with past similar projects can be helpful in this assessment.

The result of this screening-level assessment may be a summary-level list of the potential work zone impacts for each alternative, such as increased right-of-way costs, reduced access to neighboring businesses, or high utility relocation costs.

Documentation of the impacts and key factors for each MOT alternative is important to selecting the most suitable option and avoiding duplication of effort as the project progresses.



Narrator Notes:
Four alternative traffic control schemes were evaluated for replacing the I-94 bridges over Riverside Drive project: detouring traffic; constructing a temporary bridge, operating one lane with alternating traffic, or doing part-width construction of the bridge.

Detouring I-94 traffic was not feasible because detouring high volumes to existing routes would result in unacceptable delays and congestion on the surrounding road network.

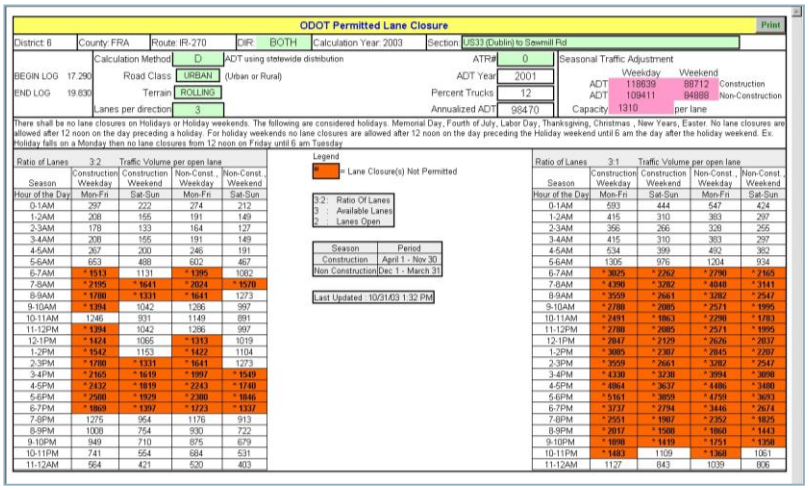
Constructing a temporary bridge was cost-prohibitive because of the steep grades and existing interchanges close to the bridge.

The third option was to keep one lane open with alternating traffic on Riverside Drive during construction. This alternative would potentially increase project construction duration to two construction seasons and was not selected.

The fourth option was to do part-width construction with two 11-ft lanes with 1-ft shy distance in each direction at all times for I-94, while closing Riverside Drive and detouring that traffic. This option was considered the best considering cost, traffic volumes, and project duration.

3. Assess Impacts of Alternatives (Macro Level) — Example

Ohio DOT MOT/PLC Policy



ODOT Permitted Lane Closure — Print

District: 8 | County: FRA | Route: IR-270 | DIR: BOTH | Calculation Year: 2003 | Section: US33 (Dublin) to Sawmill Rd

Calculation Method: D — ADT using statewide distribution | ATR#: 0 | Seasonal Traffic Adjustment

BEGIN LOG: 17.290 | END LOG: 19.830 | Road Class: URBAN (Urban or Rural) | ADT Year: 2001 | Terrain: ROLLING | Percent Trucks: 12 | Lanes per direction: 3 | Annualized ADT: 98470

	Weekday	Weekend	
ADT	118839	88712	Construction
ADT	109411	84888	Non-Construction
Capacity	1310		per lane

There shall be no lane closures on Holidays or Holiday weekends. The following are considered holidays. Memorial Day, Fourth of July, Labor Day, Thanksgiving, Christmas , New Years, Easter. No lane closures are allowed after 12 noon on the day preceding a holiday. For holiday weekends no lane closures are allowed after 12 noon on the day preceding the Holiday weekend until 6 am the day after the holiday weekend. Ex. Holiday falls on a Monday then no lane closures from 12 noon on Friday until 6 am Tuesday

Ratio of Lanes: 3:2 — Traffic Volume per open lane

Season	Construction Weekday	Construction Weekend	Non-Const. Weekday	Non-Const. Weekend
Hour of the Day	Mon-Fri	Sat-Sun	Mon-Fri	Sat-Sun
0-1AM	297	222	274	212
1-2AM	208	155	191	149
2-3AM	178	133	164	127
3-4AM	208	155	191	149
4-5AM	267	200	246	191
5-6AM	653	488	602	467
6-7AM	* 1513	1131	* 1395	1082
7-8AM	* 2195	* 1641	* 2024	* 1570
8-9AM	* 1700	* 1331	* 1641	1273
9-10AM	* 1394	1042	1286	997
10-11AM	1246	931	1149	891
11-12PM	* 1394	1042	1286	997
12-1PM	* 1424	1065	* 1313	1019
1-2PM	* 1542	1153	* 1422	1104
2-3PM	* 1700	* 1331	* 1641	1273
3-4PM	* 2165	* 1619	* 1997	* 1549
4-5PM	* 2432	* 1819	* 2243	* 1740
5-6PM	* 2598	* 1929	* 2380	* 1846
6-7PM	* 1869	* 1397	* 1723	* 1337
7-8PM	1275	964	1176	913
8-9PM	1008	754	930	722
9-10PM	949	710	875	679
10-11PM	741	554	684	531
11-12AM	564	421	520	403

Legend: * = Lane Closure(s) Not Permitted

3:2 : Ratio Of Lanes
3 : Available Lanes
2 : Lanes Open

Season	Period
Construction	April 1 - Nov 30
Non Construction	Dec 1 - March 31

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Ratio of Lanes: 3:1 — Traffic Volume per open lane

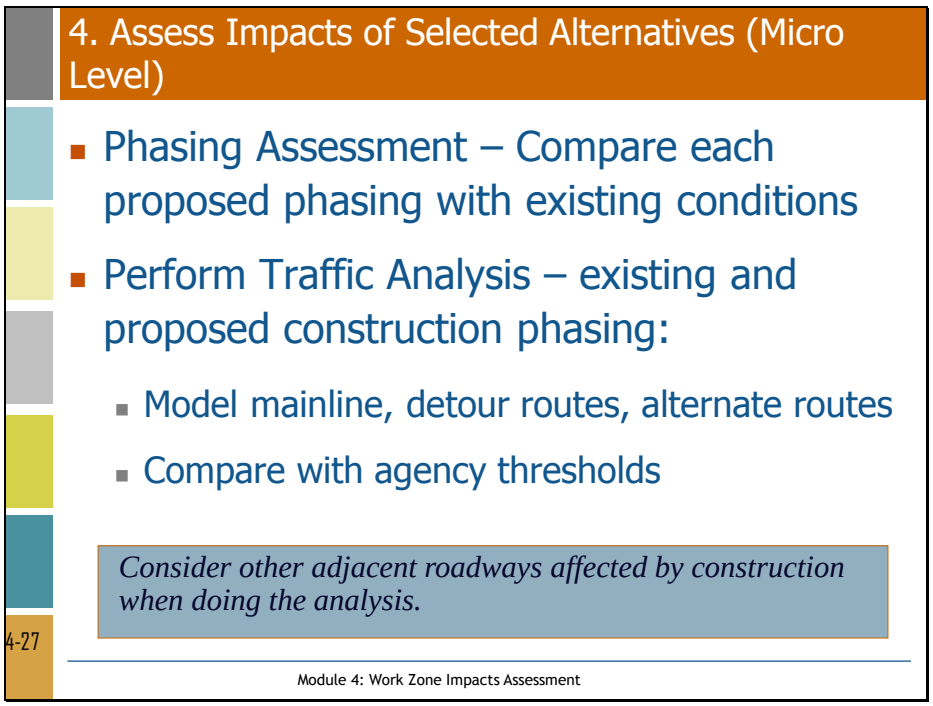
Season	Construction Weekday	Construction Weekend	Non-Const. Weekday	Non-Const. Weekend
Hour of the Day	Mon-Fri	Sat-Sun	Mon-Fri	Sat-Sun
0-1AM	593	444	547	424
1-2AM	415	310	383	297
2-3AM	356	266	328	255
3-4AM	415	310	383	297
4-5AM	534	399	492	382
5-6AM	1305	976	1204	934
6-7AM	* 3025	* 2262	* 2790	* 2165
7-8AM	* 4390	* 3282	* 4048	* 3141
8-9AM	* 3559	* 2661	* 3282	* 2547
9-10AM	* 2780	* 2085	* 2571	* 1995
10-11AM	* 2491	* 1863	* 2298	* 1783
11-12PM	* 2780	* 2085	* 2571	* 1995
12-1PM	* 2847	* 2129	* 2626	* 2037
1-2PM	* 3085	* 2307	* 2845	* 2207
2-3PM	* 3559	* 2661	* 3282	* 2547
3-4PM	* 4330	* 3238	* 3994	* 3098
4-5PM	* 4864	* 3637	* 4486	* 3480
5-6PM	* 5161	* 3859	* 4759	* 3693
6-7PM	* 3737	* 2794	* 3446	* 2674
7-8PM	* 2551	* 1907	* 2352	* 1825
8-9PM	* 2017	* 1508	* 1860	* 1443
9-10PM	* 1898	* 1419	* 1751	* 1358
10-11PM	* 1483	1109	* 1368	1061
11-12AM	1127	843	1039	806

4-26

Module 4: Work Zone Impacts Assessment

Narrator Notes:
This example shows the results of a lane closure analysis on an Interstate in Ohio. The orange color indicates the times when lane closures are not permitted on that particular segment of highway.

The analysis was done using Ohio DOT's online Permitted Lane Closure system. The system was developed for each segment of Interstate highway in Ohio based on Ohio DOT's maintenance of traffic policy and its queue limits. This tool helps designers understand what the available lane closure options are for a particular segment of road so that can be factored into the design.



Narrator Notes:
A micro-level analysis is important because it provides a comparison of baseline or existing conditions with work zone traffic conditions that would be in place during construction. Negative impacts, such as unacceptable traffic delays as defined by the Agency, can be mitigated prior to construction, or at a minimum road users can be informed well in advance of the planned activity.

The next slides provide examples of this type of analysis.

4. Assess Impacts of Selected Alternatives (Micro Level) — Example

- Comparison of future work zone traffic with existing conditions

Locations	Existing					Phase 1			
	Approach	V/C ratio	Delay	Queue Length 95th (ft)	LOS	V/C ratio	Delay (sec)	Queue Length 95th (ft)	LOS
Benning Road and Oklahoma Avenue	EB	0.31	3.2	19	A	0.31	4.3	31	A
	WB	0.38	12.7	136	B	0.38	12.7	136	B
	NB	0.25	23.0	107	C	0.25	23.0	107	C
	Intersection LOS - A					Intersection LOS - B			
Benning Road and Minnesota Avenue	EB	0.28 (L- 0.34)	14.7	68 (L-85)	B	(L- 0.41) 0.36 (R- 0.20)	36.2	(L-144) 249 (R-98)	D
	WB	0.56	24.2	166	C	1.04	93.7	454*	F
	NB	0.17 (L-0.26)	11.6	70 (L-68)	B	0.17 (L-0.26)	11.6	70 (L-68)	B
	SB	0.40 (R-0.08)	21.3	161 (R-19)	C	0.38 (L-0.10)	22.5	161 (L-40)	C
	Intersection LOS - B					Intersection LOS - C			

4-28

Module 4: Work Zone Impacts Assessment

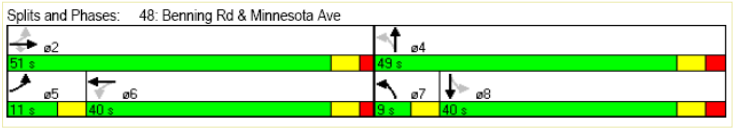
Narrator Notes:
This example project was small in scope and the Project Engineer was able to simply retime the signals and remove the anticipated traffic delays. Delays were reduced from 93.7 seconds to 22.7 seconds, and level of service was maintained at level C rather than dropping to level F.

Understanding the traffic impacts often leads to identifying simple, relatively low cost strategies to reduce or even eliminate the impacts, sometimes with minimal effort.

4. Assess Impacts of Selected Alternatives (Micro Level) — Example

- Solution to mitigate impacts can be as simple as modifying signal timing

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations									
Control Delay	44.4	45.2	26.9		22.7	19.0	15.5	21.7	23.4
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	44.4	45.2	26.9		22.7	19.0	15.5	21.7	23.4
LOS	D	D	C		C	B	B	C	C
Approach Delay		40.6			22.7		16.5		23.3
Approach LOS		D			C		B		C

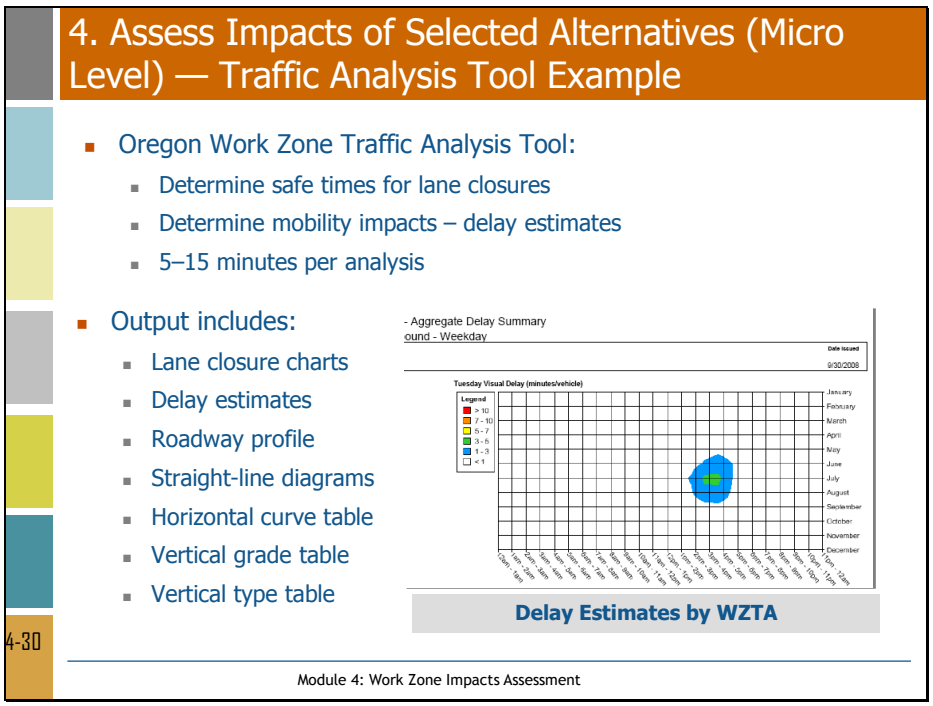


4-29

Module 4: Work Zone Impacts Assessment

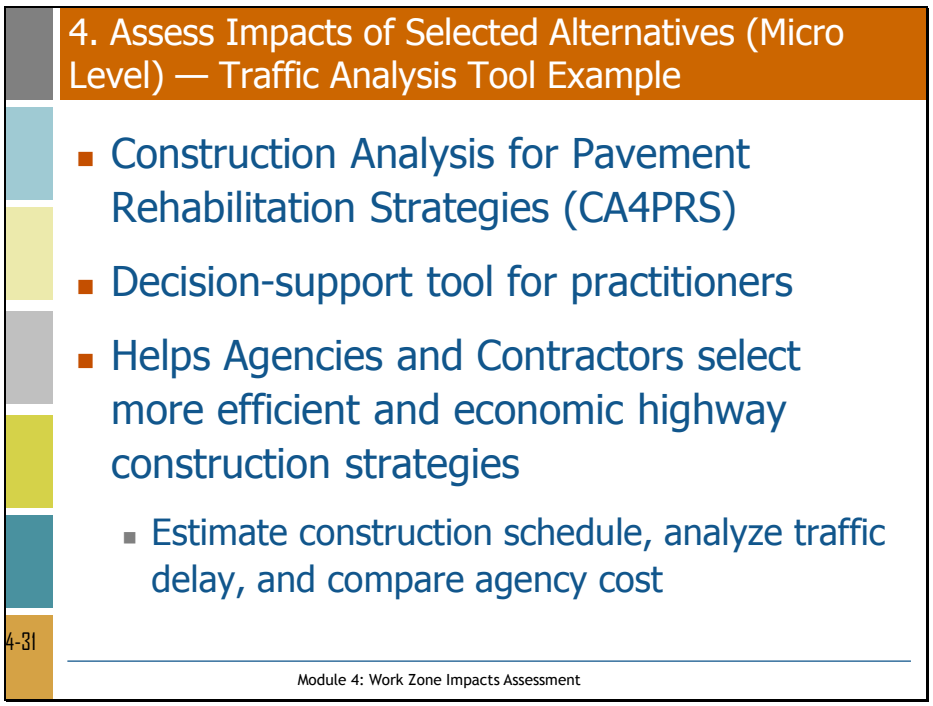
Narrator Notes:
This example project was small in scope and the Project Engineer was able to simply retime the signals and remove the anticipated traffic delays. Delays were reduced from 93.7 seconds to 22.7 seconds, and level of service was maintained at level C rather than dropping to level F.

Understanding the traffic impacts often leads to identifying simple, relatively low cost strategies to reduce or even eliminate the impacts, sometimes with minimal effort.

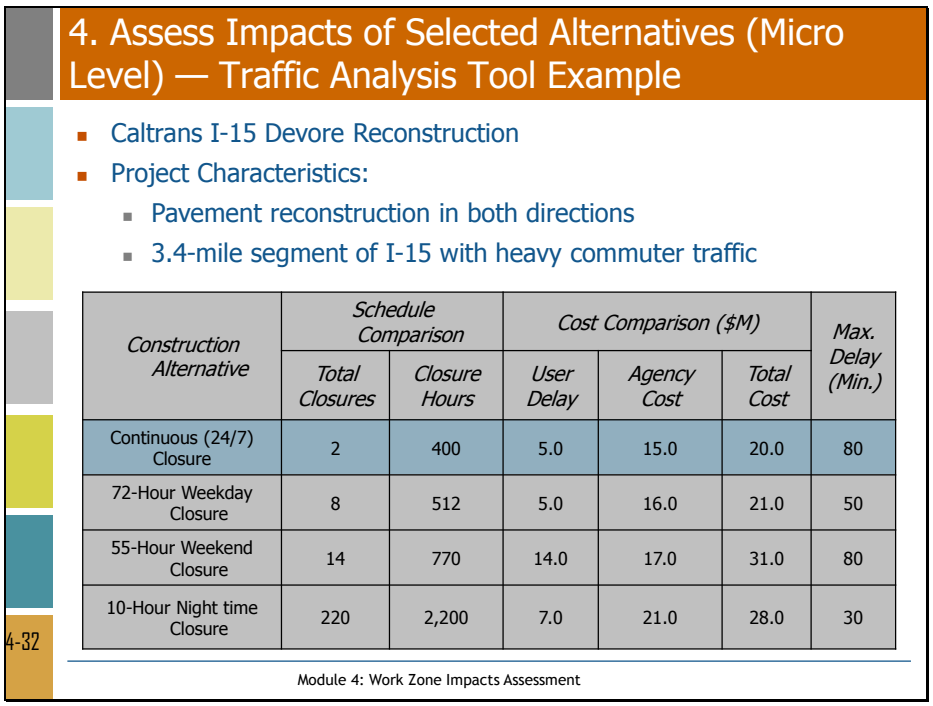


Narrator Notes:
Oregon DOT's Web-Based Work Zone Traffic Analysis Tool makes Oregon's highway data available via the Internet. Available traffic data include Average Daily Traffic, average truck percentage, horizontal curve and vertical grade, and more. The tool can be used to predict hours of the day when lanes or shoulders can reasonably be closed and the approximate delay that would develop during such closures.

A sample delay chart generated by the tool is shown here. The chart gives an estimate of the delay by month of year and time of day. The chart is color coded. For example, blue indicates an anticipated delay of 1-3 minutes per vehicle, and green indicates 3-5 minutes delay per vehicle.



Narrator Notes:
The Construction Analysis for Pavement Rehabilitation Strategies tool, referred to as CA4PRS, is an example of a schedule and traffic analysis tool that helps Agencies and Contractors determine effective, economical rehabilitation strategies. CA4PRS helps planners and designers find an optimal balance between pavement design, construction constraints, traffic operations, and budget during the planning and design of rehabilitation projects.



4. Assess Impacts of Selected Alternatives (Micro Level) — Traffic Analysis Tool Example

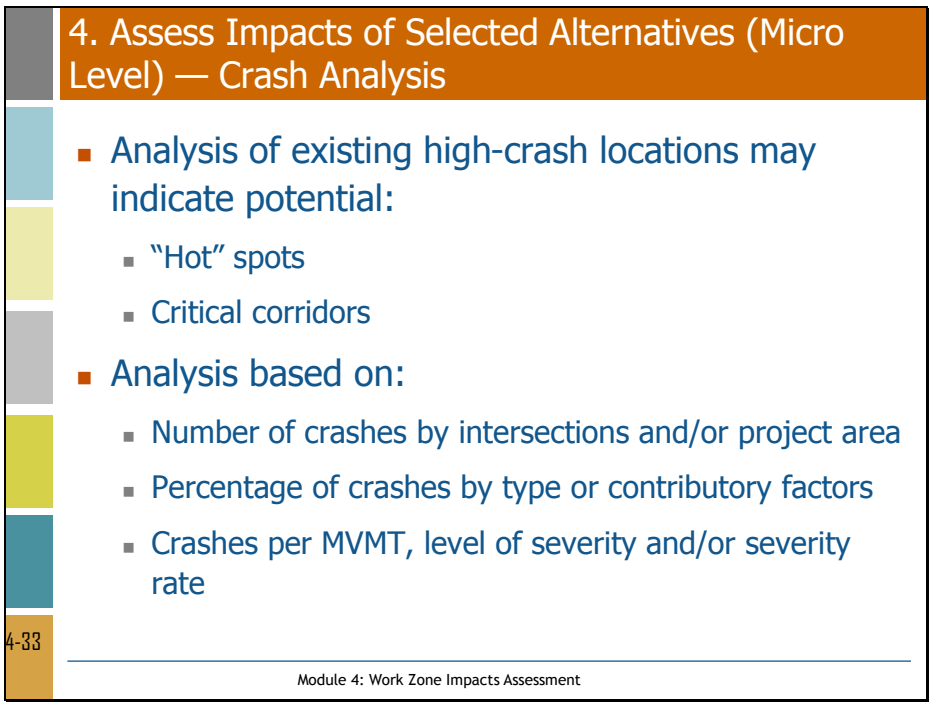
- Caltrans I-15 Devore Reconstruction
- Project Characteristics:
  - Pavement reconstruction in both directions
  - 3.4-mile segment of I-15 with heavy commuter traffic

Construction Alternative	*Schedule Comparison*		*Cost Comparison ($M)*			*Max. Delay (Min.)*
	Total Closures	*Closure Hours*	*User Delay*	*Agency Cost*	*Total Cost*	
Continuous (24/7) Closure	2	400	5.0	15.0	20.0	80
72-Hour Weekday Closure	8	512	5.0	16.0	21.0	50
55-Hour Weekend Closure	14	770	14.0	17.0	31.0	80
10-Hour Night time Closure	220	2,200	7.0	21.0	28.0	30

4-32

Module 4: Work Zone Impacts Assessment

Narrator Notes:
This is an example of a CA4PRS analysis done for a pavement reconstruction project on Interstate-15 in Devore, California. Based on the analysis, which considered schedule, delay, and Agency costs, the alternative of a one roadbed continuous closure was selected as the best option. This option helped to save the Agency significant cost as well as minimize road user delays.



Narrator Notes:
A preliminary analysis of crash data within a project area may indicate potential "hot" spots or any area of crash concentration. The analysis can use MOEs such as the number of crashes, percent of crashes, or crashes by traffic volume or severity.

Monitoring identified hot spots or critical corridors is important to ensure work zone activities don't result in additional crashes.

4. Assess Impacts of Selected Alternatives (Micro Level) — Crash Analysis

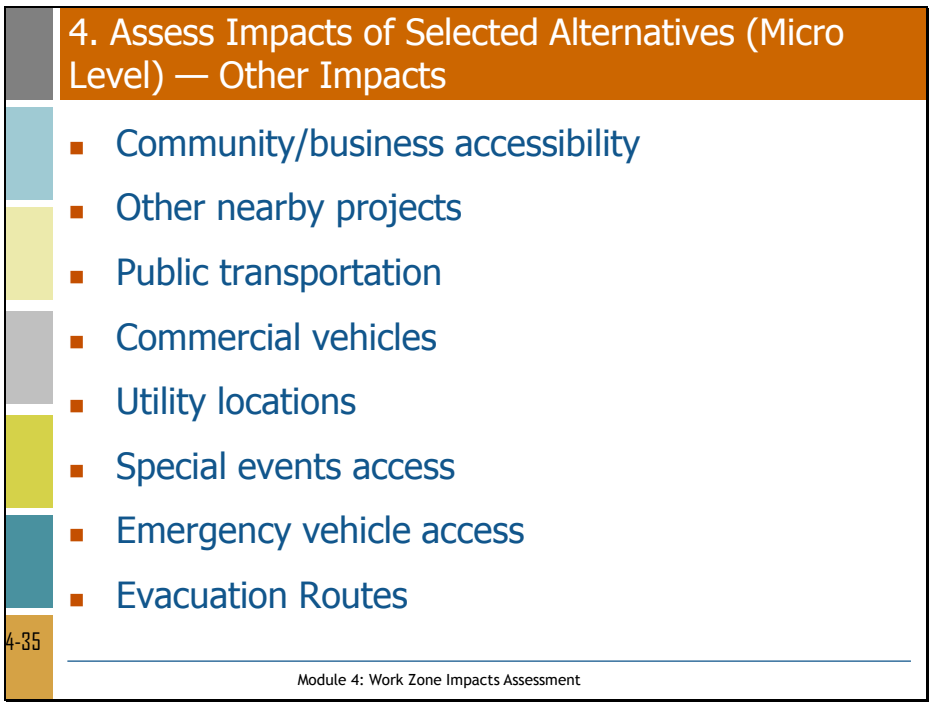
- Example – Michigan historic crash analysis
- Uses Transportation Management Systems (TMS) database
- Four years of crash data

Crash Type	Crash Count	Percentage
Fixed Object	124	22.71
Animal	97	17.77
Rear-End Straight	74	13.55
Miscellaneous 1 Vehicle	73	13.34
Side Swipe Same	59	10.81
Overturn	51	9.34
Other Object	35	6.41
Side Swipe Opposite	12	2.20
Angle Straight	10	1.83
Head-On	5	0.92
Rear-End Right Turn	2	0.37
Dual Left Turn	1	0.18
Angle Turn	1	0.18
Backing	1	0.18
Hit Parked Vehicle	1	0.18

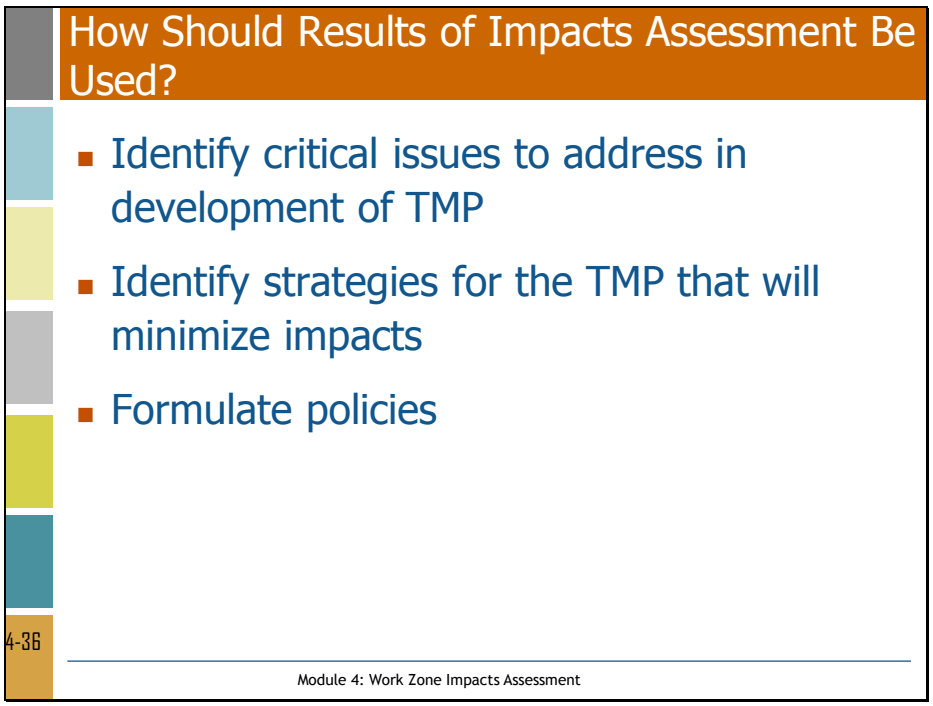
4-34

Module 4: Work Zone Impacts Assessment

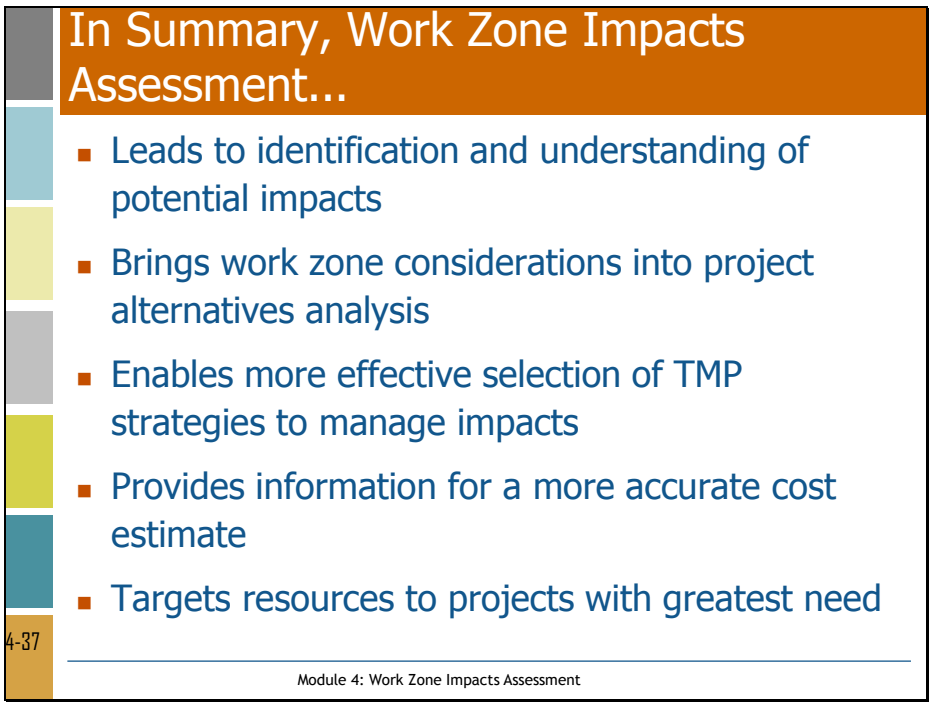
Narrator Notes:
Michigan DOT's crash analysis during project development includes a historic review of crash data for the construction area using its Transportation Management Systems database. In the example shown, four years of crash data for 2001 through 2005 was analyzed. This baseline was included in the TMP and allowed project staff to effectively monitor work zone crashes during construction.



Narrator Notes:
In addition to traffic impacts, there are a host of other impacts that can affect a project and cost resources in terms of time and money. These impacts need to be considered as the TMP is developed.

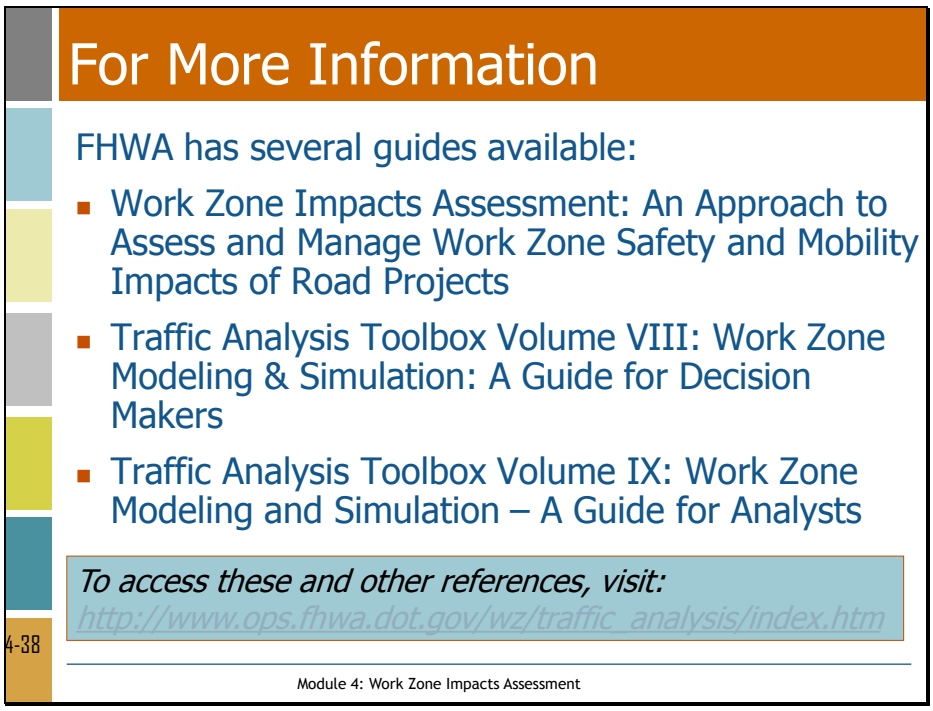


Narrator Notes:
The results of the impacts assessment guides the development of the TMP and helps in identifying strategies to mitigate negative impacts for particular projects. Impacts assessment and TMPs can also provide information to update Agency policies and procedures related to work zone safety and mobility.

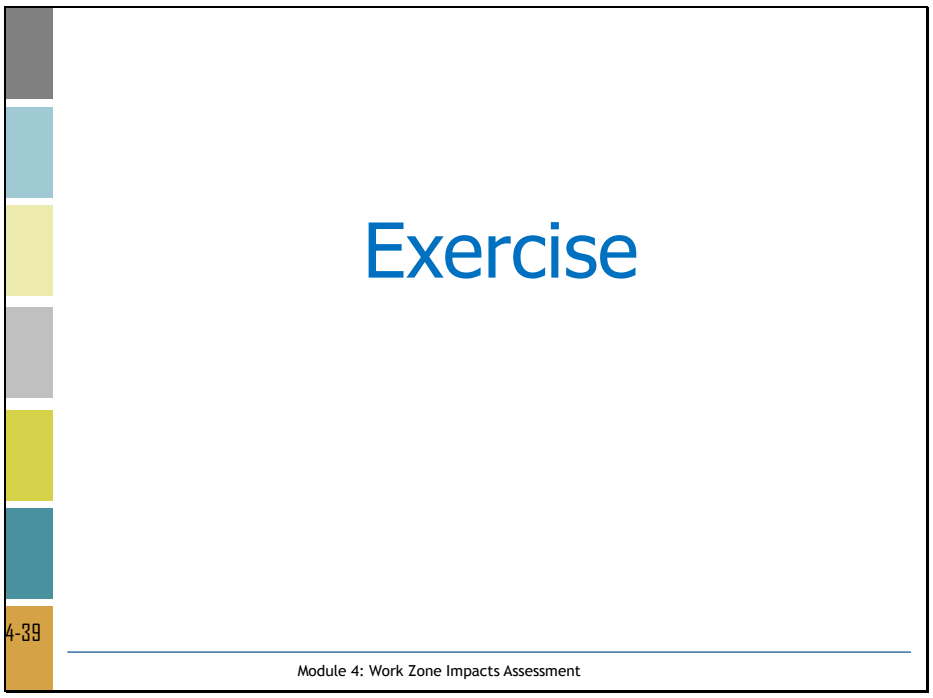


Narrator Notes:
To review what we learned in this module, work zone impacts assessment enables better and earlier identification and understanding of potential impacts and consideration of those impacts throughout project development – from project scoping and alternatives analysis through the selection of TMP strategies and implementation during construction.

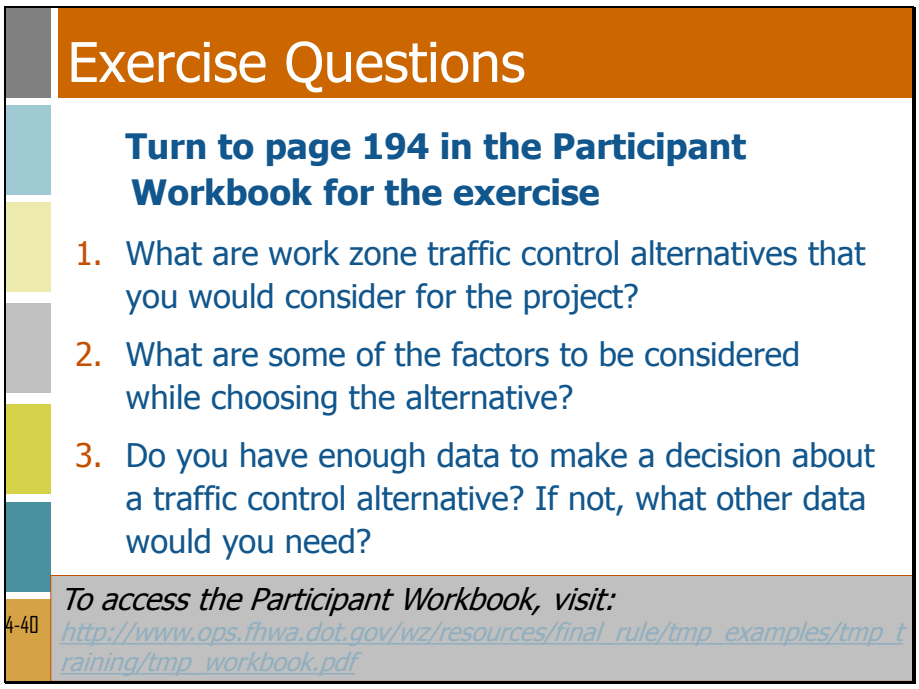
Having a good understanding of impacts from the early stages of a project will yield a more accurate project cost estimate and enables the Agency to assign resources more effectively.



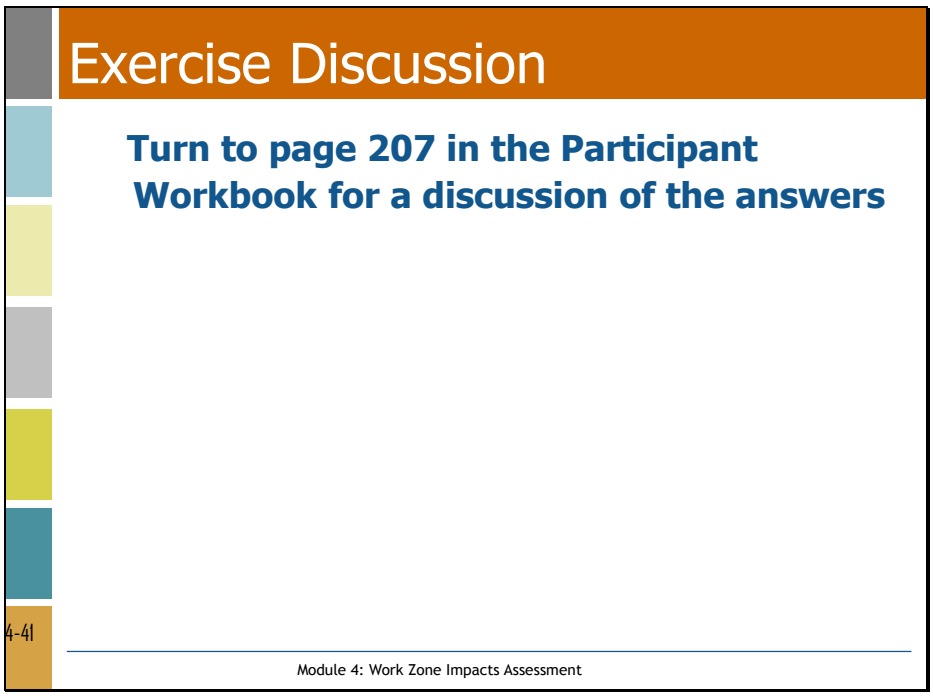
Narrator Notes:
FHWA has developed several resources to assist in work zone impacts assessment. Additional information on these documents and other references can be obtained by visiting the website listed on the slide.



Narrator Notes:
Now that you have completed Module 4, this exercise will provide you with an opportunity to apply what you have learned.

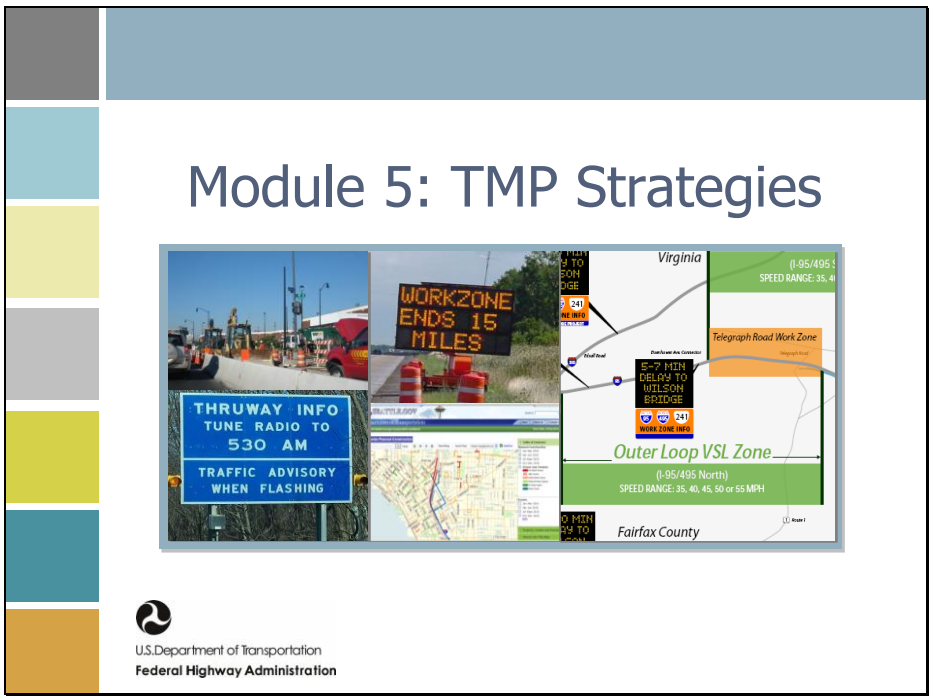


Narrator Notes:
Please turn to page 194 in Appendix C in the Participant Workbook. After reading the exercise narrative, please answer the questions on this slide.

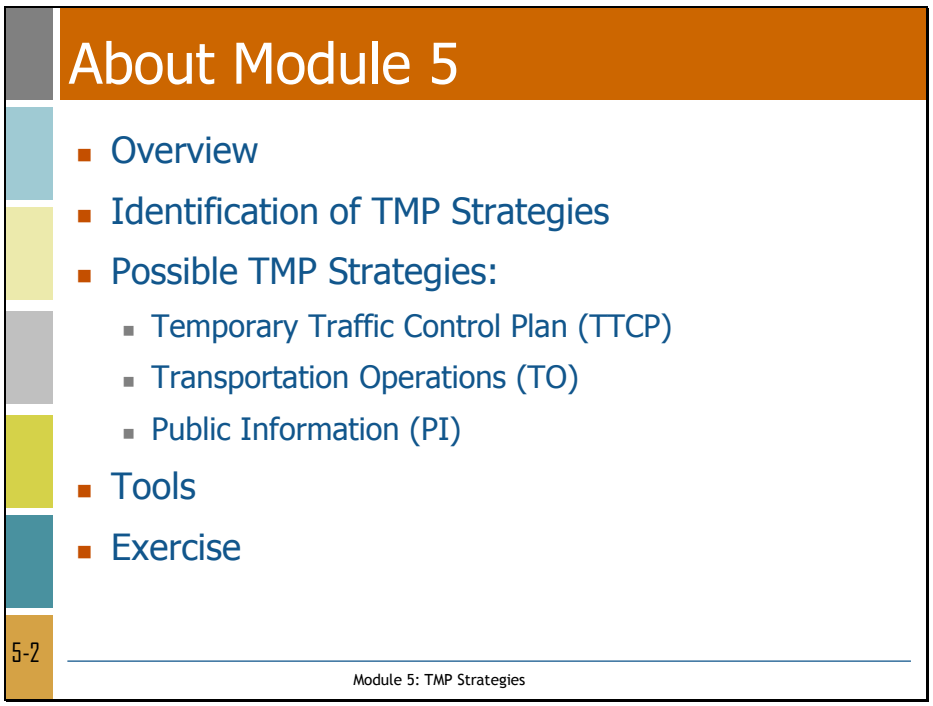


Narrator Notes:
Once you have completed responding to the questions, turn to page 207 in the Participant Workbook for a discussion of the exercise answers.

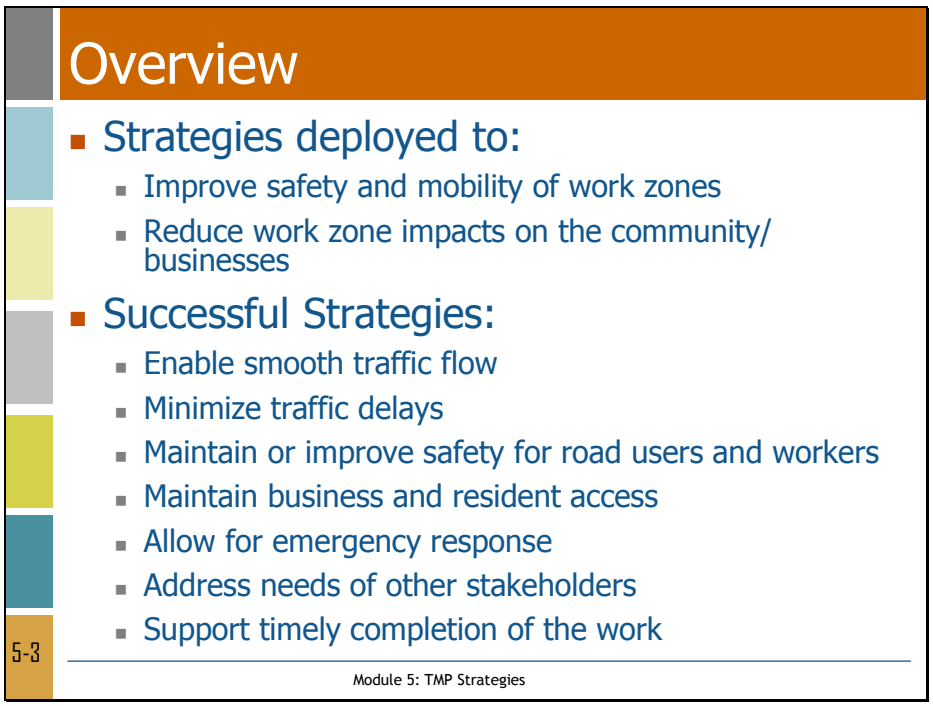
Module 5: TMP Strategies



Narrator Notes:
This module discusses TMP strategies that DOTs can use to minimize or mitigate work zone safety and mobility impacts. The module covers TMP strategies and considerations for selecting strategies based on the results of work zone impacts assessment. Impacts assessment was covered in Module 4.



Narrator Notes:
Module 5 provides an overview, and then discusses identification of TMP strategies; possible TMP strategies; and tools that some Agencies are using to help with selecting appropriate TMP strategies. The module ends with an exercise to help you apply what you have learned.

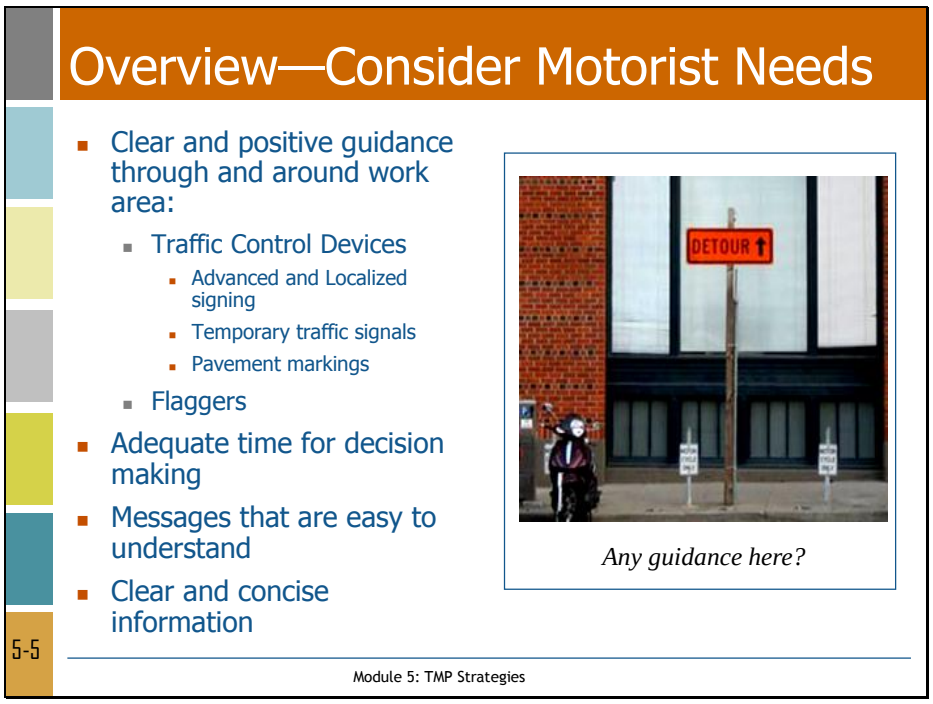


Narrator Notes:
TMP strategies are intended to improve the safety and mobility of work zones and reduce the work zone impacts on the community and businesses. Strategies should be selected to enable smooth traffic flow, minimize traffic delays, and maintain or improve safety for road users and workers. Strategies should also maintain access for businesses and residents, allow for emergency response, and address the needs of other stakeholders. TMP strategies should also support the timely completion of the project.

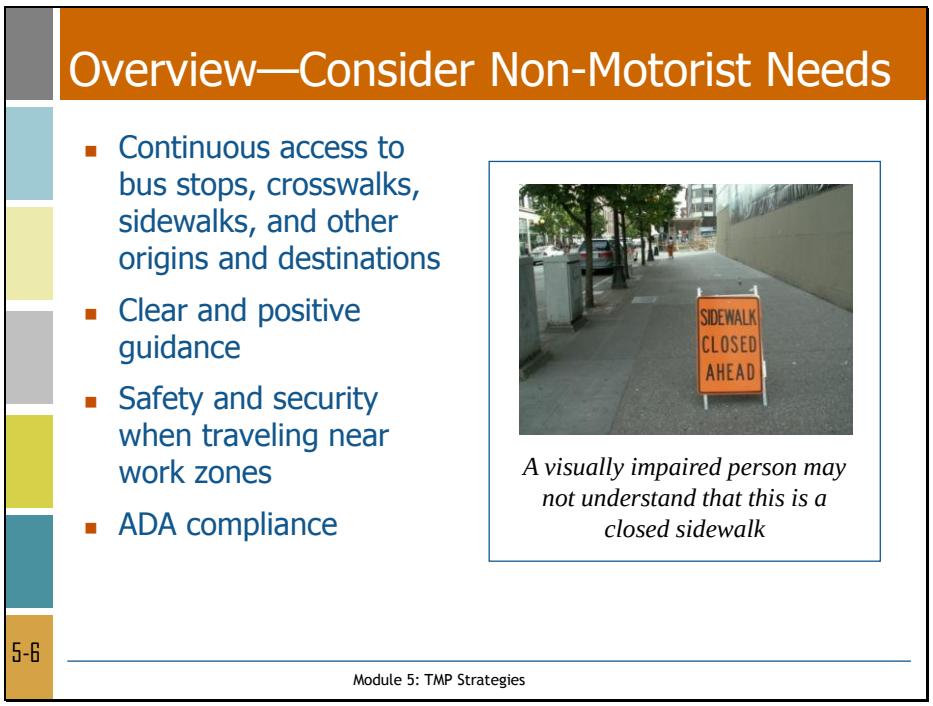
Narrator Notes:
A combination of strategies is necessary to achieve the goals just mentioned.

The Work Zone Safety and Mobility Rule groups TMP strategies into three categories: temporary traffic control, transportation operations, and public information.

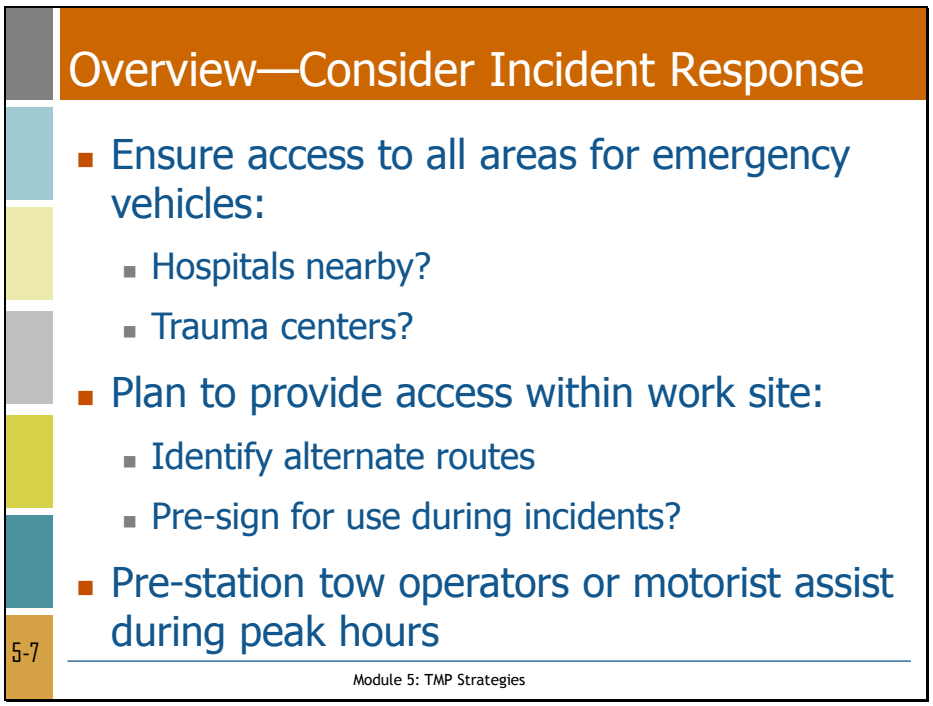
Some Agencies have created additional categories of strategies to include in their TMPs. A few States include Incident Management strategies as a separate category in their TMPs for significant projects. A few States have added a new category called Performance Monitoring strategies, that includes any specific observational, logging, and/or recording activities that are required during the project for work zone performance measurement purposes.



Narrator Notes:
In developing a TMP, consider what the needs of motorists are. Motorists must be provided with information in advance to make a safe decision. Road users generally respond to positive guidance. Guidance is often provided using traffic control devices such as advanced and localized signing, temporary traffic signals, and pavement markings; and in some cases by using flaggers. This guidance can also be combined with Intelligent Transportation Systems which provide real-time information about lane closures and travel delays. It is important that the information provided be clear, concise, and accurate. Inaccurate, untimely, or inconsistent messages can lead the public and other stakeholders to lose trust in work zone signage or the Agency's ability to provide reliable information.



Narrator Notes:
Non-motorist needs are also important, particularly in urban settings where there are pedestrians. Pedestrian accommodations should be at least similar to those existing prior to construction, and may require providing an alternate pedestrian route. Any planned detours must comply with the Americans with Disabilities Act.



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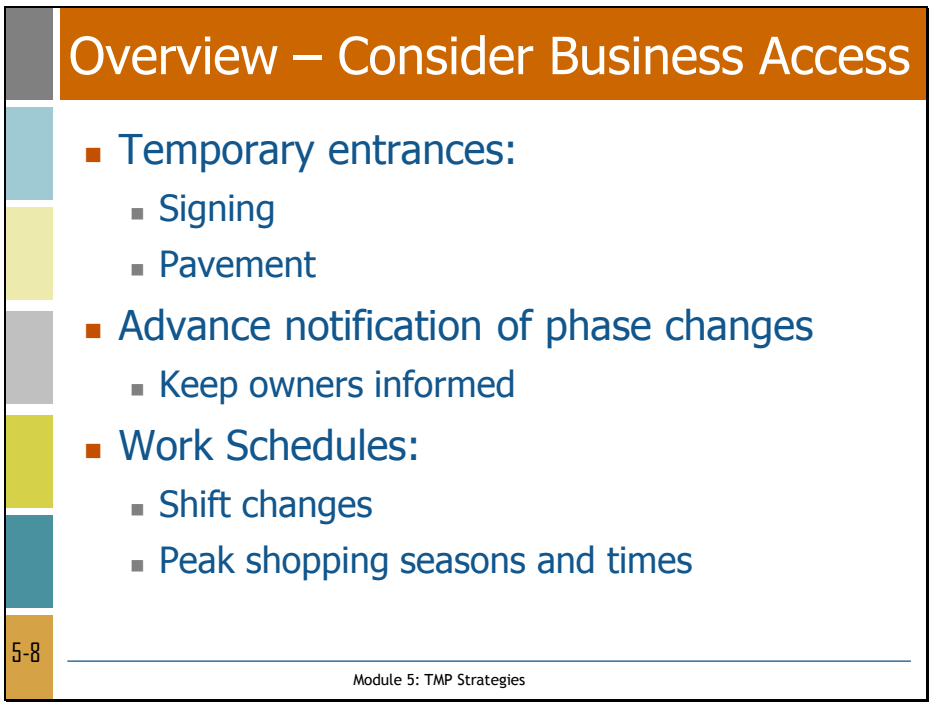
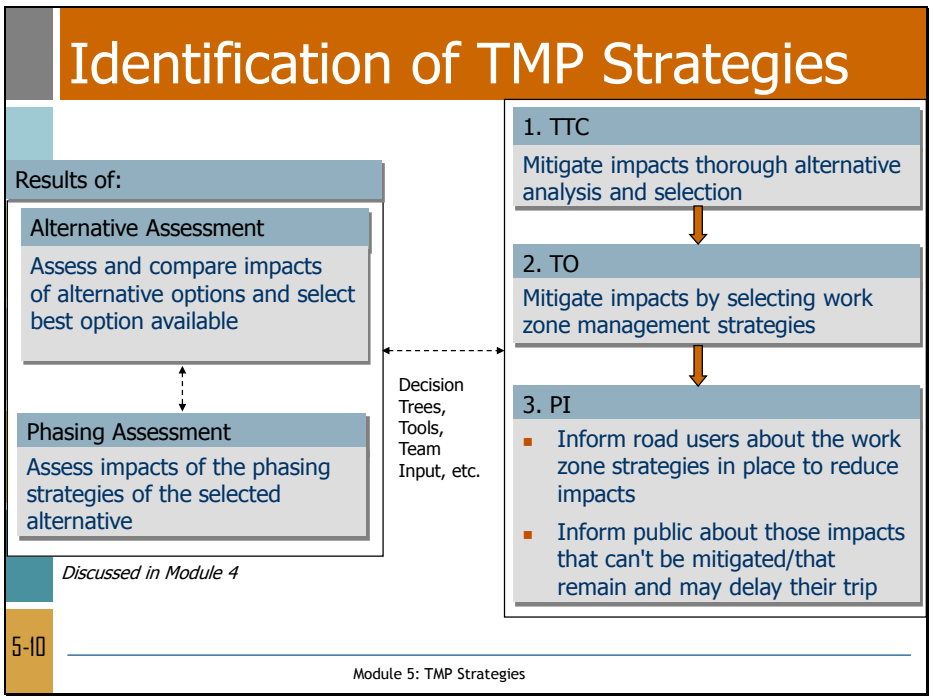


Narrator Notes:
Businesses need to continue to operate during road work, so employees, customers, and those bringing deliveries need to be able to reach businesses affected by a work zone. Access may require a temporary entrance, or signage clearly marking an obscured entrance. Keeping businesses informed and considering work schedules and peak customer periods in developing your TMP can foster good relationships with business stakeholders.

Narrator Notes:
When a project significantly affects the access of residents to their neighborhood, the TMP should include strategies aimed at keeping those residents informed and limiting the duration of the impacts.

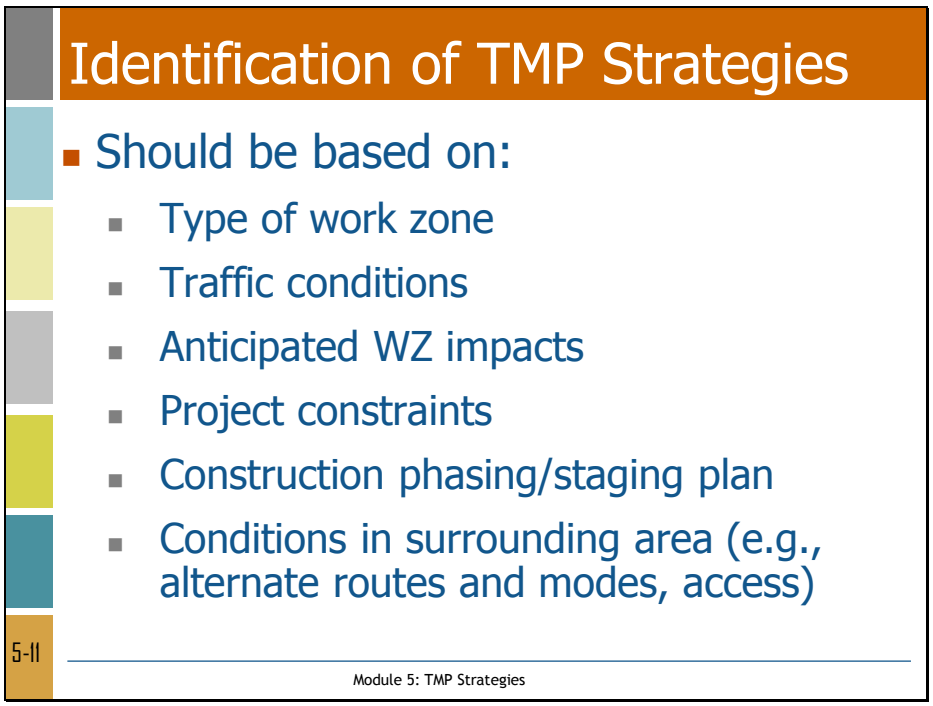


Narrator Notes:
The results of the impacts assessment should lead to TMP strategy selection.

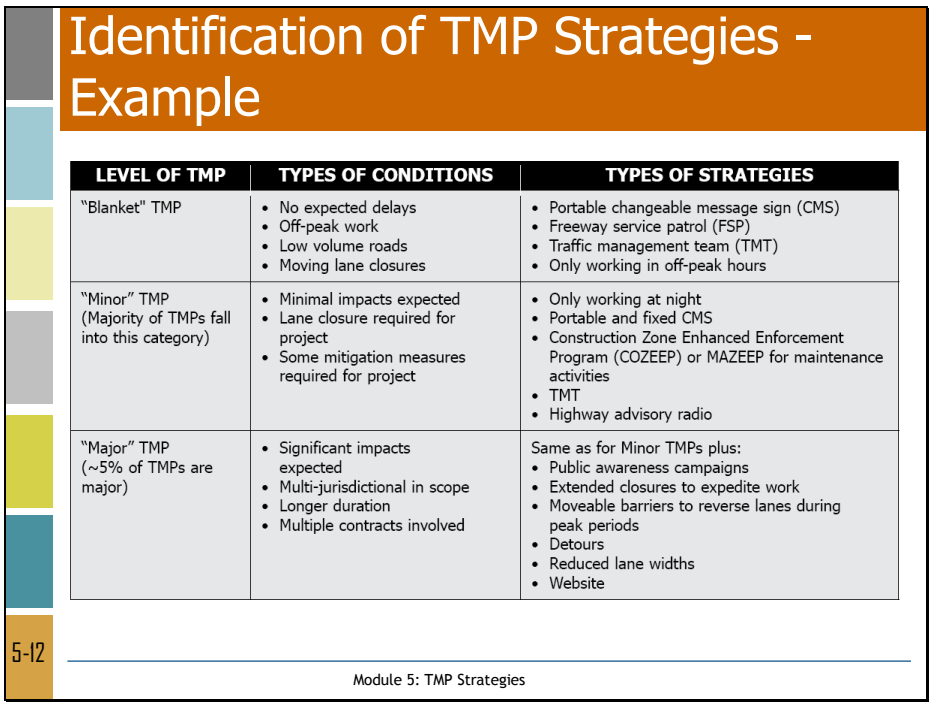
- The TTC component of the TMP implements the chosen project design strategy. This includes lane widths, taper lengths, speed limits, and the layout of traffic control devices in the traffic control plan to guide road users through or around the work zone.

- The TO component addresses strategies to improve work zone operations, such as communications and detector requirements for a work zone traffic monitoring and incident management system, and estimating traffic diversion patterns and rates to determine potential impacts and appropriately improving operations on alternate routes, such as through signal timing adjustments.

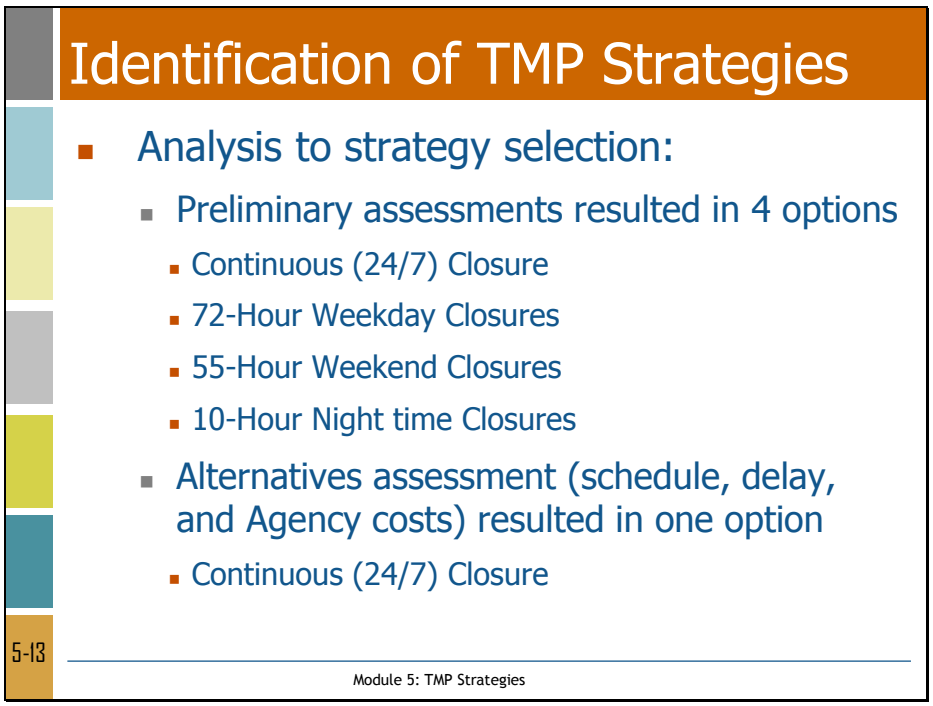
- The PI component estimates the volume of traffic that the project would affect to determine the PI needs, addresses strategies that would be effective in communicating with affected stakeholders, and coordinates with stakeholders to carry out the PI program.



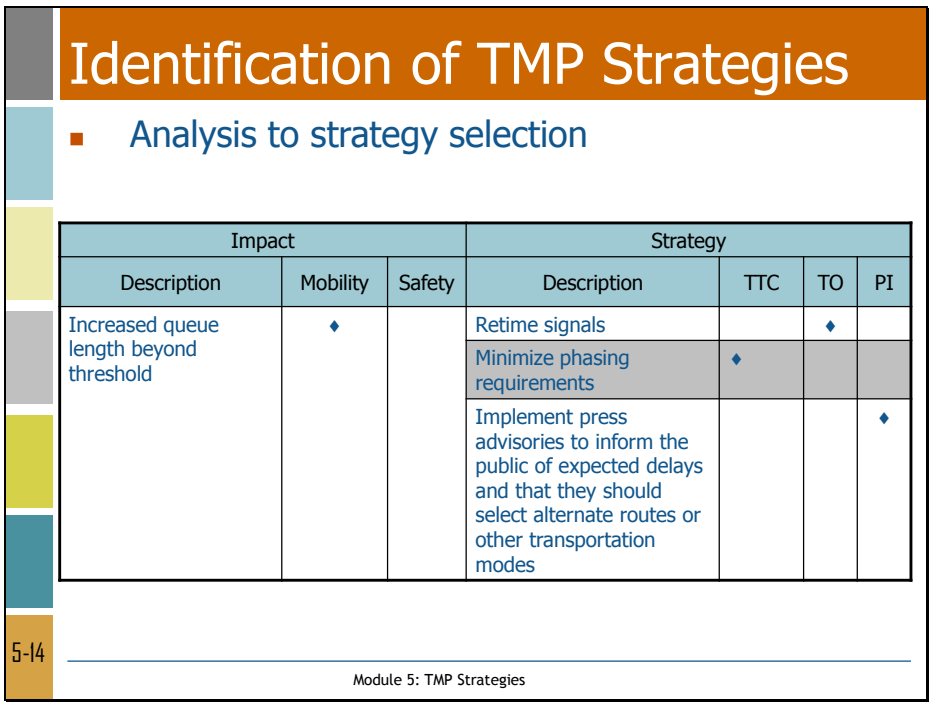
Narrator Notes:
Selection of TMP strategies is based on various factors, including the type of work zone, such as an urban Interstate paving project; traffic conditions, such as traffic demand and truck volumes; and anticipated work zone impacts, such as delays and queues. Project constraints such as increased right-of-way or construction costs and construction phasing, as well as the conditions in the surrounding area such as available alternate routes and transportation modes should also guide the selection of TMP strategies.



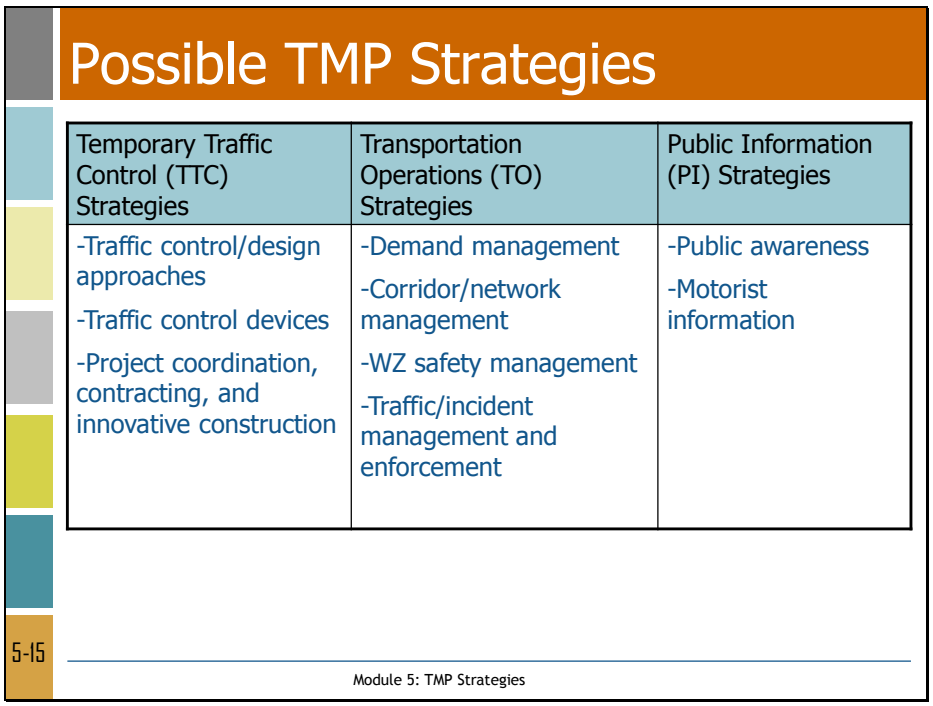
Narrator Notes:
California Department of Transportation TMPs are categorized into three levels based on project characteristics and projected delay. For each TMP level, Caltrans provides examples of the types of conditions that would be present for a project to be in that category and possible strategies to use. This table serves as a guide for Caltrans TMP developers.



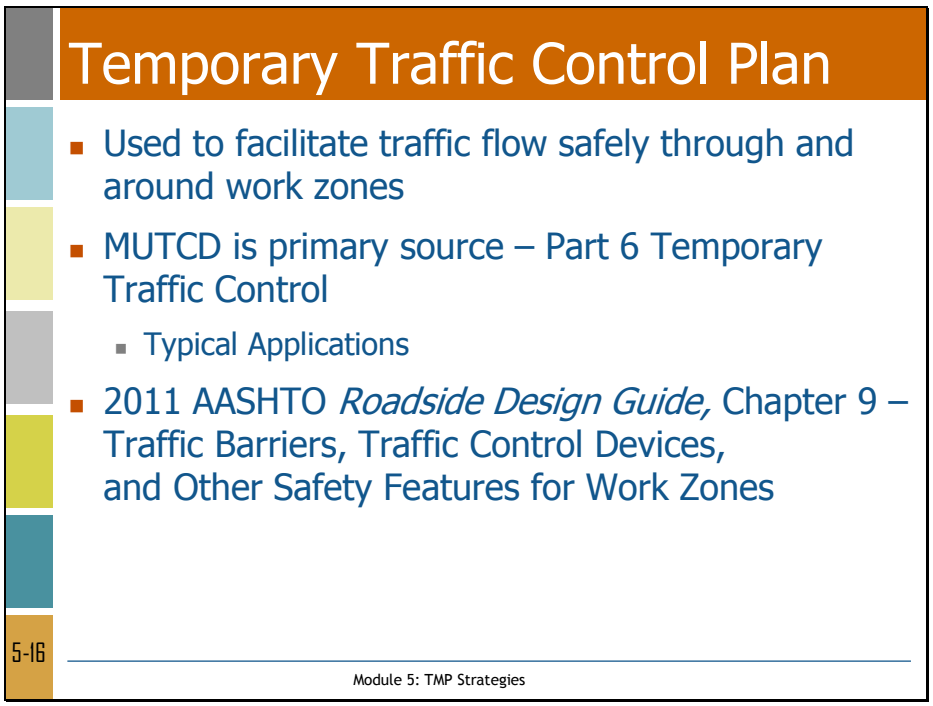
Narrator Notes:
In most cases, a preliminary assessment of impacts may result in more than one option. As design progresses, more information may become available on the feasibility of each approach, leading to detailed assessment and selection of the most viable option. In the example shown here, the preliminary assessment resulted in four options. Various measures of effectiveness such as schedule, delay, and Agency costs were considered to arrive at the best option, which was a continuous closure.



Narrator Notes:
In this example, queue length extends beyond the allowable threshold. The DOT chose to implement relatively simple strategies such as signal re-timing, phasing adjustments, and public information to mitigate the particular problem. A matrix as used here can be a useful tool in comparing and selecting the various strategies available.

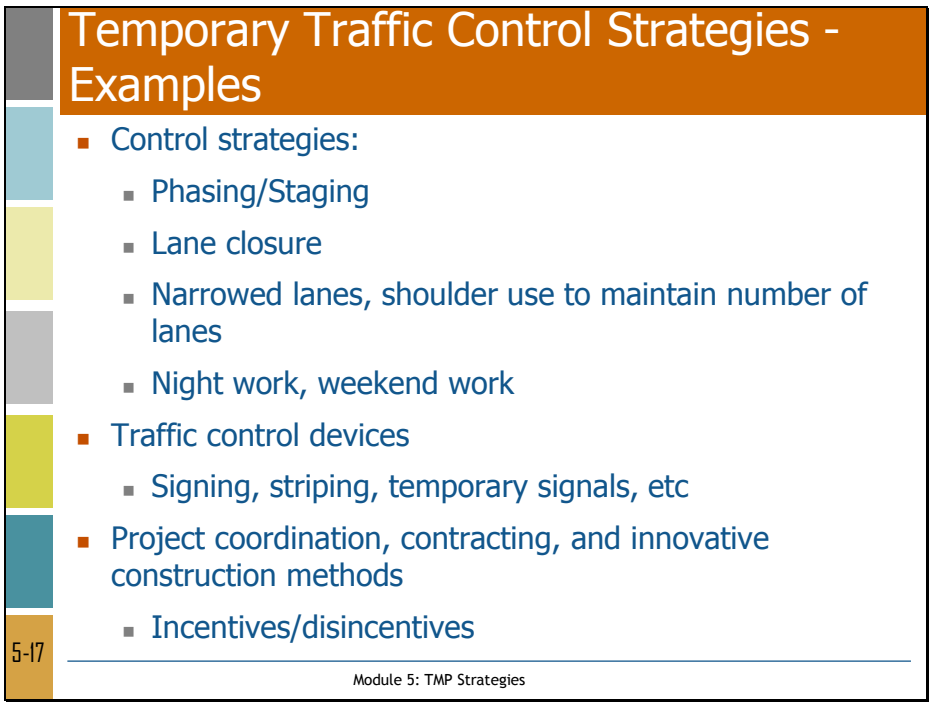


Narrator Notes:
As noted earlier, TMP strategies fall mainly into three categories. FHWA's TMP Guide subdivides those three categories into several sections based on the purpose of the strategy. These categories and subsections will be discussed in the following slides.



Narrator Notes:
Transportation Agencies use temporary traffic control strategies and traffic control devices to facilitate traffic flow safely through and around work zones. The Manual on Uniform Traffic Control Devices, or MUTCD, and the AASHTO Design Guide, provide national standards, guidance, and other information defining the proper use of traffic control strategies and devices. The MUTCD contains typical applications of traffic control layouts to assist designers.

As shown on the previous slide, there are other types of traffic control and design strategies that can be used to reduce work zone impacts. These other types of strategies include contracting, innovative construction, and project coordination techniques that can accelerate projects or minimize the occurrence of several nearby projects going on at the same time.



Narrator Notes:
The intent of any temporary traffic control strategy is to maximize traffic throughput, especially during peak hours, without compromising safety. A range of traffic control and innovative construction methods are being used to achieve this. Some examples are shown here.

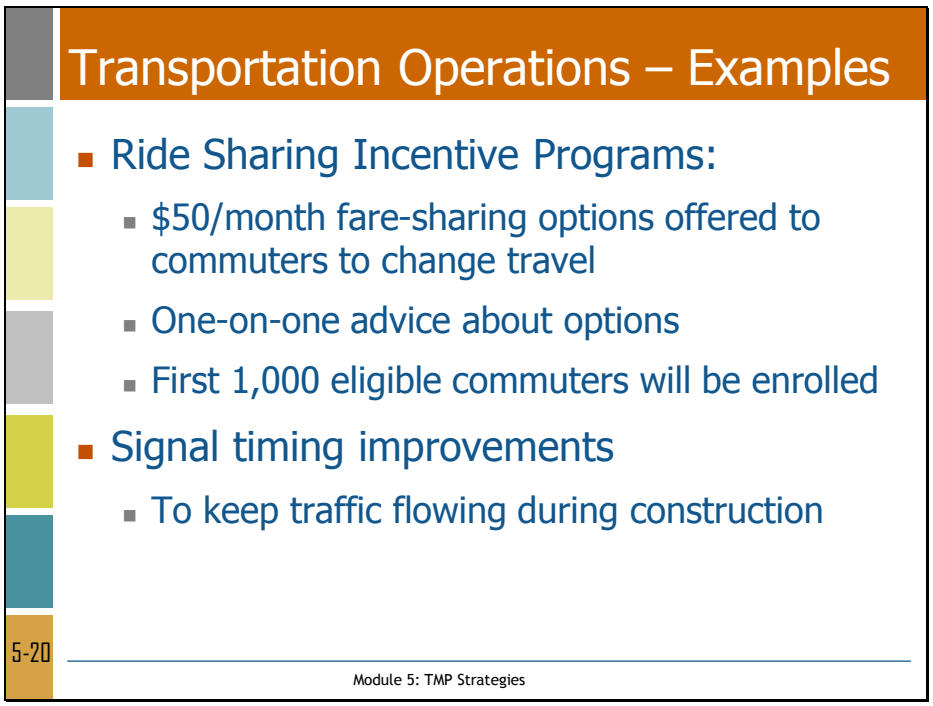
Narrator Notes:
Some additional examples of temporary traffic control strategies are temporary traffic barrier and advance work zone warning signs.

Narrator Notes:
Transportation operations strategies can mitigate work zone impacts by using improved transportation operations and management of the transportation system in and around the work zone. Strategies include demand management, where the strategies try to influence motorists to consider traveling another way, such as by transit or carpool, to reduce the volume of cars flowing through the work zone. This is particularly useful when the Agency is unable to provide the necessary capacity in a work zone.

Infrastructure or corridor management strategies are where the responsible Agency makes decisions that can affect the road user such as, signal re-timing, parking restrictions, and lane control.

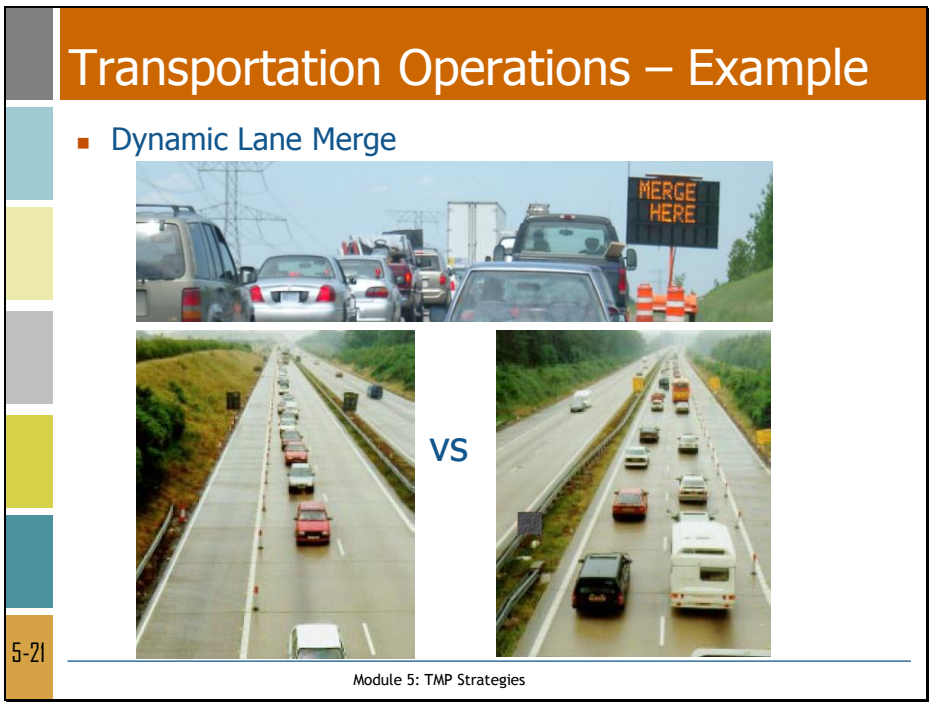
Strategies specifically focused on safety include speed management, barrier installations, and temporary rumble strips.

The last category includes strategies that involve monitoring traffic conditions and making adjustments to traffic operations based on changing conditions. These strategies include more improved detection, verification, response, and clearance of crashes; adequate enforcement of traffic regulations in work zones; and the use of ITS and traffic management centers to monitor and manage traffic.

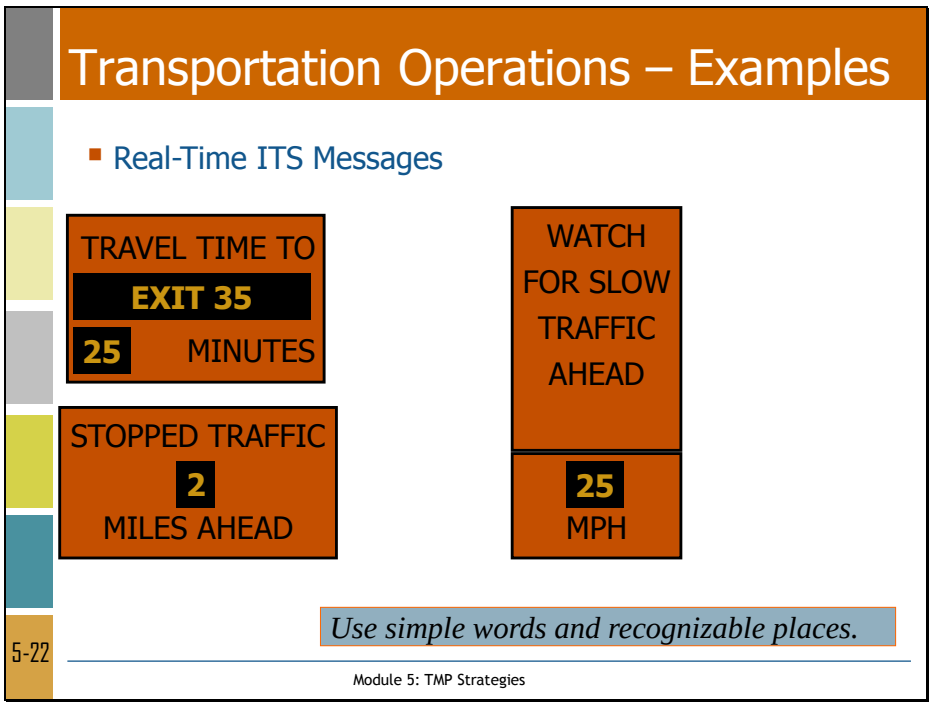


Narrator Notes:
The first example is on ride sharing incentive programs. This strategy was successfully implemented on the New York Avenue reconstruction project in Washington, D.C. The District Department of Transportation provided the first 2,000 New York Avenue commuters a $50 per month incentive to use ride-sharing alternatives such as buses, rail transit or organized vanpools. The program also provided one-on-one advice to help commuters determine which alternatives were best for their individual needs.

The second example on signal timing improvement is critical when traffic is still maintained on the main line with a reduced number of lanes compared to normal operating conditions. In such cases more green time on the main line will help keep traffic flowing during construction with less congestion. Signal timing improvements may be needed on detour routes as well, depending on the amount of expected detoured traffic and the current capacity of the detour routes.



Narrator Notes:
A dynamic lane merge system directs traffic to use both lanes (open and closed lanes) until the designated "merge point" (close to the taper) where traffic from each lane is instructed to take turns merging into the open lane. In congested conditions, this helps reduce queue lengths approaching a lane closure. Shorter queues can improve both safety and mobility.

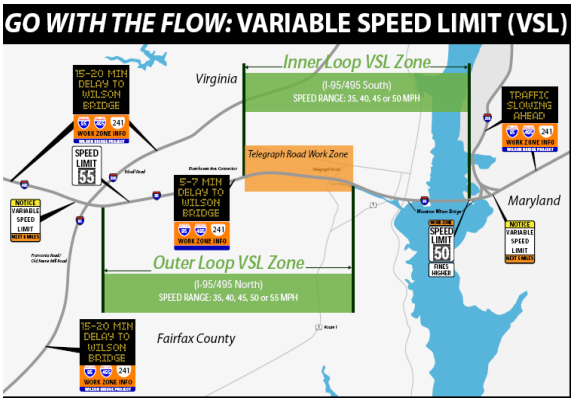


Narrator Notes:
Informative real time messages help drivers to react positively to changes occurring in traffic ahead and to make informed route choices. Clear and accurate information is the key to maintaining road user trust.

Transportation Operations – Example

- Variable Speed Limit (VSL) Technology
  - Modern systems that change the speed limits in real time

Implemented to assist drivers approaching Beltway/I-95 lane closures associated with Telegraph Road Interchange reconstruction, the final element of the Woodrow Wilson Bridge Project in VA.

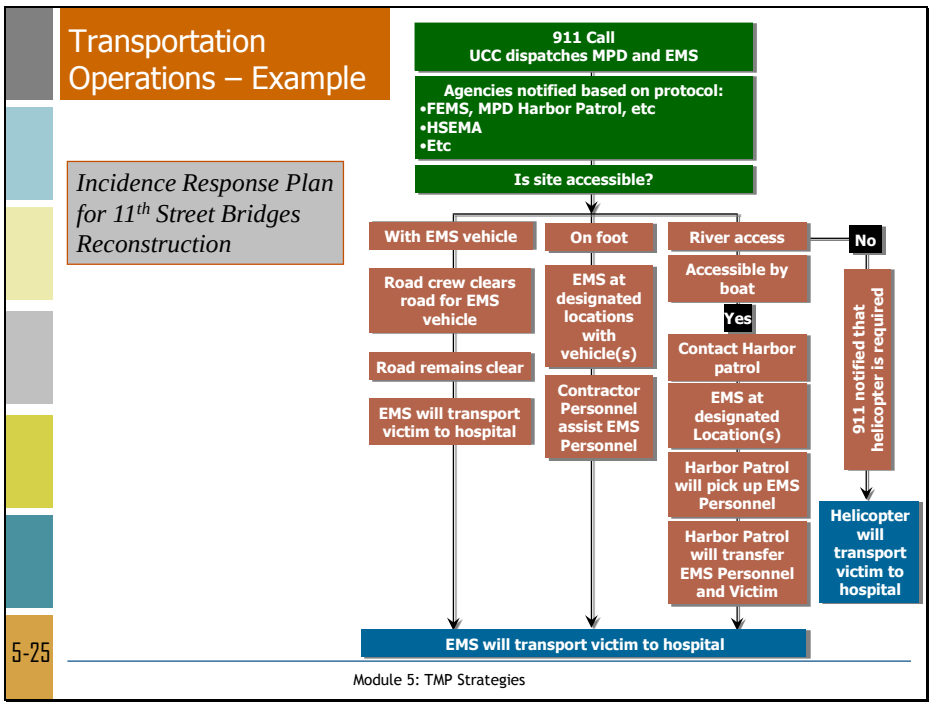


5-23

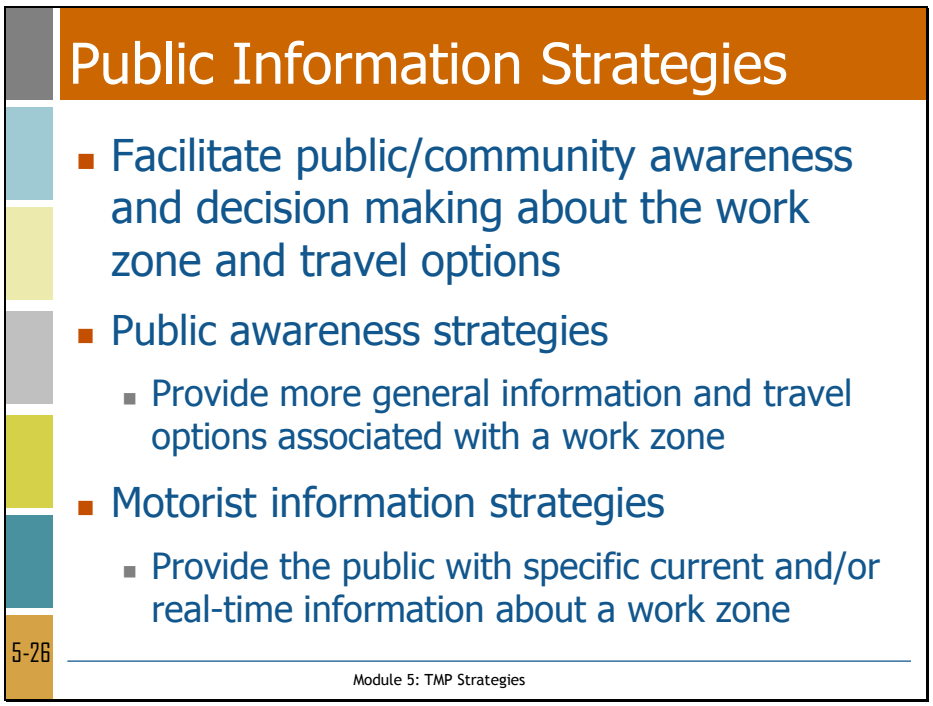
Module 5: TMP Strategies

Narrator Notes:
Variable speed limit, or VSL, technology is not often used, but on large projects with significant duration, this may be a good tool to control traffic merging. In this example, the system was used successfully on the Woodrow Wilson Bridge Project in the Washington, D.C. area. VSL systems help to maximize traffic flow and improve safety by slowing vehicles down gradually before they reach a lane reduction when there is congestion. This reduces the need for abrupt changes in speed and sudden braking, improving both safety and mobility.

Narrator Notes:
In many work zone activities, capacity is reduced due to lane closures or even lane shifts or distractions from work activities. It can be helpful to have a service patrol to help remove disabled vehicles and restore capacity quickly. Law enforcement presence can increase the awareness of motorists and help manage traffic speeds.



Narrator Notes:
In developing a TMP, incident response needs to considered. One example is this chart from a bridge project that shows a simplified incident management process from the initial 911 call through to hospital intake. It is important to make the TMP implementation team aware of the process and various roles and responsibilities in case of an accident.



Narrator Notes:
The Public Information component in the TMP has the potential to reduce work zone impacts by providing both general and specific information concerning road projects. These strategies include public awareness strategies and motorist information strategies.

Public awareness strategies educate and reach out to the public, businesses, and the community and provide general information about a road project, the work zone, and travel options.

Motorist information strategies provide more specific information that is current and possibly real-time to road users regarding traffic conditions to expect. Motorist information is generally provided during a trip, after the road user is already in the vehicle.

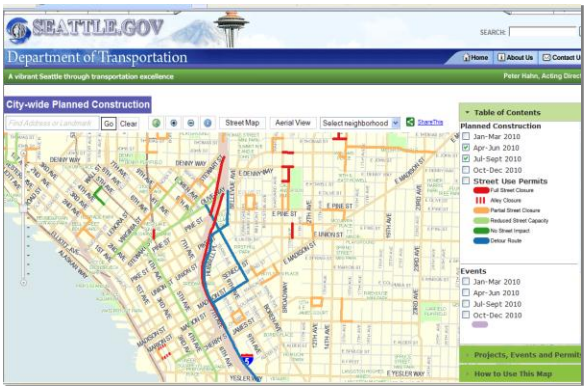
The key is to engage the public early in the TMP development process, particularly affected communities and businesses, and keep them informed throughout the project.

Narrator Notes:
Numerous approaches exist to provide the public with general information about a project. These approaches include newsletters and brochures, press releases, the use of mass media advertising, project Web sites, meetings and community events, and social media. Regardless of medium, the key is accurate, timely, and consistent information. Coordination with your Agency's public information office will help to ensure success, particularly for significant projects.

Public Information - Example

- Project Web Site

The City of Seattle introduced a Web site that consolidates information on planned projects in the City



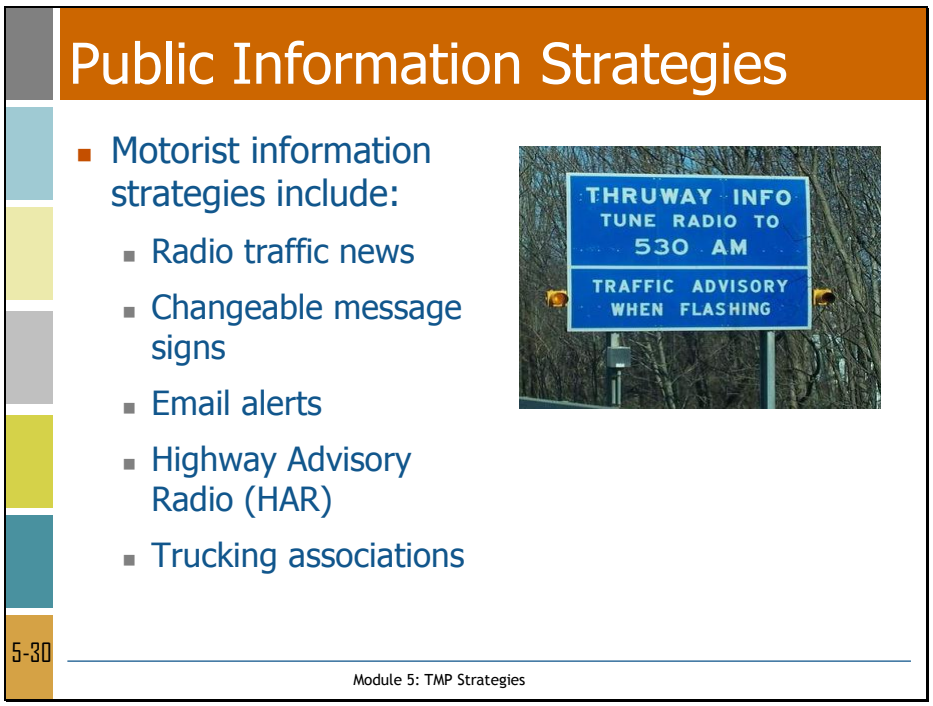
A Construction Coordination Map

5-28

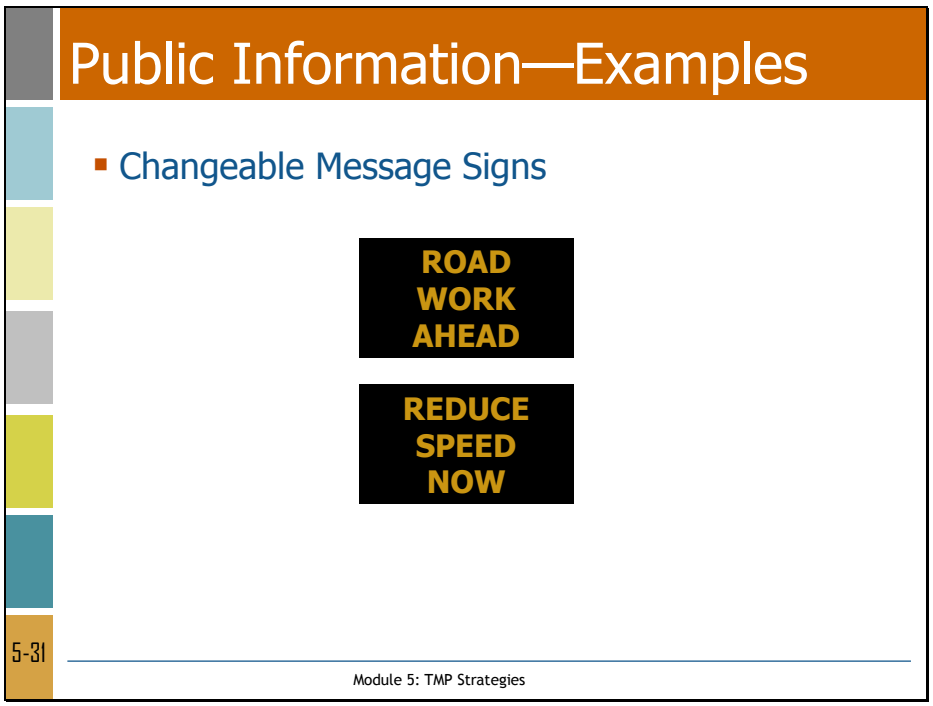
Module 5: TMP Strategies

Narrator Notes:
This is an example of the project Web site developed for the City of Seattle. The site includes a Construction Coordination Map with details on affected streets and sidewalks, detours, information on the construction projects, bicycle and freight routes, and a link to real-time congestion information.

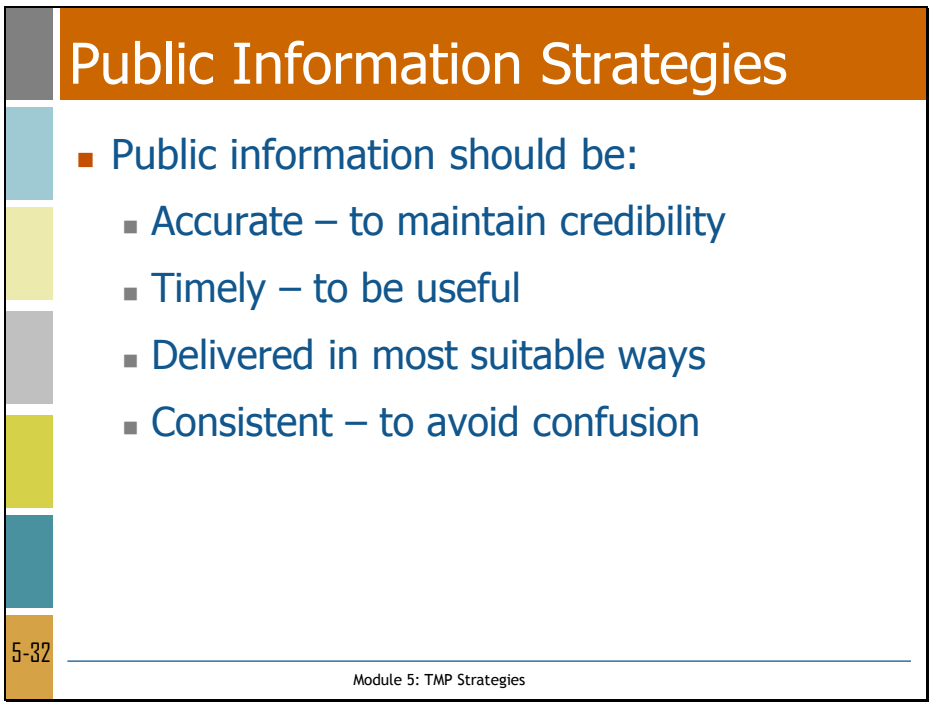
Narrator Notes:
Social media is emerging as a real time information medium. Many road users of all ages log on to Facebook and Twitter to get regular updates. This can be an effective way to share information for medium to long term projects.



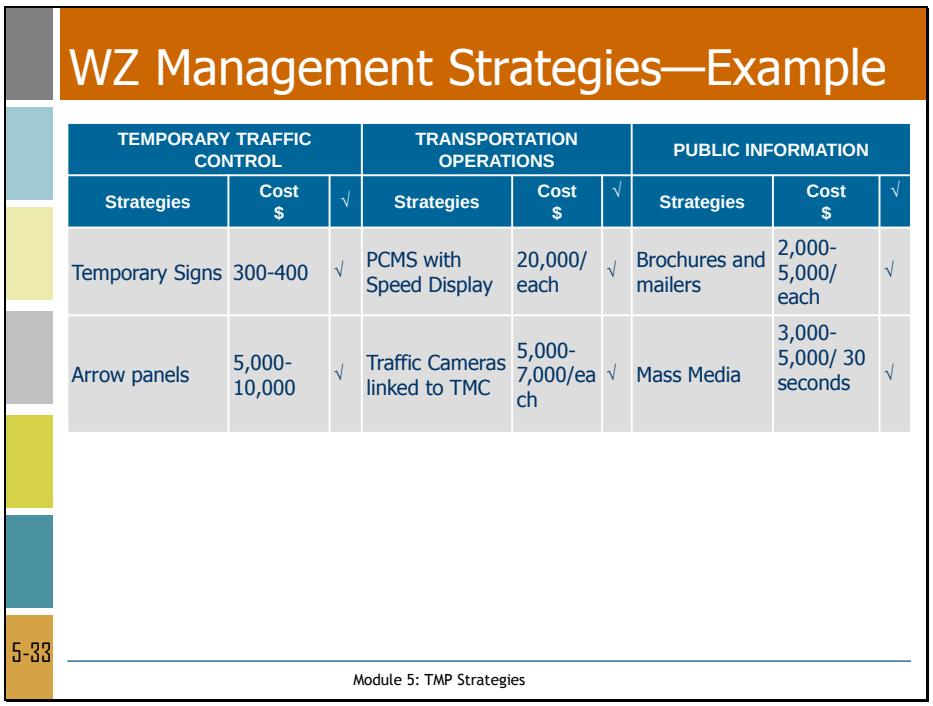
Narrator Notes:
Some motorist information strategies are shown here. Working with traffic reporters to provide near real-time information about lane closures and delays on radio traffic reports can be a good way to reach motorists already enroute in their cars. Changeable message signs and highway advisory radio allow the DOT to provide timely information about traffic conditions such as lane closures, queues, and delays, and can generally be updated by the DOT whenever needed. In areas with significant commercial vehicle traffic, the Agency should consider targeting some information to truckers, such as through a trucking association.



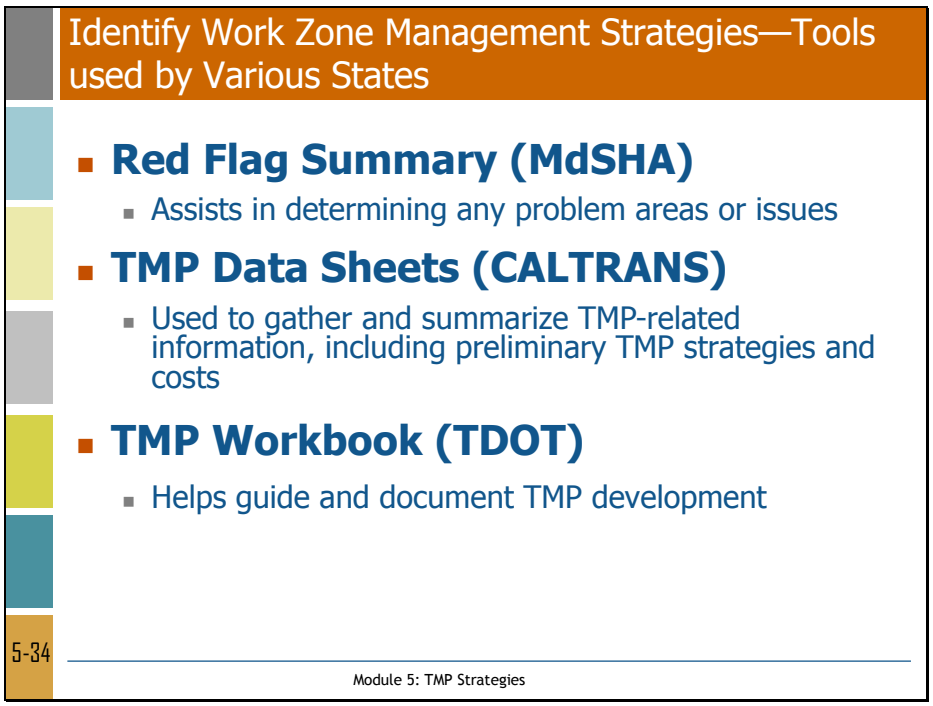
Narrator Notes:
Informative real time messages help drivers be prepared for changes occurring in traffic ahead. Accurate, clear information is the key to maintain road user trust.



Narrator Notes:
Public information should be delivered in a way that is most likely to be effective. Often the use of several formats or mediums in combination is most effective for reaching all the relevant audiences. For example, a project Web site might be used for general awareness and pre-trip planning, while changeable message signs near and within the project and radio traffic reports could be used to provide en-route information to drivers. Regardless of the types of mediums used, the information provided needs to be accurate, timely, and consistent.



Narrator Notes:
A spreadsheet or table is good for logging your selection of strategies by type and cost. This allows a designer to review the set of strategies and determine which are the most appropriate ones for that project.

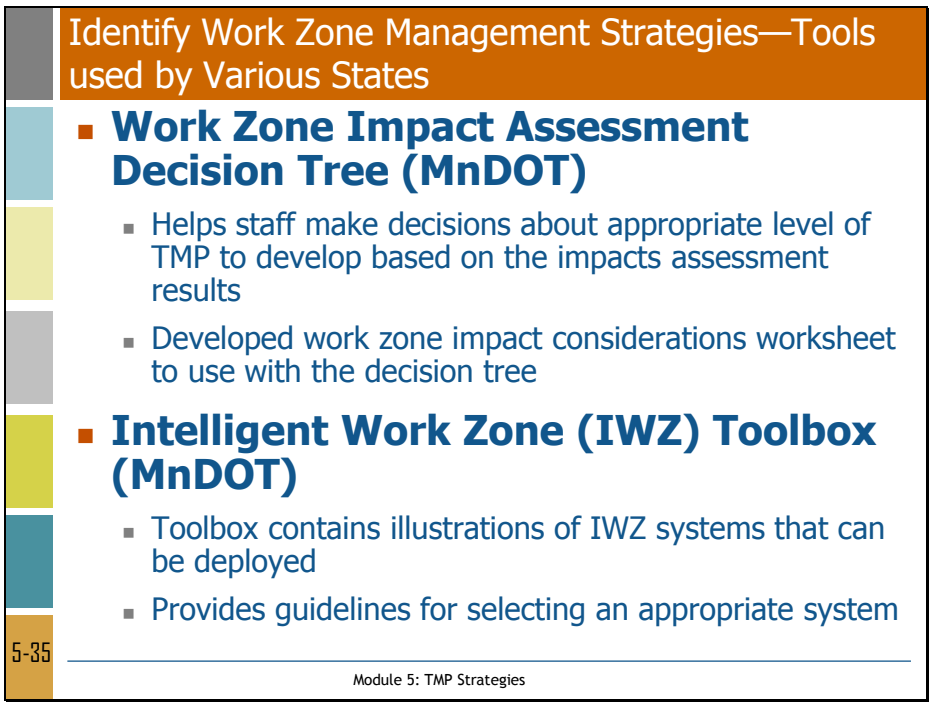


Narrator Notes:
A number of States have developed tools to assist their planners and designers in identifying impacts and selecting strategies to address those impacts.

Maryland's red flag summary assists in determining issues that are present and should be considered during project development.

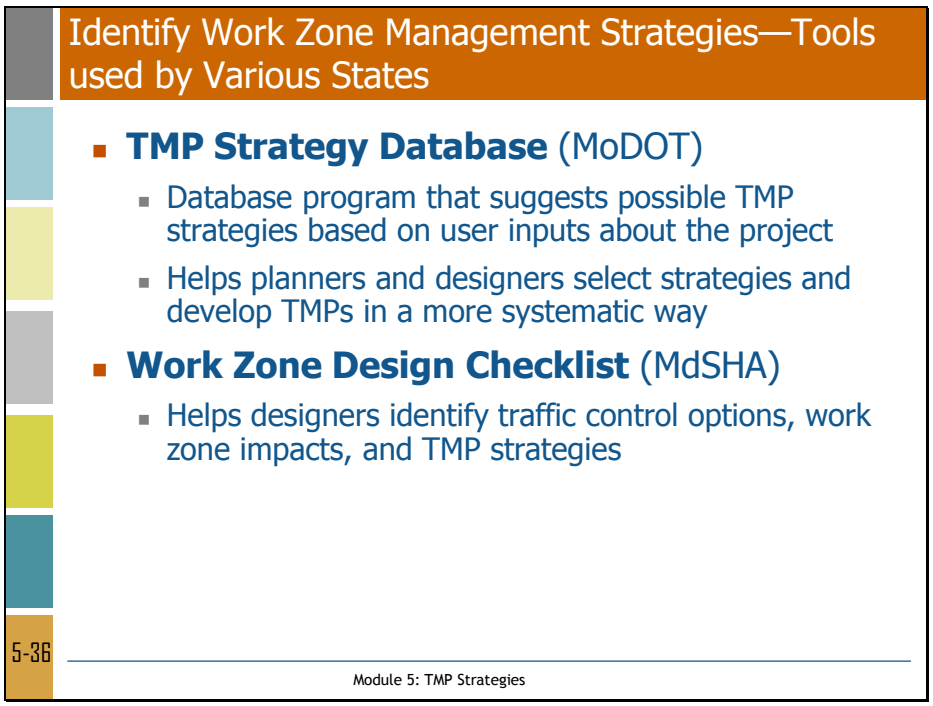
California uses TMP data sheets to gather and summarize TMP-related information, including preliminary TMP strategies and costs. Caltrans prepares a data sheet for every project and includes a work description and available information about traffic patterns.

Tennessee DOT developed a TMP workbook to aid its staff in developing TMPs. The first part of the Workbook on Project Significance Determination is completed by the planning staff, and then the workbook is passed forward to designers to complete the sections on TMP strategies during project design.



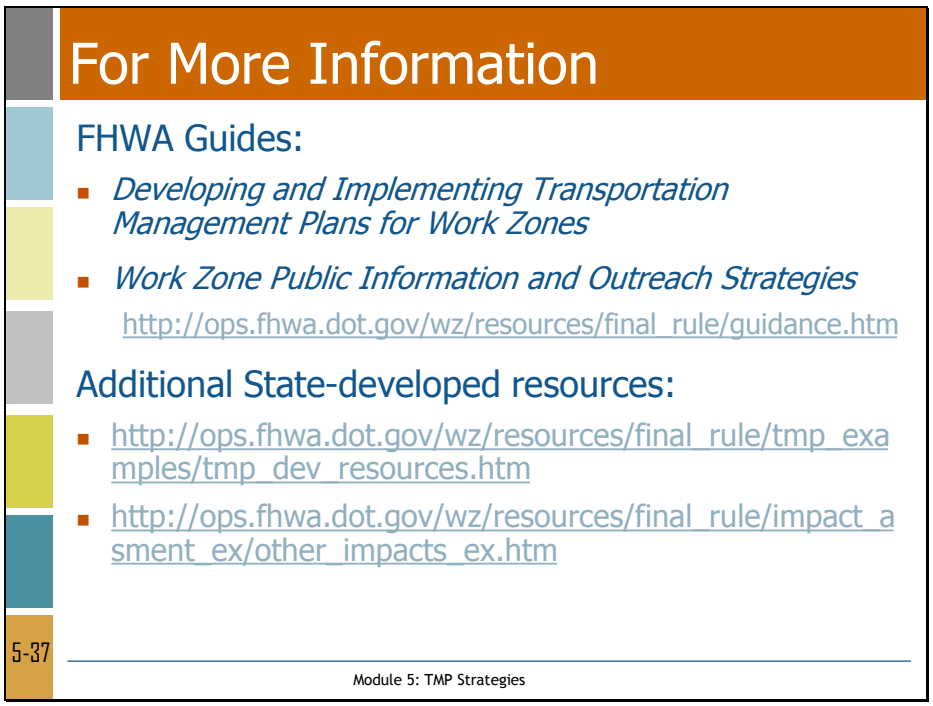
Narrator Notes:
Minnesota DOT helps staff make decisions regarding the appropriate level of TMP to be developed depending on the work zone impacts through a series of steps. Each district or local road authority is encouraged to develop and implement a general traffic delay-restriction policy for its jurisdiction. Minnesota DOT also developed a work zone impact considerations worksheet to help identify project impacts and potential mitigation strategies.

Minnesota DOT's toolbox provides guidance for selecting an appropriate intelligent work zone system to address work zone traffic issues. The toolbox contains illustrations of systems typically deployed.

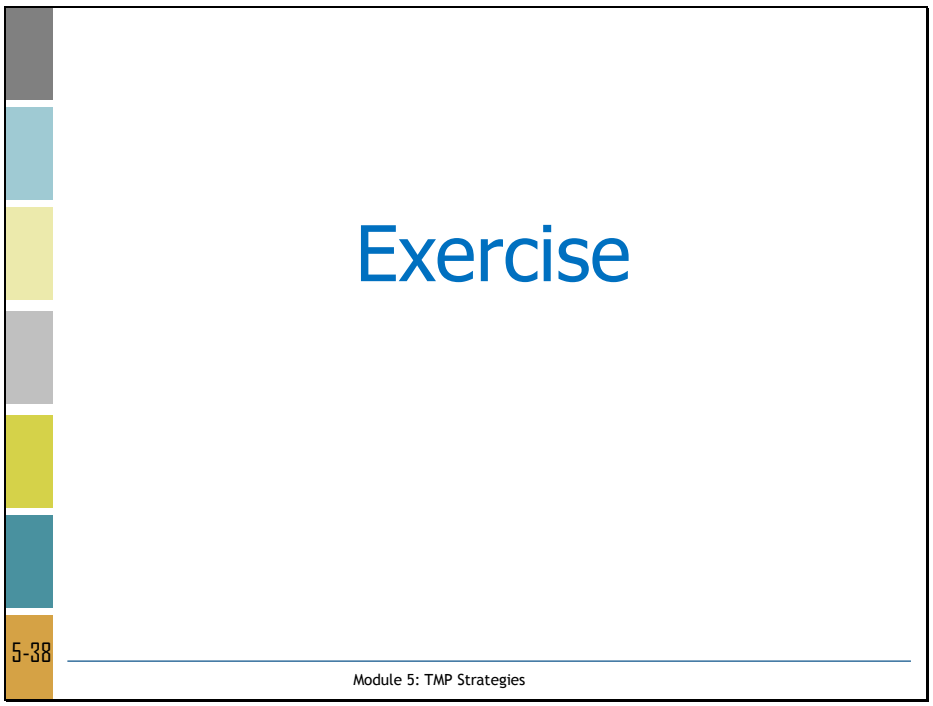


Narrator Notes:
Missouri DOT developed a TMP Strategy Database that helps planners and designers select work zone management strategies and develop TMPs in a more systematic way. The database returns possible appropriate work zone management strategies based on user inputs about project-related characteristics. Construction personnel can use the program to find a solution should a concern arise while the work zone is in operation.

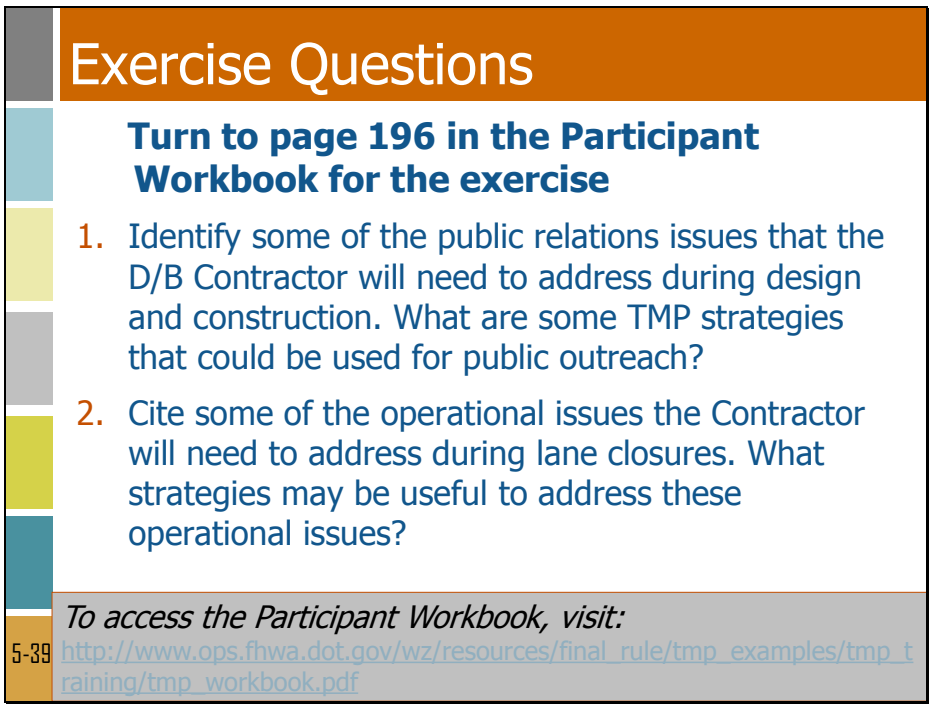
Maryland's work zone design checklist helps designers identify traffic control options, work zone impacts, and TMP strategies. It also helps ensure that all appropriate work zone options, impacts, and strategies have been considered.



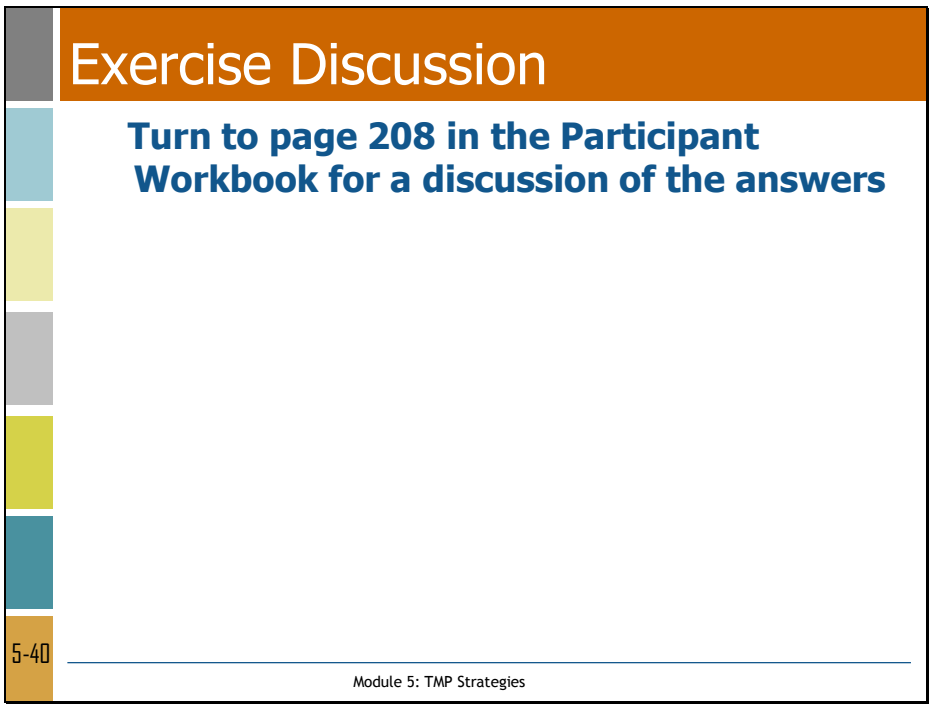
Narrator Notes:
FHWA-developed guides and additional State-developed resources are available on the websites listed on this slide.



Narrator Notes:
Now that you have completed Module 5, this exercise will provide you with an opportunity to apply what you have learned.

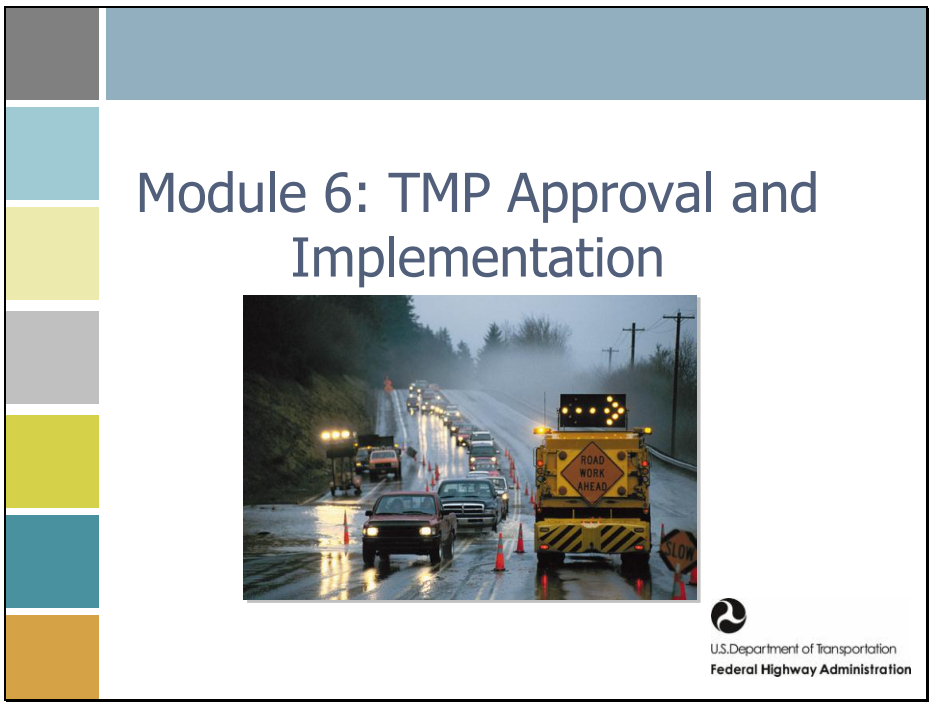


Narrator Notes:
Please turn to page 196 in Appendix C in the Participant Workbook. After reading the exercise, please answer the questions on this slide.

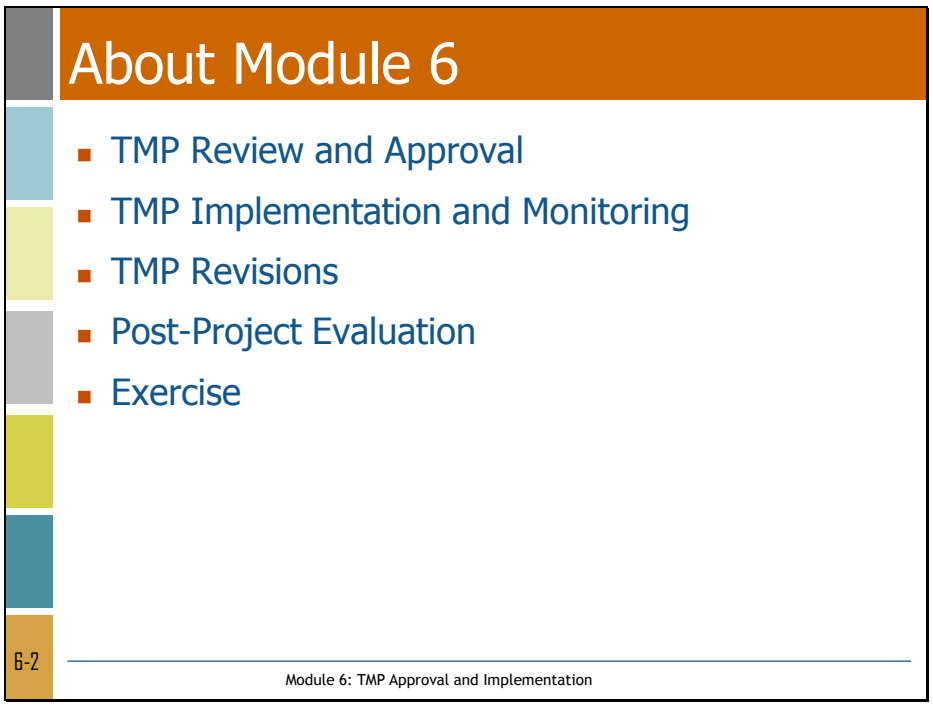


Narrator Notes:
Once you have completed answering the questions, turn to page 208 in the Participant Workbook for a discussion of the exercise answers.

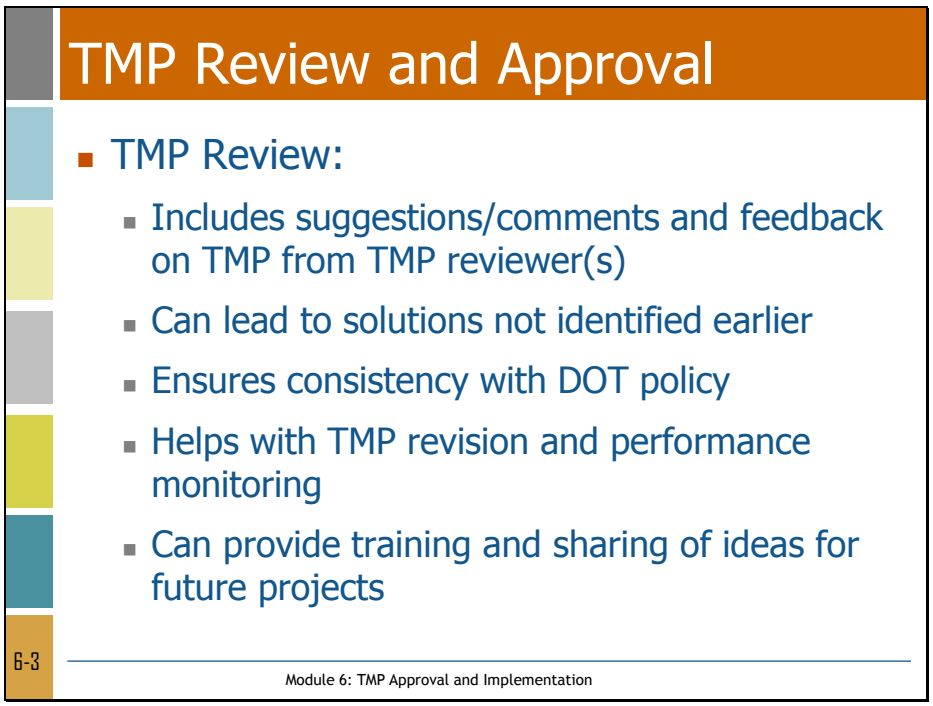
Module 6: TMP Approval and Implementation



Narrator Notes:
This module discusses TMP approval and activities during implementation of the TMP. As discussed in earlier modules, the TMP is a living document, and as construction progresses even the best design can change. Traffic conditions or other factors can also change, resulting in the need to adjust work zone management efforts. In cases where there are substantial changes to the TMP, these should be documented as addendum to the TMP and signed-off by the DOT.

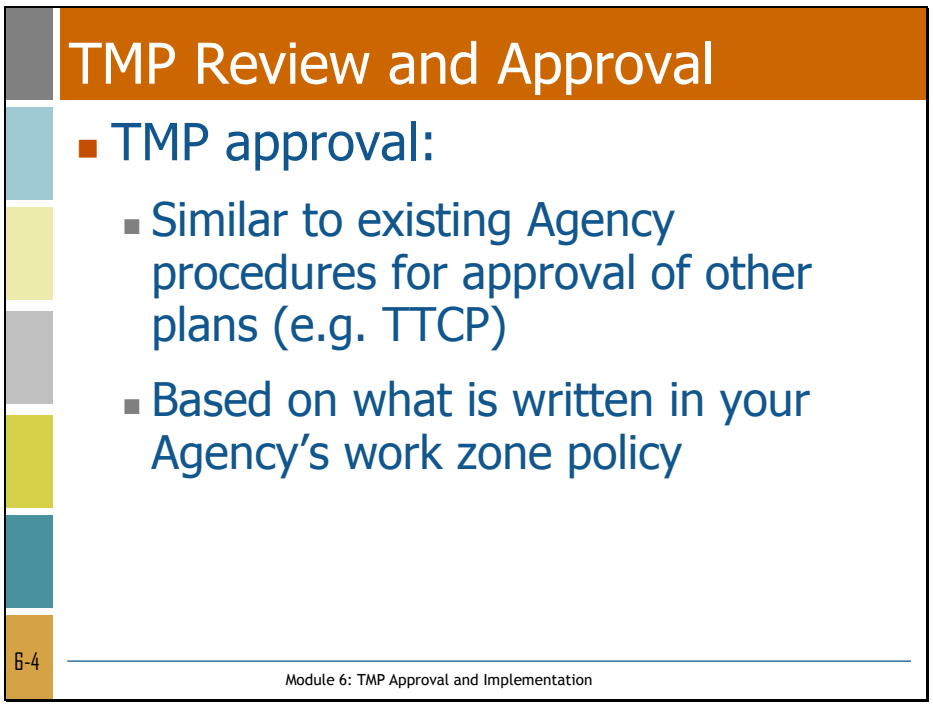


Narrator Notes:
Module 6 covers TMP review and approval; TMP implementation and monitoring; TMP revisions; and post-project evaluation. Module 6 concludes with an exercise to help you apply what you have learned.

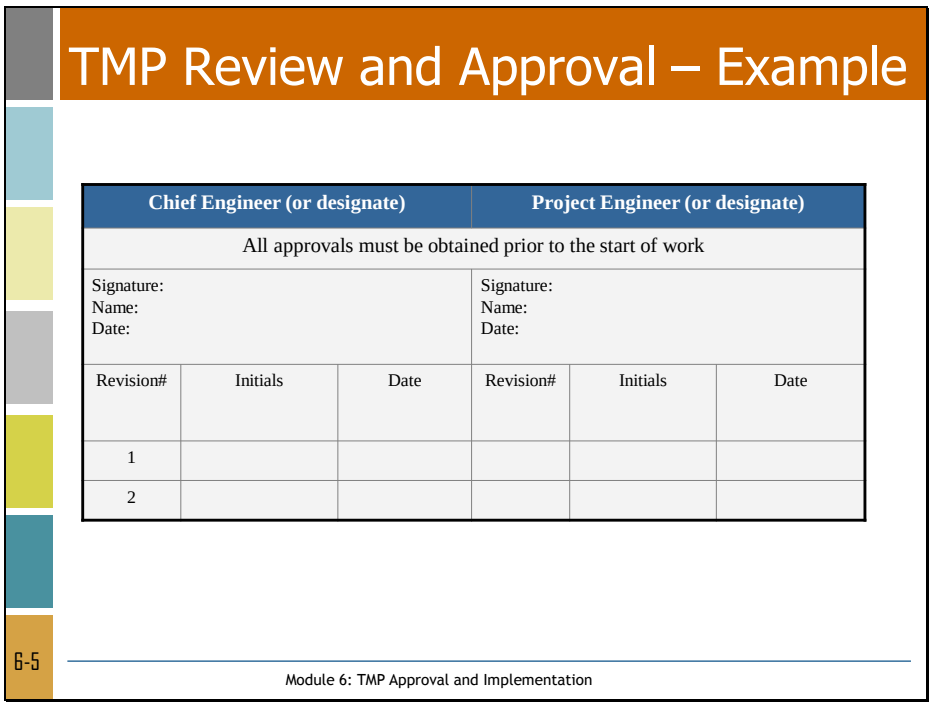


Narrator Notes:
Having a step for TMP review by District managers or senior project managers generally leads to more effective TMPs. TMP review may include suggestions and comments from TMP reviewers which can lead to solutions not identified earlier. During TMP review, the reviewers can help make sure that the TMP is developed in accordance with Agency policy and guidelines, leading to greater consistency.

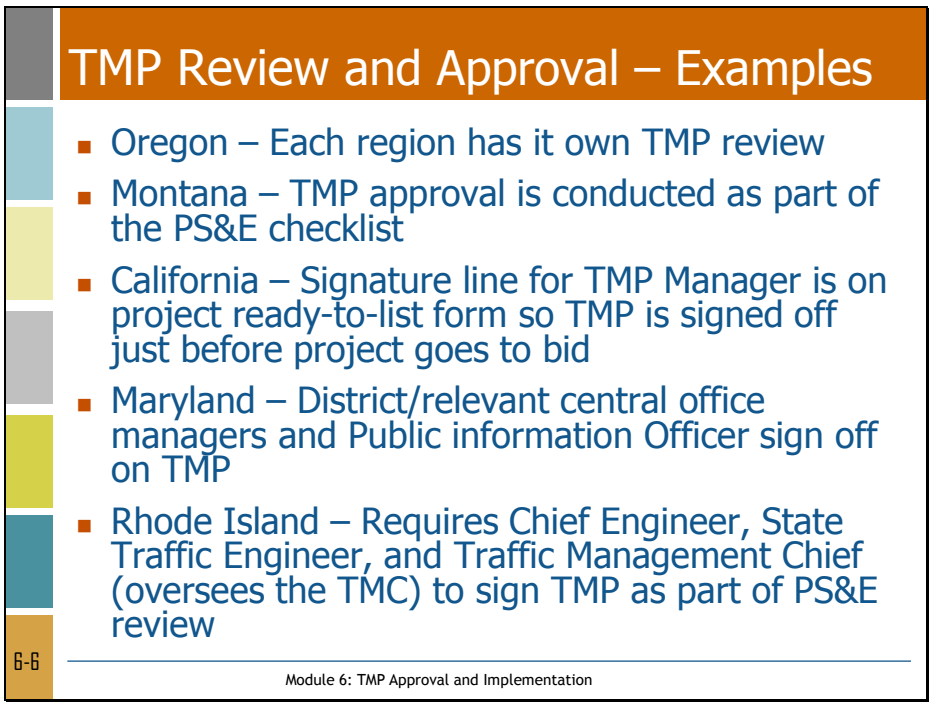
Review efforts may lead to TMP revisions, which can then be done before a project goes to bid, reducing the need for potentially costly changes later. The review process can also provide input to performance monitoring and future training.



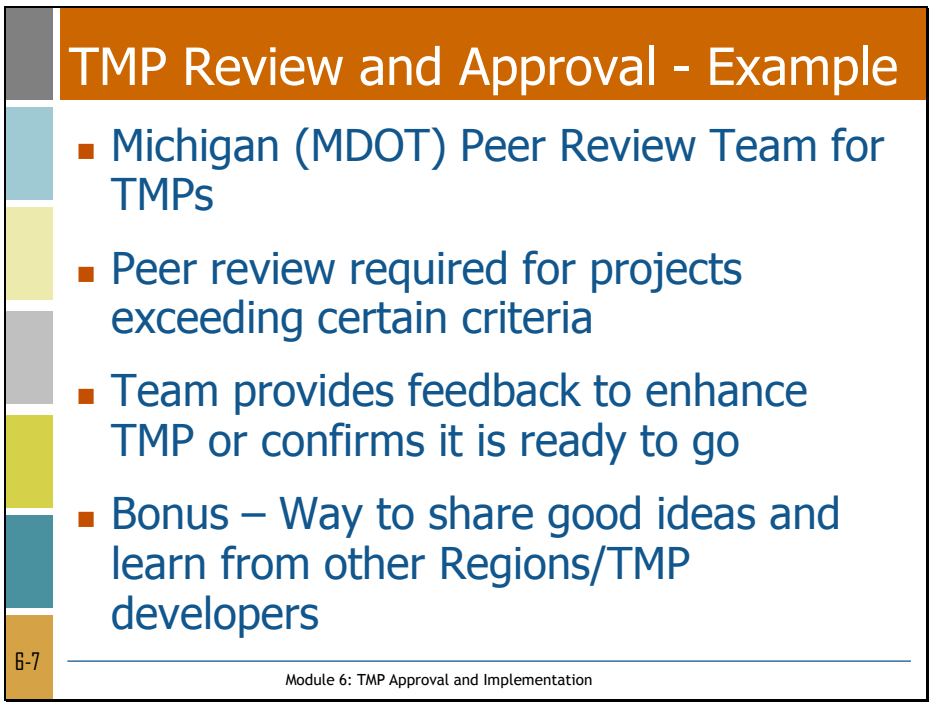
Narrator Notes:
A TMP must be approved before implementation. The process for TMP approval can be similar to your Agency's procedures for approval of other plans such as temporary traffic control plans. Most Agencies have the approval process documented in the formal work zone policy or in a procedures manual.



Narrator Notes:
Each Agency has to determine what approval process works for them. Some States have a formal documented process. Some States include a simple table in their TMP, like the one shown here, for initial sign off and for updates as major changes occur.



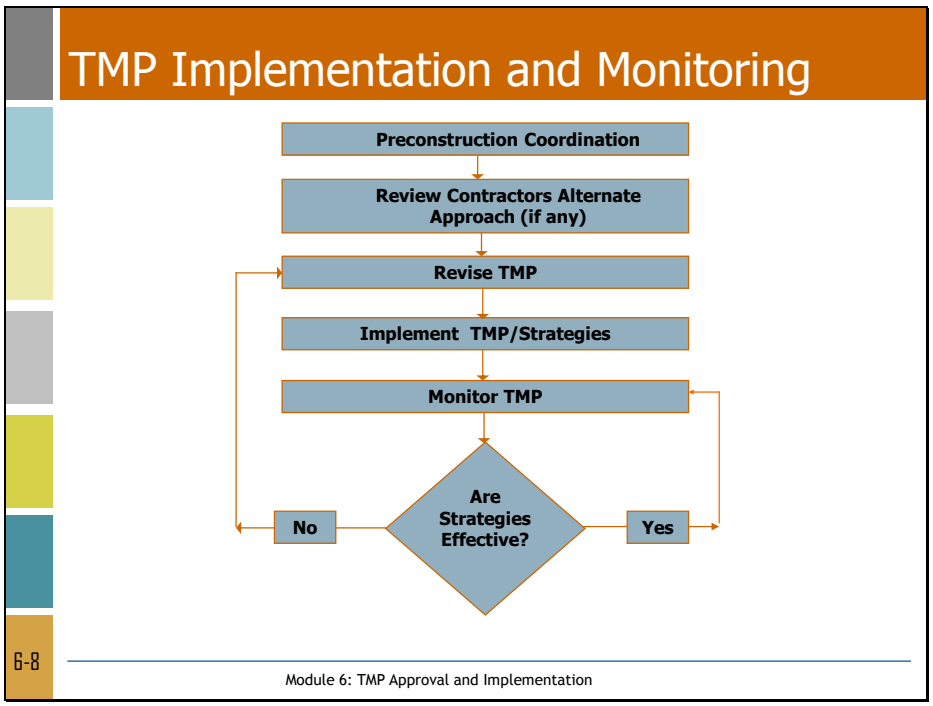
Narrator Notes:
States have different review and approval processes for TMPs. Several States include TMP review and approval as part of the review process for the PS&E package. Some States route the TMP for review separately, either in hardcopy or electronically. There are also variations across Agencies in who is required to review a TMP. A State needs to adopt a process that best suits its needs and achieves the goals of work zone safety and mobility.



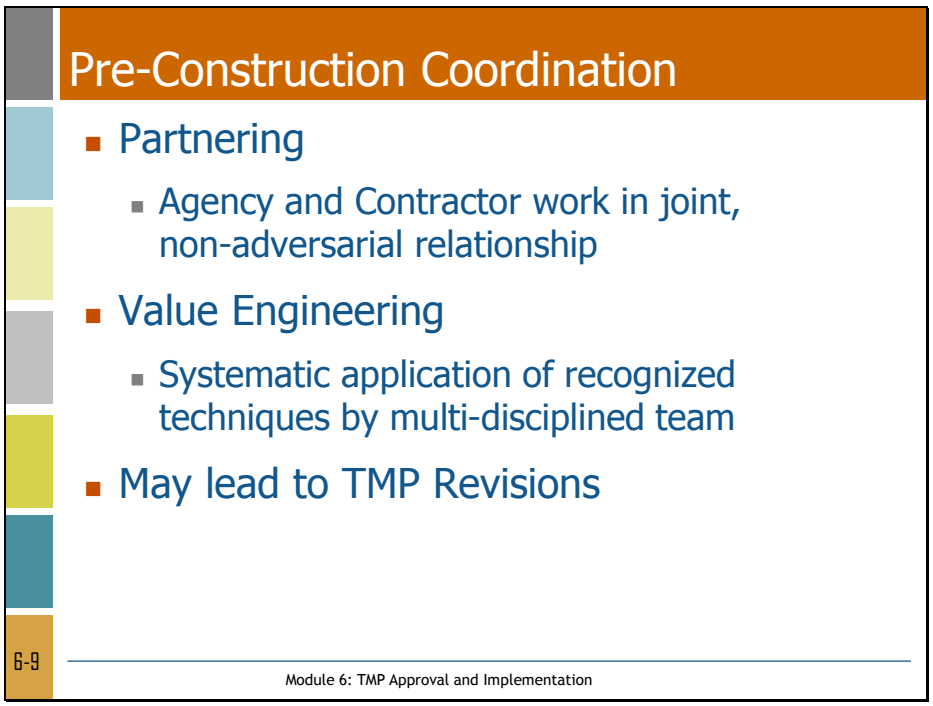
Narrator Notes:
Michigan DOT has a Peer Review Team that conducts a review of TMPs for significant projects. These projects are ones where the projected work zone delay, level of service, or volume to capacity ratio for the construction conditions would exceed policy thresholds after all reasonable mitigation has been applied. MDOT also does a TMP Peer review for projects where the cost to mitigate impacts to below the thresholds would exceed 25% of the project cost. Projects are submitted to the peer review team after Plan Review and before the errors and omissions check, so the TMP is mostly complete but there is still some flexibility in design and budget.

The review team consists of rotating personnel from MDOT headquarters and the Regions outside of where the project will be located. The team often meets virtually to discuss the TMP after reviewing it, and then provides feedback to the TMP developer. If there are significant concerns, they must be addressed before the project goes forward.

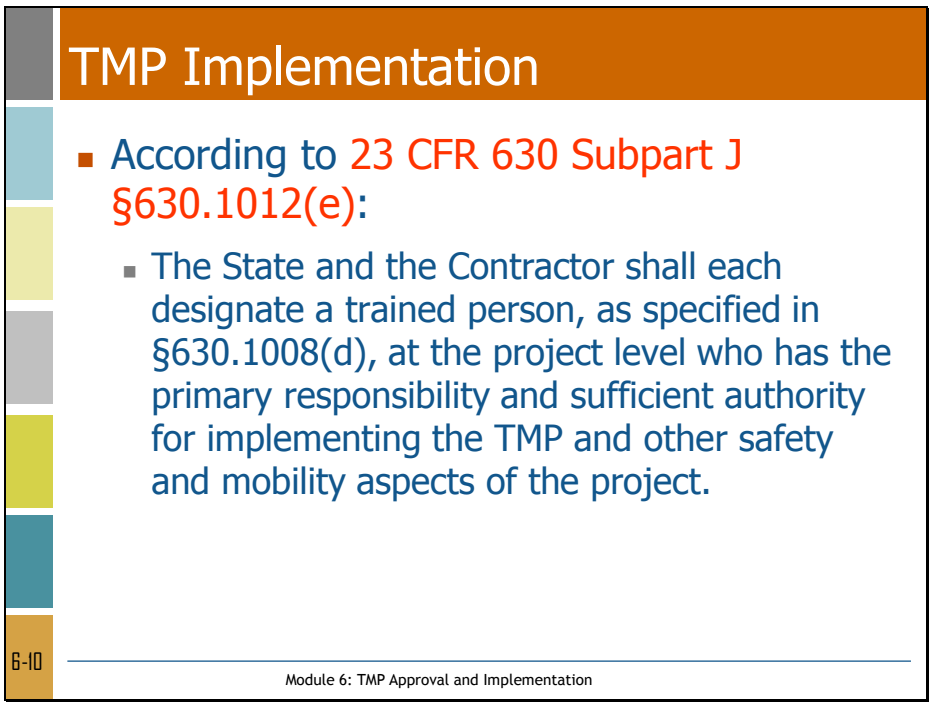
A bonus is that peer reviewers are able to learn from each other and often discover good ideas in the TMPs that they can use on their own future projects.



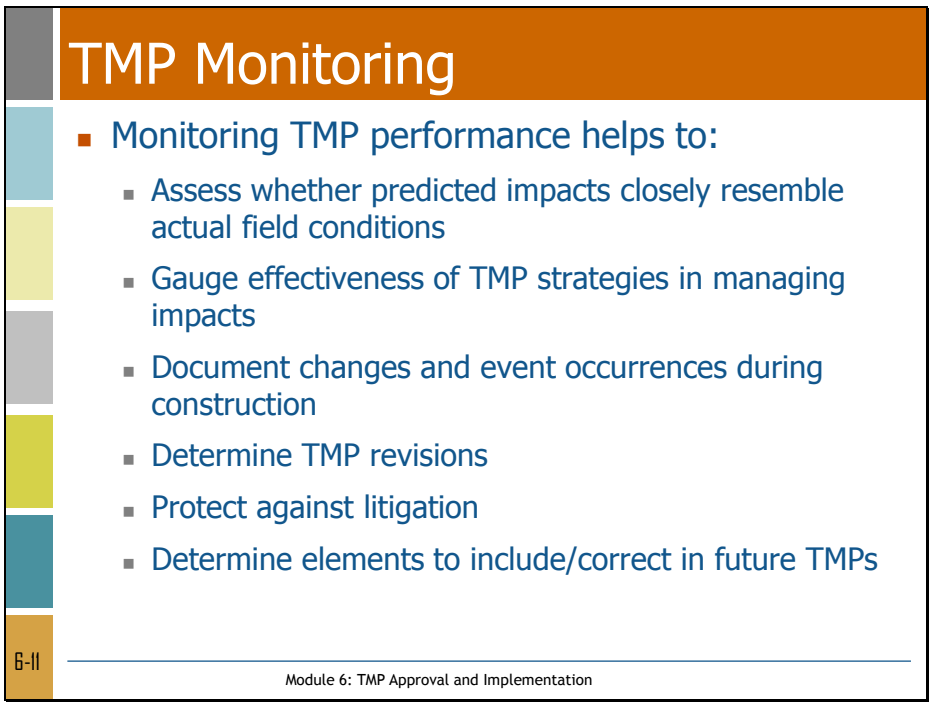
Narrator Notes:
Once the TMP is approved and the project is awarded, there may be revisions to the TMP based on pre-construction coordination meetings or any alternate approaches proposed by the Contractor before implementation. Once implemented, the TMP strategies need to be monitored throughout construction and until official "handover" to ensure they are working as intended.



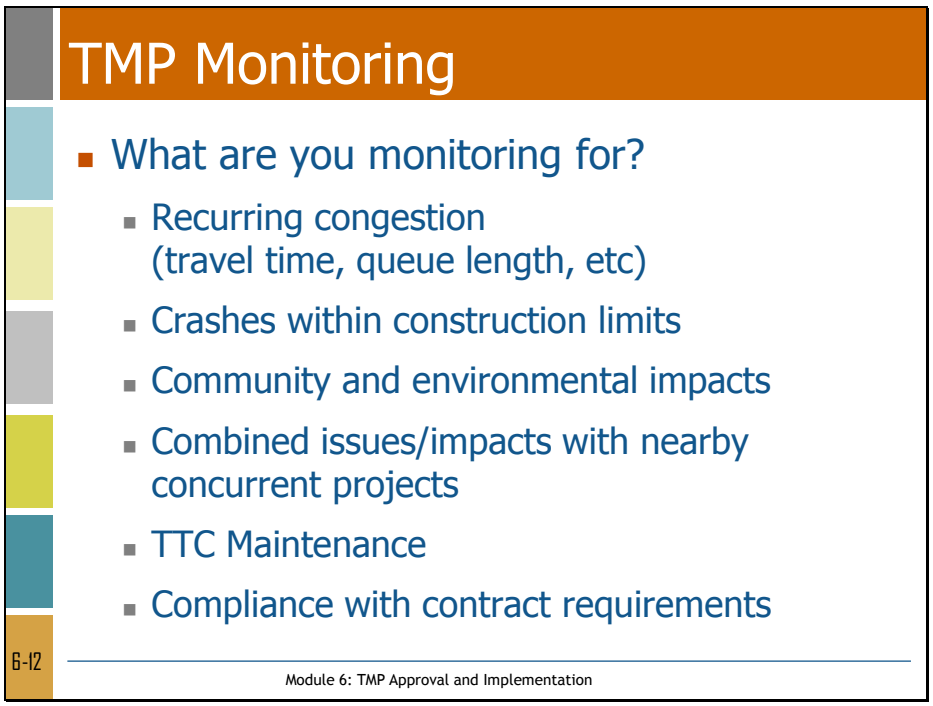
Narrator Notes:
The two most common approaches used to facilitate Contractor participation are partnering and value engineering. Partnering and value engineering can lead to suggestions for construction changes that can reduce work zone impacts or may increase them. In such cases the TMP may need to be revised and any substantial revisions must be approved by the Agency. Assessing proposed changes and revising the TMP are discussed later in this module.



Narrator Notes:
State and Local Transportation Agencies and the Contractor must have a trained person to implement the TMP. These designated responsible persons need to have primary responsibility for this duty and need to be regularly present at the job site so they can carry out this responsibility. The responsible persons for the Agency and Contractor should have "sufficient authority" to take action, should the work zone strategies be deemed ineffective.



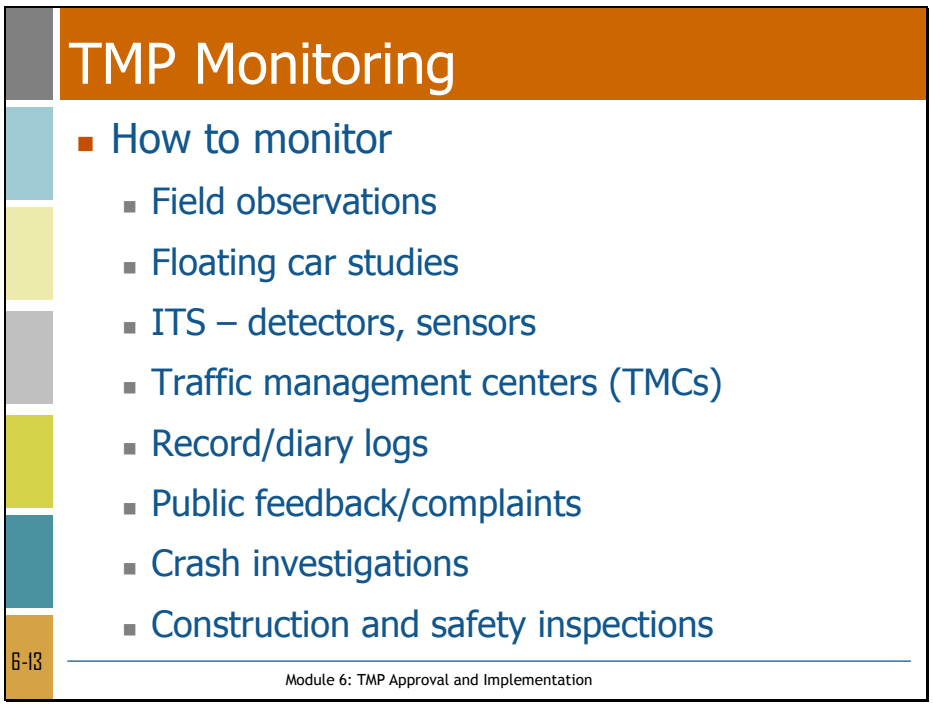
Narrator Notes:
The benefits of TMP monitoring and good documentation cannot be overstated. They not only allow you to improve performance over time, but can protect you from unwarranted litigation. Monitoring helps in identifying when adjustments are needed to the TMP strategies deployed on the current project. Monitoring also helps with determining what strategies work well, under what conditions and any lessons learned to avoid similar mistakes in the future.



Narrator Notes:
Monitoring TMP implementation is important to ensure Contractor compliance with all requirements. The requirements are stipulated to ensure that the work zone is safe and there is minimal interruption of traffic. It is the responsibility of the DOT to provide oversight of the Contractor to ensure compliance with all DOT rules and regulations. It is the responsibility of the Contractor to ensure that they comply with the DOT requirements and to the best extent possible provide a safe and efficient work zone.

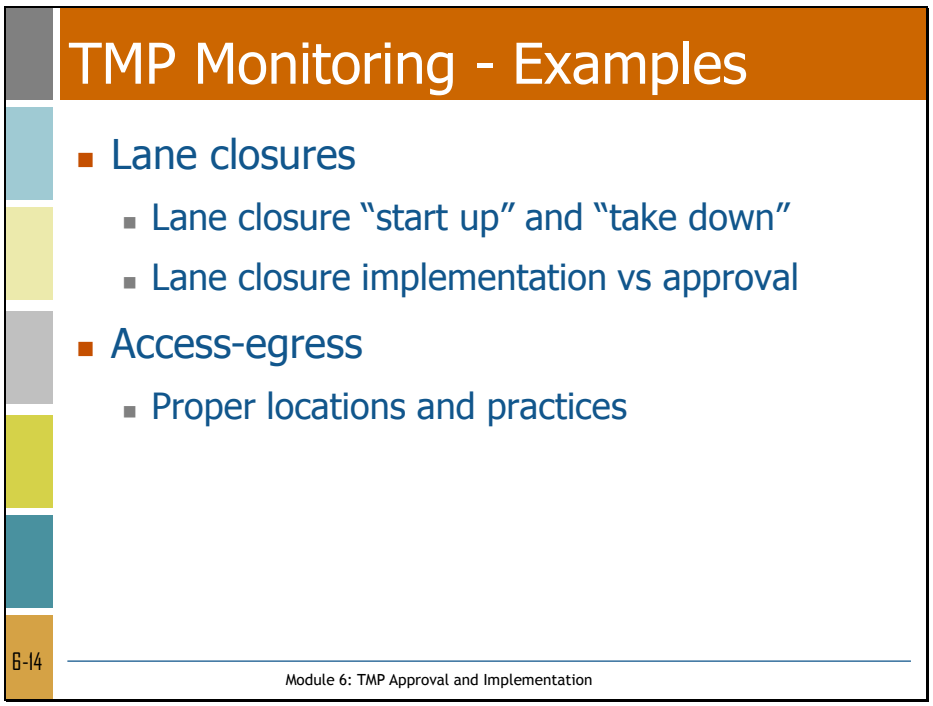
The DOT needs to monitor for recurring congestion exceeding the Agency's policy. This can be in the form of travel time, queue length, or any other performance measures set forth in the Agency policy. Impacts could be due to the project work zone itself or due to the combined impact of other projects nearby.

To ensure compliance, the project site must also be monitored for safety, and any deficiencies noted. Personnel should make a note of any crashes that occur within the construction limits and regularly inspect temporary traffic control devices for placement and visibility.



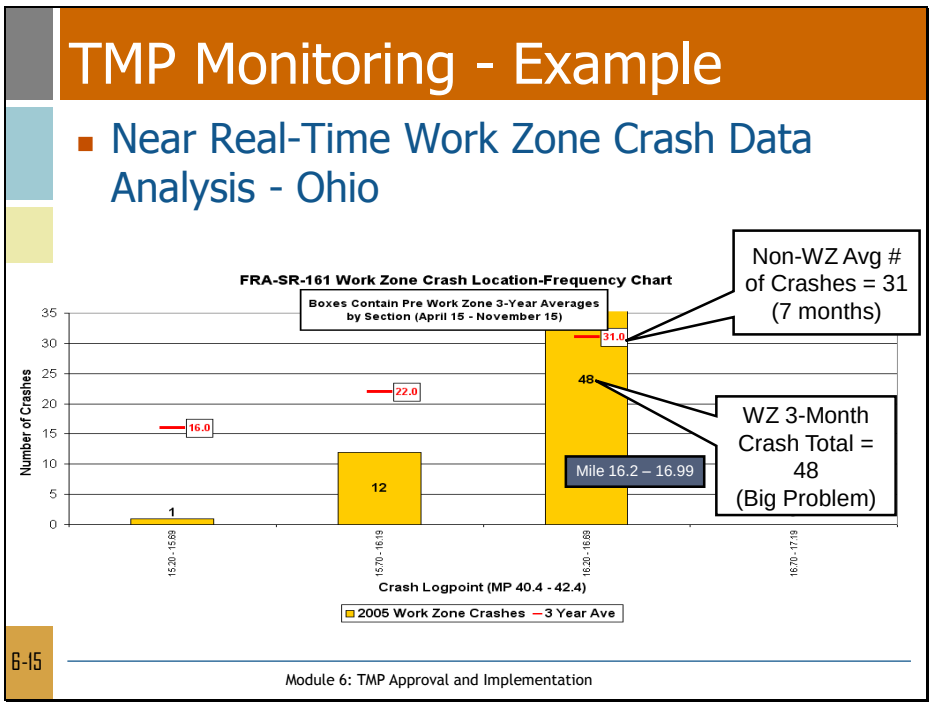
Narrator Notes:
Methods that can be used to monitor the conditions of a work zone include field observations, such as recording traffic control devices that have been regularly knocked over, or queue length and when queues form and dissipate. Sampling using floating car studies, particularly during peak traffic periods, can provide insight on TMP performance. The use of technology, such as permanent or temporary detectors and cameras, can provide real-time measurement of performance and a rich source of data for post-project assessment. Traffic management centers, where available, can be helpful in monitoring.

Diary logs of project events and incidents such as crashes and queue spillover, as well as public feedback or complaints, aid in monitoring both during the project and in performance assessment at the project end. The results of inspections and crash investigations also provide information about performance.



Narrator Notes:
In many urban areas, Contractors are not permitted to close any lanes during peak traffic hours, usually 6:30 to 9:30 a.m. and 3:30 to 6:30 p.m. However, the Contractor may attempt to setup the lane closure prior to 9:30 a.m. or take down after 3:30 p.m. Not only is this an infringement of the contract, but it often severely disrupts peak hour traffic flow. To avoid this, many States have penalty clauses that can range from a few hundred dollars to over five thousand dollars per every 15 minutes of extension into the peak hour. Monitoring can help identify or prevent such issues from occurring.

Sometimes truck deliveries to the site block one or more lanes without prior approval, resulting in an unsafe condition. Monitoring can help identify conditions like this so that unsafe access-egress practices can be addressed.

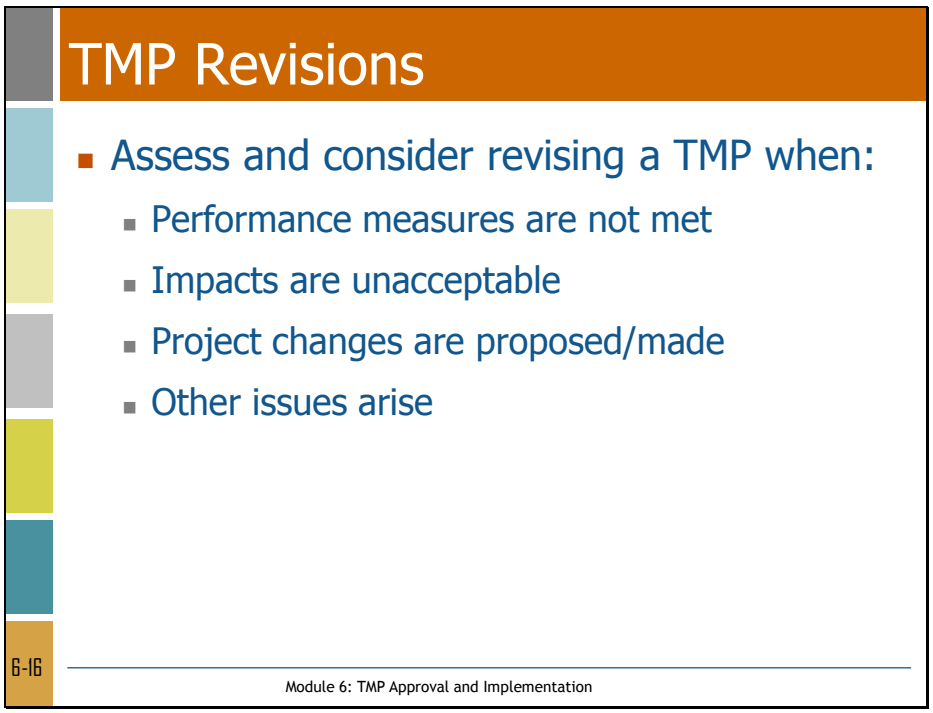


Narrator Notes:
Ohio DOT breaks a sample of work zones into half-mile segments, sorts crashes into their proper segment, and performs a *before-after* comparison of the preconstruction and construction crash frequencies for each segment. In this example, preconstruction crash data show that there were an average of 31 crashes for 7 months, or 4.4 crashes per month.

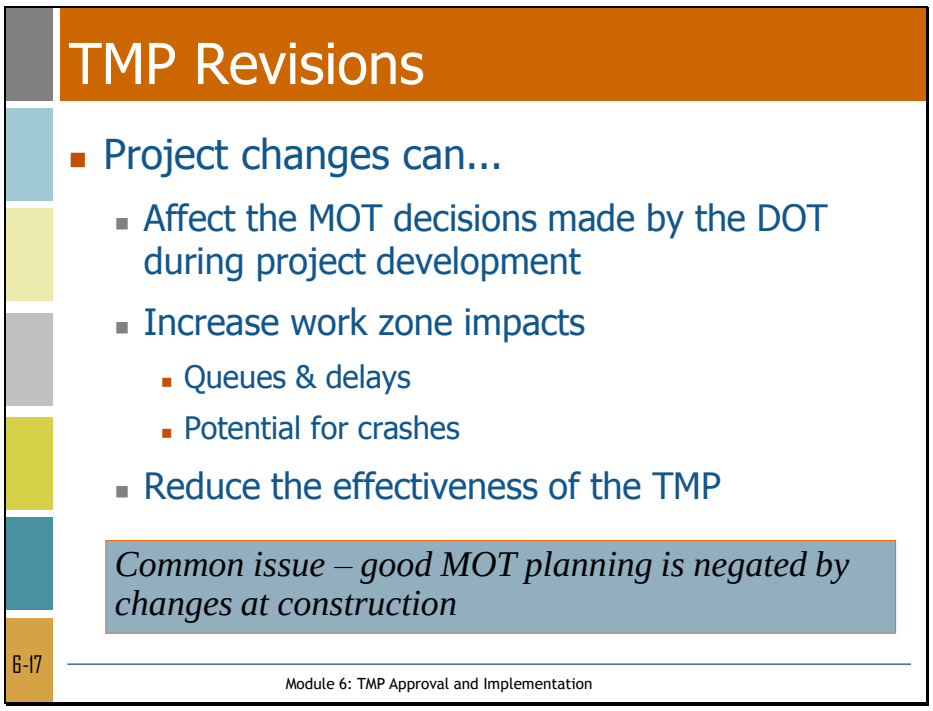
During construction, data gathered every two weeks showed crashes increased significantly to 48 in three months, an average of 16 per month. In such cases, Ohio DOT does a review to determine the contributing circumstances and mitigation treatments to address the issue.

Some additional information is available in the Participant Workbook

Other Information:
More information can be obtained from Presentation by Dave Holstein, Administrator, ODOT Office of Traffic Engineering available at:
http://ops.fhwa.dot.gov/wz/decision_support/perf_meas_examples.htm

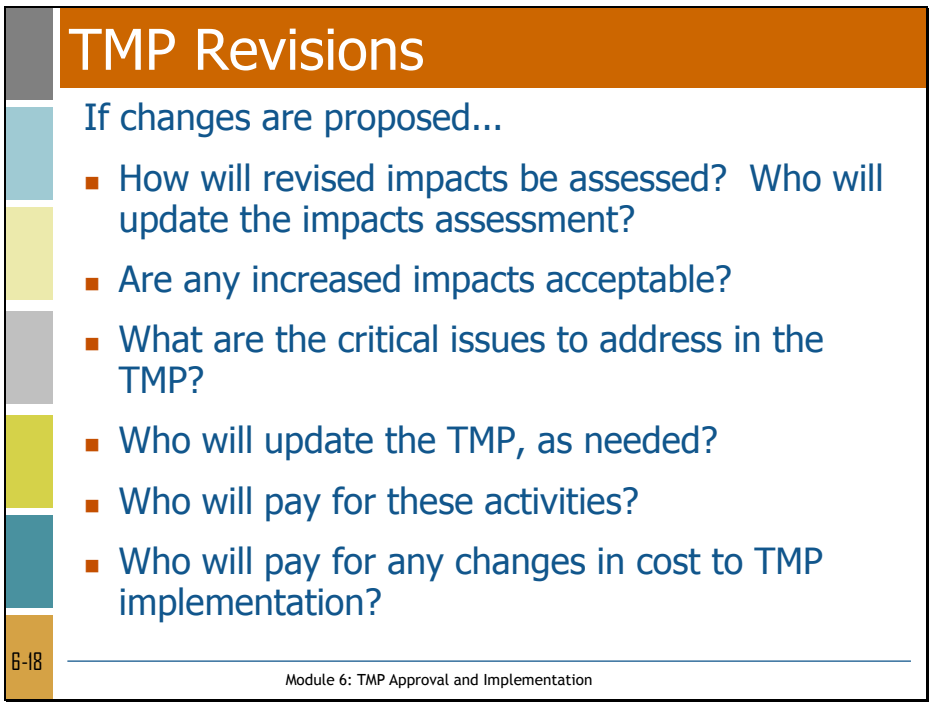


Narrator Notes:
Monitoring may result in the realization that the TMP is not working as well as planned, or conditions have changed. The TMP needs to be assessed and revised when performance measures are not met, such as if actual queue lengths or delays are not within acceptable limits. If construction changes are proposed that could affect traffic, such as new work activities that alter traffic control requirements, changes to work activity hours, or revised phasing, the TMP may need to be revised. If issues arise such as increased crashes or problems with construction vehicle access, mitigation measures will be needed.



Narrator Notes:
When changes are proposed during pre-construction or construction, it's important to remember that much has happened up to this point. The project should have been identified as significant or not, an assessment of impacts done, and the impacts considered in selecting the preferred alternative for the project. Based on that, the TMP was developed and approved for the project and was included in the PS&E. Then the project was bid and awarded.

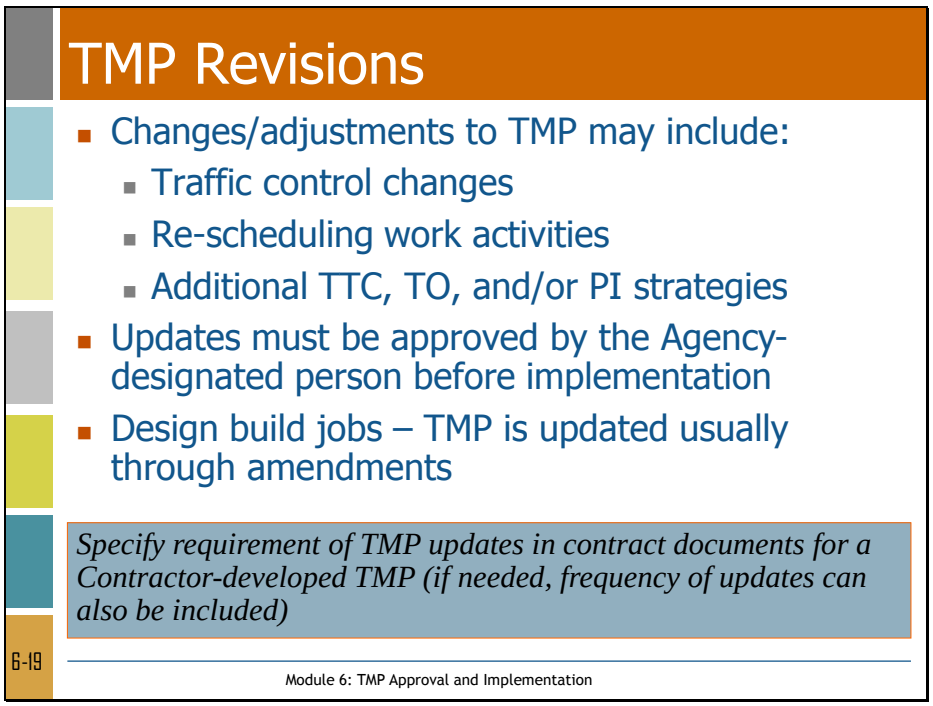
After this work and planning has been done, it can all be negated by a bad decision at construction. This is why changes at this stage need to be reviewed for how they will affect the maintenance of traffic and the TMP, before a decision is made whether or not to approve the proposed changes.



Narrator Notes:
There are many TMP-related considerations if changes to the project are proposed at pre-construction or during construction. Any proposed modifications should be assessed for work zone impacts prior to approval. For example, the Contractor may propose alternative phasing to reduce project duration. The Agency should review the phasing changes to determine if they will adversely affect work zone impacts. Would the new phasing result in changes to lane closures that increase queues, or temporary alignment changes that cause access issues?

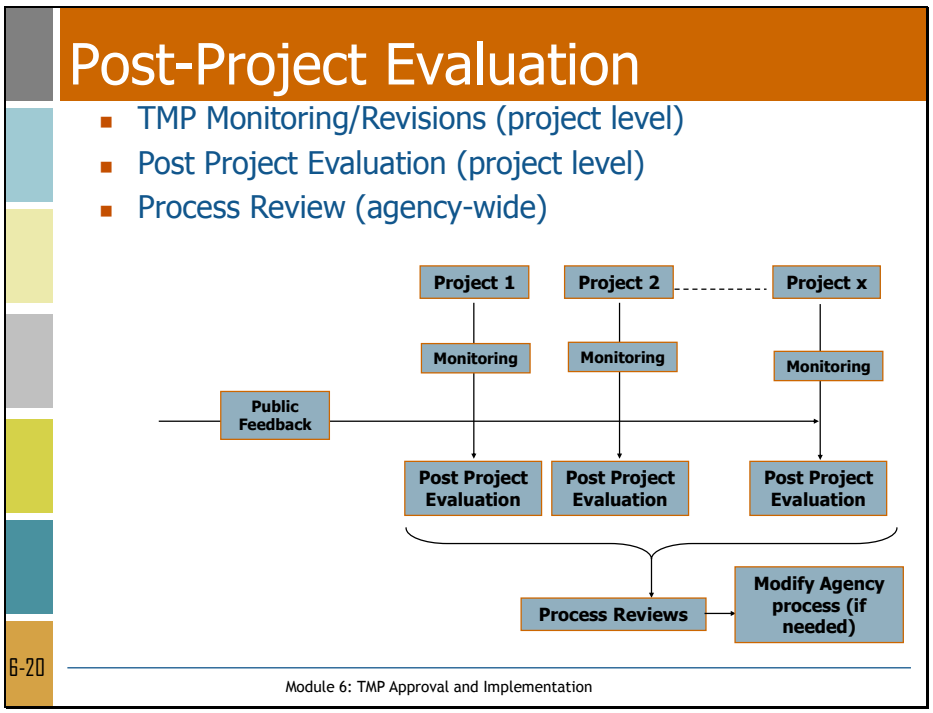
If changes are needed to the TMP to mitigate increased impacts, the Agency and Contractor will need to negotiate how those costs are paid.

The responsible persons designated for implementing the TMP on the project need to be involved in reviewing any changes that are proposed.



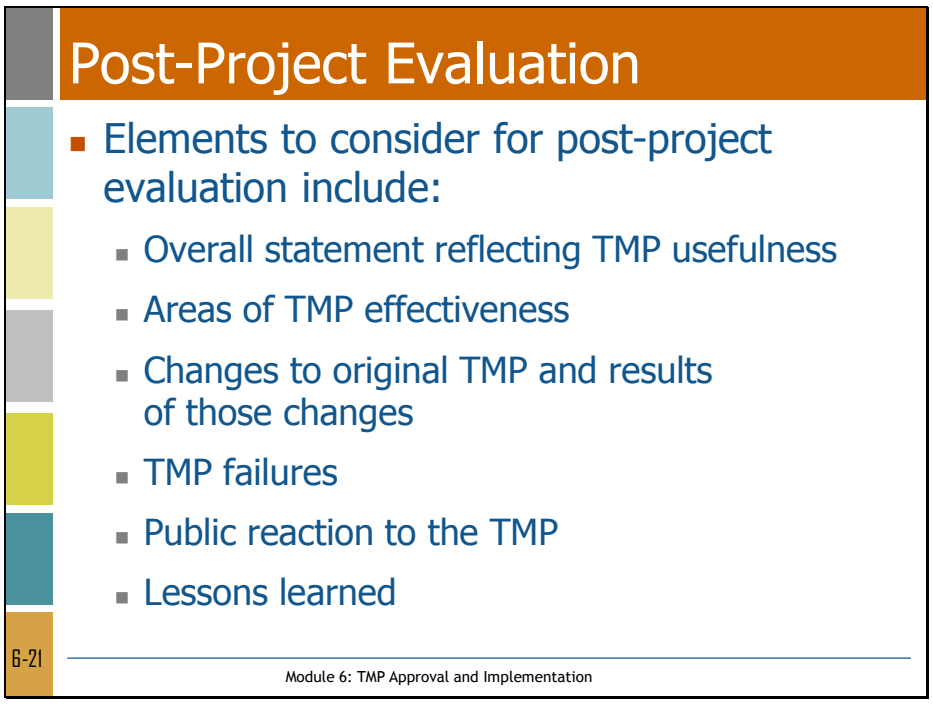
Narrator Notes:
If substantial changes are made to the project scope, schedule, phasing or other aspects, or the actual work zone impacts are not within acceptable limits, then the project team should take the necessary actions to update the TMP to minimize the impacts. TMP revisions may include changes to the temporary traffic control plan or work activity schedules, or adding or discontinuing other strategies. All TMP revisions must be approved by the Agency before implementation.

In design-build projects, the TMP generally includes guidelines and procedures for strategies like lane closures, detours, and public notification. For these projects, TMP changes are usually done through amendments that include adjustments to various strategies.

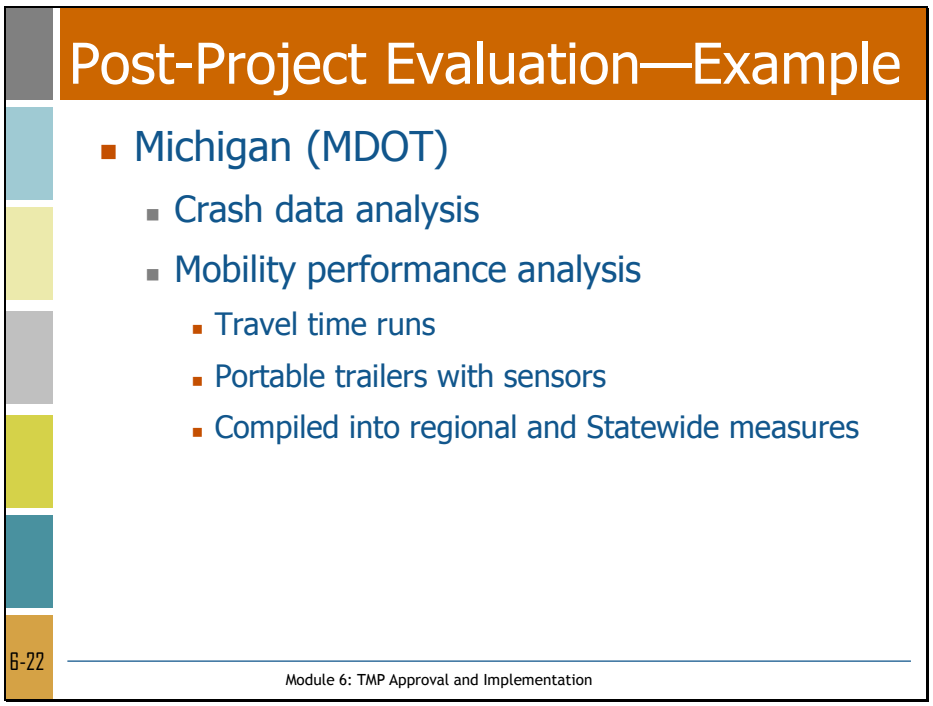


Narrator Notes:
The findings from TMP Monitoring and any TMP changes, as well as any post project evaluations done, should be recorded. Some Agencies prepare an evaluation report at the completion of significant projects. These records can help the Agency better develop TMPs in the future.

The results of TMP evaluations from several projects across the State or at the District level are useful while doing a Process Review. A process review is required every 2 years by the Work Zone Safety and Mobility Rule and is intended to help improve work zone policy and procedures, including TMP development and implementation.

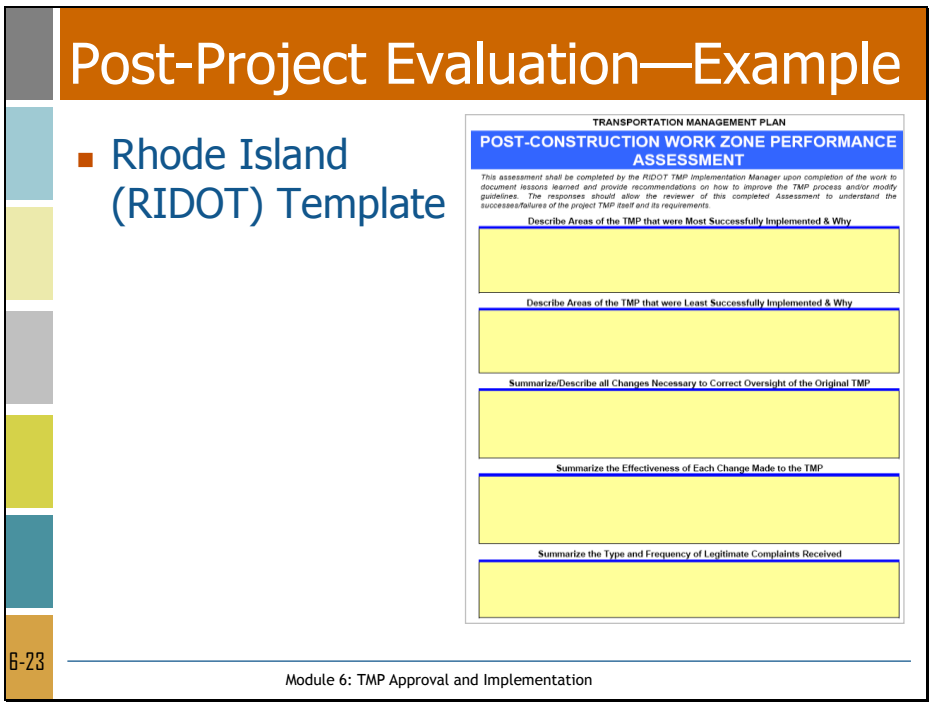


Narrator Notes:
The main emphasis of post-project evaluation is to note what worked well and what did not. In addition to an overall assessment of how well the TMP worked, it is helpful to make notes about which TMP strategies worked well based on monitoring results and the reaction from the public and other stakeholders. Notes about TMP changes made, how effective they were, and whether the process worked smoothly are also a good idea. Sometimes the most useful information to future TMP developers is lessons learned.

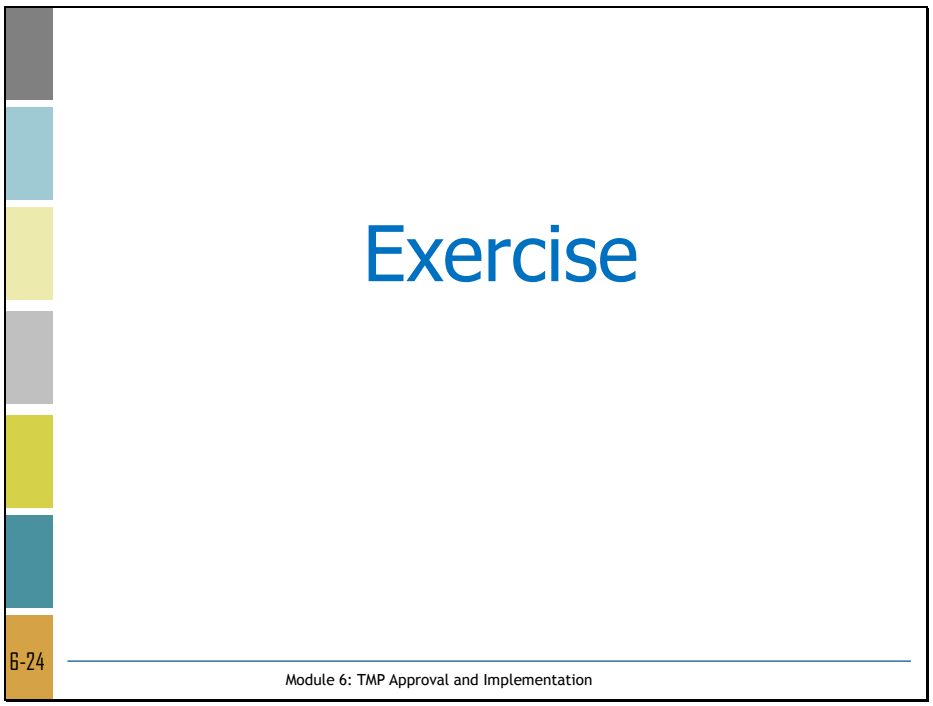


Narrator Notes:
Michigan DOT measures work zone performance, specifically in the areas of work zone crashes and travel time. Crash data is retrieved through the Transportation Management System (TMS) database. Performance can be presented as total numbers of crashes as well as a detailed breakdown of crashes on a project-by-project basis.

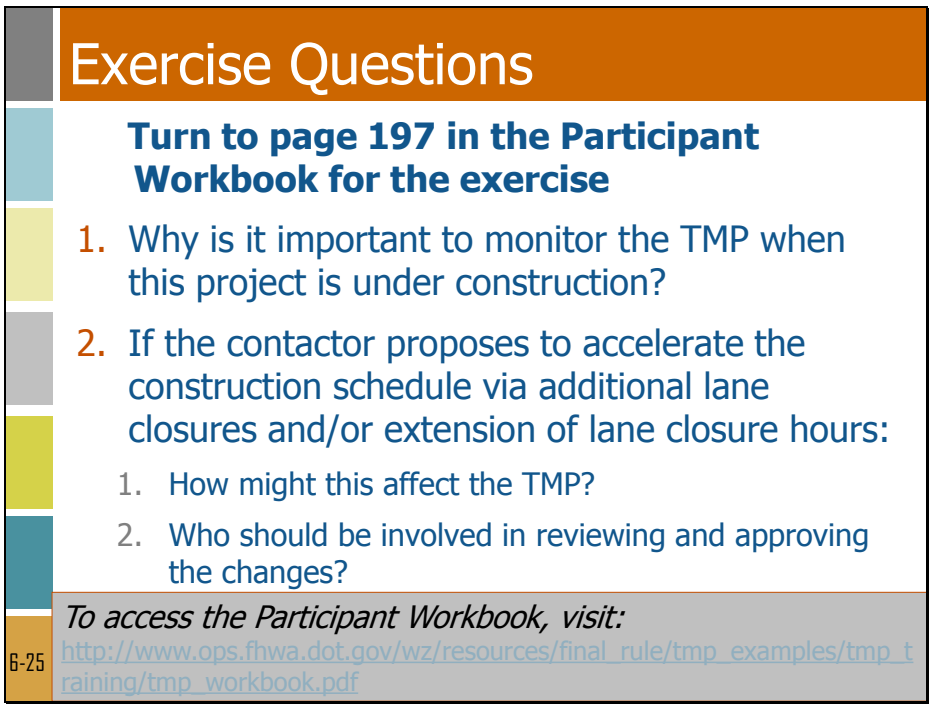
Travel time is determined through various methods such as real-time measurement of vehicle speeds and occupancy using portable trailers with sensors that are rotated between work zones. Michigan DOT also uses co-op assistance from students for data collection, such as driving through work zones to measure queues and record delay time. Michigan DOT combines the project mobility data into regional and Statewide measures of the percent of its work zones meeting mobility goals.



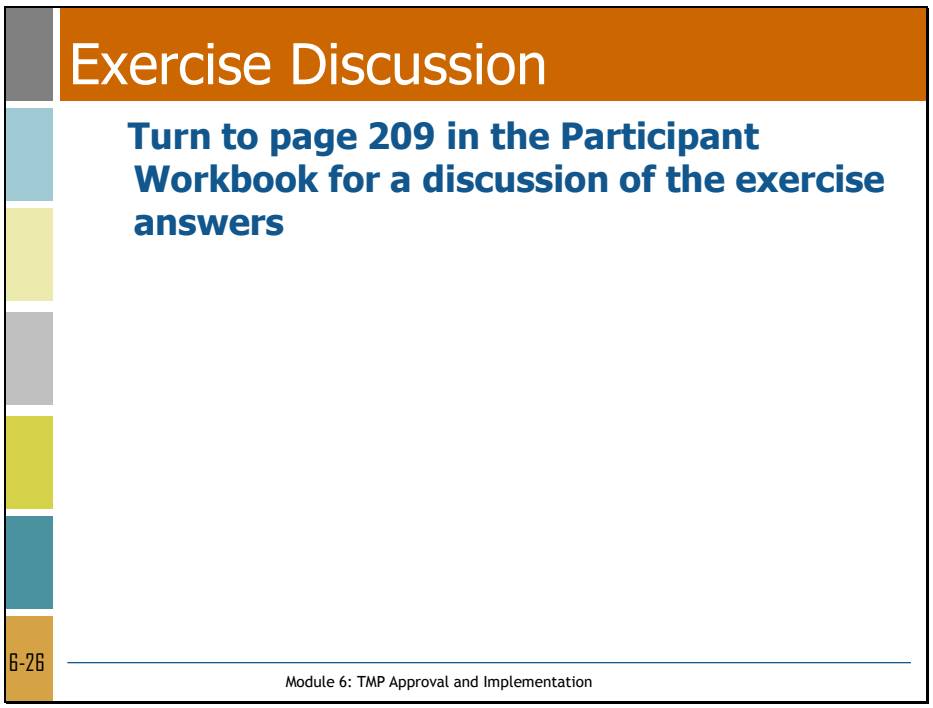
Narrator Notes:
Rhode Island DOT uses a template to document its post construction assessment. The template includes lessons learned and recommendations on ways to improve the TMP process or modify guidelines. The template is filled in by the TMP implementation manager upon the completion of the project.



Narrator Notes:
Now that you have completed Module 6, this exercise will provide you with an opportunity to apply what you have learned.

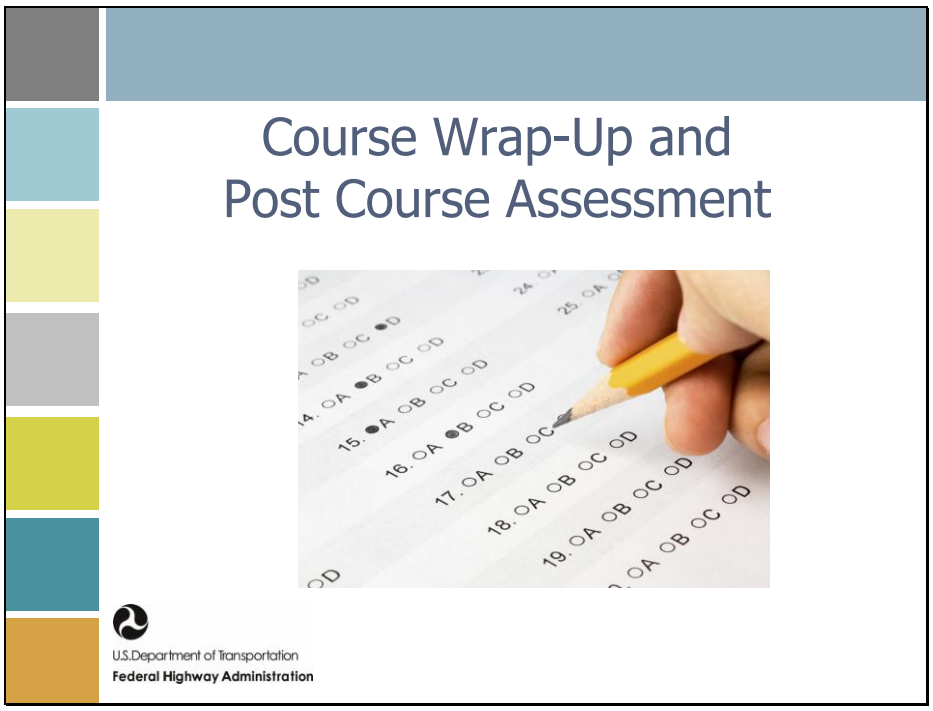


Narrator Notes:
Please turn to page 197 in Appendix C in the Participant Workbook. After reading the exercise, please answer the questions on this slide.



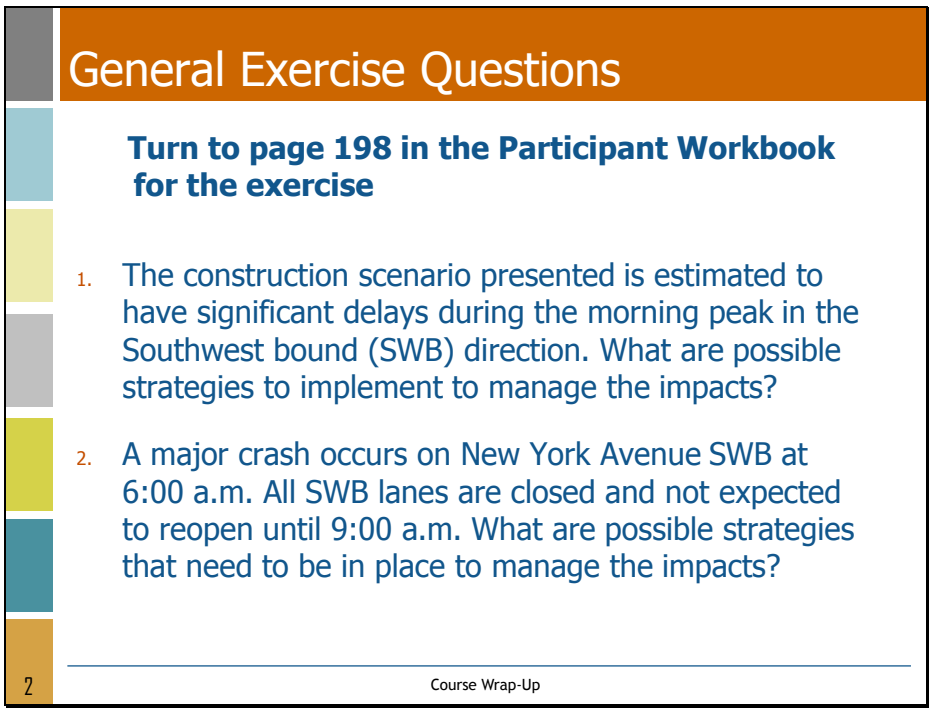
Narrator Notes:
Once you have completed answering the questions, turn to page 209 in the Participant Workbook for a discussion of the exercise answers.

Course Wrap-Up

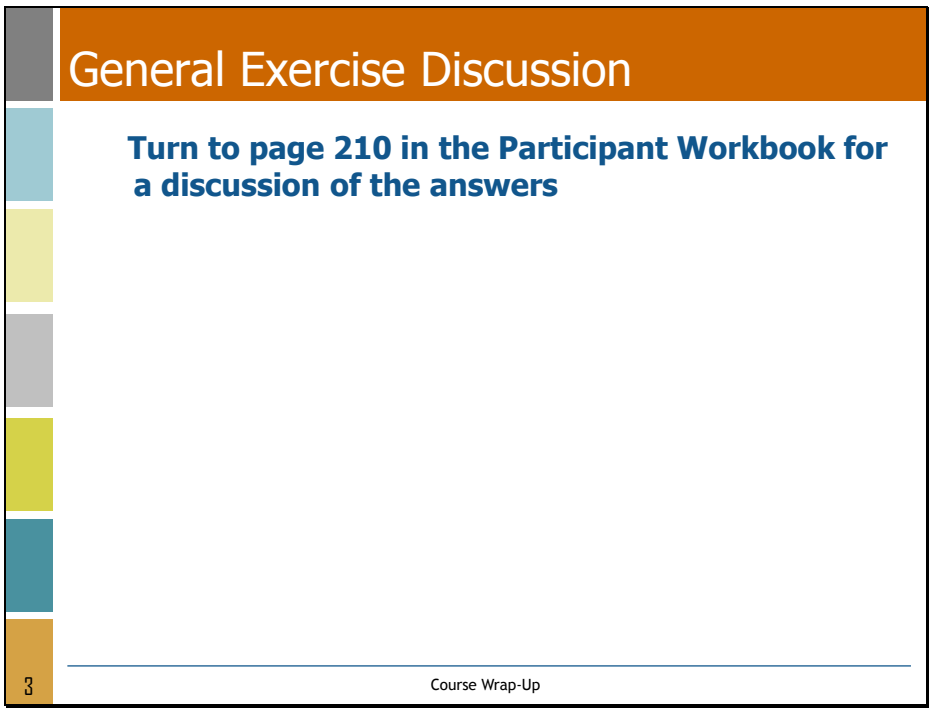


Narrator Notes:
The course wrap-up section includes a general exercise to use your new skills by applying your knowledge to real world problems. A post-test is also included to help you assess how well you understand the material that was presented.

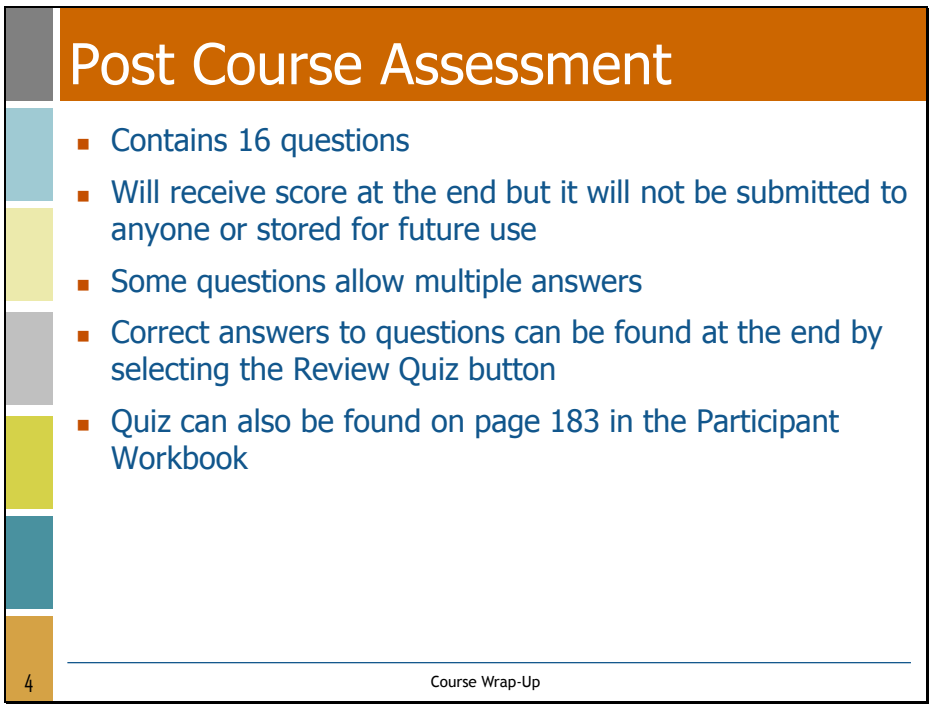
If you have feedback on the course and your learning experience, instructions on how to provide that are included at the end.



Narrator Notes:
Now that you have completed the course please turn to page 198 in Appendix C in the Participant Workbook. After reading the exercise, please answer the questions on this slide.



Narrator Notes:
Once you have completed answering the questions, turn to page 210 in the Participant Workbook for a discussion of the exercise answers.

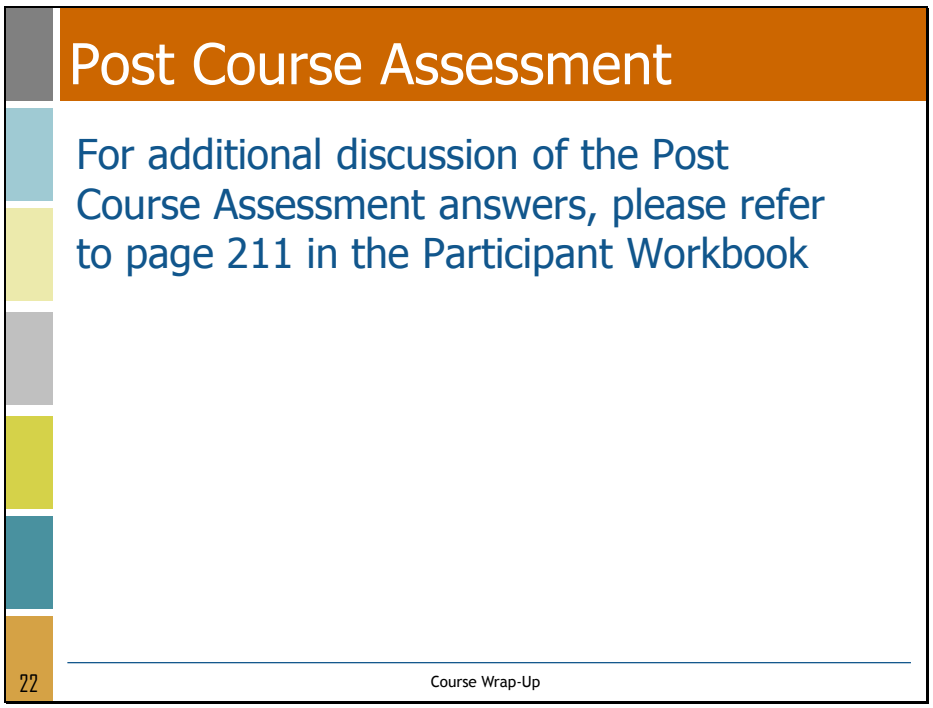


Narrator Notes:
This Post Course Assessment contains 16 questions. The Assessment is for your own benefit. You will receive a score at the end. Your score will not be submitted to anyone or stored for future access.

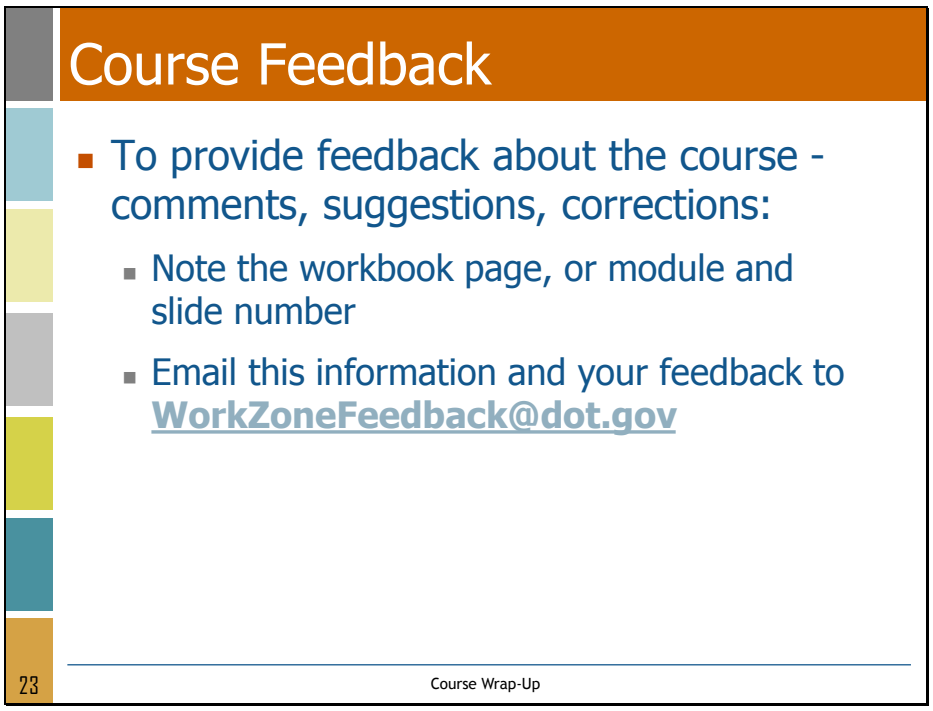
Some questions have multiple answers, so be sure to select all the correct answers. You can find the correct answers to all the questions by clicking on the Review Quiz button at the end of the assessment.

If you prefer to take this assessment on paper, it can be found in the Participant Workbook on page 183.

Note: In the electronic version of this module, Slides 5 through 21 contain an interactive post course assessment. This assessment can be found in the Workbook on page 183.



Narrator Notes:
For additional discussion of the Post Course Assessment answers, please refer to page 211 in the Participant Workbook. The discussion in the workbook includes references to where these topics are covered in the course materials.



Narrator Notes:
Thank you for completing the *Developing Transportation Management Plans for Work Zones* self-paced training course.

We have taken careful measures to assure that this material is error-free. However, in the event that you find something wrong or unclear, or wish to provide other feedback on the course, please make a note of the relevant workbook page, or module and slide number and email this information and your feedback to WorkZoneFeedback@dot.gov.

Appendices

Appendix A: Post Course Assessment

Post Course Assessment

Place a checkmark in the box next to the one correct answer for each question.

1. What are the primary components of the Work Zone Safety and Mobility Rule?

   A. Work zone safety and mobility policy

   B. Processes and procedures to implement work zone policy

   C. Project-level procedures to assess and mange impacts on individual projects

   D. Use of law enforcement in work zones

   ☐ A and B

   ☐ B and C

   ☐ A and D

   ☐ A, B, and C

   ☐ All of the above

2. The Work Zone Safety and Mobility Rule requires that a Transportation Management Plan (TMP) be developed for _____? (choose the best answer)

   ☐ Projects with a budget of more than $100 million

   ☐ Interstate projects only

   ☐ Federal-aid projects

   ☐ All projects with lane closures

3. Which component(s) of the TMP is/are always required?

   A. Temporary Traffic Control Plan

   B. Transportation Operations Plan

   C. Public Information and Outreach Plan

   D. Incident Management Plan

   ☐ A and C

   ☐ A only

   ☐ B only

   ☐ A, B, and C

   ☐ All of the above

4. A significant project is one that has the potential to cause a relatively high level of disruption.
   - ☐ The above statement is true
   - ☐ The above statement is false

5. Which of the following is/are a required component(s) of the TMP for *significant* projects?
   - A. Temporary Traffic Control Plan
   - B. Transportation Operations Plan
   - C. Public Information and Outreach Plan
   - D. Incident Management Plan
   - ☐ A only
   - ☐ B and C
   - ☐ A, B, and C
   - ☐ B, C, and D
   - ☐ All of the above

6. FHWA requires a specific format for all TMPs.
   - ☐ The above statement is true
   - ☐ The above statement is false

7. The TMP should always be paid for:
   - ☐ As a single pay item in the construction contract
   - ☐ As an incidental item and not paid for separately
   - ☐ As a separate pay item for every strategy
   - ☐ None of the above

8. When in TMP development should coordination with key stakeholders occur?
   - ☐ During the preliminary engineering phase
   - ☐ During the design phase
   - ☐ During the construction phase
   - ☐ All of the above

9. Traffic analysis tools are used to:

   A. Quantify corridor delay resulting from capacity decreases in work zones
   B. Support tradeoff analyses between construction costs and delay costs
   C. Identify safety impacts of alternative project phasing plans
   D. Assess travel demand measures and other delay mitigation strategies

   ☐ A and B
   ☐ A and C
   ☐ A, B, and C
   ☐ A, B, and D
   ☐ All of the above

10. When should the work zone impacts assessment process start?

   ☐ During early scoping stages of the project
   ☐ During preliminary project design stages
   ☐ During final project design stages
   ☐ None of the above

11. During construction, pedestrian and bicycle access should be maintained to a similar level as that existing prior to construction.

   ☐ The above statement is true
   ☐ The above statement is false

12. Which among the following is a Transportation Operations strategy?

   A. Alternate construction phasing/staging
   B. Transit incentives
   C. Signal timing/coordination improvements
   D. Press releases about the project

   ☐ A only
   ☐ A and C
   ☐ B and C
   ☐ All of the above

13. Public information provided during a project should always be:

- ☐ A. Timely, Low-Cost, and Consistent
- ☐ B. Accurate, Timely, and Consistent
- ☐ C. Accurate, Consistent, and Web-Based
- ☐ D. Accurate, Consistent, and Real-time

14. Who should designate a trained, responsible person at the project level to implement and monitor TMP elements?

- ☐ State Agency only
- ☐ Contractor only
- ☐ Both State Agency and Contractor
- ☐ None of the above

15. Which among the following is a benefit of TMP monitoring during construction?

A. A TMP is a static document and should not be monitored during construction.

B. Determine if TMPs on future similar projects are not needed.

C. Protect against litigation

D. Determine elements to include/correct in future TMPs

- ☐ A and B
- ☐ B and C
- ☐ C and D
- ☐ A, B, C, and D

16. A contractor can make changes to a TMP on its own.

- ☐ The above Statement is true
- ☐ The above Statement is false

This is the end of the assessment.

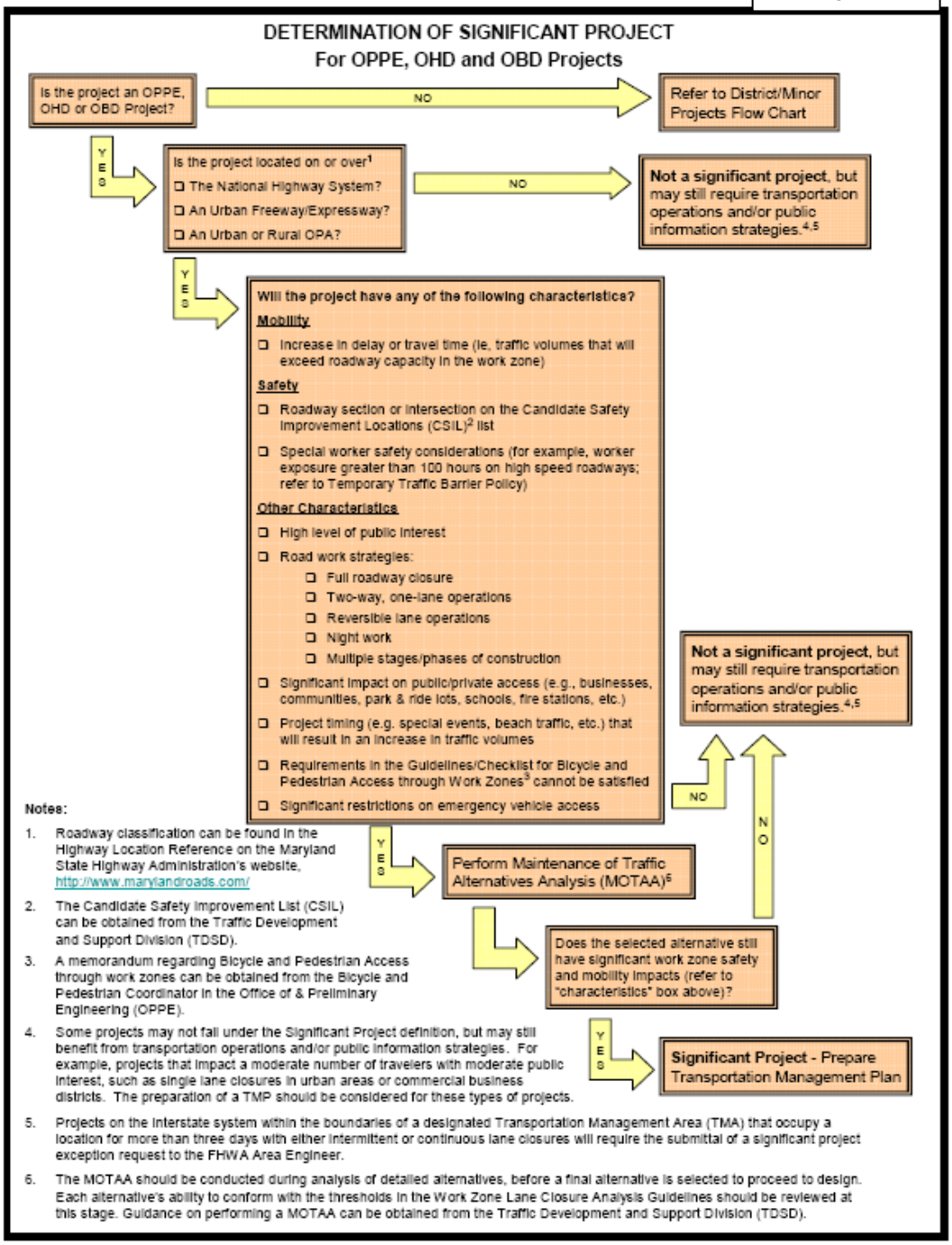
Please turn to page 211 of the Participant Workbook for the answer key.

Appendix B: Sample Significant Project Flow Charts

For use in Module 2, TMP Basics

Maryland State Highway Administration
Guidance on Identifying Significant Projects

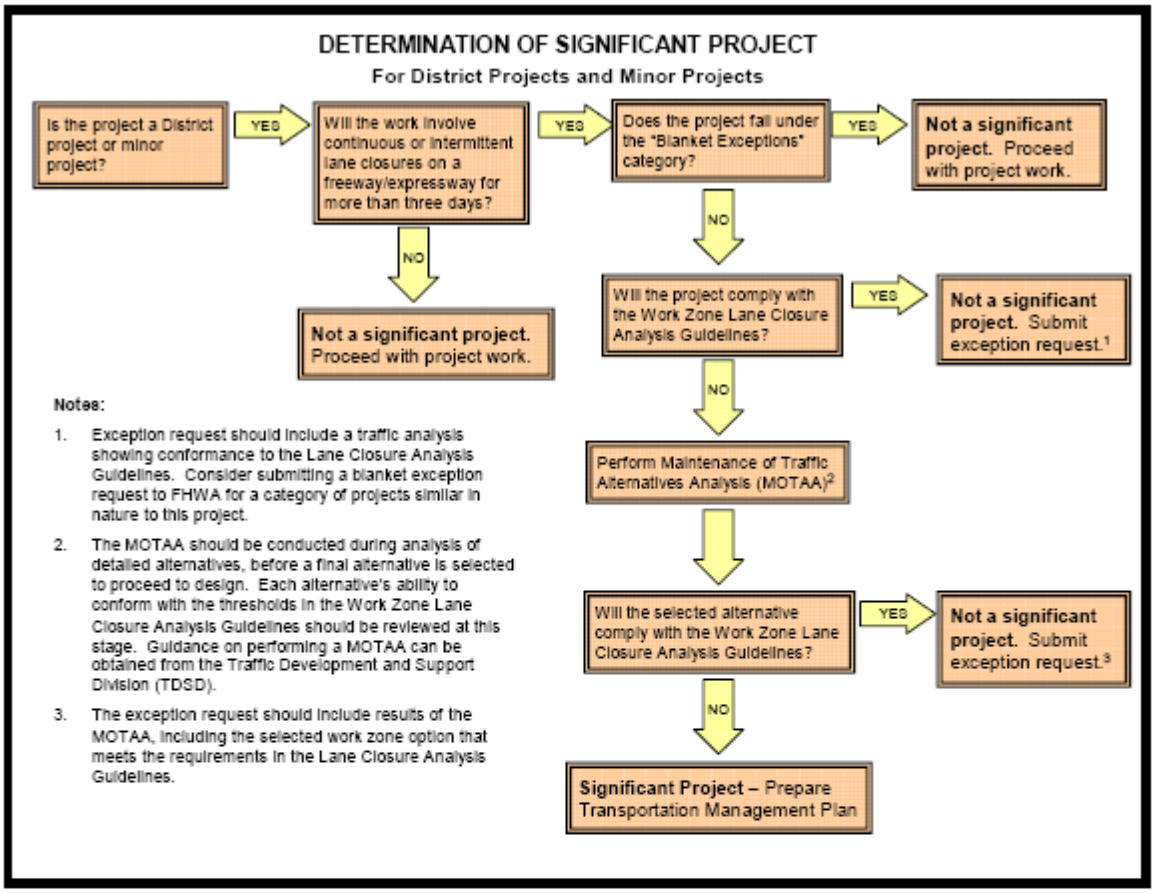
Maryland



Source: Maryland Sate Highway Administration, Guidance on Identifying Significant Projects

Maryland State Highway Administration
Guidance on Identifying Significant Projects

Maryland



Acronyms:

CSIL – Candidate Safety Improvement Locations

FHWA – Federal Highway Administration

MOTAA – Maintenance of Traffic Alternatives Analysis

OBD – Office of Bridge Development

OHD – Office of Highway Development

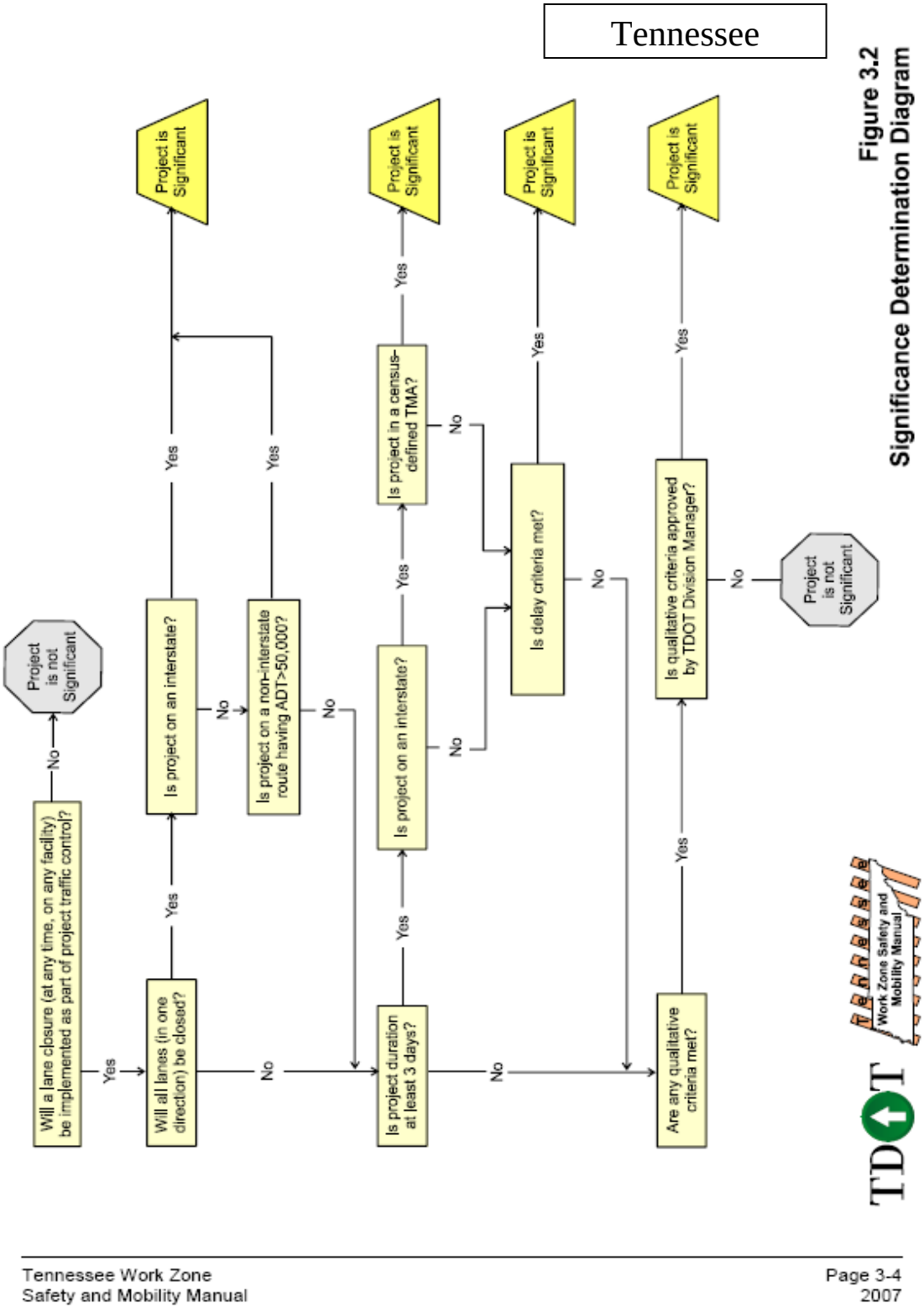
OPA – Other Principal Arterial

OPPE – Office of Planning and Preliminary Engineering

TMA – Transportation Management Area

TMP – Transportation Management Plan

Source: Maryland Sate Highway Administration, Guidance on Identifying Significant Projects



Source: Tennessee Department of Transportation, Work Zone Safety and Mobility Policy, Part III

Appendix C: Exercises

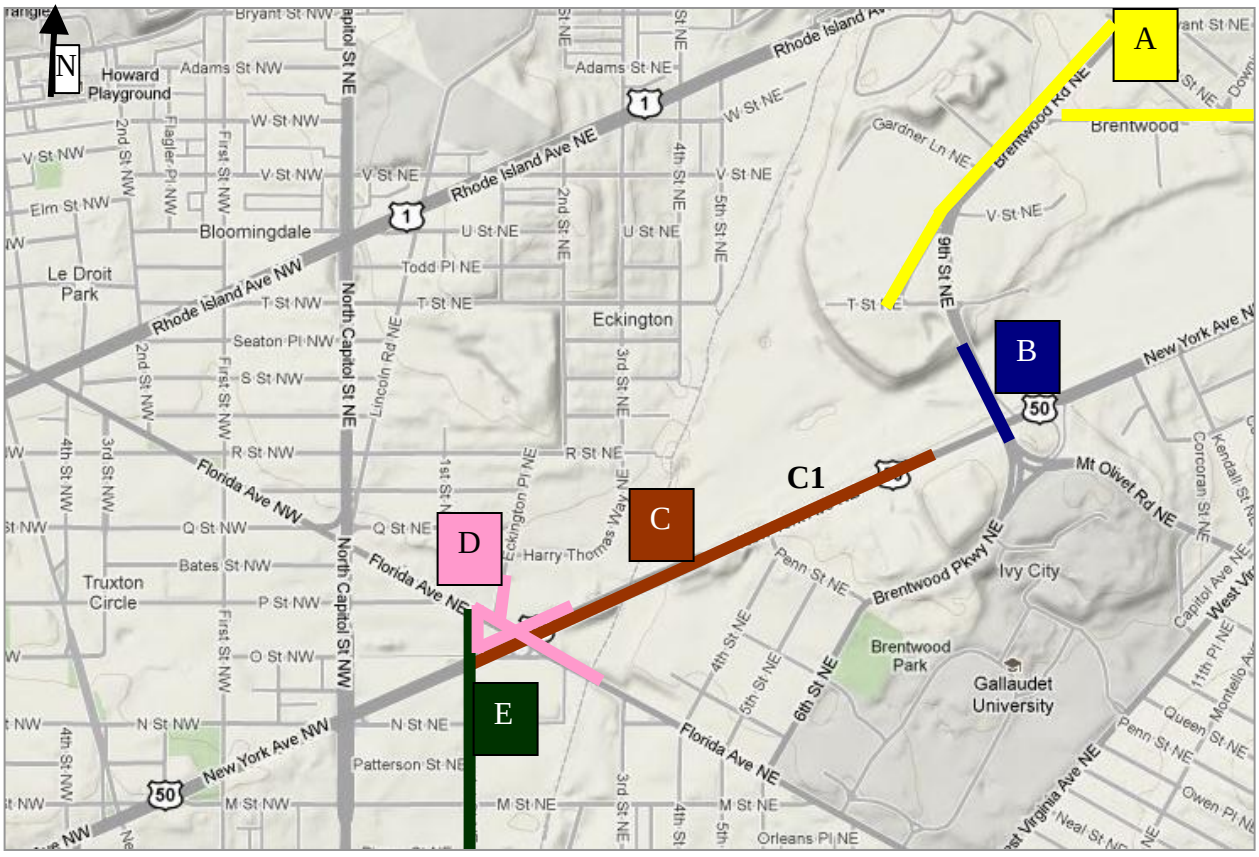
The data used in these exercises are fictitious and are for demonstration purposes only.

Module 3—Exercise

Project Coordination

A transportation agency is planning several road projects. These projects include significant infrastructure improvements in close proximity (within 1 square mile) to each other. The projects were designed at different times, as noted below, but lack of funding delayed construction. The DOT now has programmed funding to undertake all projects in fall 2013.

The main corridor is a 6-lane arterial with an ADT of 65,000 vehicles; approximately 60% is commuter traffic.



The projects (see figure above) in the vicinity include (design dates in parenthesis):

- Project A (2010): Resurface/Rehabilitate Brentwood Road
- Project B (2010): Replace Bridge over New York Avenue
- Project C (2008): Reconstruct the New York Avenue including bridge (C1)
- Project D (2008): Traffic Safety Improvement Project at intersection
- Project E (2006): Reconstruction of 1st Street

Questions

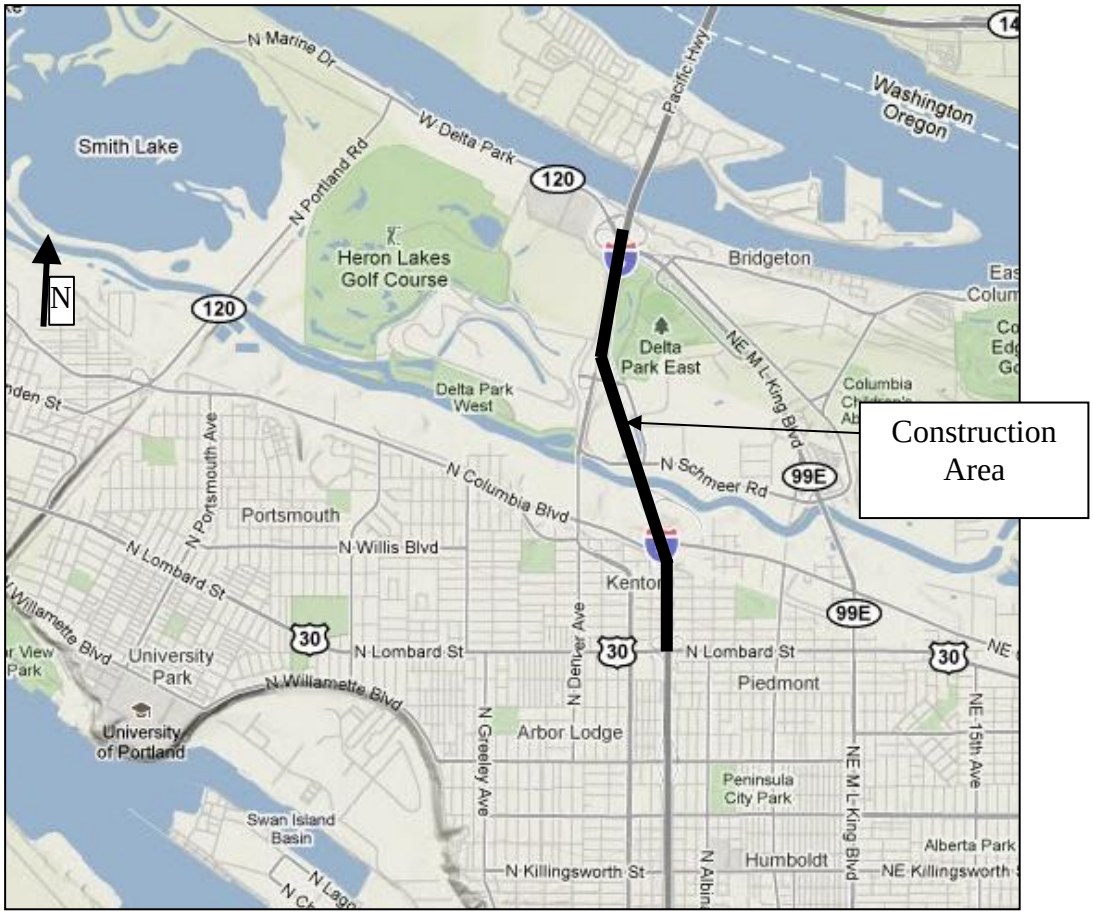
1. As the Project Engineer for one of the five construction projects, identify some key issues that could arise if all projects start together, as planned for fall 2013?
2. What are some possible ways to handle coordination?

Module 4—Exercise

Corridor Rehabilitation

A transportation agency is planning to rehabilitate an approximately 0.81-mile section (southbound only) of the I-5 Freeway from W. Delta Park to N. Lombard Street (see figure below). I-5 is a designated north - south major freight route, within the Functional Classification of Urban Principal Arterial – Interstate. I-5 currently has three northbound travel lanes and two southbound travel lanes through the project area. This section of Pacific Highway (I-5) is access controlled and has local street/highway access only through the freeway on-off ramp system.

The two-lane southbound section creates a traffic bottleneck that results in congestion and safety problems. This section of I-5 also has substandard shoulders, medians, and acceleration lanes. The proposed improvements (southbound only) would provide a three-lane section for southbound direction with standard shoulders, median, and acceleration lanes. Traffic volumes along the I-5 corridor in the vicinity of the project are over capacity with 55,000 ADT per day in the southbound direction. Heavy vehicles account for 7% of the traffic.



Question

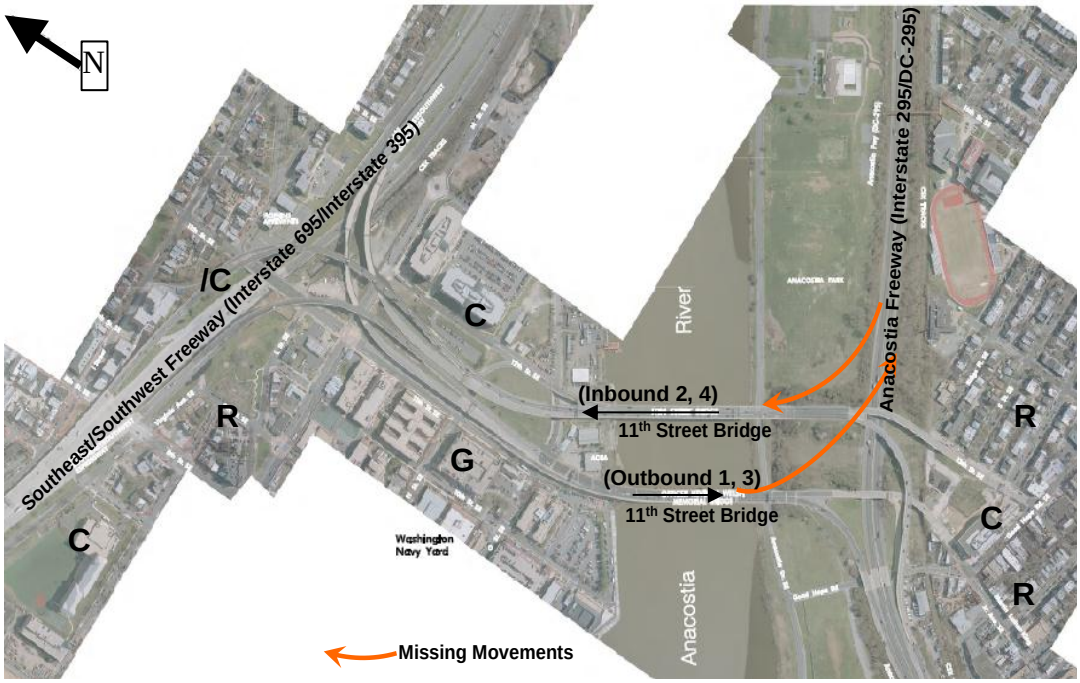
1. What are work zone traffic control alternatives that you would consider for the project?
2. What are some of the factors to be considered while choosing the alternative?
3. Do you have enough data to make a decision about a traffic control alternative? If not, what other data would you need?

Module 5—Exercise

Bridge Replacement

The 11th Street Bridges are a pair of one-way bridges across the Anacostia River in a major urban area. The bridges currently provide a connection from the Anacostia Freeway (I-295/DC-295) to the Southeast/Southwest Freeway (I-695/I-395); however, there is no direct connection between the Southeast Freeway and the northern segment of the Anacostia Freeway (see figure below). Because of this unfinished connection, regional commuting traffic from surrounding jurisdictions is forced to use neighborhood streets to reach the Anacostia Freeway to and from the Southeast Freeway. This causes significantly increased traffic on local streets.

The 11th Street Bridge reconstruction project is a Design-Build Project intended to replace this aging pair of Anacostia River bridges and to construct the missing connection The project will also add a third bridge dedicated to local traffic, which will accommodate bicyclists and pedestrians along with streetcar tracks for improved transit accommodations. It is anticipated that during any one day of the construction as many as 10-15 different lane closures will be operational within the construction limits.



1 – Average a.m. peak traffic outbound (1000 v/h)
2 – Average a.m. peak traffic inbound (2800 v/h)
3 – Average p.m. peak traffic outbound (3200 v/h)
4 – Average p.m. peak traffic inbound (2000 v/h)

R – Residential
B – Local Businesses
C– Commercial
G – U.S Department of Navy complex with docking facility

Questions

1. Identify some of the public relations issues that the D/B contractor will need to address during design and construction. What are some TMP strategies that could be used for public outreach?
2. Cite some of the operational issues the contractor will need to address during lane closures. What strategies may be useful to address these operational issues?

Module 6—Exercise

A transportation agency is reconstructing a major bridge at mile marker 104 on I-95. I-95 runs north-south and has three lanes in each direction at this location. While some work will be completed outside of existing roadway limits with no impact to road users, other portions of the work will require temporary restrictions of traffic, including lane closures, shoulder closures, and lane shifts. During the morning peak condition (6:30 a.m. to 9:30 a.m.) the average hourly lane volume is 1300 vph for the southbound direction. The off peak hourly volume is 400 vph. There is no p.m. peak in the southbound direction. In the northbound direction the evening peak period is 3:30 p.m. to 6:30 p.m. with an average hourly lane volume of 1450 vph. The northbound off peak hourly volume is 400 vph. The construction is expected to be completed in 18 months.

Traffic impact assessment was conducted based on the following constraints:

1. All lanes shall be kept open during the peak hour by direction
2. At all other times at least two lanes must be kept open
3. Lane closures are limited to 9:30 a.m.to 3:30 p.m. and 8:00 p.m. to 6:30 a.m., Monday through Friday.
4. If the queue length extends 2.5 miles beyond the work zone or the travel time exceeds 30 minutes, contractor operations shall be adjusted to open all lanes until either the queue length reduces to 1.0 mile or the travel time to 10 minutes.

Based on this analysis, appropriate strategies (TTC, TO, and PI&O) were selected to mitigate the impacts. The construction activities are being done in accordance with contract requirements and the approved TMP is being implemented.

Questions

1. Why is it important to monitor the TMP when this project is under construction?

2. If the contactor proposes to accelerate the construction schedule via additional lane closures and/or extension of lane closure hours:
    a. How might this affect the TMP?
    b. Who should be involved in reviewing and approving the changes?

General Exercise

A transportation agency is planning several projects in a heavily developed urban area; one scenario is presented here for discussion. As part of the project, the agency is reconstructing the bridge over New York Avenue. New York Avenue is a major principal arterial with three lanes in each direction, and is a designated emergency route. The transportation agency has determined that this is a significant project with major anticipated impacts.

Construction Conditions New York Avenue:

- Average weekday volume—65,000 vpd (a.m. split 75/25).
- Posted speed limit—35 mph.
- Truck Percentage—6%.
- Average weekday volume on (ramp)—52,000 vpd (split 75/25).
- 2 southwest bound New York Avenue lanes in a.m. peak hour (7:00–10:00 a.m.) (12-ft lanes).
- 3 northeast bound New York Avenue lanes in p.m. peak (3:30–6:30 p.m. (9-ft lanes).
- Close Ramp from SB 9th Street ramp to SWB New York Avenue.
- Implement Detour Plan—Traffic to continue on Brentwood Parkway and make a right on Penn Street to get to New York Avenue.

The agency used Synchro to analyze the existing conditions and the proposed construction conditions presented here. Following table summarizes the results.

Intersection (Cross Street, signalized)	New York Ave (SWB a.m.)				New York Ave (NEB p. m.)			
	Existing /Baseline		Construction		Existing / Baseline		Construction	
	Queue (ft)	LOS	Queue (ft)	LOS	Queue (ft)	LOS	Queue (ft)	LOS
Florida Avenue	1243	E	2190	F	450	C	400	D
Penn Street	167	C	631	F	125	C	225	D
Fairview Avenue	150	C	550	F	115	C	125	D
Bladensburg Road	1166	E	2005	F	350	C	425	D
Notes: SWB—Southwest bound; NEB—Northeast bound								

Corridor Extent New York Avenue from Bladensburg Road to Florida Avenue	New York Ave (a.m. peak)	
	SWB	NEB
	Travel time (min)	
Baseline	18.5	7.5
Construction	38.0	9.2

A map of the construction area (figure 1) is shown in the following page.

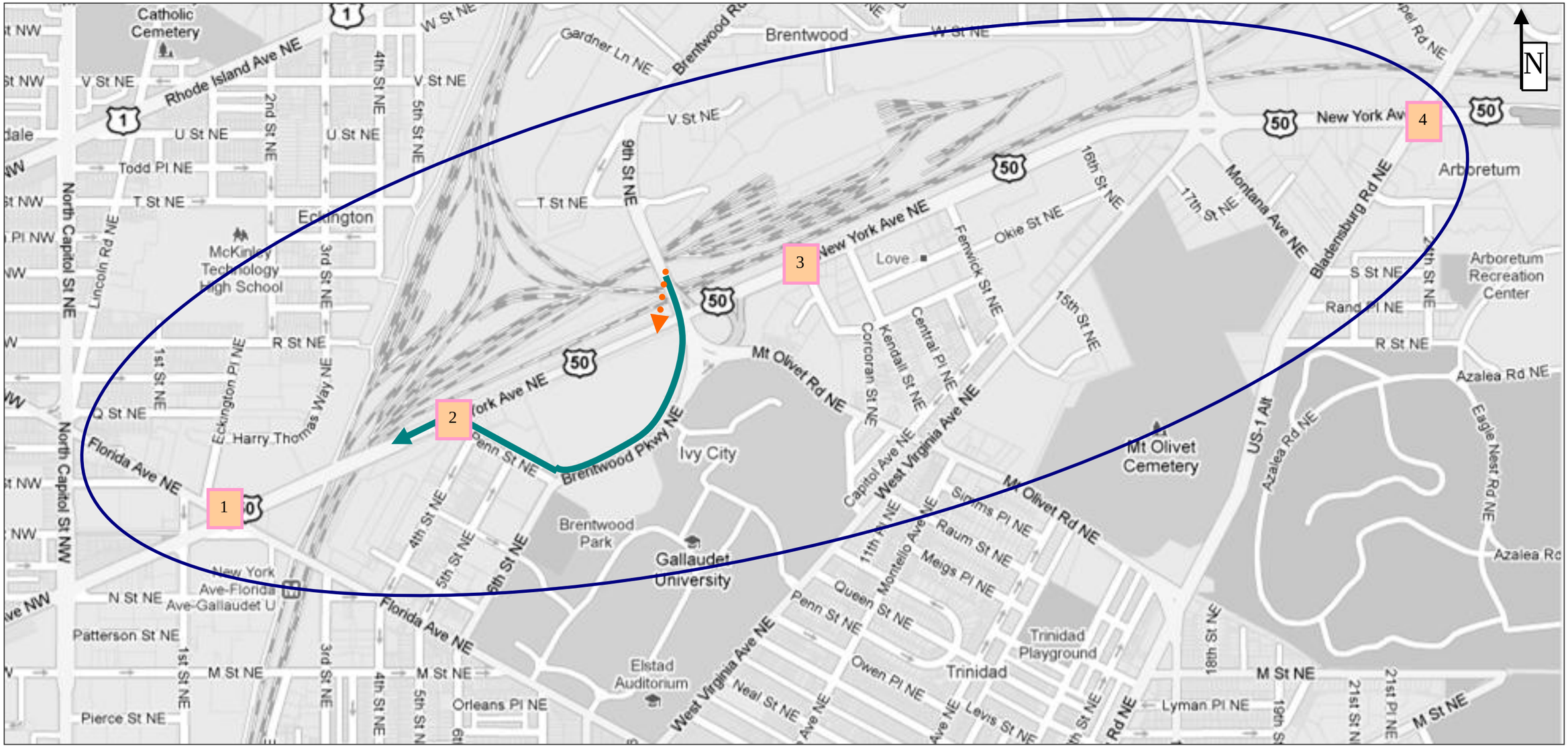


Figure 1: Construction Area Map

Detour Ramp Closed Construction Area Major Intersections

1. New York Ave & Florida Ave
2. New York Ave & Penn St
3. New York Ave & Fairview Ave
4. New York Ave & Bladensburg Rd

Questions

1. The construction scenario presented above is estimated to have significant delays during the morning peak (SWB). What are possible strategies to implement to manage the impacts?
2. A major crash occurs on New York Avenue SWB at 6:00 a.m. (see figure 2 below). All SWB lanes are closed and not expected to reopen until 9:00 a.m. What are possible strategies that need to be in place to manage the impacts?

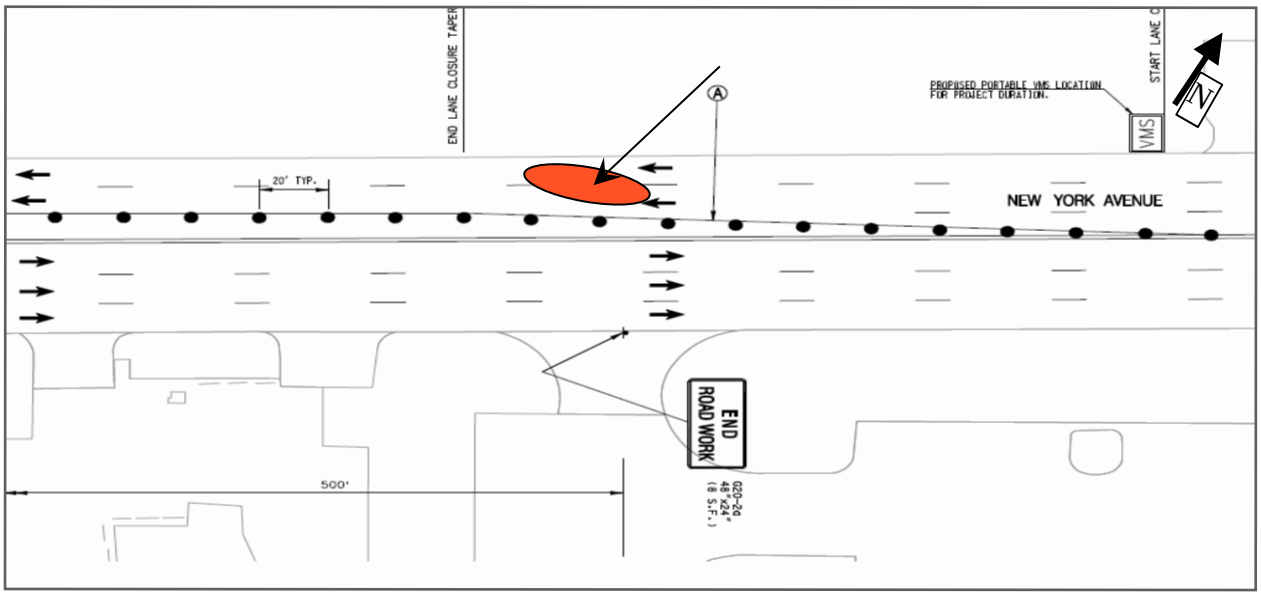


Figure 2: Crash Location

A sample work zone management strategies checklist is provided on the following page.

Work Zone Management Strategies Tool Box

1. Temporary Traffic Control

1.1. Control Strategies	√
Construction phasing/staging	
Full roadway closures	
Lane shifts or closures	
One-lane, two-way controlled operation	
Two-way, one-lane traffic/Reversible lanes	
Ramp closures/relocation	
Freeway-to-freeway interchange closures	
Night work	
Weekend work	
Work hour restrictions for peak travel	
Pedestrian/Bicyclist access improvements	
Business access improvements	
Off-site detours/use of alternate routes	

1.2. Traffic Control Devices	√
Temporary signs	
Portable changeable message signs (PCMS)	
Arrow boards	
Channelizing devices	
Temporary pavement markings	
Flaggers and uniformed traffic control officers	
Temporary traffic signals	
Lighting devices	

1.3. Project Coordination Strategies	√
Other area projects	
Utilities	
Right-of-Way	
Other transportation infrastructure	

1.4. Innovative Contracting Strategies	√
Design-build	
ALB Bidding	
Incentive/Disincentive clauses	
Lane rental	
Performance specifications	

1.5. Innovative or Accelerated Construction Techniques	√
Prefabricated/ recast elements	
Rapid cure materials	

2. Transportation Operations

2.1. Demand Management Strategies	√
Transit service improvements	
Transit incentives	
Shuttle services	
Parking supply management	
Variable work hours	
Telecommuting	
Ridesharing/carpooling incentives	
Park-and-Ride promotion	

2.2. Corridor/Network Management Strategies	√
Signal timing/coordination improvements	
Temporary traffic signals	
Street/intersection improvements	
Bus turnouts	
Turn restrictions	
Parking restrictions	
Truck/heavy vehicle restrictions	
Reversible lanes	
Dynamic lane closure system	
Ramp closures	
Railroad crossing controls	
Coordination with adjacent construction site(s)	

2.3. Work Zone ITS Strategies	√
Late lane merge	
PCMS with speed display	
Travel time estimation system	
Advanced speed information system	
Advanced congestion warning system	
Conflict warning system (e.g., construction vehicles entering roadway)	
Travel time monitor system	
Freeway queue monitor system	
CCTV monitoring	
Real-time detour	

2.4. Work Zone Safety Management Strategies	√
Speed limit reduction/variable speed limits	
Temporary traffic signals	
Temporary traffic barrier	
Movable traffic barrier systems	
Crash-cushions	
Temporary rumble strips	

2.4. Work Zone Safety Management Strategies	√
Intrusion alarms	
Warning lights	
Automated flagger assistance devices (AFADs)	
Project task force/committee	
Construction safety supervisors/inspectors	
Road safety audits	
TMP monitor/inspection team	

2.5. Incident Management (ICM) and Enforcement Strategies	√
ITS for traffic monitoring/management	
TMC	
Surveillance (e.g., CCTV)	
Helicopter for aerial surveillance	
Traffic Screens	
Call boxes	
Mile-post markers	
Tow/freeway service patrol	
Total station units	
Photogrammetry	
Media coordination	
Local detour routes	
Contract support for ICM	
Incident/Emergency management coordination	
Incident/Emergency response plan	
Dedicated (paid) police enforcement	
Cooperative police enforcement	
Automated enforcement	
Increased penalties for work zone violations	
Emergency pull-offs	

3. Public Information and Outreach

3.1. Public Awareness Strategies	√
Branding	
Press kits	
Brochures and mailers	
Press releases/media alerts	
Mass media (earned and/or paid)	
Paid advertisements	
Project information center	
Telephone hotline	
Planned lane closure website	
Project website	
Public meetings/hearings, workshops	
Community task forces	
Coordination with media/schools/business/FEMS	
Work zone education and safety campaigns	
Rideshare promotions	
Visual information	

3.2. Motorist Information Strategies	√
Radio traffic news	
Changeable message signs	
Temporary motorist information signs	
Dynamic speed message sign	
Highway Advisory Radio (HAR)	
Extinguishable signs	
Highway information network (web-based)	
Traveler information systems(wireless, handheld)	
Transportation Management Center (TMC)	
Live traffic camera(s) on a website	
Project information hotline	
Email alerts	

Appendix D: Discussion of Answers to Exercises

Module 3 - Answers

1. Examples of conflicts include:
   - Overlap of construction limits,
   - Contradictory temporary signing and pavement marking plans,
   - Contradictory lane shifts, closures, and sidewalks, and
   - Contradictory work zone information provided to public.

Project coordination is required to ensure that all MOT strategies, including temporary lane closures and various traffic switches are coordinated to minimize road user confusion and impacts. Because of the close proximity of the projects C, D, and E to each other, it is crucial to have lane closures between projects well-coordinated and consistent to avoid driver confusion and potential unsafe situations.

2. Coordination within and across agencies and other stakeholders of all the projects is crucial for the successful development and implementation of a TMP. Some possible ways to achieve this coordination are:
   - A joint stakeholder meeting to coordinate development of individual project TMPs.
   - An impact assessment of the combined impacts of the projects on mobility and safety, using updated traffic data since several of these projects were designed years earlier.
   - Development of an area-wide TMP including all the projects (A through E) and project stakeholders.
   - Clearly defining roles and responsibilities.
   - A working meeting among all project engineers prior to construction initiation.
   - Regular (e.g., weekly) project meetings to discuss upcoming lane closures, traffic shifts, etc.
   - Central public relations personnel for all projects to ensure consistent public message.
   - Quarterly stakeholder meetings with emergency services, utilities, transit, etc., to keep all abreast of upcoming events.

Module 4 – Answers

1. Traffic control alternatives to consider include:
   - Weekend/ off peak lane closures – have less traffic impacts. However, they may extend project duration.
   - Nighttime only lane closures – maintain normal capacity during the day and have less traffic impacts. However, this type of closure is more costly for labor and may extend project duration. There may also be project lighting issues.
   - Continuous 24/7 lane closures, and detour existing southbound I-5 traffic to other routes – faster construction, reduces the need to set up and take down traffic control, safer for workers, and can provide more work space. This option may have the largest impact to traffic.
   - Part-width construction (reduced lane widths to maintain number of lanes) – easier design, detours may not be needed, and less delays. The option may take longer to construct and have possible safety impacts from narrowed lanes.

2. Selecting a work zone alternative depends on many factors, such as:
   - Ability to meet thresholds described in the state/agency work zone policy guidelines,
   - Ability to maintain access to surrounding streets,
   - Impacts on pedestrian and bicycle facilities,
   - Impacts to transit and other public transportation options,
   - Duration of the project,
   - Utilities affected,
   - Impacts on emergency services (fire, ambulance, police, hospitals),
   - Safety impacts,
   - Total road user cost (e.g., user delay), and
   - Total cost for work zone management strategies (TTC, TO, & PI&O).

3. No, the following necessary information is not provided
   - Adequate operational data,
   - Information on lane closure restrictions,
   - Traffic and roadway characteristics of the surrounding street network,
   - Land use characteristics,
   - Any major facilities or traffic sources nearby (e.g., hospitals, stadiums),
   - Pedestrian, bicycle, and transit facilities information, and
   - Crash data.

Module 5 – Answers

Bridge Replacement

1. The primary public relations issue will be the need to get timely information to motorists about the many lane closures that will take place during the project. It is likely that these closures will cause concern and complaints, and information must be made available to make motorists feel more comfortable about the closures. As the bridge connects surrounding jurisdictions, coordination with the DOT personnel from neighboring jurisdictions is also crucial. Also, coordination with commuter organizations, local residents, local businesses, emergency services, police, and nearby Federal Agencies, will be necessary to keep the residents and commuters informed about the upcoming lane closures, other traffic pattern changes, available commuter options (such as transit incentives), available detours, etc.

   Some of the public outreach strategies to be considered include public information meetings (including stakeholder meetings), social marketing (e.g. Twitter), a project website, changeable message signs that provide motorist information on upcoming lane closures and detours, a temporary intelligent transportation system (ITS) to provide real time information on traffic delays, Highway Advisory Radio, and materials targeted toward bicyclists and pedestrians. Since this is an urban area, a regional TMC is likely available to help monitor current traffic conditions and provide traveler information on permanent message boards.

2. Some of the potential operational issues include:

   - Peak-hour traffic congestion for both regional commuters and local traffic,
   - Key traffic "hot" spots,
   - Needs of a unique stakeholder - U.S Department of Navy – due to its large workforce and dock,
   - Lighting requirements if work is done at night,
   - Access to key institutions - schools, hospitals, etc.,
   - Need for access to evacuation routes,
   - Traffic capacity of the detour routes, and
   - Truck traffic needs (if detoured).

Some of the strategies that could be considered to address the operational issues include: adjustment of allowable lane closure times to accommodate the peak traffic, ridesharing and carpooling incentives to reduce the peak hour traffic, temporary lighting, developing and implementing an incident management plan, making freeway service patrol available, signal/timing or coordination improvements on detour routes, transit service improvements on major lines and/or detour routes, and a designated truck traffic detour route.

Module 6 – Answers

1. Monitoring TMP performance helps to:
   - Assess whether predicted impacts closely resemble actual field conditions
   - Gauge effectiveness of TMP strategies in managing impacts
   - Document changes and event occurrences during construction
   - Determine TMP revisions
   - Protect against litigation
   - Determine elements to include/correct in future TMPs

Monitoring TMP implementation is important to ensure contractor compliance with all requirements stipulated, to ensure that the work zone is safe and there is minimal interruption of traffic. The DOT needs to monitor for recurring congestion beyond the thresholds set in the contract. The DOT should also do some monitoring to see if the impacts caused by the project meet any thresholds in the Agency's work zone policy. Such thresholds can be in the form of travel time, queue length, or any other performance measures set forth in the policy. Field personnel as well as the use of technology can monitor conditions on the project to identify when impacts are becoming unacceptable. Some technologies can be set to send alerts to key personnel as queues and/or travel time or traffic speeds get closer to the thresholds. If a threshold is being exceeded, then mitigation measures may be needed.

Question 2:

a. The construction could be expedited either by additional lane closures or extension of lane closure hours. Additional lane closures, for example, reducing to one lane in each direction during the off peak period, may not increase traffic congestion. The volume to capacity ratio will be approximately 60-70%. This will require further discussion with the DOT prior to implementation based on the criteria set. Similarly, extension of existing lane closure periods may not increase the congestion during the peak period. Since there is no reverse peak period the contractor can potentially work from 9:30 a.m. to 5:00 a.m. the following day in the southbound direction. Similarly, work could be done from 6:30 p.m. to 3:30 p.m. the following day in the northbound direction as the volume to capacity ratio is less than 70%. In either case, the impacts to traffic need to be re-assessed based on the proposed changes in lane configuration. If unacceptable impacts will be created, additional TMP strategies may be needed to mitigate/reduce these impacts, or the requested changes may need to be disapproved.

b. The Agency designated personnel should be involved in reviewing and approving these changes to TMP before implementation. This should include the person the Agency designated as the responsible person for this project, as well as whoever performed earlier impacts analysis for the project. The Contractor's responsible person for the project should also be involved in the process, as appropriate.

General – Answers

1. New York Avenue SWB operational degradation in the a.m. peak hour is primarily a result of a reduced number of lanes; however, additional traffic turning left at Penn Street (detour) also has an impact. New York Avenue NEB also lost one level of service during construction in the p.m. peak hour. The options to consider include:

   - Retime the signals – The signals can be retimed to give more green for the New York Avenue approaches. This will help to reduce delays and improve the level of service.
   - Lane closure restrictions for peak travel – Another strategy to reconsider is restricting the lane closure hours for New York Avenue during the a.m. peak period. Restricting lane closures during the p.m. peak period will help to maintain an existing level of service for that period.
   - Night work and/or weekend work – The New York Avenue Bridge is in an urban area and is heavily used by commuter traffic. Hence, night work and/or weekend work will help in reducing the work zone impacts during the heaviest traffic periods.

2. The New York Avenue Bridge reconstruction is a significant project in an urban area. In addition, New York Avenue is a major principal arterial and a designated emergency route carrying an average weekday volume of 65,000 vpd. Hence, the TMP should include an incident management element for an effective and efficient response, site management, site clearance, and motorist information. The crash is of a major type and closed lanes for more than 2 hours. In such cases, immediate response is required from emergency responders (numerous emergency responders and numerous non-emergency responders) including all or some of the following:

   - Emergency Contacts (Fire Department, Law Enforcement, EMS, HAZMAT),
   - Environmental Clean-up Crew,
   - Affected Transportation Agencies,
   - Public Information Officer,
   - MOT Coordinator,
   - News media (regional in nature),
   - Towing companies(Roadway Patrol), and
   - Other Support agencies.

   Traffic impacts are far reaching and could include implementing alternate routes and notifying the public. Site management involves significant interagency cooperation among high-ranking incident commanders. Public information strategies to consider may include:

   a. Highway Advisory Radio (HAR) advisories,
   b. PCMS messages,
   c. Media advisories, and
   d. Project Website update.

Appendix E: Answer Key to Post Course Assessment

Question #	Answer	Explanation
1.	A, B, and C	The Work Zone Safety and Mobility Rule (23 CFR 630 Subpart J) advocates a systematic approach for managing work zone safety and mobility, and has 3 primary components: Agency work zone safety and mobility policy, Agency-level processes and procedures, and Project-level procedures to address work zone impacts. (Slide #5 in Module 1)
2.	Federal-aid projects	A TMP is required for every Federal-aid highway project by the Work Zone Safety and Mobility Rule. A State/Agency's own policy may extend this requirement to all projects. (Slide #3 in Module 2)
3.	A only	For all projects, the Rule requires that the TMP include a Temporary Traffic Control (TTC) plan that addresses traffic safety and control through the work zone. If a project is expected to be significant, the TMP for that project must also contain both transportation operations and public information components. However, agencies are encouraged to consider transportation operations and public information strategies for all projects. (Slide #8 in Module 2)
4.	The above statement is true	The Rule defines a significant project as "one that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts that are greater than what is considered tolerable based on State policy and/or engineering judgment." In addition, the Rule specifies that all Interstate system projects within the boundaries of a designated Transportation Management Area (TMA) that occupy a location for more than three days with either intermittent or continuous lane closures are considered significant projects. Simply stated, a significant project is a project that an agency expects will cause a relatively high level of disruption. (Slide #7 in Module 2)
5.	A, B, and C	See explanation for Question # 3 above.
6.	The above statement is false	TMPs are a formal plan, but their format can vary and depends on the DOT and its policy guidelines. (Slide #20 in Module 2)

Question #	Answer	Explanation
7.	None of the above	TMP strategies may be paid for as part of the construction contract, through a separate contract, done by Agency personnel and therefore not in a contract, or some combination of these. For those items the contractor will be responsible for, the TMP can be paid for in the contract as individual pay items for each strategy, a single pay item for a group of strategies, or some combination. TMP strategies should not be considered incidental to a contract. (Slide #25 in Module 2)
8.	All of the above	Coordination within and across agencies, stakeholders, and other non-public entities at different stages of the project is crucial for the successful development and implementation of the TMP. (Slide #3 in Module 3)
9.	A, B, and D	Traffic analyses tools are used to quantify the Measures of Effectiveness (MOEs). The MOE's may include vehicular delay, travel time, level of Service, construction cost, queue length, etc. The type of tools to be used for assessment should always be proportional to the type, size, and complexity of the project. Other types of tools can be used for assessing safety impacts. (Slides # 19 and 23 in Module 4)
10.	During early scoping stages of the project	An assessment of work zone impacts during the early scoping stages of the project will help identify issues or uncover problem areas that should be considered during project development. It is helpful to begin impacts assessment at this stage, and then update the assessment as the project goes through the later stages. (Slide # 12 in Module 4)
11.	The above statement is true	Depending on the location, size, and complexity of the project, the work zone can also impact pedestrians, and bicyclists. During construction, pedestrian and bicycle access should be maintained to a similar level as that existing prior to construction. Any pedestrian detour must comply with the ADA Act, 1990. (Slide # 6 in Module 5)

Question #	Answer	Explanation
12.	B and C	Transit incentives and signal timing/coordination improvements are transportation operations strategies, whereas, alternate construction phasing/staging is a traffic control strategy and press releases about the project is a public information strategy. (Slide # 19 in Module 5)
13.	B	Providing accurate, timely and consistent information, regardless of how it is delivered, is key to effective public outreach. (Slides # 27, 30, and 32 in Module 5)
14.	Both State Agency and Contractor	The Rule requires that both the State and the contractor each designate a trained person at the project level who has the primary responsibility and sufficient authority for implementing the TMP and other safety and mobility aspects of the project. Both the Agency and the contractor have key roles in and share responsibility for providing a safe and effective work zone. (Slide #10 in Module 6)
15.	C, and D	A TMP is a dynamic plan and should be monitored and revised as necessary during construction. TMP monitoring not only allows you to see how well the TMP is working and determines if changes are needed, but can also protect you from unwarranted litigation. Monitoring also helps in determining what strategies work best, under what conditions, so they can be used effectively in the future. TMPs are always required for all Federal-aid projects, and may be required for other projects in a given State based on the State's policy. (Slides # 11-16 in Module 6)
16.	The above Statement is false	Generally, the contractor cannot make changes to the TMP or revise it on its own. The agency's contract provisions will also typically retain review and approval of TMP elements and changes to those elements. (Slides # 9, 10, and 18 in Module 6)

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